PROJECT MANUAL
FOR
CITY OF LYNCHBURG

REBID
Jefferson Park Drainage Improvement Project (RWS1509−0003)

BID: 2017-003

July 2016

PROCUREMENT DIVISION
3RD FLOOR CITY HALL
900 CHURCH STREET
LYNCHBURG, VA 24504
TELEPHONE (434) 455-3970
FAX (434) 845-0711

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Attachment 1 – Previous addendum questions and responses.

ADVERTISEMENT FOR BIDS

Sealed bids for "**REBID Jefferson Park Drainage Improvement Project (RWS1509−0003)**", will be received by the City of Lynchburg, Procurement Division, City Hall, Lynchburg, VA, until**, 3:00 P.M. on July 28, 2016,** and then publicly opened and read, in the Bidder's Room, Third Floor, City Hall.

Project Description: Contractor shall install new storm 24" and 36" storm sewer, grass channels, inlet trash screens, and a surface treated access road to correct a bank erosion issue at the edge of an abandoned landfill adjacent to a trail and creek.

The Project Manual and Drawings for this project may be viewed and downloaded from the City's website:. http://www.lynchburgva.gov/current-solicitations

An **Optional Pre-Bid Conference** will be held at **11:00 a.m., July 14, 2016, in the Bidders Room, 3rd Floor City Hall 900 Church Street Lynchburg, VA.**

All requests for clarification of or questions regarding this Advertisement for Bids or for additional information must be made in writing, by facsimile (434) 845-0711 or email to lisa.moss@lynchburgva.gov and received by 9:00 A.M. July 21, 2016. All posted clarifications or addenda must be signed and accompany any bid submitted.

BID FORM

Lisa Moss
Buyer-Procurement Division
City of Lynchburg
Third Floor, City Hall
900 Church Street
Lynchburg, Virginia 24504

Dear Ms. Moss:

The undersigned, as bidder, hereby declares that the only persons interested in this bid as principal, or principals, is or are named herein and that no person other than herein mentioned has any interest in this bid or in the Construction Agreement to be entered into; that this bid is made without connection with any other person, company, or parties making a bid; and that it is in all respects fair and in good faith, without collusion or fraud.

The undersigned, having visited and examined the site and having carefully studied all the Contract Documents, including without limitation, all drawings and specifications pertaining to **"Jefferson Park Drainage Improvement Project (RWS1509−0003)"** for the City of Lynchburg, Virginia, hereby proposes to furnish all labor, equipment, materials, and services and to perform all operations necessary to execute and complete the Work required for the project, in strict accordance with the Contract Documents, The City of Lynchburg Manual of Specifications and Standard Details, (12/2013) together with Addenda numbered _____ through _____ issued during bidding period and hereby acknowledged, subject to the terms and conditions of the Construction Agreement which shall be referred to hereinafter as the Base Bid.

BID SHEET					
SECTION A: CONSTRUCTION					
ITEM				**UNIT**	
#	**DESCRIPTION**	**UNIT**	**QTY**	**PRICE**	**TOTAL**
1	Mobilization	LS	1		
2	Construction Surveying	LS	1		
3	Geotechnical & Compaction Testing	LS	1		
4	Clearing & Grubbing	AC	.5		
5	Demolition (Structure Adjustment, Sidewalk)	LS	1		
6	Import & Place Satisfactory Fill Material	CY	5200		
7	Excavation & Off-site Disposal	CY	900		
8	Import & Place Satisfactory Clay Barrier	CY	500		
9	Temporary Safety Fencing	LF	810		
10	Silt Fence	LF	2450		
11	Stone Construction Entrance	EA	1		
12	Inlet Protection	EA	5		
13	STD EC-2 Matting	SY	8000		

14	Temporary Diversion Dike	LF	330		
15	Temporary Slope Drain	LF	275		
16	Permanent Seeding	AC	3.3		
17	Sodding	SY	800		
18	Erosion Control Mulch	AC	3.3		
19	Channel Turf Reinforcement Matting	SY	800		
20	Sidewalk, 6-in Concrete	SY	110		
21	Abandon Manholes / Pipes	LS	1		
22	Gravel for Access Road (VDOT #1 Coarse Agg)	CY	100		
23	Gravel Water Bars	EA	10		
24	Chip Seal/Gravel Access Road	SY	650		
25	Relocated Sign	EA	1		
26	Endwall EW-1 for Pipe Culverts 12" - 36"	EA	1		
27	End Section ES-1	EA	1		
28	Inlets, DI-7	EA	4		
29	Manholes	EA	5		
30	24" RCP Storm Sewer	LF	55		
31	36" HDPE Storm sewer	LF	300		
32	Plunge Pool	LS	1		
33	Gas Vents	EA	7		
34	TrashGuard Insert	EA	10		
35	Triton Curb Inlet Insert	EA	1		
				TOTAL SECTION A	
PART B: Excavation of Additional Unsuitable Material: Excavation of unsuitable material (non-waste), where authorized or directed, below or in addition to the levels required for the Work in Parts A and backfill with compacted material per specifications. (Price per cubic yard) Final amount shall be adjusted upward or downward based on actual quantity authorized.					
36	Unsuitable Material	CY	10		
				TOTAL SECTION B:	
SECTION C: EXCAVATION OF ROCK MATERIAL: Excavation of ROCK material, where authorized or directed, and proper disposal off-site of excess material, complete per specifications. (Price per cubic yard) Final amount shall be adjusted upward or downward based on actual quantity authorized.					
37	Rock Material	CY	10		
				TOTAL SECTION C:	

SECTION D: EXCAVATION OF WASTE MATERIAL: Excavation of WASTE material, where authorized or directed, proper disposal off-site of excess material and backfill with compacted trench fill material per specifications. (Price per cubic yard) Final amount shall be adjusted upward or downward based on actual quantity authorized. The City will allow tipping fees to be paid on the City's account at the Region 2000 landfill. Arrangements and account information for the project will be provided to the successful bidder.					
38	Waste Material	CY	2000		
				TOTAL SECTION D:	
				TOTAL BASE BID (SECTIONS A, B, C, D)	

Contract award will be based on the TOTAL BASE BID AMOUNT (SECTIONS A through D)

Base Bids for SECTION A, B, C, D shall be based on the estimated quantities indicated to be provided complete and in accordance with the applicable portions of the plans and specifications. Payment amounts for each of these items will be based on the actual quantities authorized, provided and approved times the unit prices indicated by the bidder. The final contract amount shall be adjusted upward or downward based on the actual payment amounts versus the bid amounts for SECTIONS A, B, C, and D.

It is understood and agreed that the Owner, in protecting its best interests, reserves the right to reject any or all bids or waive any defects. Any changes, erasures, modifications, deletions in the bid form, or alternate proposals not specified in the Advertisement for Bids may make the bid irregular and subject to rejection.

Contractors will indicate a unit price for each item listed. If the Construction Agreement is for a lump sum price, unless clearly and specifically indicated otherwise in the Contract Documents, all unit prices only apply to changes in the Work. The listed bid items are to contain all necessary costs required for completion of the Work in accordance with the Contract Documents.

If the Construction Agreement is for unit prices and not for a lump sum price, it is understood that all quantities listed on the following pages are estimated quantities, and the Owner reserves the right to raise, lower, or eliminate any quantity or item, and in any case, the unit prices shall be used in determining partial and final payment. It is further understood that costs to cover all components of the Work as described in the Contract Documents are included in this bid, even in cases where specific line items are not identified.

The Bidder affirms that they are properly equipped to execute all work of the character and extent required by the Contract Documents, and will enter into the Construction Agreement for the execution and completion of the Work in accordance with the Contract Documents; and further agree that, if awarded the Construction Agreement, Bidder will commence the Work on the date stated in the "Notice to Proceed" and will maintain a work force large enough to execute the Work and all obligations no later than the completion date stated in the Contract Documents.

Enclosed herewith is the following Security, offered as assurance that the undersigned will enter into the Construction Agreement for the execution and completion of the Work in accordance with the Contract Documents:

Bidder's Certified Check issued by_____(name of bank) in the amount of:

$_____(5% of Base Bid amount)

Bidder's Bid Bond for 5% of Base Bid Amount Issued by _____
(name of surety authorized to do business in Virginia).

The undersigned hereby agrees, if awarded the Construction Agreement, to execute and deliver to the City within ten (10) days after his receipt of the Notice of Award, a performance bond and a payment bond, in forms

satisfactory to the City, from sureties authorized to do business in Virginia satisfactory to the City, in the amount of one hundred (100) percent of the Base Bid.

The undersigned further agrees that, in case of failure on his part to execute the said Construction Agreement within the ten (10) days after written notice being given on the award of the Construction Agreement or the failure to deliver the required performance and payment bonds within the ten (10) days, the monies payable by the Security accompanying this bid shall be paid to the City of Lynchburg, Virginia, as liquidated damages for such failure; otherwise the Security accompanying this Bid shall be returned to the undersigned.

Attached herewith are completed Statement of Experience and Statement of Resources forms which include the information requested.

The undersigned further certifies that this bid is not the result of, or affected by, any act of collusion with another person engaged in the same line of business, or any act punishable under the Virginia Governmental Frauds Act, or other law.

This bid remains valid and may not be withdrawn for a period of 60 days from this date.
CURRENT VIRGINIA CLASS A CONTRACTOR'S LICENSE/ REGISTRATION NO.:_____

Respectfully submitted,

_____
CONTRACTOR

_____
DATE

_____

_____
ADDRESS

BY:_____

ITS:_____
(Title)

ELECTION OF ESCROW ACCOUNT PROCEDURE FOR RETAINAGE

If determined to be the successful low bidder(s), the above signed elects to use the Escrow Account Procedure for retainage.

_____

Write “Yes” or “No” on above line

If the successful bidder elects to use the Escrow Account Procedure for Retainage, the "Escrow Agreement" form shall be executed and submitted to the City of Lynchburg Engineering Division within fifteen (15) calendar days after notification. If the "Escrow Agreement" form is not submitted within the fifteen (15) day period, the Contractor shall forfeit his rights to the use of the Escrow Account Procedure.

Company_____

Authorized Signature_____

EQUAL OPPORTUNITY REPORT STATEMENT

The Bidder shall complete the following statement by checking the appropriate blank as follows.

The Bidder has_____ has not _____ participated in a previous contract subject to the nondiscrimination clause prescribed by Executive Order 10925, dated March 6, 1961, or Executive Order 11114 dated June 22, 1963.

In conjunction with the City of Lynchburg's policy to utilize Minority and Disadvantaged Business Enterprises ("DBE") wherever possible, the Bidder has solicited quotations for labor, material and/or services from the following Minority and Disadvantaged Business Enterprises:

NAME OF FIRM	PERSON(S) CONTACTED	DATE

Of those listed above, we intend, at this time, to utilize the following in the completion of the Work required by this Construction Agreement:

_____

_____

_____

"This firm assures that it will give its best efforts to utilize Minority and Disadvantaged Business Enterprises whenever possible."

CERTIFIED BY: _____(Signature)

_____(Typed/Printed name & Title)

BIDDER'S NAME: _____

TAXPAYER IDENTIFICATION NUMBER:_____

_____This firm will perform all construction with its own employees and, therefore, is not required to solicit quotations from DBEs.

FAILURE TO DOCUMENT AND REPORT DBE CONTACTS ON THIS FORM MAY BE A BASIS FOR REJECTION OF THE BID AS NONCONFORMING.

STATEMENT OF EXPERIENCE

Proposer: _____

_____

How Long In Business:_____ At Current Address: _____

Principals: _____Title:_____

_____Title:_____

_____Title:_____

Type of Work Normally Performed:_____

_____

Projects of this type previously completed:

1._____

_____ Amount $_____

2._____

_____ Amount $_____

3._____

_____ Amount $_____

Reference (for Projects listed above):

1._____

_____ Tel.No._____

2._____

_____ Tel.No._____

3._____

_____ Tel No._____

STATEMENT OF AVAILABLE RESOURCES

Equipment:_____

_____

_____

Number of Personnel Currently Employed:_____

Number of Personnel Available for Project:_____

Other Pertinent Information:_____

_____

_____

_____

_____

_____

_____

_____

CORPORATE STATUS FORM

ALL PROSPECTIVE FIRMS MUST RESPOND TO THE FOLLOWING

If a limited liability company, limited liability partnership or a limited partnership, indicate by checking one: _____Limited liability company

_____Limited liability partnership

_____Limited partnership

Have you registered with the Virginia State Corporation Commission, to conduct business in Virginia?
☐ Yes ☐ No

Name and address of organizer: _____

_____

_____

_____

List who is authorized to execute contracts:

_____

If conducting business under an assumed (fictitious) business name, fill out the following information:

Names of persons or entities owning business using assumed business name:_____

Owners' addresses: _____

Registration date: _____ Expires: _____

If conducting business as a sole proprietorship, general partnership, or joint venture, fill out the following information:

Names of all persons liable for obligations of the business: _____

Addresses of such persons:_____

Questions to Bidders/Offerors

Bidders/Offerors are to respond to the following question: Have any of the individual(s), owner(s), and/or principal officer(s) of the firm submitting the bid/proposal ever been convicted of (1) a felony, or (2) a misdemeanor involving moral turpitude?

YES _____ NO _____

If yes, list individual or officer and title and give details.

_____

_____

_____

_____

_____

_____

_____

_____

NOTE: Answering yes to this question will not necessarily exclude your company from consideration but will be used to weigh the relationship between the offense and the contract to be performed.

Is your firm currently involved in litigation or a dispute involving arbitration?

YES _____ NO _____

If yes, for litigation list the litigation by case name, name of court, case number, and jurisdiction, and for arbitration, list the organization administering, if any, its contact information, any case number assigned, the arbitrators, and the location of the arbitration. For litigation and arbitration, briefly describe the claims and status, and give contact information for the opposing party or parties.

_____

_____

_____

_____

CONSTRUCTION AGREEMENT

This Construction Agreement (the "Contract") made and entered into on the _____ day of _____, 2016, by and between _____, party of the first part, hereinafter referred to as Contractor, and the City of Lynchburg, a municipal corporation of the Commonwealth of Virginia, party of the second part, hereinafter referred to as the Owner or City.

That the Contractor, for the consideration hereinafter fully set out, hereby agrees with the Owner as follows:

1. That the Contractor shall furnish all labor, materials, tools, and equipment and perform all Work required by the Contract Documents (as defined in the General Conditions hereto) for **REBID Jefferson Park Drainage Improvement Project (RWS1509−0003)**

2. That the Contractor shall commence Work within ten (10) days after Notice to Contractor to Proceed with the Work under Contract ("Notice to Proceed"), and shall substantially complete the Work within **120 calendar days**. Owner and Contractor recognize that time is of the essence of this Contract and that the Owner will suffer financial loss if the Work is not completed within the times specified in the Notice to Proceed, plus any extensions thereof. They also recognize the delays, expense and difficulties involved in providing the actual loss suffered by Owner if the Work is not completed on time. Accordingly, instead of requiring any such proof, Owner and Contractor agree that as liquidated damages for certain losses Owner is expected to suffer due to delay (but not as a penalty) Contractor shall pay **$500.00** for each day that expires after the time specified for completion. If the Contractor is subject to liquidated damages, the City has the right, but not the obligation, to withhold the liquidated damages from the Contractor's regular payments or retainage. Rights and obligations relating to these liquidated damages are set out more fully in the General Conditions.

3. The Owner hereby agrees to pay the Contractor for the faithful performance of this Contract in accordance with the Contract Documents, subject to additions and deductions as provided in the Contract Documents, in lawful money of the United States, as follows:

_____Dollars

($_____)

4. The Owner shall make partial payment on a monthly basis to the Contractor in accordance with the Contract Documents on the basis of a duly certified and approved estimate of work performed during the preceding calendar month by the Contractor, less five percent (5%) of the amount of such estimate which may be retained by the Owner until all Work has been performed strictly in accordance with the Contract Documents and until such Work has been accepted by the Owner.

5. Within ninety (90) days after submission by the Contractor of evidence satisfactory to the Owner that all payrolls, material bills and other costs incurred by the Contractor in connection with the construction of the Work have been paid in full, satisfaction of all the requirements of the Contract Documents, and acceptance of such Work by the Owner, final payment on account of this Contract shall be made.

6. It is further mutually agreed between the parties hereto that if, at any time after the execution of this Contract, the performance bond provided for its faithful performance and the payment bond, the Owner shall deem the surety or sureties upon such bonds or either of them to be unsatisfactory, or if for

any reason, such bonds cease to be adequate to cover the performance of the Work, the Contractor shall, at his own sole expense, within five (5) days after the receipt of Notice from the Owner so to do, furnish an additional bond or bonds in such form and amount, and with such surety or sureties as shall be satisfactory to the Owner. In such event, no further payment to the Contractor shall be deemed to be due under this Contract until such new or additional security for the faithful performance of the Work shall be furnished in manner and form satisfactory to the Owner.

7. Contractor agrees to fulfill all requirements of state, Federal, and municipal laws which may be applicable to this project.

8. This Contract is subject to the General Conditions accompanying it, and all the documents defined by the General Conditions to be the Contract Documents are a part of this Contract.

This Contact is executed in two counterparts, each of which shall, without proof or accounting for the other counterparts, be deemed an original contract.

IN WITNESS WHEREOF, _____ has caused its name to be subscribed to this Contract by _____, its _____, and its corporate seal to be hereunto affixed and attested by _____, its _____, said officers being duly authorized therefore; and the City of Lynchburg has caused its name to be hereunto subscribed by Bonnie Svrcek, City Manager, and its corporate seal to be hereunto affixed and attested by Valeria Chambers, its Clerk of Council, said officers being duly authorized therefore, all as to the day and year first above written.

CONTRACTOR

BY: _____

ITS: _____

(SEAL)

_____

ATTEST:

_____

CITY OF LYNCHBURG

(SEAL)

BY: _____

City Manager

_____

ATTEST:

_____

Clerk of Council

CITY OF LYNCHBURG, VIRGINIA
STANDARD PERFORMANCE BOND

KNOW ALL MEN BY THESE PRESENTS: That_____
_____, the Contractor ("Principal"), whose principal place of business is located at _____
_____and_____
_____("Surety"), are held and firmly bound unto the City of Lynchburg, Virginia, the Owner ("Obligee"), in the amount of

_____Dollars
($_____) for the payment whereof Principal and Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS,

Principal has, entered into a Construction Agreement with Obligee for certain work on a construction project known as **REBID Jefferson Park Drainage Improvement Project (RWS1509−0003)**, which contract (the "Contract") is by reference expressly made a part hereof;

NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION is such that, if the Principal shall promptly and faithfully perform said Contract in strict conformity with the plans, specifications and conditions of the Contract and its Contract Documents, then this obligation shall be null and void; otherwise it shall remain in full force and effect.

Provided, that any alterations which may be made in the terms of the Contract, or in the Work to be done under it, or the giving by the Obligee of any extension of time for the performance of the Contract, or any other alterations, extensions or forbearance on the part of either or both of the Obligee or the Principal to the other shall not in any way release the Principal and the Surety, or either of them, their heirs, executors, administrators, successors or assigns, from their liability hereunder, notice to the Surety of any such alterations, extensions, or forbearance being hereby waived.

No action shall be brought on this bond unless brought within one year after: (a) completion of the Contract and all Work thereunder, including expiration of all warranties and guarantees, or (b) discovery of the defect or breach of warranty or guarantee if the action be for such.

The Surety represents to the Principal and to the Obligee that it is legally authorized to do business in the Commonwealth of Virginia.

Signed and sealed this_____day of_____, 2016.

_____(SEAL)
Contractor/Principal

By:_____

Witness:_____ Title:_____

_____(SEAL)
Surety

By:_____
Attorney -in-Fact

My Power of Attorney is recorded in the Clerks Office of the Circuit Court of_____,
Virginia in Deed Book_____, Page_____, and has not been revoked.

_____
Attorney-in-Fact

AFFIDAVIT AND ACKNOWLEDGEMENT OF ATTORNEY-IN-FACT

COMMONWEALTH OF VIRGINIA
(or, alternatively, Commonwealth or State of_____)

CITY/COUNTY OF_____to wit:

I, the undersigned notary public, do certify that_____personally appeared before me in the jurisdiction aforesaid and made oath that he is the attorney-in-fact of_____, the Surety, that he is duly authorized to execute on its behalf the aforesaid Bond(s) as its act and deed.
Given under my hand this_____day of_____2016 .

_____(SEAL)
Notary Public

My Commission expires:_____

APPROVED:

_____
City Attorney/Designee Date

CITY OF LYNCHBURG
STANDARD LABOR AND MATERIAL PAYMENT BOND

KNOW ALL MEN BY THESE PRESENTS: That _____

_____, the Contractor ("Principal") whose principal

place of business is located at_____

_____and_____

_____("Surety") are held and firmly bound unto the City of Lynchburg,

Virginia, the Owner ("Obligee") in the amount of_____Dollars

($_____) for the payment whereof Principal and Surety bind themselves, their heirs,

executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS,

Principal has by written agreement dated_____entered into a Construction Agreement

with Obligee for **REBID JEFFERSON PARK DRAINAGE IMPROVEMENT PROJECT(RWS1509−0003)**

which contract (the "Contract") is by reference expressly made a part hereof;

NOW THEREFORE, THE CONDITION OF THIS OBLIGATION is such that, if the Principal shall promptly make payment to all claimants as hereinafter defined, for labor performed and material furnished in the prosecution of the Work provided for in the Contract and its Contract Documents, then this obligation shall be void~~,~~; otherwise it shall remain in full force and effect, subject, however, to the following conditions.

The Principal and Surety, jointly and severally, hereby agree with Obligee as follows:

1. A claimant is defined as one having a direct contract with the Principal or with a subcontractor of the Principal for labor, material, or both for use in the performance of the Contract. A "subcontractor" of the Principal, for the purposes of this bond only, includes not only those subcontractors having a direct contractual relationship with the Principal but also any other contractor who undertakes to participate in the Work which the Principal is to perform under the aforesaid Contract, whether there are one or more intervening subcontractors contractually positioned between it and the Principal (for example, a subcontractor). "Labor" and "material" shall include, but not be limited to, public utility services and reasonable rentals of equipment, but only for periods when the equipment rented is actually used at the Work site.

2. Subject to the provisions of paragraph 3, any claimant who has performed labor or furnished material in accordance with the Contract Documents in the prosecution of the Work provided in the Contract, who has not been paid in full therefore before the expiration of ninety (90) days after the day on which such claimant performed the last of such labor or furnished the last of such

materials for which he claims payment, may bring an action on this bond to recover any amount due him for such labor or material, and may prosecute such action to final judgment and have execution on the judgment. The Obligee need not be a party to such action and shall not be liable for the payment of any costs, fees or expenses of any such suit.

3. Any claimant who has a direct contractual relationship with any subcontractor of the Principal from whom the Principal has not required a subcontractor payment bond, but who has no contractual relationship, express or implied, with the Principal, may bring an action on this bond only if he has given written notice to the Principal within one hundred eighty (180) days from the day on which the claimant performed the last of the labor or furnished the last of the materials for which he claims payment, stating with substantial accuracy the amount claimed and the name of the person for whom the Work was performed or to whom the material was furnished. Notice to the Principal shall be served by registered or certified mail, postage prepaid, in an envelope addressed to the Principal at any place where his office is regularly maintained for the transaction of business. Claims for sums withheld as retainages with respect to labor performed or materials furnished shall not be subject to the time limitations stated in this paragraph 3.

4. No suit or action shall be commenced hereunder by any claimant.

   a. Unless brought within one year after the day on which the person bringing such action last performed labor or last furnished or supplied materials, it being understood, however, that if any limitation embodied in this bond is prohibited by any law controlling the construction hereof, the limitation embodied within this bond shall be deemed to be amended so as to be equal to the minimum period of limitation permitted by such law.

   b. Other than in a Virginia court of competent jurisdiction, with venue as provided by statute, or in the United States District Court for the district in which the project, or any part thereof is situated.

5. The amount of this bond shall be reduced by and to the extent of any payment or payments made in good faith hereunder.

6. This bond is intended to comply with the requirements and to afford all the benefits of a payment bond consistent with the requirements of Virginia Code § 2-2-4337 and § 2-2-4341. To the extent that those sections as they are in effect as of the date of issuance of this bond confer any requirements on Principal or Surety, or confer any additional benefits on any claimant (as the term "claimant" is used within either the meaning of those sections or this bond), those requirements and benefits shall be deemed to be incorporated into and be part of this bond.

Signed and sealed this_____ day of_____.

_____(SEAL)
Contractor/ Principal

By:_____

Witness:_____ Title:_____

_____(SEAL)
Surety

By:_____
Attorney-in-Fact

Typed Name:_____

My Power of Attorney is recorded in the Clerks Office of the Circuit Court of_____ Virginia in Deed Book_____, Page_____, and has not been revoked.

_____
Attorney-in-Fact

AFFIDAVIT AND ACKNOWLEDGEMENT OF ATTORNEY-IN-FACT

COMMONWEALTH OF VIRGINIA

(or, alternatively, Commonwealth or State of_____)

CITY / COUNTY OF_____

I, the undersigned notary public, do certify that_____personally appeared before me in the jurisdiction aforesaid and made oath that he is the attorney-in-fact of _____, the Surety, that he is duly authorized to execute on its behalf the foregoing bond pursuant to the Power of Attorney noted above, and on behalf of said Surety, acknowledged the aforesaid bond(s) as its act and deed.

Given under my hand this_____day of _____.

_____(SEAL)

Notary Public

_____

My Commission expires:_____

APPROVED:

_____
City Attorney/Designee Date

ESCROW AGREEMENT

THIS AGREEMENT ("Agreement"), made and entered into this ____ day of _____, 2016 by, between and among the City of Lynchburg ("City"), _____ ("Contractor"), and

_____
(Name of Bank)

_____
(Address of Bank)

a trust company, bank, or savings and loan institution with its principal office located in the Commonwealth of Virginia (hereinafter referred to as "Bank" or "Escrow Agent"), and _____

_____ ("Surety") provides:

I.

The City and the Contractor have entered into the Construction Agreement ("Contract") with respect to City Project No. 14012-W and 11011-W and Name: **REBID Jefferson Park Drainage Improvement Project (RWS1509−0003)** (the Contract"). This Agreement is pursuant to, but in no way amends or modifies, the Contract. Payments made hereunder or the release of funds from escrow shall not be deemed approval or acceptance by the City of performance by the Contractor or Surety.

II.

In order to assure full and satisfactory performance by the Contractor of its obligations under the Contract, the City may, pursuant to the Contract Documents, retain certain amounts otherwise due the Contractor. The Contractor has, with the approval of the City, elected to have these retained amounts held in escrow by the Bank. This Agreement sets forth the terms of the escrow. The Bank shall not be deemed a party to, bound by, or required to inquire into the terms of, the Contract or any other instrument or agreement between the City and the Contractor.

III.

The City may from time to time pursuant to this Agreement pay to the Bank amounts retained by the City under the Contract. Except as to amounts actually withdrawn from escrow by the City, the Contractor shall look solely to the Bank for payment of funds retained under the Contract and paid by the City to the Bank.

The risk of loss by diminution of the principal of any funds invested under the terms of this Agreement shall be solely upon the Contractor.

Funds and securities held by the Bank pursuant to this Agreement shall not be subject to levy, garnishment, attachment, lien, or other process whatsoever. Contractor agrees not to assign, pledge, discount, sell or otherwise transfer or dispose of his interest in the escrow account or any part thereof, except to the Surety.

IV.

Upon receipt of checks or warrants drawn by the City's Director of Finance and made payable to it as escrow agent, the Bank shall promptly notify the Contractor, negotiate the same and deposit or invest and reinvest the proceeds in "Approved Securities" within the meaning of this Agreement in accordance with the written instruction of the Contractor. In no event shall the Bank invest the escrowed funds in any security that is not an "Approved Security."

V.

The following securities, and none other, are Approved Securities for all purposes of this Agreement:

(1) United States Treasury Bonds, United States Treasury Notes, United States Treasury Certificates of Indebtedness or United States Treasury Bills,

(2) Bonds, notes and other evidences of indebtedness unconditionally guaranteed as to the payment of principal and interest by the United States,

(3) Bonds or notes of the City,

(4) Bonds of any political subdivision of the City, if such bonds carried, at the time of purchase by the Bank or deposit by the Contractor, a Standard and Poor's or Moody's Investors Service rating of at least "A", and

(5) Certificates of deposit issued by commercial Banks located within the Commonwealth, including, but not limited to, those insured by the Bank and its affiliates,

(6) Any bonds, notes, or other evidences of indebtedness listed in Section (1) through (3) may be purchased pursuant to a repurchase agreement with a Bank, within or without the City ,having a combined capital, surplus and undivided profit of not less than $25,000,000 provided the obligation of the Bank to repurchase is within the time limitations established for investments as set forth herein. The repurchase agreement shall be considered a purchase of such securities even if title, and/or possession of such securities is not transferred to the Escrow Agent, so long as the repurchase obligation of the Bank is collaterized by the securities themselves, and the securities have on the date of the repurchase agreement a fair market value equal to at least 100 percent of the amount of the repurchase obligation of the Bank, and the securities are held by a third party, and segregated from other securities owned by the Bank.

No security is an Approved Security hereunder if it matures more than five years after the date of its purchase by the Bank or deposit by the Contractor.

VI.

The Contractor may from time to time withdraw the whole or any portion of the escrowed funds by depositing with the Bank Approved Securities in an amount equal to, or in excess of, the amount so withdrawn. Any securities so deposited or withdrawn shall be valued at such time of deposit or withdrawal at the lower of par or market value, the latter as determined by the Bank. Any securities so deposited shall thereupon become a part of the escrowed fund.

Upon receipt of a direction signed by the City's Director of Public Works or the City Engineer, the Director of Finance or the City Accountant shall authorize the Bank to pay the principal of the fund, or

any specified amount thereof, to the account of the City of Lynchburg. Such payment shall be made in cash as soon as is practicable after receipt of the direction.

Upon receipt of a direction signed by the City's Director of Public Works or the City Engineer, the Director of Finance or the City Accountant shall authorize the Bank to pay and deliver the principal of the fund, or any specified amount thereof, to the Contractor, in cash or in kind, as may be specified by the Contractor. Such payment and delivery shall be made as soon as is practicable after receipt of the direction.

VII.

For its services, hereunder the Bank shall be entitled to a reasonable fee in accordance with its published schedule of fees or as may be agreed upon by the Bank and the Contractor. Such fee and any other costs of administration of this Agreement shall be paid from the income earned upon the escrowed fund, and, if such income is not sufficient to pay the same, by the Contractor.

VIII.

The net income earned and received upon the principal of the escrowed fund shall first be paid or applied to pay the Bank's fee and any other costs of administration and such income shall be deemed a part of the principal of the fund. After all of the Bank's fees and other costs of administration have been paid from such income, the net income earned thereafter may then be paid over to Contractor in installments.

IX.

The Surety undertakes no obligation hereby but joins in this Agreement for the sole purpose of acknowledging that its obligations as surety for the Contractor's performance of the Contract are not affected hereby.

WITNESS the following signatures, all as of the day and year first above written.

CITY OF LYNCHBURG CONTRACTOR: _____

BY: _____ BY: _____
City Manager Officer, Partner, or Owner (Seal)

SURETY:

By: _____

Its: President (Seal)

ATTEST:

_____
Secretary

By: _____
Attorney-in-Fact

AFFIDAVIT AND ACKNOWLEDGEMENT OF ATTORNEY-IN-FACT

COMMONWEALTH OF VIRGINIA
(or, alternatively, Commonwealth or State of _____)
CITY / COUNTY OF _____

I, the undersigned notary public, do certify that _____personally appeared before me in the jurisdiction aforesaid and made oath that he is the attorney-in-fact of _____, the Surety, that he is duly authorized to execute on its behalf the foregoing bond pursuant to the Power of Attorney noted above, and on behalf of said Surety, acknowledged the aforesaid bond(s) as its act and deed.
Given under my hand this_____day of _____.

_____(SEAL)
Notary Public

My Commission expires: _____

APPROVED:

_____
City Attorney/Designee Date

INSTRUCTIONS TO BIDDERS

DESCRIPTION OF WORK
The Work included under this Contract shall consist of all labor, materials, equipment, and the performance of all work necessary to complete the project known as "**REBID Jefferson Park Drainage Improvement Project (RWS1509−0003)**" as described in the Contract Documents. This Work shall be performed in accordance with the Contract Documents.

SCOPE OF WORK:
Contractor shall install new storm sewer, grass channels inlet trash screens, and an access road to correct a bank erosion issue at the edge of an abandoned landfill adjacent to a trail and creek.

1. General: Subject to Owner's right to waive informalities, to be valid for consideration, bids must be completed and submitted in accordance with these instructions to bidders. All individual bid unit price items must be filled in, regardless of the quantity shown.

2. Plans and Specifications: The Project Manual and Drawings for this project may be viewed and downloaded from the City's website: http://www.lynchburgva.gov/current-solicitations

3. Qualification of Bidders: Each bidder must be prepared to submit within five calendar days of the Owner's request written evidence of his qualifications for the project, including, without limitation, financial data, previous experience, resources, personnel and evidence of authority to conduct business in the jurisdiction where the project is located.

4. Examination of Bid Documents and Site:

   4.1 Before submitting bids, each bidder must examine bid documents, including, without limitation, all the Contract Documents, thoroughly; familiarize himself with Federal, state and local laws, ordinances, rules, codes, and regulations affecting the Work; and correlate his observations with requirements of the bid documents.

   4.2 Bidders are requested and expected to visit the site of the project to alert themselves to local and special conditions which may be encountered during construction of the project such as: labor and transportation, handling and storage of materials, the availability of materials, and site access. Failure to make such investigations shall not relieve the successful bidder from performing and completing the Work in accordance with the Contract Documents.

      a. An optional pre-bid conference will be held at the time and place stated in the Advertisement for Bids.

5. Clarification:

   5.1 No oral clarification of the bid documents will be made to any bidder. To be given consideration, requests for clarification must be received in time to allow preparation of a written response at least seven (7) days prior to date fixed for opening of bids. Clarifications will be issued in the form of written addenda to the bid documents and posted to the Procurement Website within five (5) days of the bid opening. Only clarifications by formal written addenda will be binding.

   (1) All communications in regard to clarifications and any other matters related to this project shall be addressed to: Lisa Moss Procurement Division, 900 Church Street, Lynchburg, VA 24504, Fax: 434-845-0711, email: lisa.moss@lynchburgva.gov.

6. Substitutions:

6.1 Substitutions of material or equipment or both may be offered by the Contractor with his bid, provided that, if approved:

a. No major changes in the construction or design intent of the project would be required. Changes required to accommodate substituted items shall be made by the Contractor at no additional cost or time delay.

b. Features of quality, capacity, construction, performance, appearance, size, arrangement, and general utility, including economy of operation of substitutes offered, either parallel or exceed those of specified products.

c. The provisions of the General Conditions are met, and the provisions of the General Conditions any other guarantees, if required by the specification sections, shall apply in full force and effect to the performance of such substitute products, approved for incorporation into the Work.

6.2 Technical data covering the proposed substitution shall be furnished with the bid when possible, and not later than 10 days after bid submission.

7. Bid Submission:

7.1 Submit bids using forms furnished in the Project Manual and fill in all blank spaces on the form. Repeat notation "Contractor's Current Virginia License No._____" on outside of inner envelope containing bid and bid security, and place this envelope within another envelope addressed to:

City of Lynchburg
Procurement Division
900 Church Street
Third Floor, City Hall
Lynchburg, VA 24504

Bidders shall include the following with their bid submission:

- Bid Form
- Statement of Experience
- Statement of Available Resources
- Equal Opportunity Report Statement
- Corporate Status Form
- Questions to Offeror Form
- Bid Bond or Cashiers Check Equivalent

7.2 Both the inner and outer envelopes shall have noted thereon:

a. "**Sealed Bid 2017-003 Enclosed for REBID Jefferson Park Drainage Improvement Project (RWS1509−0003)**

b. The bidder's name and address;

c. Repeat notation "Current Registered Virginia Contractor No. ____" on the outside envelope.

7.3 Each bid must be accompanied by a cashier's check payable to the City drawn on a bank satisfactory to the City, or a Bid Bond, in the amount of five percent (5%) of the amount of the total base bid, with the City as obligee, as assurance that the successful bidder will enter into the Contract within ten (10) days after Notice of Award.

If the successful bidder defaults by failure to enter into the Contract and to provide required performance and payment bonds, the certified check or Bid Bond accompanying the successful bid shall be collected by the City, not as a penalty but as liquidated damages for delays and such additional expenses as may be incurred by the City for reasons of such default.

7.4 Contractors will indicate a lump sum bid for on the bid form. The lump sum bid shall contain all necessary costs required for completion of the Work. Any changes, erasures, modifications, or deletions in the bid form, or alternate proposals not specified in the bid proposal may make the proposal irregular and subject to rejection.

7.5 Receipt deadline for bids will be as stated in the Advertisement for Bids.

7.6 Bids will be opened publicly in accordance with the Advertisement for Bids.

7.7 Withdrawal of bid after bid opening: To withdraw a bid after bid opening, a bidder must satisfy the substantive requirements of Va. Code §2.2-4330. In addition, the following procedures shall apply:

a. The bidder shall give notice in writing of his claim of right to withdraw his bid within two business days after the conclusion of the bid opening procedure and shall submit original work papers with such notice.

b. The mistake may be proved only from the original work papers, documents and materials used in preparation of the bid and delivered as required herein.

8. Bonds and Damages:

8.1 Bonds shall be with a surety company acceptable to the Owner~~.~~ that is legally authorized to do business in Virginia and in a form acceptable to Owner.

8.2 A performance bond and a labor and material payment bond will be required in the amount of 100 percent of the bid.

8.3 Liquidated damages shall be as indicated in the Contract Documents.

9. Award of Contract:

9.1 The award of the Contract will be the responsible bidder submitting the lowest responsive base bid.

Selection of the apparently successful bidder's responsibility will include a serious evaluation of whether the bidder has conscientiously attempted to meet Minority and Disadvantaged Business Enterprise goals. A requirement of the Contract bidder will be that a genuine concerted effort will be utilized to meet the Contract goal.

9.2 Before the Contract is awarded, the bidder submitting the lowest responsive bid must satisfy the City that it has the requisite organization, capital, equipment, ability, resources, personnel, management, business integrity, and at least five years experience in the type municipal work for which it has submitted a bid. Each bidder shall, with his bid, submit a list of at least five projects of similar size and dollar value completed within the last five years, giving location, dollar value, year completed, and the name(s) of the owner(s) and architect/engineers(s). The bidder shall verify to the City that it has the sufficient and qualified personnel to provide for the Contact Work. Failure by the lowest responsive bidder to sufficiently satisfy the City of its ability to meet any of the above requirements may serve as grounds for rejection of the bid.

9.3 The Owner reserves the right to cancel the Advertisement for Bids, reject any and all bids, waive any and all informalities, and disregard all conforming, nonconforming, conditional bids or counterproposals.

9.4 Unless canceled or rejected, a responsive bid from the lowest responsible bidder shall be accepted as submitted, except that if the responsive bid from the lowest responsible bidder exceeds available funds, pursuant to Section 18.1-9 of the Lynchburg Public Procurement Code, the Owner may negotiate with the apparent low bidder to obtain a contract price within available funds.

a. Procedures for Negotiations: If the Owner wishes to negotiate with the apparent low bidder to obtain a contract price within available funds, negotiations shall be conducted in accordance with the following procedures:

1. If the using agency wishes to conduct negotiations pursuant to this section, it shall provide the procurement administrator with a written determination that the bid from lowest responsive, responsible bidder exceeds available funds. This determination shall be confirmed in writing by the director of finance or his designee. The using agency shall also provide the procurement administrator with suggested measures to bring the proposed purchase within budget through negotiations with the lowest responsive, responsible bidder, including reductions in scope, changes in quality, value engineering, changes in terms and conditions, or changes in schedule.

2. The procurement administrator shall advise the lowest responsive, responsible bidder, in writing, that the proposed purchase exceeds available funds. He shall further invite proposed measures, such as a reduction in scope, change in quality, value engineering, changes in terms or conditions, or changes in schedule for the proposed purchase, and invite the lowest responsive, responsible bidder to amend its bid based upon the proposed measures to bring the purchase within available funds.

3. Informal discussions between the City and the lowest responsive, responsible bidder, either in person, by e-mail, by telephone, or by other means, may be used to attempt to obtain a contract within available funds.

4. Following any successful negotiations, the lowest responsive, responsible bidder shall submit a proposed addendum to its bid, which addendum shall include the specific changes in the proposed purchase, the reduction in price, and the new contract value. The addendum shall be reviewed by the purchasing agency, the City Manager, and City Attorney for acceptability.

5. If an addendum is acceptable to the City, the City may award a contract within funds available to the lowest responsive, responsible bidder based upon the amended bid proposal.

6. If the City and the lowest responsive, responsible bidder cannot negotiate a contract within available funds, all bids shall be rejected.

9.5 Protests of Award or Decisions to Award of Contract

a. The following are the exclusive procedures for a bidder or offeror to protest the City's award or decision to award a contract.

1. Any protest to award a contract shall be in writing and shall be delivered so that it is received by the City Manager not later than five (5) business days after announcement of the award or decision to award, whichever comes first. Otherwise any such protest shall be deemed to be waived.

2. Except for a protest of an emergency or sole source procurement, a protest of a City award or decision to award a contract may only be made by a person who submitted a bid or proposal for the procurement at issue and who was reasonably likely to have its bid or proposal accepted but for the City's decision. In the case of an emergency or sole source procurement, a protest may only be made by a person who can show that he was reasonably likely to have submitted a successful bid or proposal if the procurement had been other than emergency or sole source.

3. Protests shall only be granted if (1) the protester has complied fully with Sec. 18.1-6 of the Lynchburg Public Procurement Code and there has been a violation of law, the Lynchburg Public Procurement Code, or mandatory terms of the solicitation that clearly prejudiced the protestor in a material way, or (2) a statute requires voiding of the decision.

4. The City Manager shall issue a written decision on a protest within ten (10) days of its receipt by the City Manager.

5. If the protest is denied, the protestor may only appeal the denial or otherwise contest or challenge the procurement by then filing suit in the Lynchburg Circuit Court, Lynchburg, Virginia, and serving the city with such suit within ten (10) days of such denial. Otherwise, the City Manager's decision shall be final and conclusive, and the protester's right to appeal the denial or to otherwise contest or challenge the procurement shall be deemed to be waived.

6. Strictly following these procedures shall be a mandatory prerequisite for protest of the City's award or decision to award a contract. Failure by a bidder to follow these procedures strictly shall preclude that bidder's protest and be deemed to constitute a waiver of any protest.

b. A protest may not be based upon the alleged non-responsibility of a person to whom the City awards or makes a decision to award a contract.

10. Bidders are referred to the General Conditions for the meanings of capitalized terms.

End of Instructions to Bidders

GENERAL CONDITIONS

ARTICLE 1	CONTRACT DOCUMENTS AND DEFINITIONS
ARTICLE 2	ARCHITECT/ENGINEER
ARTICLE 3	OWNER
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GENERAL CONDITIONS

ARTICLE 1 CONTRACT DOCUMENTS AND DEFINITIONS

1.1 DEFINITIONS

1.1.1 CONTRACT AND CONTRACT DOCUMENTS:
The Contract Documents include: (1) the Construction Agreement (the "Contract"), its General Conditions, its Special Conditions (if any) and its attachments (if any); (2) the City's Invitation for REBID No. 2017-003 dated July 2016, and any addenda; (3) the Contractor's bid dated July 28, 2016; (4) the Contract plans, drawings, and specifications and any addenda; and (5) any Modifications and any Field Orders. Any soils, geotechnical or other reports, surveys and analyses which may be made available to the Contractor for review or information under this Contract, are not adopted by reference into, nor are they part of the Contract Documents.

1.1.2 MODIFICATION:
A Modification is (1) a written amendment to the Contract signed by both parties (Project Manager for City of Lynchburg and authorized agent for the Contractor), (2) a written Change Order signed by the Project Manager or Owner's authorized representative and an authorized agent for the Contractor, or (3) a written Change Directive signed by the Owner's authorized representative. Modifications may be made to the Contract and Contract Documents without notice to any surety for the performance or payment bonds for the Work. Any Modification that increases the Contract Sum by more than $50,000 or that causes total expenditures for the Contract to exceed the amount budgeted for the Contract may only be made with the specific approval of the City Manager.

1.1.3 WORK:
"Work" means the construction and services required by the Contract Documents and includes all services, plant, labor, materials, supplies, equipment and other things necessary for Contractor to carry out and complete the requirements of the Contract Documents. "Work" includes material suitably stored and protected. "Work" also includes any portion of the Work, whether completed or not.

1.1.4 PROJECT:
The Project is the total construction of which the Work performed by Contractor under the Contract Documents may be the whole or a part.

1.1.5 FURNISH, INSTALL & PROVIDE:
The terms "Furnish" or "Install" or "Provide", unless specifically limited in context, mean furnishing and incorporating a specified item, product or material into the Work, including all necessary labor, materials, equipment to make the item and the Work ready for use.

1.1.6 EXTRA WORK:
The term "Extra Work" as used herein, refers to and includes work required by the Owner, which, in the judgment of the Owner involves changes in or additions to the Work required by the Contract Documents in their then-existing form.

1.1.7 NOTICE OF AWARD:
"Notice of Award" is the written notice of the Owner's acceptance of the Contractor's bid given by the Owner to Contractor as the successful bidder.

1.1.8 NOTICE:
"Notice" means written notice made in the manner specified in this paragraph.

1.1.8.1 "Notice" shall be deemed to have been given to the Owner if sent to the following persons by the means indicated in 1.1.8.3 and either such Notice actually was received by such persons or adequate proof of receipt is made:

Department of Public Works	Procurement Division	City Attorney
Public Works Administration 1700 Memorial Ave Lynchburg, Virginia 24502	3rd Floor, City Hall 900 Church Street Lynchburg, Virginia 24504	3rd Floor, City Hall 900 Church Street Lynchburg, Virginia 24504

1.1.8.2 "Notice" shall be deemed to have been given to the Contractor if sent to the following person by the means indicated in 1.1.8.3 and either such Notice was received by such person or the Contractor or adequate proof of receipt by such person or the Contractor is made:

(Insert Successful bidder authorized representatives name and address)

_____

1.1.8.3 "Notice" shall be sent by special courier, recognized overnight delivery service, or United States mail. With the exception of original bid documents, facsimile copies and e-mail shall be acceptable if the original is then sent by special courier, recognized overnight delivery service, or United States mail within three business days.

1.1.9 CHANGE DIRECTIVES:
If the parties cannot agree to a written amendment to the Contract or to a Change Order, Owner may, by issuance of a written "Change Directive," direct Contractor to perform Work that Owner acknowledges, or that Contractor contends, to be a change to the Work required by the Contract Documents. A change order signed by the Owner that Contractor fails or refuses to sign shall be considered a "Change Directive."

1.1.10 MISCELLANEOUS WORDS OR TERMS:
1.1.10.1 Whenever they refer to the Work or its performance, "directed", "required", "permitted", "ordered", "designated", "prescribed", and words of like import shall imply the direction, requirements, permission, order, designation or prescription of the Owner, and "approved", "acceptable", "satisfactory", "in the judgment of" and words of like import shall mean approved by or acceptable to or satisfactory to or in the judgment of the Owner.

1.1.10.2 The Contract Documents generally refer to the Owner, Contractor, Architect/Engineers, entities, and persons as if masculine in gender and singular in number. Such references are intended to include the feminine or neutral in gender and/or the plural in number when appropriate.

1.2 EXECUTION, CORRELATION AND INTENT OF CONTRACT DOCUMENTS

1.2.1 Two originals of the Contract shall be executed.

1.2.2 The intent of the Contract Documents is to include all items necessary for the proper execution and completion of the Work, including without limitation, all items reasonably inferable from the Contract Documents. The Contract Documents are complementary, and what is required by any one shall be as binding as if required by all. Words and abbreviations which have well-known technical or trade meanings are used in the Contract Documents in accordance with such recognized meanings.

1.2.3 Anything shown on the drawings and not mentioned in the specifications or mentioned in the specifications and not shown on the drawings shall have the same effect as if shown or mentioned respectively in both. Technical specifications take priority over general specifications, and detail drawings take precedence over general drawings. Contractor shall promptly notify the A/E and Owner of

any conflict or inconsistency in the Contract Documents, upon its discovery, and promptly submit an explanation in writing of the conflict or inconsistency to the A/E, with a copy to the Owner. The A/E's decision thereon shall be final. In case of conflict or inconsistency between the drawings and the specifications, the specifications shall govern.

1.2.4 Should any labor, material, or equipment be required which is not denoted in the drawings and specifications, but which is, nevertheless, reasonably necessary for the proper carrying out of the intent of the Work, it is agreed that the labor, material, or equipment is implied, and the Contractor shall provide such labor and furnish such materials and equipment as fully as if they were completely delineated and prescribed, without additional cost to the Owner.

1.2.5 The Contractor may be furnished additional instructions and detail drawings to carry out the Work included in the Contract Documents. The additional drawings and instructions thus supplied to the Contractor will coordinate with the Contract Documents and will be so prepared that they can be reasonably interpreted as a part thereof. The Contractor shall carry out the Work in accordance with the additional detail drawings and instructions.

1.2.6 The drawings and specifications are divided into sections for convenience and clarity only. The Contractor shall not construe this division as a division of the Work into various subcontractor units. The Contractor may subcontract the Work in such divisions as he sees fit, but he is ultimately responsible for furnishing all Work required by the Contract Documents.

1.2.7 The provisions of this Contract cannot be amended, modified, varied or waived in any respect that causes a change to the Contract Sum or Contract Time except by a Modification. **The Contractor is hereby given notice that no person has authority to orally waive, or to release the Contractor from any of the Contractor's duties or obligations under or arising out of the Contract Documents.** Any waiver, approval or consent granted by Modification or Field Order to the Contractor shall be limited to those matters specifically and expressly stated thereby to be waived, approved or consented to and shall not relieve the Contractor of the obligation to obtain any future waiver, approval or consent.

1.3 OWNERSHIP AND USE OF DOCUMENTS

1.3.1 All plans, drawings, specifications, and documents relating to the Work are the property of the Owner and are to be used only for the Project.

ARTICLE 2 ARCHITECT/ENGINEER

2.1 DEFINITIONS

2.1.1 The term Architect/Engineer, hereinafter "A/E" or "Architect" or "Engineer", shall mean the consulting firm or City Department/Division, or their duly authorized representatives, lawfully licensed to practice in Virginia, that is responsible for the activities specified herein.

2.1.2 Although the A/E is referred to throughout the Contract Documents as if singular in number and masculine in gender, A/E includes plural in number and feminine or neuter in gender, as appropriate.

2.2. ARCHITECT/ENGINEER SERVICES

2.2.1 The A/E will provide services as described in these General Conditions.

2.2.2 The A/E will advise and consult with the Owner. The Owner's instructions to the Contractor may be forwarded through the A/E. The A/E has authority to act on behalf of the Owner only to the extent

provided in the Contract Documents, and the A/E does not have authority to approve a change to the Contract Sum or the Contract Time.

2.2.3 The A/E may visit the site at intervals appropriate to the stage of construction to familiarize himself generally with the progress and quality of the Work and to determine in general if the Work is proceeding in accordance with the Contract Documents. Any visits or inspections by the A/E, any Owner's representative, or any consultant retained by the Owner are solely for the Owner's benefit and shall not confer any rights on Contractor or excuse Contractor from any obligation under the Contract Documents.

2.2.4 The A/E will immediately inform the Owner and Contractor whenever, in the reasonable opinion of the A/E, any of the Work is proceeding contrary to the requirements of the Contract Documents and will be unacceptable. Such notification by the A/E is solely for the benefit of the Owner and will not be a cause for the Contractor to claim either delay of the Work or any increase in the Contract Sum or Contract Time.

2.2.5 The A/E, the Owner and other governmental representatives shall at all times have access to the Project site and the Work regardless of its stage of progress. The Contractor shall provide facilities for such access so that the A/E, the Owner and other governmental representatives may perform their functions under the Contract Documents.

2.2.6 Where applicable, based on the A/E's observations and an evaluation of the Contractor's Applications for Payment, the A/E will recommend the amounts owing to the Contractor and will issue Certificates for Payment in such amounts, as provided in Article ~~9~~9, Payments and Completion.

2.2.7 The A/E will be an interpreter of the requirements of the Contract Documents. The A/E will render interpretations necessary for the proper execution and progress of the Work, with reasonable promptness and in accordance with any time limit agreed upon. Either party to the Contract may make written request to the A/E for such interpretations. All interpretations of the A/E shall be consistent with the intent of, and reasonably inferable from, the Contract Documents and will be in writing and/or in the form of drawings.

2.2.8 The A/E will recommend to the Owner the rejection of Work that does not conform to the Contract Documents. Whenever, in his opinion, he considers it necessary or advisable for the implementation of the intent of the Contract Documents, he will have authority to require special inspection or testing of the Work in accordance with Subparagraph 7.6.2 whether or not such Work be then fabricated, installed or completed.

2.2.9 The A/E will review and approve or take other appropriate action upon Contractor's submittals such as Shop Drawings, Product Data, Samples and Manuals, but only for conformance with the design concept of the Work and with the information given in the plans, drawings, and specifications. Contractor shall ensure that all submittals are complete and have had included with them all correlated items that the A/E requires for his review. In the A/E's and Owner's sole discretion, the A/E may decline to review partial submittals or submittals for which correlated items have not been included. Contractor shall clearly note, both in a cover letter with any submittal and on the submittal itself, any deviation or inconsistency of anything submitted with the requirements of the Contract Documents. The A/E's approval of a specific item shall not indicate approval of an assembly of which the item is a component. The A/E's review and approval is for the sole benefit of the Owner and is not for the benefit of the Contractor. The A/E's review and approval shall in no way excuse Contractor from fully complying with the Contract Documents.

2.2.10 The A/E's acceptance of materials or products on behalf of the Owner shall not bar future rejection of such items (a) if they are subsequently found to be defective or inferior in quality or uniformity to the materials or products specified by the Contract Documents, (b) if such materials or products are not as

represented by the Contractor, or (c) if such materials or products do not conform to the requirements of the Contract Documents.

2.2.11 As required, the A/E will conduct inspections to assist the Owner in determining the dates of Substantial Completion and Final Completion, will receive and forward to the Owner for the Owner's review written warranties and related documents required by the Contract Documents and assembled and submitted by the Contractor, and will recommend a final Certificate for Payment upon Contractor's full compliance with the requirements of Article 9, Payment and Completion.

2.2.12 All claims, disputes, or other matters or questions between the Contractor and Owner arising out of or relating to the A/E's interpretation of the Contract Documents or arising out of any other decisions, communications, or actions of the A/E relating to the performance of the Work shall be resolved as set forth in Article 12, Changes and Modifications in the Work, and Article 13, Claims.

2.2.13 In case of the termination of the employment of the A/E, the Owner shall appoint a new A/E, who shall have the same status under the Contract Documents as the former A/E.

ARTICLE 3 OWNER

3.1 DEFINITION

3.1.1 The Owner is the City of Lynchburg, Virginia ("City"). The term Owner means the Owner or its authorized representative. The Departmental Director, or his designee, is the authorized Owner's representative for this Contract. Notwithstanding the foregoing, the authority of the Owner's representative is subject to the limitations in the Lynchburg Public Procurement Code.

3.1.2 The Departmental Director, will designate a single Owner's representative, with the title of Project Manager (PM), who will have the power to act, within the scope of his delegated authority, for and on behalf of the Owner, in accordance with the terms of the Contract Documents.

3.1.3 For purposes of any change in the Work, the term "Owner" or "Owner's representative" specifically excludes any and all inspectors having building code or City ordinance responsibilities or jurisdiction under the requirements of the building permit for the Project.

3.2 INFORMATION POSSESSED BY OWNER

3.2.1 The Owner, as a courtesy, may make available for the Contractor's reasonable review, at the Owner's offices or together with the Contract Documents, certain boring logs, geotechnical, soils and other reports, surveys and analyses pertaining to the Project site. Any such information provided to the Contractor is intended to be for the Contractor's convenience only, and its accuracy and completeness are not guaranteed or warranted by the Owner or the A/E, it being the Contractor's sole responsibility to verify the accuracy and completeness of such information. Such information is not incorporated by reference into or made a part of the Contract Documents.

3.2.1.1 Notwithstanding any information provided by Owner or anyone acting on the behalf of Owner, the Contractor assumes full responsibility for inspection of the site and for the means and methods of construction that he employs when performing the Work. The Owner shall not be liable for any additional work or costs arising as a result of any conclusions reached or assumptions derived by the Contractor from or based upon any such information that the Owner makes available for the Contractor's convenience.

3.3 OWNER-PAID PERMITS AND FEES

3.3.1 The Owner will, where applicable, pay for:

.1 Sewer availability fees;

.2 Water availability/meter connection fee;

.3 Electrical, natural gas, telephone, and cable TV permanent installation charges;

.4 Any easements required;

.5 Railroad flagging services; and

.6 Permits for work in Virginia Department of Transportation (VDOT) right-of-way. The Contractor is required to comply with the general requirement for work in the VDOT right-of-way as outlined in the The Manual of Specifications and Standard Details, 2005 for the City of Lynchburg, and the VDOT Manual for this work. Upon completion of all work in the VDOT right-of-way, the VDOT Personnel will conduct an inspection and issue a punch list. The Contractor shall be responsible for completion of those items on the punch list and for obtaining the written release of the permit.

3.3.2. The Contractor's attention is directed to Article 4.7, Contractor-Paid Taxes, Permits, Fees, and Notices, describing other permits to be obtained and fees to be paid by the Contractor.

3.4 OWNER'S RIGHT TO STOP WORK

3.4.1 If the Contractor fails to correct defective Work as required herein or persistently fails to carry out the Work in accordance with the Contract Documents, the Owner, by a written order, may order the Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, this right of the Owner to stop the Work shall not give rise to any duty on the part of the Owner to exercise this right for the benefit of the Contractor or any other person or entity.

3.5 OWNER'S RIGHT TO CARRY OUT THE WORK

3.5.1 If the Contractor defaults or neglects to carry out the Work in accordance with the Contract Documents and fails within seven (7) days after receipt of Notice from the Owner to commence and continue correction of such default or neglect with diligence and promptness, the Owner may, without prejudice to any other remedy he may have, rectify such deficiencies, including without limitation, by performing the Work or having the Work performed by other contractors, as outlined in Section 6.1, Owner’s Right to Perform Work and to Award Separate Contracts. In such case, an appropriate Change Order or Change Directive shall be issued by Owner deducting from the payments then or thereafter due the Contractor the cost of correcting such deficiencies, including compensation for the A/E's additional services made necessary by such default, neglect or failure. If the payments then or thereafter due the Contractor are not sufficient to cover such amount, the Contractor shall pay the difference to the Owner.

3.5.2 Neither the Owner nor the A/E nor their officers, agents, assigns or employees are in any way liable or accountable to the Contractor or his surety for the method by which Work performed by the Owner or performed by other contractors pursuant to this Article 3.5, or any portion thereof, is accomplished or for the price paid therefore. Notwithstanding the Owner's exercise of its rights under this Article 3.5, the Contractor and its surety shall have sole responsibility to maintain and protect the Work, including without limitation, that portion of the Work performed by or on behalf of Owner pursuant to this Article 3.5.

3.6 SUSPENSION OF WORK

3.6.1 The Owner shall have the authority to suspend the Work, in whole or in part, for such periods and such reasons as the Owner may deem necessary or desirable, in its sole discretion, including without limitation:

.1 Unsuitable weather;

.2 Other conditions considered unfavorable for the suitable prosecution of the Work; and/or

.3. Other conditions considered adverse to the best interests of the Owner.

3.6.2 Any such suspension shall be made by Owner by written order to the Contractor. The Contractor shall obey immediately such order of the Owner and shall not resume the Work until so ordered in writing by the Owner. The Contractor shall be entitled to an extension of the Contract Time, subject to the provisions of Article 8, Contract Time, herein.

3.6.3 No such suspension of the Work shall be the basis of a claim by the Contractor for any increase in the Contract Sum or for any other damages, losses, costs or expenses if the suspension is for a reasonable time under the circumstances then existing and the cause thereof is beyond the control and is without the fault or negligence of the Owner or those acting on Owner's behalf.

3.6.4 In the event of suspension of Work, the Contractor will, and will cause his Subcontractors and others providing any of the Work through Contractor to, protect carefully his and their materials and Work against damage or injury from the weather and maintain completed and uncompleted portions of the Work as required by the Contract Documents. If, in the opinion of the Owner, any Work is damaged or injured by reason of failure on the part of the Contractor or any of his subcontractors to so protect same, such Work shall be removed and replaced at the expense of the Contractor.

3.7 USE AND OCCUPANCY PRIOR TO FINAL ACCEPTANCE BY OWNER

3.7.1 The Owner has the right to take possession of and use any completed or partially completed portions of the Work, notwithstanding that the time for completing the entire Work or any portions thereof may, or may not, have expired. The taking of possession and use by the Owner shall be in accordance with the provisions in Article 9.8, Substantial Completion and Guarantee Bond. If such prior use delays the Work, the Contractor may submit a request for a time extension in accordance with the requirements of Article 8, Contract Time.

3.8 RIGHT TO AUDIT AND PRESERVATION OF RECORDS

3.8.1 The Contractor shall maintain books, records and accounts that completely and accurately account for all of his costs and receipts relating to the Project in accordance with generally accepted accounting principles and practices. The Owner or its authorized representatives shall have the right to review, inspect, audit and/or copy the books, records, accounts and related documents, including without limitation, supporting documents, of the Contractor under any of the following conditions:

.1 If the Contract is terminated for any reason in accordance with the provisions of these Contract Documents, in order to arrive at equitable termination costs;

.2 If the Contractor and the Owner dispute the amount due the Contractor under the terms of this Contract;

.3 To check or substantiate any amounts invoiced or paid that are required to reflect the costs of the Contractor, or the Contractor's efficiency or effectiveness under this Contract or in connection with

any extras, changes, claims, additions, backcharges, or other, as may be provided for in this Contract; and/or

.4 If it becomes necessary to determine the Owner's rights and the Contractor's obligations under the Contract or to ascertain facts relative to any Claim.

3.8.2 These provisions for review, inspection, audit and copying shall give the Owner unlimited access during normal working hours to the Contractor's books, records, accounts and supporting documents under the conditions stated above.

3.8.3 The Contractor shall make all his books, records, accounts, and all other documents relating to his costs and receipts under this Contract, including without limitation any supporting documents, available to the Owner and its representatives for review, audit, inspection and copying at any time during the period from entry into this Contract through three years after Final Payment or termination of this Contract, whichever occurs later.

3.8.4 Any payments made under this Contract shall not constitute a waiver of the Owner's rights to review, inspect, copy and audit. Payments shall not constitute a waiver or agreement by the Owner that it accepts as correct the billings, invoices or other charges upon which the payments are based. If the Owner's review and audit produces a claim against the Contractor, the Owner may pursue all its legal remedies, even though Owner has made all or part of the payments required by this Contract.

3.8.5 If any review or audit by the Owner or the Owner's representatives discloses an underpayment by the Owner, the Owner shall pay any amounts found by the audit to be owed to the Contractor. If such audit discloses an overpayment, the Contractor reimburse the Owner for the amount of the overpayment.

3.8.6 The Owner's right to review, inspect, audit and copy, and the Contractor's duty as to preservation of records shall terminate at the end of three (3) years after Final Payment or termination of this Contract, whichever occurs later. The Contractor shall include this "Right to Audit and Preservation of Records" clause in all his subcontracts, and he shall require the same to be inserted by all Subcontractors and lower-tier subcontractors in their subcontracts~~,~~ for any portion of the Work. Should Contractor fail to cause this clause to be included in any such subcontract or lower tier subcontract or otherwise fail to ensure the Owner's rights under this Article 3.8, Contractor shall be liable to Owner for all costs, expenses and attorney's fees that Owner may incur in order to obtain the information that would have otherwise been available to Owner under this Article 3.8, and the absence of such information shall create a presumption in the Owner's favor, which Contractor must overcome with clear and convincing evidence, that the missing information does not support the payment to Contractor or Contractor claim at issue.

3.8.7 Review, inspection, audit and copying pursuant to this Article 3.8 may be conducted by the Owner or its authorized representatives.

3.8.8 Documents subject to this Article 3.8 shall be made available to Owner and its representatives in whatever formats Owner requests, including without limitation, any electronic formats and/or in paper formats.

3.9 RIGHT TO REVIEW OTHER DOCUMENTS AND MATERIALS

3.9.1 In addition to the rights granted to the Owner under Article 3.8, Right to Audit and Preservation of Records or Documents, the Owner shall have the right to inspect, review and copy any and all of the Contractor's records or documents pertaining to or relating in any way to the Work, including, but not limited to, correspondence, memoranda, minutes, reports, intra- and inter-office communications, work papers, estimating sheets, progress reports, forecasts, audio or video recordings, computer disks, e-mails, films, or any other materials, regardless of physical form or characteristics, which were prepared by or in

the possession of, or obtainable by, the Contractor. The Contractor shall make all such documents and records available to the Owner upon ten (10) days Notice to the Contractor of the Owner's intent to inspect and review such documents. The Contractor shall include this "Right to Review Documents and Other Materials" clause in all its subcontracts, and Contractor shall cause the same to be inserted by all Subcontractors and lower-tier subcontractors in their subcontracts for any portion of the Work. The Contractor hereby waives any right he may have to additional compensation or time extensions in the event he fails or refuses to preserve and produce records pertaining to any such claim as requested by the Owner pursuant to this paragraph. In addition, the Owner may withhold all or any portion of any progress payments, which may be otherwise due, in the event Contractor refuses to comply with its obligations under this Article 3.9. The review, inspection and copying of documents and other records under this Article 3.9 may be conducted by the Owner or its authorized representatives.

3.9.2 Records and documents subject to this Article 3.9 shall be made available to Owner and its representatives in whatever formats Owner requests, including without limitation, any electronic formats and/or in paper formats.

ARTICLE 4 CONTRACTOR

4.1 DEFINITION

4.1.1 The Contractor is the person or entity identified in the Contract as such, and is generally referred to throughout the Contract Documents as if singular in number and masculine in gender but includes the feminine and neuter in gender, as appropriate. The term Contractor means the Contractor or his authorized representative.

4.1.2 This entire Contract is not one of agency by the Contractor for Owner but one in which the Contractor is engaged independently in the business of providing the services and performing the Work herein described as an independent contractor.

4.2 REVIEW OF CONTRACT DOCUMENTS

4.2.1 The Contractor shall not perform any portion of the Work at any time without having obtained and carefully reviewed the Contract Documents or, where required, approved Shop Drawings, Product. Data, Samples or Manuals for such portion of the Work.

4.2.2 The Contractor shall keep at the Project site at least two (2) copies of the drawings and specifications and shall at all times give the A/E, inspectors, and representatives of the Owner access thereto. Further, said drawings and specifications shall be the approved sets issued to the Contractor by the appropriate City permit agencies

4.3 CONTRACTOR'S REPRESENTATIONS

By entering into this Contract with the Owner, the Contractor represents and warrants the following, together with all other representations and warranties in the Contract Documents

4.3.1 That he is experienced in and competent to perform the type of work required and to furnish the plant, materials, supplies or equipment to be so performed or furnished by him;

4.3.2 That he is financially solvent, able to pay his debts as they mature, and possessed of sufficient working capital to initiate and complete the Work required by the Contract Documents;

4.3.3 That he is familiar with all federal, state, and local government laws, ordinances, permits, regulations and resolutions that may in any way affect the Work or those employed therein;

4.3.4 That such temporary and permanent Work required by the Contract Documents which is to be done by him will be satisfactorily constructed and fit for use for its intended purpose and that such construction will not injure any person, or damage any property;

4.3.5 That he has carefully examined the Contract Documents and the site of the Project and the Work and that from his own investigations, he has satisfied himself and made himself familiar with: (1) the nature and location of the Work, (2) the character, quality and quantity of materials likely to be encountered, including, but not limited to, all structures and obstructions on or at the project site, both natural and man-made; (3) the character of equipment and other facilities needed for the performance of the Work, (4) the general and local conditions, including without limitation its climatic conditions, the availability and cost of labor and the availability and cost of materials, tools and equipment; (5) the quality and quantity of all materials, supplies, tools, equipment, labor and professional services necessary to complete the Work in the manner required by the Contract Documents; and (6) all other matters or things which could in any manner affect the performance of the Work;

4.3.6 That he will fully comply with all requirements of the Contract Documents;

4.3.7 That he will perform the Work consistent with good workmanship, sound business practice, and in the most expeditious and economical manner consistent with the best interests of the Owner;

4.3.8 That he will furnish efficient business administration, an experienced superintendent, and an adequate supply of workmen, equipment, tools and materials at all times;

4.3.9 That he will complete the Work within the Contract Time;

4.3.10 That his Contract Sum is based upon the labor, materials, systems and equipment required by the Contract Documents, without exception; and

4.3.11 That he has satisfied himself as to the feasibility and correctness of the Contract Documents for the construction of the Work.

4.4 SUPERVISION AND CONSTRUCTION PROCEDURES

4.4.1 The Contractor shall supervise and direct the Work, using his best skill and attention. He shall be solely responsible for all construction means, methods, techniques, sequences and procedures and for coordinating all portions of the Work under the Contract; subject, however, to the Owner's right to reject means and methods proposed by the Contractor which are unsafe or otherwise not in compliance with the Contract Documents.

4.4.2 The Contractor shall be responsible to the Owner for the acts and omissions of Contractor's employees, Subcontractors and sub-subcontractors, suppliers, their agents and their employees, and of any other persons providing any of the Work through Contractor, and for their compliance with each and every requirement of the Contract Documents, in the same manner as if they were directly employed by the Contractor.

4.4.3 The Contractor understands and agrees that he shall not be relieved of his obligations to perform the Work in accordance with the Contract Documents either by the activities or duties of the Owner or the A/E in their administration of the Contract or by inspections, tests, or approvals required or performed under Article 7 by persons other than the Contractor.

4.4.4 Before starting a section of the Work, the Contractor shall carefully examine all preparatory work that has been executed by others to receive his Work to see that it has been completed. He shall check carefully,

by whatever means are required, to ensure that his Work and adjacent, related work will finish to proper quality, contours, planes, and levels.

4.4.5 The Contractor understands and agrees that the Owner and A/E will not have any liability for or any responsibility to exercise any control over construction means, methods, techniques, sequences or procedures, or for safety precautions and programs in connection with the Work, and they will not be responsible for the Contractor's failure to carry out the Work in accordance with the Contract Documents. The Owner and the A/E will not have any liability for or any responsibility to exercise any control over the acts or omissions of the Contractor, Subcontractors, sub-subcontrators or any of their agents or employees, or any other persons performing any of the Work.

4.4.6 The Contractor shall use no plant, equipment, materials, or persons for this Work to which the Owner objects.

4.4.7 The Contractor shall not remove any portion of the Work or stored materials from the site of the Project without the Owner's prior, written approval.

4.5 LABOR, MATERIALS AND EQUIPMENT

4.5.1 The Contractor shall furnish all plant, labor, materials, supplies, equipment and other facilities and things necessary or proper for, or incidental to, the Work, and will perform all other obligations imposed on him by the Contract Documents. Final payment will not be made until the Work is so completed.

4.5.2 Unless otherwise provided in the Contract Documents, the Contractor shall provide and pay for all labor, materials, equipment, tools, construction equipment and machinery, water, heat, utilities, transportation, and other facilities and services necessary for the proper execution and completion of the Work, whether temporary or permanent and whether or not incorporated or to be incorporated in the Work.

4.5.3 Work, materials, and equipment which are necessary in the construction but which are not specifically referred to in the specifications or shown in the drawings but implied by the Contract Documents shall be furnished by the Contractor at his own cost and expense. Such work and materials shall correspond with the general character of the Work as may be determined by the A/E subject to review as provided in Article 2.2.11.

4.5.4 The Contractor shall perform at least that percentage of the Work specified in the Contract to be Contractor self performed with forces that are in the direct employment of the Contractor. The Contractor shall submit to the Owner within thirty (30) days after award of the Contract a designation of the Work to be performed by the Contractor with his own forces. The percentage of the Work to be performed under subcontract shall be calculated by adding the amounts of all subcontracts and dividing this sum by the total Contract Sum.

4.5.5 The Contractor shall at all times enforce strict discipline, safety and good order among all persons providing any of the Work through him and shall not cause or allow to be used for the Work any unfit person or anyone not skilled in the task assigned to him. If any person providing any of the Work through the Contractor shall appear to the Owner to be incompetent or to act in a disorderly or improper manner, such person shall be removed immediately, at the request of the Owner, and shall not provide any of the Work except on written consent of the Owner.

4.5.6 No materials or supplies for the Work shall be purchased by the Contractor or by any Subcontractor subject to any chattel mortgage, or under a conditional sale or other agreement by which an interest is retained by the seller. The Contractor warrants that he has good title to all materials and supplies used by him in the Work.

4.5.7 The Contractor shall provide approved and adequate sanitary accommodations. All wastes shall be covered, disinfected, incinerated or otherwise disposed of legally.

4.5.8 All equipment, apparatus and/or devices of any kind to be incorporated into the Work that are shown or indicated on the drawings or called for in the specifications or required for the completion of the Work shall be entirely satisfactory to the Owner as regards operation, capacity and/or performance. No approval, either written or verbal, of any drawings, descriptive data or samples of such equipment, apparatus, and/or device shall relieve the Contractor of his responsibility to turn over the same in good working order for its intended purpose at the completion of the Work in complete accordance with the Contract Documents. Any equipment, apparatus and/or device not fulfilling these requirements shall be removed and replaced by Contractor with proper and acceptable equipment, apparatus, and/or device, or put in good working order satisfactory to the Owner by Contractor without additional cost to the Owner.

4.6 WARRANTY

4.6.1 The Contractor warrants to the Owner that all materials and equipment furnished under this Contract will be new unless otherwise specified, and that all workmanship will be of first class quality, free from faults and defects and in conformance with the Contract Documents and all other warranties and guaranties specified therein. Where no standard is specified for such workmanship or materials, they shall be the best of their respective kinds. All Work not conforming to these requirements, including substitutions not properly approved and authorized, may be considered defective. If required by the Owner, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment. This warranty is not limited by the provisions of Article 13, Uncovering and Correction of Work.

4.6.2 The Work included in this Contract is specified in the Contract Documents. The Contractor shall be required to complete the Work specified and to provide all items needed for construction of the Work, complete and in good order.

4.7 CONTRACTOR-PAID TAXES, PERMITS, FEES AND NOTICES

4.7.1 The Contractor shall pay all sales, consumer, use and other similar taxes for the Work or portions thereof provided by the Contractor which are legally enacted at the time bids are received, whether or not yet effective. Taxes to be paid by the Contractor shall include, but shall not be limited to, the Lynchburg City Business, Professional and Occupational License Tax (a gross receipts tax).

4.7.2 Except as provided in Article 3.3, Owner-Paid Permits and Fees, the Contractor will be responsible for obtaining and paying for all other fees, permits and licenses necessary for the proper execution of the Work, including but not limited to:

.1 Building Permit and inspections (City fees waived);

.2 Plumbing, Electrical, Mechanical Permits and inspections (City fees waived);

.3 Temporary water meter, temporary electrical and telephone installations and temporary utility usage;

.4 Temporary security lighting;

.5 All other permits necessary in order to perform the Work shall also be secured by the Contractor, and fees necessary in order to perform the Work shall be paid by him as part of this Contract at no additional cost to the Owner.

4.7.3 The Contractor shall give all notices and comply with all laws, ordinances, rules, regulations, codes, permits, resolutions and lawful orders of any public authority bearing on the performance of the Work; including but not limited to OSHA, Title 40.1 Labor and Employment Chapter 3 of the Code of Virginia, and Title VII of the Civil Rights Act of 1964, as amended. All safety violations shall be corrected immediately upon receipt of notice of violation.

4.8 COMPLIANCE

4.8.1 All demolition and excavation shall comply with all laws, ordinances, rules and regulations, and lawful orders of public authority, including without limitation, those for the prevention of accidents as issued by the Department of Labor and Industry of the Commonwealth of Virginia.

4.8.2 To the extent of the Work indicated in the Contract Documents, the Contractor shall comply and the construction shall conform with all applicable and current editions or revisions of the following codes, specifications and standards. In case of conflict, the order of precedence shall be as hereinafter listed:

.1 Lynchburg Public Procurement Code;

.2 Contract Documents;

.3 The Virginia Uniform Statewide Building Code (“USBC”), as amended including, without limitation, The International Building Code ("IBC") and other codes incorporated by the USBC and IBC); and

.4 The Virginia Department of Transportation Road and Bridge Specifications and the Road Designs and Standards.

4.8.3 If the Contractor (or any person in a contract with the Contractor relating to the Work) finds an error, inconsistency, omission, ambiguity, discrepancy, conflict or variance in the Contract Documents, or between the Contract Documents and any provisions of law, ordinance, rule, or regulations or any of the codes, specifications and standards set forth in 4.8.2 herein, the Contractor has the obligation to promptly seek in writing a clarification thereof from the A/E, with a copy to the Owner, prior to the time of beginning any of the Work that is affected by such error, inconsistency, omission, ambiguity, discrepancy, conflict or variance. The Owner will welcome such a clarification request, and, if deemed necessary by the Owner, the Owner will issue a written instruction clarifying the matter in question. If the Contractor feels that the written clarification requires additional work, the Contractor shall follow the change process in Article 12, Changes and Modifications in the Work.

Should the Contractor fail to seek such a clarification thereof immediately upon the discovery of the need therefor, prior to the time the said Work is performed, the Contractor thereby assumes all risk of loss related to such error, inconsistency, ambiguity, discrepancy, conflict or variance which the Contractor (and any person in contract with Contractor relating to the Work) knew or should have known, using a normal, professional standard of care, existed prior to the time the Work was performed.

4.8.4 Any material or operation specified by reference to publications, or published specifications of a manufacturer, a society, an association, a code, or other published standard, shall comply with the requirements of the referenced document which is current on the date of receipt of bids. If the Contractor observes that any of the Contract Documents are at variance with any such referenced publications, codes, published specifications, or published standards in any respect, he shall promptly notify the A/E in writing, with a copy to the Owner. The A/E will make such judgments as are necessary and notify the Contractor prior to the performance of the Work.

4.8.5 If the Contractor performs any Work contrary to any law, code, ordinance, regulation, publication, standard, permit, rule, regulation or resolution, he shall assume full responsibility therefore and shall bear all costs attributable thereto.

4.8.6 The Contractor is responsible for locating all underground structures such as water, oil and gas mains, water and gas services, storm and sanitary sewers and telephone and electric conduits that may be encountered during construction. The Contractor shall have Miss Utility locate all utilities on the site within the area of the Work and shall dig test holes, to determine the position of the underground structures. The Contractor shall pay the cost of digging test holes and likewise he shall pay the cost of the services of the representatives of the owners of such utilities for locating the said utilities. The cost of determining the location of any and all utilities is to be included in the bid price. The Owner shall pay the owners of such utilities for fees or charges for relocation of gas, electric, telephone, cable or other lines and/or services indicated to be relocated by others.

4.8.7 If utilities are marked which are not shown on the plans, the Contractor shall immediately give Notice to the Owner and the A/E of such finding. The Owner and A/E shall provide a direction to the Contractor within a reasonable period of time if additional work is required as a result of the finding. If the Contractor believes that it requires additional work, the Contractor shall follow the change process in Article 12, Changes and Modifications in the Work.

4.9 ALLOWANCES

4.9.1 The Special Conditions, if any, will contain provisions for allowances, if applicable to this Contract.

4.10 SUPERINTENDENT

4.10.1 The Contractor shall employ and have present at the Project site a competent Superintendent and any necessary assistants to ensure adequate supervision of the Work. The Superintendent shall have full authority to represent the Contractor, and all communications given to the Superintendent shall be as binding as if given to the Contractor.

4.10.2 Such Superintendent shall be acceptable to the Owner and shall be one who will be continued in that capacity for duration of this Project, unless he ceases to be on the Contractor's payroll. The Superintendent shall not be employed on any other project during the performance of this Contract.

4.11 CONSTRUCTION SCHEDULE

4.11.1 The Contractor shall, within twenty (20) days after issuance of the Notice of Award, prepare and submit to the A/E and Owner for review, a reasonably practicable and feasible Construction Schedule, showing the method by which the Contractor will comply with Completion Date requirements as set forth in the Contract. Unless otherwise agreed in writing by Owner or indicated in the specifications, the Construction Schedule shall use the Critical Path Method ("CPM") and an industry-standard computer software program, such as Primvera, acceptable to Owner and A/E, and shall be provided in electronic and paper format. The Construction Schedule shall show in detail how the Contractor plans to execute and coordinate the Work. The Contractor shall use this schedule in the planning, scheduling, direction, coordination and execution of the Work. The Construction Schedule shall encompass all of the work of all trades necessary for construction of the Project and shall be sufficiently complete and comprehensive to enable progress to be monitored on a day-to-day basis. The Owner and A/E shall each be provided with a copy of all schedules, updates, reports and other documentation required herein, which shall be suitable for reproduction by the Owner, and, unless otherwise agreed by Owner, shall be in electronic and paper format. When required to assist the A/E with Project staffing requirements for the following week, the Contractor shall provide the A/E, on each Friday, with a detailed work schedule for the following week. The Contractor shall provide the A/E with at least a seventy-two (72) hour notice for the following

items: (1) All traffic lane changes, (2) Work ready for inspection or testing, (3) _____. The Contractor may be charged for additional costs of inspection when material and workmanship are found to not be ready for inspection or testing at the time the Contractor calls for inspection or testing.

4.11.2 It is the sole responsibility of the Contractor to prepare, maintain, update, revise and utilize the Construction Schedule as outlined in this Article 4.11, Construction Schedule. The Construction Schedule shall be the sole overall schedule utilized by the Contractor in managing this Project; provided, however, that Contractor may, at its option, employ and utilize other schedules based upon and consistent with the Construction Schedule. In general, it is the intent of this paragraph 4.11.2 to allow the Contractor to choose its own means, methods and construction procedures consistent with good practice and the Contract Documents.

4.11.3 If the Contractor should express an intention to complete the Work earlier than any required Milestone or Completion Date, including without limitation, in any schedule, the Owner shall not be liable to the Contractor for any delay or associated extra costs based upon the Contractor being unable to complete the Work before such earlier date. The duties, obligations and warranties of the Owner to the Contractor apply only to the completion of the Work on the Milestone and Completion Dates required by the Contract Documents and do not apply to early completion.

4.11.4 Submission to the Owner of the Construction Schedule is advisory only, does not satisfy any requirement for any notice required by the Contract Documents or the Lynchburg Public Procurement Code, and such submission shall not relieve the Contractor of the responsibility for accomplishing the Work within each and every required Milestone and Completion Date. Omissions and errors in the approved Construction Schedule shall not excuse performance that is not in compliance with the Contract Documents. Submission to the Owner and/or A/E in no way makes the Owner and/or A/E an insurer of the Construction Schedule's success or makes Owner and/or the A/E liable for time or cost overruns flowing from the Construction Schedule's shortcomings. The Owner hereby disclaims any obligation or liability by reason of Owner and/or A/E approval or failure to object to the Construction Schedule, and any such approval or failure to object shall not be considered an admission by the Owner that the Construction Schedule was reasonably practicable or feasible.

4.11.5 Contractor shall consult with and obtain information from principal Subcontractors necessary in preparation of the Construction Schedule, and for updates and revisions required therein. Contractor shall provide each principal Subcontractor with copies of the Construction Schedule and any revisions or updates affecting that Subcontractor's work. Contractor shall hold appropriate progress meetings with Subcontractors and shall direct and coordinate the work of Subcontractors consistent with and as required herein. Owner shall have the right to attend Subcontractor progress meetings but shall not be required to participate in such meetings or provide information to Subcontractors, except through the Contractor. Contractor shall keep up-to-date minutes of subcontractor progress meetings and shall provide same to Owner. The Contractor shall ensure that each Subcontractor, sub-subcontractor or supplier acknowledges and accepts the requirements of the Construction Schedule relating to their part of the Work.

4.11.6 If Contractor's Construction Schedule indicates that Owner, the A/E, or a separate contractor is to perform an activity by a specific date, or within a certain duration, Owner, the A/E, or any separate contractor shall not be bound to said date or duration unless Owner expressly and specifically agrees in writing to the same. The Owner's and/or A/E's overall review and acceptance or approval of the schedule does not constitute an agreement to specific dates or durations for activities of the Owner, A/E, or any separate contractor.

4.11.7 The Contractor's Superintendent shall maintain at the Project site a current, updated Construction Schedule, indicating actual monthly progress for those portions of the Project on which Work has been or is being performed.

4.11.8 If an extension or contraction of any Milestone or Completion Date is authorized by any Change Order, the Contractor shall revise his Construction Schedule, Milestone and Completion Dates accordingly.

4.11.9 If, in the opinion of the Owner, the Construction Schedule does not accurately reflect the actual progress and sequence of the Contractor's performance of the Work, the Contractor shall revise the Construction Schedule, upon the Owner's request, and submit a revised Construction Schedule that accurately represents the progress and sequence of the Contractor's performance of the Work.

4.11.10 Contractor shall submit to the Owner the name of any scheduling consultant that Contractor may select or retain, prior to using such consultant. Contractor shall not utilize any particular scheduling consultant over the reasonable objection of the Owner to that consultant.

4.11.11 Contractor covenants, warrants, and guarantees that Contractor will not:

.1 Misrepresent to Owner its planning and scheduling of the Work;

.2 Utilize schedules materially different from those made available to the Owner or any subcontractors for the direction, execution and coordination of the Work, or which are not feasible or realistic;

.3 Prepare schedules, updates, revisions or reports that do not accurately reflect Contractor's actual intent or Contractor's reasonable and actual expectations as to:

(a) The sequences of activities,

(b) The duration of activities,

(c) The responsibility for activities,

(d) Resource availability,

(e) Labor availability or efficiency,

(f) Expected weather conditions,

(g) The value associated with the activity,

(h) The percentage complete of any activity,

(i) Completion of any item of work or activity,

(j) Project completion,

(k) Delays, slippages, or problems encountered or expected,

(l) Subcontractor requests for time extension, or delay claims of subcontractors, and

(m) If applicable, the float time available.

4.11.12 Contractor's failure to substantially comply with the foregoing covenants, warranties and guarantees of paragraph 4.11.11 shall be a substantial and material breach of contract which will permit Owner to terminate Contractor for default~~,~~ or withhold payments under the Contract Documents~~,~~ and shall entitle Owner to the damages afforded by these Contract Documents or applicable law.

4.11.13 Should Contractor fail to substantially comply with the provisions of the Contract Documents relating to scheduling and execution of the Work by the overall Construction Schedule, Owner shall have the right, at its option, to retain the services of scheduling consultants or experts (including attorneys if necessary in the opinion of the Owner) to prepare schedules, reports, updates and revisions of the schedule in accordance with the Contract Documents and to review and analyze same, in order to allow Owner and the A/E to evaluate the progress of the Work by Contractor, to determine whether Contractor is substantially complying with the Contract Documents, and to direct such action by the Contractor, as permitted by the Contract Documents, as required to ensure, under the Owner's schedule prepared hereunder, that Contractor will complete the Work within the Contract Time. All costs and expenses and fees incurred by Owner in exercising its rights hereunder shall be charged to Contractor's account. If Contractor fails to substantially comply with the scheduling and execution of the Work requirements of the Contract Documents, Contractor hereby agrees, in such instance, to comply with such Owner-prepared schedules, if any, or directions, activity sequences and durations as Owner may reasonably require, without additional cost to the Owner (subject only to cost adjustments for such changes in the Work as Owner may direct), to ensure completion within the Contract Time.

4.11.14 The Construction Schedule shall be utilized by Owner, A/E and Contractor for submission, review and approval of monthly Payment Requests. The schedule must be updated by Contractor monthly with each progress payment application and submitted to the Owner and A/E for review with the progress payment application. Owner shall not be required to process and review Contractor's Application for Payment if Contractor has failed or refused to provide the scheduling update information required herein.

4.11.15 The type of schedule to be utilized on this Project, along with its particular elements, shall be as specified in the Contract Documents.

4.12 RESPONSIBILITY FOR COMPLETION

4.12.1 The Contractor shall furnish such manpower, materials, facilities and equipment and shall work such hours, including night shifts, overtime operations and Sundays and holidays, as may be necessary to ensure the performance of the Work within the Milestone and Completion dates specified in the Contract. If the Owner notifies the Contractor that it has become apparent that the Work will not be completed within required Milestone or Completion Dates and such is not due solely to circumstances for which Contractor has established entitlement to an extension to the Contract Time, the Contractor agrees that it will assume full responsibility to take some or all of the following actions, at no additional cost to the Owner (except for circumstances beyond the Contractors' control), in order to ensure, in the opinion of the Owner, that the Contractor will comply with all Milestone and Completion Date requirements:

.1 Increase manpower, materials, crafts, equipment and facilities;

.2 Increase the number of working hours per shift, shifts per working day, working days per week, or any combination of the foregoing; and

.3 Reschedule activities to achieve maximum practical concurrency of accomplishment of activities.

Failure of the Owner to notify the Contractor of the apparent delay shall not relieve Contractor of the obligation to finish the Work within the required Milestone or Completion date.

4.12.2 If the actions taken by the Contractor to remedy delays not due solely to circumstances for which Contractor has established entitlement to a time extension are not satisfactory, the Owner may direct the Contractor to take any and all actions necessary to ensure completion within the required Milestone and

Completion Dates, without additional cost to the Owner. In such event, the Contractor shall continue to assume responsibility for his performance and for completion within the required dates.

4.12.3 If, in the opinion of the Owner, the actions taken by the Contractor pursuant to this Article or the progress or sequence of Work are not accurately reflected on the Construction Schedule, the Contractor shall revise such schedule to accurately reflect the actual progress and sequence of Work.

4.12.4 Failure of the Contractor to substantially comply with the requirements of this Article is grounds for a determination by the Owner, pursuant to Article 15, Termination Of The Contract, that the Contractor is failing to prosecute the Work with such diligence as will ensure its completion within the time specified.

4.12.5 The Owner may, at its sole discretion and for any reason, including when it is apparent to the A/E or Owner that the Work will not be completed within the required Milestone or Completion Dates, require the Contractor to accelerate the Construction Schedule by providing overtime, Saturday, Sunday and/or holiday work and/or by having all or any subcontractors designated by the Owner provide overtime, Saturday, Sunday, and/or holiday work. If the Owner requires overtime, Saturday, Sunday or holiday work by the Contractor's or his Subcontractor's own forces, and such requirement is not related in any way to the Contractor's apparent inability to comply with Milestone and Completion Date requirements, the Owner shall reimburse the Contractor for the direct cost to the Contractor of the premium time for all labor utilized by the Contractor in such overtime, Saturday, Sunday or holiday work (but not for the straight time costs of such labor), together with any Social Security and State or Federal unemployment insurance taxes in connection with such premium time. However, no overhead supervision costs, commissions, profit or other costs and expenses shall be payable in connection therewith.

4.12.6 This provision does not eliminate the Contractor's responsibility to comply with the City's noise ordinances, all VDOT permit requirements, and all other applicable laws, regulations, rules, ordinances, resolutions, and permit requirements.

4.13 DOCUMENTS AND SAMPLES AT THE SITE

4.13.1 The Contractor shall, at the Owner's direction, maintain at the site for the Owner one record copy of all drawings, specifications, addenda, Change Orders and other Modifications, and Field Orders in good order and marked currently to record all changes made during construction, and approved Shop Drawings, Product Data, Samples and Manuals. These shall be available to the A/E. These shall be delivered to the Owner upon completion of the Work.

4.14 SHOP DRAWINGS, PRODUCT DATA, SAMPLES AND MANUALS

4.14.1 SHOP DRAWINGS are drawings, diagrams, schedules and other data specially prepared for the Work by the Contractor or any Subcontractor, manufacturer, supplier or distributor to illustrate some portion of the Work.

4.14.2 PRODUCT DATA are illustrations, standard schedules, performance charts, instructions, brochures, diagrams and other information furnished by the Contractor to illustrate a material, product or system for some portion of the Work.

4.14.3 SAMPLES are physical examples that illustrate materials, equipment or workmanship and establish standards by which the Work will be judged.

4.14.4 MANUALS are manufacturer's installation, start-up, operating, maintenance and repair instructions, together with parts lists, pictures, sketches and diagrams that set forth the manufacturer's requirements, for the benefit of the Contractor and the Owner.

4.14.5 The Contractor shall review, approve and submit, with reasonable promptness and in such sequence as to cause no delay in the Work or in the work of the Owner or any separate contractor, all Shop Drawings, Product Data, Samples and Manuals required by the Contract Documents.

4.14.6 By approving and submitting Shop Drawings, Product Data, Samples and Manuals, the Contractor represents that he has determined and verified all materials, field measurements, and field construction criteria related thereto, and that he has checked and coordinated the information contained within such submittals with the requirements of the Work and of the Contract Documents.

Parts and details not fully indicated on the contract drawings shall be detailed by the Contractor in accordance with standard engineering practice. Dimensions on the drawings, as well as detailed drawings themselves, are subject in every case to measurements of existing, adjacent, incorporated and completed Work, which shall be taken by the Contractor before undertaking any Work dependent on such data.

4.14.7 The Contractor shall not be relieved of responsibility for any deviation from the requirements of the Contract Documents by the Owner or A/E's approval of Shop Drawings, Product Data, Samples or Manuals under Article 2, Architect/Engineer unless the Contractor has specifically informed the Owner and A/E in writing of such deviation at the time of submission and the Owner has given specific written approval to the specific deviation. The Contractor shall not be relieved from responsibility for errors or omissions in the Shop Drawings, Product Data, Samples or Manuals by the A/E's approval thereof.

4.14.8 The Contractor shall direct specific attention, in writing or on resubmitted Shop Drawings, Product Data or Samples, to revisions other than those requested by the Owner or A/E on previous submittals.

No portion of the Work requiring submission of Shop Drawings, Product Data, or Samples shall commence until the submittal has been approved by the Owner and A/E as provided in Article 2, Architect/Engineer. All such portions of the Work shall be in accordance with approved submittals.

4.14.9 For substances that are proposed for use in the Project that may be hazardous to human health, the Contractor shall submit to the A/E, for information only, information on precautions for safely using these substances, including Material Safety Data Sheets and certification of registration by the Contractor with authorities under the respective Virginia and Federal Toxic Substances Control Acts.

4.14.10 Unless otherwise modified by the Owner in writing, the Contractor shall label or stamp and number all Shop Drawings, Product Data, Samples or Manuals as prescribed by the Project Manager.

4.14.11 The Contractor shall submit a copy of each submittal, including the transmittal sheet (for shop drawings, product data, samples or manuals) to the Owner simultaneously with the Contractor's submission of said drawings, data, samples or manual packages to the A/E.

4.15 EQUAL PRODUCTS:

4.15.1 The term "Product" as used in the Contract Documents refers to materials, equipment, supplies, articles, fixtures, devices, types of construction, or products, as appropriate.

4.15.2 All products furnished shall, whenever specified and otherwise wherever practicable, be the standard products of recognized, reputable manufacturers. If the manufacturer cannot make scheduled delivery of an approved item, the Contractor may request approval of the A/E to use another brand, make, manufacturer, article, device, product, material, fixture, form or type of construction which the Contractor judges to be equal to that specified. An item need not be considered by the A/E for approval as equal to the item so named or described unless it (1) it is at least equal in quality, durability, appearance, strength, and design; (2) it will perform at least equally the specific function imposed by the general design for the work being contracted for or the material being purchased; and (3) it conforms substantially, even with

deviations, to the detailed requirements for the item in the specifications. Approval shall be at the sole discretion of the A/E and will be based upon considerations of quality, workmanship, economy of operation, suitability for the purpose intended, and acceptability for use on the project. Any such approval must be in writing to be effective, and the decision of the A/E shall be final.

4.15.4 To obtain such approval of equal products other than those specified in Contract Documents, and not previously approved during the bidding, the Contractor's request for approval of any equal product shall include the following:

.1 Complete data substantiating compliance of the proposed equal product with the Contract Documents;

.2 Accurate cost data on proposed equal product in comparison with product or method specified;

.3 Product identification including manufacturer's name, address, and phone number;

.4 Manufacturer's literature showing complete product description, performance and test data, and all reference standards;

.5 Samples and colors in the case of articles or products;

.6 Name and address of similar projects on which the product was used and date of installation;

.7 All directions, specifications, and recommendations by manufacturers for installation, handling, storing, adjustment, and operation.

4.15.5 The Contractor shall also submit with his request for approval a statement which shall include all of the following representations by the Contractor, namely that:

.1 He has investigated the proposed equal product and determined that it is equal or better in all respects to that specified and that it fully complies with all requirements of the Contract Documents;

.2 He will meet all contract obligations with regard to this substitution;

.3 He will coordinate installation of accepted equal products into the work, making all such changes and any required schedule adjustments, at no additional cost to the Owner, as may be required for the Work to be complete in all respects;

.4 He waives all claims for additional costs and additional time related to equal products. He also agrees to hold the Owner harmless from claims for extra costs and time incurred by subcontractors and suppliers, or additional services which may have to be performed by the A/E, for changes or extra work that may, at some later date, be determined to be necessary in order for the Work to function in the manner intended in the Contract Documents;

.5 He will provide the same warranty and guarantee, and perform any work required in accordance therewith, for the equal product that is applicable to the specified item for which the equal product is requested;

.6 Material will be installed, handled, stored, adjusted, tested, and operated in accordance with the manufacturers' recommendation and as specified in the Contract Documents;

.7 In all cases, new materials will be used unless this provision is waived in writing by, the Owner or unless otherwise specified in the Contract Documents;

.8 All material and workmanship will be in every respect, in accordance with that which in the opinion of the Owner, is in conformity with approved modern practice; and

.9 He has provided accurate cost data on the proposed equal product in comparison with the product or method specified, if applicable.

4.15.6 The Owner may require tests of all products proposed as equal products so submitted to establish quality standards, at the Contractor's expense. After approval of an equal product, if it is determined that the Contractor submitted defective information or data regarding the equal product upon which Owner's approval was based, and that unexpected or uncontemplated redesign or rework of the Project will be required in order to accommodate the equal product, or that the item will not perform or function as well as the specified item for which equal product was requested, the Contractor will be required to furnish the original specified item or request approval to use another equal product. The Contractor shall pay all costs, expenses or damages associated with or related to the unacceptability of such an equal product and the resultant utilization of another item, and no time extension shall be granted for any delays associated with or related to such an equal product.

4.15.7 Equal products will not be considered for approval by the Owner if:

.1 The proposed equal product is indicated or implied on the Contractor's shop drawing or product data submittals and has not been formally submitted for approval by the Contractor in accordance with the above-stated requirements; or

.2 Acceptance of the proposed equal product will require substantial design revisions to the Contract Documents or is otherwise not acceptable to the Owner.

4.15.8 Except as otherwise provided for by the provisions of any applicable laws, the Contractor shall not have any right of appeal from the decision of the Owner disapproving any products submitted if the Contractor fails to obtain the approval for an equal product under this Article.

4.15.8 If the Contractor proposes a product which the Owner determines is not equal to the product named in Contract Documents but which the Owner nevertheless is willing to accept, Contractor shall provide, upon request by the Owner, an itemized comparison of the proposed substitution with the product specified and the cost differential which shall be credited to the Owner in a Change Order issued in accordance with Article 12, Changes and Modifications in the Work.

4.16 USE OF SITE

4.16.1 The Contractor shall confine his operations at the site to areas permitted by law, ordinances, permits, easements, right-of-way agreements and the Contract Documents. The Contractor shall not unreasonably encumber the site, in the opinion of the Owner, with any materials, equipment or trailers, nor shall Contractor block the entrances or otherwise prevent reasonable access to the site, other working and parking areas, completed portions of the Work and/or properties, storage areas, areas of other facilities that are adjacent to the worksite. If the Contractor fails or refuses to move said material, equipment or trailers within 24 hours of Notice by the Owner to so do, the Owner shall have the right, without further Notice, to remove, at the Contractor's expense, any material, equipment and/or trailers which the Owner deems are in violation of this paragraph.

4.17 CUTTING AND PATCHING OF WORK

4.17.1 The Contractor shall be responsible for all cutting, fitting or patching that may be required to complete the Work and to make its several parts fit properly and in accordance with the Contract Documents.

4.17.2 The Contractor shall not damage or endanger any portion of the Work or the work of the Owner or any separate contractors by cutting, patching or otherwise altering any work, or by excavation. The Contractor shall not cut or otherwise alter the work of the Owner or any separate contractor except with the written consent of the Owner and of such separate contractor. The Contractor shall not unreasonably withhold from the Owner or any separate contractor Contractor's consent to cutting or otherwise altering the Work. The Owner shall not be required to accept Work with a cut, splice, or patch when such cut, splice or patch is not generally accepted practice for the particular work involved or is otherwise unworkmanlike in the opinion of the Owner.

4.18 SITE CLEAN UP

4.18.1 The Contractor at all times shall keep the Project site and adjacent areas free from accumulation of waste materials or rubbish caused by his operations. Before final payment is made, the Contractor shall remove all of his waste materials, rubbish, scrap materials, debris, tools, construction equipment, machinery, surplus materials, falsework, temporary structures, including foundations thereof and plant of any description, from the Project site and put the site in a neat, orderly condition.

4.18.2 If the Contractor fails to clean up as required herein at any time during the performance of the Work or at the completion of the Work, the Owner may, upon 24 hours notification, clean up the site at the Contractor's expense.

4.19 PATENTS, ROYALTIES, ETC.

4.19.1 The Contractor guarantees to save harmless the Owner, its officers, agents, servants and employees from liability of any kind or nature, including without limitation, cost, expense and attorney's fees, on account of suits and claims of any kind for violation or infringement of any patents or patent rights by the Contractor, or by anyone directly or indirectly employed by him, or by reason of the use of any art, process, method, machine, manufacture, or composition of matter patented or unpatented in the performance of this Contract in violation or infringement of any letter or rights. The Contractor agrees to pay all royalties, fees, licenses, etc. required in respect of the Work or any part thereof as part of his obligations hereunder without any additional compensation.

4.20 INDEMNIFICATION

4.20.1 It is hereby mutually covenanted and agreed that the relation of the Contractor to the Work to be performed by him under this Contract shall be that of an independent contractor and that as such he will be responsible for all damages, loss or injury, including death, to persons or property that may arise or be incurred in or during the conduct and progress of said work as the result of any action, omission or operation under the Contract or in connection with the Work, whether such action, omission or operation is attributable to the Contractor, subcontractor, any material supplier, or anyone directly or indirectly employed by any of them. The Contractor shall make good any damages that may occur in consequence of the Work or any part of it. The Contractor shall assume all liability, loss and responsibility of whatsoever nature by reason of his neglect or violation of any federal, state, county or local laws, regulations , codes or ordinances.

4.20.2 The Contractor shall indemnify, hold harmless and defend the Owner, its employees, agents, servants and representatives from and against any and all claims, suits, demands, actions (regardless of the merits thereof) and damages of whatever nature arising out of or resulting from the performance of the Work or

the failure to perform the Work, including without limitation, jurisdictional labor disputes or other labor troubles that may occur during the performance of the Work.

4.20.3 The indemnification obligations under this Article shall not be affected in any way by any limitation on the amount or type of damages, compensation or benefits payable by or for the Contractor or any Subcontractor under worker's or workman's compensation acts, disability benefit acts or other employee benefit acts.

4.20.4 The obligations of the Contractor under this Article 4.20 shall not extend to the actions or omissions of the A/E, his agents or employees, arising out of the preparation or approval of maps, drawings, opinions, reports, surveys, change orders, designs or specifications.

4.20.5 The obligations of the Contractor under this Article 4.20 shall not extend to the proportion of damages, loss or injury, including death, to persons or property that may arise or be incurred as the result of any action, omission or operation of the Owner, or Owner's separate contractor(s), and their employees, agents, servants, and/or representatives.

4.21 NON-DISCRIMINATION IN EMPLOYMENT

4.21.1 During the performance of this Contract, the Contractor agrees as follows:

.1 The Contractor will not discriminate against any employee or applicant for employment because of race, religion, color, sex, national origin, age, disability, or any other basis prohibited by state law relating to discrimination in employment, except where there is bona fide occupational qualification reasonably necessary to the normal operation of the Contractor. The Contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices setting forth the provisions of this nondiscrimination clause.

.2 The Contractor, in all solicitations or advertisements for employees placed by or on behalf of the Contractor, will state that such Contractor is an equal opportunity employer.

.3 Notices, advertisements and solicitations placed in accordance with federal law, rule or regulation shall be deemed sufficient for the purpose of meeting the requirements of this section.

.4 The Contractor will include the provisions of the foregoing paragraphs 1, 2, and 3 in every subcontract or purchase order of over $10,000, so that the provisions will be binding upon each subcontractor or vendor.

4.21.2 DRUG-FREE WORKPLACE REQUIRED:

As required by section 2.2-4312 of the Code of Virginia during the performance of the Contract, Contractor agrees to (i) provide a drug-free workplace for the contractor's employees; (ii) post in conspicuous places, available to employees and applicants for employment, a statement notifying employees that the unlawful manufacture, sale, distribution, dispensation, possession, or use of a controlled substance or marijuana is prohibited in the Contractor's workplace and specifying the actions that will be taken against employees for violations of such prohibition; (iii) state in all solicitations or advertisements for employees placed by or on behalf of the Contractor that the Contractor maintains a drug-free workplace; and (iv) include the provisions of the foregoing clauses in every subcontract or purchase order of over $10,000, so that the provisions will be binding upon each subcontractor or vendor.

For the purposes of this Article 4.21, "drug-free workplace" means a site for the performance of Work done in connection with this Contract where Contractor's employees are prohibited from engaging in the unlawful

manufacture, sale, distribution, dispensation, possession or use of any controlled substance or marijuana during the performance of the Contract.

4.22 CONTRACT SECURITY

4.22.1 The Contractor shall deliver to the Owner, within ten (10) working days from Notice of Award, two (2) originals of a Performance Bond and a separate Labor and Material Payment Bond, in a form acceptable to the Owner, and each in an amount required by the Contract Documents and the Virginia Public Procurement Act, as security for the faithful performance of the Contract, and the payment of all persons performing labor and furnishing materials in connection with this Contract. The City will not issue Notice to Proceed until the bonds are received. The amount of the Performance and Payment Bonds shall be increased to the same extent the Contract Sum is increased due to Modifications. The form of bonds shall be acceptable to the Owner, and the surety shall be such surety company or companies as are acceptable to the Owner and as are authorized to transact business in the Commonwealth of Virginia. The cost of such bonds shall be included in the Contractor's bid amount.

4.22.2 The bonds shall irrevocably obligate the Contractor and surety to the full amount of the bonds unless and until all of Contractor's obligations under the Contract Documents have fully been fulfilled.

4.22.3 If, at any time, any surety or sureties for any bond relating to the Work becomes insolvent or is determined by the Owner to be unable to adequately secure the interest of the Owner, the Contractor shall, within (30) days after Notice from the Owner to do so, substitute an acceptable bond(s) in such form and sum and with such other sureties as obligors as may be satisfactory to the Owner. The premiums on such bond(s) shall be paid by the Contractor.

ARTICLE 5 SUBCONTRACTORS

5.1 DEFINITIONS

5.1.1 A Subcontractor is a person or entity who has a direct contract with the Contractor to perform or supply any of the Work at the site. Subcontractor means a Subcontractor or his authorized representative. The term Subcontractor does not include any separate contractor performing work pursuant to Article 6 or his subcontractors.

5.1.2 A Sub-subcontractor is a person or entity who has a direct or indirect contract with a Subcontractor to perform or supply any of the Work at the site. The term Sub-subcontractor includes a Sub-subcontractor or an authorized representative thereof.

5.1.3 The A/E will not deal directly with any Subcontractor or Sub-subcontractor or materials supplier. Subcontractor, Sub-subcontractors or material suppliers shall route requests for information or clarification through the Contractor to the A/E, with a copy to the Owner.

5.2 AWARD OF SUBCONTRACT AND OTHER CONTRACTS FOR PORTIONS OF THE WORK

5.2.1 The Contractor shall submit to the Owner with a copy to the A/E prior to the award of any subcontract for Work under this Contract and thirty (30) calendar days after the award of this Contract, the names of the suppliers of principal items, systems, materials, and equipment proposed for the Work; the names and addresses, business and emergency phones of the Subcontractors which he proposes to employ under this Contract, as well as such other information as may be requested by the Owner. The Owner will review each Subcontractor and supplier based upon his apparent financial soundness and responsibility, his known or reported performance on previous similar work, and his available plant, equipment and personnel to perform the Work. The Contractor shall not employ a

Subcontractor or supplier to whom the Owner reasonably objects. The Owner's objection to a proposed Subcontractor or supplier shall not affect the Contract Sum.

5.2.2 The Contractor shall make no substitutions for any Subcontractor, person or entity previously selected unless first submitted to the Owner for review and approval.

5.3 SUBCONTRACTUAL RELATIONS

5.3.1 By an appropriate written agreement, the Contractor shall require each Subcontractor, to the extent of the Work to be performed by the Subcontractor, to be bound to the Contractor by the terms of the Contract Documents, and to assume toward the Contractor all the obligations and responsibilities which the Contractor, by these Contract Documents, assumes toward the Owner and the A/E. Said agreement shall preserve and protect the rights of the Owner and the A/E under the Contract Documents with respect to the Work to be performed by the Subcontractor so that the subcontracting thereof will not prejudice such rights, and shall allow to the Subcontractor, unless specifically provided otherwise in the Contractor-Subcontractor agreement, the benefit of all rights, remedies and redress against the Contractor that the Contractor, by these Contracts Documents, has against the Owner. Where appropriate, the Contractor shall require each Subcontractor to enter into similar agreements with his Sub-subcontractors. The Contractor shall make available to each proposed Subcontractor, prior to the execution of the subcontract, copies of all of the Contract Documents, and identify to the Subcontractor any terms and conditions of the proposed subcontract which may be at variance with the Contract Documents. Each Subcontractor shall similarly make copies of such Contract Documents available to his Sub-subcontractor's. Each subcontract agreement shall insure that all appropriate provisions of the Contract Documents are complied with by the Subcontractor.

5.3.2 The provisions herein regarding the City's reasonable objection to any Subcontractor shall in no way affect the liability of the Contractor to Owner regarding performance of all obligations by or payment of Subcontractors. The City's failure to object to any given Subcontractor shall not relieve the Contractor of his obligation to perform or have performed to the full satisfaction of the Owner all of the work required by this Contract.

5.3.3 Neither this article nor any other provision of the Contract Documents shall be deemed to make the Owner a joint venture or partner with the Contractor or to place the Subcontractor and materialmen in privity of contract with the Owner.

5.4 QUALIFICATION SUBMITTALS

5.4.1 Specific qualification submittals may be required of the Contractor, Subcontractors, installers and suppliers for certain critical items of the Work. Required qualification submittals are set forth in detail in the Instruction to Bidders and shall be provided, collected and submitted by the Contractor to the A/E with copies to the Owner. All information required of a single Subcontractor, installer or supplier shall be contained in a single, complete submittal. The Contractor shall submit the required qualification information within ten (10) days after receipt of the Owner's request.

5.4.2 The Owner may reject any proposed Subcontractor, installer or supplier, or any qualification submittals related thereto, for the following reasons:

.1 The Contractor's failure to submit requested information within the specified time; or

.2 The Contractor's failure to provide all of the requested information; or

.3 The Contractor's submission of a Subcontractor, installer or supplier, or qualifications thereof, which are unacceptable in the judgment of the Owner.

5.4.3 Should the Owner have reasonable objection to any proposed Subcontractor, installer or supplier, the Contractor shall submit another firm for approval by the Owner at no additional cost to the Owner.

ARTICLE 6 WORK BY OWNER OR BY SEPARATE CONTRACTORS

6.1 OWNER'S RIGHT TO PERFORM WORK AND TO AWARD SEPARATE CONTRACTS

6.1.1 The Owner reserves the right to perform work related to the Project with his own forces, and to award separate contracts in connection with other portions of the Project or other work on the site.

6.1.2 When separate contracts are awarded for different portions of the Project or other work on the site, the term "contractor" in the contract documents in each case shall mean the contractor who executes each separate construction agreement.

6.2 MUTUAL RESPONSIBILITY

6.2.1 The Contractor shall afford other contractors and the Owner reasonable opportunity for the introduction and storage of their materials and equipment and the execution of their work and shall properly connect and coordinate the Work with such other work. The Contractor shall coordinate his Work with the Owner and other contractors and store his apparatus, materials, supplies and equipment in such orderly fashion at the site of the Work as will not unduly interfere with the progress of the Work or the work of any other contractors.

6.2.1.1 If the execution or result of any part of the Work depends upon any work of the Owner or of any separate contractor, the Contractor shall, prior to proceeding with the Work, inspect and promptly report to the Owner in writing any apparent discrepancies or defects in such work of the Owner or of any separate contractor that render it unsuitable for the proper execution or result of any part of the Work.

6.2.1.2 Failure of the Contractor to so inspect and report shall constitute an acceptance of the Owner's or separate contractor's work as fit and proper to receive the Work, except as to defects which may develop in the Owner's or separate contractor's work after completion of the Work and which the Contractor could not have discovered by its inspection prior to completion of the Work.

6.2.2 Should the Contractor cause damage to the work or property of the Owner or of any separate contractor on the Project, or to other work on the site, or delay or interfere with the Owner's work on ongoing operations or facilities or adjacent facilities or said separate contractor's work, the Contractor shall be liable for the same; and, in the case of another contractor, the Contractor shall attempt to settle said claim with such other contractor prior to such other contractor's institution of litigation or other proceedings against the Contractor.

If such separate contractor sues the Owner on account of any damage, delay or interference caused or alleged to have been so caused by the Contractor, the Owner shall notify the Contractor, who shall defend the Owner in such proceedings at the Contractor's expense. If any judgment or award is entered against the Owner, the Contractor shall satisfy the same and shall reimburse the Owner for all damages, expenses, and other costs that the Owner incurs as a result thereof.

6.2.3 Should Contractor have a dispute with a separate contractor with whom the Owner has contracted regarding damage to the Work or the property of Contractor or to the Work or property of said separate contractor or with regard to any delays or interferences which either Contractor or said separate contractor has caused to the performance of the other's Work, Contractor agrees to attempt to settle such dispute directly with said separate contractor. Contractor agrees that it will not seek to recover from the Owner any damages, costs, expenses (including, but not limited to, attorney's fees) or losses of profit incurred by

the Contractor as a result of any damage to the Work or property of the Contractor or for any delay or interference caused or allegedly caused by any separate contractor.

6.3 OWNER'S RIGHT TO CLEAN UP

6.3.1 If a dispute arises between the Contractor and separate contractors as to their responsibility for cleaning up as required by Article 4, Contractor, the Owner may clean up and charge the cost thereof to the contractor responsible as the Owner shall determine to be just.

ARTICLE 7 MISCELLANEOUS PROVISIONS

7.1 GOVERNING LAW

The provisions of this Contract shall be interpreted in accordance with the laws of the Commonwealth of Virginia.

7.2 PROVISIONS REQUIRED BY LAW DEEMED INSERTED

Each and every provision of law and clause required by law to be inserted in this Contract shall be deemed to be inserted herein, and the Contract shall be read and enforced as though it were included herein and if through mistake or otherwise, any such provision is not inserted or is not correctly inserted, then upon the application of either party, the Contract shall forthwith be physically amended to make such insertion.

7.3 SUCCESSORS AND ASSIGNS

The Owner and the Contractor each binds himself, his partners, successors, assigns and legal representatives to the other party hereto and to the partners, successors, assigns and legal representatives of such other party in respect to all covenants, agreements and obligations contained in the Contract Documents. Neither party to the Contract shall assign the Contract or sublet it without the written consent of the other, nor shall the Contractor assign any monies due or to become due to him hereunder, without the previous written consent of the Owner and the Contractor's surety.

In the event the Contractor desires to make an assignment of all or part of the Contract or any monies due or to become due hereunder, the Contractor shall file a copy of consent of surety, together with a copy of the assignment to the Owner and A/E. In the event the Contractor assigns all or any part of the monies due or to become due under this Contract, the instrument of assignment shall state that the right of assignees in and to any monies due to or to become due to Contractor shall be subject to prior liens and claims of all persons, firms and corporations that provided labor services or furnished material and equipment during the performance of the Work. The rights of assignees shall further be subject to the payment of any liens, claims, or amounts due to Federal, state, or local governments.

7.4 RIGHTS AND REMEDIES

7.4.1 The duties and obligations imposed by the Contract Documents and the rights and remedies available thereunder shall be in addition to, and not a limitation of, any duties, obligations, rights and remedies otherwise imposed or available by law, not inconsistent with the Contract Documents. No time limitations described in this Contract shall be construed to alter the applicable statutory period of limitations with regard to the enforcement of the obligations of the parties.

7.4.2 No action or failure to act by the Owner, A/E or Contractor shall constitute a waiver of any right or duty afforded any of them under the Contract, nor shall any such action or failure to act constitute an approval of or acquiescence in any breach thereunder, except as may be specifically agreed in writing.

7.4.3 Contractor agrees that he can be adequately compensated by money damages for any breach of this Contract which may be committed by the Owner and hereby agrees that, no default, act, or omission of the Owner or the A/E, except for failure to make payments as required by the Contract Documents, shall constitute a material breach of the Contract entitling Contractor to cancel or rescind the provisions of this Contract or (unless the Owner shall so consent or direct in writing) to suspend or abandon performance of all or any part of the Work. Contractor hereby waives any and all rights and remedies to which he might otherwise be or become entitled, saving only its right to money damages.

7.5 SEVERABILITY

In the event that any provision of this Contract shall be adjudged or decreed to be invalid, such ruling shall not invalidate the entire agreement but shall pertain only to the provision in question and the remaining provisions shall continue to be valid, binding, and in full force and effect.

7.6 TESTS

7.6.1 If the Contract Documents, laws, ordinances, rules, regulations, codes, permits, resolutions or orders of any public authority having jurisdiction require any portion of the Work to be inspected, tested or approved, the Contractor shall give the Owner at least 24 hours notice of its readiness so that the Owner or the A/E or other representatives of the Owner may observe such inspection, testing or approval. The Contractor shall bear all costs of such inspections, tests or approvals conducted by public authorities. Site inspections, tests conducted on site or tests of materials gathered on site, which the Contract requires to be performed by independent testing entities, shall be contracted and paid for by the Contractor. Examples include, but are not limited to, the testing of cast-in-place concrete, foundation materials, soil compaction, pile installations, caisson bearings, and steel framing connections.

7.6.2 All materials and workmanship (if not otherwise designated by the specifications) shall be subject to inspection, examination or test by the Owner, A/E, and other representatives of the Owner, at any and all times during the manufacture and/or construction and at any and all places where such manufacture and/or construction are carried on. Special, full-sized and performance tests shall be as described in the specifications. Without additional charge, the Contractor shall furnish promptly all reasonable facilities, labor and materials necessary to make tests safe and convenient.

7.6.3 The selection of bureaus, laboratories and/or agencies for the inspection and tests of supplies, materials or equipment shall be subject to the approval of the Owner. Satisfactory documentary evidence, including but not limited to certificates of inspection and certified test reports that the material has passed the required inspection and tests must be furnished to the Owner, with a copy to the A/E, by the Contractor prior to the incorporation of the supplies, materials or equipment into the Work or at such times as to allow for appropriate action by the Owner.

7.6.4 Inspection or testing performed exclusively for the Contractor's convenience shall be the sole responsibility of the Contractor. Tests required by Contractor's or Subcontractor's error, omission or non-compliance with the Contract Documents, shall be paid for by the Contractor.

7.6.5 It is specifically understood and agreed that an inspection and approval of the materials by the Owner shall not in any way subject the Owner to pay for the said materials or any portion thereof, even though incorporated in the Work, if said materials shall in fact turn out to be unfit to be used in the Work, nor shall such inspection be considered as any waiver of objection to the Work on account of the unsoundness or imperfection of the material used.

ARTICLE 8 CONTRACT TIME

8.1 DEFINITION

8.1.1 Unless otherwise provided, the Contract Time is the period of time specified in the Contract Documents for Substantial Completion of the Work as defined herein, including authorized adjustments thereto. The Contractor shall complete his Work within the Contract Time.

8.1.2 The date of commencement of the Work is the date established in the Notice to Proceed

The Contractor shall not commence Work or store materials or equipment on site until written Notice to Proceed is issued or until the Contractor otherwise receives the Owner's written consent. The Contractor shall commence work no later than ten (10) days after the date established in the Notice to Proceed.

8.1.3 The date of Substantial Completion of the Work or designated portion thereof is the date determined by Owner when: (1) construction is sufficiently complete, in accordance with the Contract Documents, so the Owner can occupy or utilize the Work or designated portion thereof for the use for which it is intended; and (2) the Contractor has satisfied all other requirements for Substantial Completion which may be set forth in the Contract Documents.

8.1.4 The date of Final Completion of the Work is the date determined by the Owner when the Work is totally complete, to include punch list work, in accordance with the Contract Documents and the Owner may fully occupy and utilize the Work for the use for which it is intended.

8.1.5 The term “day” as used in the Contract Documents shall mean calendar days unless otherwise specifically designated.

8.2 PROGRESS AND COMPLETION

8.2.1 All time limits stated in the Contract Documents, including without limitation the date of Substantial Completion of the Work, are of the essence of the Contract.

8.2.2 The Contractor shall begin the Work on the date of commencement as defined herein. He shall carry the Work forward expeditiously with adequate forces and shall achieve Substantial and Final Completion as required by the Contract Documents.

8.3 CLAIMS FOR TIME EXTENSIONS

8.3.1 The time during which the Contractor is delayed in the performance of the Work by the acts or omissions of the Owner, the A/E or their employees or agents, acts of God, unusually severe and abnormal climatic conditions, fires, floods, epidemics, quarantine restrictions, strikes, riots, civil commotion or freight embargoes, or other conditions beyond the Contractor's control and which the Contractor could not reasonably have foreseen and provided against, shall be added to the time for completion of the Work (i.e., the Contract Time) stated in the Agreement; however, no claim by the Contractor for an extension of time for delays will be considered unless made in compliance with the requirements of this Article and other provisions of the Contract Documents.

8.3.2 The Owner shall not be obligated or liable to the Contractor for, and the Contractor hereby expressly waives any claims against the Owner on account of, any indirect or direct damages, costs or expenses of any nature which the Contractor, its Subcontractors, or Sub-subcontractor's or any other person may incur as a result of (1) any delays, reasonable or unreasonable, foreseeable or unforeseeable, which are either not caused by the acts or omissions of the Owner, its agents or employees or which arise from or out of (or due to) causes not within the control of the Owner, its agents or employees, or (2) any reasonable

delay regardless of its cause, it being understood and agreed that the Contractor's sole and exclusive remedy in any such events shall be an extension of the Contract Time, but only as determined in accordance with the provisions of the Contract Documents.

8.3.3 The burden of proof to substantiate a claim for an extension of the Contract Time shall rest with the Contractor, including evidence that the cause was beyond his control. It shall be deemed that the Contractor has control over the supply of labor, materials, equipment, methods and techniques of construction and over the Subcontractors, Sub-contractors, and suppliers, unless otherwise specified in the Contract Documents.

8.3.4 In the event of changes in the Work, the Contractor must identify any additional time required in the Proposed Change Order. The Owner need not consider any time extensions for changes in the Work not included in the Proposed Change Order.

8.3.5 No time extensions will be granted as a result of the Contractor's improper or unreasonable scheduling or for the Contractor's failure to have Shop Drawings, Product Data, Samples or Manuals submitted in ample time for review under a reasonable and agreed upon schedule.

8.3.6 Delays by Subcontractors, Sub-subcontractors or suppliers will not be considered justification for a time extension, except for the same valid reasons and conditions enumerated herein.

8.3.7 The Contractor acknowledges and agrees that actual delays due to changes, suspension of work or excusable delays, in activities which, according to the Construction Schedule, do not affect the Contract Time will not be considered to have any effect upon the Contract Time and therefore will not be the basis for a time extension.

8.3.8 The Contractor acknowledges and agrees that time extensions will be granted only to the extent that: (1) excusable delays exceed the available flexibility in the Contractor's schedule; and (2) Contractor can demonstrate that such excusable delay actually caused, or will cause, delay to the Contractor's schedule that will extend the Contract Time.

8.3.9 With respect to Suspensions of Work under Paragraph 3.6, Suspension of Work, herein, the Contractor shall be entitled to an extension of the Contract Time not to exceed the length of time that the Work was suspended (unless as determined under this Article and the other requirements of the Contract Documents that a further extension is justified and warranted) if the claim is submitted in accordance with the requirements of this Article, and if the suspension is not due to any act or omission of the Contractor, any Subcontractor or Sub-subcontractor or any other person or organization for whose acts or omission the Contractor may be liable. The Contractor's claim will be evaluated in accordance with the terms of this Article.

8.3.10 The Contractor shall not be entitled to any extension of time for delays resulting from any conditions or other causes unless it shall have given written Notice to the Owner, within seven (7) calendar days following the commencement of each such condition or cause, describing the occurrence, the activities impacted and the probable duration of the delay. The Contractor's complete claim submittal for a time extension shall be submitted no later than twenty (20) calendar days after cessation of the delay or within such other longer period as the Owner may agree in writing to allow.

8.3.11 No such extension of time shall be deemed a waiver by the Owner of his right to terminate the Contract for abandonment or delay by the Contractor as herein provided or to relieve the Contractor from full responsibility for performance of his obligations hereunder.

8.4 CHANGE ORDER WORK

8.4.1 The Contractor shall make every reasonable effort to perform Change Order work within the Contract Time and in such manner as to have minimum delaying effects on all remaining Work to be performed under the Contract. If, however, the Change Order work results in an unavoidable increase in the time required to complete the Work, an extension of the Contract Time may be granted to the Contractor for the Change Order work. The Contractor's request shall be determined in accordance with the provisions of Article 8.3, Claims for Time Extensions, herein and as follows:

.1 If the time required for performance of the Change Order work has an unavoidable, direct, delaying effect on the primary sequence of Work activities remaining after rescheduling (e.g., the critical path in CPM type scheduling), the overall Contract Time may be extended by the minimum number of days required for the Change Order work as mutually agreed upon by the Owner and the Contractor;

.2 If the time required for performance of the Change Order work does not have an unavoidable direct delaying effect on the primary sequence of Work activities but is ordered by the Owner at a time such that insufficient Contract Time remains for completion of the Change Order work (and any limited number of contingent work activities), the Contract Time may be extended by the minimum number of days required for the Change Order work as mutually agreed upon by the Owner and the Contractor but only for the Change Order work and contingent activities, All other unaffected Work shall be performed within the Contract Time;

.3 Failure of the Owner and the Contractor to agree on a Contract Time extension as specified in .1 and .2 above shall not relieve the Contractor from proceeding with and performing the Change Order work promptly, as well as in such manner as to have minimal delaying effects on all remaining Work to be performed under the Contract. Such disagreement shall be resolved as soon as practical by negotiation.

8.5 LIQUIDATED DAMAGES FOR DELAY

8.5.1 The damages incurred by the Owner due to the Contractor's failure to complete the Work within required Milestone Dates and the Contract Time, including any extensions thereof, shall be in the amount set forth in the Construction Agreement, for each consecutive day beyond the Milestone Dates or the Contract Time (Sundays and all holidays included) for which the Contractor shall fail to complete the Work.

8.5.2 The parties hereby agree that the amount of liquidated damages provided in this Contract is neither a penalty nor a forfeiture and is intended to compensate the Owner solely for the Owner's inability to use the Work for its fully intended purpose, and is not intended to, nor does said amount include: (1) any damages, additional or extended costs~~,~~ incurred by the Owner for extended administration of this Contract, or by the Owner's agents, consultants or independent contractors for extended administration of this Contract, or (2) any additional services, relating to or arising as a result of the delay in the completion of the Work. Owner shall be entitled to claim against Contractor for its actual damages ~~and~~for any damages not specifically included within the liquidated damages as set forth herein. Such damages shall be computed separately, and, together with liquidated damages, either deducted from the Contract Sum or billed to the Contractor, at the option of the Owner.

Contractor agrees that it will not challenge the per diem amounts of liquidated damages imposed pursuant to this Article 8.5 except as to whether Contractor is responsible for the delays, themselves, that have resulted in the assessment of liquidated damages. The Contractor waives any challenge as to the validity of any liquidated damages specified on the grounds that such liquidated damages allegedly are void as penalties or allegedly are not reasonably related to Owner’s actual damages.

Owner may, in its sole discretion, deduct from any payments otherwise due Contractor amounts of liquidated damages assessable under this Article 8.5. Owner's failure to deduct liquidated damages assessable under this Article 8.5 from payments to Contractor shall not be deemed a waiver by Owner of any entitlement to such liquidated damages.

8.6 TIME EXTENSIONS FOR WEATHER

8.6.1 The Contract Time will not be extended due to inclement weather conditions that are normal to the general locality of Work site. The time for performance of this Contract includes an allowance for workdays (based on a 5-day workweek) which, according to historical data, may not be suitable for construction work.

.1 The following is the schedule of monthly anticipated normal inclement weather workdays for the Project location and will constitute the base line for monthly weather time extension evaluations.

ANTICIPATED NORMAL INCLEMENT WEATHER WORK-DAYS INCLUDED IN THE CONTRACT TIME OF PERFORMANCE											
JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
7	7	7	7	9	7	7	7	6	6	6	7

8.6.2 The Contractor, in his planning and scheduling of the Work as required by the Contract Documents, shall allow for the normal inclement weather for the locality of the Work site. If the Contractor believes that the progress of the Work has been adversely affected and that it will directly result in a failure to meet Substantial Completion within the Contract Time, by weather conditions above and beyond the amount normally expected, he shall submit a written request to the Owner, with a copy to the A/E, for an extension of time, pursuant to Paragraph 8.3, Claims for Time Extensions.

8.6.3 Such request shall be evaluated by the Owner in accordance with the provisions of the Contract Documents and shall include a comparison of actual weather statistics compiled by City of Lynchburg's Department of Public Works, for the time of year, locality of the particular Work site with the days claimed by the Contractor and the anticipated normal inclement weather as stated in subparagraph 8.6.1. The normal inclement weather expected has been included in the designated Contract Time for completion. The decision of the Owner shall be final.

8.6.4 The Contractor shall not be entitled to any money damages whatsoever for any delays resulting from inclement weather, whether normal or abnormal, foreseeable or unforeseeable. The Contractor and Owner stipulate and agree that, for delays due to weather as determined in 8.6.3, the Contractor's sole relief is a time extension granted in accordance with this Article 8.6, Time Extensions for Weather.

ARTICLE 9 PAYMENTS AND COMPLETION

9.1 CONTRACT SUM

9.1.1 The Contract Sum is stated in the Construction Agreement and, including authorized adjustments thereto, is the total amount payable by the Owner to the Contractor for the performance of the Work under the Contract Documents. The Contract Sum includes, but is not limited to, the Contractor's profit and general overhead and all costs and expenses of any nature whatsoever (including without limitation taxes, labor, equipment and materials), foreseen or unforeseen, and any increases in said costs and expenses, foreseen or unforeseen, incurred by the Contractor in connection with the performance of the Work, all of which

costs and expenses shall be borne solely by the Contractor. The Contractor agrees to assume all increases in costs of any nature whatsoever that may develop during the performance of the Work.

9.2 SCHEDULE OF VALUES

9.2.1 For Lump Sum Price contracts, before the pre-construction meeting, the Contractor shall submit to the Owner and A/E a schedule of values allocated to the various portions of the Work, prepared on payment forms provided by the Owner and supported by such data to substantiate its accuracy as the Owner may require. This schedule of values, unless rejected by the Owner, shall be used as a basis for the Contractor's Applications for Payment.

9.2.2 For Unit Price contracts, the Contractor shall utilize the payment request form provided by the Owner, wherein the schedule of values shall correspond with the individual unit price bid items. When so requested by the Owner, the Contractor shall provide a more detailed cost breakdown of the unit price items.

9.2.3 Contractor may include in his schedule of values a line item for "mobilization" which shall include a reasonable amount for mobilization for the Contractor and his Subcontractors. The Contractor shall not front-end load his schedule of values.

9.3 APPLICATION FOR PAYMENT

9.3.1 The Contractor shall submit to the A/E three (3) originally executed, itemized Applications for Payment (and one (1) copy to the Owner) by the tenth of each month, along with any authorized change orders for that billing cycle. The Applications for Payment shall be notarized, indicate in complete detail all labor and material incorporated in the Work during the month prior to submission, and supported by such data substantiating the Contractor's payment request as the Owner may require. The Applications for Payment shall also contain Contractor's certification that due and payable amounts and bills have been paid by the Contractor for Work for which previous Certificates of Payment were issued and payments received from the Owner.

9.3.2 Payment may be made for the value of materials, which are to be incorporated into the finished Work, and which are delivered to and suitably stored and protected on the Work site. The Contractor shall provide releases or paid invoices from the seller of such materials to establish, to the Owner's satisfaction, that the Owner has title to said material. Stored materials shall be in addition to the Work completed and shall be subject to the same retainage provisions as the completed Work. Material once paid for by the Owner becomes the property of the Owner and may not be removed from the Work site without the Owner's written permission.

9.3.3 The requirements for payment for materials stored off-site shall include, but are not limited to, those specified in Paragraph 9.3.2 and the additional requirements hereinafter specified. Material stored off-site under this provision shall be included in the definition of Work, Article 1, Contract Documents.

9.3.3.1 The requirements of Paragraph 10.2, Safety of Persons and Property, are fully applicable to materials stored off-site.

9.3.3.2 For purposes of administering this provision, the following definitions are provided.

a. Material stored NEAR the Work site: A storage location shall be considered near the Work site if it is not more than fifty (50) miles (approximately a one-hours drive) from the Work site.

b. Material stored DISTANT from the Work site: Locations beyond the limit of fifty (50) miles shall be considered distant.

9.3.3.3 All proposed off-site locations, regardless of whether they are near or distant, shall be approved by the Owner prior to any payment under this Article. The approval process will include an inspection of the proposed storage site, which may or may not coincide with any inspection of materials stored.

9.3.3.4 Prior to payment for any material stored off-site, said material shall be inspected to verify that it is properly stored; i.e., segregated, inventoried, identified as the property of the Owner and Contractor, and duly protected as required in Article 10.2, Safety of Persons and Property. This material shall be clearly identified and physically segregated from any other material or stock, in such a manner that it is clear, from casual observationthat said material is not a part of any other stock or stored material.

9.3.3.5 For materials stored distant to the Work site, the Contractor shall reimburse the Owner for all reasonable costs incurred by the Owner, to include but not limited to salary, transportation, lodging and per diem, for the Owner's or the A/E's employees to travel to and from the storage locations for the purpose of verifying that the material is properly stored. It is anticipated that such trips would occur whenever additional material is claimed for payment and/or at least every six (6) months until the material is delivered to the Work site.

9.3.3.6 Except for unusual circumstances, the Contractor will not be required to reimburse the Owner's costs for visits to storage locations near the Work site.

9.3.3.7 The Contractor shall hold the Owner harmless from any and all losses, additional costs, direct or indirect damages and/or delays, whatsoever, which may occur as a result of a failure of the Contractor to deliver (or have delivered), in a timely manner, materials (for which payment has been made) to the Work site for installation and incorporation into the Work.

9.3.3.8 The Contractor shall provide to the Owner a release of lien or other suitable certification by the seller of the materials, in addition to paid invoices, verifying that the Contractor has valid title to all materials for which payment is requested. The seller, however, shall not be required to waive his rights for recovery against Contractor or any surety if his contract is breached.

9.3.4 The Contractor warrants that title to all Work, materials and equipment covered by an Application for Payment will pass to the Owner, either by incorporation in the construction or upon the receipt of payment by the Contractor, whichever occurs first, free and clear of all liens, claims, security interests or encumbrances, hereinafter referred to as "liens". The Contractor further warrants that no Work, materials or equipment covered by an Application for Payment will have been acquired by the Contractor or by any other person performing Work at the site or furnishing materials and equipment for the Work that is subject to an agreement under which an interest therein or an encumbrance thereon is retained by the seller or otherwise imposed by the Contractor or such other person.

9.3.5 The Contractor's Application for Payment shall provide that the payment request attests that all Work for which the request is made has been completed in full according to all the requirements of the Contract Documents. By submitting his Application for Payment, the Contractor also represents that he has no knowledge that any Subcontractors or suppliers have not been fully and timely paid and that, insofar as he knows, the only outstanding items for payment with respect to the Contract are those to be paid from the funds for which application is being made.

9.4 CERTIFICATES FOR PAYMENT

9.4.1 The A/E will, within seven (7) calendar days after the receipt of the Contractor's Application for Payment, recommend a Certificate for Payment to the Owner, for such amount as the A/E determines is properly

due, with his reasons for any withholding or adjusting a Certificate as provided in Paragraph 9.6, Payments Withheld.

9.4.2 After the Certificate for Payment is recommended by the A/E, the Owner will review it and make any changes deemed necessary by the Owner's representative. The recommendation of the Certificate for Payment by the A/E does not waive or limit the Owner's right to reduce the amount of the payment due to the Contractor as determined to be appropriate by the Owner.

9.4.3 The recommendation of a Certificate for Payment will constitute a representation by the A/E to the Owner, based on his observations at the site as provided in Article 2, Architect/Engineer, and the data comprising the Application for Payment, that the Work has progressed to the point indicated; that, to the best of his knowledge, information and belief: (1) the quality of the Work is in accordance with the Contract Documents (subject to an evaluation of the Work for conformance with the Contract Documents upon Substantial or Final Completion, to the results of any subsequent tests required by or performed under the Contract Documents, to minor deviations from the Contract Documents correctable prior to completion, and to any specific qualifications stated in his Certificate); and that (2) the Contractor is entitled to payment in the amount certified. However, by recommending a Certificate for Payment, the A/E shall not thereby be deemed to represent that he has made exhaustive or continuous on-site inspections to check the quality or quantity of the Work or that he has reviewed the construction means, methods, techniques, sequences or procedures, or that he has made any examination to ascertain how or for what purpose the Contractor has used the moneys previously paid on account of the Contract Sum.

9.4.3.1.1 The Application for Payment shall be on a form approved by the City. Payment for stored material delivered but not incorporated in the work will be the invoiced amount only. Stored materials drawdown shall be approved by the Owner. Submit applicable invoices with Application for Payment. Monthly partial payment request shall be submitted in **TRIPLICATE** to Owner's representative for approval by the 25th of the month so that the Owner can approve payment request by the first working day of the next month. Partial payments shall be made on a monthly basis on or before the end of the next month for which the Work was performed, in accordance with the Contract Documents.

9.4.3.1.2 The Owner shall pay to the Contractor 95 percent of the total amount due and the Owner shall retain five (5) percent of the amount due until all work has been performed strictly in accordance with the Contract Documents and until such work has been accepted by the Owner.

9.5.1 The Owner shall make payment in the manner and within thirty (30) calendar days after receipt of the Certificate of Payment from the A/E based upon the Owner's approval or adjustment of said Certificate. The Contractor shall be paid the amount approved or adjusted by the Owner, less 5% retainage which is being held to assure faithful performance; provided however, that said retainage is not applicable to Time and Material Change Orders.

9.5.1.1 In relation to punch list or other uncompleted Work and in lieu of a portion of the above-specified five-percent 5% retainage, the Owner may, at its sole discretion, elect to retain fixed amounts directly relating to the various items of uncompleted Work. All amounts withheld shall be included in the Final Payment.

9.5.2 The Contractor shall, within seven (7) days after receiving payment from the Owner, do one of the following:

9.5.2.1 Pay all Subcontractors for the proportionate share of the total payment received from the Owner for Work performed by each Subcontractor under the Contract; or

9.5.2.2 Notify the Owner and Subcontractor(s), in writing, of his intention to withhold all or part of the Subcontractor's payment with the reason for nonpayment.

9.5.3 The Contractor shall make payment to Subcontractors as heretofore specified. Each payment shall reflect the percentage actually retained, if any, from payments to the Contractor on account of such Subcontractor's Work.

9.5.4 The Contractor shall provide the Owner with his social security number, if an individual, or his federal identification number, if a corporation, partnership, or other entity.

9.5.5 The Contractor shall pay unpaid Subcontractors interest on payments that are not made in accordance with this Article 9.5, Progress Payments. The rate of interest shall be in compliance with the Prompt Payment section of the Virginia Public Procurement Act of the Code of Virginia. The Contractor shall, by an appropriate agreement with each Subcontractor, require each Subcontractor to make payments to his Sub-subcontractors according to all the same requirements as provided in this Article 9.5 Progress Payments.

9.5.6 The Owner may, upon written request, furnish to any Subcontractor, if practicable, information regarding the percentages of completion or the amounts applied for by the Contractor and the action taken thereon by the Owner on account of Work done by such Subcontractor.

9.5.7 Neither the Owner nor the A/E shall have any obligation to pay or to see to the payment of any monies to any Subcontractor except as may otherwise be required by law.

9.5.8 No Certificate for Payment, nor any payment, nor any partial or entire use or occupancy of the Project by the Owner, shall constitute an acceptance of any Work not in accordance with the Contract Documents, nor shall it waive any right or claim by Owner based upon the Work, or any portion of the Work, including Work for which payment has been made, not conforming to the requirements of the Contract Documents.

9.6 PAYMENTS WITHHELD

9.6.1 The Owner may withhold the payment in whole or in part, if necessary to reasonably protect the Owner. If the A/E is unable to make representations as provided in subparagraph 9.4.3 and to recommend payment in the amount of the application, he will notify the Owner as provided in subparagraph 9.4.1. If the Contractor and the Owner cannot agree on a revised amount, the Owner will promptly issue a Certificate for Payment for the amount for which he is able to make representations with respect to payment, due for Work performed. The Owner may also decline to certify or make payment because of subsequently discovered evidence or subsequent observations, and the Owner may nullify the whole or any part of any Certificate for Payment previously issued.

9.6.2 The Owner may withhold from the Contractor so much of any payment approved by the A/E, as may in the judgment of the Owner be necessary:

.1 To protect the Owner from loss due to defective work not remedied;

.2 To protect the Owner upon receipt of notice of the filing in court or in an arbitration proceeding as may be required in any third party contract, of verified claims of any persons supplying labor or materials for the Work, or other verified third party claims;

.3 To protect the Owner upon reasonable evidence that the Work will not be completed for the unpaid balance of the Contract Sum;

.4 To protect the Owner upon reasonable evidence that the Work will not be completed within the Contract Time established by this Contract; or

.5 To protect the Owner upon the Contractor's failure to properly schedule and coordinate the Work in accordance with or as required by the Contract Documents, or failure to provide progress charts, revisions, updates or other scheduling data as required by the Contract Documents, or upon the Contractor's failure to provide as-built drawings as required herein, or upon Contractor's failure to otherwise substantially or materially comply with the Contract Documents.

9.6.3 If required by the Contract Documents, the Contractor shall, concurrent with his submission of the Construction Schedule, submit a practicable and realistic payment schedule showing the dates on which the Contractor will submit each and every Application for Payment and the amount he expects to receive for each and every monthly progress payment. If during the performance of the Work, the Contractor expects to receive an amount for a monthly progress payment larger than that indicated on the payment schedule, the Contractor shall notify the Owner at least thirty (30) days in advance of that payment so that the necessary allocation of funds can be processed. If Contractor fails to submit a practicable and realistic payment schedule, the Contractor's Application for Payment shall be honored only to the extent that the Work is actually performed and that the proportion of payments made to the Contract Sum does not exceed the proportion of the Contract Time expired as of the time of the request.

9.7 FAILURE OF PAYMENT

If the Owner does not make payment to the Contractor within the thirty (30) calendar days after receipt of the Contractor's Application for Payment by the A/E through no fault of Contractor, and the Owner otherwise not being entitled under the Contract Documents or applicable law to withhold payment, then the Contractor may, upon fifteen (15) additional days' written Notice to the Owner and the A/E, stop the Work until payment of the amount owing has been received. In such event, the Contract Sum shall be increased by the amount of the Contractor's reasonable costs of shutdown, delay and start-up, which shall be effected by appropriate Change Order as provided herein.

9.8 SUBSTANTIAL COMPLETION AND GUARANTEE BOND

9.8.1 Unless otherwise specified in Article 9.9, Final Completion and Final Payment, when the Contractor considers that the Work, or a designated portion thereof which is acceptable to the Owner, is substantially complete as defined in Article 8, Contract Time, the Contractor shall request in writing that the A/E and the Owner perform a Substantial Completion inspection. Prior to such inspection the Contractor shall:

.1 If applicable, secure a Certificate of Occupancy for the Project or a designated portion thereof; and

.2 Submit five (5) copies each of the Operations and Maintenance Manuals to the A/E as specified and one (1) copy to the Owner.

9.8.2 The Owner shall determine whether the Work is substantially complete and shall compile a punch list of items to be completed or corrected. The failure to include any items on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents.

9.8.3 When the Owner on the basis of his inspection determines that the Work or a designated portion thereof is substantially complete, the A/E will then prepare a Certificate of Substantial Completion which shall establish the Date of Substantial Completion and shall state the responsibilities of the Owner and the Contractor for security, maintenance, heat, utilities, damage to the Work and insurance. The Certificate of Substantial Completion shall be submitted to the Owner and the Contractor for their written acceptance of the responsibilities assigned to them in such Certificate.

9.8.4 The Contractor shall have thirty (30) days from the Date of Substantial Completion to complete all items on the punch list to the satisfaction of the Owner. If the Contractor fails to complete all punch list items within the designated time, the Owner shall have the option to correct or conclude any remaining items by utilizing its own forces or by hiring others. The cost of such correction of remaining punch list items by the Owner or others shall be deducted from the final payment to the Contractor, and if the Owner has not retained sufficient funds to cover the cost, Contractor or its surety shall pay the difference within 30 days of a written demand by the Owner to do so.

9.8.5 Guarantees and warranties required by the Contract Documents shall commence on the Date of Final Completion of the Work, unless otherwise provided in the Certificate of Substantial or Final Completion, or the Contract Documents. Provided, however~~,~~ that if Contractor does not complete certain punch list items within the time period~~,~~ specified in 9.8.4, all warranties and guarantees for such incomplete Punch List items shall become effective upon issuance of final payment for the Work.

9.8.5.1 The Contractor shall guarantee for a term of one (1) year from the date of Final Completion or Final Payment, whichever comes later, (unless otherwise provided for in the Certificate(s) of Substantial or Final Completion or the Contract Documents): (1) the quality and stability of all materials equipment and Work; (2) all the Work against defects in materials, equipment or workmanship; and (3) all shrinkage, settlement or other faults of any kind which are attributable to defective materials or workmanship. The Contractor shall remedy at his own expense, when so notified in writing to do so by the Owner, and to the satisfaction of the Owner, the Work or any part thereof that does not conform to any of the warranties and guaranties described in the Contract Documents~~.~~ or that otherwise does not conform to the requirements of the Contract Documents

9.8.5.2 In order to make good the guarantee as herein required, the Contractor shall deposit with the Owner, after Substantial Completion but before Final Payment, a Guarantee Bond(s) issued by a surety licensed to do business in Virginia and otherwise acceptable to the Owner, for the faithful performance of the guarantee. Said Bond(s) shall be for a period of one (1) year from the date the guaranties and warranties commence and in the amount of five percent (5%) of the final gross value of the Contract.

9.8.5.3 The Contractor shall complete repairs during the guarantee period~~,~~ within five (5) working days after the receipt of Notice from the Owner, and if the Contractor shall fail to complete such repairs within the said five (5) working days, the Owner may employ such other person or persons as it may deem proper to make such repairs and pay the expenses thereof out of any sum retained by it, provided nothing herein contained shall limit the liability of the Contractor or his surety to the Owner for non-performance of the Contractor's obligations at any time.

9.8.6 The issuance of the Certificate of Substantial Completion does not indicate final acceptance of the Work by the Owner, and the Contractor is not relieved of any responsibility for the Work except as specifically stated in the Certificate of Substantial Completion.

9.8.7 Upon Substantial Completion of the Work, or designated portion thereof, and upon application by the Contractor and certification by the A/E, the Owner shall make payment, adjusted for retainage and payments withheld, if any, for such Work or portion thereof, as provided in the Contract Documents.

9.8.8 Should the Owner determine that the Work or a designated portion thereof is not substantially complete, he shall provide the Contractor a written Notice stating why the Work or designated portion is not substantially complete. The Contractor shall expeditiously complete the Work and shall re-request in writing that the Owner perform a Substantial Completion inspection.

9.9 FINAL COMPLETION AND FINAL PAYMENT

9.9.1 A Certificate of Final Completion shall be issued by the A/E prior to final payment. At the Owner's sole option, this Final Completion Certificate may be issued without a Certificate of Substantial Completion. The Contractor, prior to application for Final Payment and within the time specified for completion of the Work, shall complete all Work, to include punch list items and provide operation and maintenance manuals and as-built data, for the Work, as completed and in place. Said Certificate of Final Completion shall be issued, even if a Certificate of Substantial Completion has been issued previously and temporary authority to operate the Work has been granted.

9.9.1.1 The Certificate of Final Completion shall certify that all Work has been completed in accordance with Contract Documents and is ready for use by the Owner.

9.9.2 For all projects where Substantial Completion Certificates have been issued for various portions of the Work, at differing times, the Contractor shall request and the Owner shall, prior to final payment, issue a Certificate of Final Completion which certifies that all required Work, including punch list items, has been completed in accordance with the Contract Documents.

9.9.3 Neither the final payment nor any remaining retainage shall become due until the Contractor submits to the A/E the following:

.1 An Application for Payment for all remaining monies due under the -Contract.

.2 Consent of surety to final payment;

.3 If required by the Owner, other data establishing payment or satisfaction of all such obligations, such as receipts, releases and waivers of claims arising out of the Contract, to the extent and in such form as may be designated by the Owner. If any Subcontractor refuses to furnish waiver of claims satisfactory to the Owner, the Contractor may furnish a bond satisfactory to the Owner to indemnify Owner against any such claim. If any such claim remains unsatisfied after all payments are made, the Contractor shall refund to the Owner all monies that the latter may be compelled to pay in discharging such claim, including all costs and reasonable attorneys' fees;

.4 As-built drawings, operation and maintenance manuals and other project closeout submittals, as required by the Contract Documents;

.5 Construction releases as required by the Contract Documents from each property owner on whose property an easement for construction of the Work has been obtained by the Owner, such release to be in the forms to be provided by the Owner. This release is for the purpose of releasing the Owner and the Contractor from liability, claims, and damages arising from construction operations on or adjacent to the easement and includes proper restoration of the property after construction. It shall be the Contractor's sole responsibility to obtain all such releases and furnish them to the Owner; and

.6 A written certification that:

.1 The Contractor has reviewed the requirements of the Contract Documents,

.2 The Work has been inspected by the Contractor for compliance with all requirements of the Contract Documents,

.3 Pursuant to this inspection, the Contractor certifies and represents that the Work complies in all respects with the requirements of the Contract Documents,

.4 The Contractor further certifies and represents that all equipment and systems have been installed in accordance with the Contract Documents and have been tested in accordance with specification requirements and are operational, and

.5 The Contractor hereby certifies and represents that the Work is complete in all respects and ready for final inspection.

9.9.4 Upon receipt of the documents required in subparagraph 9.9.3 and upon receipt of a final Application for Payment, the A/E and Owner will promptly make a final inspection. When the A/E finds the Work acceptable under the Contract Documents and the Contract fully performed, he will issue within seven (7) days a final Certificate for Payment and a Final Certificate of Completion.

The Certificate of Completion will state that to the best of his knowledge, information and belief, and on the basis of his observations and inspections, the Work has been completed in accordance with the terms and conditions of the Contract Documents and that the entire balance designated in the final Certificate for Payment is due and payable. The final Certificate for Payment will constitute a further representation that the conditions precedent to the Contractor's being entitled to final payment as set forth in Subparagraph 9.9.3 have been fulfilled. The Owner shall review the Certificate of Payment and shall accept it and issue final acceptance, or reject it and notify the Contractor, within ten (10) days. Final payment to the Contractor shall be made within thirty (30) days after final acceptance. All prior estimates and payments, including those relating to Change Order work, shall be subject to correction by this final payment.

9.9.5 The making of Final Payment shall constitute a waiver of all claims by the Owner, except those arising from:

.1 Unsettled claims;

.2 Faulty, defective, or non-conforming Work discovered or appearing after Substantial or Final Completion;

.3 Failure of the Work to comply with the requirements of the Contract Documents;

.4 Terms of any warranties or guarantees required by the Contract Documents; or

.5 Fraud or bad faith committed by the Contractor or any subcontractor or supplier during performance of Work but discovered by Owner after Final Payment.

9.9.6 The acceptance of Final Payment shall constitute a waiver of all claims by the Contractor, except those previously made in writing and so identified by the Contractor~~,~~ as unsettled at the time of the final Application for Payment. No payment, however, final or otherwise, shall operate to release the Contractor or his sureties from any obligations under this Contract or the Performance, Payment, or Guarantee Bonds.

ARTICLE l0 PROTECTION OF PERSONS AND PROPERTY

10.1 SAFETY PRECAUTIONS AND PROGRAMS

10.1.1 The Contractor shall be responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the Work. The requirement applies continuously throughout the Contract performance, until Final Payment is made, and is not limited to regular working hours.

10.2 SAFETY OF PERSONS AND PROPERTY

10.2.1 The Contractor shall take all reasonable precautions for the safety of, and shall provide all reasonable protection to prevent damage, injury or loss to:

.1 All persons performing any of the Work and all other persons who may be affected thereby;

.2 All the Work and all materials and equipment to be incorporated therein, whether in storage on or off the site, under the care, custody or control of the Contractor or any of his Subcontractors or Sub-subcontractor's. Machinery, equipment and all hazards shall be guarded or eliminated in accordance with the safety provisions of the Manual of Accident Prevention in Construction published by the Associated General Contractors of America, to the extent that such provisions are not in contravention of applicable law; and

.3 Other property at the site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures and utilities not designated for removal, relocation or replacement in the course of construction.

10.2.2 The Contractor shall give all notices and comply with all applicable laws, ordinances, codes, rules, regulations, permits, resolutions and lawful orders of any public authority bearing on the safety of persons or property or their protection from damage, injury or loss.

The Contractor shall at all times safely guard the Owner's property from injury or losses in connection with the Contract. Contractor shall at all times safely guard and protect his Work and adjacent property as provided by law and the Contract Documents, from damage. All passageways, guard fences, lights and other facilities required for protection by local authorities or local conditions must be provided and maintained without additional cost to the Owner.

10.2.3 The Contractor shall erect and maintain, as required by existing conditions and progress of the Work, all reasonable safeguards for safety and protection, including posting danger signs and other warnings against hazards, promulgating safety regulations and notifying owners and users of adjacent utilities.

10.2.4 When the use or storage of explosives or other hazardous materials or equipment is necessary for the execution of the Work, the Contractor shall exercise the utmost care and shall carry on such activities under the supervision of properly qualified personnel.

10.2.5 The Contractor is responsible for the proper packing, shipping, handling and storage (including but not limited to shipment or storage at the proper temperature and humidity) of materials and equipment to be incorporated in the Work, so as to insure the preservation of the quality and fitness of the materials and equipment for proper installation and incorporation in the Work, as required by the Contract Documents.

For example, but not by way of limitation, Contractor shall, when necessary, place material and equipment on wooden platforms or other hard and clean surfaces and not on the ground and/or place such material and equipment under cover or in any appropriate shelter or facility. Stored materials or equipment shall be located so as to facilitate proper inspection. Material and equipment that is delivered crated shall remain crated until ready for installation. Lawns, grass plots or other private property shall not be used for storage purposes without the written permission of the owner or lessee unless otherwise within the terms of the easements obtained by the Owner.

10.2.6 In the event of any indirect or direct damage to public or private property referred to in Paragraphs 10.2.1.2 and 10.2.1.3, caused in whole or in part by an act, omission or negligence on the part of the Contractor, any Subcontractor, any Sub-subcontractor, or anyone directly or indirectly employed by any of them or by anyone for whose acts any of them may be liable, the Contractor shall at his own expense

and cost promptly remedy and restore such property to a condition equal to or better than existing before such damage was done. The Contractor shall perform such restoration by underpinning, replacing, repairing, rebuilding, replanting, or otherwise restoring as may be required or directed by the Owner, or shall make good such damage in a satisfactory and acceptable manner. In case of failure on the part of the Contractor to promptly restore such property or make good such damage, the Owner may, upon two (2) calendar days written Notice, proceed to repair, replace, rebuild or otherwise restore such property as may be necessary and the cost thereof, or a sum sufficient in the judgment of the Owner to reimburse the owners of property so damaged, will be deducted from any monies due or to become due the Contractor under the Contract. If insufficient monies remain due or will become due to pay such sum, Contractor or its surety shall, within 30 days of receipt of a written demand from Owner to do so, pay Owner such sum.

10.2.7 The Contractor shall designate a responsible member of his organization at the site whose duty shall be the prevention of accidents and the protection of material, equipment and other property. This person shall be the Contractor's superintendent unless otherwise designated by the Contractor in writing to the Owner.

10.2.8 The Contractor shall not load or permit any part of the Work to be loaded so as to endanger the safety of any portion of the Work.

10.2.9 The Contractor shall give notice in writing at least forty-eight (48) hours before breaking ground, to all persons, Public Utility Companies, owners of property having structures or improvements in proximity to site of the Work, superintendents, inspectors, or those otherwise in charge of property, streets, water pipes, gas pipes, sewer pipes, telephone cables, electric cables, railroads or otherwise, who may be affected by the Contractor's operation, in order that they may remove any obstruction for which they are responsible and have representative(s) on site to see that their property is properly protected. Such notice does not relieve the Contractor of responsibility for any damages and claims. Nor does such notice relieve the Contractor from his responsibility to defend and indemnify the Owner from actions resulting from the Contractor’s performance of such work in connection with or arising out of the Contract.

10.2.10 The Contractor shall protect all utilities encountered while performing its work, whether indicated on the Contract Drawings or not. The Contractor shall maintain utilities in service until moved or abandoned. The Contractor shall exercise due care when excavating around utilities and shall restore any damaged utilities to the same condition or better as existed prior to starting the Work, at no cost to the Owner. The Contractor shall maintain operating utilities or other services, even if they are shown to be abandoned on the drawings, in service until new facilities are provided, tested and ready for use.

10.2.11 The Contractor shall return all improvements on or about the site and adjacent property which are not shown to be altered, removed or otherwise changed to conditions which existed prior to starting the Work.

10.2.12 The Contractor shall protect the Work, including but not limited to, the site, stored materials and equipment, excavations, and excavated or stockpiled soil or other material, intended for use in the Work, and shall take all necessary precautions to prevent or minimize damage to same and to prevent detrimental effect upon his performance or that of his Subcontractors, caused by or due to rain, snow, ice, run-off, floods, temperature, wind, dust, sand and flying debris. For example, but not by way of limitation, Contractor shall, when necessary, utilize temporary dikes, channels or pumping to carry-off, divert or drain water, and shall as necessary tie-down or otherwise secure the Work and employ appropriate covers and screens.

10.3 OBLIGATION OF CONTRACTOR TO ACT IN AN EMERGENCY

10.3.1 In case of an emergency that threatens immediate loss or damage to property and/or safety of life, the Contractor shall act to prevent threatened loss, damage, injury or death. The Contractor shall notify the Owner of the situation and all actions taken immediately thereafter. If the Contractor fails to act and any loss, damage, injury or death occurs that could have been prevented by the Contractor's prompt and immediate action, the Contractor shall be fully liable to the Owner or any other party for all costs, damages, claims, actions, suits, costs of defense, and all other expenses arising therefrom or relating thereto.

10.3.2 Prior to commencing the Work and at all times during the performance of the Work, the Contractor shall provide the Owner two, twenty-four hour (24) emergency phone numbers where his representatives can be contacted at any time.

ARTICLE 11 INSURANCE FOR CONTRACTS

11.1 CONTRACTOR'S INSURANCE

11.1.1 During the term of this Contract, the Contractor shall procure and maintain insurance coverages with insurance companies rated by A. M. Best Company as A – VIII or better. The company(ies) shall be authorized to do business under the laws of the Commonwealth of Virginia and be acceptable to the City of Lynchburg and shall provide the following minimum types of insurance:

a. **Commercial General Liability Insurance** – This will cover claims for Bodily Injury, Property Damage, Personal and Advertising Injury, Products and Completed Operations, which may arise from operations under the Contract, whether such operations be performed by the Contractor or by any Subcontractor or Independent Contractor, or by anyone directly or indirectly employed by any of them. Such insurance shall include coverages "X", "C" and "U" for explosion, collapse of other structures and underground utilities, as well as Contractual Liability Insurance covering the requirements outlined in the General Conditions. This insurance shall name the City, the City Council and its employees as additional insureds ***by endorsement*** to the Commercial General Liability policy. Such policy shall not have a restriction on the limits of coverage provided to the City of Lynchburg as an additional insured. The City of Lynchburg shall be entitled to protection up to the full limits of the Contractor's policy regardless of the minimum requirements specified in this Contract. If endorsements to the Commercial General Liability insurance policies cannot be made, then separate policies providing such protection shall be purchased by the Contractor.

1. The Policy shall have the following ***minimum*** limits:

$1,000,000 Each Occurrence Limit
$1,000,000 General Aggregate Limit
$1,000,000 Personal and Advertising Injury Limit
$1,000,000 Products and Completed Operations Aggregate Limit
$5,000 Medical Expense Limit

This insurance shall include the following provisions and /or endorsements:

1) The General Aggregate limit shall apply on a "per project" and on a "per location" basis;
2) Coverage shall apply to all liability arising from all premises and operations conducted by the Contractor, Subcontractors and independent contractors;
3) The Contractor agrees that liability arising from Products and Completed Operations will be covered. Such liability coverage will be maintained for two years after completion of the Work.

4) The Contractor shall require each of his Subcontractors to procure and maintain Commercial General Liability Insurance of the type specified in these Contract Documents in the minimum amounts required by the Owner and the Contractor (which shall be the amounts required by this paragraph 11.1.1. of Contractor unless otherwise agreed in writing by Owner), during the term of their subcontracts.

b. **Worker's Compensation and Employer's Liability Insurance** for the Contractor's employees engaged in the Work under this Contract, in accordance with statutory requirements of the Commonwealth of Virginia. The Contractor shall require each of his Subcontractors to provide Worker's Compensation and Employer's Liability Insurance for all of the Subcontractor's employees engaged on such subcontracts. If any class of employees engaged on Work under the Contract is not protected under the Worker's Compensation statute, the Contractor shall provide similar protection for these employees in amounts not less than the legal requirements. The amount of Employer's Liability Insurance for the Contractor and each of his Subcontractors shall be not less than:

$100,000 per employee for Bodily Injury.
$100,000 per employee for disease
$500,000 per policy for disease

The Worker's Compensation and Employer's Liability Insurance policy shall include an "all states" or "other states" endorsement.

c. **Commercial Automobile Liability Insurance**, including coverage for owned, hired, non owned and borrowed vehicles used in the work with ***minimum*** limits of $1,000,000 Combined Single Limit per occurrence. This insurance shall name the City, the City Council and its employees as additional insureds ***by endorsement*** to the Commercial Automobile Liability policy. Such policy shall not have a restriction on the limits of coverage provided to the City of Lynchburg as an additional insured. The City of Lynchburg shall be entitled to protection up to the full limits of the Contractor's policy regardless of the minimum requirements specified in this Contract.

d. **Umbrella Liability or Excess Liability** Insurance with the following minimum limits of:

$5,000,000 Each Occurrence
$5,000,000 Annual Aggregate

The following policies shall be scheduled as underlying policies:

Commercial General Liability
Commercial Automobile Liability
Employers Liability

This insurance shall name the City, the City Council and its employees as additional insureds ***by endorsement*** to the Umbrella or Excess Liability policy. Such policy shall not have a restriction on the limits of coverage provided to the City of Lynchburg as an additional insured. The City of Lynchburg shall be entitled to protection up to the full limits of the Contractor's policy regardless of the minimum requirements specified in this Contract.

11.2

11.1.2 Proof of insurance for each type of coverage listed herein shall be provided within 10 days after issuance of the award letter for the Contract, and no Work shall proceed unless all such insurance is in

effect. The Contractor shall not allow any Subcontractor to commence work on his subcontract until all such insurance of the Subcontractor has been so obtained and approved by the Contractor and found to be in accordance with the requirements set forth herein. The Contractor certifies by commencement of the Work that his insurance and that of Subcontractors is in effect and meets the requirements set forth herein.

11.1.3 The Contractor shall purchase and maintain required liability and all other insurance as is appropriate for the Work being performed and furnished. The insurance shall provide protection from claims which may arise out of or result from Contractor's performance and furnishing of the Work and Contractor's other obligations under the Contract Documents, whether it is to be performed or furnished by Contractor, any Subcontractor or Supplier, or by anyone directly or indirectly employed by any of them to perform or furnish any of the Work, or by anyone for whose acts any of them may be liable:

a. claims under Worker's Compensation, Employers Liability, disability benefits, and other similar employee benefit acts;

b. claims for damages because of bodily injury, occupational sickness or disease, or death of Contractor's employees;

c. claims for damages because of bodily injury, sickness or disease, or death of any person other than Contractor's employees;

d. claims for damages insured by personal injury liability coverage which are sustained: (1) by any person as a result of an offense directly or indirectly related to the employment of such person by Contractor; or (2) by any other person for any other reason;

e. claims for damages, other than to the Work itself, because of injury to or destruction of tangible property wherever located, including loss of use resulting therefrom; and

f. claims for damages because of bodily injury or death of any person or property damage arising out of the ownership, maintenance, or use of any motor vehicle.

11.1.4 The insurance required to be purchased and maintained by the Contractor shall:

a. include completed operations insurance;

b. with respect to any other insurance coverage written on a claims-made basis, remain in effect for at least 2 years after final payment (and Contractor shall furnish the City and A/E evidence satisfactory to the City of continuation of such insurance at final payment and 1 year thereafter);

c. contain a cross liability or severability of interest clause or endorsement. Insurance covering the specified additional insureds shall be primary insurance, and all other insurance carried by the additional insureds shall be excess insurance.

11.1.5 All of the aforesaid insurance policies must be endorsed to provide that the insurance company ***shall give 30 days written notice to the City*** if the policies are to be terminated or if any changes are made during the Contract period which will affect in any way the insurance provided pursuant to such policy. Before starting the Work, the Contractor shall provide the City with a copy of each policy that he and each of his Subcontractors is required to carry in accordance with this Article 11, together with receipted bills evidencing proof of premium payment. These policies shall contain endorsements to the policies naming the City of Lynchburg as an additional insured as required.

11.1.6 Nothing contained herein shall effect, or shall be deemed to affect, a waiver of the City's sovereign immunity under law.

ARTICLE 12 CHANGES AND MODIFICATIONS IN THE WORK

12.1 CHANGES IN THE WORK

12.1.1 The Owner, without invalidating the Contract and without notice to the surety, may order a change to the Work consisting of additions, deletions or other revisions to the general scope of the Contract, or changes in the sequence of the performance of the Work. The Contract Sum and the Contract Time shall be adjusted accordingly. All such changes in the Work shall be authorized by Change Order, Modification, or Change Directive, and all Work involved in a change shall be performed in accordance with the terms and conditions of the Contract Documents. If the Contractor should proceed with a change in the Work upon an oral order, by whomsoever given, it shall constitute a waiver by the Contractor of any claim for an increase in the Contract Sum and/or Contract Time, on account thereof.

12.2 FIELD ORDER

12.2.1 A Field Order is a written order to the Contractor signed by the Owner's designated representative, interpreting or clarifying the Contract Documents or directing the Contractor to perform minor changes in the Work. Any work relating to the issuance of a Field Order shall be performed promptly and expeditiously and without additional cost to the Owner and within the Contract Time, unless the Contractor submits a Proposed Change Order, defined below, which is approved by the Owner. Field Orders shall be numbered consecutively by date of issuance by the Owner.

12.3 OWNER CHANGE REQUEST

12.3.1 An Owner Change Request is a written request from the Owner to the Contractor that describes a proposed change in the Work. The Contractor is required to submit a complete proposal for the total cost and additional time, if any, necessary to perform the proposed change in the Work. Owner Change Requests shall be numbered consecutively by date of issuance by the Owner.

12.4 CONTRACTOR'S PROPOSED CHANGE ORDER

12.4.1 A Contractor's Proposed Change Order is a written request from the Contractor to the Owner requesting a change in the Contract Sum and/or Contract Time. A Contractor's Proposed Change Order is submitted as a proposal in response to a Owner Change Request or as a claim for an increase in the Contract Sum or Contract Time pursuant to the issuance of a Field Order, or as a result of unforeseen circumstances, such as an unknown site conditions.

Change Orders for unforeseen site conditions will only be entertained if the Contractor has not accepted responsibility for the unforeseen site conditions pursuant to other provisions in the Contract Documents. A Contractor's Proposed Change Order must be submitted within twenty (20) calendar days of the issuance of a Owner Change Request or a Field Order or the discovery of an unforeseen circumstance. The Contractor shall not be entitled to any adjustment to the Contract Time or Contract Sum if Contractor fails to comply strictly with the requirements of the preceding sentence. Contractor's Proposed Change Orders shall be numbered consecutively by date of issuance by the Contractor. The Contractor shall also indicate on the Proposed Change Order the number of the Owner Change Request or the Field Order to which it responds. The Contractor understands and agrees to the City's provisions and policy regarding Change Orders as outlined in Article 1, section 1.1.2 of these General Conditions.

12.4.2 In the case of unit price items, it is understood and agreed by the Contractor that the estimates of the quantities in unit price items are approximate only and are presented solely for the purpose of comparing bids and may not represent the actual amount of work to be performed. The Contractor, therefore, understands and agrees that the Owner reserves the right to increase, decrease or eliminate entirely the quantity of work to be done under any item. If called upon to do more work under any unit price item named in the Bid Documents, he will perform all such additional work and accept as payment the unit price named in the proposal, subject to the 20% deviation limitations specified in subparagraph 12.4.2.2.

12.4.2.1 The Contractor's Proposed Change Order shall be determined by applicable unit prices, if any, as set forth in the Contract.

12.4.2.2 However, if changes in quantities are of an item increase the actual work to more than twenty percent (20%) of the original bid quantity for that item, or decrease quantities of that item more than 20% of the original bid quantity for that item, then the Owner or the Contractor shall have the right to request a decrease or an increase in the unit price for the item for quantities greater than 120% or less than 80% of the original bid quantity for that item.

12.4.2.3 It shall be understood that such unit prices shall constitute full payment for the extra work performed, including, but not limited to, “general conditions” costs, plant, materials, labor, equipment, overhead, profit, and safety requirements.

12.4.3 If no such unit prices are set forth, the Contractor's proposal shall be on a lump sum basis and shall be itemized and segregated by labor, equipment, and materials for the various components of the change in the Work (no aggregate labor total will be acceptable) and shall be accompanied by signed proposals of any Subcontractors who will perform any portion of the change in the Work and of any persons who will furnish materials or equipment for incorporation therein.

12.4.3.1 The portion of the proposal relating to labor, whether by the Contractor's forces or the forces of any of its Subcontractors, may include reasonably anticipated gross wages of job site labor, including foremen, who will be directly involved in the change in the Work (for such time as they will be so involved), plus separately identified payroll costs (including premium costs of overtime labor, if overtime is authorized, Social Security, Federal or State unemployment insurance taxes and fringe benefits required by collective bargaining agreements entered into by the Contractor or any such Subcontractor in connection with such labor).

12.4.3.2 The portion of the proposal relating to materials may include the reasonably anticipated direct costs to the Contractor or to any of its Subcontractors of materials to be purchased for incorporation in the change in the Work, plus transportation and applicable sales or use taxes.

12.4.3.3 The proposal may further include the Contractor's and any of his Subcontractor's reasonably anticipated equipment rental costs, except small hand tools, in connection with the change in the Work.

12.4.4 Base Cost is defined as the total of labor, material and equipment rentals as described in subparagraphs 12.4.3.1, 12.4.3.2 and 12.4.3.3. The actual net cost in money to the Owner for the change in the Work shall be computed as follows:

.1 If the Contractor performs the change in the Work without use of Subcontractors or sub-subcontractors, his compensation will be the Base Costs as described above, plus a maximum mark-up of 15% for overhead and profit.

.2 If the work is performed by a bona fide Subcontractor, the Subcontractor's compensation will be the Base Costs as described above plus a maximum mark-up of 15% for overhead and profit. The Contractor's compensation will be a maximum mark-up of five percent (5%) of the Subcontractors Base Costs for his overhead and profit.

.3 If the Work is performed by a bona fide Sub-subcontractor, the Subcontractor's compensation will be the Base Costs as herein described, plus a maximum mark-up of 15% for overhead profits. The mark-up of any Sub-subcontractor's work by the Contractor and all intervening tiers of Subcontractors shall not exceed a total of 10%.

12.4.5 The mark-up on the cost of labor, materials, and equipment described in Paragraphs 12.4.4.1, 12.4.4.2, and 12.4.4.3 shall be all the compensation to which the Contractor, Subcontractors and Sub-subcontractor are entitled for all indirect costs associated with or relating to the change in the Work including, but not limited to, labor and/or equipment inefficiency, changes in sequence, delays, interferences, impact on unchanged work, gross receipts tax, superintendent, small tools, reproduction, administration, insurance, unrelated safety requirements, temporary structures and offices, all other general and administrative, home office and field office expenses.

12.4.6 The Proposed Change Order may also include the cost of increases in premiums for the Payment Bond and the Performance Bond, provided coverage for the cost of the change in Work results in such increased costs. At the Owner's request, the Contractor shall provide proof of his notification to the surety of the change in the Work and of the surety's agreement to include such change in its coverage. The cost of the increase in premiums shall not be marked up.

12.4.7 In the event that it is necessary to increase the Contract Time in order to perform the change in the Work, the Contractor shall provide an estimate of the increase in the Contract Time as part of the Proposed Change Order. The Contractor's request for a time extension shall be evaluated in accordance with the criteria described in Article 8.3, Claims for Time Extensions.

12.4.8 If the Contractor's Proposed Change Order is rejected by the Owner as being within the scope of the Work required by the Contract Documents, the Owner may, at its sole option and discretion, direct the Contractor to perform the Work which is the subject of the said Proposed Change Order, with claimed compensation to be accounted for pursuant to 12.6 and to be subject to the procedures of Article 13. The Contractor shall then promptly proceed with said Work. Nothing herein shall excuse the timely performance by the Contractor of the Work because any Proposed Change Order is pending.

12.5 CHANGE ORDER

12.5.1 A Change Order is a written order to the Contractor signed by the Owner, issued after execution of the Contract, authorizing a change in the Work or an adjustment in the Contract Sum and/or the Contract Time. The Contract Sum and the Contract Time may be changed only by Change Order. A Change Order signed by the Contractor indicates his agreement therewith, including the adjustment in the Contract Sum and/or the Contract Time. Change Orders shall be numbered consecutively by date of issuance by the Owner and shall, if applicable, indicate the number of the Field Order(s), Request for Proposal(s) and/or Proposed Change Order(s) to which they relate.

12.5.1.1 If the Owner determines that the Contractor's Proposed Change Order, submitted pursuant to Article 12.4 for a change in the Contract Sum or Contract Time, is acceptable, the Owner shall prepare and issue a Change Order which will authorize the

Contractor to proceed with the change in the Work with the adjustment to Contract Sum and Contract Time stated in the Proposed Change Order, or as otherwise may be agreed upon by the parties. The amounts stated in the Change Order for the adjustment to Contract Sum and Contract Time for the change in the Work shall be binding on the parties.

12.5.2 After issuance of the Change Order, the Contractor shall ensure that the amount of the Performance and Payment Bond coverage has been revised to reflect the increase in the Contract Sum due to the Change Order. Notwithstanding the foregoing, Contractor's failure to do so shall not release any surety from its obligations under any bonds.

12.6 CHANGE DIRECTIVE

12.6.1 If Owner and Contractor cannot agree as to whether something constitutes a change to the Work originally contemplated by the Contract Documents, or if they cannot agree as to the adjustment to the Contract Sum or Contract Time required for what Owner acknowledges to be a change to the Work constituting Extra Work, Owner may, in his sole discretion, issue a written Change Directive directing Contractor to perform such work. Contractor shall then promptly proceed with the work at issue. Owner may elect, in its sole discretion, to have the compensation or claimed compensation for such work accounted for on either a time and material basis or lump sum basis as described in 12.6.2 and 12.6.3.

12.6.2 If Owner elects to have the compensation and/or claimed compensation accounted for on a time and materials basis, the following procedures apply:

12.6.2.1 Change Directive work, the compensation or claimed compensation for which is being accounted for on a time and material basis shall be performed, whether by the Contractor's forces or the forces of any of its Subcontractors' or Sub-subcontractors', at actual cost to the entity performing the Work (without any charge for administration, clerical expense, supervision or superintendent of any nature whatsoever). The percent mark-ups for the Contractor, Subcontractors and Sub-subcontractor's shall be as described in subparagraphs 12.4.4 and 12.4.5.

12.6.2.2 Prior to starting the Change Directive work on a time and material basis, the Contractor shall notify the Owner in writing as to what labor, materials, equipment or rentals are to be used for the change or claimed change in the Work. During performance, the Contractor shall submit to the Owner daily time and material tickets, which shall list the categories and amounts of labor and equipment for which Change Directive compensation is to be charged for the previous work day. Such tickets shall specifically include the following information: location and description of the change in the Work, the classification of labor employed, including names and social security numbers of laborers, labor trades used, man hours, wage rates, insurance, taxes and fringe benefits, equipment and materials suppliers' quotations with detailed break-out and pricing, rental equipment hours and rates, and materials quantities and unit prices and such other evidence of cost as the Owner may require.

12.6.2.3 The Contractor shall commence submission of daily time and material tickets immediately upon commencement of the Change Directive work and continue to submit them until completion of the Change Directive work. The Owner may require authentication of all time and material tickets and invoices by persons designated by the Owner for such purpose.

12.6.2.4 No payment will be made to the Contractor for any portion of the Change Directive work that Owner acknowledges to be Extra Work unless and until such daily time and material tickets and invoices are submitted. The submission of any such ticket or invoice shall not constitute an acknowledgment by the Owner that the items thereon were reasonably required for the Change Directive work.

12.6.2.5. For any work performed on a time and material basis, the Contractor shall submit its complete submission of the reasonable actual cost and time to perform the change in the Work within twenty (20) days after such Work has been completed. If Change Directive work includes both Work that Owner acknowledges to be Extra Work and work that Owner disputes to be Extra Work, Contractor shall clearly segregate its accounting for the two. The Owner shall review the costs and time submitted by the Contractor on the basis of reasonable expenditures and savings of those performing the Change Directive work. If such costs and time are acceptable to the Owner, or if the parties otherwise agree to the actual reasonable cost to perform the Change Directive work, a Change Order will be issued for the cost and time agreed upon. The amounts stated in the Change Order for the cost and time to perform the Change Directive work shall be binding upon the parties.

12.6.3 If Owner elects to have the compensation or claimed compensation accounted for on a lump sum basis, Owner may make a unilateral determination of a reasonable adjustment in Contract Sum and Contract Time due to the Change Directive. Any unresolved dispute about the reasonableness of Owner's unilateral determination shall be subject to Article 13, Claims and Dispute Procedure.

12.7 DECREASES AND WORK NOT PERFORMED (Deductive Change Orders)

12.7.1 Should it be deemed expedient by the Owner to decrease the dimensions, quantity of material or Work, or vary in any other way the Work required by the Contract Documents, the Owner may direct by written Change Order, such decreases to be made or performed without in any way affecting the validity of the Contract. The Contractor shall, comply with the Change Order from the Owner. The difference in expense occasioned by such decrease shall be deducted from the amount payable under this Contract.

12.7.2 When Work is deleted from the Contract by Owner, the amounts to be credited to the Owner shall reflect the same current pricing as if the Work were being added to the Contract at the time the deletion is ordered, and Contractor shall provide documentation for a credit as specified in Article 12.5.4. If such deleted materials and equipment shall have already been purchased and stored on site and cannot be used in other projects, cannot be returned for credit or cannot be returned for credit at the price paid by the Contractor at the time of purchase, the Contractor shall be entitled, upon proper documentation and certification, to an adjustment in the pricing of the credit to avoid hardship to the Contractor. If necessary in order to establish such reasonable value, the Contractor may be required to submit a detailed breakdown of his original bid and all documents upon which Contractor's bid was based for the items or Work involved.

12.7.3 If Work is not performed, and such deletion of Work was not directed or approved by the Owner, the Owner shall ascertain the amount of the credit due.

12.8 CHANGES IN LINE AND GRADE

12.8.1 The Owner reserves the right to make such alterations in the line and grade of various structures or pipe lines shown on the drawings, as may be necessitated by conditions found during construction or that in the judgment of the Owner appears advisable. Such alterations shall in no way affect the validity of the Contract

12.8.1.1 In case of a unit price contract, if such changes increase the amount of the Work or materials, the Contractor will be paid according to the quantity of Work actually done at the prices established for such Work under the Contract.

12.8.1.2 In case of a lump sum contract, the price for the Work shall be determined as specified in Article 12.4, Proposed Change Order.

12.9 SUBSURFACE CONDITIONS FOUND DIFFERENT

12.9.1 Should the Contractor encounter subsurface and/or latent conditions at the site materially differing from those shown on the drawings or indicated in the specifications, he shall immediately give Notice to the Owner of such conditions before they are disturbed. The Owner shall thereupon promptly investigate the conditions and if he finds that they materially differ from those shown on the drawings or indicated in the specifications, he shall at once make such changes in the drawings and/or specifications as he may find necessary. Any increase or decrease of cost resulting from such changes shall be adjusted in the manner provided herein for adjustments as to extra and/or additional work and changes. Notwithstanding the foregoing, if the Contract Documents indicate elsewhere that excavation is to be on an unclassified basis, Contractor shall not be entitled to any adjustment to the Contract Sum or Contract Time based upon this 12.9.

12.10 OTHER CLAIMS

If the Contractor claims that additional cost or time is involved because of, but not limited to, (1) any written interpretation pursuant to Article 2, Architect/Engineer, (2) any order by the Owner to stop the Work pursuant to Article 3, Owner, where the Contractor was not at fault, (3) failure of payment by the Owner pursuant to Article 9 Payments and Completion, or (4) any written order for a minor change in the Work issued pursuant to Article 12.8, Changes in Line and Grade~~;~~, the Contractor shall make such claim as provided in Section 12, Changes and Modification in the Work~~.~~, and Article 13, Claims and Dispute Procedure.

ARTICLE 13 CLAIMS AND DISPUTE PROCEDURE

Any Claims by the Contractor arising under or relating to the Contract or the Contract Documents shall only be resolved as follows:

13.1. INITIAL NOTICE, SUBMISSION OF CLAIM, AND CONSIDERATION.

a. The Contractor shall give the Owner and the A/E written notice of any Claim within ten (10) days of the beginning of the occurrence of the event leading to the Claim. The written notice shall be a document from the Contractor addressed to the Owner's and A/E's officials or employees designated by the Contract Documents to receive such notice, or if no one is so designated, to the Owner's City Manager and to the A/E. The written notice shall clearly state the Contractor's intention to make a claim, shall describe the occurrence involved, and shall be transmitted in a manner to ensure receipt by the Owner and A/E within the ten (10) days. The Contractor shall submit the Claim and any supporting data to the Owner and A/E within thirty (30) days after the occurrence giving rise to the Claim ends. The burden shall be on the Contractor to substantiate that it has given written notice and submitted its Claim in accordance with this provision.

b. The Claim must (i) be certified under oath as true and correct by a principal of Contractor; (ii) must be for specific relief; (iii) if any money is sought, must specify the dollar amount sought; and (iv) must contain sufficient supporting documentation to reasonably allow its consideration, including

without limitation, any documentation required by the Contract Documents. The burden shall be on the Contractor to substantiate the Claim.

c. The Contractor shall comply with all other terms and conditions of the Contract Documents, including without limitation, those in Articles 8 and 12, as applicable. No decision by the A/E on a claim shall be binding on the Owner, but such decision shall have whatever effect on the Contractor that the Contract Documents provide.

d. Following consideration by the A/E, and following initial, informal consideration by the Owner's City Manager or his designee, the parties shall endeavor to resolve any Claim through direct negotiations, and if such direct negotiations fail, and if the Owner requests, by non-binding mediation conducted pursuant to the Rules of the American Arbitration Association, with the site of the mediation being Lynchburg, Virginia.

e. Should the Claim remain unresolved for more than 60 days after it is submitted, then the City Manager or his designee shall, within no later than 90 days after the Claim's submission, render a written decision on the Claim on behalf of the Owner . The Contractor may not institute any legal action with respect to the Claim until after the City Manager or his designee renders his written decision or 90 days from its receipt by the City Manager has passed, whichever comes first. The only effect of the failure by the City Manager or his designee to render a decision within this 90-day period is to allow the Contractor to institute a legal action pursuant to this provision without having to wait for a decision on the Claim concerned.

13.2 APPEAL OF DENIAL OF CLAIM.

a. If the Owner denies in whole or part a Claim by Contractor or more than 90 days have passed since the Claim was received by the City Manager but no written decision has been issued, the Contractor may appeal denial of the claim by instituting an action in the Lynchburg Circuit Court, Lynchburg, Virginia, or if the subject or amount in controversy is within its jurisdiction, the Lynchburg General District Court, Lynchburg, Virginia, and may thereafter pursue all available appeals in Virginia state courts, to the extent they have jurisdiction.

b. The Contractor must initiate its appeal of the Claim within 180 days of the date it first has the right to do so or the Claim will be barred and the Owner’s decision will be binding and conclusive.

c. The Contractor may not amend its Claim on appeal to increase the amount of money sought.

d. In the event of any Claim arising, Contractor shall continue its performance diligently during such Claim's pendency and thereafter as if no Claim had arisen. During the pendency of any Claim in connection with the payments of moneys, Contractor shall be entitled to receive payments for non-disputed items, subject to any right of set-off by Owner.

13.3 Notwithstanding anything in the Contract Documents to the contrary, the Owner may, in its discretion, assert a Claim without first resorting to any procedures contained in the Contract Documents.

13.4 "Claim" means a "claim" as defined in the Lynchburg Public Procurement Code.

13.5 Notwithstanding anything in the Contract Documents to the contrary, Owner shall not be liable to Contractor for any damages or increase in the Contract Sum due to delays to Contractor, any Subcontractor, or any other person except due to extent required by Virginia Code § 2.2-4335.

ARTICLE 14 UNCOVERING AND CORRECTION OF WORK

14.1 UNCOVERING OF WORK

14.1.1 If any portion of the Work should be covered contrary to: (1) the request of the A/E or Owner; (2) requirements specifically expressed in the Contract Documents; or (3) the requirements of applicable permits, it must, if required in writing by the Owner, be uncovered for the Owner's and A/E's observation and shall be replaced at the Contractor's expense.

14.1.2 If any other portion of the Work has been covered which the Owner has not specifically requested to observe prior to being covered, the Owner may request to see such Work and it shall be uncovered by the Contractor. If such Work be found in accordance with the Contract Documents, the cost of uncovering and replacement shall, by appropriate Change Order, be charged to the Owner. If such Work be found not in accordance with the Contract Documents, the Contractor shall pay such costs unless it is found that this condition was caused solely by the Owner, in which event the Owner shall be responsible for the payment of such costs. If such Work be found not in accordance with the Contract Documents and the condition was caused by a separate contractor, Contractor may proceed against said separate contractor as provided in Article 6, Work by Owner or by Separate Contractors.

14.2 WARRANTY AND CORRECTION OF WORK

14.2.1 The Contractor guarantees and warrants to the Owner all Work as follows:

.1 That all materials and equipment furnished under this Contract will be new and the best of its respective kind unless otherwise specified;

.2 That all Work will be of first-class quality and free of omissions and faulty, imperfect or defective material or workmanship;

.3 That the Work shall be entirely watertight and leakproof in accordance with all applicable industry customs and practices, and shall be free of shrinkage and settlement which are attributable to defective materials or workmanship;

.4 That the Work, including but not limited to, mechanical and electrical machines, devices and equipment shall be fit and fully usable for its intended and specified purpose and shall operate satisfactorily with ordinary care;

.5 That consistent with requirements of the Contract Documents the Work shall be installed and oriented in such a manner as to facilitate unrestricted access for the operation and maintenance of fixed equipment; and

.6 That the Work will be free of abnormal or unusual deterioration which occurs because of poor quality materials or workmanship.

14.2.2 All Work not conforming to guarantees and warranties specified in the Contract Documents, including substitutions not properly approved and authorized, may be considered defective. If required by the Owner, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment furnished and installed.

14.2.3 The Contractor shall within five (5) working days after receipt of written Notice from the Owner during the performance of the Work, reconstruct, replace or correct all Work rejected by the A/E or Owner as defective, as failing to conform to the Contract Documents, or as not in accordance with the guarantees and warranties specified in the Contract Documents , whether observed before or after Substantial Completion and whether or not fabricated, installed or completed. The Contractor shall bear all costs of

reconstructing, replacing or correcting such rejected Work, including compensation for the A/E's additional services made necessary thereby.

14.2.4 If, within one (1) year after the Date of Final Completion of the Work or designated portion thereof or within one (1) year after acceptance by the Owner of designated equipment or within such longer period of time as may be prescribed by law or by the terms of any applicable special warranty required by the Contract Documents, any of the Work is found to be defective, not in accordance with the Contract Documents, or not in accordance with the guarantees and warranties specified in the Contract Documents, the Contractor shall correct it within five (5) working days after receipt of a written Notice from the Owner to do so unless the Owner has previously given the Contractor a written acceptance of such condition pursuant to 14.3, Acceptance of Faulty, Defective or Non-Conforming Work. This obligation shall survive termination of the Contract. The Owner shall give such Notice within a reasonable time after discovery of the condition.

14.2.5 Subject to limitation as prescribed by law, if at any time deficiencies in the Work are discovered which are found to have resulted from fraud or misrepresentation, or an intent or attempt to defraud the Owner by the Contractor, any Subcontractor or supplier, the Contractor will be liable for replacement or correction of such Work and any damages which Owner has incurred related thereto, regardless of the time limit of any guarantee or warranty.

14.2.6 Any materials or other portions of the Work, installed, furnished or stored on site which are not of the character or quality required by the specifications, or are otherwise not acceptable to the Owner, shall be immediately removed and replaced by the Contractor to the satisfaction of the Owner, when notified to do so by the Owner.

14.2.7 If the Contractor fails to correct defective or nonconforming Work as required by Articles 13.2.3 and 13.2.4, or if the Contractor fails to remove defective or nonconforming Work from the site, as required by Article 13.2.6, the Owner may elect to either correct such Work in accordance with Article 3.5, Owner’s Right to Carry Out the Work, or remove and store materials and equipment at the expense of the Contractor. If the Contractor does not pay the cost of such removal and storage within ten (10) days thereafter, the Owner may, upon ten additional days written Notice, sell such Work at auction or at public or private sale and shall account for the net proceeds thereof, after deducting the costs of the sale and all of the costs that should have been borne by the Contractor, including compensation for the A/E's additional services made necessary thereby. If such proceeds of sale do not cover all costs indicated in the previous sentence, the difference shall be charged to the Contractor and an appropriate Change Order shall be issued. If the payments then or thereafter due the Contractor are not sufficient to cover such amount, the Contractor or its surety shall pay the difference to the Owner.

14.2.8 The Contractor shall bear the cost of making good all work of the Owner, separate contractors or others, destroyed or damaged by such correction or removal required under this Article.

14.3 ACCEPTANCE OF FAULTY, DEFECTIVE OR NON-CONFORMING WORK

If the Owner prefers to accept faulty, defective or nonconforming Work, he may do so instead of requiring its removal and correction, in which case a Change Order will be issued at Owner's option, to reflect a reduction in the Contract Sum in an amount to be determined by the Owner.

ARTICLE 15 TERMINATION OF THE CONTRACT

15.1 CONTRACTOR'S RIGHT TO STOP WORK OR TERMINATE CONTRACT

If the Work should be stopped under an order of any court or other public authority for a period of ninety (90) days through no fault of the Contractor or anyone providing services, materials or equipment through him, or if the Owner should fail to pay to the Contractor within thirty (30) days any sum for which a

Certificate of Payment has been certified when no dispute exists as to the sum due and Owner has no right to withhold payment under any provision of the Contract Documents, then the Contractor may, upon ten (10) days written Notice to the Owner, stop Work or terminate the Contract and recover from the Owner payment for the cost of the Work actually performed, together with overhead and profit thereon, but profit on the Work performed shall be recovered only to the extent that the Contractor can demonstrate that he would have had profit on the entire Contract if he had completed the Work. The Contractor may not receive profit or any other type of compensation for parts of the Work not performed. The Contractor may recover the reasonable cost of physically closing down the Site, but no other costs of termination. The Owner may offset any claims it may have against the Contractor against the amounts due to the Contractor. In no event shall termination of the Contract by the Contractor terminate the obligations of the Contractor's surety on its payment and performance bonds.

15.2 OWNER'S RIGHT TO TERMINATE CONTRACT FOR CAUSE

15.2.1 The Owner may terminate the Contract for cause based upon any of the following grounds:

.1 If the Contractor should be adjudged as bankrupt, or if he should make a general assignment for the benefit of his creditors, or if a receiver should be appointed on account of his insolvency.

.2 If the Contractor should refuse or should repeatedly fail, except in cases for which extension of time is provided, to supply enough properly skilled workmen or proper materials and equipment.

.3 If the Contractor should fail to make prompt payment to subcontractors or suppliers of material of labor.

.4 If the Contractor should disregard laws, ordinances, codes, regulations, or the written instructions of the Architect/Engineer or the Owner.

.5 If the Contractor be in substantial violation of any provision of the Contract Documents.

15.2.2 For termination for cause based upon the grounds in 15.2.1.1, Owner may terminate without prior notice and without giving Contractor any opportunity to rectify the basis for termination. For termination for cause based upon any other grounds, prior to termination of the Contract, the Owner shall give the Contractor and his surety Notice followed by a ten (10) day period during which the Contractor and/or his surety may rectify the basis for the Notice. If rectified to the satisfaction of the Owner within said ten (10) days, the Owner may rescind its notice of termination. If not, the termination for cause shall become effective at the end of the ten (10) day notice period. Notwithstanding the foregoing, the Owner may, in writing, postpone the effective date of the termination for cause, at its sole discretion, if it should receive reassurances from the Contractor and/or his surety that the basis for the termination will be remedied within a time and in a manner which the Owner finds acceptable. If at any time after such postponement, the Owner determines that Contractor and/or his surety has not or is not likely to rectify the causes of termination in an acceptable manner or within the time allowed, then the Owner may immediately terminate the Contract for cause, without the necessity of allowing any further opportunity by the Contractor and/or surety to rectify the basis for the Notice, by notifying the Contractor and his surety in writing of the termination. In no event shall termination for cause terminate the obligations of the Contractor's surety on its payment and performance bonds.

15.2.3 Upon termination of the Contract, the Contractor shall immediately cease Work, and the Owner may take possession of the site and of all materials, tools and equipment thereon and finish the Work by whatever method he may deem expedient. In such case, the Contractor shall not be entitled to receive any further payment until the Owner has finally completed the Work through its own resources or those of a subsequent contractor. If the Owner's damages, including the expense of finishing the Work, compensation for additional design, managerial and administrative services, any liquidated damages, and

any claims by the Owner, shall exceed the unpaid balance of the Contract Sum, the Contractor shall pay the difference to the Owner, together with any other expenses of terminating the Contract and having it completed by others. If the unpaid balance of the Contract Sum exceeds Owner's damages, including the costs of finishing the Work, compensation for additional design, managerial and administrative services, any liquidated damages and any claims by Owner, together with any other expenses of terminating the Contract and having it completed by others, such excess shall be paid to the Contractor.

15.2.4 If it should be judicially determined that the Owner improperly terminated this Contract for cause, then the termination shall be deemed to be a termination for the convenience of the Owner, with Contractor's recovery limited to what is allowed for a termination for convenience under the Contract Documents.

15.2.5 Termination of the Contract under this Section is without prejudice to any other right or remedy of the Owner.

15.3 OWNER'S RIGHT TO TERMINATE CONTRACT FOR CONVENIENCE

15.3.1 Owner may terminate this Contract, in whole or in part, at any time without cause upon giving the Contractor written Notice of such termination. Upon such termination, the Contractor shall immediately cease Work and remove from the site all of its labor forces and such of its materials and equipment as Owner elects not to purchase or to assume in the manner hereinafter provided. Upon such termination, the Contractor shall take such steps as Owner may require to assign to the Owner the Contractor's interest in all subcontracts and purchase orders designated by Owner. After all such steps have been taken to Owner's satisfaction, the Contractor shall receive as full compensation for termination and assignment the following:

.1 Amounts due for Work performed in accordance with the Contract through the date of termination.

.2 Reasonable compensation for the actual cost of demobilization incurred by the Contractor as a direct result of such termination. The Contractor shall not be entitled to any compensation or damages for lost profits or for any other type of contractual compensation or damages other than those provided by the preceding sentence. Upon payment of the foregoing, Owner shall have no further obligations to Contractor of any nature.

15.3.2 In no event shall termination for the convenience of the Owner terminate the obligations of the Contractor's surety on its payment and performance bonds.

15.3.3 After receipt of a Notice of termination, the Contractor shall promptly submit to the Owner his termination claim. Such claim shall be submitted no later than forty-five (45) days from the effective date of termination. Upon failure of the Contractor to submit his termination claim within the time allowed, the Owner may determine, on the basis of information available to it, the amount, if any, due to the Contractor by reason of the termination.

15.4 CONTRACTOR'S RESPONSIBILITIES UPON TERMINATION

15.4.1 After receipt of a notice of termination pursuant to 15.3, Owner's Right to Terminate Contract for Convenience, the Contractor shall mitigate any damages to the extent reasonably possible.

15.4.2 In addition to the provisions of 15.4.1, the Contractor shall:

.1 At the option of the Owner, assign to the Owner, in the manner, at the time, and to the extent directed by the Owner, all of the right, title, and interest of the Contractor under the orders and

subcontracts so terminated, in which case the Owner shall have the right, in its discretion, to settle or pay any or all claims arising out of the termination of such orders and subcontracts;

.2 Transfer title and deliver to the Owner in the manner, at the times, and to the extent, if any, directed by the Owner:

a) The fabricated or un-fabricated parts, work in process, completed Work, supplies, and other material and equipment procured as a part of, or acquired in connection with the performance of the Work terminated by the Notice of Termination, and

b) The completed or partially completed drawings, releases, information, manuals and other property which, if the Contract had been completed, would have been required to be furnished to the Owner;

.3 Complete performance of such part of the Work as shall not have been terminated by the Notice of Termination; and

.4 Take such action as may be necessary, or as the Owner may direct, for the protection and preservation of the property related to this Contract which is in the possession of the Contractor and in which the Owner has or may acquire an interest.

ATTACHMENT 1

1. Dual wall, watertight HDPE pipe is recommended for this application.

2. In the pre bid it was mentioned that a report after bores are done will come out in an addendum and this might address these questions.

Refer to attached Figure 1 – Geoprobe Locations for information regarding depth to waste from existing grade along the proposed swales.

3. At the prebid it was mentioned that there may be some trash that will be have to be removed as part of our excavation and that this is to be included in our price. Will there be a depth of excavation once we hit trash that we are to stop excavation at so we can try to estimate how much trash and how many trips to the landfill will need to be made? And we also will have to figure how much material to bring back in to the site to replace the trash that was removed. We would recommend the City somehow paying for any removal of trash separate from the lump sum. Otherwise you will be getting inflated prices to cover this.

The Bidder can use the attached Figure 1 and site observations to estimate the volume of waste that may be generated for disposal at a landfill. If waste is encountered, it shall be over excavated by 2'-0" and refilled with compacted soil. Waste must be collected in container at time of removal and covered for final transport to the Region 2000 landfill in Rustburg VA.

4. Can the amount of 120 calendar days to complete the work be extended?

This project must be completed no later than November 30, 2016. Once construction is underway, if conditions on the site warrant expanding the work schedule into weekends/holidays, we would consider that as an option at that time.

5. Will there be a fee associated with trash that needs to go the Landfill and is the contractor responsible for that fee?

The Contractor will charge tipping fees to the City's account at the Region 2000 landfill in Rustburg, VA. Account information will be provided to the successful bidder.

6. Is the contractor or City responsible for any testing?

No, the City will be responsible for testing at the site.

7. Being that the work will be in close proximity to the Jefferson Park Apartments will there be any changes to the time we are allowed to work?

The City of Lynchburg Noise Ordnance will apply in this instance. The ordinance prohibits work between 9 PM to 7 AM daily.

8. Page 10 of the SWPPP plan says new vegetation will need to be maintained for 1 year after planting. Is this something the Contractor will need to do and if so what specifically does that include having to do?

No, the City will assume maintenance responsibility of plantings upon completion of the project.

9. The detail for sidewalk shows stone under the concrete extending out further than the concrete, is this extra stone needed? If so the detail does not tell us how far outside of the concrete the stone goes.

The stone does not need to extend further out than the concrete.

10. Can we get some clarification on some details? For the storm trench there is one detail and then there is another detail for the North Storm Bedding and they each show different things. They each call for different stone for bedding. One shows Clay lining the trench the other doesn't. Is clay needed to line all of the storm trenches or just where there is a gas vent since it only shown on that detail?

The north storm sewer bedding and backfill detail should be used for the storm line from structures 20-28. The City of Lynchburg standard storm bedding detail should be used for the pipe downstream of structure 32.

JEFFERSON PARK STORMWATER IMPROVEMENTS

Stormwater Pollution Prevention Plan (SWPPP)
Lynchburg, Virginia

PREPARED FOR:

Gaynelle Hart, Director of Public Works
City of Lynchburg
1700 Memorial Avenue
Lynchburg, Virginia 24501

December 11, 2015

Draper Aden Associates
Engineering • Surveying • Environmental Services

DAA Project Number: B14111B-05

Stormwater Pollution Prevention Plan

For:

Jefferson Park Stormwater Improvements
Lynchburg, Virginia

Operator(s):

TBD

Stormwater Manager:

TBD

SWPPP Contact(s):

TBD

SWPPP Preparation Date:

12 / 11 / 2015

Estimated Project Dates:

Start of Construction: mm / dd / yyyy
Completion of Construction: mm / dd / yyyy

CERTIFICATION AND NOTIFICATION

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Name: _____ Title: _____

Signature: _____ Date: _____

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SECTION 1: SITE INFORMATION

1.1 Project/Site Information

1. Project/Site Name: Jefferson Park Stormwater Improvements
2. Project Street/Location: York/Chambers Streets
3. City/Town: Lynchburg City
4. State: Virginia
5. Zip Code: 24422
6. County: N/A
7. Subdivision: N/A
8. Tax Reference Number of Parcel(s): Refer to Plans
9. Parcel Number(s): 0206001 (see plans for additional parcel numbers)
10. Latitude: 37 º 25 ' 3 '' N (degrees, minutes, seconds)
    Longitude: 79 º 9 ' 56 '' W (degrees, minutes, seconds)
11. Method for determining latitude/longitude:
    ☐ USGS topographic map ☐ EPA Web site ☐ GPS
    ☒ Other (please specify): Google Maps
12. Is this project considered a federal facility? ☐ Yes ☒ No
13. VSMP permit number: TBD
14. Type of regional facility/facilities to which site contributes: None
15. Regional Facility Street/Location: N/A
16. City: N/A
17. State: N/A
18. Zip Code: N/A

1.2 Contact Information/Responsible Parties

1. **Operator(s)**: **[TBD]**

   Name:

   DEQ Certification Number:

   Address:

   Telephone:

   Fax/Email:

   Area of Control:

2. **Project Manager(s) or Site Supervisor(s)**: **[TBD]**

   Name:

   DEQ Certification Number:

   Address:

   Telephone:

   Fax/Email:

   Area of Control:

3. **Stormwater Manager and SWPPP Contact(s): [TBD]**

   Name:

   DEQ Certification Number:

   Address:

   Telephone:

   Fax/Email:

4. **This SWPPP Was Prepared By:**

   Matthew B. James, P.E.

   Draper Aden Associates

   2206 South Main St.

   Blacksburg, Virginia

   540.552.0444

   mjames@daa.com

5. **Subcontractor(s): [TBD]**

   Name:

   DEQ Certification Number:

   Address:

   Telephone:

   Fax/Email:

6. **Responsible Land Disturber: [TBD]**

   Name:

   DEQ Certification Number:

   Address:

   Telephone:

   Fax/Email:

7. **Emergency 24 hour contact: [TBD]**

   Name:

   Telephone Number:

1.3 Nature and Sequence of Construction Activity

1. The City of Lynchburg desires to alleviate stormwater-related issues at Jefferson Park, located in the vicinity of York and Chambers Streets. A large portion of the park is constructed on a closed landfill; one of the project goals is to decrease the amount of runoff stormwater onto the landfill area. Another component of this project is mitigation of an eroded channel down a steep bank to the northeast. Grass channels will be constructed around the perimeter of the park, and a storm sewer will be installed to safely convey flows down the steep embankment. An access road will also be constructed to provide maintenance access to the proposed storm sewer.
2. What is the function of the construction activity?

   ☐ Residential ☐ Commercial ☐ Industrial ☐ Road Construction

   ☒ Linear Utility

   ☐ Other (please specify):
3. Estimated Project Start Date: 03 / 01 / 2016
4. Estimated Project Completion Date: 09 / 01 / 2016

1.4 Construction Site Estimates & Statistics

The following are estimates of the construction site:

1.	Construction Site Area to be disturbed	3.6	acres
2.	Total Project Area	3.6	acres
3.	Percentage impervious area before construction	0	%
4.	Runoff coefficient before construction	Refer to Sect 4.1 & 4.2	
5.	Percentage impervious area after construction	7.5	%
6.	Runoff coefficient after construction	Refer to Sect 4.1 & 4.2	
7.	Number of Acres treated by Regional Facility	0.0	acres

1.5 Existing Conditions

1. Soil type(s): Refer to Section 2.5.
2. Slopes: Refer to Section 2.6.
3. Drainage Patterns: Refer to Section 4.1.
4. Vegetation:

The site is predominantly open space, with a portion of forested area along the steep slope to the north.

1.6 Receiving Waters

1. Receiving Waters: James River; HUC Code JM10
2. Description of storm sewer systems:

   A proposed storm sewer system will be installed to capture runoff from the proposed swales. A rip-rap energy dissipater will be installed at the outfall, which flows into an unnamed tributary of Blackwater Creek and then flows into the James River
3. Description of waters subject to TMDLs: Blackwater Creek
4. Provide link to impaired water referenced from Virginia's TMDL website: http://tinyurl.com/blackwatertmdl
5. Describe the designated uses of the water body: N/A
6. Please include a description and map of the watershed boundary: Refer to Figure 2
7. Please list any measures that will be used to meet the TMDL(s): Erosion Controls
8. Description of impaired waters:

Impaired Waters	Pollutant	Project Specific Control Measures
Blackwater Creek	E.coli	Erosion Controls

1.7 Site Features and Sensitive Areas to be Protected

Description of unique features and measures to protect them:

- Tree protection will be installed to limit construction to the site area.
- Excavation in the landfill area has been minimized to the extent practicable to limit exposure of waste.

1.8 Potential Sources of Pollution

Potentials sources of sediment to stormwater runoff:

- Erosion during grading activities prior to final stabilization.

Potential pollutants and sources, other than sediment, to stormwater runoff:

- Nutrients (Phosphorus and Nitrogen) from impervious areas, and
- Leachate from closed landfill.

SECTION 2: EROSION AND SEDIMENT CONTROL

2.1 Project Description

1. General Description: Refer to Section 1.3.

2. Schedule: Refer to Section 1.3.

3. Site Data: Refer to Section 1.4.

2.2 Existing Site Conditions:

The project is located on City of Lynchburg current and future properties and rights-of-way. The site is predominantly made up of open space and wooded areas, as well as recreational facilities. The large grassed area in the center of the park is a closed landfill, with waste two feet or more below grade.

2.3 Adjacent Property

The site is surrounded by single and multi-family residences zoned R-3 and R-4. Historically, the area to the northeast has generated a high volume of trash that frequently clogs storm sewers in the area. Part of this project included research of and recommendations for methods to prevent trash from entering the storm sewer system, especially the proposed swales and storm sewer adjacent to the landfill area.

2.4 Planned Earthwork Activities

1. General Earthwork: Earthwork activities include the construction of new berms and swales to safely convey runoff around the landfill, adjustment and installation of a storm sewer, and construction of an access drive. Several low areas within the park that have subsided over time are also proposed to be filled to prevent future ponding.

2. Off-site Disposal: Any excess or unsuitable material will be transported to off-site disposal areas with erosion control plans that are approved by the authority having jurisdiction. The names of any offsite areas must be provided to the City of Lynchburg before any soil is transported offsite. The depth of topsoil/surficial soil in existing open areas range is approximately eight (8) inches.

3. Trenching: Trenching will be performed to install the utilities.

4. Imported Material: Any imported material required for backfilling, stone bases, etc., is planned to be obtained from commercial regional quarries. All off-site land disturbing areas in which material is obtained or is disposed shall have an approved ESC plan.

2.5 Soils

According to the Custom Soil Resource Report for Campbell County and the City of Lynchburg, there are a variety of soils on-site with hydrologic soil groups ranging from B to D. A summary of soils in the vicinity of the project is as follows:

Abbreviation	*Description*
CuB	Cullen loam, 2- 6% slopes, severely eroded
CxC3	Cullen clay loam, 6-15% slopes, severely eroded
CxE3	Cullen clay loam, 15-25% slopes, severely eroded
GeB2	Georgeville loam, 2-6% slopes, eroded
GeC2	Georgeville loam, 6-15% slopes, eroded
McF	Manteo channery loam, 25-60% slopes
TIE2	Tatum loam, 15-25% slopes, eroded
TmE3	Tatum clay loam, 15-25% slopes, severely eroded
UL	Urban Land
WkF	Wilkes loam, 25-60%

Please refer to Appendix A for the Natural Resources Conservation Service Custom Soil Resource Report.

2.6 Critical Erosion Areas

Critical erosion areas may be encountered during grading operations as follows:

1. Proposed slopes near 3:1 or greater, especially the slope to the northeast of the site adjacent to the proposed storm sewer and access road.
2. Drainage swales where surface runoff will be concentrated.

The proposed erosion and sediment control measures are intended to minimize any potential problems and promote stabilization.

2.7 Erosion and Sediment Control Measures

All vegetative and structural erosion and sediment control practices will be constructed and maintained in accordance with the minimum standards and specifications of the

Virginia Erosion & Sediment Control Handbook (VESCH), latest edition, and in accordance with the conditions of any applicable environmental permits. Removal of erosion & sediment control measures is only to be conducted with the approval of the City of Lynchburg.

2.8 Structural Practices

1. **SAFETY FENCE – STD. & SPEC. 3.01**

   A protective barrier installed to prevent access to an erosion control measure. Safety fence can also double as construction fence prohibiting public access to the site.

Sequence of Installation:	Prior to any land disturbance
Maintenance:	Refer to Std. & Spec. 3.01
Removal Event:	Following permanent stabilization of entire site

2. **TEMPORARY STONE CONSTRUCTION ENTRANCE – STD. & SPEC. 3.02**

   Temporary stone construction entrance shall be installed as shown on the plans to reduce the amount of soil transported onto public roads or other paved areas.

Sequence of Installation:	Prior to any land disturbance
Maintenance:	Refer to Std. & Spec. 3.02
Removal Event:	Immediately prior to paving

3. **SILT FENCE - STD. & SPEC. 3.05**

   Disturbed areas and soil stockpile areas shall be lined with silt fence as shown on the plans to detain sediment and decrease storm water runoff velocity.

Sequence of Installation:	Prior to any land disturbance
Maintenance:	Refer to Std. & Spec. 3.05
Removal Event:	Following permanent stabilization of entire site

4. **STORM DRAIN INLET PROTECTION - STD. & SPEC. 3.07**

   Storm drain inlet protection shall be placed at existing and proposed grate inlets to prevent sediment from entering the storm piping.

Sequence of Installation:	Existing structures - prior to any land disturbance Future structures – immediately following installation
Maintenance:	Refer to Std. & Spec. 3.07

Removal Event:	Following permanent stabilization of all upland areas

5. CULVERT INLET PROTECTION – STD. & SPEC. 3.08

Culvert inlet protection shall be installed and consist of a sediment filter located at the inlet to storm sewer culverts, which prevents sediment from entering, accumulating in and being transferred by the culvert. It provides erosion control at culverts during the phase of the project where elevations and drainage patterns are changing, causing original control measures to be ineffective.

Sequence of Installation:	Existing structures - prior to any land disturbance Future structures – immediately following installation
Maintenance:	Refer to Std. & Spec. 3.08
Removal Event:	Following permanent stabilization of all upland areas

6. TEMPORARY DIVERSION DIKE - STD. & SPEC. 3.09

Temporary diversion dikes shall be constructed to divert runoff from a disturbed area to a sediment-trapping facility.

Sequence of Installation:	Concurrent with the construction of the sediment traps
Maintenance:	Refer to Std. & Spec. 3.09
Removal Event:	Following permanent stabilization of all upland areas

7. TEMPORARY SLOPE DRAIN – STD. & SPEC. 3.15

Temporary slope drains shall be constructed as shown on the plans to temporarily conduct concentrated stormwater runoff safely down the face of a cut or fill slope without causing erosion on or below the slope.

Sequence of Installation:	As part of grading activities
Maintenance:	Refer to Std. & Spec. 3.15
Removal Event:	Following permanent stabilization of upland and down slope areas.

8. STORMWATER CONVEYANCE CHANNEL (SCC) – STD. & SPEC. 3.17

Permanent SCCs are proposed to provide adequate channel to convey runoff, and shall be constructed in accordance with the plans, specifications, and engineering design calculations.

Sequence of Installation:	As part of grading activities
Maintenance:	Refer to Std. & Spec. 3.17
Removal Event:	This is permanent and shall not be removed.

9. RIPRAP – STD. & SPEC. 3.19

Large, loose, angular stone with filter fabric installed to protect soil from the erosive forces of concentrated runoff or stabilize slopes.

Sequence of Installation:	As part of grading activities
Maintenance:	Refer to Std. & Spec. 3.19
Removal Event:	This is permanent and shall not be removed.

10. MS-16: UTILITY INSTALLATION

No more than 500 linear feet of utility trench may be opened at one time. Excavated material shall be placed on the uphill side of trenches. Effluent from dewatering operations shall be filtered or passed through approved sediment trapping device, or both, and discharged in a manner that does not adversely affect flowing streams or off-site property. Backfill material shall be properly compacted to minimize erosion and promote stabilization.

2.9 Vegetative Practices

GENERAL: A permanent vegetative cover shall be established on denuded areas not otherwise permanently stabilized by concrete or pavement. Permanent vegetation shall not be considered established until a ground cover is achieved that is uniform, mature enough to survive and will inhibit erosion. New vegetation shall be maintained for one full year after planting. New seeding shall be supplied with adequate moisture, especially late in the season, and in abnormally hot or dry weather. Stabilization practices shall be accomplished in accordance with the appropriate VESCH Std. & Spec. as provided in the Appendix, and the Erosion and Sediment Control Plan. Selection of the appropriate seed mixture for temporary seeding will depend upon the time of year it is applied.

1. TOPSOILING – STD. & SPEC. 3.30

In order to stabilize final site grades, suitable, organic growth medium shall be used. This can be accomplished through on-site preservation of existing topsoil or imported topsoil.

Sequence of Installation:	Following final grading/surface roughening where applicable.

Maintenance:	Refer to Std. & Spec. 3.30; areas which fail to establish vegetative cover adequate to prevent rill erosion are to be reseeded.
Removal Event:	This is a permanent practice and shall not be removed.

2. PERMANENT SEEDING – STD. & SPEC. 3.32

Permanent seeding shall also be used on all areas that are not at final grade and that will be left dormant for a period of more than 1 year. If conflicts exist between the project specifications and the VESCH Std. & Spec. 3.32, the more stringent requirement shall apply. Permanent seeding mixes and rates are found on sheet [XXX] Erosion and Sediment Control Details.

Sequence of Installation:	Within 7 days of achieving final grade or as noted above
Soil Testing Requirements:	Refer to Std. & Spec. 3.32
Maintenance:	Refer to Std. & Spec. 3.32; areas which fail to establish vegetative cover adequate to prevent rill erosion are to be immediately reseeded, following identification of the cause of poor germination.

3. SODDING – STD. & SPEC. 3.33

Sod shall be installed where indicated on the plans in fine-graded areas to establish an immediate permanent turf cover.

Sequence of Installation:	Following establishment of final grade
Maintenance:	Refer to Std. & Spec. 3.33
Removal Event:	This is a permanent practice and should not be removed.

4. SOIL STABILIZATION BLANKETS AND MATTING – STD. & SPEC. 3.36

Blankets and matting shall be used to aid in controlling erosion on critical areas by providing a microclimate which protects young vegetation and promotes its establishment. In addition, some types of soil stabilization mats are also used to raise the maximum permissible velocity of turf grass stands in channelized areas by "reinforcing the turf" to resist the forces of erosion during storm events.

Sequence of Installation:	Following establishment of final grade and placement of lime, fertilize, and seed.
Maintenance:	Refer to Std. & Spec. 3.36
Removal Event:	This is permanent and shall not be removed.

5. MULCHING – STD. & SPEC. 3.35

Application of plant residues or other suitable material shall be installed to prevent erosion and foster growth of vegetation to areas which have been seeded or in areas which cannot be seeded because of season to provide some protection to the soil surface.

Sequence of Installation:	Following establishment of final grade and placement of lime, fertilize, and seed or in areas which cannot be seeded because of the season
Maintenance:	Refer to Std. & Spec. 3.35
Removal Event:	not applicable unless used for temporary cover in areas which cannot be seeded because of the season

6. SOIL STABILIZATION BLANKETS AND MATTING – STD. & SPEC. 3.36

Blankets and matting shall be used to aid in controlling erosion on critical areas by providing a microclimate which protects young vegetation and promotes its establishment. In addition, some types of soil stabilization mats are also used to raise the maximum permissible velocity of turf grass stands in channelized areas by "reinforcing the turf" to resist the forces of erosion during storm events.

Sequence of Installation:	Following establishment of final grade and placement of lime, fertilize, and seed.
Maintenance:	Refer to Std. & Spec. 3.36
Removal Event:	This is permanent and shall not be removed.

7. DUST CONTROL – STD. & SPEC. 3.39

During land disturbance, reduce surface and air movement of dust in areas subject to dust problems in order to prevent soil loss and reduce the presence of potentially harmful airborne substances.

Sequence of Installation:	Immediately as needed to reduce surface and air movement of dust in areas subject to dust problems
Maintenance:	Refer to Std. & Spec. 3.39
Removal Event:	N/A

2.10 Management Strategies

The Contractor will designate an employee certified as the "Responsible Land Disturber" (RLD), by the Commonwealth of Virginia, Department of Environmental Quality (VADEQ), who is in charge of and is responsible for carrying out the land-disturbing activities on this project. This employee shall also inspect for deficiencies immediately after each rainfall, at least daily during prolonged rainfall, and at least weekly when no rainfall occurs. Contractors shall provide written documentation to the City of Lynchburg that they meet this requirement prior to the City awarding the construction contract, and the City shall provide the name of the RLD to VADEQ prior to land disturbance. In the interim until the work starts, Carolyn A. Howard, P.E. is the RLD.

1. As first step measures, the construction entrance, silt fence, diversions, and inlet/culvert protection shall be installed as indicated prior to upslope land disturbance.

2. Stabilization measures shall be applied to earthen structures such as diversions immediately after installation.

3. Inlet protection as indicated on the Plan shall be installed for new inlets as they become operational.

4. Stockpiling of soil is not planned.

5. Permanent seeding will be used on all disturbed areas that are not scheduled to receive concrete surfacing, or landscaping (hardwood mulch, etc.).

6. Areas that are not to be disturbed shall be clearly marked by flags, signs, etc.

7. All temporary erosion and sediment control measures shall be removed within 30 days after final site stabilization or after temporary measures are no longer needed, unless otherwise authorized by the local program authority. Trapped sediment and the disturbed soil areas resulting from the disposition of temporary measures shall be permanently stabilized to prevent further erosion and sedimentation.

2.11 Phased Construction Activities

Construction should proceed in a manner to prevent sediment leaving the site. The temporary slope drain and associated diversions should be constructed prior to work within the eroded channel and installation of associated storm sewer system. Please refer to the erosion & sediment control plans for more detailed information and phasing of E&SC measures.

2.12 Permanent Stabilization

All areas disturbed by construction shall be stabilized with permanent seeding, landscaping, pavement, or concrete following the final grading.

2.13 Maintenance

1. The contractor shall inspect all erosion control measures immediately after each run-off producing rainfall event, at least daily during prolonged rainfall, at least weekly when no rainfall occurs, and in accordance with the Virginia Stormwater Management Program (VSMP) Permit Regulations. The following areas will be checked in particular:

    a. All devices used at entrances to the storm drain system shall be checked for their performance. If repairs need to be made, they shall be done in a responsible manner.

    b. Sediment shall be removed when the sediment has accumulated to one half the design depth of the barrier. Removed sediment shall be deposited in a suitable area and in such a manner that it will not erode.

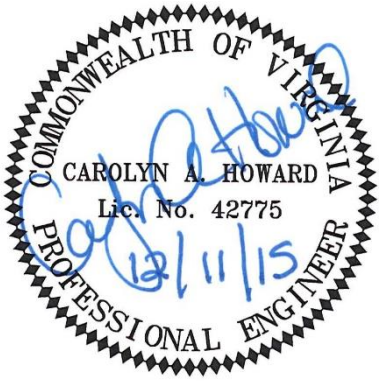
    c. All vegetated areas shall be checked regularly to ensure that a good stand is maintained. Areas shall be fertilized and repaired by reseeding as necessary.

2. City of Lynchburg personnel will be responsible for maintenance following construction.

Required Certification

The submitted erosion and sediment control narrative (Section 2), including its referenced appendices, and attached plans are complete and meet all applicable requirements to the best of my knowledge.

Licensed Professional Signature / Seal or Applicant



SECTION 3: POLLUTION PREVENTION PLAN

3.1 Equipment and Vehicle Washing

No construction vehicle washing is allowed on the project site, except to wash soiled tires prior to returning to a public street. Wash water shall be directed to an approved sediment settling area.

3.2 Building Materials/Products, Construction Wastes, Landscape Materials, and/or Other Materials

The contractor shall prevent the discharge of solid materials, including building materials, garbage, and debris to state waters, except as authorized by a Clean Water Act § 404 permit. At the close of each business day, the contractor shall clear the construction site of all unnecessary material and debris and collect any material transported outside the limits of disturbance. Accumulation of construction waste materials is not allowed, and all waste shall be contained in waste containers.

The contractor shall comply with applicable state and local waste-disposal, sanitary sewer or septic system regulations.

The project specifications shall be referenced to determine waste material storage practices, to minimize exposure of the materials to stormwater, and for spill prevention and response. No pollutant leaching products are anticipated to be stored on site.

3.3 Chemical Spill/Leak Prevention and Control Plan

Hazardous chemicals shall not be stored on-site.

3.4 Washout Areas

To minimize the potential for stormwater pollution from washout areas for concrete mixers, paint, stucco, etc., washout shall be directed to an approved washout collection area/device with no connection to the soil, groundwater, or downstream receiving channels. Washout shall then be appropriately disposed of in accordance with all applicable waste-disposal, sanitary sewer, or septic system regulations.

3.5 Equipment/Vehicle Fueling and Maintenance Practices

Fuels for equipment/vehicle fueling shall be stored in spill-proof containers in an area designated for fuel storage. Fuel storage areas shall be selected so as to minimize the potential for accidental spills (i.e. to minimize equipment / vehicle interactions and avoid impact with fuel).

During re-fueling operations, the contractor shall take care to minimize fuel spillage, and use containment measures such as drip pans. If spillage from fuels, oils, soaps, solvents, etc. occurs, the contractor shall use an appropriate spill kit to clean the spill and prevent contamination of soils, groundwater, and downstream stormwater conveyances in accordance with the project specifications**.**

3.6 Allowable non-stormwater discharges

The following are the only allowable sources of nonstormwater discharges, except for flows from firefighting activities:

- *Fire Hydrant Flushing:* Water from flushing operations shall be directed into stabilized areas. Downstream of the flushing operation, ensure that downstream inlet protection or other type of sediment barrier is in place.
- *Waters used to wash vehicles where detergents are not used:* No construction vehicle washing is allowed on the project site, except to wash soiled tires prior to returning to a public street. Wash water shall be directed to an approved sediment settling area.
- *Water used to control dust:* Water shall be applied at a controlled rate to prevent runoff from leaving the site and to prevent erosion.
- *Potable water sources, including waterline flushing:* Water from flushing operations shall be directed into stabilized areas. Ensure that inlet protection or other type of sediment barrier is in place downstream of the operations.
- *Water used for hydrostatic testing of new pipeline construction:* Water from testing operations shall be directed into stabilized areas. Ensure that inlet protection or other type of sediment barrier is in place downstream of the operations.
- *Routine external building wash down which does not use detergents:* Water from wash down operations shall be directed into stabilized areas. Ensure that inlet protection or other type of sediment barrier is in place downstream of the operations.
- *Pavement wash waters where spills or leaks of toxic or hazardous materials have not occurred (unless all spilled material has been removed) and were detergents are not used:* Water from wash down operations shall be directed into stabilized areas.

Ensure that inlet protection or other type of sediment barrier is in place downstream of the operations.

- *Uncontaminated air conditioning or compressor condensate:* Not applicable.
- *Uncontaminated ground water or spring water:* Dispose of water removed by dewatering in a manner that avoids endangering public health, property, and portions of work under construction or completed. Dispose of water in a manner that avoids inconvenience to others. Provide sumps, sedimentation tanks, and other flow-control devices as required by authorities having jurisdiction.
- *Foundations or footing drains where flows are not contaminated with process materials such as solvents*: Not applicable
- *Uncontaminated excavation dewatering*: Dispose of water removed by dewatering in a manner that avoids endangering public health, property, and portions of work under construction or completed. Dispose of water in a manner that avoids inconvenience to others. Provide sumps, sedimentation tanks, and other flow-control devices as required by authorities having jurisdiction.
- *Landscape irrigation:* Not applicable.

3.7 Material Handling and Waste Management

All trash, sanitary waste, recycling, and other solid waste materials shall be disposed of at an approved facility in a manner consistent with local, state, and federal regulations. Any material stored on site should be contained in such a way that limits the possibility of contaminating adjacent stormwater conveyances.

SECTION 4: STORMWATER MANAGEMENT

4.1 General Information

1. Existing Conditions: Refer to Sections 1.5, 2.5, 2.6, and 4.1 of this report and refer to Figures 1a and 1b showing a map of existing conditions for the overall watershed and project site.

2. Proposed Conditions: Refer to Sections 1.3 and 1.4 of this report. Please refer to Figures 1 and 2 for maps showing individual project drainage areas and the overall watershed.

3. Rainfall Values: Rainfall values were based on the VDOT's adoption & implementation of NOAA Atlas 14 rainfall precipitation frequency data. Rational runoff method was utilized to determine peak design flows for the runoff analysis. Rainfall values can be found in Appendix B and are available online at http://hdsc.nws.noaa.gov/hdsc/pfds/pfds_map_cont.html?bkmrk=va.

4. Time of Concentration: Times of Concentration (Tc) for drainage areas were calculated utilizing the TR-55 method. The calculations for Tc are located in Appendix C.

5. Hydrologic Methodology: The NRCS TR-55 method was used to calculate pre- and post-development runoff peak flows and volumes for the site and overall watershed. Calculations were performed using Autodesk Hydraflow Hydrographs software.

6. Hydraulic Methodology: Proposed storm sewers were analyzed for capacity using Autodesk Hydraflow Storm Sewers software.

7. Pre-Development Analysis

   Refer to Figure 1 and Appendix C for drainage area delineation and calculations.

DRAINAGE AREA	AREA (acres)	COMPOSITE CN	Tc (min.)	Q_1 (cfs)	Q_{10} (cfs)
1	1.5	87	5	3.8	8.4
2	2.4	87	5	6.3	14.0
3	1.9	76	5	2.9	8.2
4	4.9	87	5	13.0	28.5
5	8.9	81	34	8.0	21.1
6	8.6	67	29	2.8	13.5
7	2.2	78	16	2.7	7.5
8	4.5	74	11	4.9	15.4

9	0.4	79	5	0.7	2.0
COMBINED				**37.1**	**97.6**

8. Post-Development Analysis

   Following construction, stormwater conveyance channels will intercept off-site runoff and convey it to a proposed storm sewer to the northwest. A grass channel BMP will be constructed to meet runoff reduction and water quality requirements. The table below reflects the adjusted curve number as the result of this practice, as shown in drainage area 4. Values that remain unchanged from the pre-development condition are shown in gray.

DRAINAGE AREA	AREA (acres)	COMPOSITE CN	Tc (min.)	Q_1 (cfs)	Q_{10} (cfs)
1	1.5	87	5	3.8	8.4
2	2.4	87	5	6.3	14.0
3	1.9	76	5	2.9	8.2
4	4.9	86	5	12.4	27.9
5	8.9	81	34	8.0	21.1
6	8.6	67	29	2.8	13.5
7	2.2	78	16	2.7	7.5
8	4.5	74	11	4.9	15.4
9	0.4	79	5	0.7	2.0
COMBINED				**36.6**	**97.0**

4.2 Water Quality Compliance

1. Water quality requirements were calculated using the Virginia Runoff Reduction Method (VRRM) spreadsheet, version 2.8. For the site area of approximately 3.6 acres, approximately 0.8 pound per year of phosphorus removal is required; construction of a grass channel using BMP Clearinghouse Specification No. 3 will provide the required pollutant removal for this project. The channel is also designed to receive runoff from Drainage Area 4, which includes a portion of the housing development to the northeast of Chambers Street. Please refer to Appendix C for water quality and swale calculations.

2. Proposed Best Management Practices (BMPs)
   a. Grass Channel
      i. Location: SCC-4 on project site
      ii. 1.6 total lbs / acre / year of phosphorus removal provided

3. Compliance - Runoff Reduction Method: Refer to Appendix C for the runoff reduction spreadsheet.
    a. Requirement: 0.83 total lbs / acre / year of phosphorus removal
    b. Provided: 1.6 total lbs / acre / year of phosphorus removal

4.3 Water Quantity Compliance

1. *Downstream Channel Adequacy – MS-19 (9VAC-25-840-40)*

   Downstream channel adequacy is met on this project by meeting the water quantity control criteria as outlined in 9VAC25-870-66, as described below.

2. *Channel Protection (9VAC25-870-66B)*

   Concentrated stormwater discharge will enter a natural channel, just upstream of Blackwater Creek, to the northwest of Jefferson Park. The drainage area is greater than 1% of the total drainage area to this point; the energy balance equation for the one-year 24-hour storm has been used to satisfy section 3 of the channel protection criteria. The use of grass channels designed to meet BMP Clearinghouse Specification No. 3 will satisfy this requirement.

   The general form of the energy balance equation is shown below, using an improvement factor of 0.8 because the project area is greater than 1 acre.

$$Q_{Developed} \leq 0.8*(Q_{Pre\text{-}developed}* RV_{Pre\text{-}Developed})/RV_{Developed}$$

   To determine the required amount of detention for the project site area, the equation was transposed as follows:

$$RV_{Developed}*Q_{Developed} \leq 0.8*(Q_{Pre\text{-}developed}* RV_{Pre\text{-}Developed})$$

   Site Limits:

A.	Pre-development $Q_{p,1\text{-}year}$	=	5.06 cfs
B.	Pre-development $RV_{1\text{-}year}$	=	13,284 cf
C.	Pre-development $RV*Q_p$ (A*B)	=	67,217 cf*cfs
D.	Improvement Factor	=	0.8
E.	***Reduction Required*** (C – (C*D))	***=***	***13,443 cf*cfs***

   Drainage Area 4 (area treated by grass channel):

F.	Pre-development Qp,1-year	=	12.95 cfs
G.	Pre-development RV1-year	=	26,269 cf
H.	Pre-development RV*Qp (F*G)	=	340,184 cf*cfs
I.	Post-development Qp, 1-year	=	12.37 cfs
J.	Post-development RV1-year	=	25,040 cf

K. Post-development RV*Qp (I*J) = 309,745 cf*cfs

L. Reduction Provided (K-I) = 30,439 cf*cfs

Note: Post-development peak flows and runoff volumes reflect adjusted curve number calculated by the runoff reduction spreadsheet.

Water quality criteria is met since the volume reduction from the treatment of drainage area 4 (L) exceeds the reduction required for the site improvements (E).

3. *Flooding Protection (9VAC25-870-66C)*

The post-development 10-year peak flow rate from the project will be less than the pre-development rate, which satisfies section 2b of the flooding protection criteria. Please refer to Appendix C for calculations.

	10-year, 24-Hour Peak Release Rate, CFS
Pre-Development	97.61
Post-Development	97.05

4. *Proposed Stormwater Management Facilities*

The grass channel described in section 4.2.3 of this report is proposed to provide runoff reduction required to meet stormwater quantity criteria.

4.5 Post-Construction Inspections

1. BMP Description: Grass Swale

a. Installation Schedule: Following upslope disturbance/stabilization

b. Maintenance and Inspection:

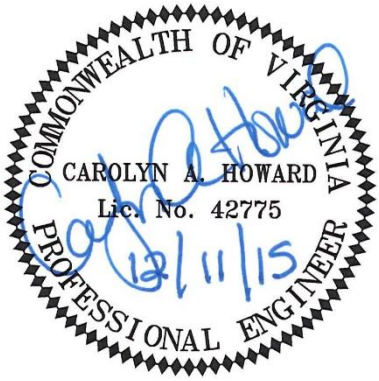
Description	Method	Frequency	Time of year
Visual Inspection and Cleaning	Remove accumulated sediment and debris as needed.	Annually	TBD

c. Responsible Persons: City of Lynchburg Personnel

Required Certification

The submitted stormwater management narrative (Section 4), including its referenced appendices, and attached plans are complete and meet all applicable requirements to the best of my knowledge.

Licensed Professional Signature / Seal or Applicant



SECTION 5: CONSTRUCTION INSPECTIONS and MAINTENANCE

5.1 Inspections

- **Inspection Personnel:**

  Identify the person(s) who will be responsible for conducting inspections and describe their qualifications.

- **Inspection Schedule and Procedures:**

  a. Inspections will be conducted at least once every 14 calendar days and within 48 hours following any runoff producing storm event. Where areas have been temporarily stabilized or runoff is unlikely due to winter conditions (e.g., the site is covered with snow or ice, or frozen ground exists) such inspections will be conducted at least once every month.

  b. Describe the general procedures for correcting problems when they are identified. Include responsible staff and timeframes for making corrections.

  c. Attach a copy of the inspection report you will use for your site.

5.2 Maintenance of Controls

Table 5.1 – Maintenance Procedures

Schedule Frequency	Actions to be Taken	Persons Responsible

SECTION 6: TRAINING

Describe Training Conducted:

- General stormwater and BMP awareness training for staff and subcontractors
- Detailed training for staff and subcontractors with specific stormwater responsibilities
- Individual(s) Responsible for Training:

6.1 Pre-Construction Training

Date: __ / __/ ____ **Start Time:** **Finish Time:**

Attendees

☐ Locality Number of attendees:

☐ A/E Number of attendees:

☐ Contractor Number of attendees:

☐ Subcontractor(s) Number of attendees:

Subjects Covered

- **Locality**
- **Engineer**
  - ☐ ESC/SWM Measures
  - ☐ BMPs
  - ☐ Other(s)
- **Contractor**
  - ☐ Project Sequencing
  - ☐ Material Handling and Waste Management

☐ Building Material Staging Area

☐ Washout Areas

☐ Equipment/Vehicle Fueling and Maintenance Areas

☐ Allowable Non-Stormwater Discharges

☐ Spill Prevention

☐ Map of Good Housekeeping BMPs

☐ Other(s)

- **Subcontractor(s)**

6.2 Progress Report Meeting

Date: __ / __ / ____ **Start Time:** **Finish Time:**

Months to Project Completion:

Attendees

☐ Locality Number of attendees:

☐ Engineer Number of attendees:

☐ Contractor Number of attendees:

☐ Subcontractor(s) Number of attendees:

Subjects Covered

- **Locality**

- **Engineer** ☐ Final Stabilization Measures

(Refer to Section 7)

☐ Other(s)

- **Contractor**
- **Subcontractor(s)**

6.3 Post-Construction Training

Date: __ / __ / ____ **Start Time:** **Finish Time:**

Attendees

☐ Locality Number of attendees:

☐ Engineer Number of attendees:

☐ Contractor Number of attendees:

☐ Subcontractor(s) Number of attendees:

Subjects Covered

- **Locality**
- **Engineer**

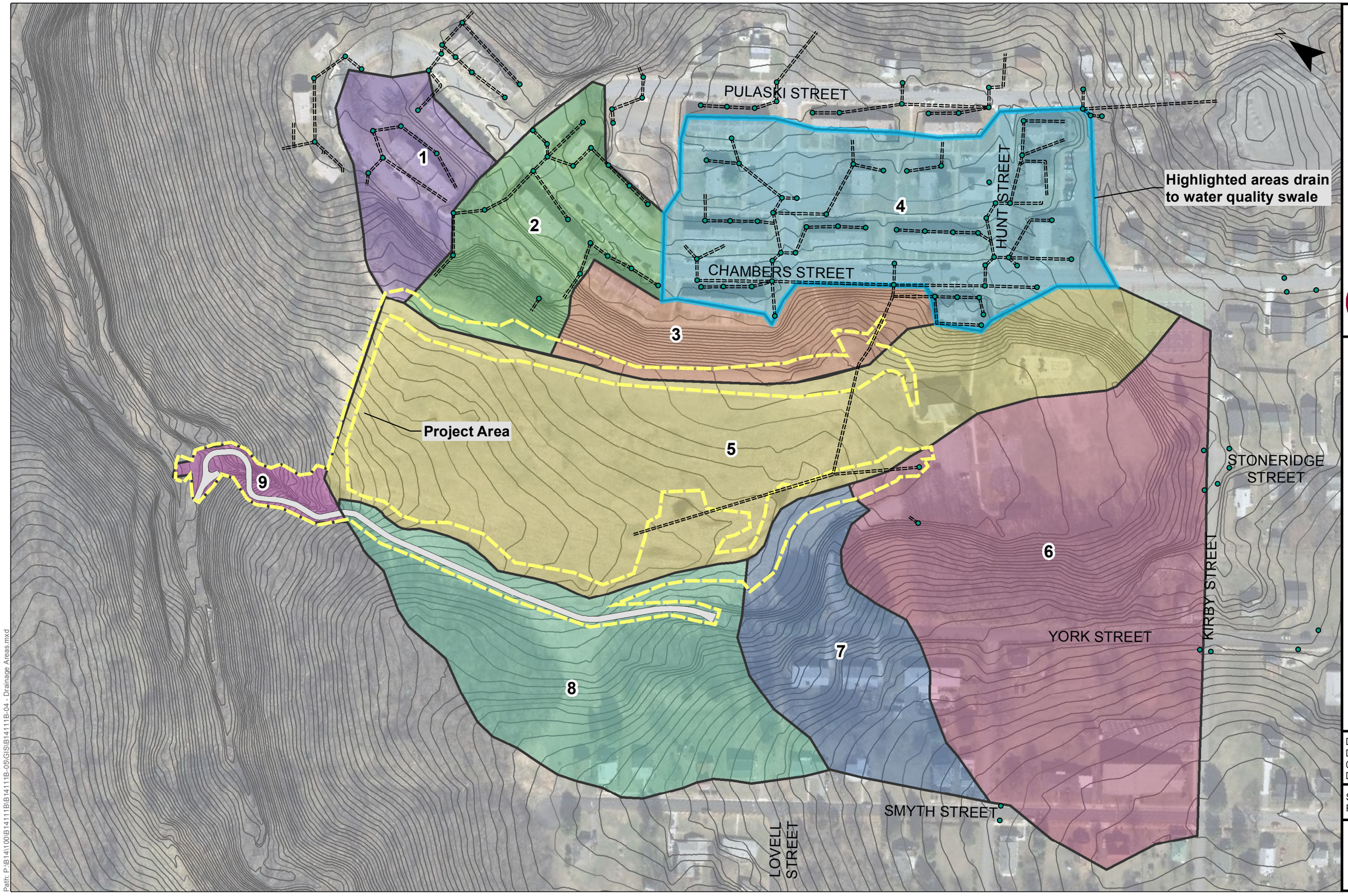
☐ Final Stabilization Measures
(Refer to Section 7)

☐ Post-Construction BMPs
(Refer to Section 4)

☐ Other(s)

- **Contractor**
- **Subcontractor(s)**

SECTION 7: FINAL STABILIZATION



Draper Aden Associates
Engineering • Surveying • Environmental Services
2206 South Main Street
Blacksburg, VA 24060
540-552-0444 Fax: 540-552-0291
Richmond, VA
Charlottesville, VA
Hampton Roads, VA
Coats, NC

Post-Development Drainage Areas
Jefferson Park Stormwater Improvements

DESIGNED	MBJ
DRAWN	CEP
CHECKED	CAH
DATE	8/31/15

Scale: 1"=150'
Plan No. B14111B-05

Figure 1

Path: P:\B14\100\B14111B\B14111B-05\GIS\B14111B-04 - Drainage Areas.mxd

Overall Watershed Map

Draper Aden Associates
Engineering ◆ Surveying ◆ Environmental Services
2206 South Main Street
Blacksburg, VA 24060
540-552-0444 Fax: 540-552-0291
Richmond, VA
Charlottesville, VA
Hampton Roads, VA

DESIGNED	MBJ
DRAWN	MBJ
CHECKED	CAH
DATE	8/31/15

SCALE 1"=600'

PLAN NO. B14111B-05

FIGURE 2

Path: P:\B14\100\B14111B\B14111B-05\GIS\B14111B-04 - Overall Drainage Area.mxd

Appendix A

NRCS Custom Soil Resource Report

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 Campbell County and the City of Lynchburg, Virginia

July 24, 2015

Preface

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

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

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

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

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

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

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means

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How Soil Surveys Are Made

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

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

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

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

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

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

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

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

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

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

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

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

Soil Map

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

Custom Soil Resource Report
Soil Map

Map Scale: 1:4,100 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 50 100 200 300

Feet: 0 150 300 600 900

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 1:15,800.

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: Campbell County and the City of Lynchburg, Virginia
Survey Area Data: Version 11, Dec 11, 2013

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

Date(s) aerial images were photographed: Nov 8, 2010—Mar 17, 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

Campbell County and the City of Lynchburg, Virginia (VA631)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
CuB	Cullen loam, 2 to 6 percent slopes	0.4	0.9%
CxC3	Cullen clay loam, 6 to 15 percent slopes, severely eroded	1.2	2.6%
CxE3	Cullen clay loam, 15 to 25 percent slopes, severely eroded	2.4	5.5%
GeB2	Georgeville loam, 2 to 6 percent slopes, eroded	1.1	2.4%
GeC2	Georgeville loam, 6 to 15 percent slopes, eroded	0.3	0.7%
McF	Manteo channery loam, 25 to 60 percent slopes	8.4	19.0%
TlE2	Tatum loam, 15 to 25 percent slopes, eroded	4.9	10.9%
TmE3	Tatum clay loam, 15 to 25 percent slopes, severely eroded	3.6	8.1%
UL	Urban land	20.9	47.2%
WkF	Wilkes loam, 25 to 60 percent slopes	1.1	2.5%
Totals for Area of Interest		**44.3**	**100.0%**

Map Unit Descriptions

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

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

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a

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

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

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

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

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

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

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

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

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Campbell County and the City of Lynchburg, Virginia

CuB—Cullen loam, 2 to 6 percent slopes

Map Unit Setting

National map unit symbol: 41l8
Elevation: 300 to 1,200 feet
Mean annual precipitation: 34 to 52 inches
Mean annual air temperature: 46 to 67 degrees F
Frost-free period: 180 to 220 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Cullen and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Cullen

Setting

Landform: Hillslopes
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Mixed mafic residuum

Typical profile

H1 - 0 to 5 inches: loam
H2 - 5 to 36 inches: clay
H3 - 36 to 53 inches: clay loam
H4 - 53 to 68 inches: loam

Properties and qualities

Slope: 2 to 6 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: 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: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 8.1 inches)

Interpretive groups

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

CxC3—Cullen clay loam, 6 to 15 percent slopes, severely eroded

Map Unit Setting

National map unit symbol: 41ld
Elevation: 300 to 1,200 feet
Mean annual precipitation: 34 to 52 inches
Mean annual air temperature: 46 to 67 degrees F
Frost-free period: 180 to 220 days
Farmland classification: Not prime farmland

Map Unit Composition

Cullen and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Cullen

Setting

Landform: Hillslopes
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Mixed mafic residuum

Typical profile

H1 - 0 to 5 inches: clay loam
H2 - 5 to 36 inches: clay
H3 - 36 to 53 inches: clay loam
H4 - 53 to 68 inches: loam

Properties and qualities

Slope: 6 to 15 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 8.0 inches)

Interpretive groups

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

CxE3—Cullen clay loam, 15 to 25 percent slopes, severely eroded

Map Unit Setting

National map unit symbol: 41lf
Elevation: 300 to 1,200 feet
Mean annual precipitation: 34 to 52 inches
Mean annual air temperature: 46 to 67 degrees F
Frost-free period: 180 to 220 days
Farmland classification: Not prime farmland

Map Unit Composition

Cullen and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Cullen

Setting

Landform: Hillslopes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Mixed mafic residuum

Typical profile

H1 - 0 to 5 inches: clay loam
H2 - 5 to 36 inches: clay
H3 - 36 to 53 inches: clay loam
H4 - 53 to 68 inches: loam

Properties and qualities

Slope: 15 to 25 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 8.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B

GeB2—Georgeville loam, 2 to 6 percent slopes, eroded

Map Unit Setting

National map unit symbol: 41lr
Elevation: 300 to 1,100 feet
Mean annual precipitation: 34 to 52 inches
Mean annual air temperature: 46 to 67 degrees F
Frost-free period: 180 to 220 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Georgeville and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Georgeville

Setting

Landform: Hillslopes
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Residuum weathered from schist

Typical profile

H1 - 0 to 6 inches: loam
H2 - 6 to 14 inches: clay loam
H3 - 14 to 58 inches: clay
H4 - 58 to 70 inches: silt loam

Properties and qualities

Slope: 2 to 6 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: 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: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: High (about 9.7 inches)

Interpretive groups

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

GeC2—Georgeville loam, 6 to 15 percent slopes, eroded

Map Unit Setting

National map unit symbol: 41ls
Elevation: 300 to 1,100 feet
Mean annual precipitation: 34 to 52 inches
Mean annual air temperature: 46 to 67 degrees F
Frost-free period: 180 to 220 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Georgeville and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Georgeville

Setting

Landform: Hillslopes
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Residuum weathered from schist

Typical profile

H1 - 0 to 6 inches: loam
H2 - 6 to 14 inches: clay loam
H3 - 14 to 58 inches: clay
H4 - 58 to 70 inches: silt loam

Properties and qualities

Slope: 6 to 15 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: High (about 9.7 inches)

Interpretive groups

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

McF—Manteo channery loam, 25 to 60 percent slopes

Map Unit Setting

National map unit symbol: 41mk
Elevation: 350 to 1,000 feet
Mean annual precipitation: 34 to 52 inches
Mean annual air temperature: 46 to 67 degrees F
Frost-free period: 180 to 220 days
Farmland classification: Not prime farmland

Map Unit Composition

Manteo and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Manteo

Setting

Landform: Hillslopes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Residuum weathered from mica schist

Typical profile

H1 - 0 to 10 inches: channery loam
H2 - 10 to 15 inches: very channery loam
H3 - 15 to 25 inches: bedrock

Properties and qualities

Slope: 25 to 60 percent
Depth to restrictive feature: 10 to 20 inches to lithic bedrock
Natural drainage class: Somewhat excessively 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
Available water storage in profile: Very low (about 1.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: D

TIE2—Tatum loam, 15 to 25 percent slopes, eroded

Map Unit Setting

National map unit symbol: 41np
Mean annual precipitation: 34 to 52 inches
Mean annual air temperature: 46 to 67 degrees F
Frost-free period: 180 to 220 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Tatum and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Tatum

Setting

Landform: Hillslopes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Residuum weathered from schist

Typical profile

H1 - 0 to 8 inches: loam
H2 - 8 to 29 inches: clay
H3 - 29 to 50 inches: silt loam
H4 - 50 to 54 inches: bedrock

Properties and qualities

Slope: 15 to 25 percent
Depth to restrictive feature: 40 to 60 inches to paralithic 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
Available water storage in profile: Moderate (about 8.8 inches)

Interpretive groups

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

TmE3—Tatum clay loam, 15 to 25 percent slopes, severely eroded

Map Unit Setting

National map unit symbol: 41nr
Mean annual precipitation: 34 to 52 inches
Mean annual air temperature: 46 to 67 degrees F
Frost-free period: 180 to 220 days
Farmland classification: Not prime farmland

Map Unit Composition

Tatum and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Tatum

Setting

Landform: Hillslopes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Residuum weathered from schist

Typical profile

H1 - 0 to 8 inches: clay loam
H2 - 8 to 29 inches: clay
H3 - 29 to 50 inches: silt loam
H4 - 50 to 54 inches: bedrock

Properties and qualities

Slope: 15 to 25 percent
Depth to restrictive feature: 40 to 60 inches to paralithic 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
Available water storage in profile: Moderate (about 8.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: C

UL—Urban land

Map Unit Setting

National map unit symbol: 41nw
Mean annual precipitation: 34 to 52 inches
Mean annual air temperature: 46 to 67 degrees F
Frost-free period: 180 to 220 days
Farmland classification: Not prime farmland

Map Unit Composition

Urban land: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

WkF—Wilkes loam, 25 to 60 percent slopes

Map Unit Setting

National map unit symbol: 41pg
Mean annual precipitation: 34 to 52 inches
Mean annual air temperature: 46 to 67 degrees F
Frost-free period: 180 to 220 days
Farmland classification: Not prime farmland

Map Unit Composition

Wilkes and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Wilkes

Setting

Landform: Hillslopes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Mixed mafic residuum

Typical profile

H1 - 0 to 4 inches: loam
H2 - 4 to 11 inches: clay
H3 - 11 to 29 inches: loam
H4 - 29 to 39 inches: bedrock

Properties and qualities

Slope: 25 to 60 percent
Depth to restrictive feature: 20 to 48 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 low (0.00 to 0.01 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 4.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: C

References

American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.

American Society for Testing and Materials (ASTM). 2005. Standard classification of soils for engineering purposes. ASTM Standard D2487-00.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deep-water habitats of the United States. U.S. Fish and Wildlife Service FWS/OBS-79/31.

Federal Register. July 13, 1994. Changes in hydric soils of the United States.

Federal Register. September 18, 2002. Hydric soils of the United States.

Hurt, G.W., and L.M. Vasilas, editors. Version 6.0, 2006. Field indicators of hydric soils in the United States.

National Research Council. 1995. Wetlands: Characteristics and boundaries.

Soil Survey Division Staff. 1993. Soil survey manual. Soil Conservation Service. U.S. Department of Agriculture Handbook 18. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_054262

Soil Survey Staff. 1999. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. 2nd edition. Natural Resources Conservation Service, U.S. Department of Agriculture Handbook 436. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053577

Soil Survey Staff. 2010. Keys to soil taxonomy. 11th edition. U.S. Department of Agriculture, Natural Resources Conservation Service. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053580

Tiner, R.W., Jr. 1985. Wetlands of Delaware. U.S. Fish and Wildlife Service and Delaware Department of Natural Resources and Environmental Control, Wetlands Section.

United States Army Corps of Engineers, Environmental Laboratory. 1987. Corps of Engineers wetlands delineation manual. Waterways Experiment Station Technical Report Y-87-1.

United States Department of Agriculture, Natural Resources Conservation Service. National forestry manual. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/home/?cid=nrcs142p2_053374

United States Department of Agriculture, Natural Resources Conservation Service. National range and pasture handbook. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/landuse/rangepasture/?cid=stelprdb1043084

United States Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook, title 430-VI. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/scientists/?cid=nrcs142p2_054242

United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land resource regions and major land resource areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053624

United States Department of Agriculture, Soil Conservation Service. 1961. Land capability classification. U.S. Department of Agriculture Handbook 210. http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_052290.pdf

Appendix B

Rainfall Values

NOAA Atlas 14, Volume 2, Version 3
LYNCHBURG WSO AIRPORT
Station ID: 44-5120
Location name: Lynchburg, Virginia, US*
Latitude: 37.3208°, Longitude: -79.2067°
Elevation:
Elevation (station metadata): 940 ft*
* source: Google Maps

POINT PRECIPITATION FREQUENCY ESTIMATES

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

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

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

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.328 (0.300-0.360)	0.390 (0.356-0.430)	0.464 (0.422-0.511)	0.519 (0.472-0.570)	0.585 (0.530-0.642)	0.632 (0.570-0.693)	0.678 (0.607-0.742)	0.718 (0.639-0.789)	0.765 (0.674-0.843)	0.802 (0.701-0.886)
10-min	0.524 (0.479-0.576)	0.624 (0.570-0.687)	0.744 (0.677-0.819)	0.830 (0.755-0.911)	0.933 (0.844-1.02)	1.01 (0.907-1.10)	1.08 (0.965-1.18)	1.14 (1.01-1.25)	1.21 (1.07-1.33)	1.26 (1.10-1.40)
15-min	0.655 (0.598-0.720)	0.784 (0.716-0.864)	0.941 (0.856-1.04)	1.05 (0.955-1.15)	1.18 (1.07-1.30)	1.28 (1.15-1.40)	1.36 (1.22-1.49)	1.44 (1.28-1.58)	1.52 (1.34-1.68)	1.59 (1.39-1.75)
30-min	0.898 (0.820-0.986)	1.08 (0.989-1.19)	1.34 (1.22-1.47)	1.52 (1.38-1.67)	1.75 (1.59-1.92)	1.92 (1.73-2.10)	2.08 (1.87-2.28)	2.24 (1.99-2.46)	2.43 (2.14-2.67)	2.57 (2.24-2.84)
60-min	1.12 (1.02-1.23)	1.36 (1.24-1.50)	1.71 (1.56-1.89)	1.98 (1.80-2.18)	2.33 (2.11-2.56)	2.60 (2.34-2.85)	2.87 (2.57-3.15)	3.13 (2.79-3.44)	3.48 (3.07-3.83)	3.75 (3.28-4.14)
2-hr	1.32 (1.20-1.46)	1.60 (1.46-1.77)	2.04 (1.85-2.25)	2.38 (2.15-2.62)	2.83 (2.55-3.11)	3.20 (2.86-3.51)	3.57 (3.17-3.92)	3.95 (3.48-4.34)	4.46 (3.89-4.92)	4.87 (4.20-5.38)
3-hr	1.42 (1.29-1.58)	1.73 (1.57-1.92)	2.19 (1.98-2.43)	2.55 (2.31-2.83)	3.04 (2.74-3.36)	3.43 (3.07-3.79)	3.84 (3.41-4.23)	4.24 (3.74-4.68)	4.79 (4.17-5.31)	5.23 (4.50-5.81)
6-hr	1.77 (1.62-1.97)	2.15 (1.95-2.38)	2.71 (2.46-3.00)	3.17 (2.87-3.51)	3.82 (3.43-4.21)	4.35 (3.88-4.80)	4.92 (4.34-5.42)	5.51 (4.81-6.07)	6.36 (5.45-7.00)	7.04 (5.96-7.76)
12-hr	2.17 (1.98-2.42)	2.63 (2.40-2.93)	3.33 (3.02-3.69)	3.93 (3.54-4.35)	4.79 (4.28-5.29)	5.52 (4.89-6.08)	6.32 (5.53-6.95)	7.18 (6.19-7.90)	8.43 (7.12-9.31)	9.50 (7.89-10.5)
24-hr	2.72 (2.52-2.96)	3.29 (3.05-3.59)	4.20 (3.88-4.59)	4.97 (4.57-5.41)	6.10 (5.59-6.63)	7.07 (6.42-7.66)	8.12 (7.32-8.79)	9.29 (8.29-10.0)	11.0 (9.67-11.9)	12.5 (10.8-13.5)
2-day	3.22 (2.97-3.49)	3.90 (3.60-4.23)	4.94 (4.56-5.36)	5.81 (5.34-6.29)	7.06 (6.45-7.64)	8.10 (7.37-8.75)	9.22 (8.34-9.98)	10.4 (9.37-11.3)	12.2 (10.8-13.3)	13.7 (12.0-14.9)
3-day	3.41 (3.14-3.70)	4.12 (3.81-4.47)	5.23 (4.82-5.67)	6.14 (5.64-6.65)	7.45 (6.81-8.07)	8.54 (7.77-9.24)	9.72 (8.78-10.5)	11.0 (9.85-11.9)	12.8 (11.4-13.9)	14.4 (12.6-15.6)
4-day	3.59 (3.32-3.90)	4.35 (4.02-4.72)	5.51 (5.08-5.98)	6.47 (5.94-7.01)	7.84 (7.16-8.50)	8.99 (8.17-9.74)	10.2 (9.22-11.1)	11.5 (10.3-12.5)	13.5 (11.9-14.6)	15.1 (13.2-16.4)
7-day	4.15 (3.85-4.49)	5.00 (4.63-5.41)	6.24 (5.77-6.74)	7.25 (6.69-7.83)	8.70 (7.99-9.37)	9.90 (9.05-10.7)	11.2 (10.2-12.0)	12.5 (11.3-13.5)	14.5 (12.9-15.6)	16.1 (14.2-17.4)
10-day	4.72 (4.39-5.08)	5.66 (5.27-6.09)	6.98 (6.48-7.51)	8.04 (7.45-8.64)	9.53 (8.80-10.2)	10.7 (9.88-11.5)	12.0 (11.0-12.9)	13.3 (12.1-14.3)	15.2 (13.7-16.3)	16.7 (14.9-18.0)
20-day	6.29 (5.90-6.73)	7.50 (7.03-8.03)	9.05 (8.48-9.67)	10.3 (9.60-11.0)	11.9 (11.1-12.7)	13.2 (12.3-14.1)	14.5 (13.4-15.5)	15.9 (14.6-17.0)	17.7 (16.2-19.0)	19.1 (17.3-20.5)
30-day	7.74 (7.30-8.19)	9.17 (8.66-9.71)	10.8 (10.2-11.5)	12.1 (11.4-12.8)	13.7 (12.9-14.5)	15.0 (14.1-15.9)	16.2 (15.2-17.2)	17.4 (16.2-18.5)	18.9 (17.6-20.2)	20.1 (18.6-21.4)
45-day	9.70 (9.20-10.2)	11.4 (10.9-12.1)	13.4 (12.7-14.1)	14.8 (14.0-15.6)	16.6 (15.7-17.5)	18.0 (17.0-18.9)	19.3 (18.2-20.3)	20.5 (19.3-21.7)	22.1 (20.7-23.4)	23.2 (21.7-24.7)
60-day	11.5 (11.0-12.1)	13.5 (12.9-14.2)	15.6 (14.8-16.4)	17.1 (16.3-18.0)	19.1 (18.1-20.0)	20.5 (19.4-21.5)	21.8 (20.7-23.0)	23.1 (21.8-24.3)	24.7 (23.2-26.1)	25.9 (24.3-27.3)

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

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

Please refer to NOAA Atlas 14 document for more information.

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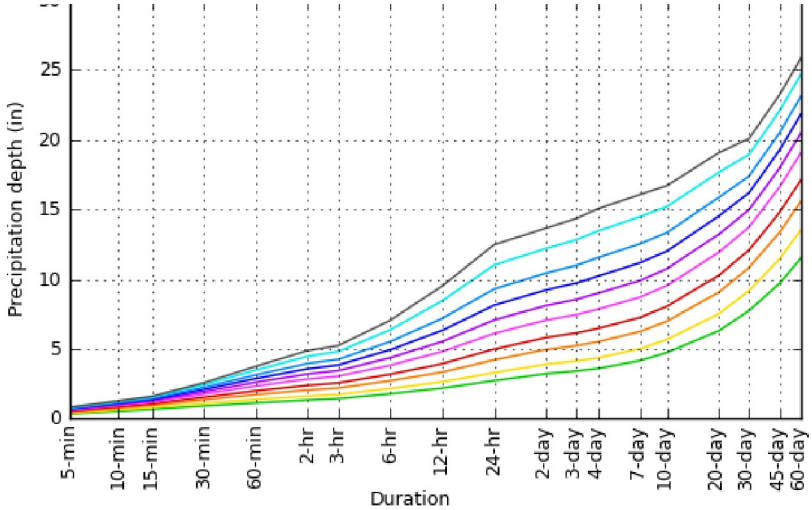
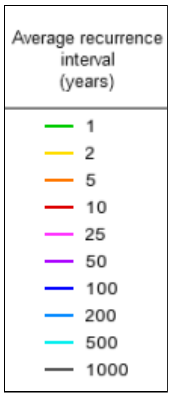
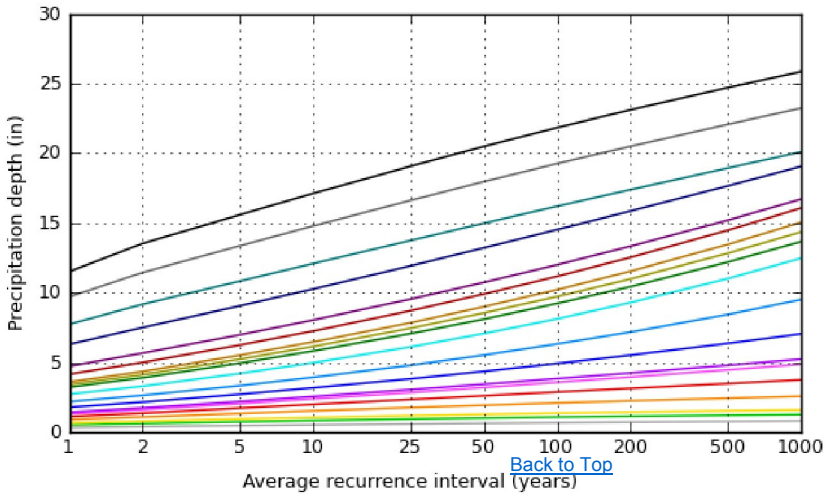
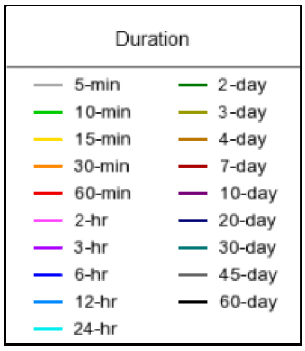
PF graphical









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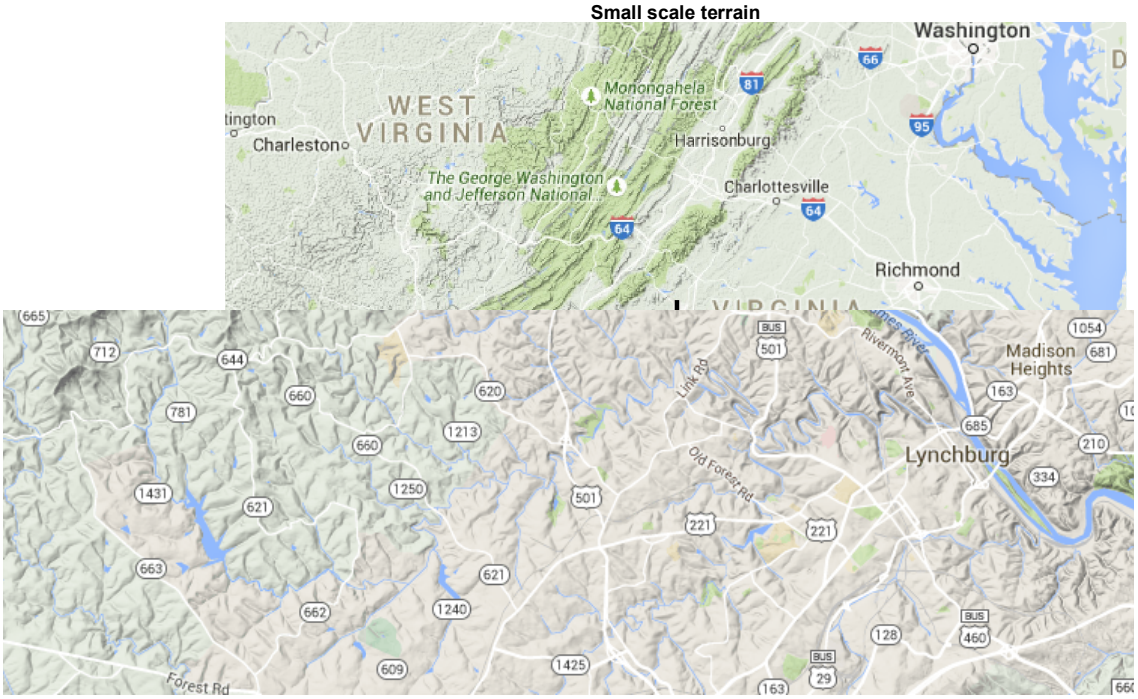
NOAA Atlas 14, Volume 2, Version 3

Created (GMT): Wed Aug 26 20:50:04 2015

Maps & aerials

Small scale terrain



Large scale aerial

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National Oceanic and Atmospheric Administration
National Weather Service
Office of Hydrologic Development
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Disclaimer

Appendix C

Stormwater Calculations

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Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

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Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

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	3.808	2	716	7,726	------	------	------	DA 1
2	SCS Runoff	6.329	2	716	12,841	------	------	------	DA 2
3	SCS Runoff	2.874	2	718	5,768	------	------	------	DA 3
4	SCS Runoff	12.95	2	716	26,269	------	------	------	DA 4
5	SCS Runoff	7.982	2	736	37,106	------	------	------	DA 5
6	SCS Runoff	2.800	2	734	15,256	------	------	------	DA 6
7	SCS Runoff	2.657	2	724	7,698	------	------	------	DA 7
8	SCS Runoff	4.851	2	722	13,265	------	------	------	DA 8
9	SCS Runoff	0.747	2	718	1,493	------	------	------	DA 9
10	SCS Runoff	5.059	2	722	13,284	------	------	------	Site Only - Pre
11	SCS Runoff	12.37	2	716	25,040	------	------	------	DA 4 - Adjusted CN
12	Combine	9.018	2	724	36,219	6, 7, 8,	------	------	SCC-1
13	Combine	25.86	2	716	52,605	1, 2, 3, 4,	------	------	SCC-2
14	Combine	22.05	2	716	44,879	2, 3, 4,	------	------	SCC-3
15	Combine	36.39	2	718	125,930	5, 12, 13,	------	------	Structure 27 Inflow
16	Combine	29.25	2	718	89,711	5, 13,	------	------	Structure 28 DA
17	Combine	37.14	2	718	127,422	5, 6, 7, 8, 9, 13,	------	------	Pre - Entire Site
18	Combine	29.48	2	718	89,975	1, 2, 3, 5, 9, 11,	------	------	Post (interim calc)
19	Combine	36.61	2	718	126,194	12, 18	------	------	Post - Entire Site

Hydrograph Report

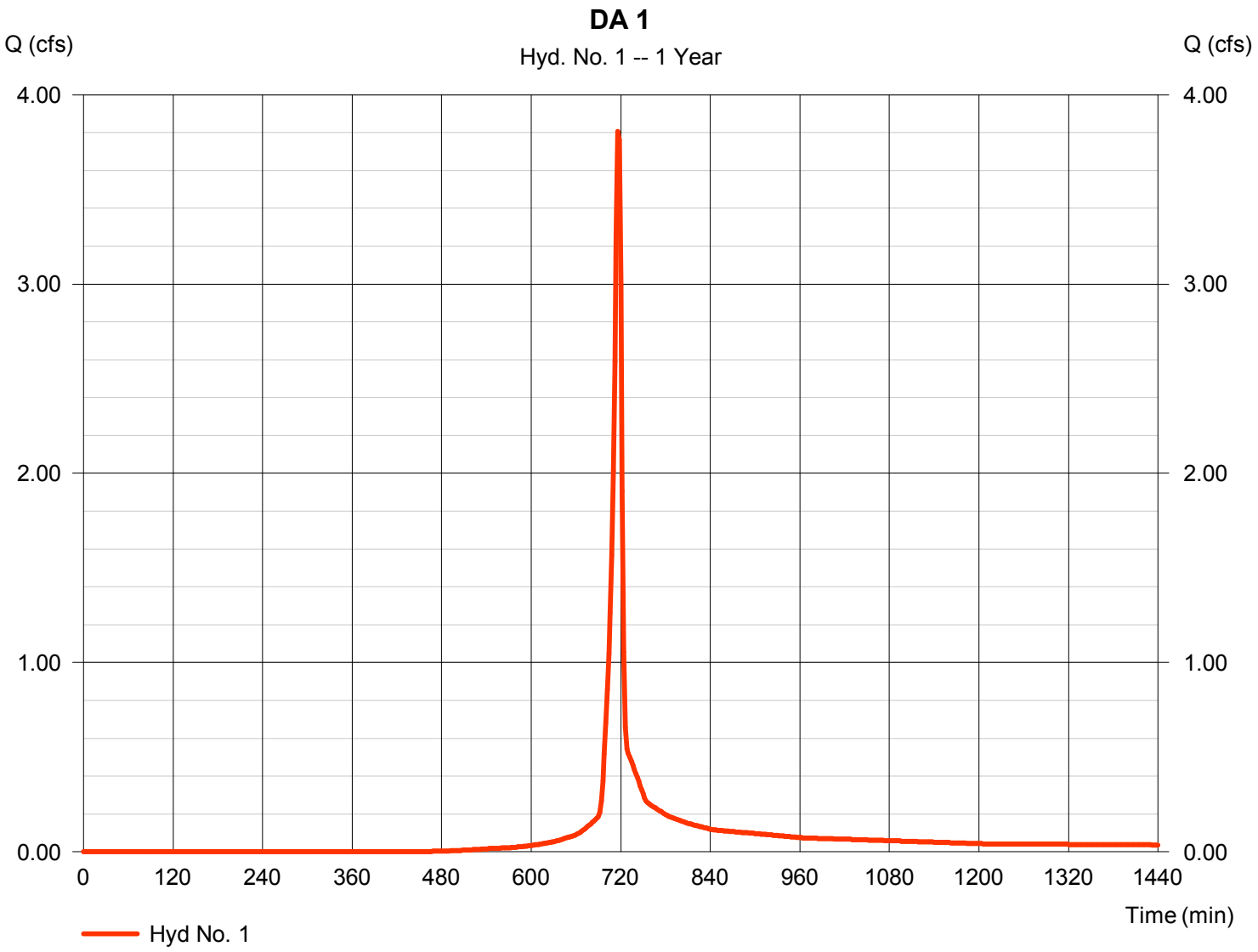
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4 Monday, 08 / 31 / 2015

Hyd. No. 1

DA 1

Hydrograph type	= SCS Runoff	Peak discharge	= 3.808 cfs
Storm frequency	= 1 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 7,726 cuft
Drainage area	= 1.450 ac	Curve number	= 87*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 2.80 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.600 x 98) + (0.620 x 80) + (0.230 x 77)] / 1.450



Hydrograph Report

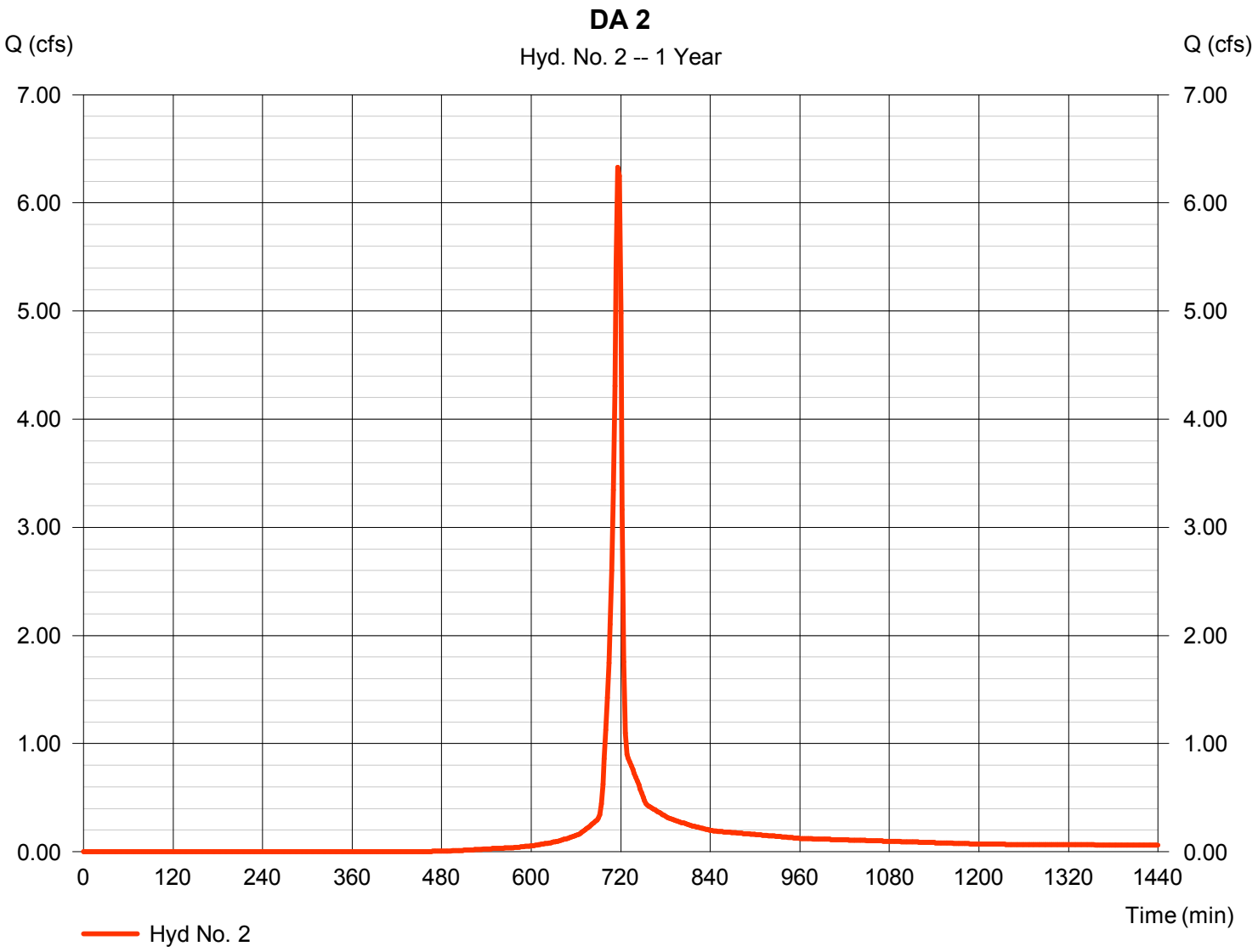
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4 Monday, 08 / 31 / 2015

Hyd. No. 2

DA 2

Hydrograph type	= SCS Runoff	Peak discharge	= 6.329 cfs
Storm frequency	= 1 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 12,841 cuft
Drainage area	= 2.410 ac	Curve number	= 87*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 2.80 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.000 x 98) + (1.070 x 80) + (0.340 x 78)] / 2.410



Hydrograph Report

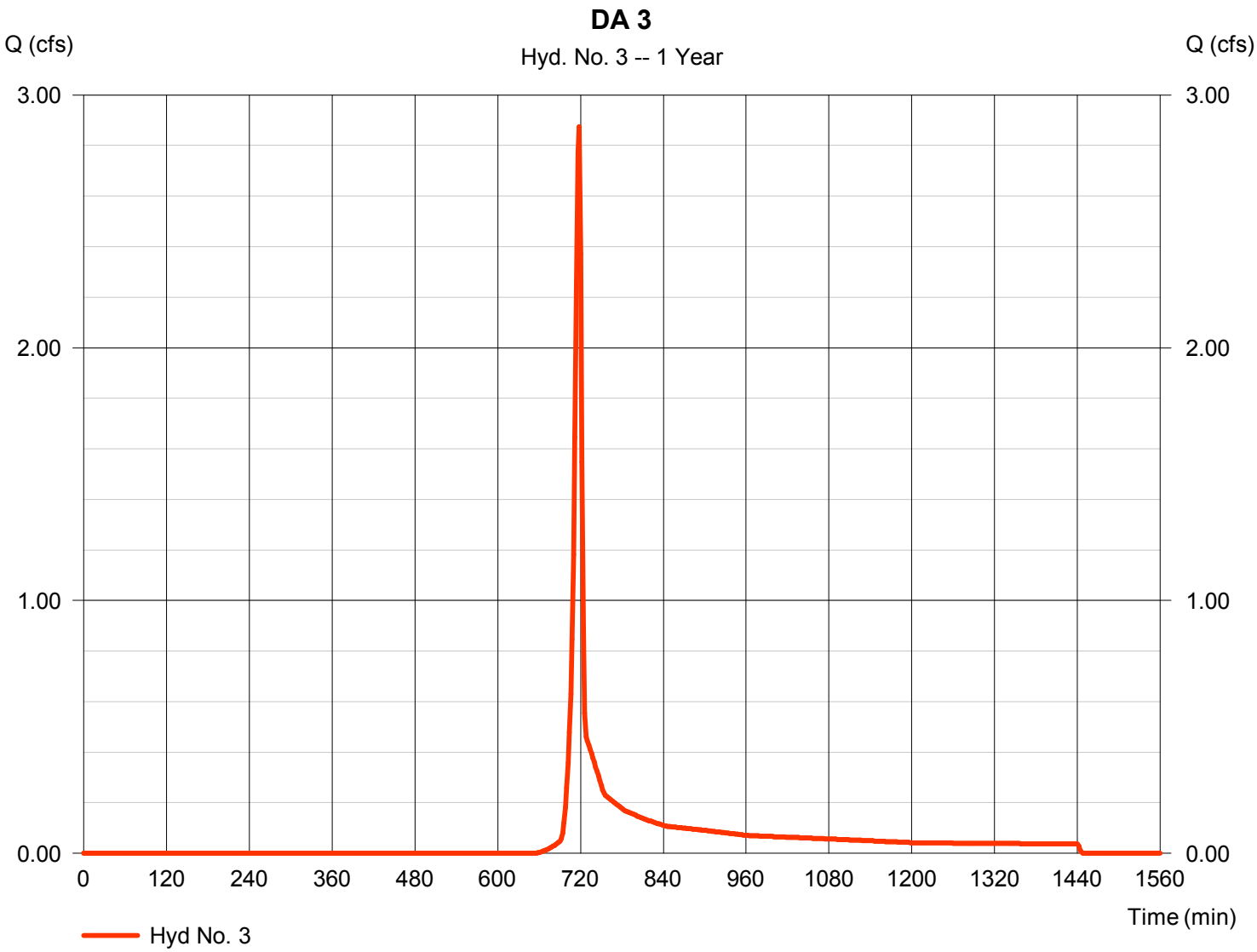
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4 Monday, 08 / 31 / 2015

Hyd. No. 3

DA 3

Hydrograph type	=	SCS Runoff	Peak discharge	=	2.874 cfs
Storm frequency	=	1 yrs	Time to peak	=	718 min
Time interval	=	2 min	Hyd. volume	=	5,768 cuft
Drainage area	=	1.920 ac	Curve number	=	76*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	5.00 min
Total precip.	=	2.80 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.170 x 98) + (1.750 x 74)] / 1.920



Hydrograph Report

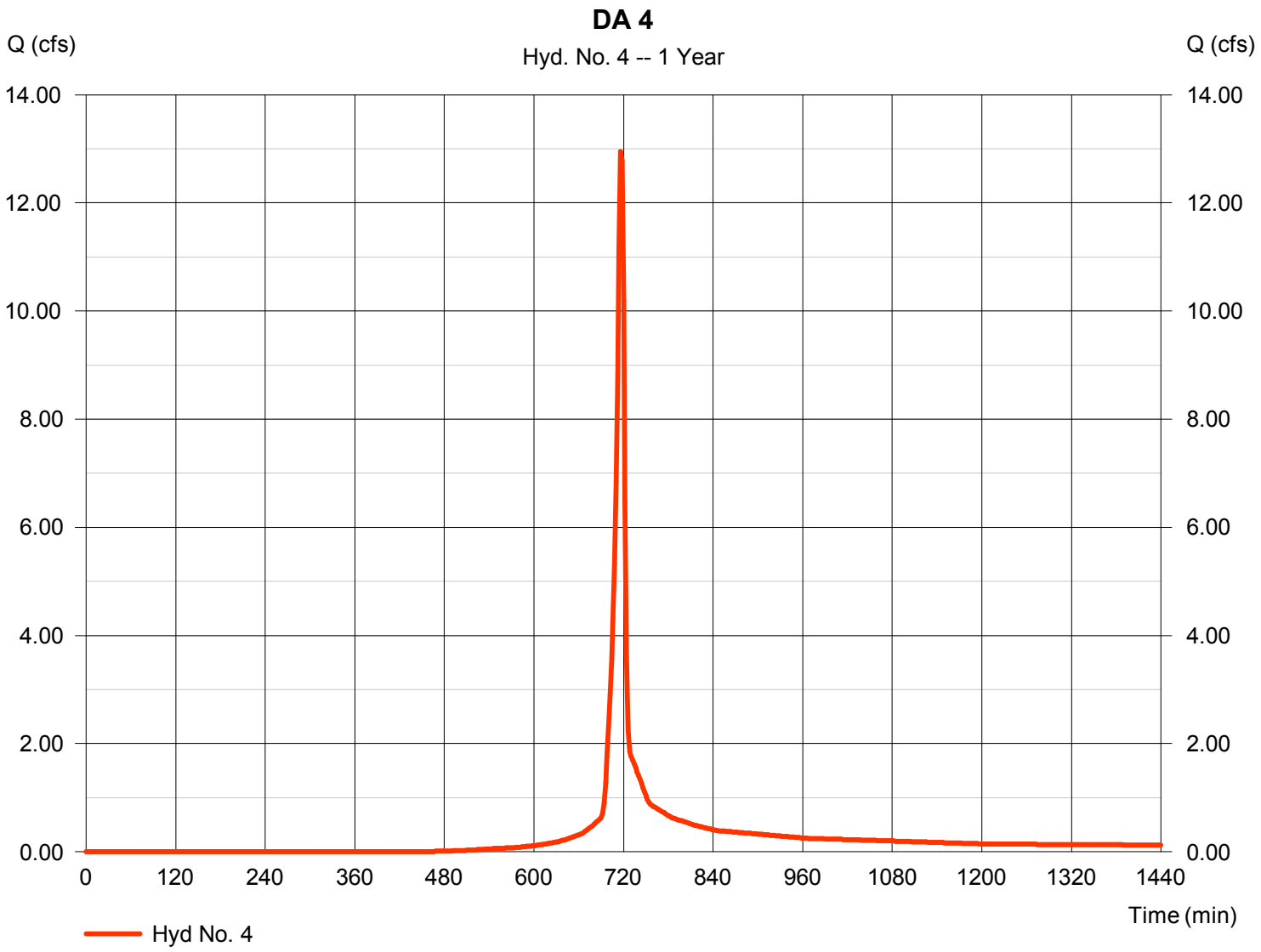
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4 Monday, 08 / 31 / 2015

Hyd. No. 4

DA 4

Hydrograph type	= SCS Runoff	Peak discharge	= 12.95 cfs
Storm frequency	= 1 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 26,269 cuft
Drainage area	= 4.930 ac	Curve number	= 87*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 2.80 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(2.620 x 98) + (2.310 x 74)] / 4.930



Hydrograph Report

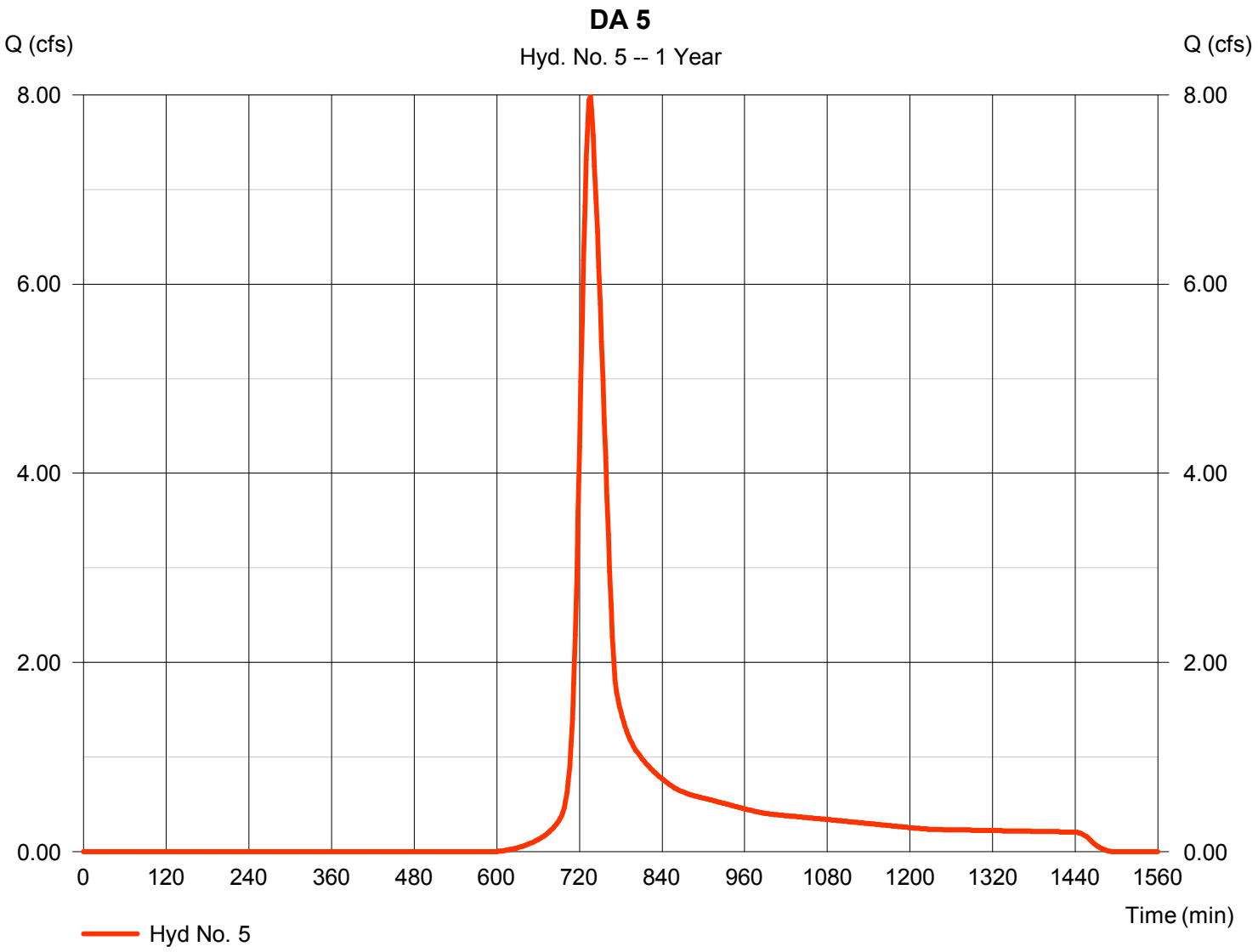
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4 Monday, 08 / 31 / 2015

Hyd. No. 5

DA 5

Hydrograph type	= SCS Runoff	Peak discharge	= 7.982 cfs
Storm frequency	= 1 yrs	Time to peak	= 736 min
Time interval	= 2 min	Hyd. volume	= 37,106 cuft
Drainage area	= 8.900 ac	Curve number	= 81*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 33.80 min
Total precip.	= 2.80 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.300 x 98) + (8.600 x 80)] / 8.900



TR55 Tc Worksheet

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

Hyd. No. 5

DA 5

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.250		0.011		0.011		
Flow length (ft)	= 215.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 3.30		0.00		0.00		
Land slope (%)	= 2.00		0.00		0.00		
Travel Time (min)	**= 26.78**	**+**	**0.00**	**+**	**0.00**	**=**	**26.78**
Shallow Concentrated Flow							
Flow length (ft)	= 1253.00		0.00		0.00		
Watercourse slope (%)	= 3.40		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=2.98		0.00		0.00		
Travel Time (min)	**= 7.02**	**+**	**0.00**	**+**	**0.00**	**=**	**7.02**
Channel Flow							
X sectional flow area (sqft)	= 0.00		0.00		0.00		
Wetted perimeter (ft)	= 0.00		0.00		0.00		
Channel slope (%)	= 0.00		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	=0.00						
			0.00				
					0.00		
Flow length (ft)	({0})0.0		0.0		0.0		
Travel Time (min)	**= 0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**

Total Travel Time, Tc ..... 33.80 min

Hydrograph Report

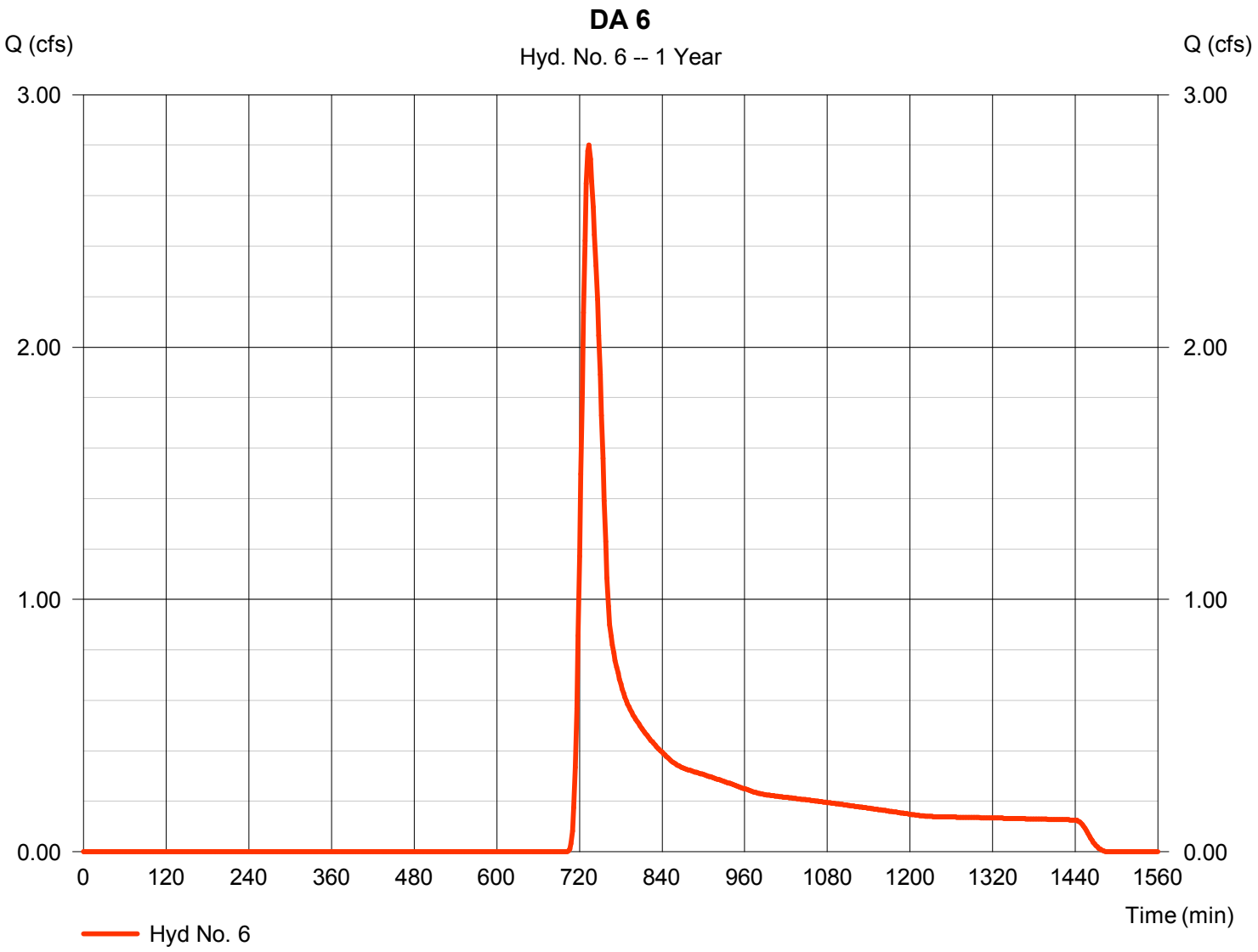
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4 Monday, 08 / 31 / 2015

Hyd. No. 6

DA 6

Hydrograph type	= SCS Runoff	Peak discharge	= 2.800 cfs
Storm frequency	= 1 yrs	Time to peak	= 734 min
Time interval	= 2 min	Hyd. volume	= 15,256 cuft
Drainage area	= 8.600 ac	Curve number	= 67*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 29.30 min
Total precip.	= 2.80 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.800 x 98) + (4.800 x 61) + (2.000 x 55)] / 8.600



TR55 Tc Worksheet

Hyd. No. 6

DA 6

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.250		0.011		0.011		
Flow length (ft)	= 224.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 3.30		0.00		0.00		
Land slope (%)	= 2.00		0.00		0.00		
Travel Time (min)	**= 27.68**	**+**	**0.00**	**+**	**0.00**	**=**	**27.68**
Shallow Concentrated Flow							
Flow length (ft)	= 551.00		0.00		0.00		
Watercourse slope (%)	= 11.60		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=5.50		0.00		0.00		
Travel Time (min)	**= 1.67**	**+**	**0.00**	**+**	**0.00**	**=**	**1.67**
Channel Flow							
X sectional flow area (sqft)	= 0.00		0.00		0.00		
Wetted perimeter (ft)	= 0.00		0.00		0.00		
Channel slope (%)	= 0.00		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	=0.00						
			0.00				
					0.00		
Flow length (ft)	({0})0.0		0.0		0.0		
Travel Time (min)	**= 0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**

Total Travel Time, Tc ..... 29.30 min

Hydrograph Report

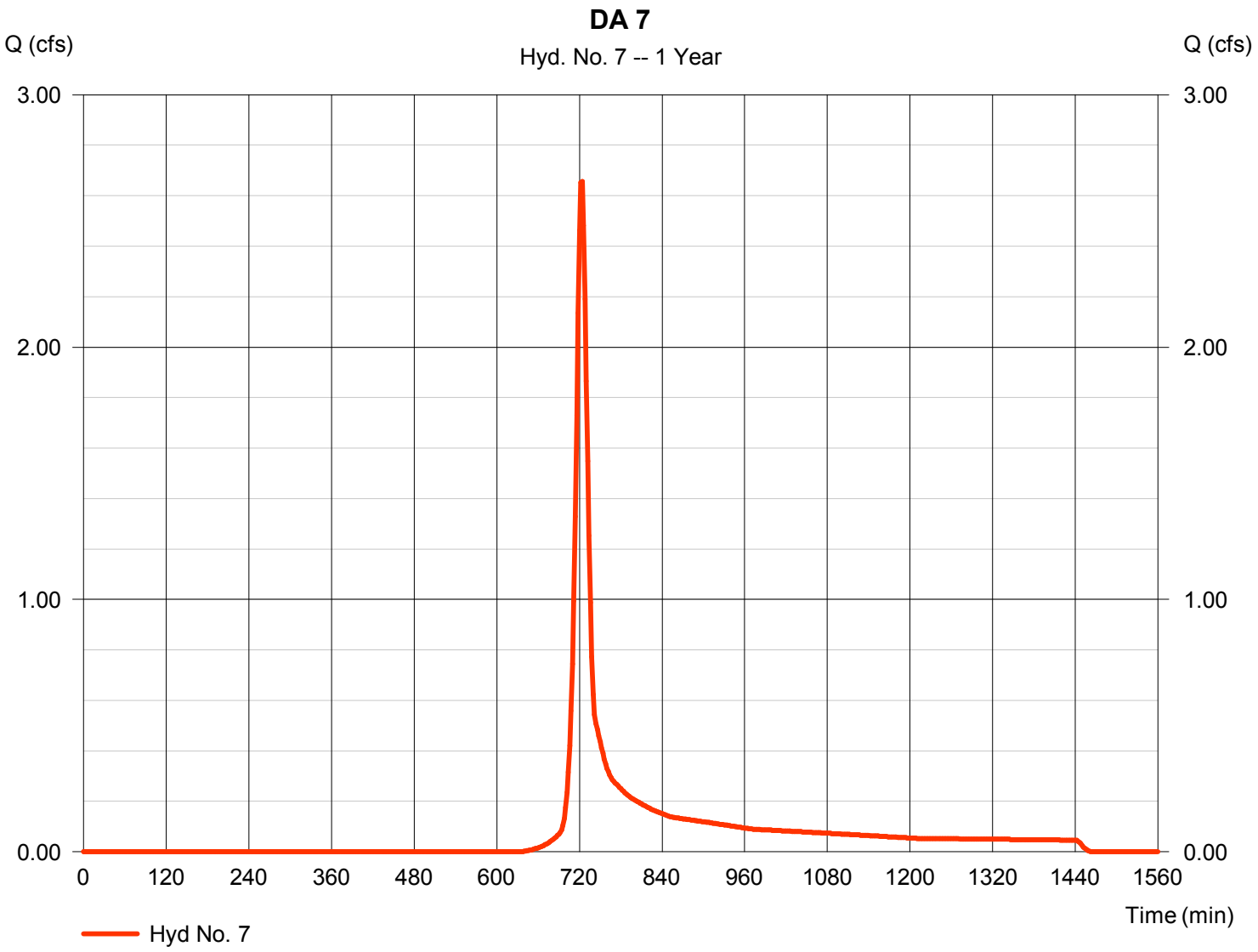
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4 Monday, 08 / 31 / 2015

Hyd. No. 7

DA 7

Hydrograph type	= SCS Runoff	Peak discharge	= 2.657 cfs
Storm frequency	= 1 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 7,698 cuft
Drainage area	= 2.200 ac	Curve number	= 78*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 15.80 min
Total precip.	= 2.80 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.400 x 98) + (1.750 x 74) + (0.050 x 70)] / 2.200



TR55 Tc Worksheet

Hyd. No. 7

DA 7

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.240		0.011		0.011		
Flow length (ft)	= 250.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 3.30		0.00		0.00		
Land slope (%)	= 11.00		0.00		0.00		
Travel Time (min)	**= 14.79**	**+**	**0.00**	**+**	**0.00**	**=**	**14.79**
Shallow Concentrated Flow							
Flow length (ft)	= 313.00		0.00		0.00		
Watercourse slope (%)	= 10.20		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=5.15		0.00		0.00		
Travel Time (min)	**= 1.01**	**+**	**0.00**	**+**	**0.00**	**=**	**1.01**
Channel Flow							
X sectional flow area (sqft)	= 0.00		0.00		0.00		
Wetted perimeter (ft)	= 0.00		0.00		0.00		
Channel slope (%)	= 0.00		0.00		0.00		
Manning's n-value	= 0.030		0.015		0.015		
Velocity (ft/s)	=0.00						
			0.00				
					0.00		
Flow length (ft)	({0})0.0		0.0		0.0		
Travel Time (min)	**= 0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**

Total Travel Time, Tc ..... 15.80 min

Hydrograph Report

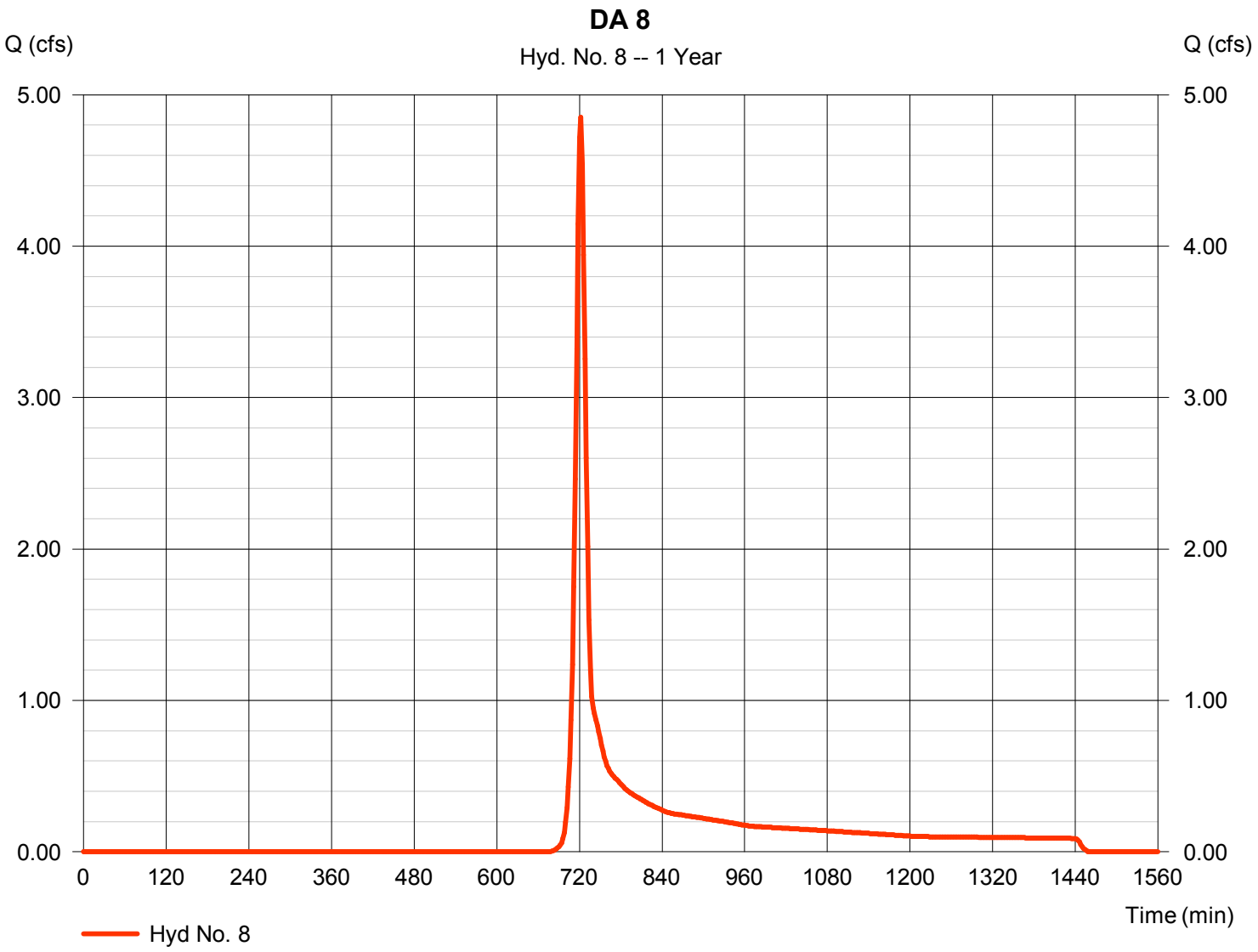
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4 Monday, 08 / 31 / 2015

Hyd. No. 8

DA 8

Hydrograph type	= SCS Runoff	Peak discharge	= 4.851 cfs
Storm frequency	= 1 yrs	Time to peak	= 722 min
Time interval	= 2 min	Hyd. volume	= 13,265 cuft
Drainage area	= 4.520 ac	Curve number	= 74*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 11.30 min
Total precip.	= 2.80 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.340 x 98) + (2.620 x 74) + (1.560 x 70)] / 4.520



TR55 Tc Worksheet

Hyd. No. 8

DA 8

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.240		0.011		0.011		
Flow length (ft)	= 130.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 3.30		3.30		0.00		
Land slope (%)	= 9.20		0.00		0.00		
Travel Time (min)	**= 9.41**	**+**	**0.00**	**+**	**0.00**	**=**	**9.41**
Shallow Concentrated Flow							
Flow length (ft)	= 400.00		0.00		0.00		
Watercourse slope (%)	= 13.00		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=5.82		0.00		0.00		
Travel Time (min)	**= 1.15**	**+**	**0.00**	**+**	**0.00**	**=**	**1.15**
Channel Flow							
X sectional flow area (sqft)	= 11.00		0.00		0.00		
Wetted perimeter (ft)	= 8.00		0.00		0.00		
Channel slope (%)	= 3.00		0.00		0.00		
Manning's n-value	= 0.030		0.015		0.015		
Velocity (ft/s)	=10.65						
			0.00				
					0.00		
Flow length (ft)	({0})455.0		0.0		0.0		
Travel Time (min)	**= 0.71**	**+**	**0.00**	**+**	**0.00**	**=**	**0.71**

Total Travel Time, Tc ..... 11.30 min

Hydrograph Report

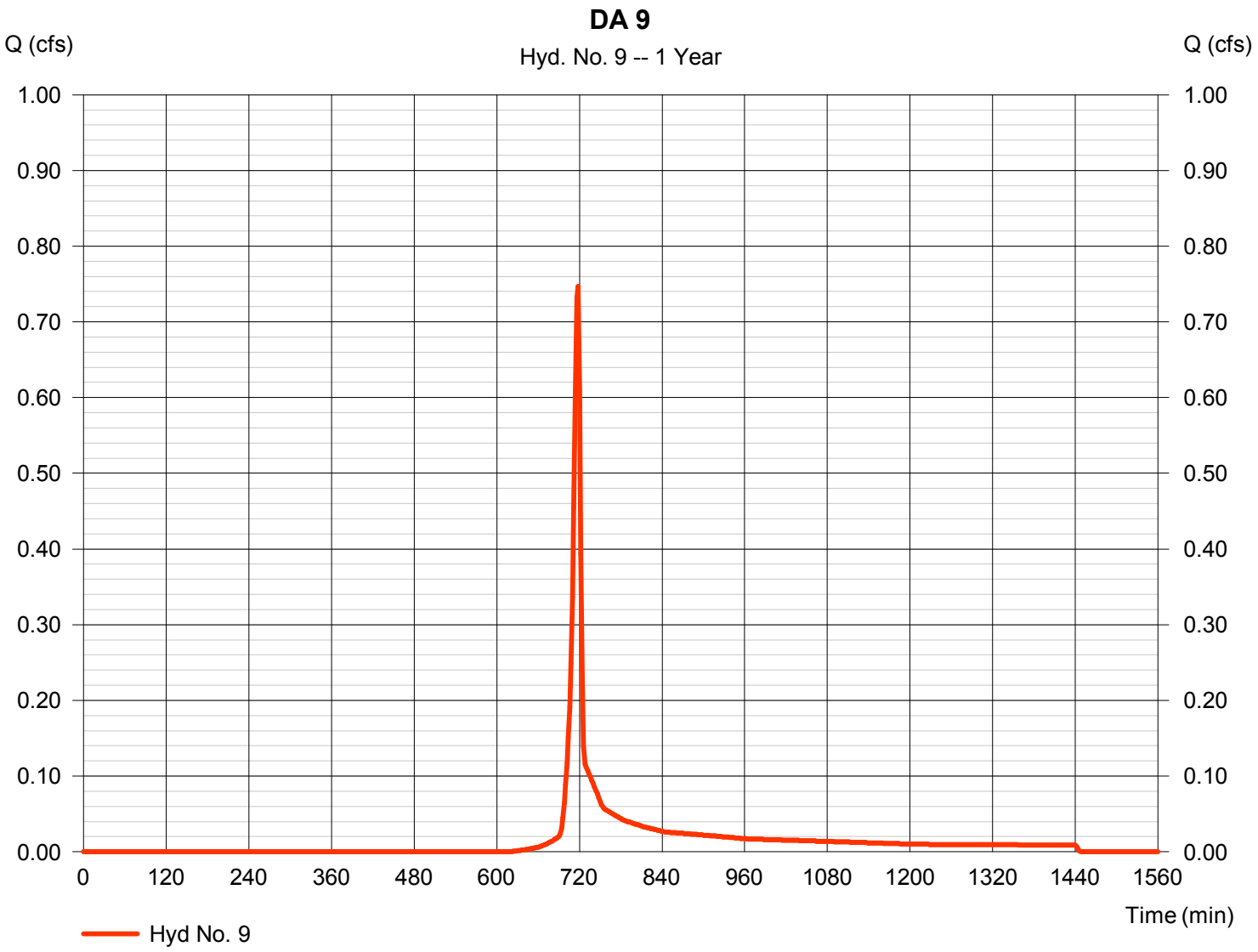
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4 Monday, 08 / 31 / 2015

Hyd. No. 9

DA 9

Hydrograph type	= SCS Runoff	Peak discharge	= 0.747 cfs
Storm frequency	= 1 yrs	Time to peak	= 718 min
Time interval	= 2 min	Hyd. volume	= 1,493 cuft
Drainage area	= 0.420 ac	Curve number	= 79*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 2.80 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.090 x 98) + (0.330 x 74)] / 0.420



Hydrograph Report

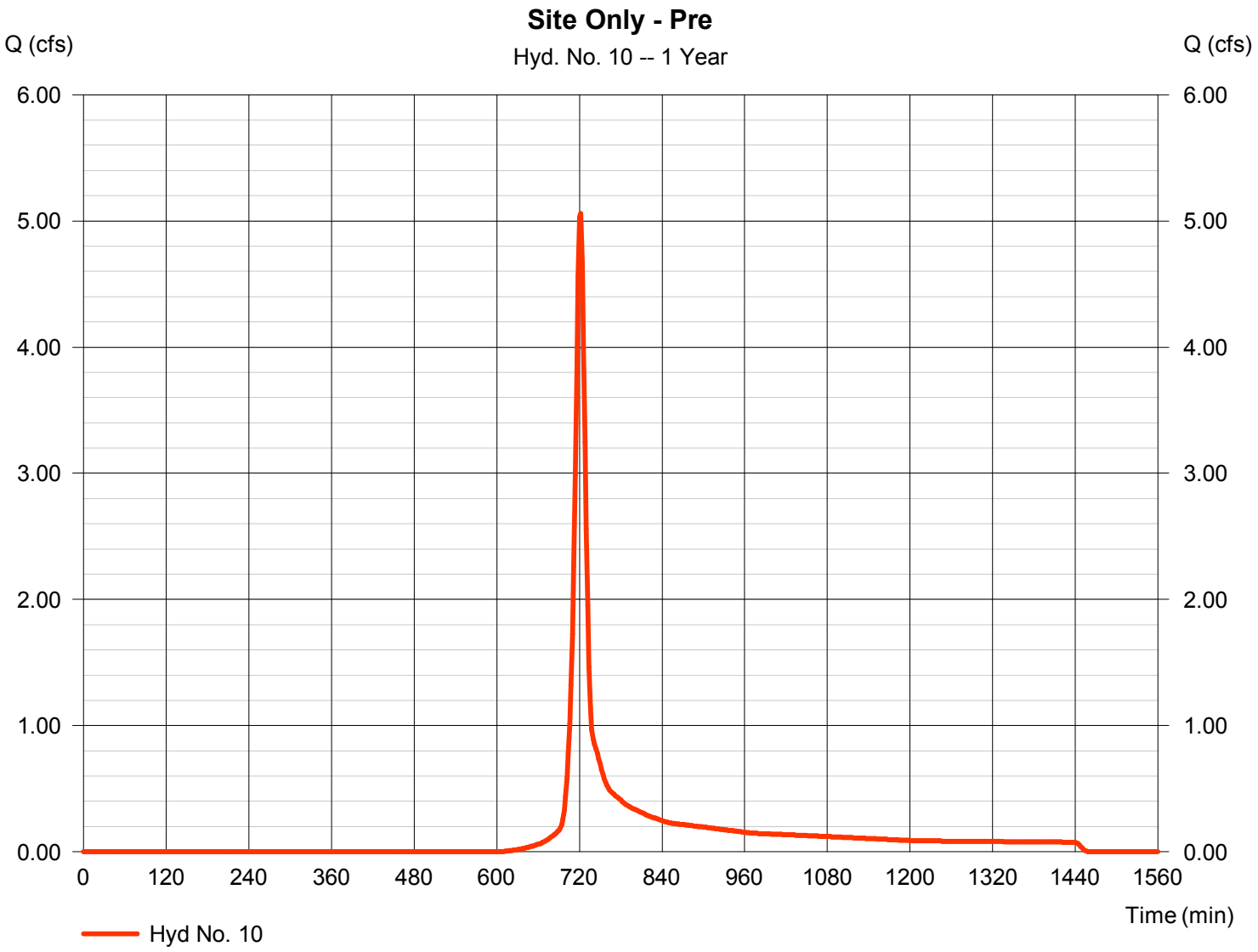
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4 Monday, 08 / 31 / 2015

Hyd. No. 10

Site Only - Pre

Hydrograph type	= SCS Runoff	Peak discharge	= 5.059 cfs
Storm frequency	= 1 yrs	Time to peak	= 722 min
Time interval	= 2 min	Hyd. volume	= 13,284 cuft
Drainage area	= 3.220 ac	Curve number	= 80*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 10.00 min
Total precip.	= 2.80 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(2.820 x 80) + (0.400 x 77)] / 3.220



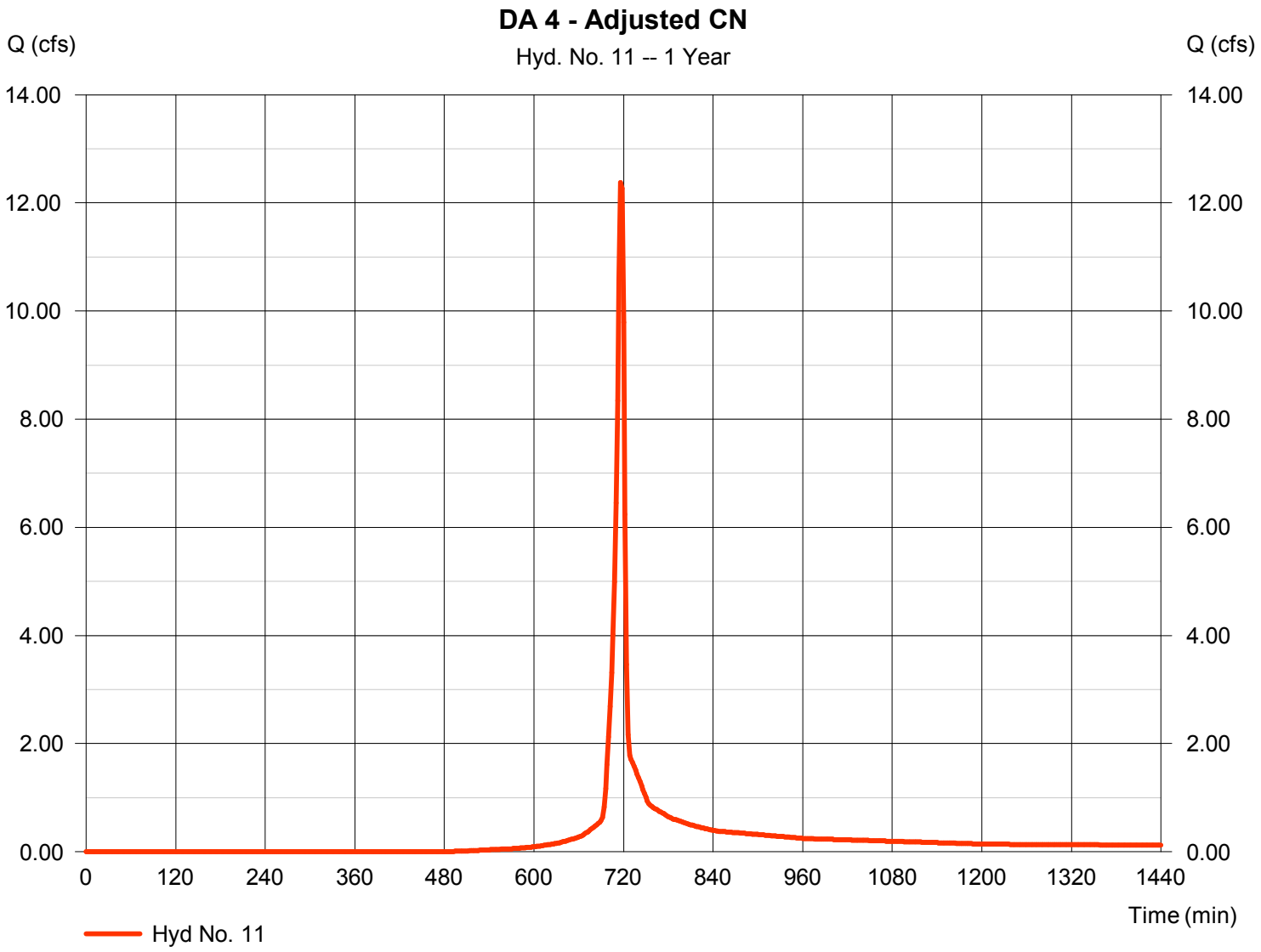
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4 Monday, 08 / 31 / 2015

Hyd. No. 11

DA 4 - Adjusted CN

Hydrograph type	= SCS Runoff	Peak discharge	= 12.37 cfs
Storm frequency	= 1 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 25,040 cuft
Drainage area	= 4.930 ac	Curve number	= 86
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 2.80 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



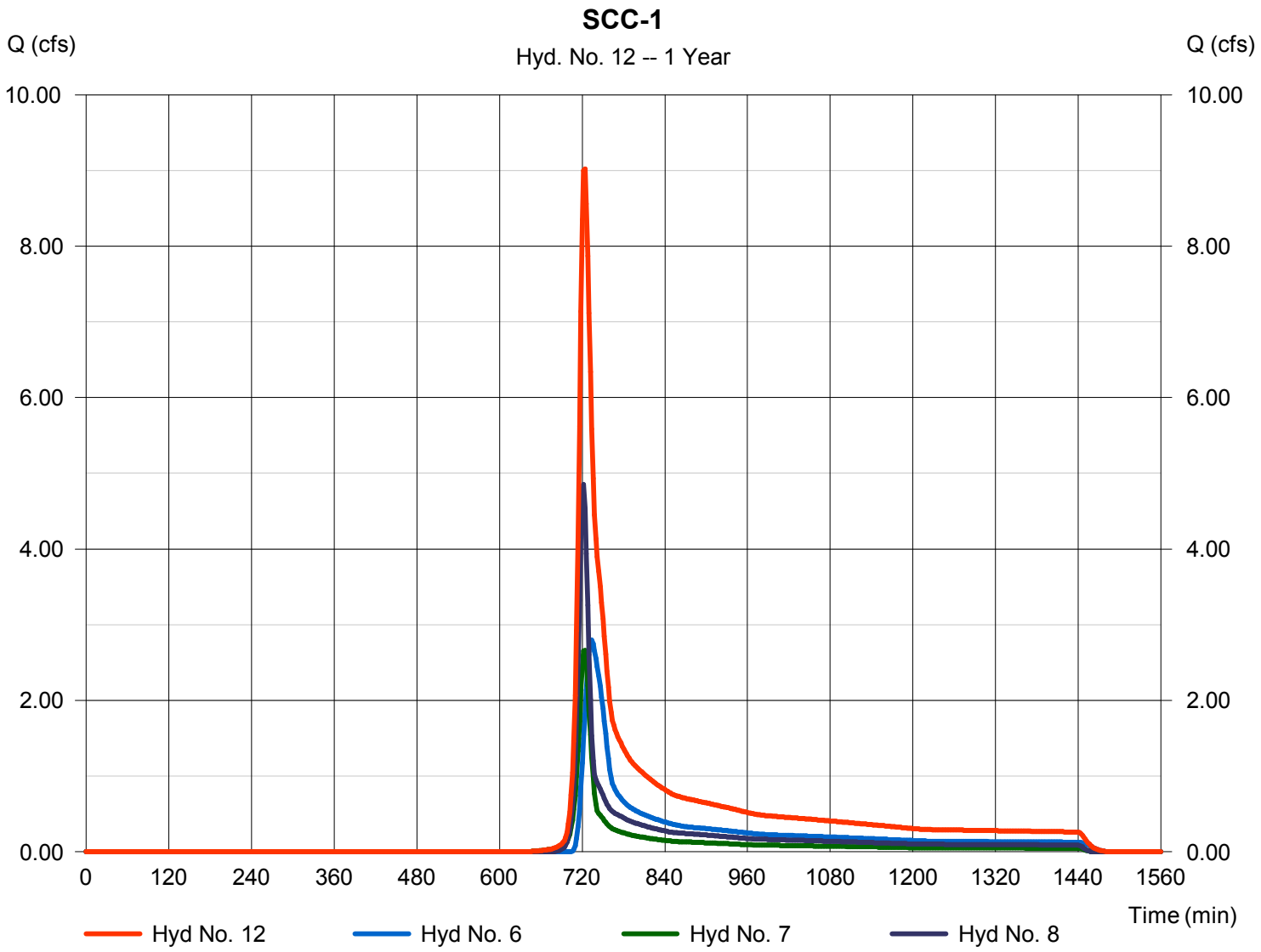
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4 Monday, 08 / 31 / 2015

Hyd. No. 12

SCC-1

Hydrograph type	= Combine	Peak discharge	= 9.018 cfs
Storm frequency	= 1 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 36,219 cuft
Inflow hyds.	= 6, 7, 8	Contrib. drain. area	= 15.320 ac



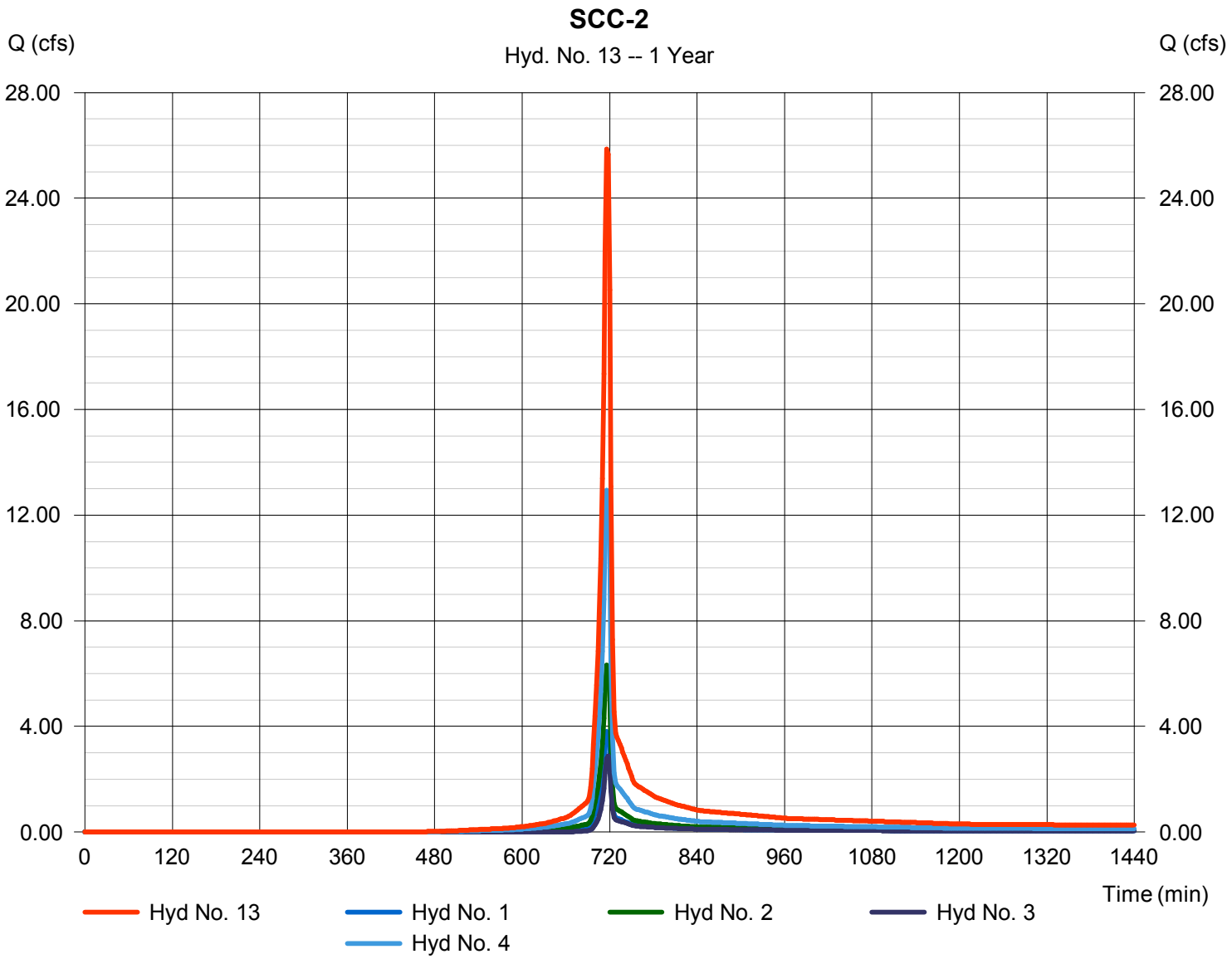
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4 Monday, 08 / 31 / 2015

Hyd. No. 13

SCC-2

Hydrograph type	= Combine	Peak discharge	= 25.86 cfs
Storm frequency	= 1 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 52,605 cuft
Inflow hyds.	= 1, 2, 3, 4	Contrib. drain. area	= 10.710 ac



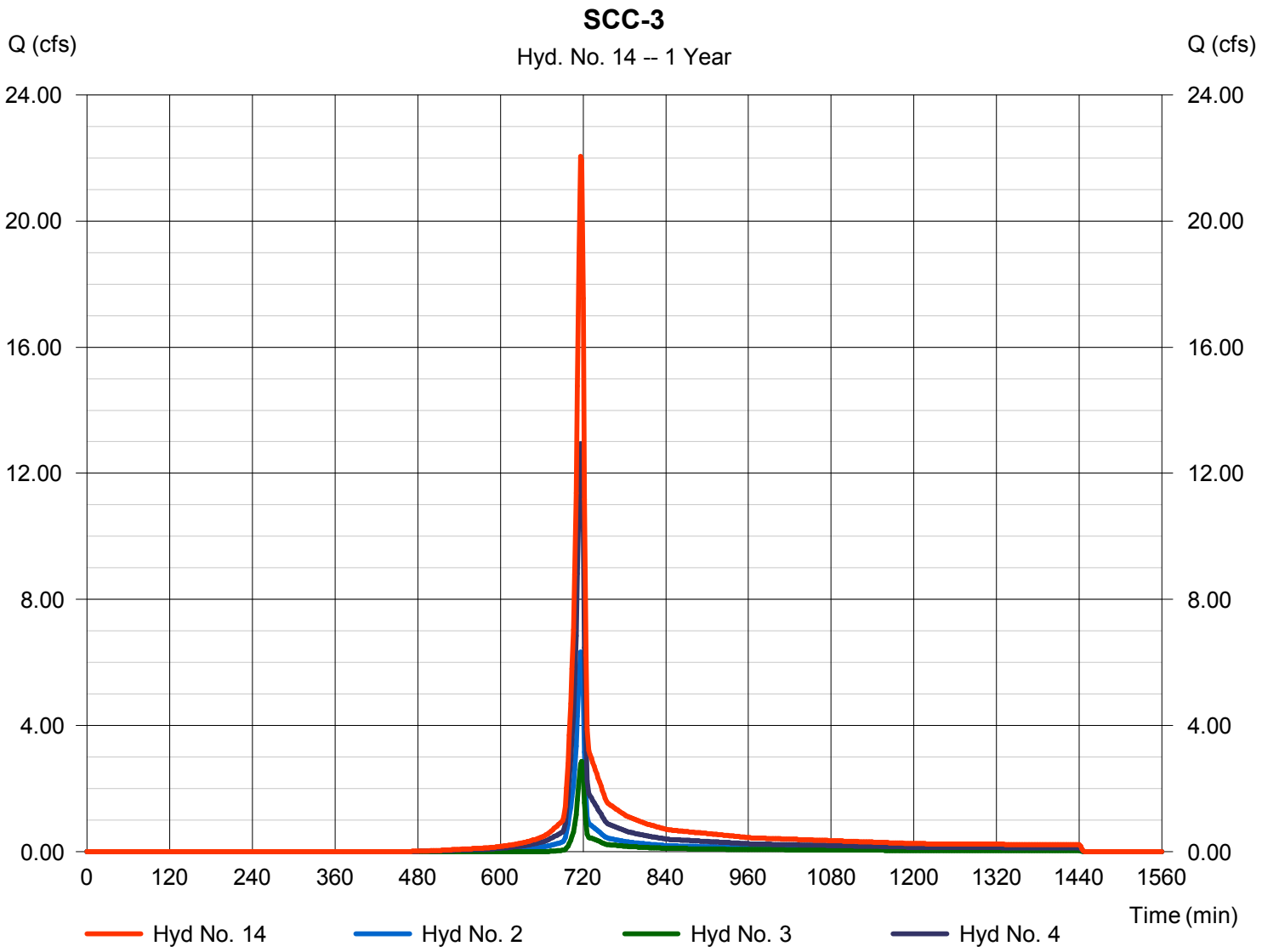
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4 Monday, 08 / 31 / 2015

Hyd. No. 14

SCC-3

Hydrograph type	= Combine	Peak discharge	= 22.05 cfs
Storm frequency	= 1 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 44,879 cuft
Inflow hyds.	= 2, 3, 4	Contrib. drain. area	= 9.260 ac



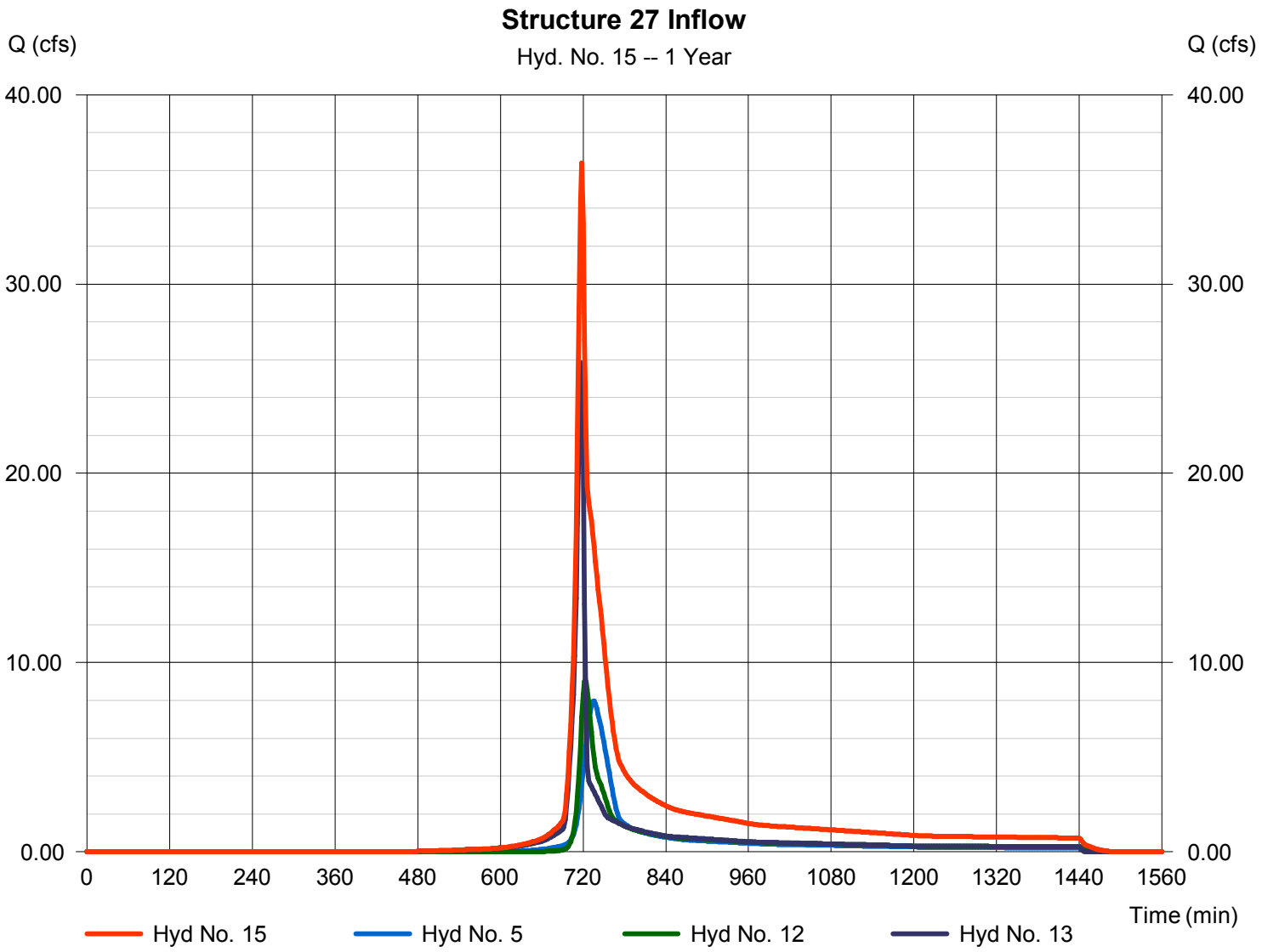
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4 Monday, 08 / 31 / 2015

Hyd. No. 15

Structure 27 Inflow

Hydrograph type	= Combine	Peak discharge	= 36.39 cfs
Storm frequency	= 1 yrs	Time to peak	= 718 min
Time interval	= 2 min	Hyd. volume	= 125,930 cuft
Inflow hyds.	= 5, 12, 13	Contrib. drain. area	= 8.900 ac



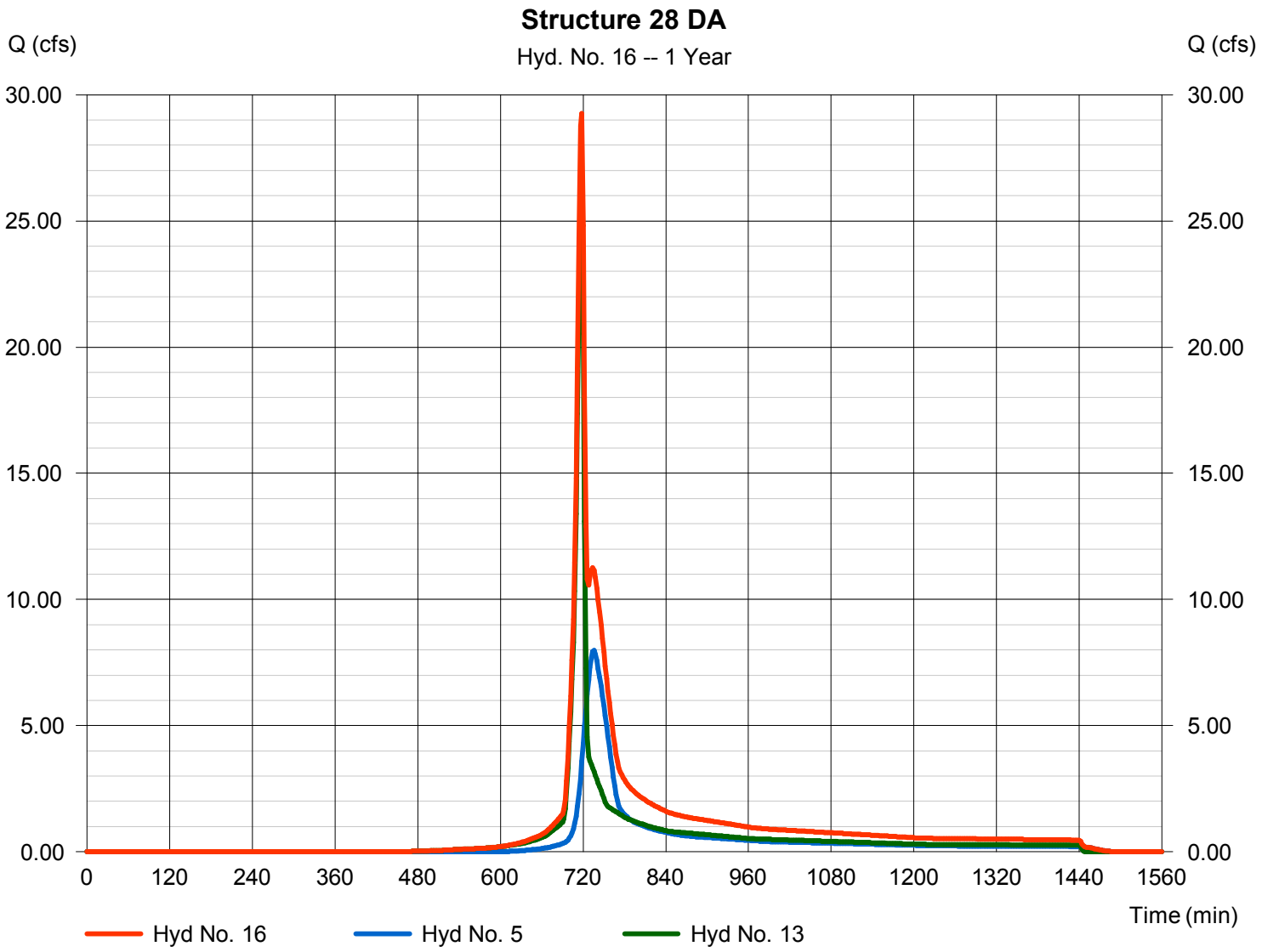
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4 Monday, 08 / 31 / 2015

Hyd. No. 16

Structure 28 DA

Hydrograph type	= Combine	Peak discharge	= 29.25 cfs
Storm frequency	= 1 yrs	Time to peak	= 718 min
Time interval	= 2 min	Hyd. volume	= 89,711 cuft
Inflow hyds.	= 5, 13	Contrib. drain. area	= 8.900 ac



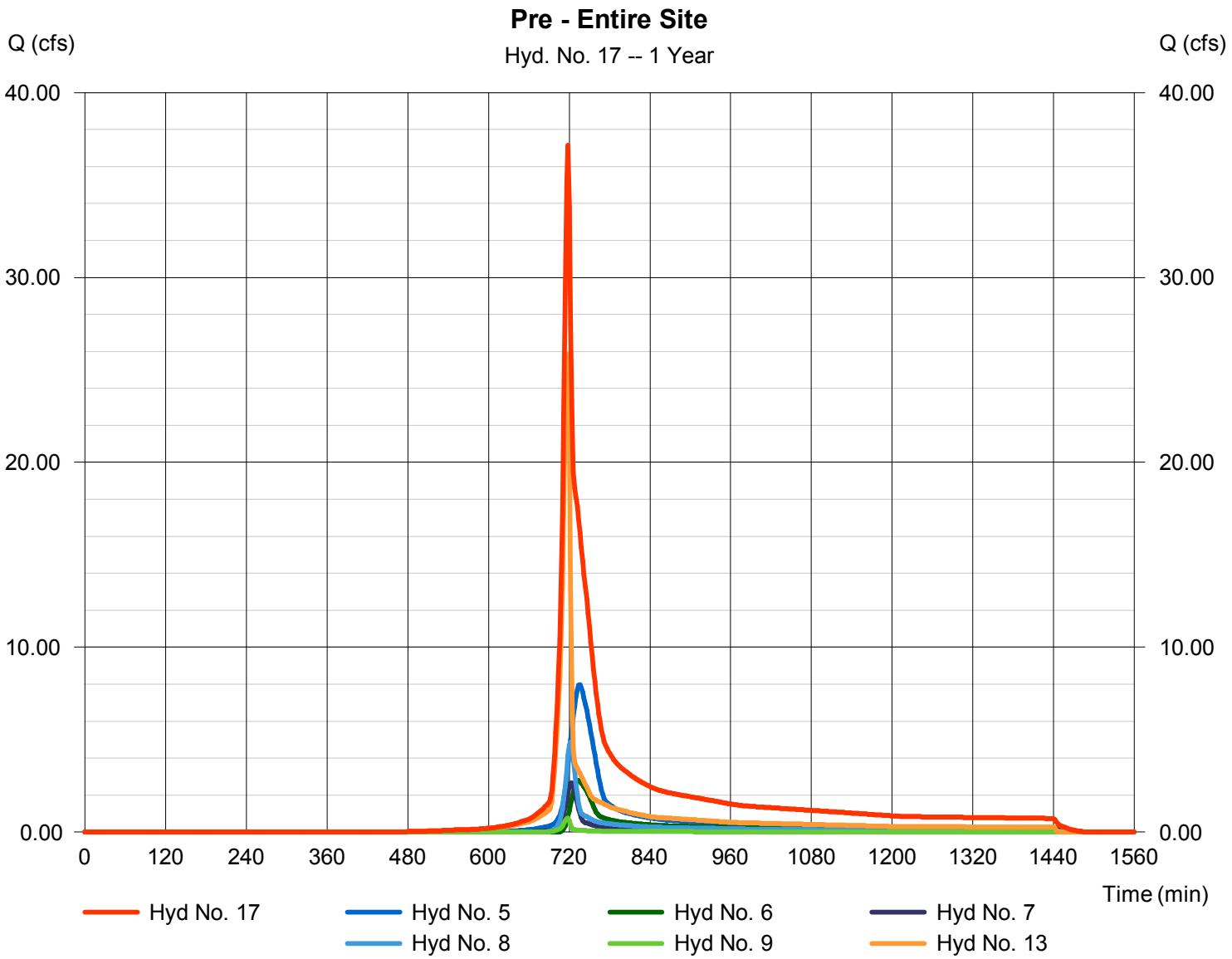
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4 Monday, 08 / 31 / 2015

Hyd. No. 17

Pre - Entire Site

Hydrograph type	= Combine	Peak discharge	= 37.14 cfs
Storm frequency	= 1 yrs	Time to peak	= 718 min
Time interval	= 2 min	Hyd. volume	= 127,422 cuft
Inflow hyds.	= 5, 6, 7, 8, 9, 13	Contrib. drain. area	= 24.640 ac



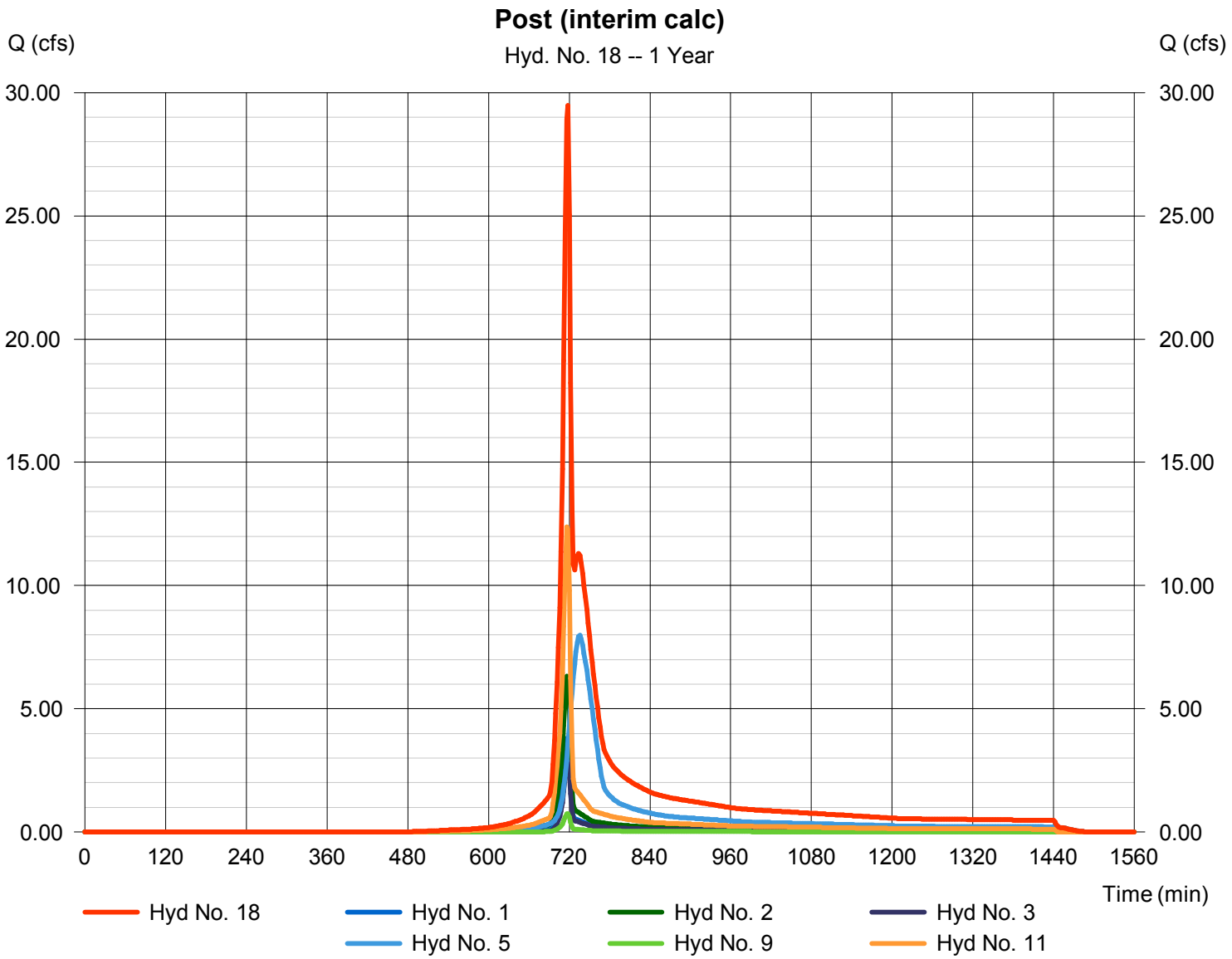
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4 Monday, 08 / 31 / 2015

Hyd. No. 18

Post (interim calc)

Hydrograph type	= Combine	Peak discharge	= 29.48 cfs
Storm frequency	= 1 yrs	Time to peak	= 718 min
Time interval	= 2 min	Hyd. volume	= 89,975 cuft
Inflow hyds.	= 1, 2, 3, 5, 9, 11	Contrib. drain. area	= 20.030 ac



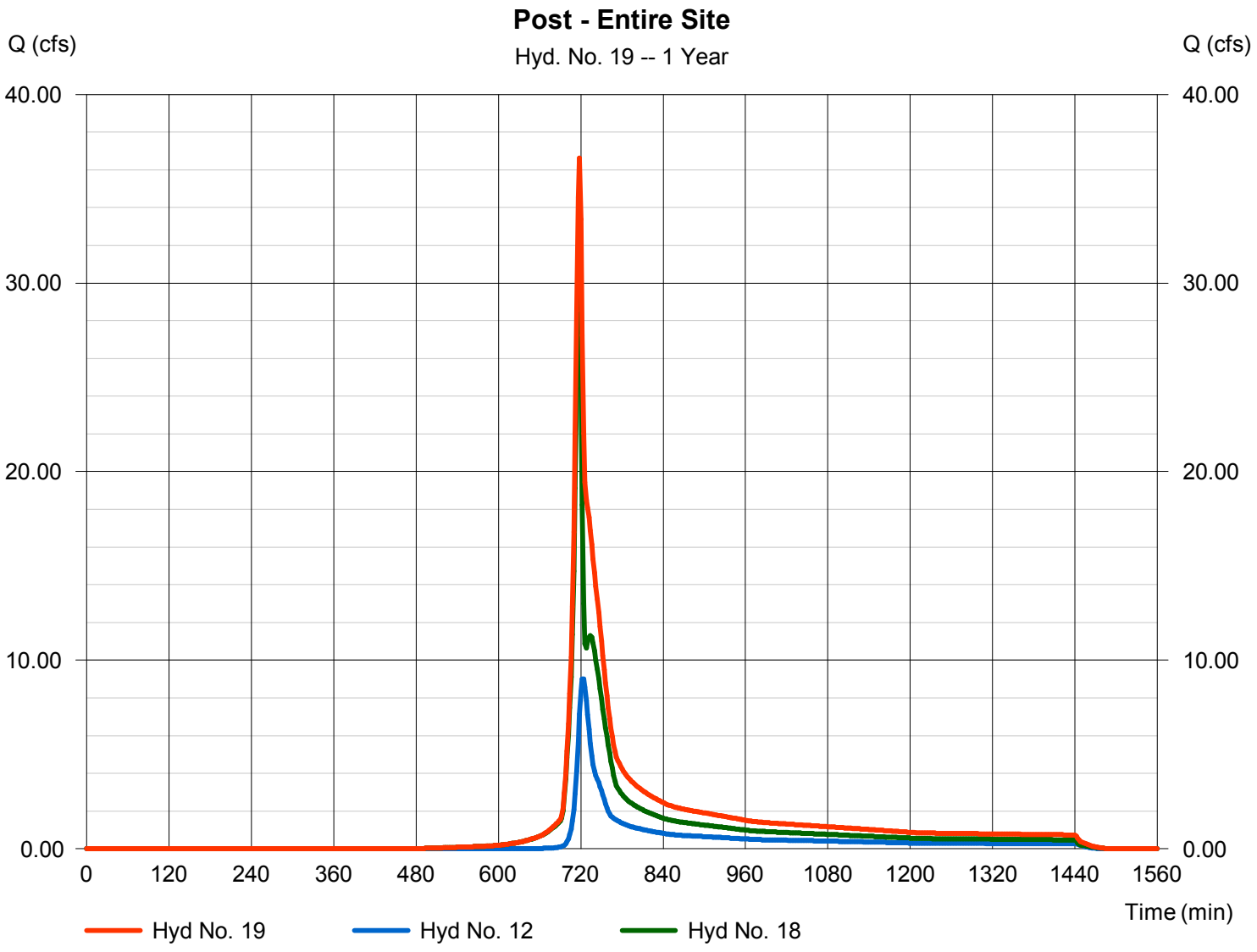
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4 Monday, 08 / 31 / 2015

Hyd. No. 19

Post - Entire Site

Hydrograph type	= Combine	Peak discharge	= 36.61 cfs
Storm frequency	= 1 yrs	Time to peak	= 718 min
Time interval	= 2 min	Hyd. volume	= 126,194 cuft
Inflow hyds.	= 12, 18	Contrib. drain. area	= 0.000 ac



Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

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	8.392	2	716	17,603	------	------	------	DA 1
2	SCS Runoff	13.95	2	716	29,257	------	------	------	DA 2
3	SCS Runoff	8.200	2	716	16,567	------	------	------	DA 3
4	SCS Runoff	28.53	2	716	59,850	------	------	------	DA 4
5	SCS Runoff	21.05	2	734	95,351	------	------	------	DA 5
6	SCS Runoff	13.47	2	732	56,287	------	------	------	DA 6
7	SCS Runoff	7.533	2	722	21,114	------	------	------	DA 7
8	SCS Runoff	15.39	2	720	40,004	------	------	------	DA 8
9	SCS Runoff	1.973	2	716	4,004	------	------	------	DA 9
10	SCS Runoff	13.43	2	720	34,870	------	------	------	Site Only - Pre
11	SCS Runoff	27.90	2	716	58,167	------	------	------	DA 4 - Adjusted CN
12	Combine	32.45	2	722	117,405	6, 7, 8,	------	------	SCC-1
13	Combine	59.07	2	716	123,277	1, 2, 3, 4,	------	------	SCC-2
14	Combine	50.68	2	716	105,674	2, 3, 4,	------	------	SCC-3
15	Combine	95.66	2	718	336,033	5, 12, 13,	------	------	Structure 27 Inflow
16	Combine	68.25	2	718	218,628	5, 13,	------	------	Structure 28 DA
17	Combine	97.61	2	718	340,038	5, 6, 7, 8, 9, 13,	------	------	Pre - Entire Site
18	Combine	69.64	2	718	220,950	1, 2, 3, 5, 9, 11,	------	------	Post (interim calc)
19	Combine	97.05	2	718	338,355	12, 18	------	------	Post - Entire Site

Hydrograph Report

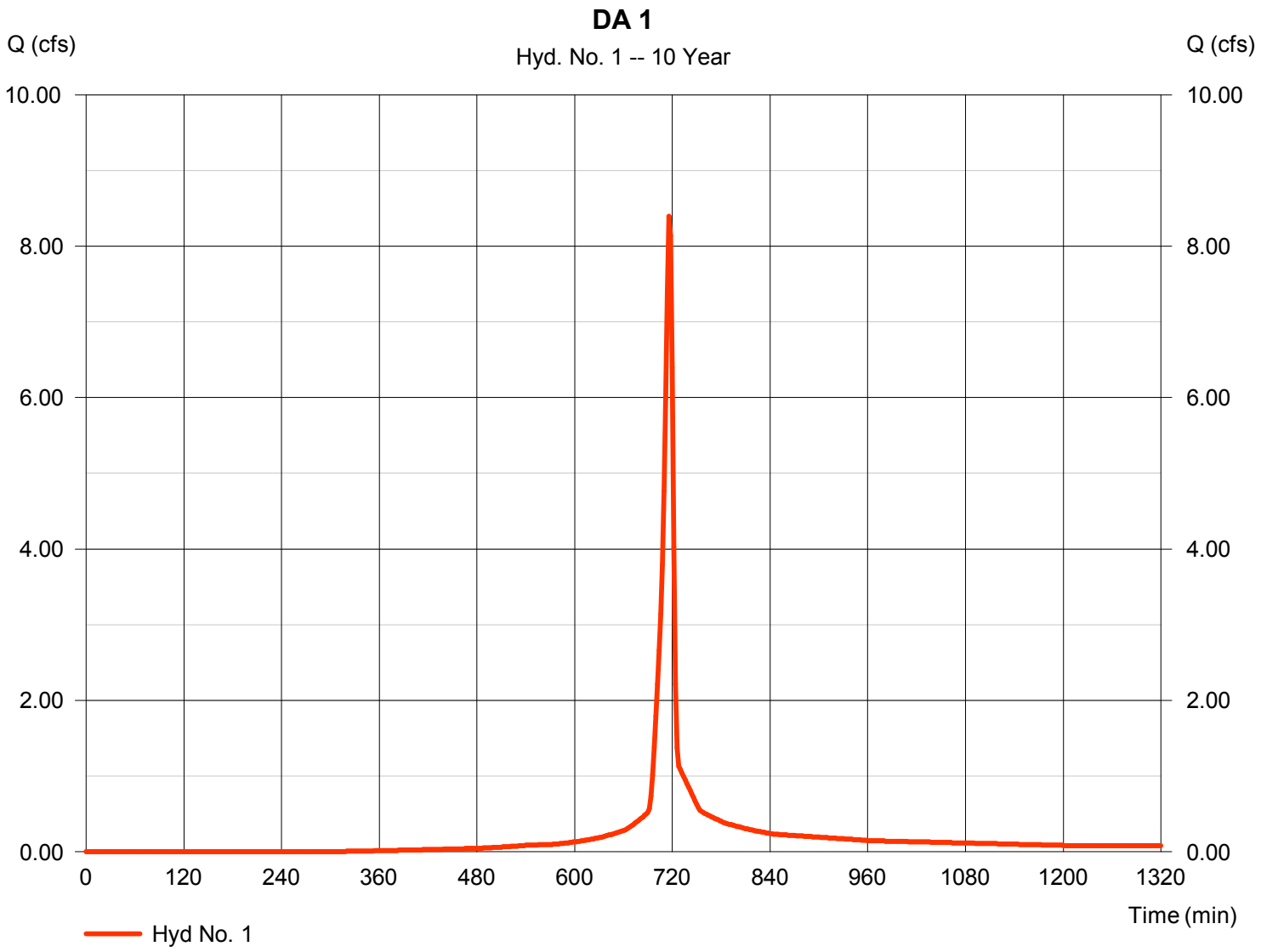
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4 Monday, 08 / 31 / 2015

Hyd. No. 1

DA 1

Hydrograph type	= SCS Runoff	Peak discharge	= 8.392 cfs
Storm frequency	= 10 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 17,603 cuft
Drainage area	= 1.450 ac	Curve number	= 87*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 5.00 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.600 x 98) + (0.620 x 80) + (0.230 x 77)] / 1.450



Hydrograph Report

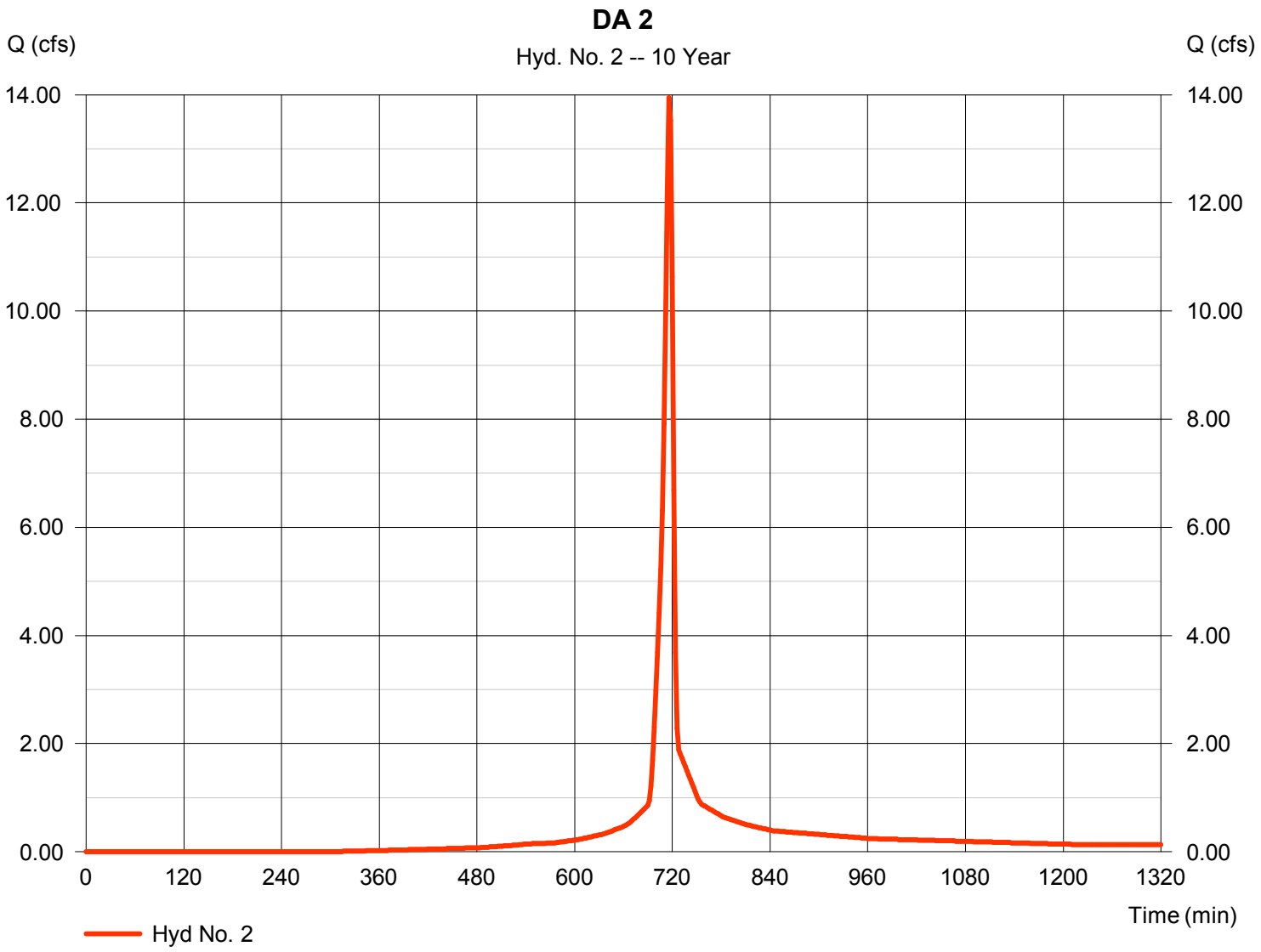
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4 Monday, 08 / 31 / 2015

Hyd. No. 2

DA 2

Hydrograph type	= SCS Runoff	Peak discharge	= 13.95 cfs
Storm frequency	= 10 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 29,257 cuft
Drainage area	= 2.410 ac	Curve number	= 87*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 5.00 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.000 x 98) + (1.070 x 80) + (0.340 x 78)] / 2.410



Hydrograph Report

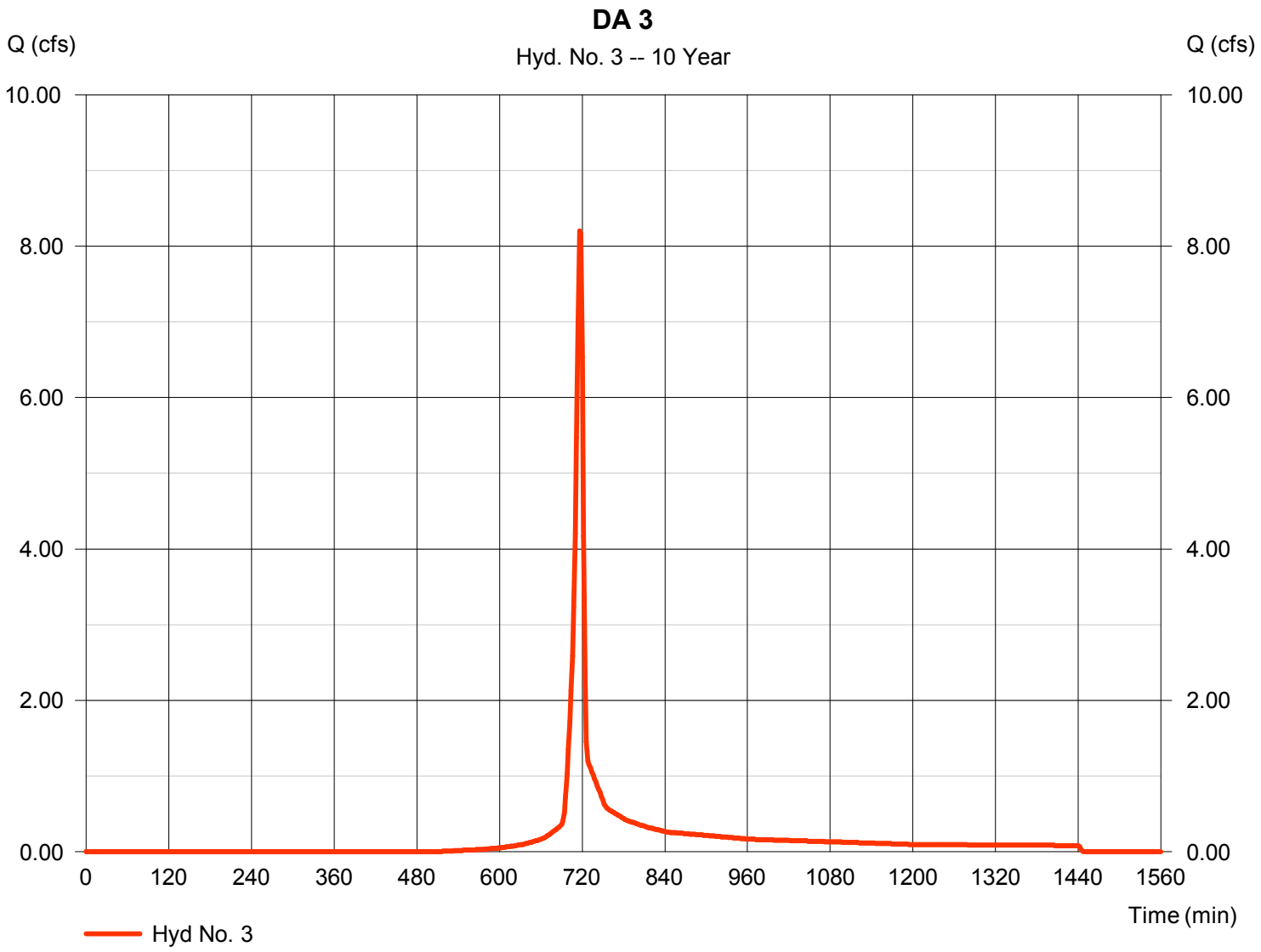
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4 Monday, 08 / 31 / 2015

Hyd. No. 3

DA 3

Hydrograph type	= SCS Runoff	Peak discharge	= 8.200 cfs
Storm frequency	= 10 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 16,567 cuft
Drainage area	= 1.920 ac	Curve number	= 76*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 5.00 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.170 x 98) + (1.750 x 74)] / 1.920



Hydrograph Report

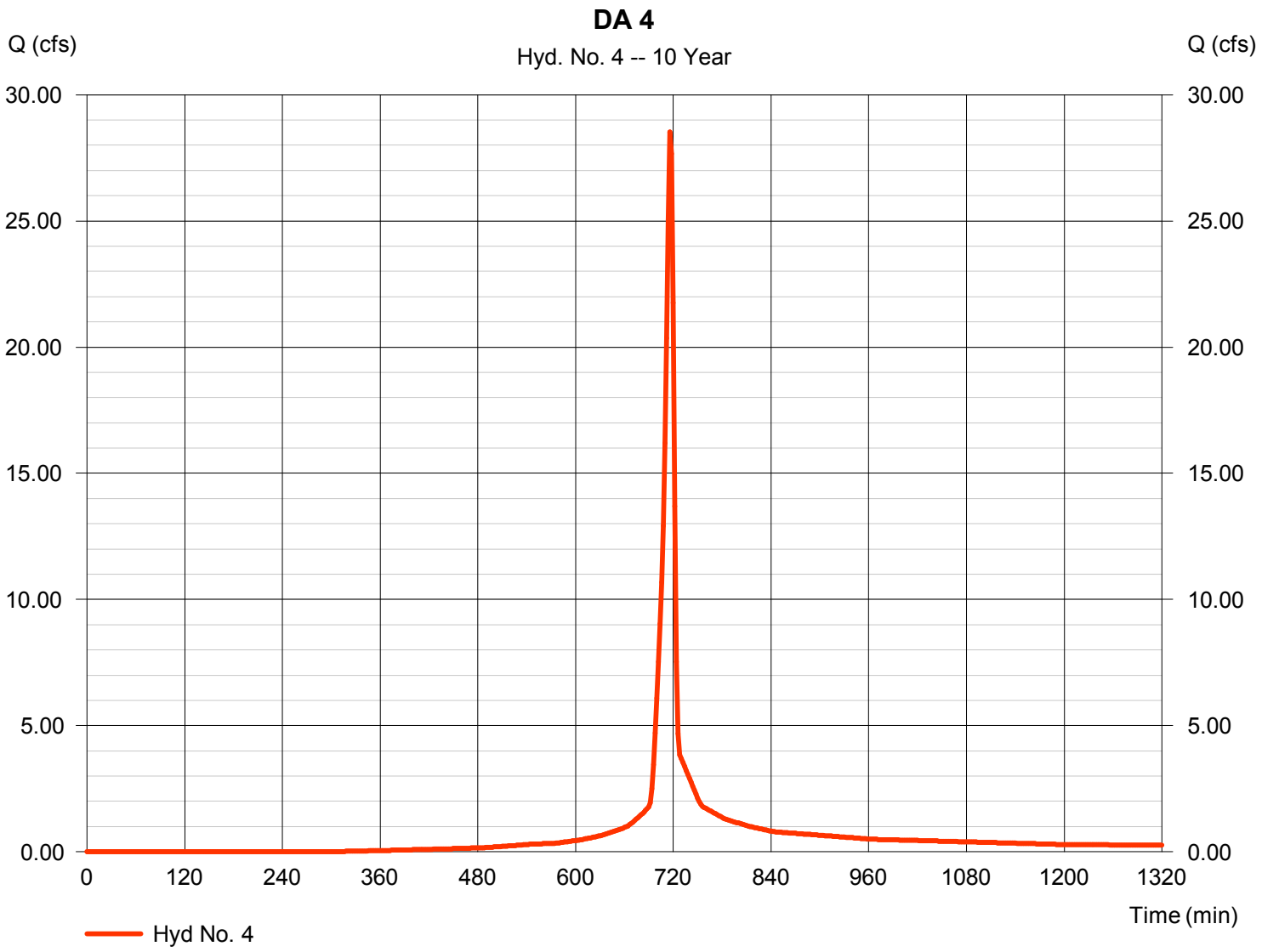
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4 Monday, 08 / 31 / 2015

Hyd. No. 4

DA 4

Hydrograph type	= SCS Runoff	Peak discharge	= 28.53 cfs
Storm frequency	= 10 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 59,850 cuft
Drainage area	= 4.930 ac	Curve number	= 87*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 5.00 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(2.620 x 98) + (2.310 x 74)] / 4.930



Hydrograph Report

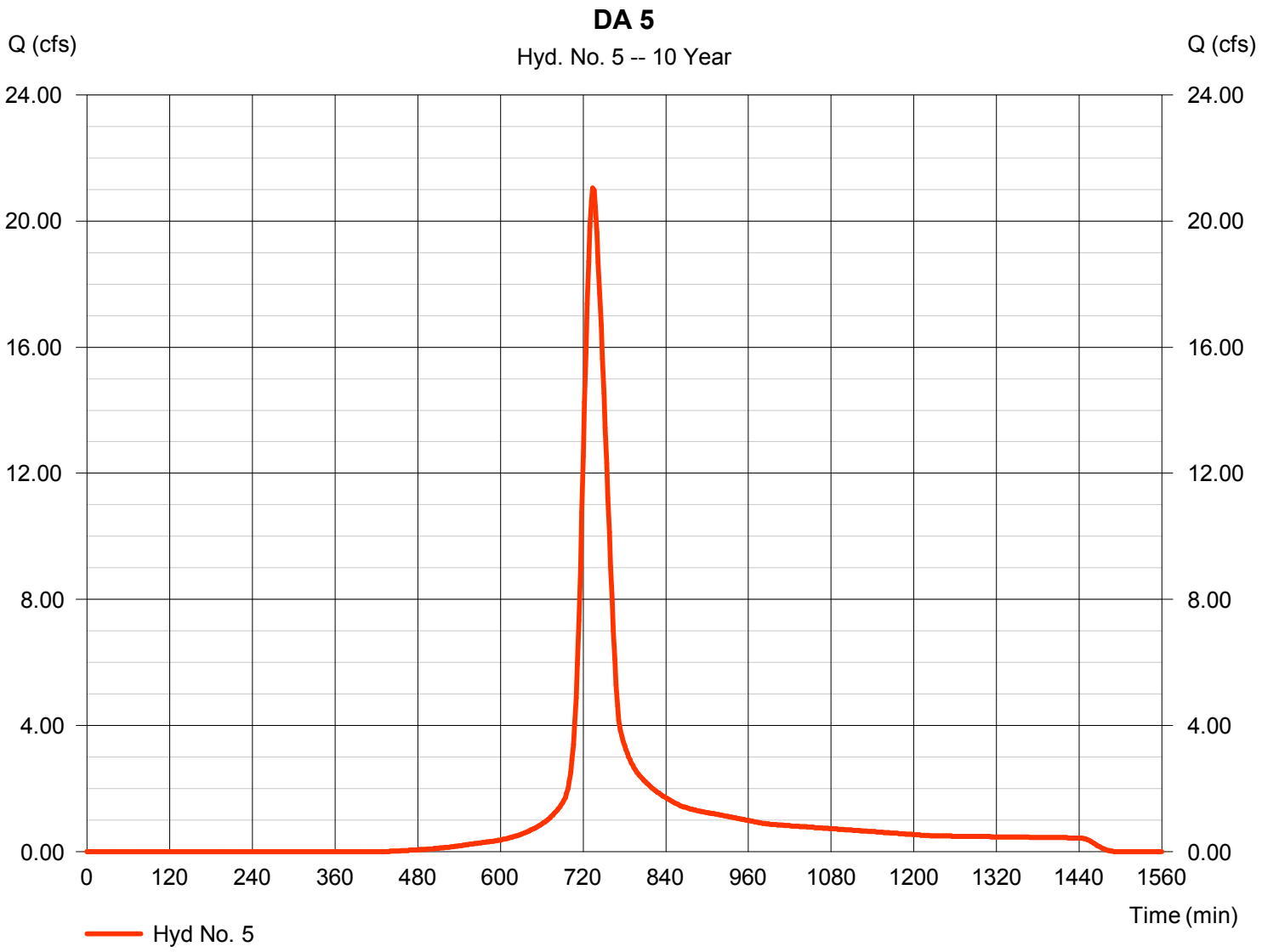
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4 Monday, 08 / 31 / 2015

Hyd. No. 5

DA 5

Hydrograph type	= SCS Runoff	Peak discharge	= 21.05 cfs
Storm frequency	= 10 yrs	Time to peak	= 734 min
Time interval	= 2 min	Hyd. volume	= 95,351 cuft
Drainage area	= 8.900 ac	Curve number	= 81*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 33.80 min
Total precip.	= 5.00 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.300 x 98) + (8.600 x 80)] / 8.900



Hydrograph Report

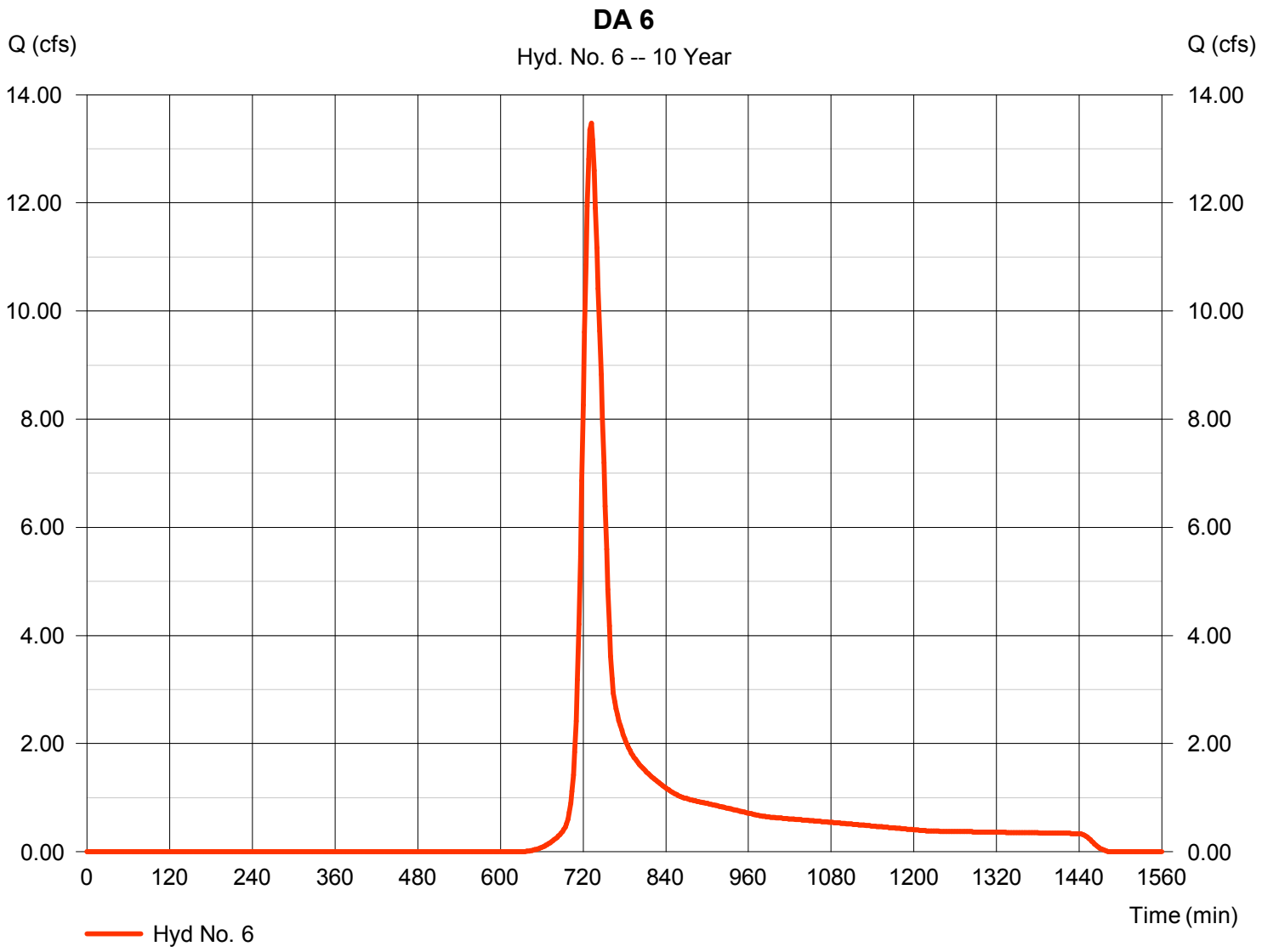
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4 Monday, 08 / 31 / 2015

Hyd. No. 6

DA 6

Hydrograph type	= SCS Runoff	Peak discharge	= 13.47 cfs
Storm frequency	= 10 yrs	Time to peak	= 732 min
Time interval	= 2 min	Hyd. volume	= 56,287 cuft
Drainage area	= 8.600 ac	Curve number	= 67*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 29.30 min
Total precip.	= 5.00 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.800 x 98) + (4.800 x 61) + (2.000 x 55)] / 8.600



Hydrograph Report

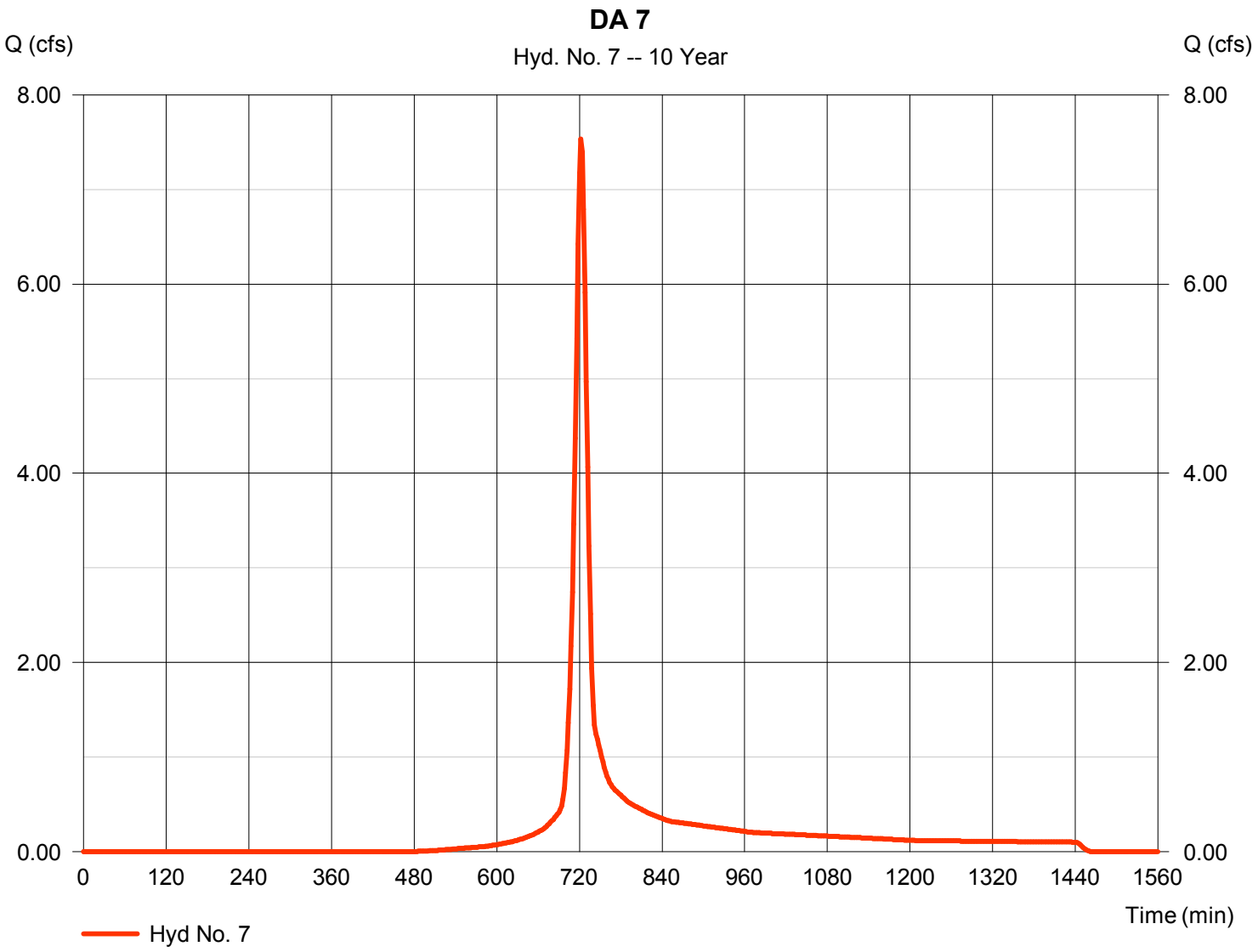
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4 Monday, 08 / 31 / 2015

Hyd. No. 7

DA 7

Hydrograph type	= SCS Runoff	Peak discharge	= 7.533 cfs
Storm frequency	= 10 yrs	Time to peak	= 722 min
Time interval	= 2 min	Hyd. volume	= 21,114 cuft
Drainage area	= 2.200 ac	Curve number	= 78*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 15.80 min
Total precip.	= 5.00 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.400 x 98) + (1.750 x 74) + (0.050 x 70)] / 2.200



Hydrograph Report

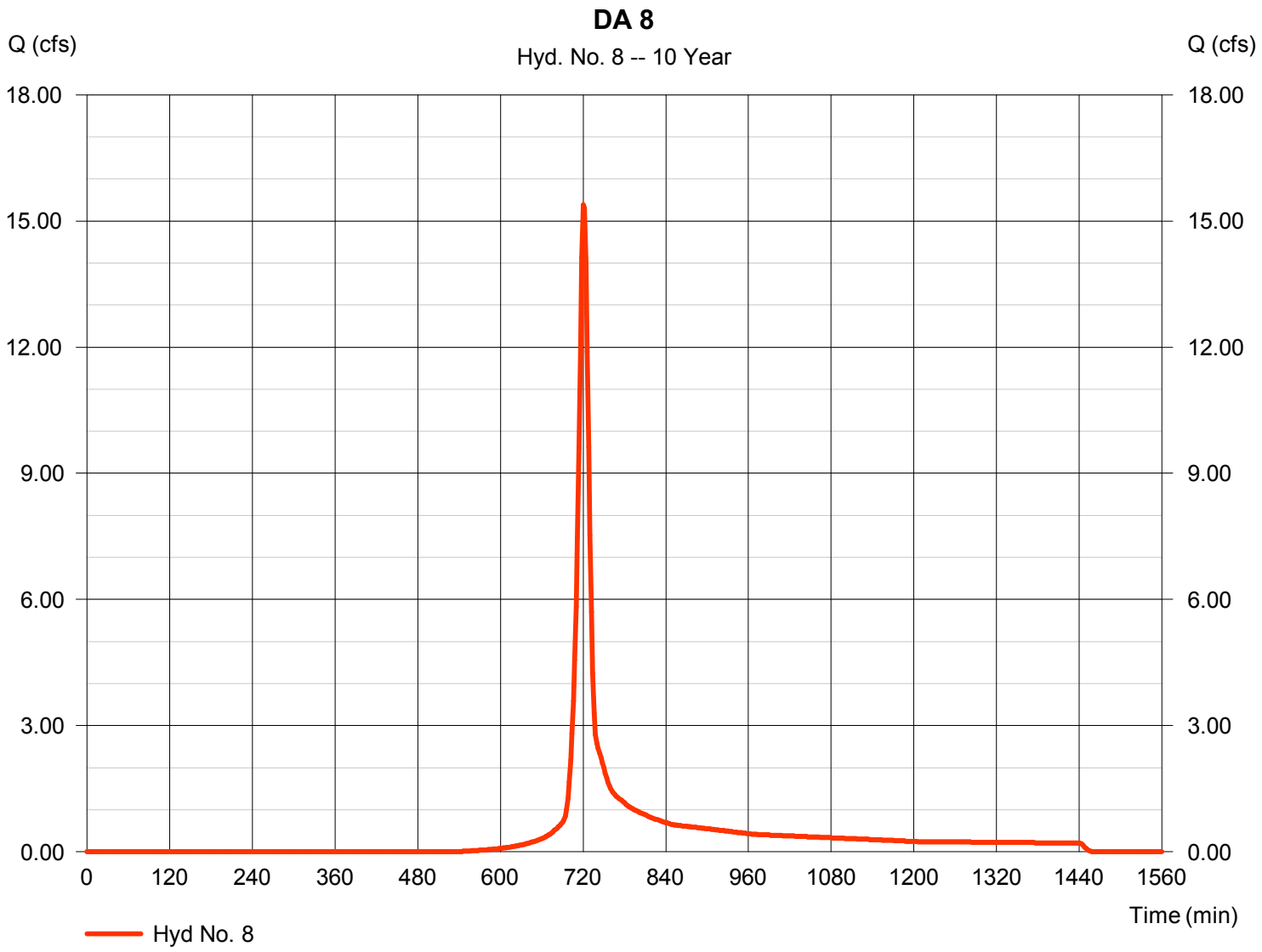
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4 Monday, 08 / 31 / 2015

Hyd. No. 8

DA 8

Hydrograph type	= SCS Runoff	Peak discharge	= 15.39 cfs
Storm frequency	= 10 yrs	Time to peak	= 720 min
Time interval	= 2 min	Hyd. volume	= 40,004 cuft
Drainage area	= 4.520 ac	Curve number	= 74*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 11.30 min
Total precip.	= 5.00 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.340 x 98) + (2.620 x 74) + (1.560 x 70)] / 4.520



Hydrograph Report

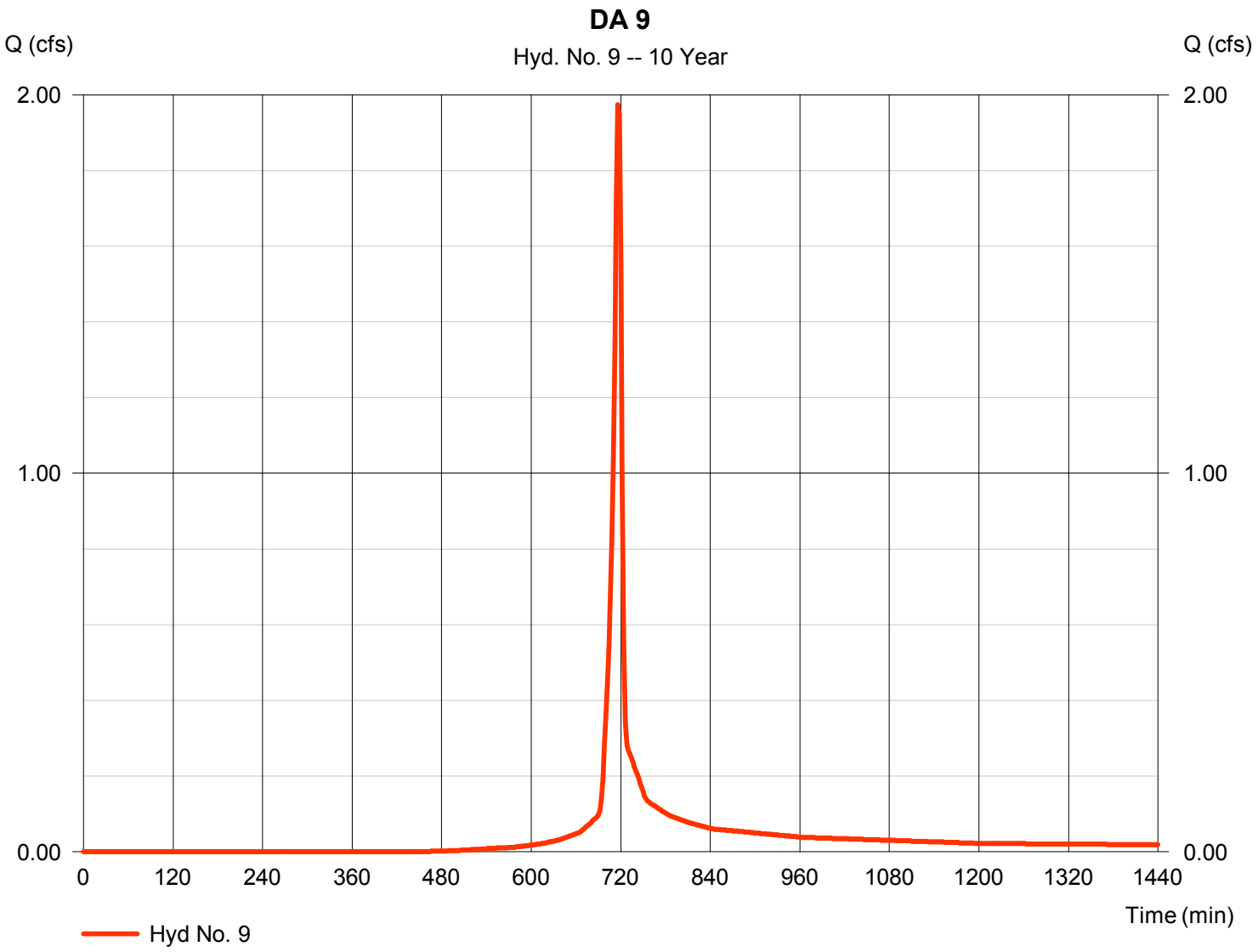
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4 Monday, 08 / 31 / 2015

Hyd. No. 9

DA 9

Hydrograph type	= SCS Runoff	Peak discharge	= 1.973 cfs
Storm frequency	= 10 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 4,004 cuft
Drainage area	= 0.420 ac	Curve number	= 79*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 5.00 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.090 x 98) + (0.330 x 74)] / 0.420



Hydrograph Report

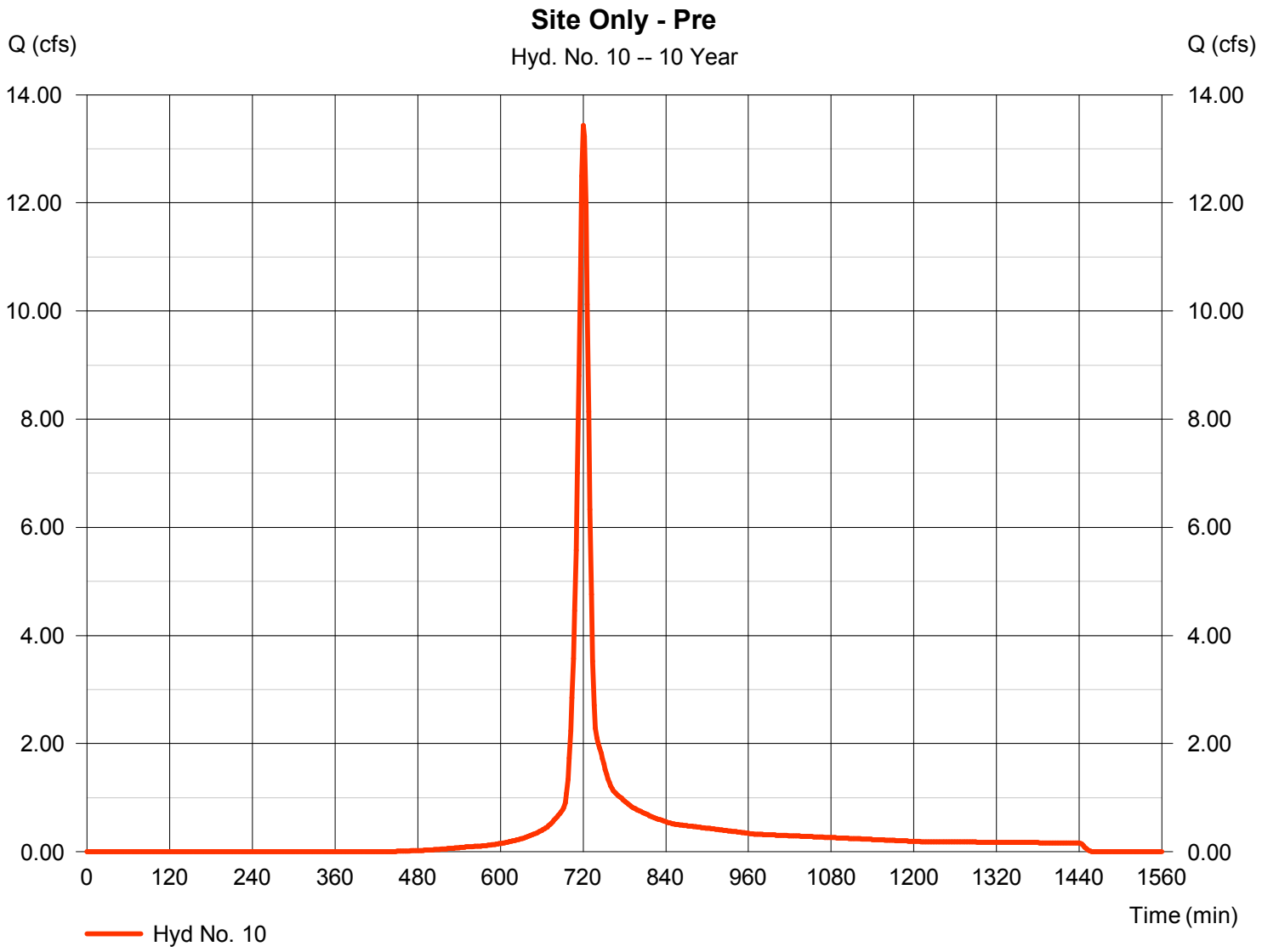
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4 Monday, 08 / 31 / 2015

Hyd. No. 10

Site Only - Pre

Hydrograph type	= SCS Runoff	Peak discharge	= 13.43 cfs
Storm frequency	= 10 yrs	Time to peak	= 720 min
Time interval	= 2 min	Hyd. volume	= 34,870 cuft
Drainage area	= 3.220 ac	Curve number	= 80*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 10.00 min
Total precip.	= 5.00 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(2.820 x 80) + (0.400 x 77)] / 3.220



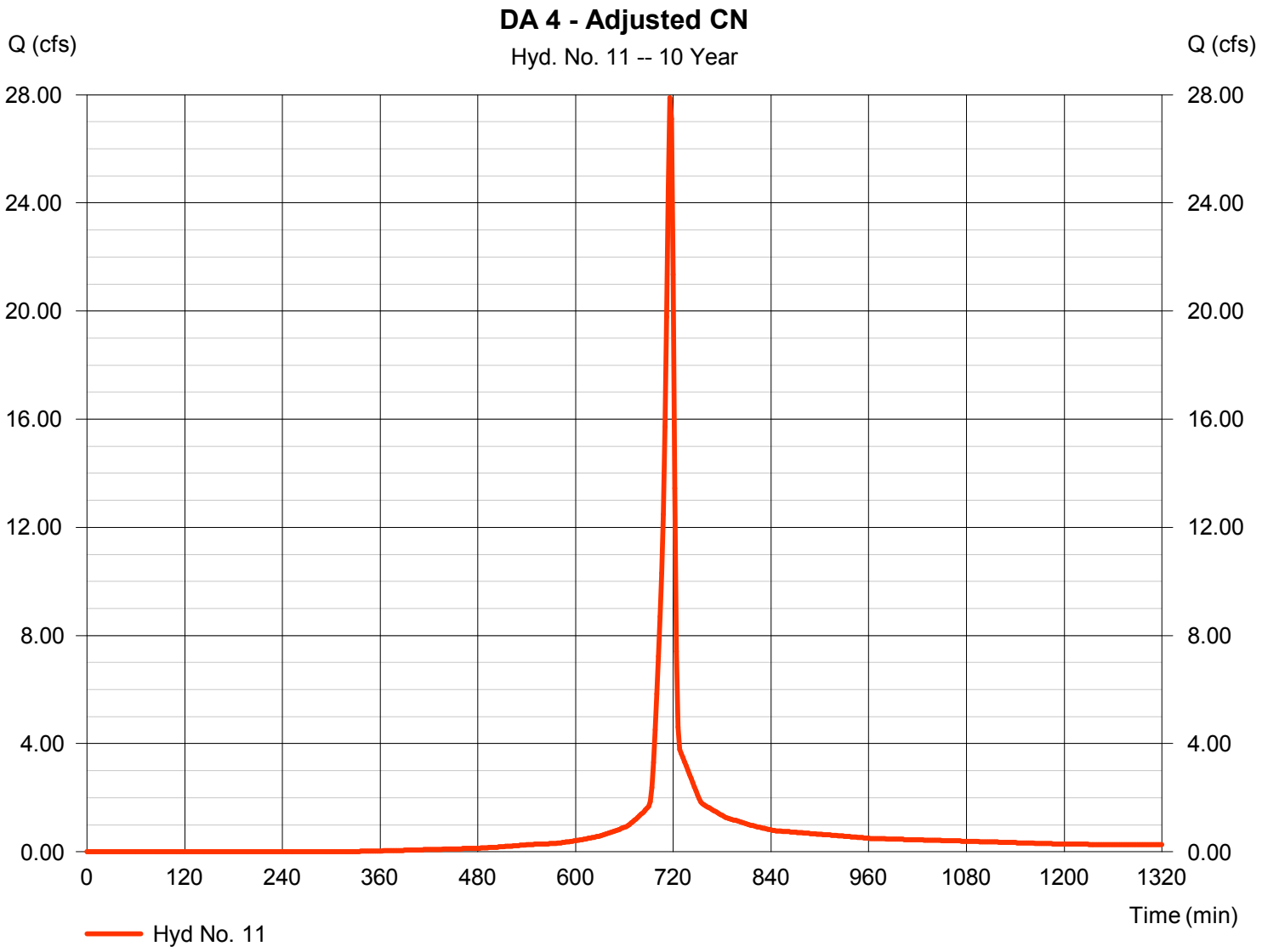
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4 Monday, 08 / 31 / 2015

Hyd. No. 11

DA 4 - Adjusted CN

Hydrograph type	= SCS Runoff	Peak discharge	= 27.90 cfs
Storm frequency	= 10 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 58,167 cuft
Drainage area	= 4.930 ac	Curve number	= 86
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 5.00 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



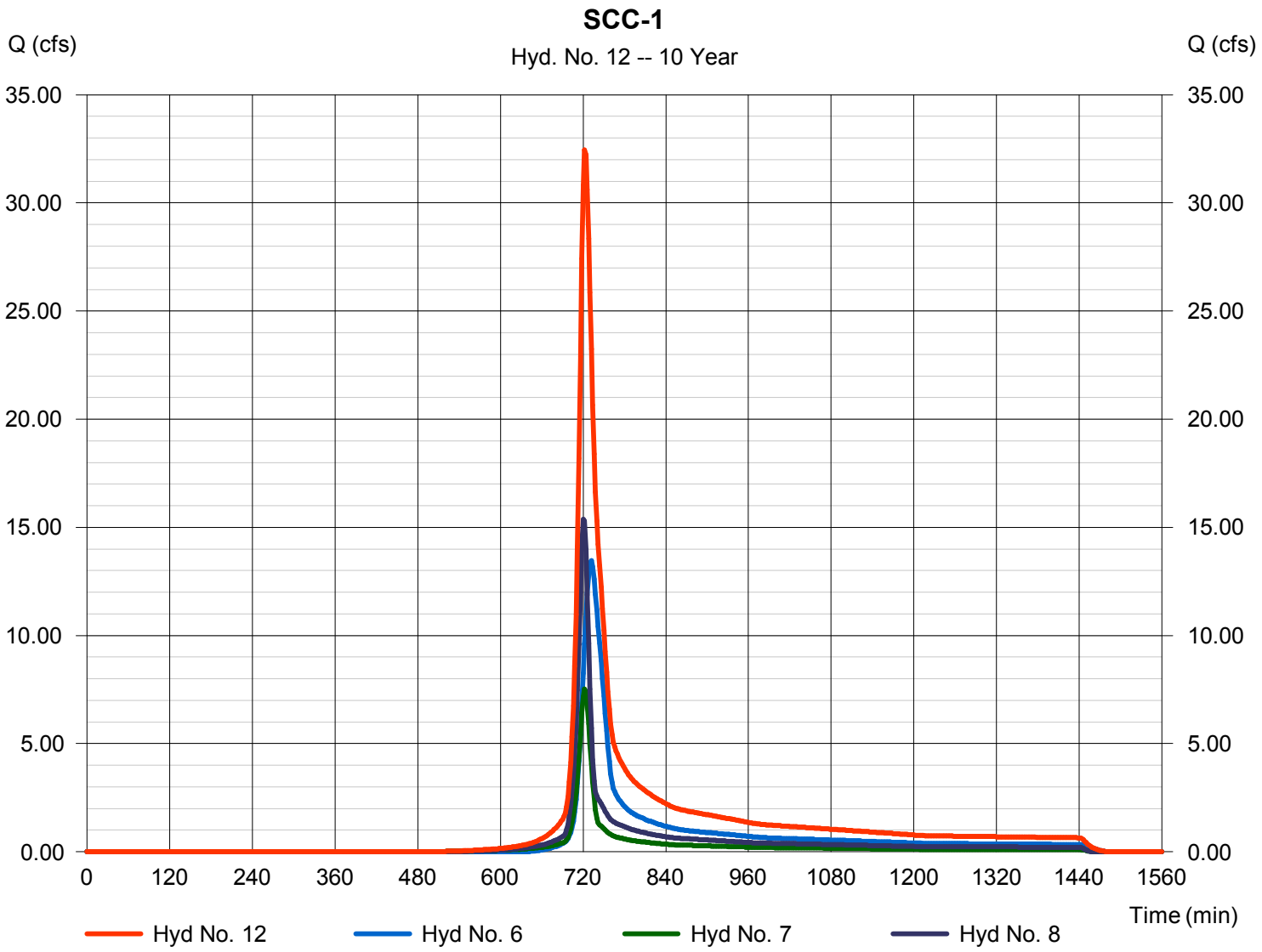
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4 Monday, 08 / 31 / 2015

Hyd. No. 12

SCC-1

Hydrograph type	= Combine	Peak discharge	= 32.45 cfs
Storm frequency	= 10 yrs	Time to peak	= 722 min
Time interval	= 2 min	Hyd. volume	= 117,405 cuft
Inflow hyds.	= 6, 7, 8	Contrib. drain. area	= 15.320 ac



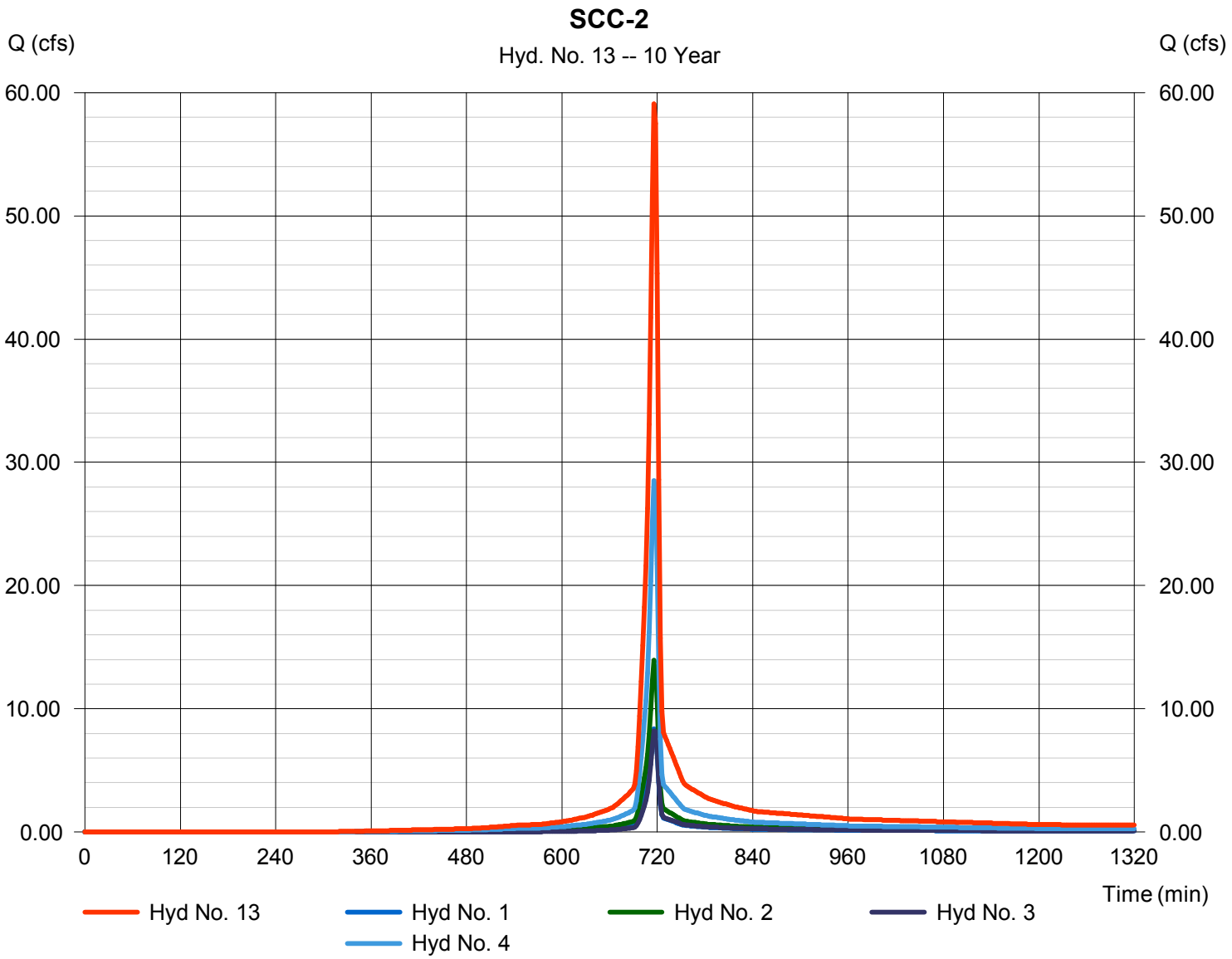
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4 Monday, 08 / 31 / 2015

Hyd. No. 13

SCC-2

Hydrograph type	= Combine	Peak discharge	= 59.07 cfs
Storm frequency	= 10 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 123,277 cuft
Inflow hyds.	= 1, 2, 3, 4	Contrib. drain. area	= 10.710 ac



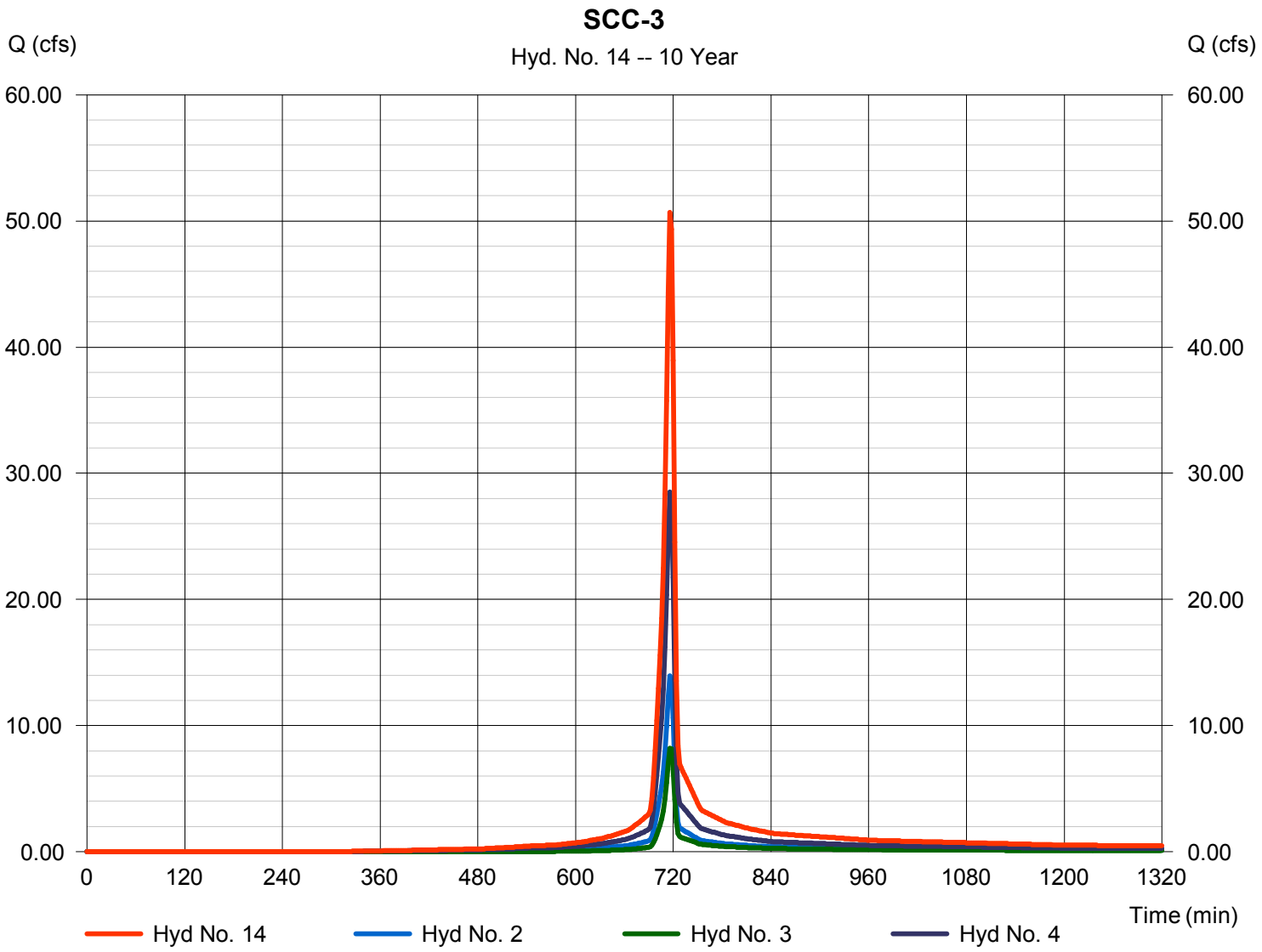
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4 Monday, 08 / 31 / 2015

Hyd. No. 14

SCC-3

Hydrograph type	= Combine	Peak discharge	= 50.68 cfs
Storm frequency	= 10 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 105,674 cuft
Inflow hyds.	= 2, 3, 4	Contrib. drain. area	= 9.260 ac



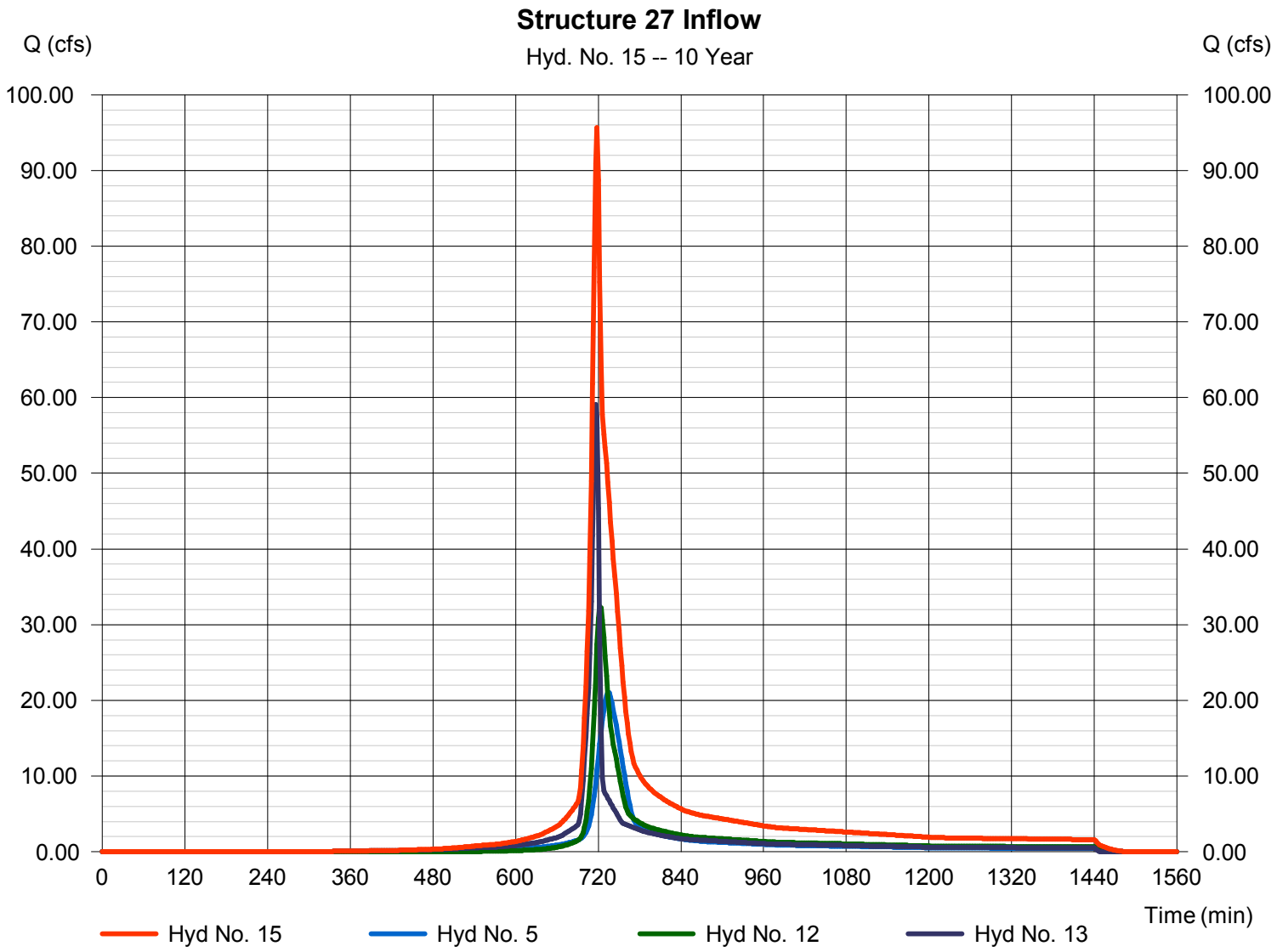
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4 Monday, 08 / 31 / 2015

Hyd. No. 15

Structure 27 Inflow

Hydrograph type	= Combine	Peak discharge	= 95.66 cfs
Storm frequency	= 10 yrs	Time to peak	= 718 min
Time interval	= 2 min	Hyd. volume	= 336,033 cuft
Inflow hyds.	= 5, 12, 13	Contrib. drain. area	= 8.900 ac



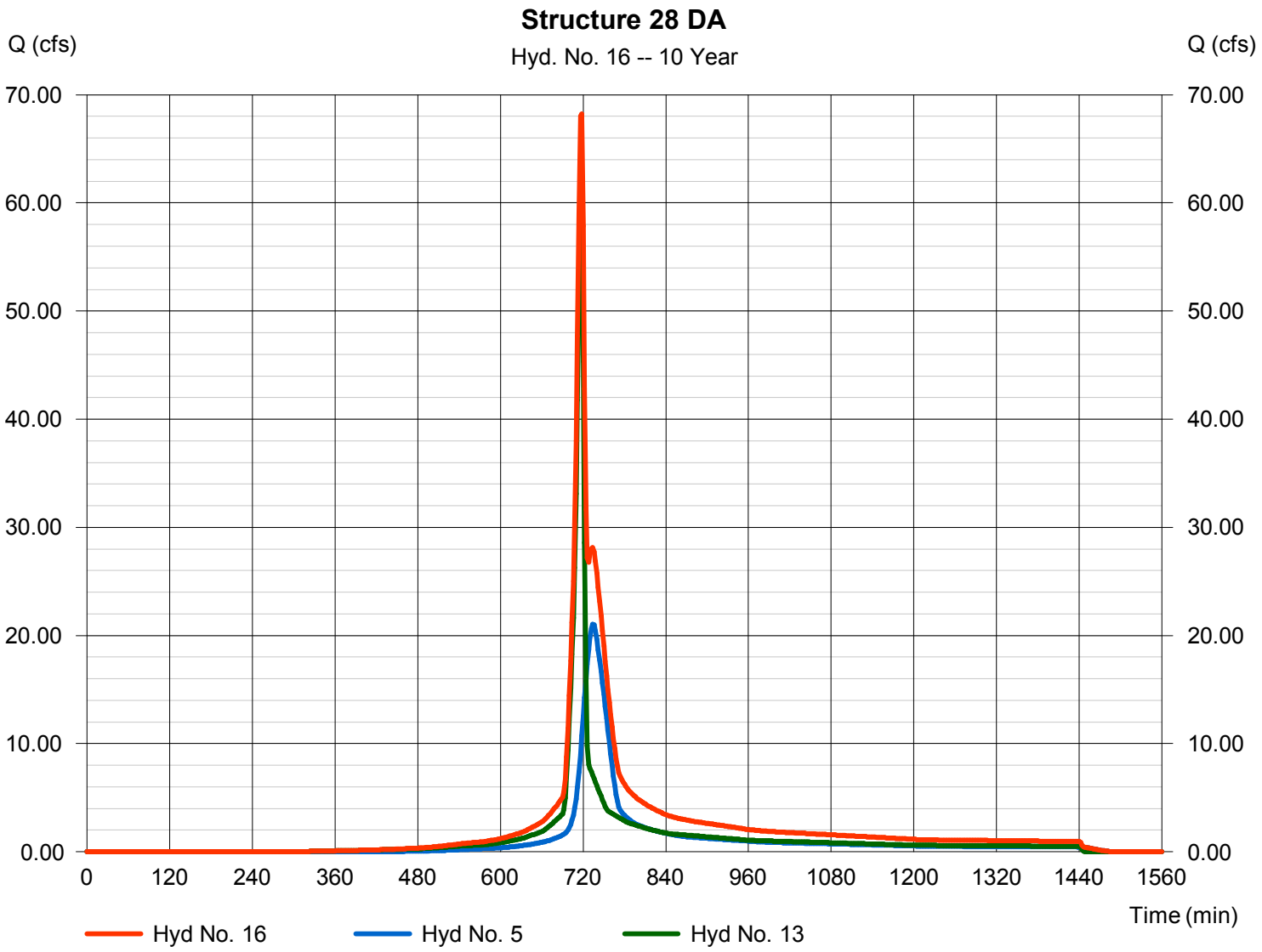
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4 Monday, 08 / 31 / 2015

Hyd. No. 16

Structure 28 DA

Hydrograph type	= Combine	Peak discharge	= 68.25 cfs
Storm frequency	= 10 yrs	Time to peak	= 718 min
Time interval	= 2 min	Hyd. volume	= 218,628 cuft
Inflow hyds.	= 5, 13	Contrib. drain. area	= 8.900 ac



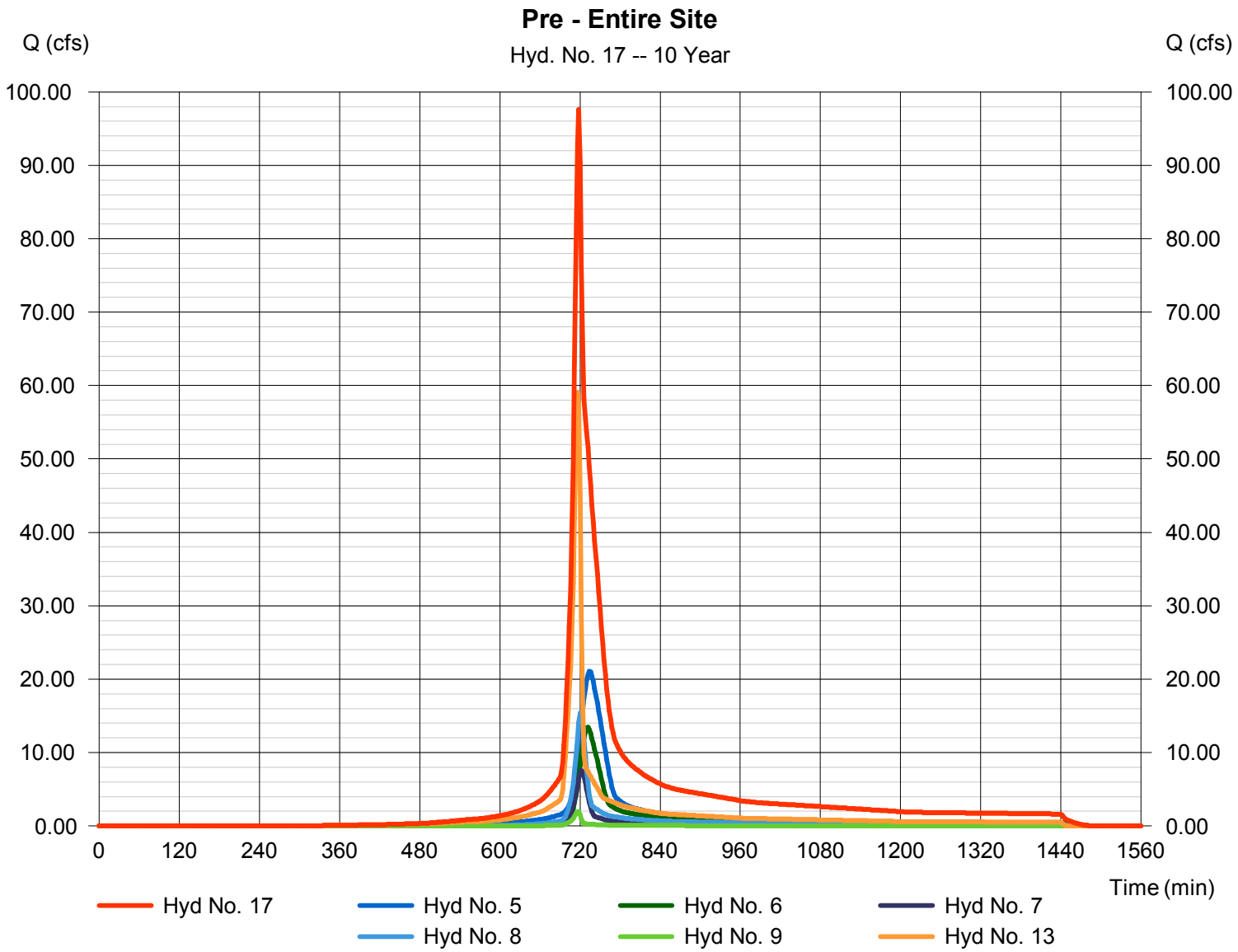
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4 Monday, 08 / 31 / 2015

Hyd. No. 17

Pre - Entire Site

Hydrograph type	= Combine	Peak discharge	= 97.61 cfs
Storm frequency	= 10 yrs	Time to peak	= 718 min
Time interval	= 2 min	Hyd. volume	= 340,038 cuft
Inflow hyds.	= 5, 6, 7, 8, 9, 13	Contrib. drain. area	= 24.640 ac



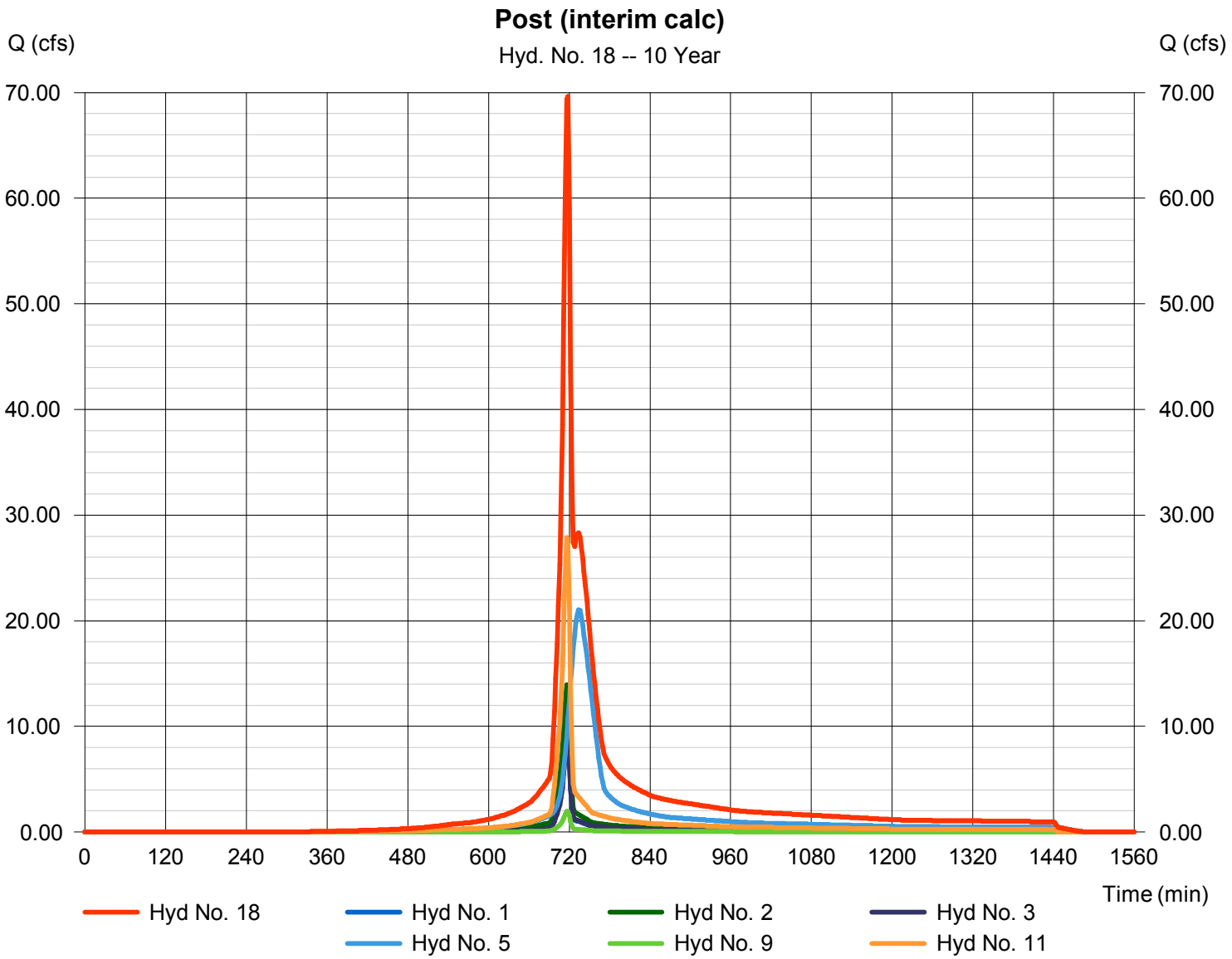
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4 Monday, 08 / 31 / 2015

Hyd. No. 18

Post (interim calc)

Hydrograph type	= Combine	Peak discharge	= 69.64 cfs
Storm frequency	= 10 yrs	Time to peak	= 718 min
Time interval	= 2 min	Hyd. volume	= 220,950 cuft
Inflow hyds.	= 1, 2, 3, 5, 9, 11	Contrib. drain. area	= 20.030 ac



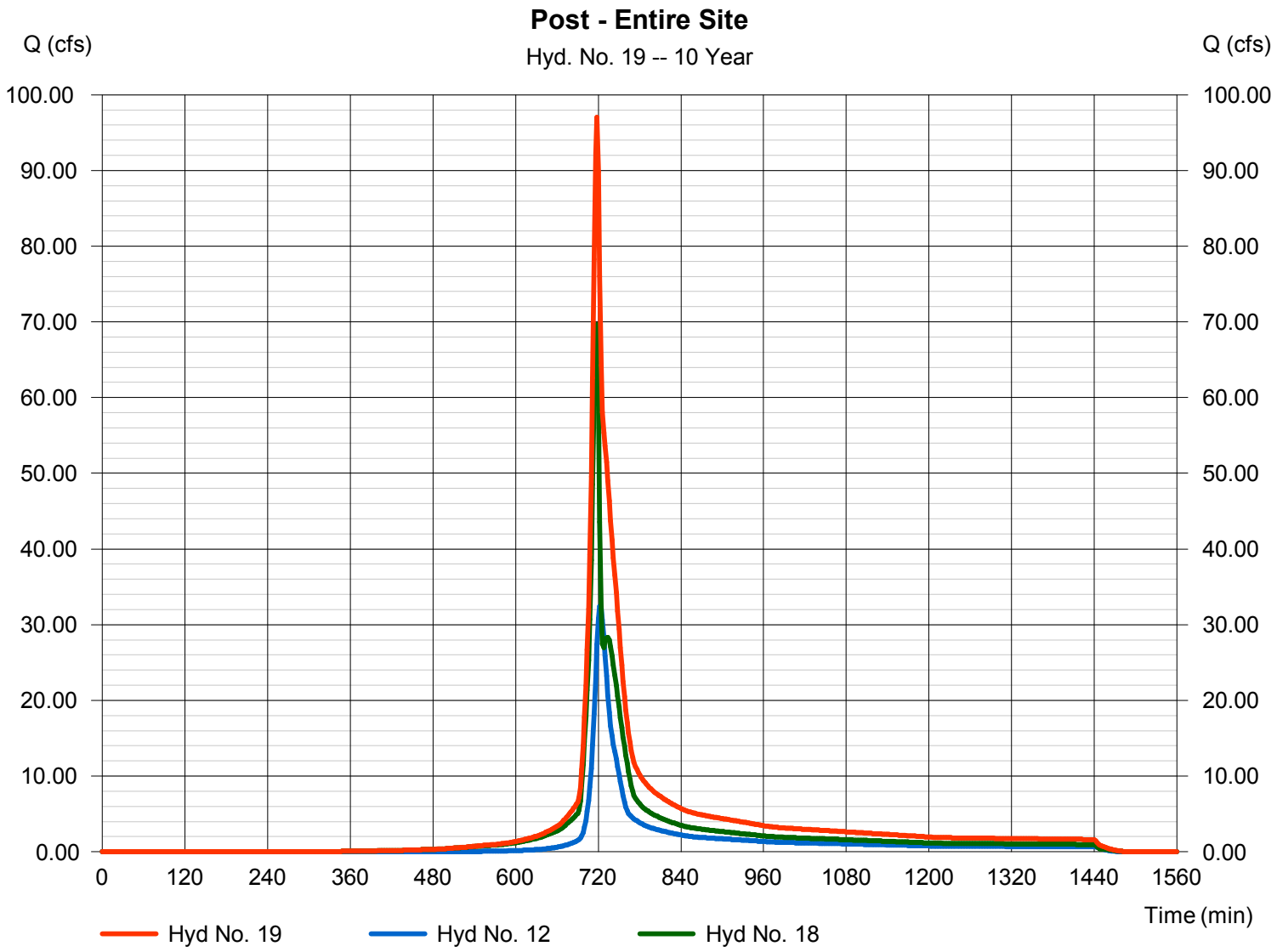
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4 Monday, 08 / 31 / 2015

Hyd. No. 19

Post - Entire Site

Hydrograph type	= Combine	Peak discharge	= 97.05 cfs
Storm frequency	= 10 yrs	Time to peak	= 718 min
Time interval	= 2 min	Hyd. volume	= 338,355 cuft
Inflow hyds.	= 12, 18	Contrib. drain. area	= 0.000 ac



Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

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	10.90	2	716	23,236	------	------	------	DA 1
2	SCS Runoff	18.11	2	716	38,619	------	------	------	DA 2
3	SCS Runoff	11.42	2	716	23,217	------	------	------	DA 3
4	SCS Runoff	37.06	2	716	79,002	------	------	------	DA 4
5	SCS Runoff	28.63	2	734	129,882	------	------	------	DA 5
6	SCS Runoff	20.55	2	732	83,724	------	------	------	DA 6
7	SCS Runoff	10.40	2	722	29,246	------	------	------	DA 7
8	SCS Runoff	21.89	2	720	56,747	------	------	------	DA 8
9	SCS Runoff	2.691	2	716	5,515	------	------	------	DA 9
10	SCS Runoff	18.28	2	720	47,760	------	------	------	Site Only - Pre
11	SCS Runoff	36.44	2	716	77,172	------	------	------	DA 4 - Adjusted CN
12	Combine	47.29	2	722	169,718	6, 7, 8,	------	------	SCC-1
13	Combine	77.49	2	716	164,074	1, 2, 3, 4,	------	------	SCC-2
14	Combine	66.59	2	716	140,839	2, 3, 4,	------	------	SCC-3
15	Combine	130.56	2	718	463,673	5, 12, 13,	------	------	Structure 27 Inflow
16	Combine	90.13	2	716	293,956	5, 13,	------	------	Structure 28 DA
17	Combine	133.19	2	718	469,189	5, 6, 7, 8, 9, 13,	------	------	Pre - Entire Site
18	Combine	92.20	2	716	297,642	1, 2, 3, 5, 9, 11,	------	------	Post (interim calc)
19	Combine	132.65	2	718	467,359	12, 18	------	------	Post - Entire Site

Hydrograph Report

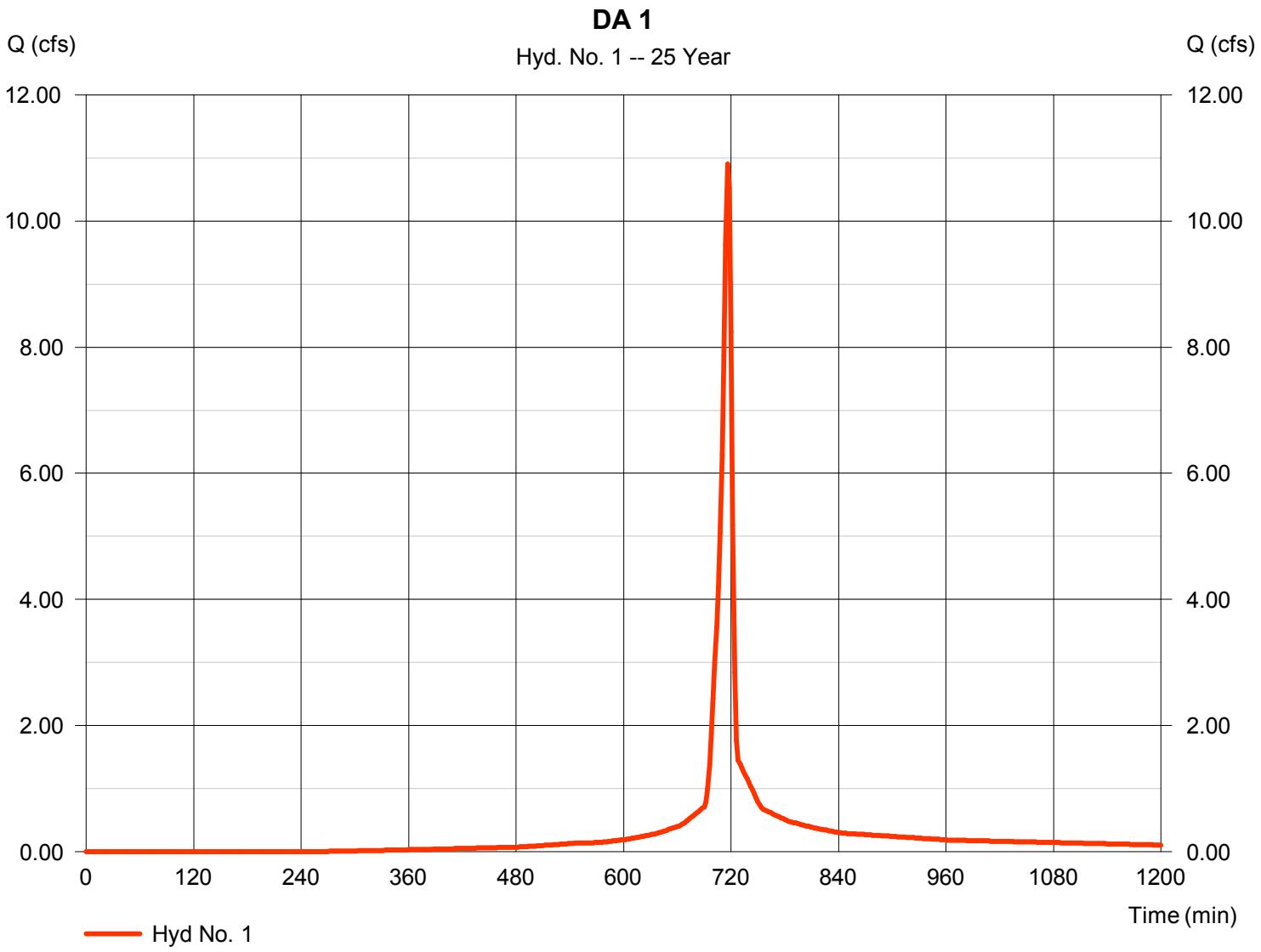
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4 Monday, 08 / 31 / 2015

Hyd. No. 1

DA 1

Hydrograph type	= SCS Runoff	Peak discharge	= 10.90 cfs
Storm frequency	= 25 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 23,236 cuft
Drainage area	= 1.450 ac	Curve number	= 87*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 6.20 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.600 x 98) + (0.620 x 80) + (0.230 x 77)] / 1.450



Hydrograph Report

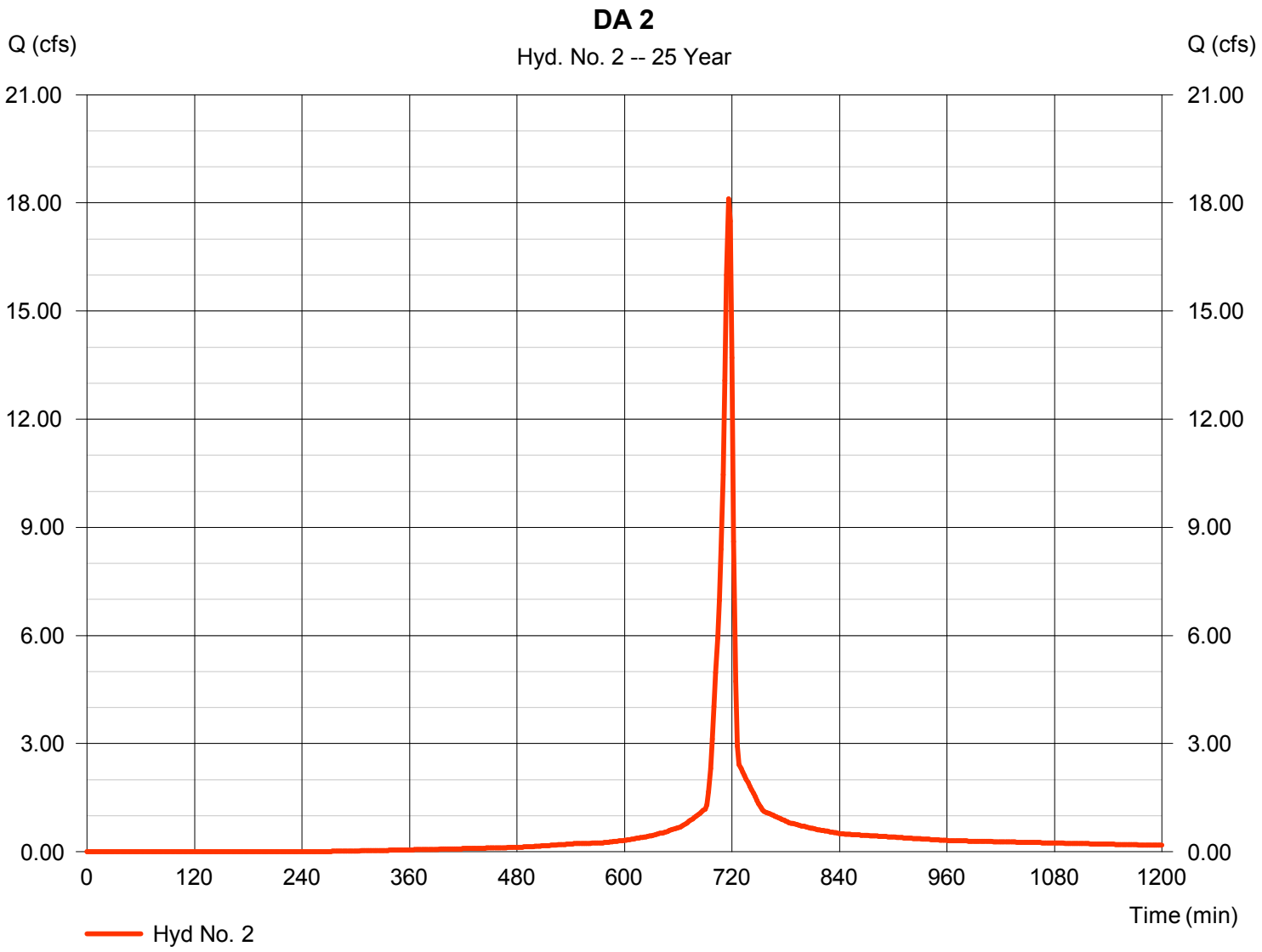
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4 Monday, 08 / 31 / 2015

Hyd. No. 2

DA 2

Hydrograph type	= SCS Runoff	Peak discharge	= 18.11 cfs
Storm frequency	= 25 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 38,619 cuft
Drainage area	= 2.410 ac	Curve number	= 87*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 6.20 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.000 x 98) + (1.070 x 80) + (0.340 x 78)] / 2.410



Hydrograph Report

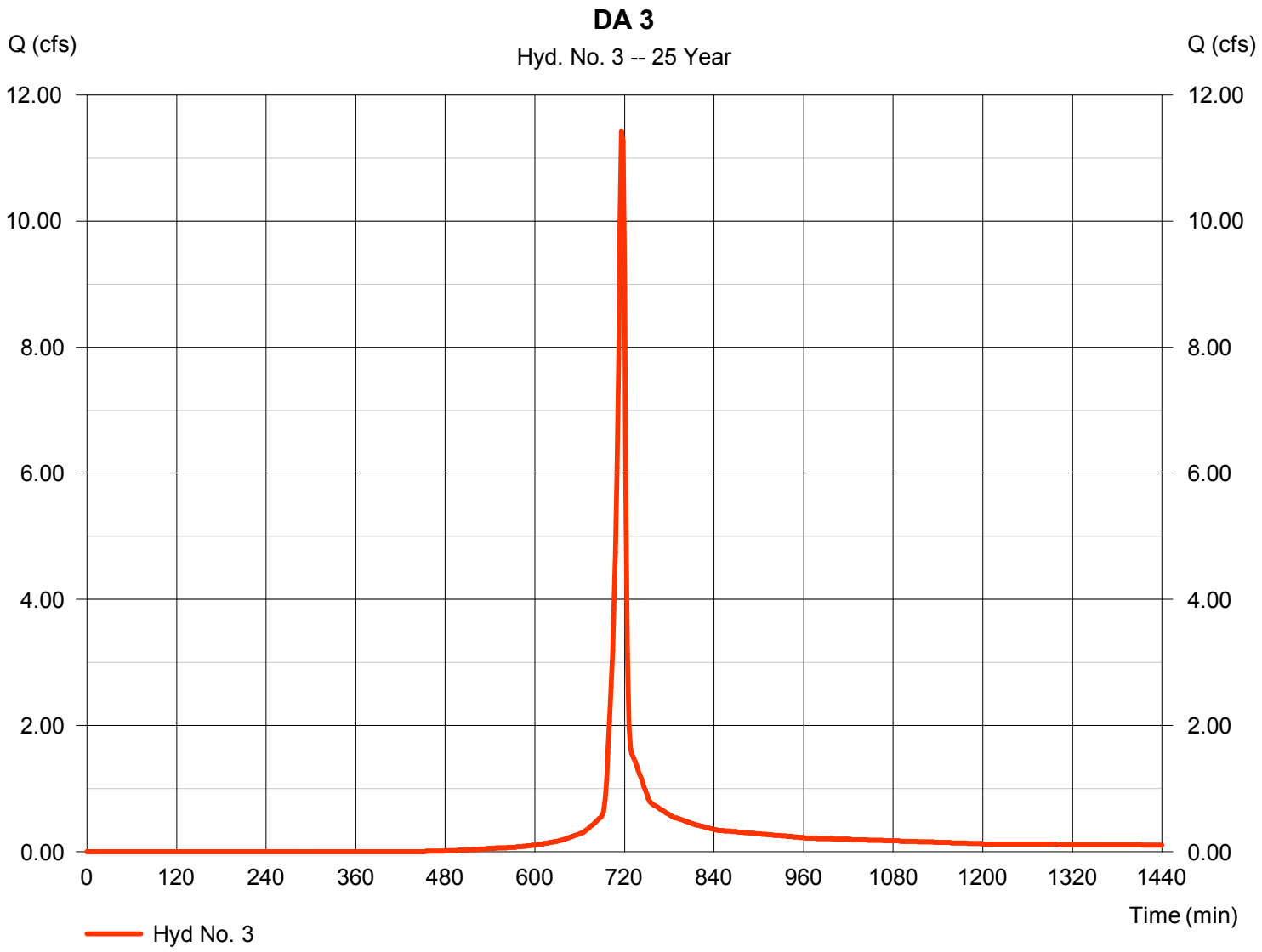
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4 Monday, 08 / 31 / 2015

Hyd. No. 3

DA 3

Hydrograph type	= SCS Runoff	Peak discharge	= 11.42 cfs
Storm frequency	= 25 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 23,217 cuft
Drainage area	= 1.920 ac	Curve number	= 76*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 6.20 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.170 x 98) + (1.750 x 74)] / 1.920



Hydrograph Report

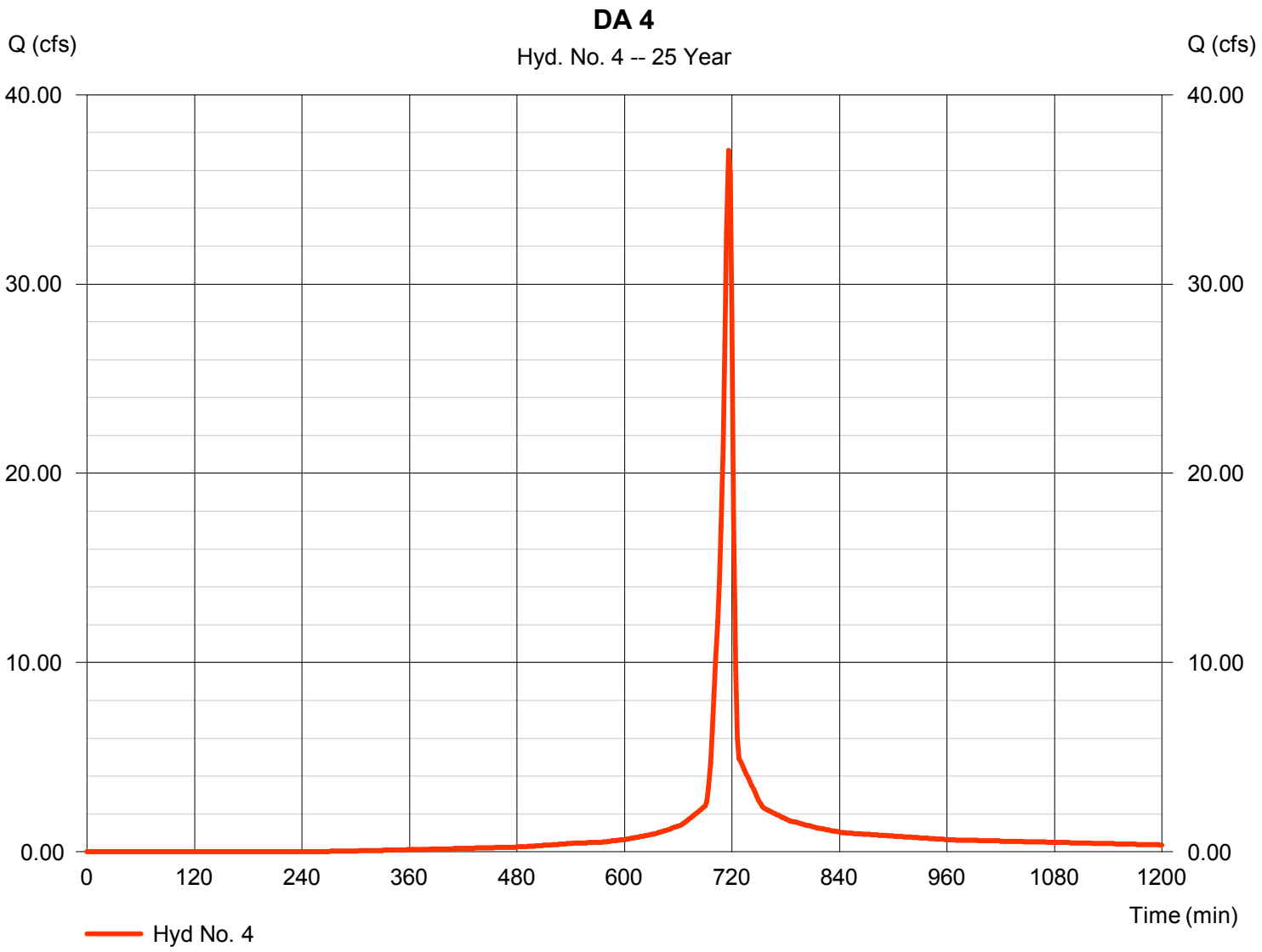
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4 Monday, 08 / 31 / 2015

Hyd. No. 4

DA 4

Hydrograph type	= SCS Runoff	Peak discharge	= 37.06 cfs
Storm frequency	= 25 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 79,002 cuft
Drainage area	= 4.930 ac	Curve number	= 87*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 6.20 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(2.620 x 98) + (2.310 x 74)] / 4.930



Hydrograph Report

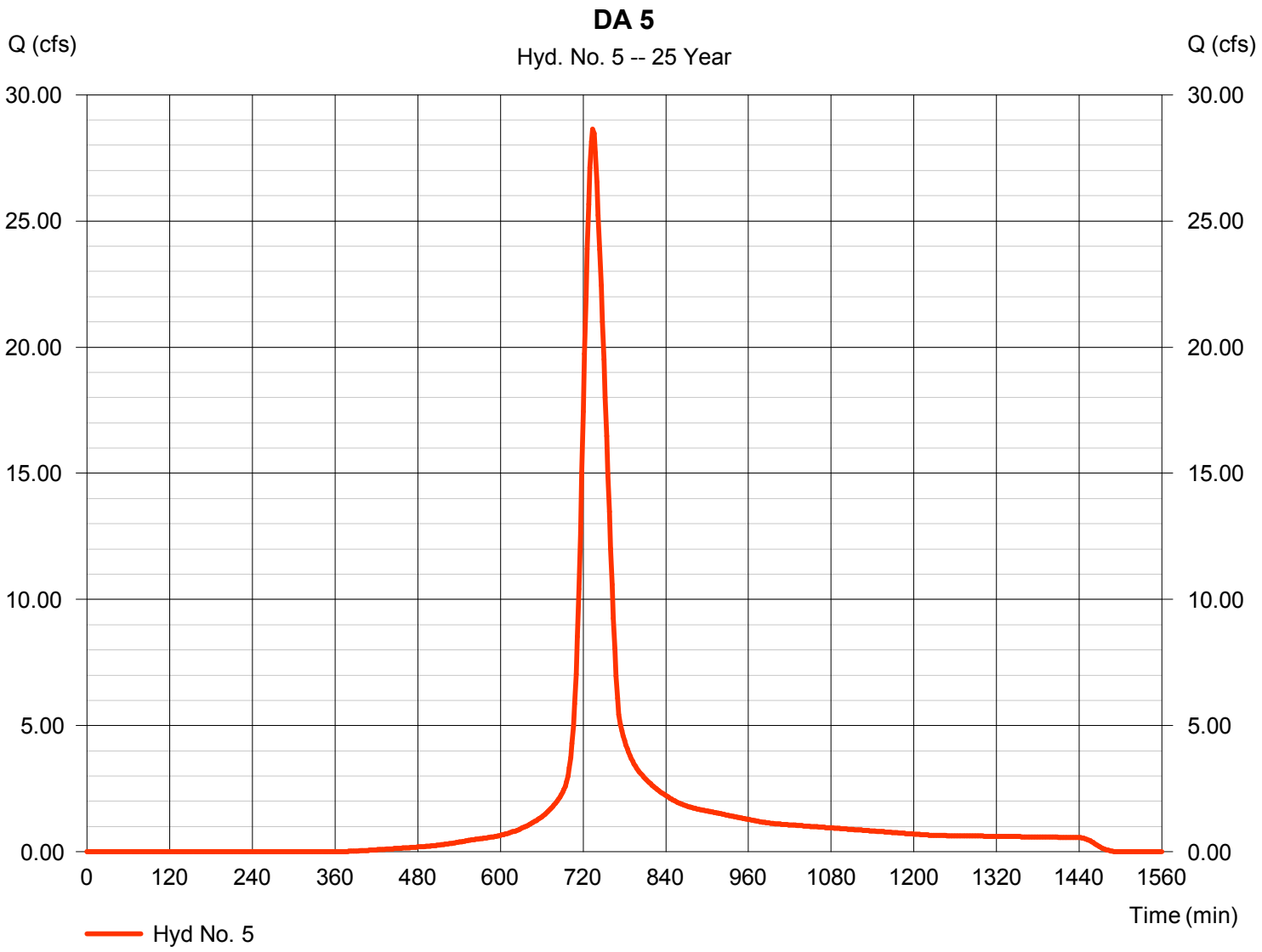
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4 Monday, 08 / 31 / 2015

Hyd. No. 5

DA 5

Hydrograph type	= SCS Runoff	Peak discharge	= 28.63 cfs
Storm frequency	= 25 yrs	Time to peak	= 734 min
Time interval	= 2 min	Hyd. volume	= 129,882 cuft
Drainage area	= 8.900 ac	Curve number	= 81*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 33.80 min
Total precip.	= 6.20 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.300 x 98) + (8.600 x 80)] / 8.900



Hydrograph Report

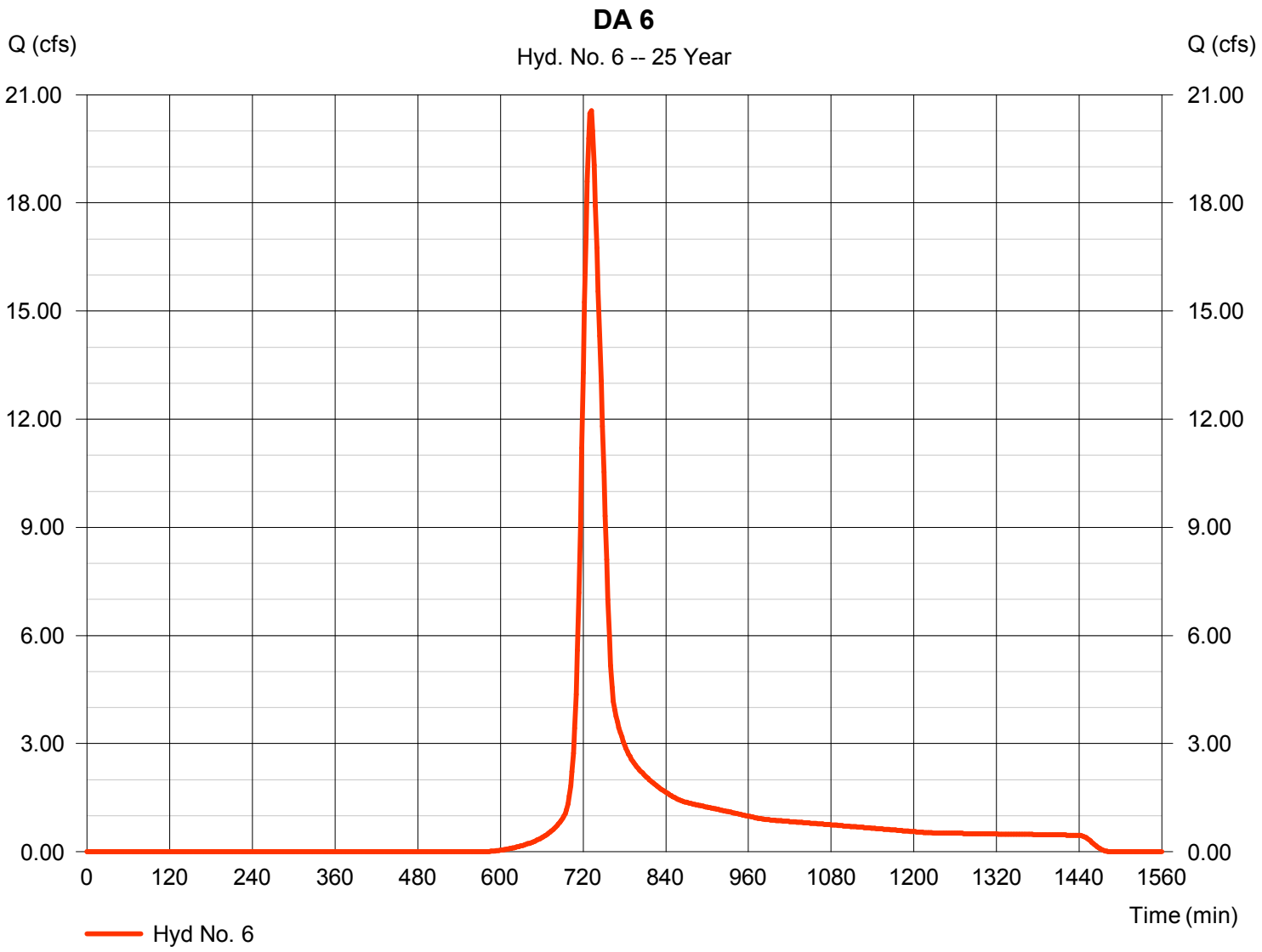
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4 Monday, 08 / 31 / 2015

Hyd. No. 6

DA 6

Hydrograph type	= SCS Runoff	Peak discharge	= 20.55 cfs
Storm frequency	= 25 yrs	Time to peak	= 732 min
Time interval	= 2 min	Hyd. volume	= 83,724 cuft
Drainage area	= 8.600 ac	Curve number	= 67*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 29.30 min
Total precip.	= 6.20 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.800 x 98) + (4.800 x 61) + (2.000 x 55)] / 8.600



Hydrograph Report

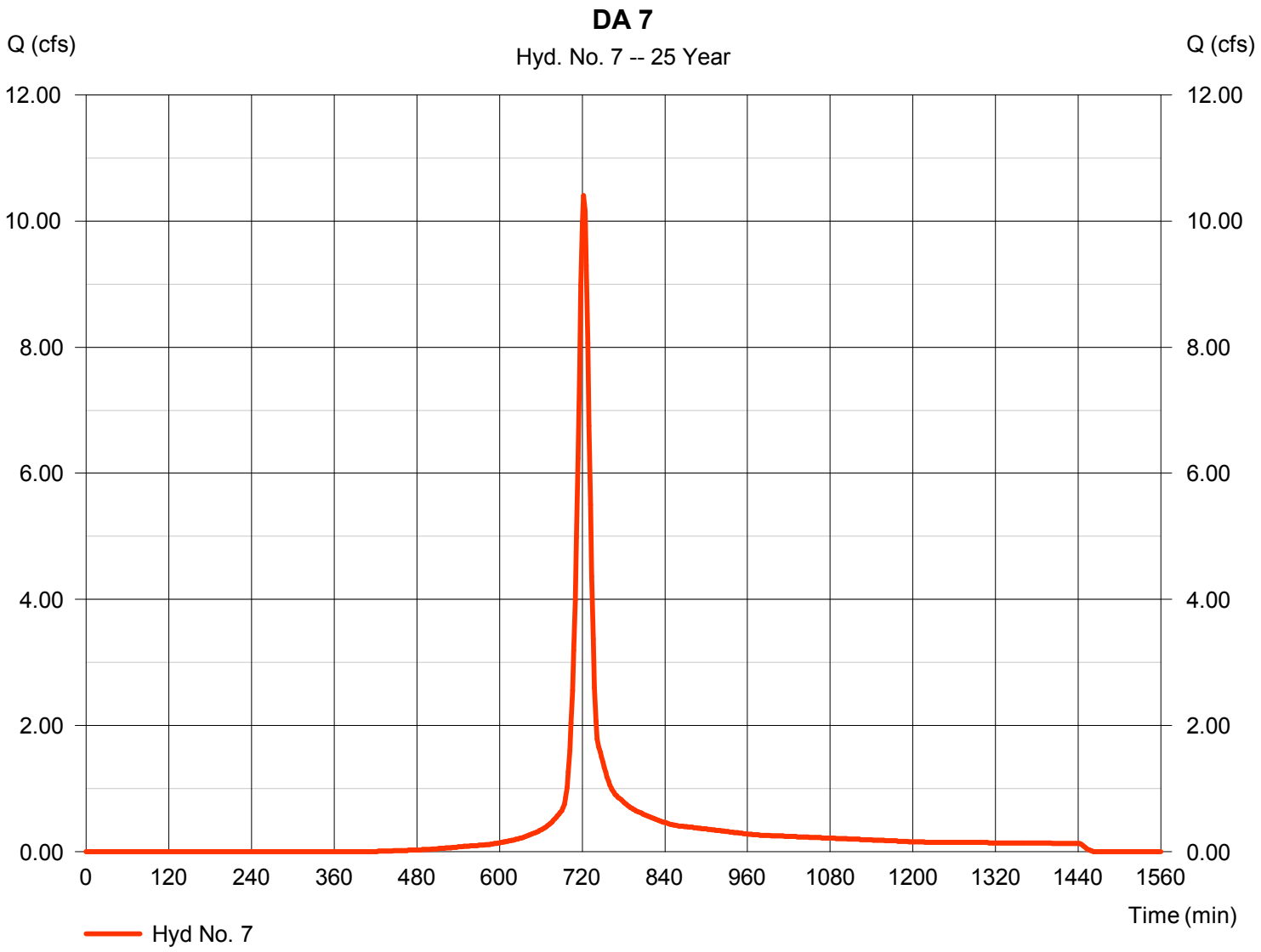
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4 Monday, 08 / 31 / 2015

Hyd. No. 7

DA 7

Hydrograph type	= SCS Runoff	Peak discharge	= 10.40 cfs
Storm frequency	= 25 yrs	Time to peak	= 722 min
Time interval	= 2 min	Hyd. volume	= 29,246 cuft
Drainage area	= 2.200 ac	Curve number	= 78*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 15.80 min
Total precip.	= 6.20 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.400 x 98) + (1.750 x 74) + (0.050 x 70)] / 2.200



Hydrograph Report

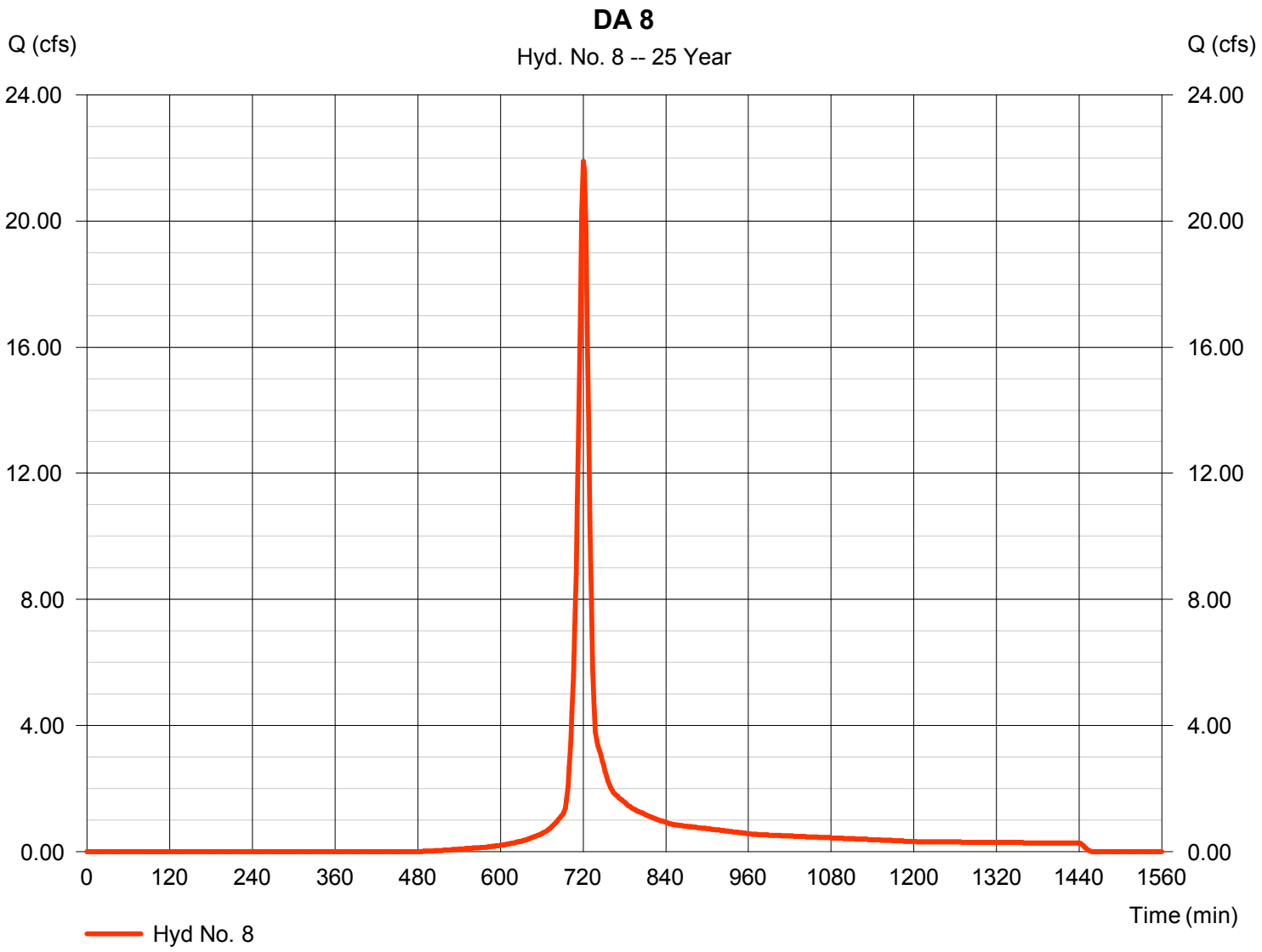
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4 Monday, 08 / 31 / 2015

Hyd. No. 8

DA 8

Hydrograph type	= SCS Runoff	Peak discharge	= 21.89 cfs
Storm frequency	= 25 yrs	Time to peak	= 720 min
Time interval	= 2 min	Hyd. volume	= 56,747 cuft
Drainage area	= 4.520 ac	Curve number	= 74*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 11.30 min
Total precip.	= 6.20 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.340 x 98) + (2.620 x 74) + (1.560 x 70)] / 4.520



Hydrograph Report

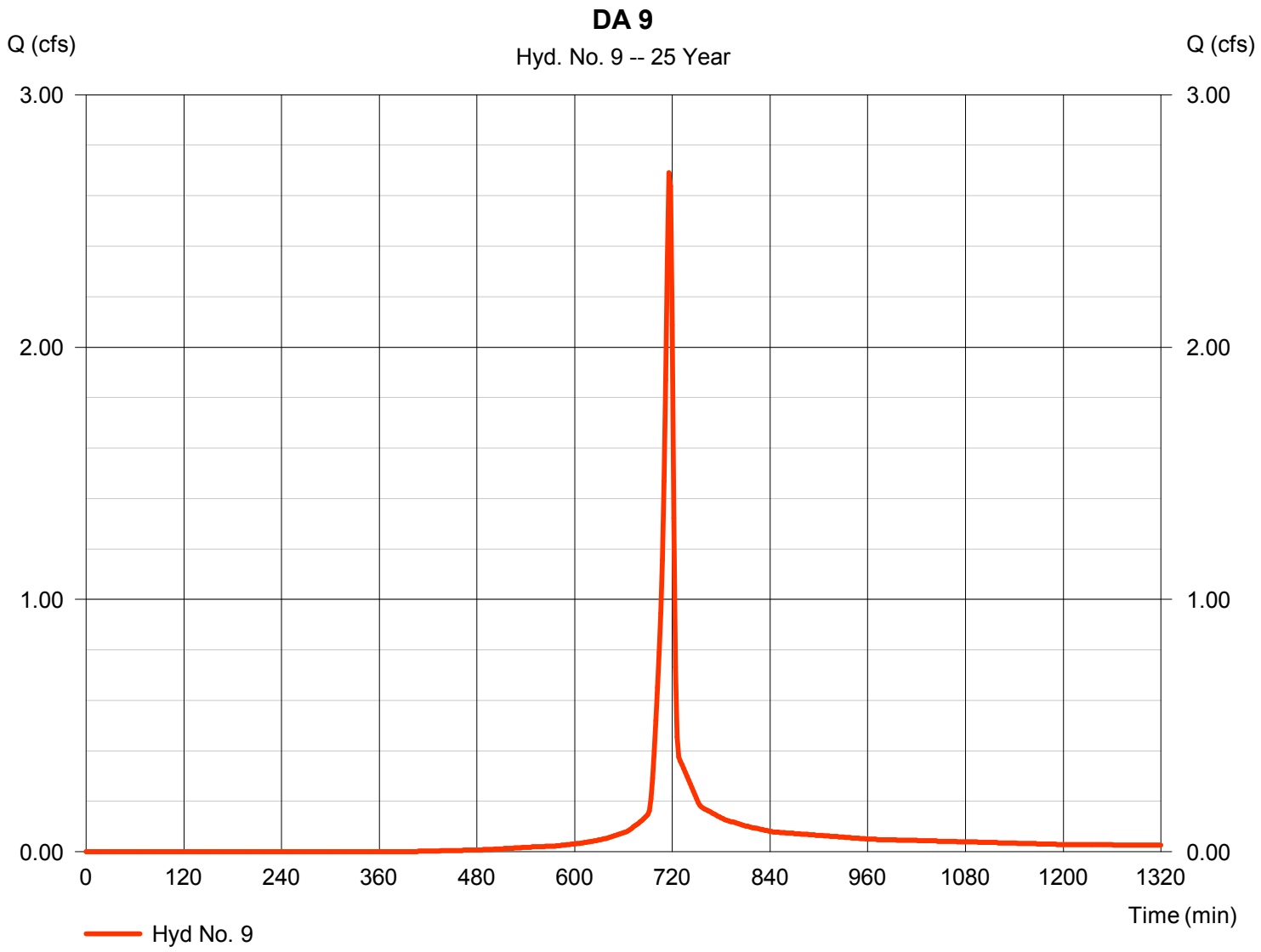
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4 Monday, 08 / 31 / 2015

Hyd. No. 9

DA 9

Hydrograph type	= SCS Runoff	Peak discharge	= 2.691 cfs
Storm frequency	= 25 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 5,515 cuft
Drainage area	= 0.420 ac	Curve number	= 79*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 6.20 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.090 x 98) + (0.330 x 74)] / 0.420



Hydrograph Report

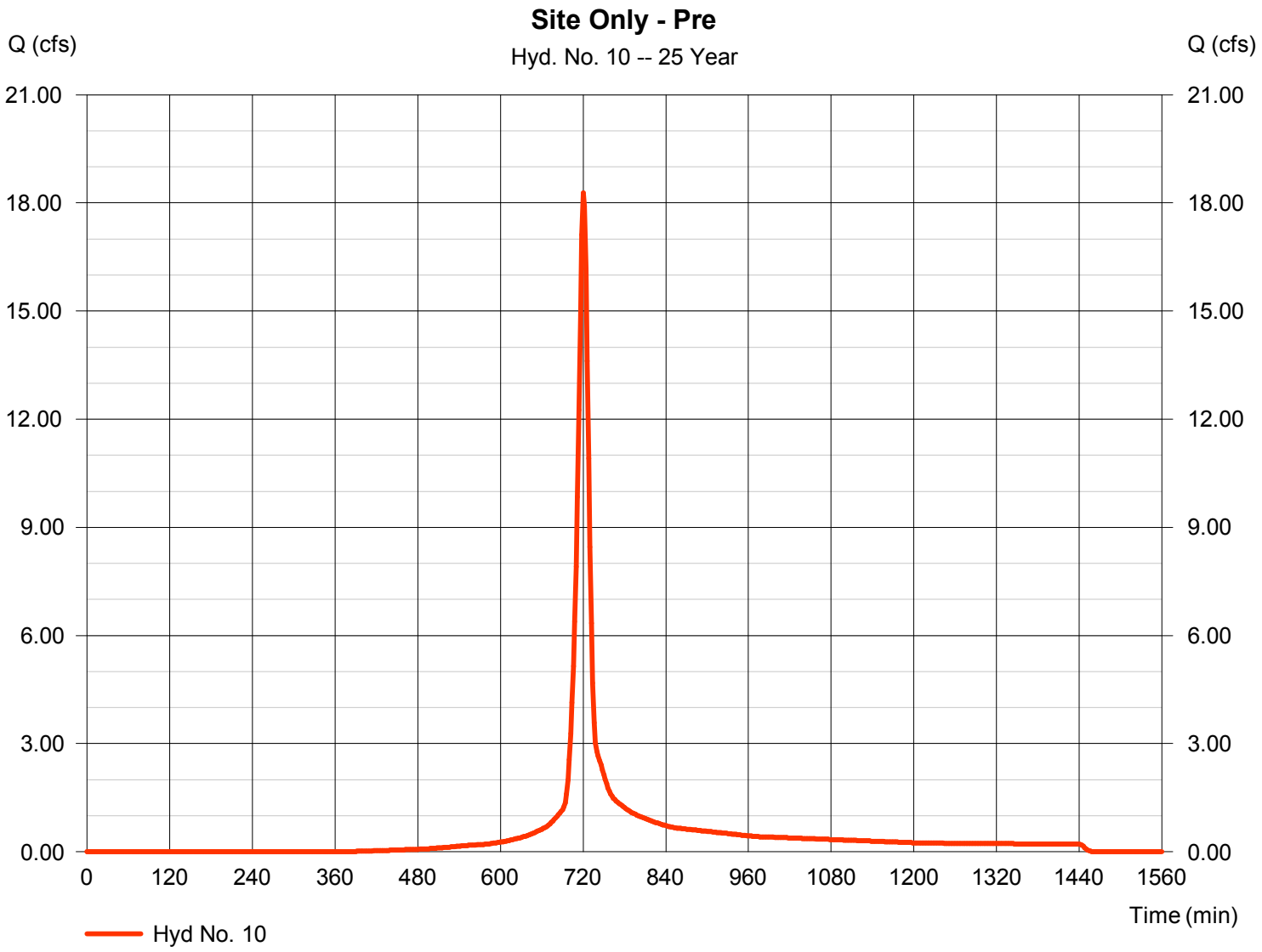
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4 Monday, 08 / 31 / 2015

Hyd. No. 10

Site Only - Pre

Hydrograph type	= SCS Runoff	Peak discharge	= 18.28 cfs
Storm frequency	= 25 yrs	Time to peak	= 720 min
Time interval	= 2 min	Hyd. volume	= 47,760 cuft
Drainage area	= 3.220 ac	Curve number	= 80*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 10.00 min
Total precip.	= 6.20 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(2.820 x 80) + (0.400 x 77)] / 3.220



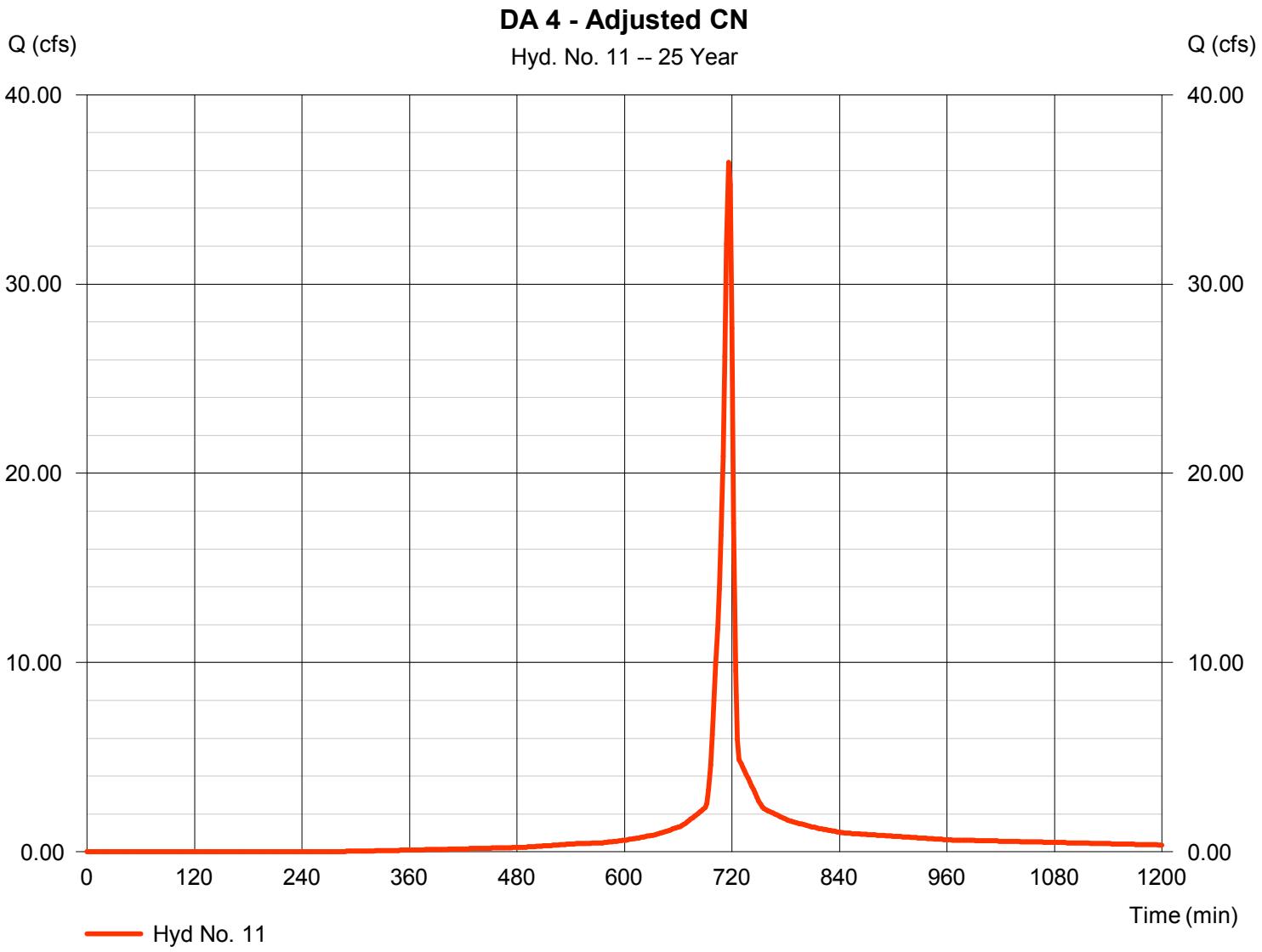
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4 Monday, 08 / 31 / 2015

Hyd. No. 11

DA 4 - Adjusted CN

Hydrograph type	= SCS Runoff	Peak discharge	= 36.44 cfs
Storm frequency	= 25 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 77,172 cuft
Drainage area	= 4.930 ac	Curve number	= 86
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 6.20 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



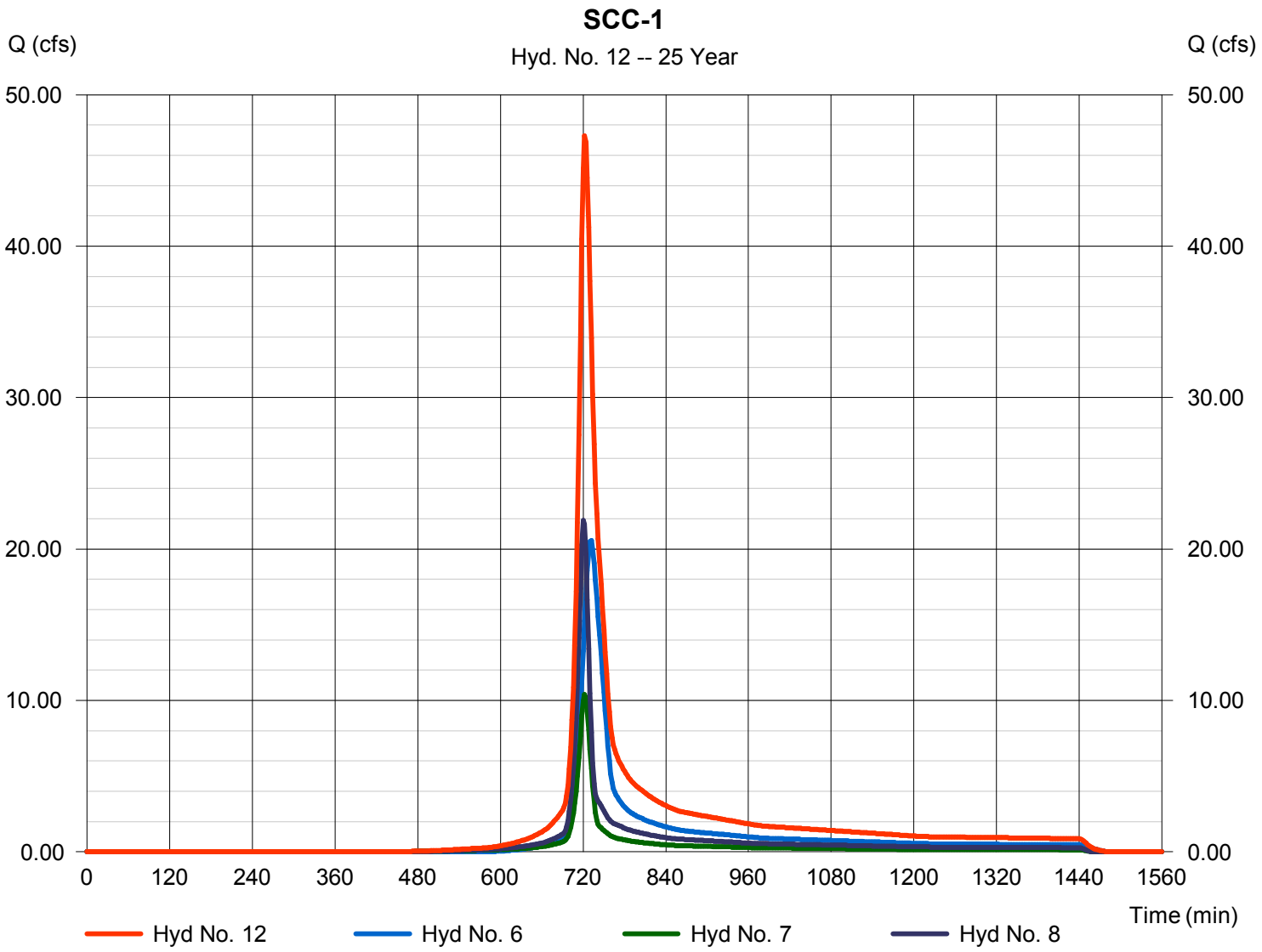
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4 Monday, 08 / 31 / 2015

Hyd. No. 12

SCC-1

Hydrograph type	= Combine	Peak discharge	= 47.29 cfs
Storm frequency	= 25 yrs	Time to peak	= 722 min
Time interval	= 2 min	Hyd. volume	= 169,718 cuft
Inflow hyds.	= 6, 7, 8	Contrib. drain. area	= 15.320 ac



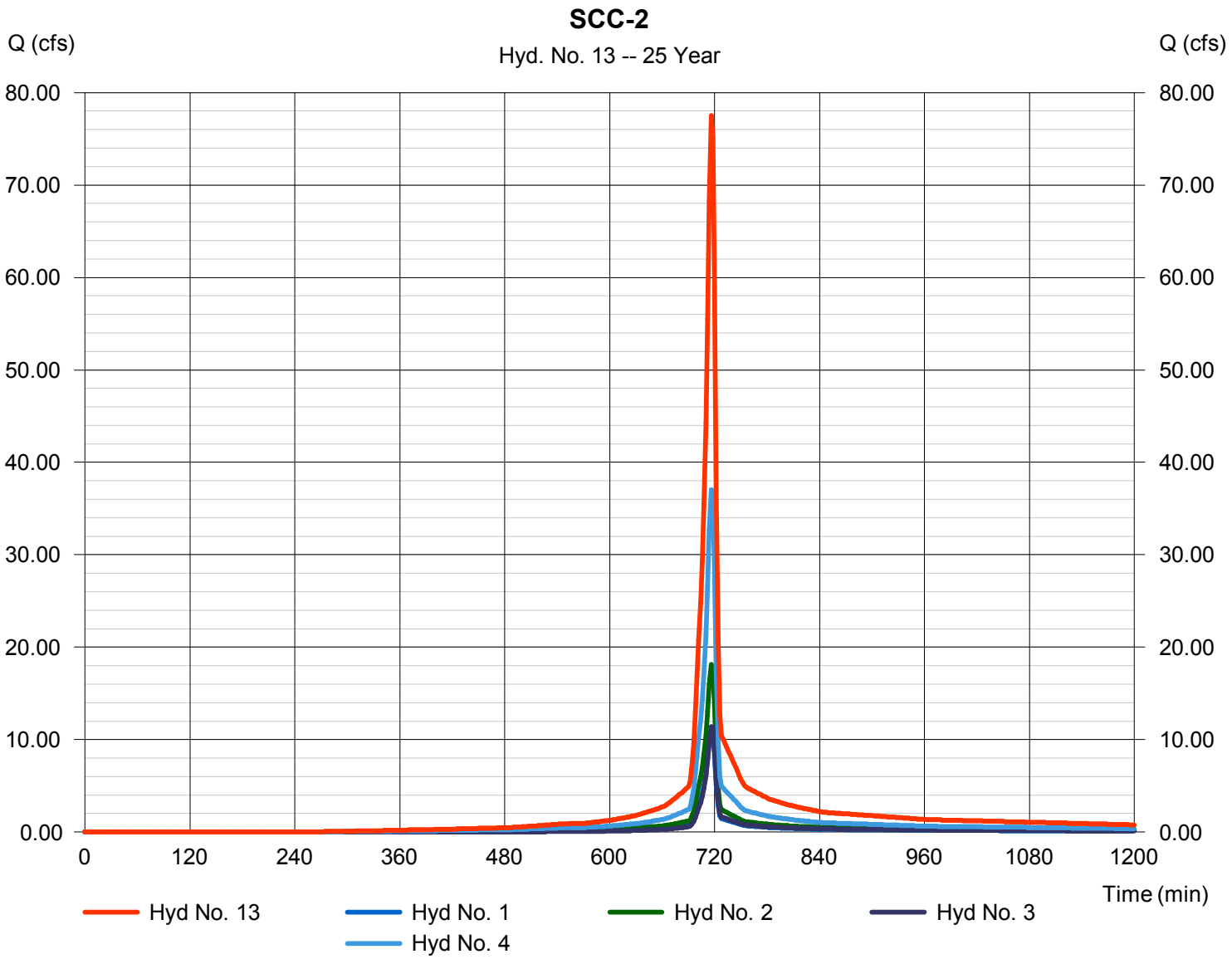
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4 Monday, 08 / 31 / 2015

Hyd. No. 13

SCC-2

Hydrograph type	= Combine	Peak discharge	= 77.49 cfs
Storm frequency	= 25 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 164,074 cuft
Inflow hyds.	= 1, 2, 3, 4	Contrib. drain. area	= 10.710 ac



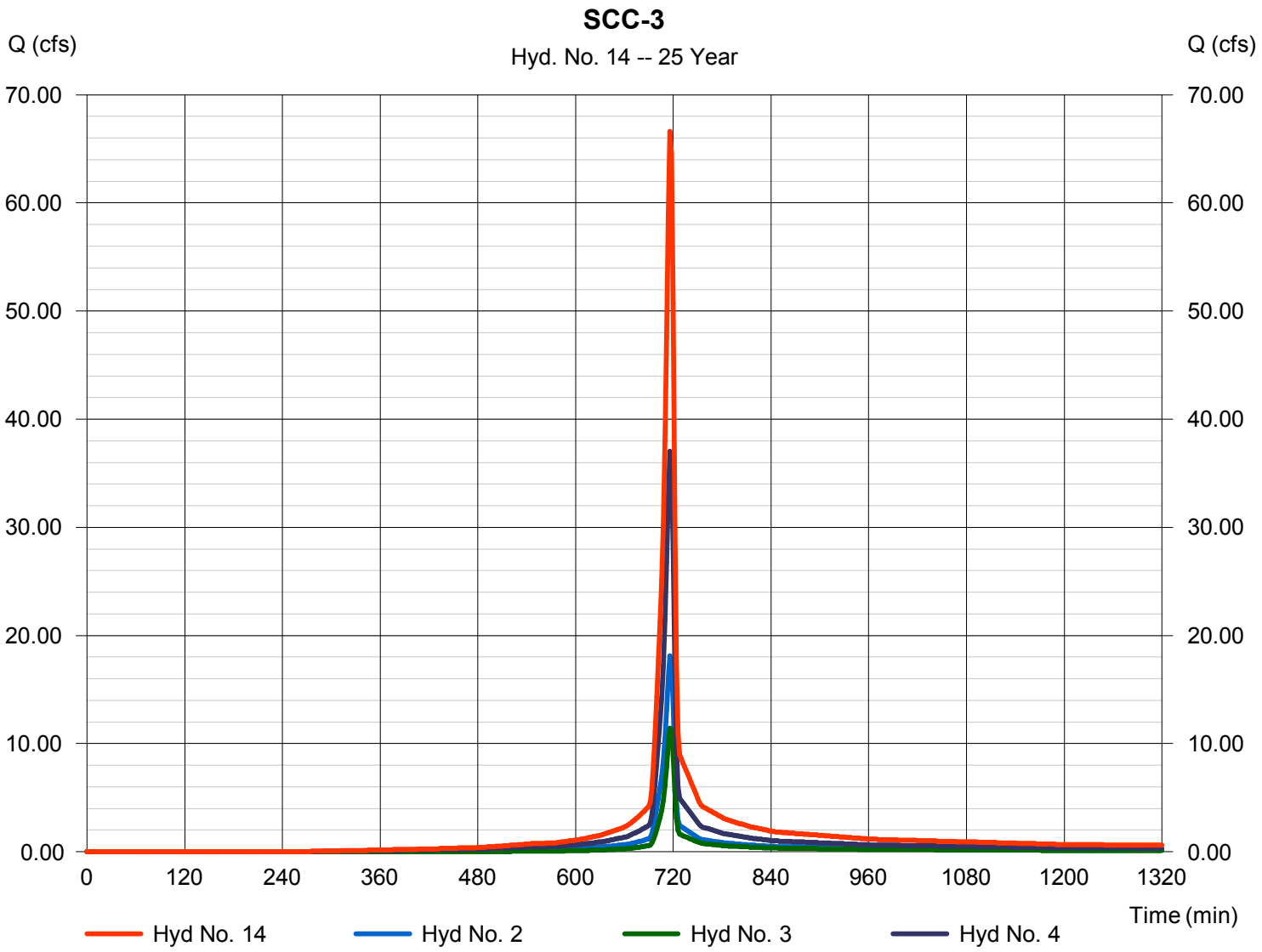
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4 Monday, 08 / 31 / 2015

Hyd. No. 14

SCC-3

Hydrograph type	= Combine	Peak discharge	= 66.59 cfs
Storm frequency	= 25 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 140,839 cuft
Inflow hyds.	= 2, 3, 4	Contrib. drain. area	= 9.260 ac



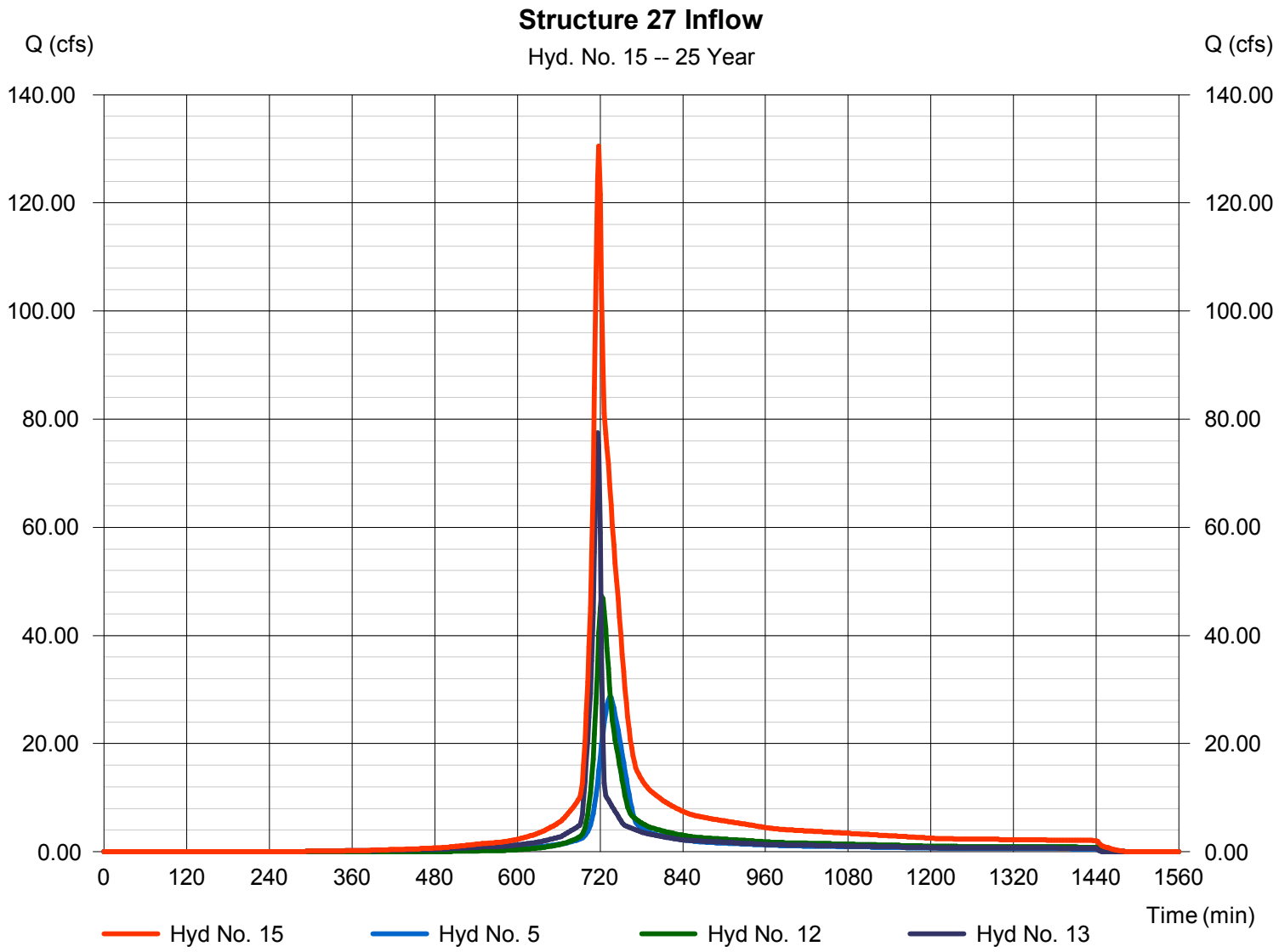
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4 Monday, 08 / 31 / 2015

Hyd. No. 15

Structure 27 Inflow

Hydrograph type	= Combine	Peak discharge	= 130.56 cfs
Storm frequency	= 25 yrs	Time to peak	= 718 min
Time interval	= 2 min	Hyd. volume	= 463,673 cuft
Inflow hyds.	= 5, 12, 13	Contrib. drain. area	= 8.900 ac



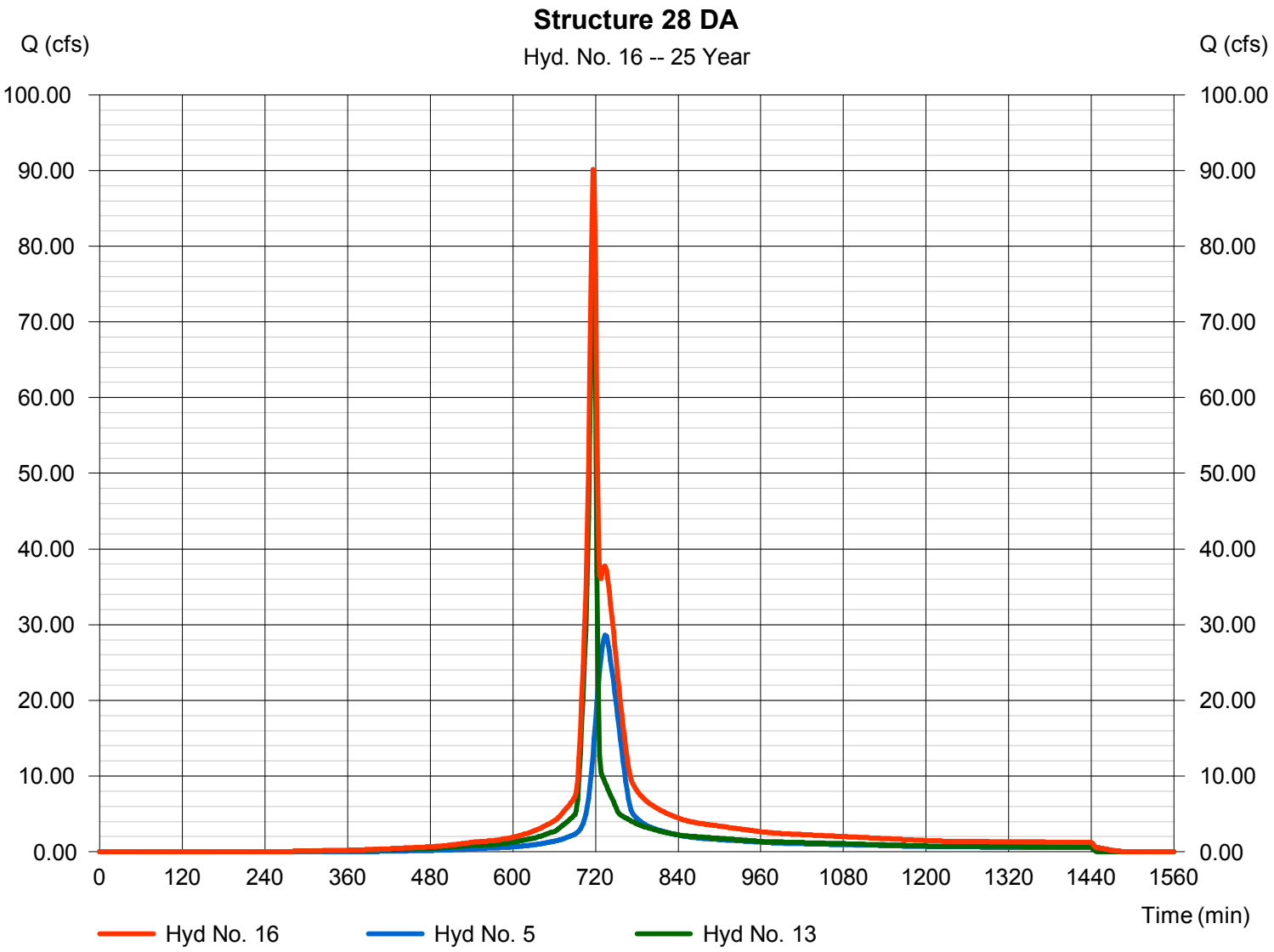
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4 Monday, 08 / 31 / 2015

Hyd. No. 16

Structure 28 DA

Hydrograph type	= Combine	Peak discharge	= 90.13 cfs
Storm frequency	= 25 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 293,956 cuft
Inflow hyds.	= 5, 13	Contrib. drain. area	= 8.900 ac



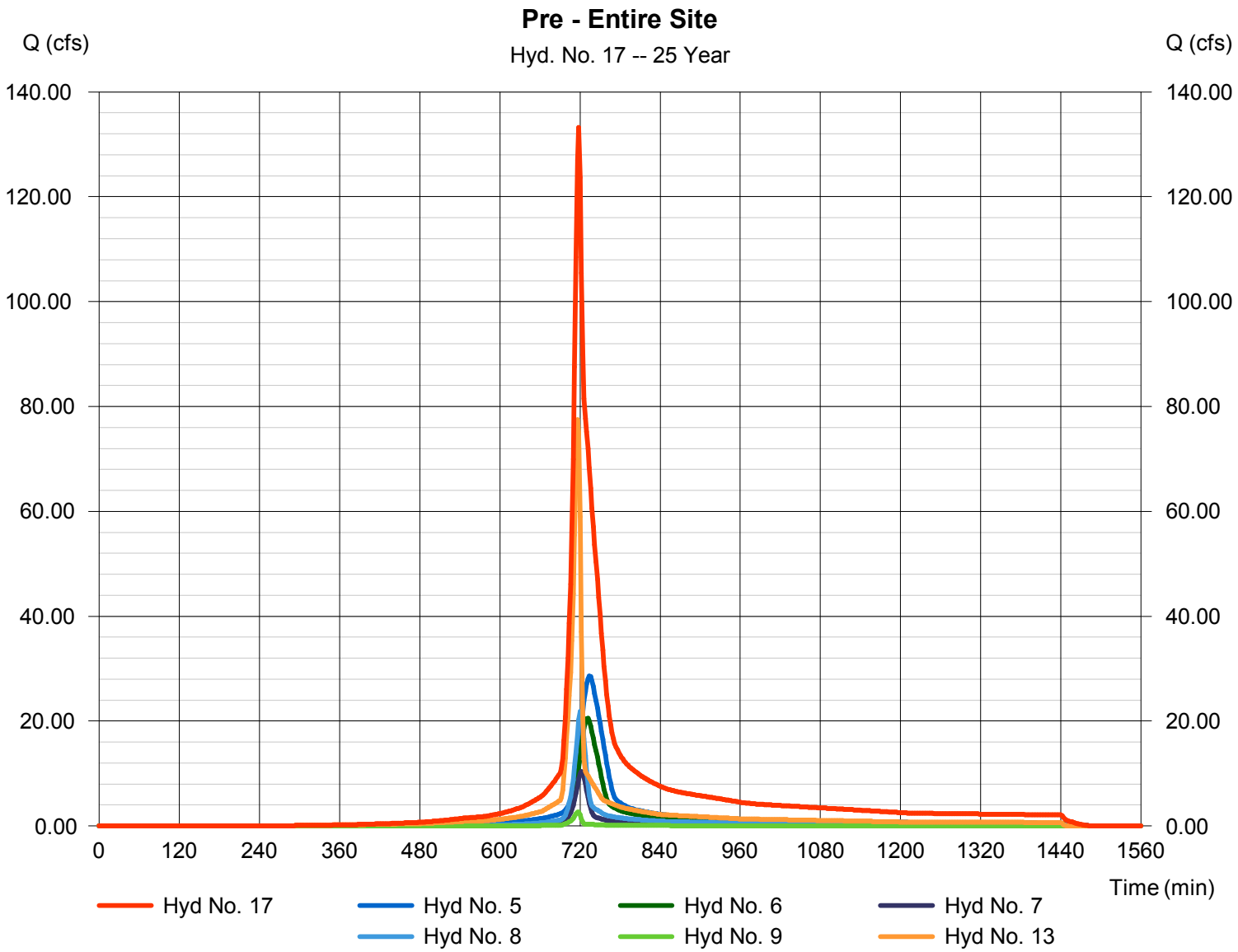
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4 Monday, 08 / 31 / 2015

Hyd. No. 17

Pre - Entire Site

Hydrograph type	= Combine	Peak discharge	= 133.19 cfs
Storm frequency	= 25 yrs	Time to peak	= 718 min
Time interval	= 2 min	Hyd. volume	= 469,189 cuft
Inflow hyds.	= 5, 6, 7, 8, 9, 13	Contrib. drain. area	= 24.640 ac



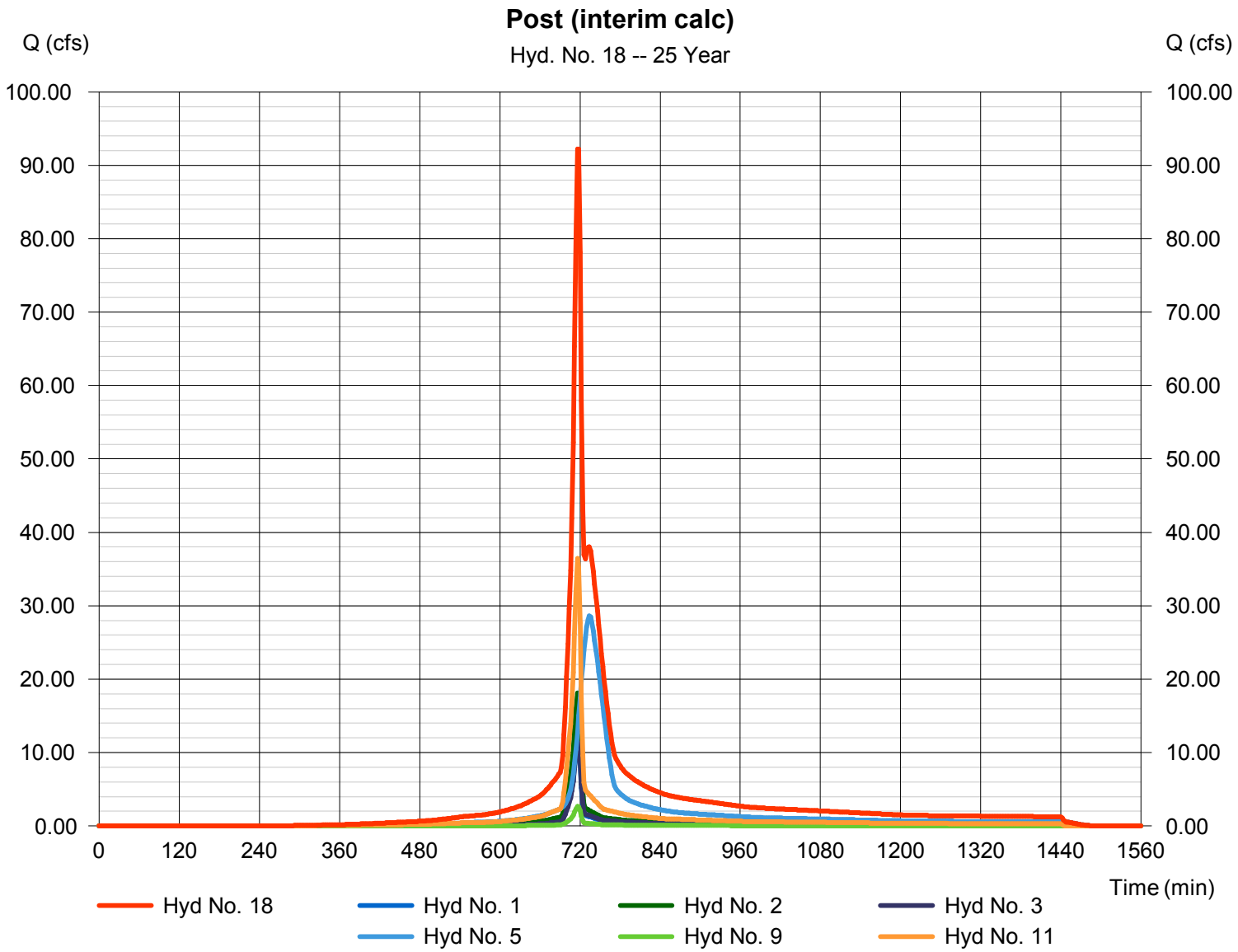
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4 Monday, 08 / 31 / 2015

Hyd. No. 18

Post (interim calc)

Hydrograph type	= Combine	Peak discharge	= 92.20 cfs
Storm frequency	= 25 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 297,642 cuft
Inflow hyds.	= 1, 2, 3, 5, 9, 11	Contrib. drain. area	= 20.030 ac



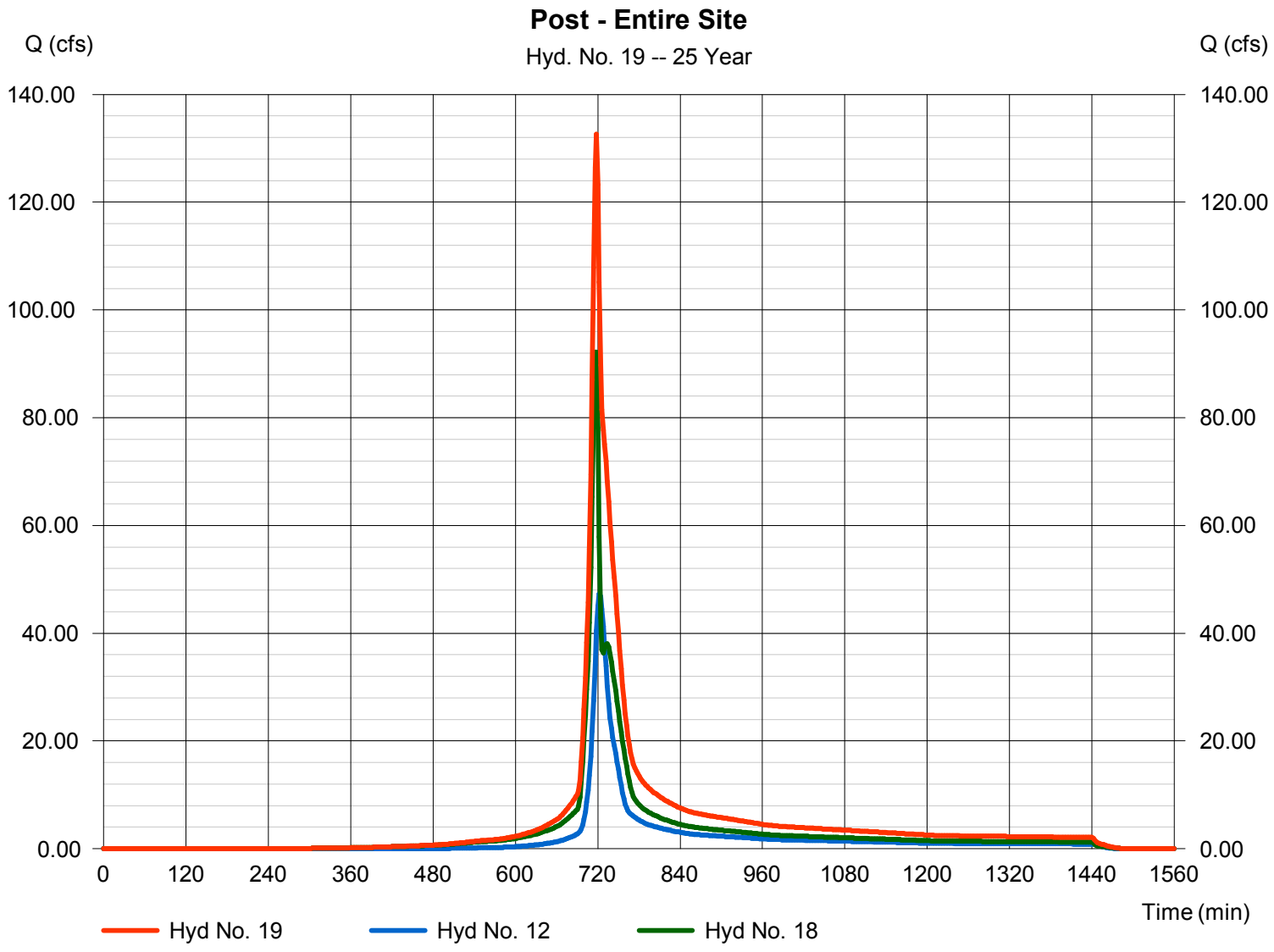
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4 Monday, 08 / 31 / 2015

Hyd. No. 19

Post - Entire Site

Hydrograph type	= Combine	Peak discharge	= 132.65 cfs
Storm frequency	= 25 yrs	Time to peak	= 718 min
Time interval	= 2 min	Hyd. volume	= 467,359 cuft
Inflow hyds.	= 12, 18	Contrib. drain. area	= 0.000 ac



Virginia Runoff Reduction Method New Development Worksheet - v2.8 - June 2014					
To be used w/ DRAFT 2013 BMP Standards and Specifications					
Site Data					
Project Name: Jefferson Park Stormwater Improvements					
Date: August 31, 2015					
	data input cells				
	calculation cells				
	constant values				
1. Post-Development Project & Land Cover Information					
Constants					
Annual Rainfall (inches)	43				
Target Rainfall Event (inches)	1.00				
Phosphorus EMC (mg/L)	0.26		Nitrogen EMC (mg/L)	1.86	
Target Phosphorus Target Load (lb/acre/yr)	0.41				
Pj	0.90				
Land Cover (acres)					
	A soils	**B Soils**	**C Soils**	**D Soils**	**Totals**
Forest/Open Space (acres) -- undisturbed, protected forest/open space or reforested land	0.00	0.00	0.00	0.38	0.38
Managed Turf (acres) -- disturbed, graded for yards or other turf to be mowed/managed	0.00	0.00	0.00	2.95	2.95
Impervious Cover (acres)	0.00	0.00	0.00	0.27	0.27
				Total	3.60
Rv Coefficients					
	A soils	**B Soils**	**C Soils**	**D Soils**	
Forest/Open Space	0.02	0.03	0.04	0.05	
Managed Turf	0.15	0.20	0.22	0.25	
Impervious Cover	0.95	0.95	0.95	0.95	
Land Cover Summary					
Forest/Open Space Cover (acres)	0.38				
Weighted Rv(forest)	0.05				
% Forest	11%				
Managed Turf Cover (acres)	2.95				
Weighted Rv(turf)	0.25				
% Managed Turf	82%				
Impervious Cover (acres)	0.27				
Rv(impervious)	0.95				
% Impervious	8%				
Total Site Area (acres)	3.60				
Site Rv	0.28				
Post-Development Treatment Volume (acre-ft)	0.08				
Post-Development Treatment Volume (cubic feet)	3,677				
Post_Development Load (TP) (lb/yr)	2.31		Post_Development Load (TN) (lb/yr)	16.53	
Total Load (TP) Reduction Required (lb/yr)	0.83				

Drainage Area A

Drainage Area A Land Cover (acres)	A soils	B Soils	C Soils	D Soils	Totals	Land Cover Rv
Forest/Open Space (acres)	0.00	0.00	0.00	0.00	0.00	0.00
Managed Turf (acres)	0.00	0.00	2.31	0.00	2.31	0.22
Impervious Cover (acres)	0.00	0.00	2.62	0.00	2.62	0.95
				Total	4.93	

Post Development Treatment Volume (cf) 10880

Apply Runoff Reduction Practices to Reduce Treatment Volume & Post-Development Load in Drainage Area A

Practice	Unit	Description of Credit	Credit	Credit Area (acres)	Volume from Upstream RR Practice (cf)	Runoff Reduction (cf)	Remaining Runoff Volume (cf)	Phosphorus Efficiency (%)	Phosphorus Load from Upstream RR Practices (lbs)	Untreated Phosphorus Load to Practice (lbs.)	Phosphorus Removed By Practice (lbs.)	Remaining Phosphorus Load (lbs.)	Downstream Treatment to be Employed	Nitrogen Efficiency (%)	Nitrogen Load from Upstream RR Practices (lbs)	Untreated Nitrogen Load to Practice (lbs.)	Nitrogen Removed By Practice (lbs.)	Remaining Nitrogen Load (lbs.)
1. Vegetated Roof														**1. Green Roof**				
1.a. Vegetated Roof #1 (Spec #5)	acres of green roof	45% runoff volume reduction	0.45	0.00	0	0	0	0	0.00	0.00	0.00	0.00		0	0.00	0.00	0.00	0.00
1.b. Vegetated Roof #2 (Spec #5)	acres of green roof	60% runoff volume reduction	0.60	0.00	0	0	0	0	0.00	0.00	0.00	0.00		0	0.00	0.00	0.00	0.00
2. Rooftop Disconnection														**2. Impervious Surface Disconnection**				
2.a. Simple Disconnection to A/B Soils (Spec #1)	impervious acres disconnected	50% runoff volume reduction for treated area	0.50	0.00	0	0	0	0	0.00	0.00	0.00	0.00		0	0.00	0.00	0.00	0.00
2.b. Simple Disconnection to C/D Soils (Spec #1)	impervious acres disconnected	25% runoff volume reduction for treated area	0.25	0.00	0	0	0	0	0.00	0.00	0.00	0.00		0	0.00	0.00	0.00	0.00
2.c. To Soil Amended Filter Path as per specifications (existing C/D soils) (Spec #4)	impervious acres disconnected	50% runoff volume reduction for treated area	0.50	0.00	0	0	0	0	0.00	0.00	0.00	0.00		0	0.00	0.00	0.00	0.00
2.d. To Dry Well or French Drain #1 (Microinfiltration #1) (Spec #8)	impervious acres disconnected	50% runoff volume reduction for treated area	0.50	0.00	0	0	0	25	0.00	0.00	0.00	0.00		15	0.00	0.00	0.00	0.00
2.e. To Dry Well or French Drain #2 (Micro-Infiltration #2) (Spec #8)	impervious acres disconnected	90% runoff volume reduction for treated area	0.90	0.00	0	0	0	25	0.00	0.00	0.00	0.00		15	0.00	0.00	0.00	0.00
2.f. To Rain Garden #1 (Micro-Bioretention #1) (Spec #9)	impervious acres disconnected	40% of volume captured	0.40	0.00	0	0	0	25	0.00	0.00	0.00	0.00		40	0.00	0.00	0.00	0.00
2.g. To Rain Garden #2 (Micro-Bioretention #2) (Spec #9)	impervious acres disconnected	80% runoff volume reduction for treated area	0.80	0.00	0	0	0	50	0.00	0.00	0.00	0.00		60	0.00	0.00	0.00	0.00
2.h. To Rainwater Harvesting (Spec #6)	impervious acres captured	based on tank size and design spreadsheet (See Spec #6)	0.00	0.00	0	0	0	0	0.00	0.00	0.00	0.00		0	0.00	0.00	0.00	0.00
2.i. To Stormwater Planter (Urban Bioretention) (Spec #9, Appendix A)	impervious acres disconnected	40% runoff volume reduction for treated area	0.40	0.00	0	0	0	25	0.00	0.00	0.00	0.00		40	0.00	0.00	0.00	0.00
3. Permeable Pavement														**3. Permeable Pavement**				
3.a. Permeable Pavement #1 (Spec #7)	acres of permeable pavement + acres of "external" (upgradient) impervious	45% runoff volume reduction	0.45	0.00	0	0	0	25	0.00	0.00	0.00	0.00		25	0.00	0.00	0.00	0.00
3.b. Permeable Pavement #2 (Spec #7)	acres of permeable pavement	75% runoff volume reduction	0.75	0.00	0	0	0	25	0.00	0.00	0.00	0.00		25	0.00	0.00	0.00	0.00
4. Grass Channel														**4. Grass Channel**				
4.a. Grass Channel A/B Soils (Spec #3)	impervious acres draining to grass channels	20% runoff volume reduction	0.20	0.00	0	0	0	15	0.00	0.00	0.00	0.00		20	0.00	0.00	0.00	0.00
	turf acres draining to grass channels	20% runoff volume reduction	0.20	0.00	0	0	0	15	0.00	0.00	0.00	0.00		20	0.00	0.00	0.00	0.00
4.b. Grass Channel C/D Soils (Spec #3)	impervious acres draining to grass channels	10% runoff volume reduction	0.10	2.62	0	904	8132	15	0.00	5.67	1.33	4.34		20	0.00	40.56	11.36	29.21
	turf acres draining to grass channels	10% runoff volume reduction	0.10	2.31	0	184	1660	15	0.00	1.16	0.27	0.89		20	0.00	8.28	2.32	5.96
4.c. Grass Channel with Compost Amended Soils as per specs (see Spec #4)	impervious acres draining to grass channels	30% runoff volume reduction	0.20	0.00	0	0	0	15	0.00	0.00	0.00	0.00		20	0.00	0.00	0.00	0.00
	turf acres draining to grass channels	30% runoff volume reduction	0.20	0.00	0	0	0	15	0.00	0.00	0.00	0.00		20	0.00	0.00	0.00	0.00
5. Dry Swale														**5. Dry Swale**				
5.a. Dry Swale #1 (Spec #10)	impervious acres draining to dry swale	40% runoff volume reduction	0.40	0.00	0	0	0	20	0.00	0.00	0.00	0.00		25	0.00	0.00	0.00	0.00
	turf acres draining to dry swale	40% runoff volume reduction	0.40	0.00	0	0	0	20	0.00	0.00	0.00	0.00		25	0.00	0.00	0.00	0.00
5.b. Dry Swale #2 (Spec #10)	impervious acres draining to dry swale	60% runoff volume reduction	0.60	0.00	0	0	0	40	0.00	0.00	0.00	0.00		35	0.00	0.00	0.00	0.00
	turf acres draining to dry swale	60% runoff volume reduction	0.60	0.00	0	0	0	40	0.00	0.00	0.00	0.00		35	0.00	0.00	0.00	0.00
6. Bioretention														**6. Bioretention**				
6.a. Bioretention #1 or Urban Bioretention (Spec #9)	impervious acres draining to bioretention	40% runoff volume reduction	0.40	0.00	0	0	0	25	0.00	0.00	0.00	0.00		40	0.00	0.00	0.00	0.00
	turf acres draining to bioretention	40% runoff volume reduction	0.40	0.00	0	0	0	25	0.00	0.00	0.00	0.00		40	0.00	0.00	0.00	0.00
6.b. Bioretention #2 (Spec #9)	impervious acres draining to bioretention	80% runoff volume reduction	0.80	0.00	0	0	0	50	0.00	0.00	0.00	0.00		60	0.00	0.00	0.00	0.00
	turf acres draining to bioretention	80% runoff volume reduction	0.80	0.00	0	0	0	50	0.00	0.00	0.00	0.00		60	0.00	0.00	0.00	0.00
7. Infiltration														**7. Infiltration**				
7.a. Infiltration #1 (Spec #8)	impervious acres draining to infiltration	50% runoff volume reduction	0.50	0.00	0	0	0	25	0.00	0.00	0.00	0.00		15	0.00	0.00	0.00	0.00
	turf acres draining to infiltration	50% runoff volume reduction	0.50	0.00	0	0	0	25	0.00	0.00	0.00	0.00		15	0.00	0.00	0.00	0.00
7.b. Infiltration #2 (Spec #8)	impervious acres draining to infiltration	90% runoff volume reduction	0.90	0.00	0	0	0	25	0.00	0.00	0.00	0.00		15	0.00	0.00	0.00	0.00
	turf acres draining to infiltration	90% runoff volume reduction	0.90	0.00	0	0	0	25	0.00	0.00	0.00	0.00		15	0.00	0.00	0.00	0.00
8. Extended Detention Pond														**8. Extended Detention Pond**				
8.a. ED #1 (Spec #15)	impervious acres draining to ED	0% runoff volume reduction	0.00	0.00	0	0	0	15	0.00	0.00	0.00	0.00		10	0.00	0.00	0.00	0.00
	turf acres draining to ED	0% runoff volume reduction	0.00	0.00	0	0	0	15	0.00	0.00	0.00	0.00		10	0.00	0.00	0.00	0.00
8.b. ED #2 (Spec #15)	impervious acres draining to ED	15% runoff volume reduction	0.15	0.00	0	0	0	15	0.00	0.00	0.00	0.00		10	0.00	0.00	0.00	0.00
	turf acres draining to ED	15% runoff volume reduction	0.15	0.00	0	0	0	15	0.00	0.00	0.00	0.00		10	0.00	0.00	0.00	0.00
9. Sheetflow to Filter/Open Space														**9. Sheetflow to Conservation Area or Filter Strip**				
9.a. Sheetflow to Conservation Area with A/B Soils (Spec #2)	impervious acres draining to conserved open space	75% runoff volume reduction for treated area	0.75	0.00	0	0	0	0	0.00	0.00	0.00	0.00		0	0.00	0.00	0.00	0.00
	turf acres draining to conserved open space	75% runoff volume reduction for treated area	0.75	0.00	0	0	0	0	0.00	0.00	0.00	0.00		0	0.00	0.00	0.00	0.00
9.b. Sheetflow to Conservation Area with C/D Soils (Spec #2)	impervious acres draining to conserved open space	50% runoff volume reduction for treated area	0.50	0.00	0	0	0	0	0.00	0.00	0.00	0.00		0	0.00	0.00	0.00	0.00
	turf acres draining to conserved open space	50% runoff reduction volume for treated area	0.50	0.00	0	0	0	0	0.00	0.00	0.00	0.00		0	0.00	0.00	0.00	0.00
9.c. Sheetflow to Vegetated Filter Strip in A Soils or Compost Amended B/C/D Soils (Spec #2 & #4)	impervious acres draining to filter strip	50% runoff volume reduction for treated area	0.50	0.00	0	0	0	0	0.00	0.00	0.00	0.00		0	0.00	0.00	0.00	0.00
	turf acres draining to filter strip	50% runoff reduction volume for treated area	0.50	0.00	0	0	0	0	0.00	0.00	0.00	0.00		0	0.00	0.00	0.00	0.00

TOTAL IMPERVIOUS COVER TREATED (ac) 2.62
TOTAL TURF AREA TREATED (ac) 2.31

AREA CHECK OK

TOTAL PHOSPHORUS REMOVAL REQUIRED ON SITE (lb/yr) 0.83
TOTAL RUNOFF REDUCTION IN D.A. A (cf) 1.088
PHOSPHORUS REMOVAL FROM RUNOFF REDUCTION PRACTICES IN D.A. A (lb/yr) 1.60
TOTAL RUNOFF REDUCTION IN D.A. A (cf) 1.088
NITROGEN REMOVAL FROM RUNOFF REDUCTION PRACTICES IN D.A. A (lb/yr) 48.85

SEE WATER QUALITY COMPLIANCE TAB FOR SITE COMPLIANCE CALCULATIONS

Apply Practices that Remove Pollutants but Do Not Reduce Runoff Volume

Practice	Unit	Description of Credit	Credit	Credit Area (acres)	Volume from Upstream RR Practice (cf)	Runoff Reduction (cf)	Remaining Runoff Volume (cf)	Phosphorus Efficiency (%)	Phosphorus Load from Upstream RR Practices (lbs)	Untreated Phosphorus Load to Practice (lbs.)	Phosphorus Removed By Practice (lbs.)	Remaining Phosphorus Load (lbs.)	Downstream Treatment to be Employed	Nitrogen Efficiency (%)	Nitrogen Load from Upstream RR Practices (lbs)	Untreated Nitrogen Load to Practice (lbs.)	Nitrogen Removed By Practice (lbs.)	Remaining Nitrogen Load (lbs.)
10. Wet Swale (Coastal Plain)														**10. Wet Swale (Coastal Plain)**				
10.a. Wet Swale #1 (Spec #11)	impervious acres draining to wet swale	0% runoff volume reduction	0.00	0.00	0	0	0	20	0.00	0.00	0.00	0.00		25	0.00	0.00	0.00	0.00
	turf acres draining to wet swale	0% runoff volume reduction	0.00	0.00	0	0	0	20	0.00	0.00	0.00	0.00		25	0.00	0.00	0.00	0.00
10.b. Wet Swale #2 (Spec #11)	impervious acres draining to wet swale	0% runoff volume reduction	0.00	0.00	0	0	0	40	0.00	0.00	0.00	0.00		35	0.00	0.00	0.00	0.00
	turf acres draining to wet swale	0% runoff volume reduction	0.00	0.00	0	0	0	40	0.00	0.00	0.00	0.00		35	0.00	0.00	0.00	0.00
11. Filtering Practices														**11. Filtering Practices**				
11.a Filtering Practice #1 (Spec #12)	impervious acres draining to filter	0% runoff volume reduction	0.00	0.00	0	0	0	60	0.00	0.00	0.00	0.00		30	0.00	0.00	0.00	0.00
	turf acres draining to filter	0% runoff volume reduction	0.00	0.00	0	0	0	60	0.00	0.00	0.00	0.00		30	0.00	0.00	0.00	0.00
11.b. Filtering Practice #2 (Spec #12)	impervious acres draining to filter	0% runoff volume reduction	0.00	0.00	0	0	0	65	0.00	0.00	0.00	0.00		45	0.00	0.00	0.00	0.00
	turf acres draining to filter	0% runoff volume reduction	0.00	0.00	0	0	0	65	0.00	0.00	0.00	0.00		45	0.00	0.00	0.00	0.00
12. Constructed Wetland														**12. Constructed Wetland**				
12.a Constructed Wetland #1 (Spec #13)	impervious acres draining to wetland	0% runoff volume reduction	0.00	0.00	0	0	0	50	0.00	0.00	0.00	0.00		25	0.00	0.00	0.00	0.00
	turf acres draining to wetland	0% runoff volume reduction	0.00	0.00	0	0	0	50	0.00	0.00	0.00	0.00		25	0.00	0.00	0.00	0.00
12.b. Constructed Wetland #2 (Spec #13)	impervious acres draining to wetland	0% runoff volume reduction	0.00	0.00	0	0	0	75	0.00	0.00	0.00	0.00		55	0.00	0.00	0.00	0.00
	turf acres draining to wetland	0% runoff volume reduction	0.00	0.00	0	0	0	75	0.00	0.00	0.00	0.00		55	0.00	0.00	0.00	0.00
13. Wet Ponds														**13. Wet Ponds**				
13.a. Wet Pond #1 (Spec #14)	impervious acres draining to wet pond	0% runoff volume reduction	0.00	0.00	0	0	0	50	0.00	0.00	0.00	0.00		30	0.00	0.00	0.00	0.00
	turf acres draining to wet pond	0% runoff volume reduction	0.00	0.00	0	0	0	50	0.00	0.00	0.00	0.00		30	0.00	0.00	0.00	0.00

13.b. Wet Pond #1 (Coastal Plain) (Spec #14)	impervious acres draining to wet pond	0% runoff volume reduction	0.00	0.00	0	0	0	45	0.00	0.00	0.00	0.00			20	0.00	0.00	0.00	0.00	
	turf acres draining to wet pond	0% runoff volume reduction	0.00	0.00	0	0	0	45	0.00	0.00	0.00	0.00			20	0.00	0.00	0.00	0.00	
13.c. Wet Pond #2 (Spec #14)	impervious acres draining to wet pond	0% runoff volume reduction	0.00	0.00	0	0	0	75	0.00	0.00	0.00	0.00			40	0.00	0.00	0.00	0.00	
	turf acres draining to wet pond	0% runoff volume reduction	0.00	0.00	0	0	0	75	0.00	0.00	0.00	0.00			40	0.00	0.00	0.00	0.00	
13.d. Wet Pond #2 (Coastal Plain) (Spec #14)	impervious acres draining to wet pond	0% runoff volume reduction	0.00	0.00	0	0	0	65	0.00	0.00	0.00	0.00			30	0.00	0.00	0.00	0.00	
	turf acres draining to wet pond	0% runoff volume reduction	0.00	0.00	0	0	0	65	0.00	0.00	0.00	0.00			30	0.00	0.00	0.00	0.00	
14. Manufactured BMP															**14. Manufactured BMP**					
14. Vortechs	impervious acres draining to device	0% runoff volume reduction	0.00	0.00	0	0	0	20	0.00	0.00	0.00	0.00			25	0.00	0.00	0.00	0.00	
	turf acres draining to device	0% runoff volume reduction	0.00	0.00	0	0	0	20	0.00	0.00	0.00	0.00			25	0.00	0.00	0.00	0.00	

TOTAL IMPERVIOUS COVER TREATED (ac)	2.62
TOTAL TURF AREA TREATED (ac)	2.31
AREA CHECK	OK
PHOSPHORUS REMOVAL BY PRACTICES THAT DO NOT REDUCE RUNOFF VOLUME IN D.A. A	0.00
TOTAL PHOSPHORUS REMOVAL IN D.A. A (lb/yr)	1.60
SEE WATER QUALITY COMPLIANCE TAB FOR SITE COMPLIANCE CALCULATIONS	
NITROGEN REMOVAL BY PRACTICES THAT DO NOT REDUCE RUNOFF VOLUME IN D.A. A	0.00
TOTAL NITROGEN REMOVAL IN D.A. A (lb/yr)	49.85

Site Results						
	D.A. A	D.A. B	D.A. C	D.A. D	D.A. E	AREA CHECK
IMPERVIOUS COVER	2.62	0.00	0.00	0.00	0.00	AREA EXCEEDED!
IMPERVIOUS COVER TREATED	2.62	0.00	0.00	0.00	0.00	AREA EXCEEDED!
TURF AREA	2.31	0.00	0.00	0.00	0.00	OK.
TURF AREA TREATED	2.31	0.00	0.00	0.00	0.00	OK.
AREA CHECK	OK.	OK.	OK.	OK.	OK.	
Phosphorus						
TOTAL TREATMENT VOLUME (cf)	3,677					
TOTAL PHOSPHORUS LOAD REDUCTION REQUIRED (LB/YEAR)	0.83					
RUNOFF REDUCTION (cf)	1088					
PHOSPHORUS LOAD REDUCTION ACHIEVED (LB/YR)	1.60					
ADJUSTED POST-DEVELOPMENT PHOSPHORUS LOAD (TP) (lb/yr)	0.71					
REMAINING PHOSPHORUS LOAD REDUCTION (LB/YR) NEEDED	CONGRATULATIONS!! YOU EXCEEDED THE TARGET REDUCTION BY 0.8 LB/YEAR!!					
Nitrogen (for information purposes)						
TOTAL TREATMENT VOLUME (cf)	3,677					
RUNOFF REDUCTION (cf)	1088					
NITROGEN LOAD REDUCTION ACHIEVED (LB/YR)	48.85					
ADJUSTED POST-DEVELOPMENT NITROGEN LOAD (TN) (lb/yr)	-32.32					

		1-year storm	2-year storm	10-year storm		
Target Rainfall Event (in)		2.80	3.30	5.00		
Drainage Area A						
Drainage Area (acres)	4.93					
Runoff Reduction Volume (cf)	1,088					
Drainage Area B						
Drainage Area (acres)	0.00					
Runoff Reduction Volume (cf)	0					
Drainage Area C						
Drainage Area (acres)	0.00					
Runoff Reduction Volume (cf)	0					
Drainage Area D						
Drainage Area (acres)	0.00					
Runoff Reduction Volume (cf)	0					
Drainage Area E						
Drainage Area (acres)	0.00					
Runoff Reduction Volume (cf)	0					

Based on the use of Runoff Reduction practices in the selected drainage areas, the spreadsheet calculates an adjusted $RV_{Developed}$ and adjusted Curve Number.

Drainage Area A		**A soils**	**B Soils**	**C Soils**	**D Soils**	
Forest/Open Space -- undisturbed, protected forest/open space or reforested land	Area (acres)	0.00	0.00	0.00	0.00	
	CN	30	55	70	77	
Managed Turf -- disturbed, graded for yards or other turf to be mowed/managed	Area (acres)	0.00	0.00	2.31	0.00	
	CN	39	61	74	80	
Impervious Cover	Area (acres)	0.00	0.00	2.62	0.00	
	CN	98	98	98	98	
					Weighted CN	**S**
					87	1.49
		1-year storm	**2-year storm**	**10-year storm**		
$RV_{Developed}$ (in) with no Runoff Reduction		1.57	2.00	3.57		
$RV_{Developed}$ (in) with Runoff Reduction		1.50	1.94	3.51		
	Adjusted CN	**86**	**86**	**86**		

Drainage Area B		**A soils**	**B Soils**	**C Soils**	**D Soils**	
Forest/Open Space -- undisturbed, protected forest/open space or reforested land	Area (acres)	0.00	0.00	0.00	0.00	
	CN	30	55	70	77	
Managed Turf -- disturbed, graded for yards or other turf to be mowed/managed	Area (acres)	0.00	0.00	0.00	0.00	
	CN	39	61	74	80	
Impervious Cover	Area (acres)	0.00	0.00	0.00	0.00	
	CN	98	98	98	98	
					Weighted CN	**S**
					0	1000.00
		1-year storm	**2-year storm**	**10-year storm**		
$RV_{Developed}$ (in) with no Runoff Reduction		0.00	0.00	0.00		
$RV_{Developed}$ (in) with Runoff Reduction		0.00	0.00	0.00		
	Adjusted CN	**#N/A**	**#N/A**	**#N/A**		

Drainage Area C		**A soils**	**B Soils**	**C Soils**	**D Soils**	
Forest/Open Space -- undisturbed, protected forest/open space or reforested land	Area (acres)	0.00	0.00	0.00	0.00	
	CN	30	55	70	77	
Managed Turf -- disturbed, graded for yards or other turf to be mowed/managed	Area (acres)	0.00	0.00	0.00	0.00	
	CN	39	61	74	80	
Impervious Cover	Area (acres)	0.00	0.00	0.00	0.00	
	CN	98	98	98	98	
					Weighted CN	**S**
					0	1000.00
		1-year storm	**2-year storm**	**10-year storm**		
$RV_{Developed}$ (in) with no Runoff Reduction		0.00	0.00	0.00		
$RV_{Developed}$ (in) with Runoff Reduction		0.00	0.00	0.00		
	Adjusted CN	**#N/A**	**#N/A**	**#N/A**		

Drainage Area D		**A soils**	**B Soils**	**C Soils**	**D Soils**	
Forest/Open Space -- undisturbed, protected forest/open space or reforested land	Area (acres)	0.00	0.00	0.00	0.00	
	CN	30	55	70	77	
Managed Turf -- disturbed, graded for yards or other turf to be mowed/managed	Area (acres)	0.00	0.00	0.00	0.00	
	CN	39	61	74	80	
Impervious Cover	Area (acres)	0.00	0.00	0.00	0.00	
	CN	98	98	98	98	
					Weighted CN	**S**
					0	1000.00
		1-year storm	**2-year storm**	**10-year storm**		
$RV_{Developed}$ (in) with no Runoff Reduction		0.00	0.00	0.00		
$RV_{Developed}$ (in) with Runoff Reduction		0.00	0.00	0.00		
	Adjusted CN	**#N/A**	**#N/A**	**#N/A**		

Drainage Area E		**A soils**	**B Soils**	**C Soils**	**D Soils**	
Forest/Open Space -- undisturbed, protected forest/open space or reforested land	Area (acres)	0.00	0.00	0.00	0.00	
	CN	30	55	70	77	

Managed Turf -- disturbed, graded for yards or other turf to be mowed/managed		Area (acres)	0.00	0.00	0.00	0.00	
		CN	39	61	74	80	
Impervious Cover		Area (acres)	0.00	0.00	0.00	0.00	
		CN	98	98	98	98	
						Weighted CN	**S**
						0	1000.00
			1-year storm	**2-year storm**	**10-year storm**		
		$RV_{Developed}$ (in) with no Runoff Reduction	0.00	0.00	0.00		
		$RV_{Developed}$ (in) with Runoff Reduction	0.00	0.00	0.00		
		Adjusted CN	**#N/A**	**#N/A**	**#N/A**		
.							

Channel Report

Hydraflow Express Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. Thursday, Aug 27 2015

SCC-4

Water Quality Swale (1-inch Storm)

Trapezoidal

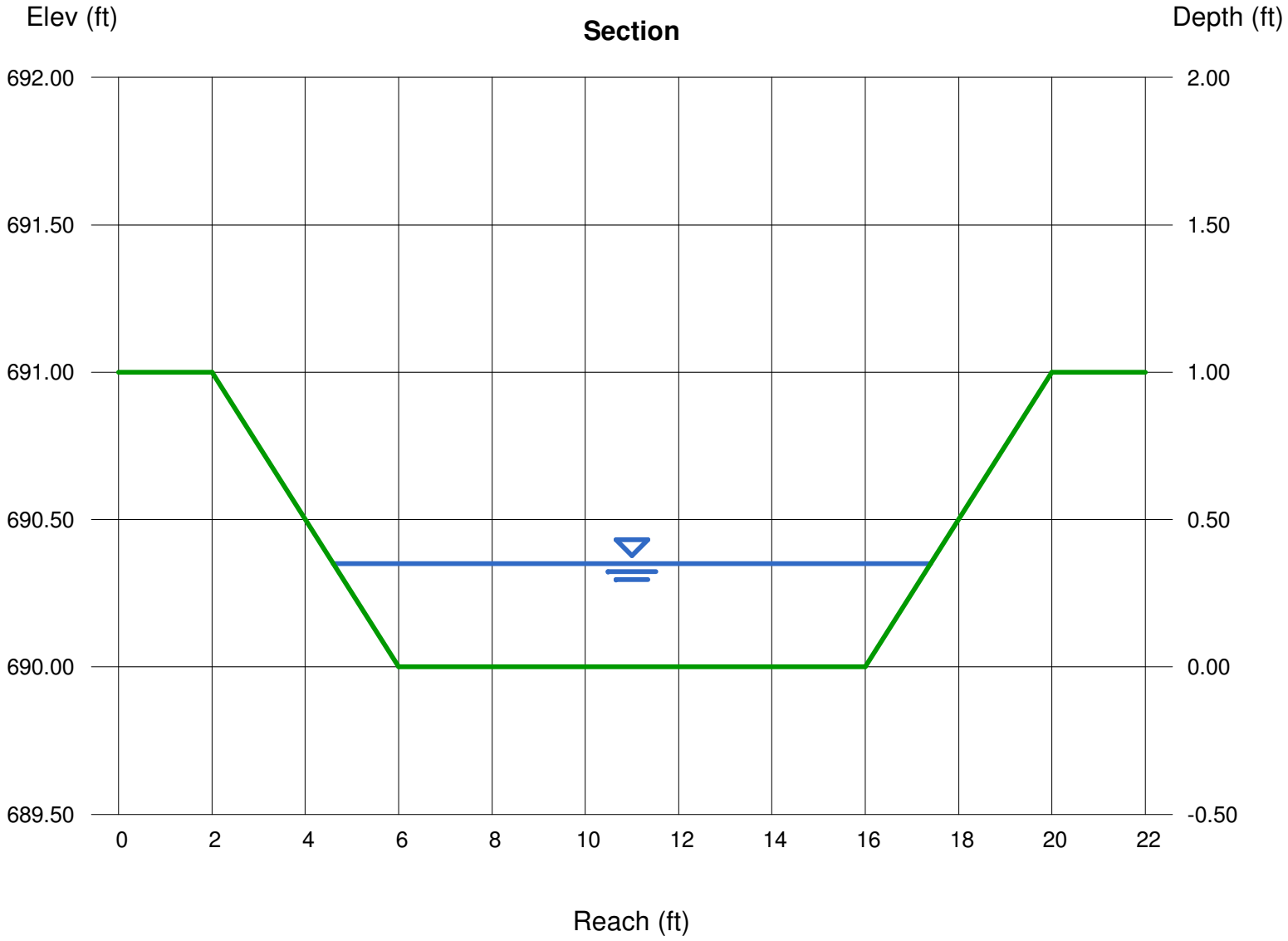
Bottom Width (ft)	=	10.00
Side Slopes (z:1)	=	4.00, 4.00
Total Depth (ft)	=	1.00
Invert Elev (ft)	=	690.00
Slope (%)	=	1.90
N-Value	=	0.200

Calculations

Compute by:		Known Q
Known Q (cfs)	=	1.80

Highlighted

Depth (ft)	=	0.35
Q (cfs)	=	1.800
Area (sqft)	=	3.99
Velocity (ft/s)	=	0.45
Wetted Perim (ft)	=	12.89
Crit Depth, Yc (ft)	=	0.10
Top Width (ft)	=	12.80
EGL (ft)	=	0.35
Length (ft)	=	300
Res Time (min)	=	11



Hydrograph Report

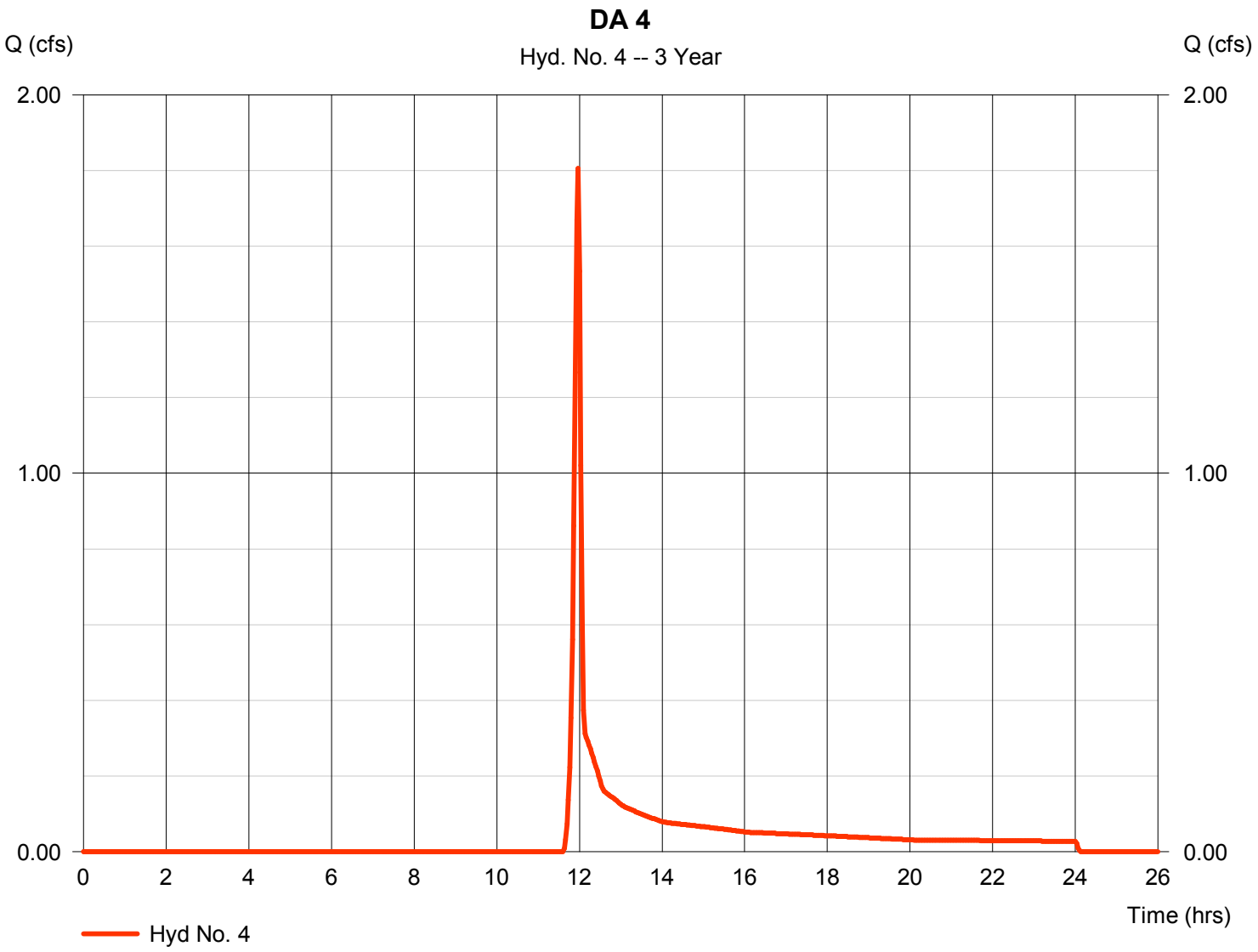
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4 Monday, 08 / 31 / 2015

Hyd. No. 4 (Water Quality Swale Inflow)

DA 4

Hydrograph type	= SCS Runoff	Peak discharge	= 1.805 cfs
Storm frequency	= WQV	Time to peak	= 11.97 hrs
Time interval	= 2 min	Hyd. volume	= 3,757 cuft
Drainage area	= 4.930 ac	Curve number	= 87*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 1.00 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(2.620 x 98) + (2.310 x 74)] / 4.930



Channel Report

Hydraflow Express Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. Thursday, Aug 27 2015

SCC-1 (Min Slope)

Trapezoidal

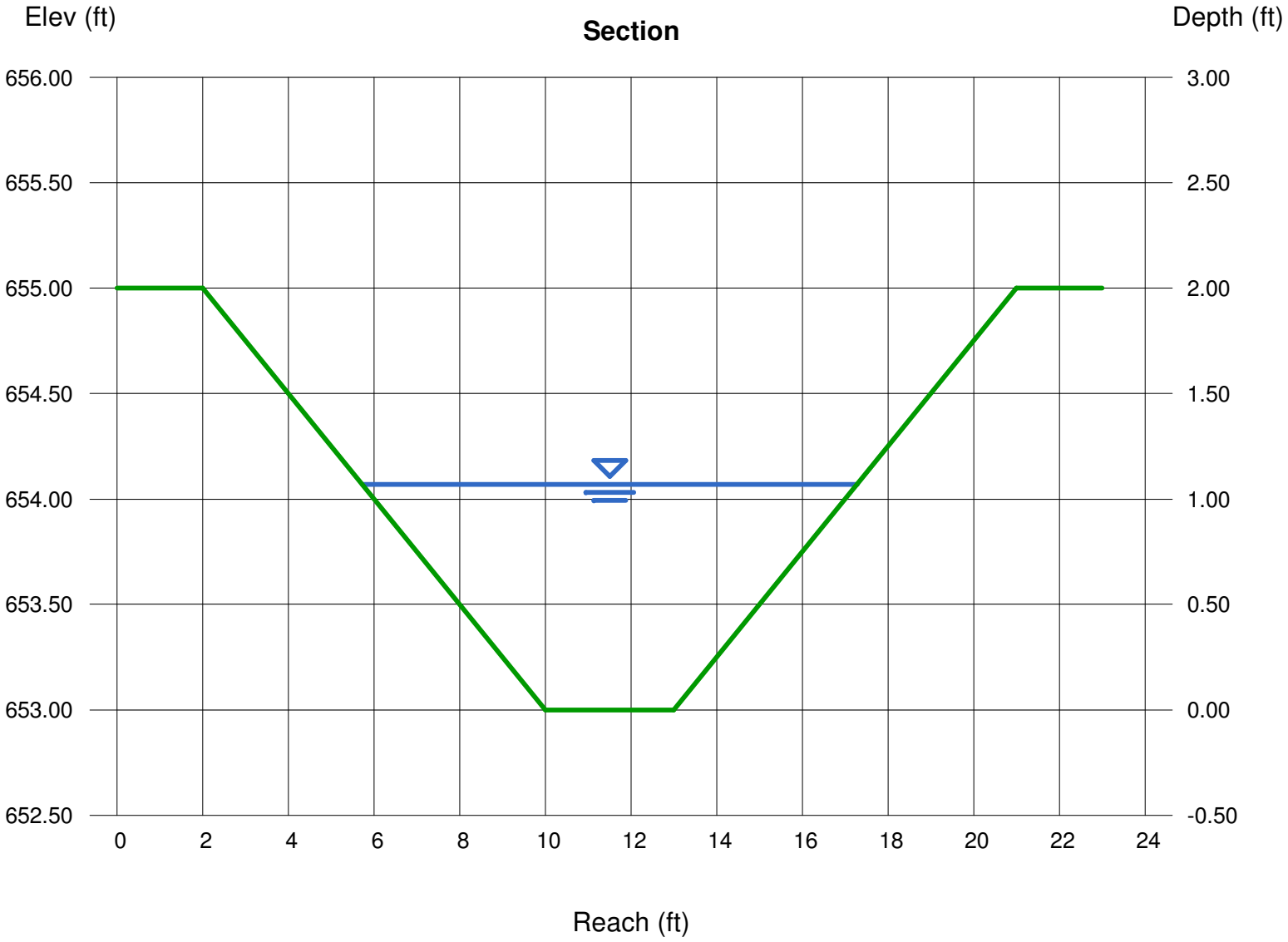
Bottom Width (ft)	=	3.00
Side Slopes (z:1)	=	4.00, 4.00
Total Depth (ft)	=	2.00
Invert Elev (ft)	=	653.00
Slope (%)	=	2.80
N-Value	=	0.030

Calculations

Compute by:		Known Q
Known Q (cfs)	=	48.00

Highlighted

Depth (ft)	=	1.07
Q (cfs)	=	48.00
Area (sqft)	=	7.79
Velocity (ft/s)	=	6.16
Wetted Perim (ft)	=	11.82
Crit Depth, Yc (ft)	=	1.23
Top Width (ft)	=	11.56
EGL (ft)	=	1.66



Channel Report

Hydraflow Express Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. Thursday, Aug 27 2015

SCC-1 (Max Slope)

Trapezoidal

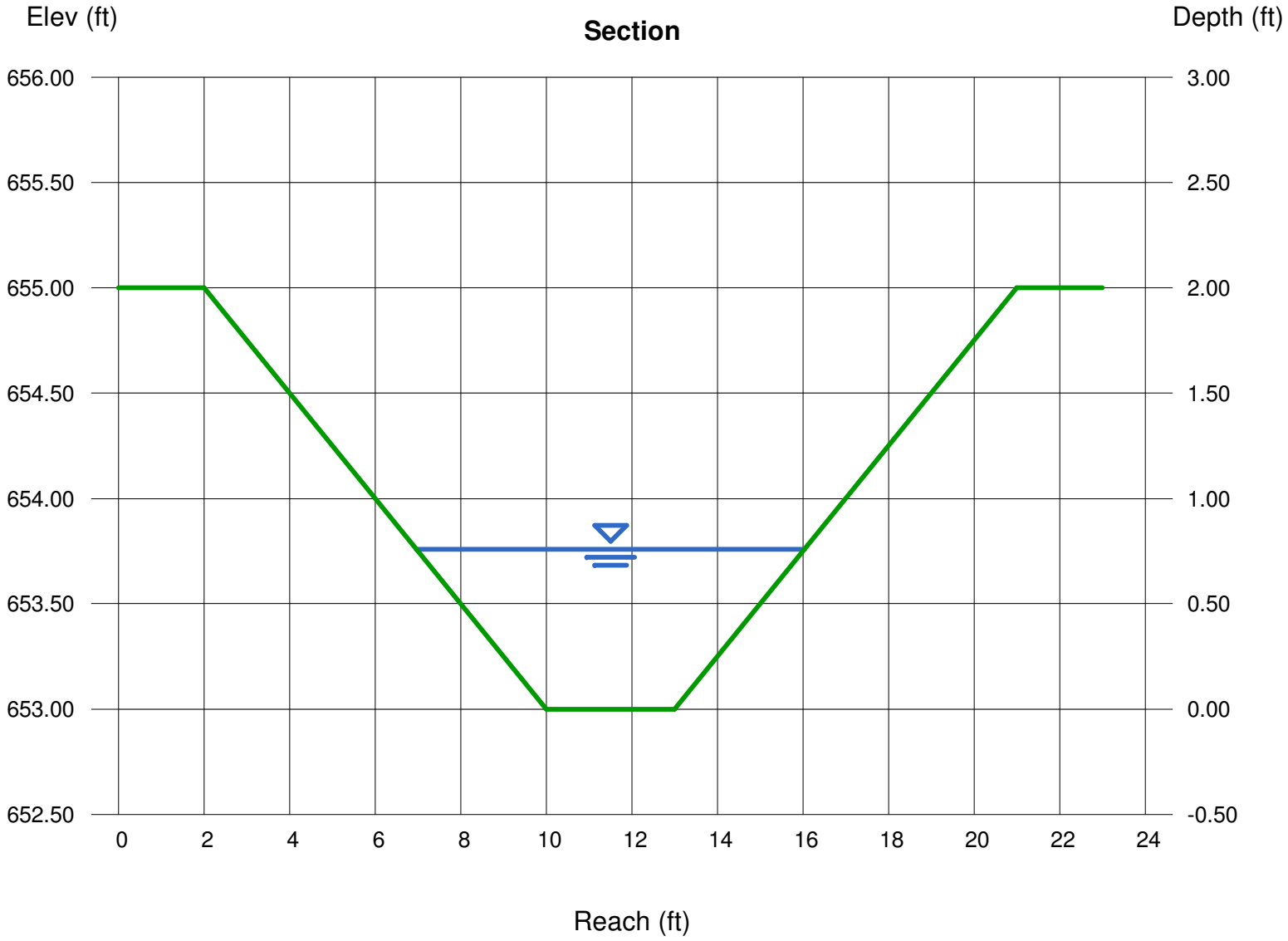
Bottom Width (ft)	=	3.00
Side Slopes (z:1)	=	4.00, 4.00
Total Depth (ft)	=	2.00
Invert Elev (ft)	=	653.00
Slope (%)	=	11.50
N-Value	=	0.030

Calculations

Compute by:		Known Q
Known Q (cfs)	=	48.00

Highlighted

Depth (ft)	=	0.76
Q (cfs)	=	48.00
Area (sqft)	=	4.59
Velocity (ft/s)	=	10.46
Wetted Perim (ft)	=	9.27
Crit Depth, Yc (ft)	=	1.23
Top Width (ft)	=	9.08
EGL (ft)	=	2.46



Channel Report

Hydraflow Express Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. Thursday, Aug 27 2015

SCC-2 (Min Slope)

Trapezoidal

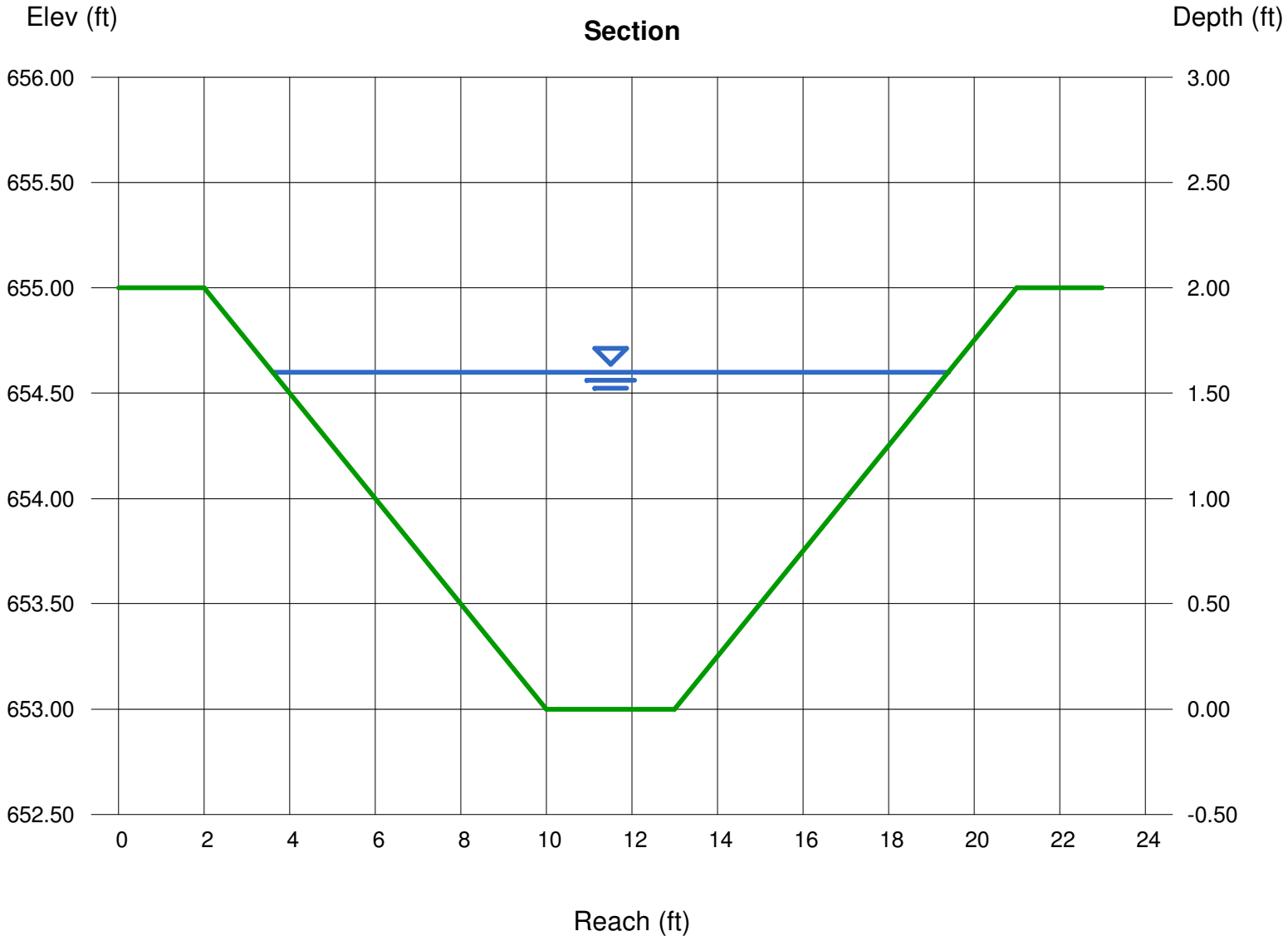
Bottom Width (ft)	=	3.00
Side Slopes (z:1)	=	4.00, 4.00
Total Depth (ft)	=	2.00
Invert Elev (ft)	=	653.00
Slope (%)	=	1.20
N-Value	=	0.030

Calculations

Compute by:		Known Q
Known Q (cfs)	=	77.00

Highlighted

Depth (ft)	=	1.60
Q (cfs)	=	77.00
Area (sqft)	=	15.04
Velocity (ft/s)	=	5.12
Wetted Perim (ft)	=	16.19
Crit Depth, Yc (ft)	=	1.55
Top Width (ft)	=	15.80
EGL (ft)	=	2.01



Channel Report

Hydraflow Express Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. Thursday, Aug 27 2015

SCC-2 (Max Slope)

Trapezoidal

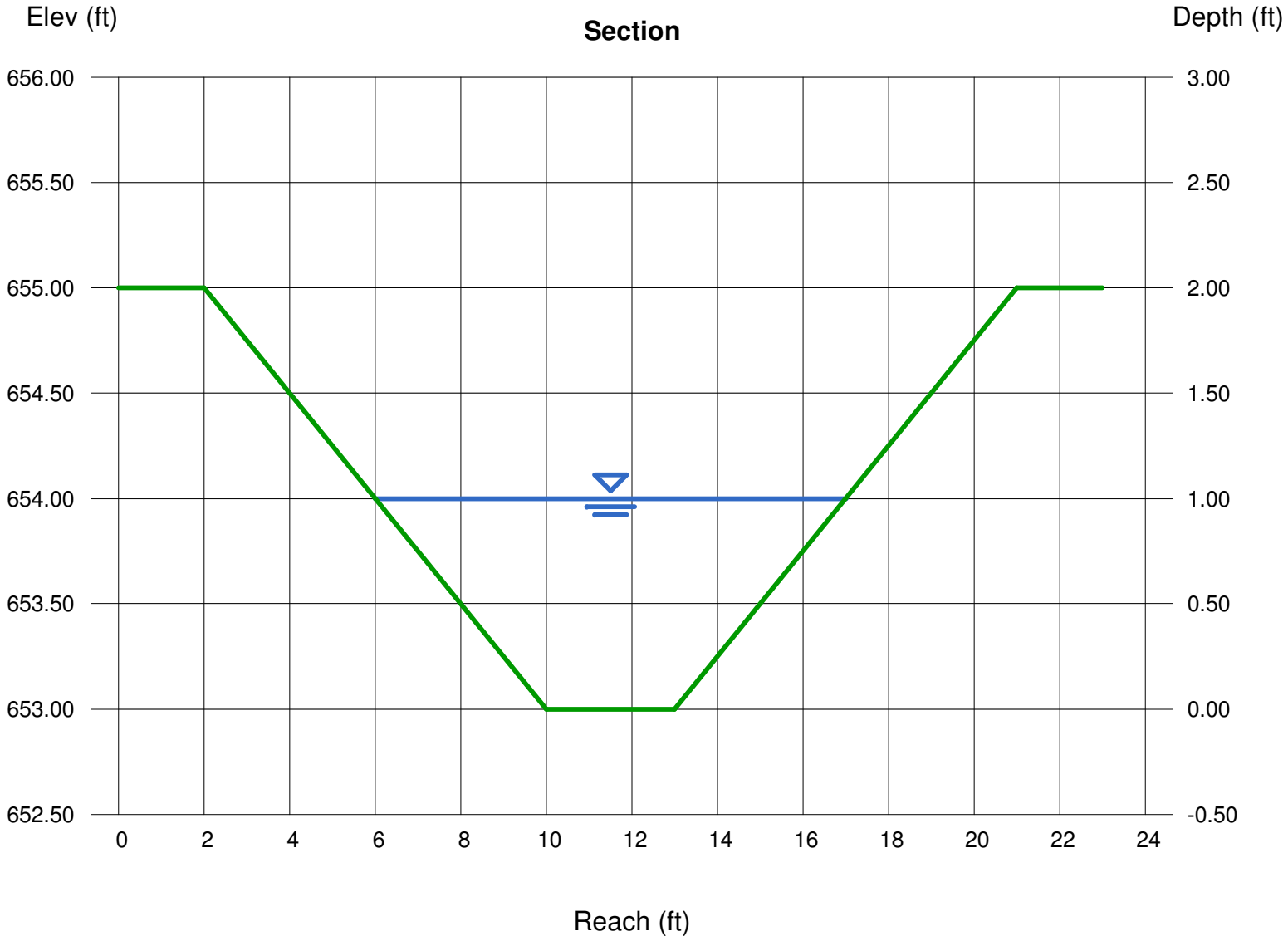
Bottom Width (ft)	=	3.00
Side Slopes (z:1)	=	4.00, 4.00
Total Depth (ft)	=	2.00
Invert Elev (ft)	=	653.00
Slope (%)	=	9.50
N-Value	=	0.030

Calculations

Compute by:		Known Q
Known Q (cfs)	=	77.00

Highlighted

Depth (ft)	=	1.00
Q (cfs)	=	77.00
Area (sqft)	=	7.00
Velocity (ft/s)	=	11.00
Wetted Perim (ft)	=	11.25
Crit Depth, Yc (ft)	=	1.55
Top Width (ft)	=	11.00
EGL (ft)	=	2.88



Channel Report

Hydraflow Express Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. Thursday, Aug 27 2015

SCC-3 (Min Slope)

Trapezoidal

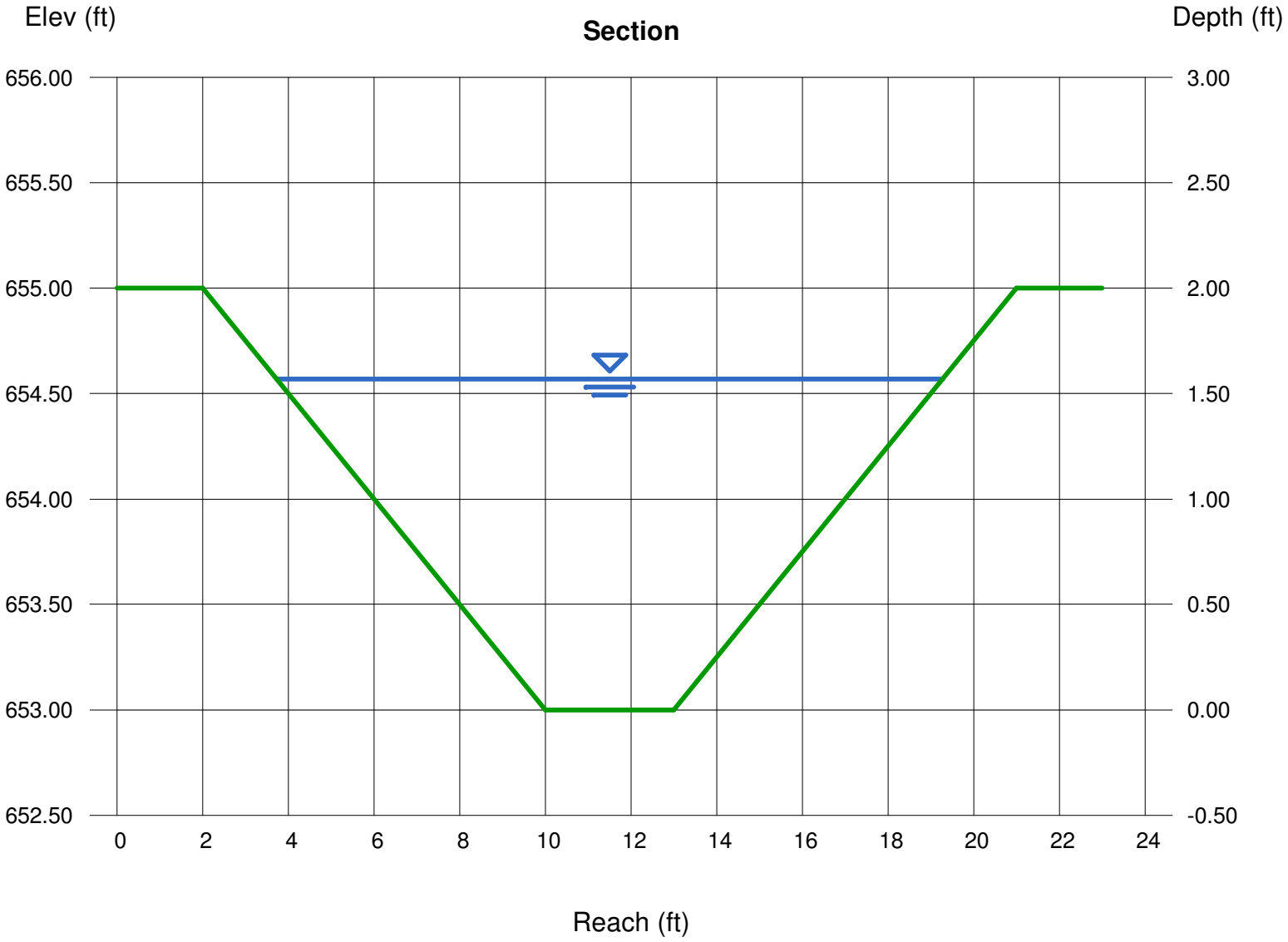
Bottom Width (ft)	=	3.00
Side Slopes (z:1)	=	4.00, 4.00
Total Depth (ft)	=	2.00
Invert Elev (ft)	=	653.00
Slope (%)	=	1.00
N-Value	=	0.030

Calculations

Compute by:		Known Q
Known Q (cfs)	=	67.00

Highlighted

Depth (ft)	=	1.57
Q (cfs)	=	67.00
Area (sqft)	=	14.57
Velocity (ft/s)	=	4.60
Wetted Perim (ft)	=	15.95
Crit Depth, Yc (ft)	=	1.45
Top Width (ft)	=	15.56
EGL (ft)	=	1.90



Channel Report

Hydraflow Express Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. Thursday, Aug 27 2015

SCC-3 (Max Slope)

Trapezoidal

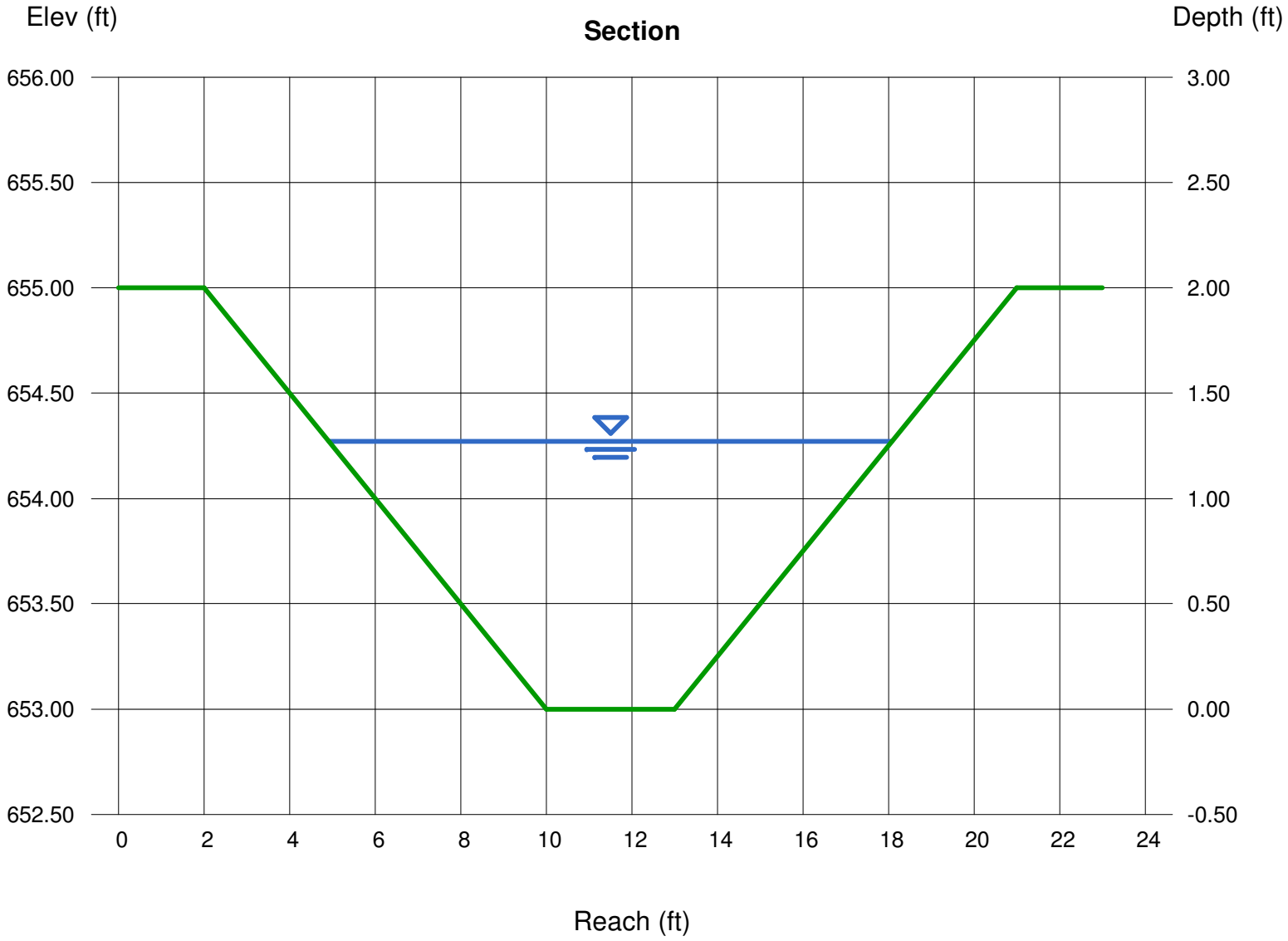
Bottom Width (ft)	=	3.00
Side Slopes (z:1)	=	4.00, 4.00
Total Depth (ft)	=	2.00
Invert Elev (ft)	=	653.00
Slope (%)	=	2.50
N-Value	=	0.030

Calculations

Compute by:		Known Q
Known Q (cfs)	=	67.00

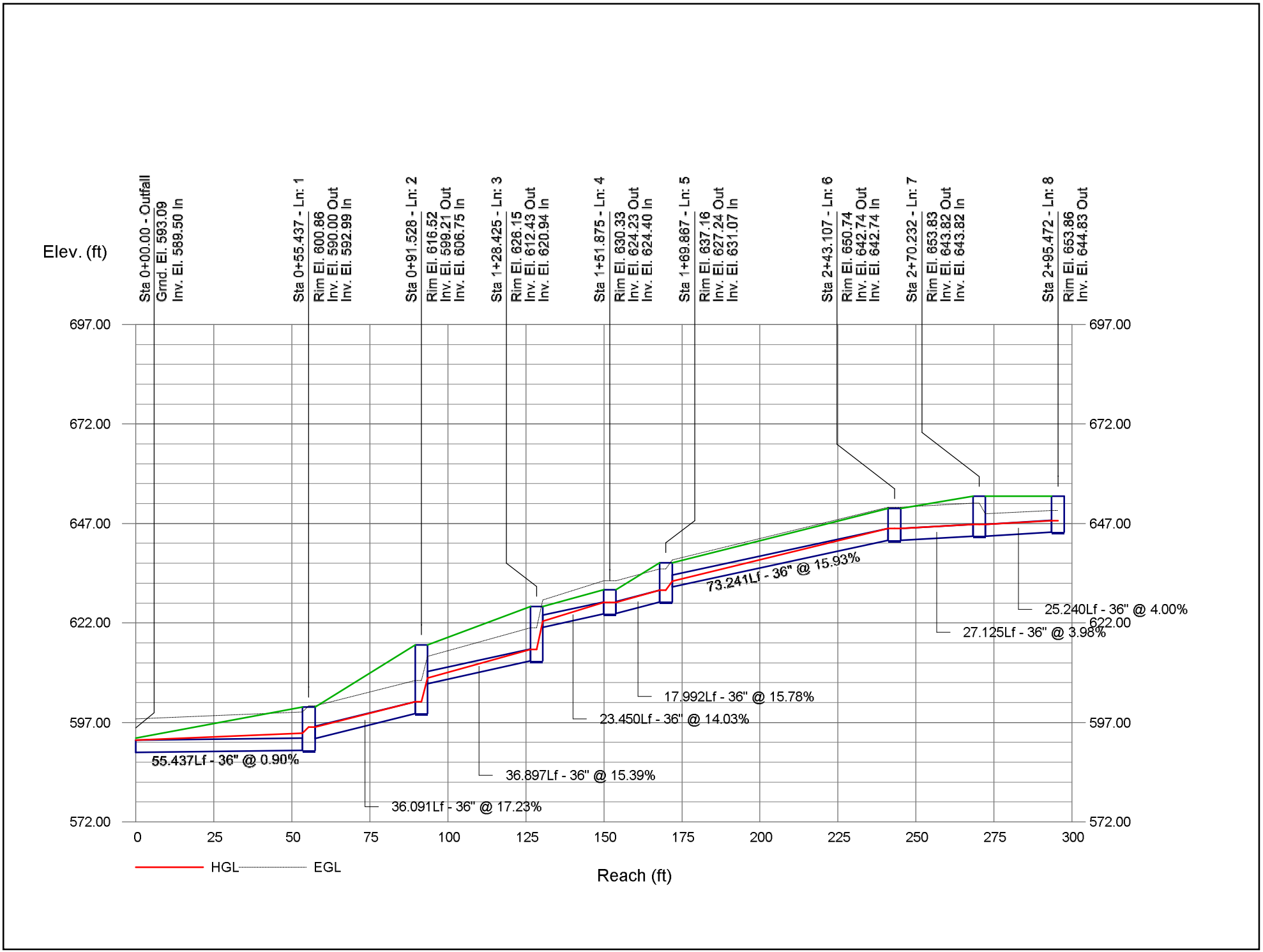
Highlighted

Depth (ft)	=	1.27
Q (cfs)	=	67.00
Area (sqft)	=	10.26
Velocity (ft/s)	=	6.53
Wetted Perim (ft)	=	13.47
Crit Depth, Yc (ft)	=	1.45
Top Width (ft)	=	13.16
EGL (ft)	=	1.93



Storm Sewer Profile

Proj. file: 15 0827 - Storm Sewer Analysis.stm



Storm

Line No.	Line ID	n-val Pipe	Line Size (in)	Line Length (ft)	Line Slope (%)	Invert Up (ft)	Gnd/Rim El Up (ft)	HGL Up (ft)	Invert Dn (ft)	Gnd/Rim El Dn (ft)	HGL Dn (ft)	Drng Area (ac)	Runoff Coeff (C)	Inlet Time (min)	Total Area (ac)	Total CxA	Tc (min)	Vel Ave (ft/s)	Capac Full (cfs)
1	21-20	0.012	36	55.437	0.90	590.00	600.86	594.32	589.50	593.09	592.50	0.00	0.00	0.0	0.00	0.00	0.2	18.53	68.62
2	22-21	0.012	36	36.091	17.23	599.21	616.52	602.17	592.99	600.86	595.82	0.00	0.00	0.0	0.00	0.00	0.2	18.77	299.95
3	23-22	0.012	36	36.897	15.39	612.43	626.15	615.39	606.75	616.52	608.18	0.00	0.00	0.0	0.00	0.00	0.2	28.94	283.48
4	24-23	0.012	36	23.450	14.03	624.23	630.33	627.19	620.94	626.15	622.41	0.00	0.00	0.0	0.00	0.00	0.1	28.26	270.63
5	25-24	0.012	36	17.992	15.78	627.24	637.16	630.20	624.40	630.33	627.19	0.00	0.00	0.0	0.00	0.00	0.1	18.84	287.05
6	26-25	0.012	36	73.241	15.93	642.74	650.74	645.70	631.07	637.16	632.49	0.00	0.00	0.0	0.00	0.00	0.1	29.20	288.41
7	27-26	0.012	36	27.125	3.98	643.82	653.83	646.78	642.74	650.74	645.70	0.00	0.00	0.0	0.00	0.00	0.0	18.58	144.17
8	28-27	0.012	36	25.240	4.00	644.83	653.86	647.68	643.82	653.83	646.78	0.00	0.00	0.0	0.00	0.00	0.0	12.87	144.53

Project File: 15 0827 - Storm Sewer Analysis.stm | Number of lines: 8 | Date: 8/31/2015

NOTES: ** Critical depth

Storm

Flow Rate (cfs)
131.00
131.00
131.00
131.00
131.00
131.00
131.00
90.00

Project File: 15 0827 - Storm Sewer Analysis.stm	Number of lines: 8	Date: 8/31/2015

NOTES: ** Critical depth

Hydraulic Grade Line Computations

Line	Size	Q	Downstream								Len	Upstream								Check		JL coeff	Minor loss
	(in)	(cfs)	Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)	(ft)	Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)	Ave Sf (%)	Enrgy loss (ft)	(K)	(ft)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
1	36	131.0	589.50	592.50	3.00	7.07	18.54	5.34	597.84	3.289	55.437	590.00	594.32	3.00	7.07	18.53	5.34	599.66	3.288	3.288	1.823	0.28	1.50
2	36	131.0	592.99	595.82	2.83	6.91	18.96	5.36	601.18	0.000	36.091	599.21	602.17	2.96**	7.05	18.58	5.36	607.54	0.000	0.000	n/a	0.41	n/a
3	36	131.0	606.75	608.18	1.43*	3.33	39.31	5.36	613.55	0.000	36.897	612.43	615.39	2.96**	7.05	18.58	5.36	620.76	0.000	0.000	n/a	0.39	n/a
4	36	131.0	620.94	622.41	1.47*	3.45	37.95	5.36	627.78	0.000	23.450	624.23	627.19	2.96**	7.05	18.58	5.36	632.56	0.000	0.000	n/a	0.68	n/a
5	36	131.0	624.40	627.19	2.79	6.86	19.11	5.36	632.56	0.000	17.992	627.24	630.20	2.96**	7.05	18.58	5.36	635.57	0.000	0.000	n/a	0.37	n/a
6	36	131.0	631.07	632.49	1.42*	3.29	39.82	5.36	637.85	0.000	73.241	642.74	645.70	2.96**	7.05	18.58	5.36	651.07	0.000	0.000	n/a	0.70	n/a
7	36	131.0	642.74	645.70	2.96*	7.05	18.58	5.36	651.07	0.000	27.125	643.82	646.78	2.96**	7.05	18.58	5.36	652.15	0.000	0.000	n/a	0.95	n/a
8	36	90.00	643.82	646.78	2.96	6.93	12.76	2.62	649.41	0.000	25.240	644.83	647.68	2.85**	6.93	12.99	2.62	650.30	0.000	0.000	n/a	1.00	n/a

Project File: 15 0827 - Storm Sewer Analysis.stm | Number of lines: 8 | Run Date: 8/31/2015

Notes: * depth assumed.; ** Critical depth. ; c = cir e = ellip b = box

Hydraflow HGL Computation Procedure

General Procedure:

Hydraflow computes the HGL using the Bernoulli energy equation. Manning's equation is used to determine energy losses due to pipe friction. In a standard step, iterative procedure, Hydraflow assumes upstream HGLs until the energy equation balances. If the energy equation cannot balance, supercritical flow exists and critical depth is temporarily assumed at the upstream end. A supercritical flow Profile is then computed using the same procedure in a downstream direction using momentum principles.

Col. 1 The line number being computed. Calculations begin at Line 1 and proceed upstream.

Col. 2 The line size. In the case of non-circular pipes, the line rise is printed above the span.

Col. 3 Total flow rate in the line.

Col. 4 The elevation of the downstream invert.

Col. 5 Elevation of the hydraulic grade line at the downstream end. This is computed as the upstream HGL + Minor loss of this line's downstream line.

Col. 6 The downstream depth of flow inside the pipe (HGL - Invert elevation) but not greater than the line size.

Col. 7 Cross-sectional area of the flow at the downstream end.

Col. 8 The velocity of the flow at the downstream end, (Col. 3 / Col. 7).

Col. 9 Velocity head (Velocity squared / 2g).

Col. 10 The elevation of the energy grade line at the downstream end, HGL + Velocity head, (Col. 5 + Col. 9).

Col. 11 The friction slope at the downstream end (the S or Slope term in Manning's equation).

Col. 12 The line length.

Col. 13 The elevation of the upstream invert.

Col. 14 Elevation of the hydraulic grade line at the upstream end.

Col. 15 The upstream depth of flow inside the pipe (HGL - Invert elevation) but not greater than the line size.

Col. 16 Cross-sectional area of the flow at the upstream end.

Col. 17 The velocity of the flow at the upstream end, (Col. 3 / Col. 16).

Col. 18 Velocity head (Velocity squared / 2g).

Col. 19 The elevation of the energy grade line at the upstream end, HGL + Velocity head, (Col. 14 + Col. 18) .

Col. 20 The friction slope at the upstream end (the S or Slope term in Manning's equation).

Col. 21 The average of the downstream and upstream friction slopes.

Col. 22 Energy loss. Average Sf/100 x Line Length (Col. 21/100 x Col. 12). Equals (EGL upstream - EGL downstream) +/- tolerance.

Col. 23 The junction loss coefficient (K).

Col. 24 Minor loss. (Col. 23 x Col. 18). Is added to upstream HGL and used as the starting HGL for the next upstream line(s).

Storm

Line No.	Line ID	n-val Pipe	Line Size (in)	Line Length (ft)	Line Slope (%)	Invert Up (ft)	Gnd/Rim El Up (ft)	HGL Up (ft)	Invert Dn (ft)	Gnd/Rim El Dn (ft)	HGL Dn (ft)	Drng Area (ac)	Runoff Coeff (C)	Inlet Time (min)	Total Area (ac)	Total CxA	Tc (min)	Vel Ave (ft/s)	Capac Full (cfs)	
1	32-Outfall	0.012	24	54.190	0.52	695.35	706.38	698.63	695.07	0.00	697.39	0.00	0.00	0.0	0.00	0.00	0.1	11.80	17.61	
2	1-32	0.012	24	44.974	19.72	710.12	715.35	712.06	701.25	706.38	702.05	0.00	0.00	0.0	0.00	0.00	0.0	21.62	108.82	
3	11-1	0.013	24	19.414	18.90	713.89	720.69	715.83	710.22	715.35	712.06	0.00	0.00	0.0	0.00	0.00	0.0	12.09	98.34	

Project File: 15 0827 - Sidewalk Storm Sewer Analysis.stm | Number of lines: 3 | Date: 10/30/2015

NOTES: ** Critical depth

Storm

Flow Rate (cfs)
37.06
37.06
37.06

Project File: 15 0827 - Sidewalk Storm Sewer Analysis.stm	Number of lines: 3	Date: 10/30/2015

NOTES: ** Critical depth

Hydraulic Grade Line Computations

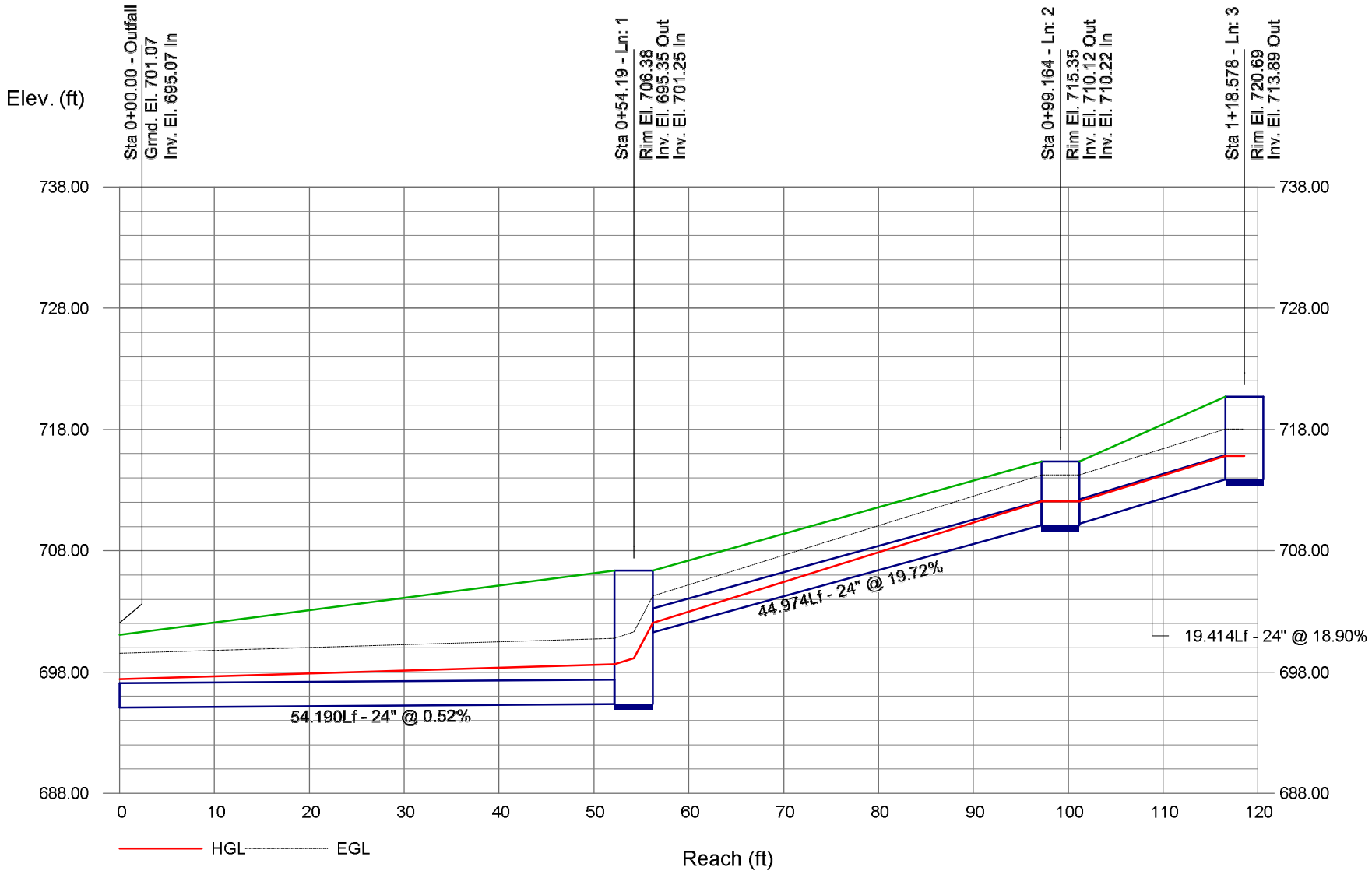
Line	Size	Q	Downstream								Len	Upstream								Check		JL coeff	Minor loss
	(in)	(cfs)	Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)	(ft)	Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)	Ave Sf (%)	Enrgy loss (ft)	(K)	(ft)
1	24	37.06	695.07	697.39	2.00	3.14	11.80	2.16	699.55	2.289	54.190	695.35	698.63	2.00	3.14	11.80	2.16	700.79	2.288	2.288	1.240	0.24	0.52
2	24	37.06	701.25	702.05	0.80*	1.18	31.32	2.21	704.26	0.000	44.974	710.12	712.06	1.94**	3.11	11.91	2.21	714.26	0.000	0.000	n/a	0.48	1.06
3	24	37.06	710.22	712.06	1.84	3.02	12.28	2.21	714.26	0.000	19.414	713.89	715.83	1.94**	3.11	11.91	2.21	718.03	0.000	0.000	n/a	1.00	2.21

Project File: 15 0827 - Sidewalk Storm Sewer Analysis.stm | Number of lines: 3 | Run Date: 10/30/2015

Notes: * depth assumed.; ** Critical depth. ; c = cir e = ellip b = box

Storm Sewer Profile

Proj. file: 15 0827 - Sidewalk Storm Sewer Analysis.stm



Appendix D

RWS Plan Submittal Checklist

RWS PLAN SUBMITTAL CHECKLIST

1. ___x___Submit this completed checklist.

Cover Sheet

2. ___x___Development name
3. ___x___Developer's name, address, telephone number, and e-mail address in lower right hand corner
4. ___x___Owner's name, address, telephone number, and e-mail address in lower right hand corner
5. ___x___Design firm name, address, telephone number, and e-mail address in lower right hand corner
6. ___x___Date
7. ___n/a___Revision numbers and dates
8. ___x___PE seal, signed and dated
9. ___x___Vicinity map showing project location
10. ___x___Index of drawings
11. ___x___Note: "Contact City construction coordinator and Miss Utility 48 hours in advance of any construction activity."
12. ___x___Note: "All construction shall be performed in accordance with City of Lynchburg Manual of Specifications and Standard Details."
13. ___x___Designer's certification

> "I hereby certify that, to the best of my ability, this plan has been prepared in accordance with the latest City of Lynchburg Manual of Specifications and Standard Details and City Code."
>
> Signature:_____
> Printed Name and Title:_____
> Date:_____Registration Number: _____

14. ___x___Owner's/developer's certification

> "I/We hereby certify that all site construction, drainage and grading will be done pursuant to this plan and that the applicable Stormwater Management conditions and requirements of the City of Lynchburg, the Commonwealth of Virginia and the Federal Government and its agencies are hereby made part of this plan."
>
> Signature:_____
> Printed Name:_____
> Title:_____Date:_____

15. ___x___Signature line for ESC/SWM Administrator on cover sheet only

All Sheets

16. x All drawings shall be 24-inch by 36-inch (size D drawings). Oversize drawings will not be accepted.
17. x Sheet Numbers
18. x Signature line for City Engineer on all RWS plan and profile and detail sheets.
19. ____ City project number shall be displayed on all sheets. Not available at time of submission.
20. x Project horizontal control shall be based on the Virginia State Plane Coordinate System, NAD 83 (2011). Vertical control shall be based on NGVD88.
21. x Drawings shall clearly differentiate between existing features and proposed improvements.

Water and Sewer Plan Sheets not applicable

22. ____ Legend
23. ____ Text and drawings shall be of appropriate scale for legibility and accurate depiction of piping locations and arrangements. (No 1" = 25' scale allowed)
24. ____ Show drawing graphic scale (minimum 1" = 50').
25. ____ North arrow
26. ____ Project horizontal and vertical control based on state plane coordinate system.
27. ____ Show all adjoining and adjacent property lines.
28. ____ Label all adjoining and adjacent property owners and property addresses or tax map numbers and City/county boundaries (if applicable).
29. ____ Show all adjoining and adjacent R-O-W lines and label all streets shown on drawings.
30. ____ Show and label all proposed (20' for water/sewer; 30' for drainage pipe > 36" dia. Or > 8' deep) and existing city easements.
31. ____ Show and label all benchmarks and monuments.
32. ____ Delineation of FEMA 100-yr floodplain labeled with flood elevation(s).
33. ____ Show lateral table to include the invert at main, invert at clean out, invert at structure, and lowest floor elevation served by gravity.

Water, Sewer, and Stormwater Plan and Profiles Sheets

34. x Text and drawings shall be of appropriate scale for legibility and accurate depiction of piping locations and arrangements. (No 1" = 25' scale allowed)
35. x Show drawing graphic scale (minimum 1" = 50').
36. x North arrow
37. x Project horizontal and vertical control based on state plane coordinate system.
38. x Show all adjoining and adjacent property lines.
39. n/a Label all adjoining and adjacent property owners and property addresses or tax map numbers, and City/county boundaries (if applicable).
40. x Show all adjoining and adjacent R-O-W lines and label all streets shown on drawings.
41. n/a Show and label all proposed (20' for water/sewer; 30' for drainage pipe > 36"

dia. Or > 8' deep) and existing city easements.

42. x Show and label all benchmarks and monuments.
43. n/a Delineation of FEMA 100-yr floodplain labeled with flood elevation(s).

44. x Submit plan and profile sheets for all proposed public water, sewer, and storm lines.
45. n/a Signature line for Water Resources (Utilities) Engineer on all water and sewer plan and profile and detail sheets.
46. n/a Show water meter locations and sizes.
47. n/a Show on profile, water line pressure information, i.e. static pressure and test pressure.
48. n/a Show and label information regarding water line tie-in, e.g. wet tap, tee, etc.
49. x Label diameter of Water/Sewer/Storm lines – existing and proposed.
50. x Label length of proposed Water/Sewer/Storm lines.
51. x Label pipe material of Water/Sewer/Storm lines – existing and proposed.
52. x Label all sewer manhole frame & covers as waterproof or standard.
53. x Label slope of Sewer/Storm lines.
54. n/a Show and label depth of water lines.
55. x Show flow arrows on existing and proposed sewer/storm lines.
56. n/a Show all clean out locations.
57. x Show horizontal control – bearings on lines/ coordinates on manholes.
58. x Label angles on lines in and out of manholes.
59. x Show and detail all misc. storm appurtenances, e.g. headwalls, endwalls, retaining walls, flared end sections, and outlet protection.
60. x Show structure elevations and information for Storm and Sewer structures
    - x All invert elevations, labeled with line size
    - x Drop connection information (both upper and lower invert elevations)
    - x Top/Rim elevation
    - x Structure numbers and stationing
61. n/a Label all water line appurtenances including fire hydrants, air release valves, bends, fittings, restraints, etc. complete with stationing.
62. x Show all ditch and stream crossings on plans and profiles.
63. x Show all miscellaneous requirements for utility lines, e.g. slope anchors, thrust collars, encasements, etc.
64. x Show and label all utility crossings.
65. x Show any associated necessary abandonment of existing utilities.

Roadway Plan and Profile Sheets

66. ___x___ Text and drawings shall be of appropriate scale for legibility and accurate depiction of piping locations and arrangements. (No 1" = 25' scale allowed)
67. ___x___ Show drawing graphic scale (minimum 1" = 50').
68. ___x___ North arrow
69. ___x___ Project horizontal and vertical control based on state plane coordinate system.
70. ___x___ Show all adjoining and adjacent property lines.
71. ___n/a___ Label all adjoining and adjacent property owners and property addresses or tax map numbers, and City/county boundaries (if applicable).
72. ___x___ Show all adjoining and adjacent R-O-W lines and label all streets shown on drawings.
73. ___x___ Show and label all proposed (20' for water/sewer; 30' for drainage pipe > 36" dia. Or > 8' deep) and existing city easements.
74. ___x___ Show and label all benchmarks and monuments.
75. ___n/a___ Delineation of FEMA 100-yr floodplain labeled with flood elevation(s).

76. ___x___ Submit plan and profile sheets for all proposed roads and road improvements.
77. ___n/a___ Show driveway profiles.
78. ___n/a___ Show all proposed curb and gutter and sidewalk.
79. ___x___ Label road grades in profiles.
80. ___n/a___ Submit cross sections for all proposed roads and road improvements at 100-foot intervals maximum.
81. ___x___ Show road horizontal and vertical curve data.
82. ___n/a___ Label site distances for all intersections and entrances.
83. ___n/a___ Show sight distance for new roadways and driveways.
84. ___n/a___ Submit pavement marking plans, when applicable.
85. ___n/a___ Submit separate traffic signal plans, when applicable.
86. ___n/a___ Show street trees every 40 feet per City Code- Zoning Ordinance-Landscaping

Calculations

87. ___n/a___ Fire flow calculations (3 copies)
88. ___x___ Calculations for Water, Sewer, Storm, Roadway, E&S, etc. See Water & Sewer Design Section (Appendix A) and Stormwater Management Design Section (Appendix B) of this Manual. (3 copies)
89. ___x___ Adequate stormwater receiving channel calculations
90. ___n/a___ Submit water/sewer need/capacity requirements to Director of Water Resources for all connections/extensions.

Erosion & Sediment Control (ESC) and Stormwater Management (SWM) Plans (in addition to general plan sheet requirements)

91. x ESC narrative
92. x General description of project
93. x General description of erosion controls
94. x General description of stormwater management facilities
95. x Discussion of critical erosion areas
96. x Discussion and quantification of off-site borrow or waste areas. Add the following note to all E&S plans: Any off-site location that is used as a source of borrow soil materials or receives waste soil materials from this site must be approved by the Erosion & Sediment Control Administrator of the jurisdiction in which that off-site area is located.
97. x Land use of surrounding areas
98. x Project schedule, narrative, sequence of construction
99. x Limits of existing vegetation
100. ____ Wetland limits waters of the US delineation still pending
101. x Original contours (2-foot intervals)
102. x Proposed contours (2-foot intervals)
103. x Existing streams, lakes, etc.
104. x Size and location of existing culverts
105. x Size and location of proposed culverts
106. x Existing drainage areas
107. x Proposed drainage areas for each feature designed or analyzed
108. x CVESCC design summary tables for each feature designed or analyzed (see www.lynchburgva.gov web site and follow links for City Departments, Community Development, Zoning and Natural Resources, Stormwater Management, then ESC Design Summary Tables and ESC Required Parameters for Summary Tables) See also Appendix B of this Manual Section 2 – Plan Submittals.
109. x Limits of construction, clearing & grading labeled with acreage
110. x Location of stormwater management facilities (includes details, plan, profile, and cross sections)
111. x Summary Table on cover sheet documenting the information for each BMP installed. See Appendix B – Section 2.1 Design Submittal Information.
112. x Maintenance plan

Other ESC and SWM Submittals

113. n/a Stormwater maintenance agreement for all SWM facilities to be privately maintained
114. TBD Evidence of Virginia Stormwater Management Permit

Other Required Submittals

115. n/a Submit proposed easement/ROW plats for review and approval.
116. TBD Submit completed record drawings and as-builts per the Procedures Section of the City of Lynchburg Manual of Specifications and Standard Details.

Appendix E

Erosion & Sediment Control
Standards & Specifications

Incorporated by reference:
Standards and Specifications
can be found in the Virginia
Erosion & Sediment Control
Handbook, Latest Edition.

02200 - EARTHWORK

(Revised 10/25/04)

SELECTED LINKS TO SECTIONS WITHIN THIS SPECIFICATION

Part 1 – General	Clearing and Grubbing	Subgrade Preparation
Part 2 – Products	Compaction – Min Requirements	Testing Frequency
Part 3 – Execution	Earthwork Volume Measurement	

PART 1 – GENERAL

The Contractor shall furnish all labor, materials, and equipment to perform all work for all site clearing, site excavation, grading and embankment, excavation and filling and backfilling for structures. Complete all as shown on the contract drawings and in accordance with these Specifications and completely coordinated with all other trades.

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Requirements and Supplementary Conditions applicable to this specification.

B. Section 01000 – General Requirements.

C. Section 02220 – Trenching, Backfilling, and Compaction of Utilities.

D. Section 02660 – Water Distribution.

E. Section 02730 – Sanitary Sewer.

1.2 SUMMARY

A. This section includes:

1) Site clearing and grubbing.

2) Stripping and stockpiling topsoil.

3) Excavation and embankment placement.

4) Preparing subgrades for pavements, walks, curb & gutter, and turfed areas.

B. Construction and materials related to this section but specified in other sections:

1) Landscaping, Seeding, and Groundcover: Section 01000 - *General Requirements.*

2) Erosion Control: See Section 01000 - *General Requirements*.

1.3 DEFINITIONS

For the purposes of this specification, the following definitions refer to earthwork that come under the authority of the City of Lynchburg, Virginia as specified within this section and other sections of this manual.

A. **Borrow**: Borrow excavation shall consist of approved select fill material imported from off-site.

B. **Clearing**: Clearing shall consist in the felling, cutting up, and satisfactory disposal of trees and other vegetation designated for removal in accordance with these specifications.

C. **Fill (in terms of volume)**: In terms of volume, fill is defined as a compacted post-construction volume in-place.

D. **Grubbing**: Grubbing shall consist of the removal of roots 1 ½ inch and larger, organic matter and debris, and stumps having a diameter of three inches or larger, to a depth of at least 18 inches below the surface and or subgrade; which ever is lower, and the disposal thereof.

E. **Regular Excavation**: Removal and disposal of any and all material above subgrade elevation, except solid rock and undercut excavation, located within the limits of construction.

F. **Rock Excavation**: Removal and satisfactory disposal of all unsuitable materials, which, in the opinion of the City Engineer, cannot be excavated except by drilling, blasting, wedging, jack hammering or hoe ramming. It shall consist of undecomposed stone, hard enough to ring under hammer. All boulders containing a volume of more than ½ cubic yard and/or solid ledges, bedded deposits, unstratified masses and conglomerations of material so firmly cemented as to possess the characteristics of solid rock which cannot be removed without systematic drilling, blasting, or hoe ramming will be classified as rock.

G. **Select Fill Material**: Nonplastic material obtained from roadway cuts, borrow areas, or commercial sources used as foundation for subbase, shoulder surfacing, fill, backfill, or other specific purposes.

H. **Structures**: Incidental buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

I. **Subgrade**: Surface or elevation remaining after completing the excavation, or top surface of a fill or backfill immediately below subbase or topsoil materials, as applicable.

J. **Topsoil**: Topsoil shall consist of friable clay loam, free from roots, stones, and other undesirable material and shall be capable of supporting a good growth of grass.

K. **Undercut Excavation**: Undercut excavation shall consist of the removal and satisfactory disposal of all unsuitable material located below subgrade elevation. Where excavation to the finished grade section results in a subgrade or slopes of muck, peat, matted roots, etc., the Contractor shall remove such material below the grade shown on the plans or as directed; and areas so excavated shall be backfilled with approved select borrow as ordered by the City Engineer.

1.4 SUBMITTALS

A. Submit product data and a sample of separation fabric and fully document each with specific location or stationing information, date and other pertinent information.

B. **Product Data**

1) Stabilization/Separation fabric
2) Turf Reinforcement Matting

C. **Material Test Reports**: Provide from a qualified testing agency test results and interpretation for compliance of the following requirements indicated:

1) Classification according ASTM D2487 of each on-site or borrow soil proposed for backfill, unless otherwise directed by the City Engineer.

2) Laboratory compaction curve according to ASTM D698 for each on-site or borrow soil material proposed for fill or backfill.

3) Laboratory compaction curve according to ASTM D1557 for each on-site borrow soil material proposed for fill and backfill.

4) Laboratory test results for clay liner material indicating permeability according to ASTM D2434.

D. **Blasting**: See Section 01000 – *General Requirements*.

1.5 QUALITY ASSURANCE

A. **Geotechnical Testing Agency Qualifications**: An independent testing agency qualified according to ASTM E 329 to conduct soil materials and rock-definition testing as documented according to ASTM D 3740 and ASTM E 548.

B. Comply with all codes, laws, ordinances, and regulations of governmental authorities having jurisdiction over this part of the work.

C. The Contractor shall comply with the latest revision of the Virginia Occupational Safety and Health Standards for the Construction Industry as adopted by the Safety and Health Codes Commission of Virginia.

D. The Contractor shall comply with Virginia Department of Conservation and Recreation, Division of Soil and Water Conservation, “Virginia Erosion and Sedimentation Control Handbook,” latest revision.

E. Comply with applicable requirements of NFPA 495, *"Explosive Materials Code."*

F. Materials and operations shall comply with the latest revision of the Codes and Standards listed below:

American Society for Testing and Materials

ASTM C 33	Concrete Aggregates
ASTM C 136	Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates Sieve Analysis of Fine and Coarse Aggregate
ASTM D 422	Standard Test Method for Particle-Size Analysis of Soils (for classification purposes only)
ASTM D 698	Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3) (Standard Proctor)
ASTM D 1556	Standard Method of Test for Density of Soil in Place by the Sand-Cone Method
ASTM D 1557	Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3) (Modified Proctor)
ASTM D1883	Standard Test Method for CBR (California Bearing Ratio) of Laboratory-Compacted Soils
ASTM D 2049	Standard Method of Test for Relative Density of Cohesionless Soils
ASTM D2167	Standard Method of Test for Density of Soil in Place by the Rubber-Balloon Method
ASTM D 2487	Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 2922	Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 4253	Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table
ASTM D 4254	Test Method for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density
ASTM D 4318	Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

American Association of State Highway & Transportation Officials

AASHTO T 99	The Moisture-Density Relations of Soils using a 5.5-pound hammer and a 12-inch drop
AASHTO T 180	The Moisture Density Relations of Soils using a 10-pound hammer and an 18-inch drop
AASHTO M 145	The Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes

1.6 STANDARD ABBREVIATIONS

ANSI	American National Standards Institute
AREA	American Railway Engineers Association
DCR	Virginia Department of Conservation and Recreation
MSDS	Material Safety Data Sheets
OHSA	Occupational Safety and Health Administration
VDH	Virginia Department of Health
VDOT	Virginia Department of Transportation

1.7 TESTING SERVICES

A. The Testing Laboratory shall be approved by the City Engineer and will be responsible for conducting and interpreting tests. The Testing Laboratory shall state in each report whether or not the test specimens conform to all requirements of the Contract Documents and specifically note any deviation.

B. Specific test and inspection requirements shall be as specified herein.

1.8 PROJECT CONDITIONS

A. **Demolition**: Demolish and completely remove from the site existing utilities, structures or surface features indicated on the plans to be removed. Coordinate with applicable utility companies to shut off services if lines are active.

B. **Environmental**: Before crossing or entering into any jurisdictional wetlands, Contractor shall verify whether or not a wetlands permit has been obtained for the encroachment and whether special restrictions have been imposed. Care shall be taken to prevent draining or otherwise destroying non-permitted wetlands. Restore as stated on either the project drawings, the contract documents, and/or as noted in the permit.

C. **Geotechnical Investigation**

1) Where a Geotechnical report has been provided to the Contractor, the data on sub-surface soil conditions is not intended as a representation or warranty of the continuity of such conditions between borings or indicated sampling locations. It shall be expressly understood that the City of Lynchburg will not be responsible for any interpretations or conclusions drawn there from by the Contractor. Data is made available for the convenience of the Contractor.

2) In addition to any report that may be made available to the Contractor, the Contractor is responsible for performing any other soil investigations he/they feel(s) is necessary for proper evaluation of the site for the purposes of planning and/or bidding the project, at no additional cost to the City of Lynchburg.

1.9 COORDINATION

A. At the direction of the City Engineer, temporary bypass pumping of sewerage flow may be required to be provided. See Section 02730 – *Sanitary Sewer* for bypass pumping requirements and procedures.

B. Refer to Section 02660 – *Water Distribution* for valve operation requirements.

C. Coordinate tie-ins to municipal system with the City of Lynchburg.

D. When traffic signals or their appurtenances are likely to be damaged or interfered with as a result of the construction, coordinate temporary operation with the City of Lynchburg Traffic Engineer. Provide a minimum of 48 hours notice prior to anticipated disturbance or interruption.

E. **Benchmark/Monument Protection**: Protect and maintain benchmarks, monuments or other established reference points and property corners. If disturbed or destroyed, replace at own expense to full satisfaction of Owner/City of Lynchburg.

PART 2 – PRODUCTS

2.1 SOIL MATERIALS

Provide borrow material when sufficient satisfactory soil material is not available from excavations.

2.1.1 MATERIAL CLASSIFICATION

A. **Excavation**: All excavation material shall be classified as either Regular, Rock, or Undercut Excavation.

B. **Off-site Borrow:** Off-site borrow shall be select fill material approved by the City Engineer from an off-site borrow source. See paragraph 1.3 of this specification for the definition of select fill material.

C. **Riprap and Riprap Bedding**: See the Virginia Department of Conservation and Recreation, Division of Soil and Water Conservation, **Virginia Erosion and Sedimentation Control Handbook**, latest edition.

D. **Topsoil**: Topsoil meeting the definition prescribed in paragraph 1.3 obtained either from on-site or an off-site source.

2.1.2 SOIL CLASSIFICATION

A. **Satisfactory Soils**: Non-plastic soils as defined by ASTM D 2487 soil classification group (Unified Classification System) (such as SW, SM, and SC); free of rock or gravel larger than 3 inches in any dimension, debris, organic matter, waste, frozen materials, muck, roots, vegetation, and other deleterious matter.

B. **Unsatisfactory Soils**: Plastic soils as defined by ASTM D 2487 soil classification group (such as ML, CL CH, MH, OH, OL and PT); soils which contain rock or gravel larger than 3 inches in any dimension, debris, organic matter, waste frozen materials, vegetation, and other deleterious matter. Unsatisfactory soils also include satisfactory soils not maintained within 20-percent of optimum moisture content at time of compaction, unless otherwise approved by either the City Engineer or a Geotechnical Engineer.

2.2 MISCELLANEOUS

Geotextile Fabric: See the Virginia Department of Conservation and Recreation, Division of Soil and Water Conservation, **Virginia Erosion and Sedimentation Control Handbook**, latest edition.

Turf Reinforcement Matting (TRM): Turf reinforcement matting shall be Propex LandLock 300 or approved equal and installed per the manufacturer's recommendations.

PART 3 – EXECUTION

3.1 GENERAL

3.1.1 GENERAL REQUIREMENTS APPLYING TO ALL AREAS

A. Contractor shall plan construction to minimize disturbance to properties adjacent to the project site and be within the construction limits shown on the plans.

B. The City Engineer reserves the right to limit the width of land to be disturbed and to designate on the drawings or in the field certain areas or items within this width to be protected from damage.

C. Any grading or excavation required for equipment travel during the course of construction as well as erosion control, access or haul road installation and removal, restoration, seeding and ground cover shall be provided by the Contractor.

D. The Contractor shall be responsible for damage to areas or items designated by the City Engineer to be protected. Repairs to, replacement of, or reparations for areas or items damaged shall be made at the Contractor's expense and to the satisfaction of the City Engineer before acceptance of the completed project.

E. Any fences disturbed by the Contractor shall be repaired to a condition equal to or better than their original condition or to the satisfaction of the City Engineer at no additional cost.

F. Contractor shall obtain written permission from property owners for use of any access other than ones located within rights-of-way. Written permission shall contain conditions for use and restoration agreements between property owner and Contractor. No additional compensation will be made for such access.

G. All areas disturbed shall be restored to a condition equal to or better than their original condition and shall be graded to drain.

H. The Contractor shall replace or repair all damaged or destroyed hedgerows and property corners. Protection of existing and restoration of damaged or destroyed property corners shall be in accordance with the requirements of Section 01000 – *General Requirements* – Construction Staking.

3.1.2 PROTECTION OF EXISTING UTILITIES

A. Contractor is responsible for protection of existing utilities in accordance with Section 01000 – *General Requirements*.

B. Should it become necessary to move the position of any underground structure, the Contractor may be required to do such work and shall be paid on a force account basis or on an extra work basis. Method of payment shall be agreed upon by the City Engineer and the Contractor prior to commencing work.

C. If existing utilities are found to interfere with the permanent facilities being constructed under this section, immediately notify the City Engineer and secure instructions. Do not proceed with permanent relocation of utilities until instructions are received from the City Engineer.

3.2 CLEARING AND GRUBBING

A. This work shall consist of clearing, grubbing, removing, and disposing of all vegetation and debris within the limits of construction, as designated on the plans or as required by the City Engineer. The Contractor shall remove only those trees and shrubs absolutely necessary to allow for the construction. The work shall also include the preservation from injury or defacement of all vegetation or objects designated to remain.

B. The area within the limits of construction or as designated shall be cleared and grubbed of all trees, stumps, roots, brush, undergrowth, hedges, heavy growth of grasses or weeds, debris and rubbish of any nature which, in the opinion of the City Engineer, is unsuitable for foundation material. Nonperishable items that will be a minimum of five feet below the finish elevation of the earthwork or slope of the embankment may be left in place.

C. The Contractor shall provide barricades, fences, coverings, or other types of protection necessary to prevent damage to existing improvements, not indicated to be removed, and improvements on adjoining property. All improvements damaged by this work shall be restored to their original condition or to a condition acceptable to the owner or other parties or authorities having jurisdiction.

D. **Protection of Trees and Vegetation**: Contractor shall protect existing trees and other vegetation indicated by the City Engineer to remain in place against cutting, breaking, or skinning of roots, skinning and bruising of bark, smothering of trees by stockpiling construction materials or excavated materials within drip line, excess foot or vehicular traffic, or parking of vehicles within drip line. Provide temporary fences or barricades as required to protect trees and vegetation to be left standing at no additional cost.

Trees and shrubs that are to remain within the construction limits will be indicated on the drawings or conspicuously marked on site. Unless otherwise noted, trees within the construction limits shall become the property of the Contractor and shall be removed from the site.

Carefully and cleanly cut roots and branches of trees indicated to remain where the roots and branches obstruct construction of the utility line. The Contractor shall provide protection for roots and branches over 1 ½ inches diameter that are cut during construction operations. Temporarily cover all exposed roots with wet burlap to prevent roots from drying out. Provide earth cover as soon as possible.

Damaged trees and vegetation designated to remain shall be repaired or replaced at Contractor's expense in a manner acceptable to the City Engineer if they are damaged by construction operations. Repair tree damage as directed by a qualified tree surgeon.

E. All brush, tree tops, stumps, and debris shall be hauled away and disposed of in accordance with all applicable laws and regulations. The contactor shall clean up debris resulting from clearing operations continuously with the progress of the work and remove promptly all salvageable material that becomes his property and is not to be reused in construction. Sale of material on the site is prohibited. Debris from the site shall be removed in such a manner as to prevent spillage. Keep pavement and area adjacent to site clean and free from mud, dirt, dust, and debris at all times.

F. The method of stripping, clearing and grubbing the site shall be at the discretion of the Contractor. However, all stumps, roots and other debris protruding through the ground surface or in excavated areas shall be completely removed to a minimum depth of 18 inches below surface and/or subgrade whichever is lower and disposed of off the site by the Contractor, at his expense.

G. **Marginal Areas**: In marginal areas, with the City Engineer's permission, remove trees where the following conditions exist.

1) **Root Cutting**: When clearing up to the "clearing limits," the Contractor shall also remove any tree which is deemed marginal such that when the roots are cut and the tree could be rendered unstable by the affects of high winds and in danger of toppling into either the right-of-way or onto private property.

2) **Slender Bending Trees**: Where young, tall, thin trees are left unsupported by the clearing operation, and are likely to bend over into the right-of-way, the Contractor, during the clearing operation, shall selectively remove those trees which are located outside and adjacent to the clearing limits and City right-of-way or easement as well. During the course of construction and during the one-year warranty period, the Contractor shall remove such young trees that overhang into the right-of-way or cleared area.

H. Remove the existing topsoil to a depth of 6 inches or to the depth encountered from all areas in which excavation will occur. The topsoil shall be stored in stockpiles, separate from the excavated material, if the topsoil is to be respread. Otherwise material shall be disposed of off-site at the Contractor's expense.

3.3 REGULAR EXCAVATION, UNDERCUTTING, BORROW, EMBANKMENT:

3.3.1 DESCRIPTION

Prior to beginning grading or embankment operations in any area, all necessary clearing and grubbing in that area shall have been performed in accordance with these specifications.

Should the Contractor, through negligence or other fault, excavate below the designated grades, he shall replace the excavation with approved satisfactory materials, in an approved method, at his own expense. All material determined unsatisfactory shall be disposed of in waste areas as directed. Topsoil shall not be used in embankments but shall be handled and placed as directed.

The Contractor shall satisfy himself as to the character, quantity, and distribution of all materials to be excavated. No payment will be made for any excavated material that is used for purposes other than those designated.

3.3.2 CONSTRUCTION METHODS

A. **Excavation**: Excavation shall be performed as indicated on the plans or as directed by the City Engineer to the lines, grades, and elevations, and shall be finished to a reasonable smooth and uniform surface. During the process of excavation, the grade shall be maintained and surface shall be rolled so that it will be well drained at all times.

When solid rock is incurred in the excavation, the rock shall be removed to a minimum depth of 12 inches below the surface of the subgrade. Material unsatisfactory for subgrade foundation shall be removed to a depth specified to provide a satisfactory foundation. The portion so excavated shall be refilled with suitable material obtained from the grading operations or borrow area and thoroughly compacted by rolling. Material obtained from on site grading operation must be approved by the City Engineer. For areas that do not require fill, scarify and compact to a depth of 6 inches.

Any removal, manipulation, aeration, replacement, and recompaction of suitable materials necessary to obtain the required density shall be considered as incidental to the construction operations, and shall be performed by the Contractor at no additional cost to the City.

No rock, stone, or rock fragments, larger than 3 inches in their greatest dimension will be permitted in the top 12 inches of the subgrade. No rock, stone, or rock fragments larger than 8 inches in their greatest dimension will be permitted in the remainder of the fill.

B. **Stabilization of Soft Subgrade with Geotextile**: The use of Geotextile material for subgrade stabilization shall be approved by the City Engineer and shall meet all applicable VDOT standards and specifications.

C. **Borrow**: Borrow shall not be used until all suitable, on-site, excavated material has been placed in the embankment, unless authorized by the City Engineer. Unless otherwise designated on the plans and contract documents, the Contractor shall make his own arrangements for obtaining select fill material for borrow and pay all costs involved. If the Contractor places more borrow than is required, and thereby causes a waste of excavation, the amount of such waste, unless authorized, will not be included for payment.

D. **Embankments**

1) **Evaluation of Subgrade**: Prior to placement of compacted fill, the City Engineer or his representative shall carefully inspect the exposed subgrade. The Contractor shall then proof roll the exposed subgrade, in the presence of the City Engineer or his representative. The inspection shall include, but not be limited to, proofrolling the prepared subgrade with a rubber-tired fully loaded dump truck that has a minimum gross weight of at least 20,000 pounds (10 tons). No other method will be acceptable. Any unsatisfactory materials thus exposed shall be removed and replaced with satisfactory select material as approved by the City Engineer. Provide the necessary amount of select fill compacted to the density requirements outlined in this specification.

2) **Preparation of Ground Surface for Embankments or Fills:** Before fill is placed, scarify existing grade to a minimum depth of 6 inches. In areas where the existing or proposed ground surface is steeper than one vertical to four horizontal, plow surface in a manner to bench and break up surface so that fill material will bind with the existing surface.

3) Embankments shall be made of satisfactory soil material and shall be built in successive horizontal layers of not more than 8 inches in loose depth for the full width of the cross sections.

The material entering the embankment in each of the layers shall be within a tolerance of plus or minus 20% of the optimum moisture content before rolling to obtain the prescribed density. Wetting or drying of the material and manipulation when necessary to secure uniform moisture content throughout the layer shall be required. Should the material be too wet to permit proper compaction or rolling, all work on the embankment shall be delayed until such time as the material has dried to the required moisture content. If high moisture is due to negligence of contractor due to improper drainage, the City Engineer may require removal and replacement of material.

Fill material shall not be placed on frozen ground or areas covered with ice and/or snow or areas with a moisture content above optimum.

E. **Preparation of areas to receive asphalt pavement or concrete**

1) **Areas to be Paved**: After all excavation, undercutting, and backfilling has been completed, the subgrade shall be properly shaped and thoroughly compacted. The compactive effort shall include all areas beneath pavement and shall extend at least a minimum of 1 foot behind the paving limits. Compaction shall be in accordance with Table 02200-1.

2) **Curb and Gutter, Sidewalks and Driveway Aprons**: The subgrade shall be constructed true to grade and cross section as may be shown on the drawings. Compaction shall be in accordance with Table 02200-1.

All subgrade shall be graded and protected as to prevent an accumulation or standing water, and consequent subgrade saturation, in the event of rain.

F. **Grading Tolerances of Finished Surface**: Earthwork shall conform to the lines, grades, and typical cross sections shown on the plans or as established by the City Engineer. Changes in grade shall be accomplished by smooth curves.

1) Shape subgrade under pavement and curb and gutter to within ½ inch of required subgrade elevations.

2) Finish pavement and curb and gutter to within ½ inch of required finish elevations.

3) Shape subgrade under sidewalks to within 0.10 foot of required subgrade elevations.

4) Finish sidewalks to within 0.10 foot of required finish elevations.

5) For all other areas, subgrade and finish elevations shall be within 0.10 foot of required corresponding elevations.

G. **Backfill of Curb and Gutter and Sidewalks**: Immediately after the removal of forms for curb and gutter, sidewalks and driveways, the space between the back of the curb, sidewalks, and driveways shall be backfilled and smoothed off in a manner to prevent the accumulation of standing water.

3.4 SUBGRADE COMPACTION TESTING AND CONTROL

A. **Municipal Projects**: For municipal projects, the City may employ and compensate a Geotechnical testing firm to provide soils testing and inspection services.

B. **Private Projects**: For private development projects which involves proposed City-owned infrastructure the developer, at the discretion of the City Engineer, may be required to employ a Geotechnical testing firm to perform the testing and provide copies of the tests reports to the City for approval and record.

C. **All Projects**

1) **Minimum Compaction Testing Frequency**

Location	Frequency
Buildings and structures	1 test group[a] for every 5,000 square feet
Road	1 test group[a] for every 300 feet of road
Parking Lots	1 test group[a] for every 10,000 square feet
Unpaved areas	1 test group[a] for every 20,000 square feet
Pipe Trench	1 test group for every 300 feet

[a] One test group consists of compaction tests on each layer of fill and backfill material.

2) In the absence of a pre-construction Geotechnical investigation, the Geotechnical testing firm is to perform laboratory Proctor tests to establish a moisture-density relationship for all materials that are proposed to be used as fill.

3) Contractor shall give a 24-hour notice to Geotechnical testing firm when ready for Proctor, compaction, or subgrade testing and inspection.

4) Should any moisture-density test fail to meet specification requirements, the Contractor shall perform corrective work necessary to bring the material in compliance and retest the failed area at no additional cost to the City.

3.5 SUBGRADE PREPARATION AND COMPACTION REQUIREMENTS

A. **Minimum Compaction Requirements**: Compaction percentages are percentages of maximum dry density as determined by indicated ASTM Standards. Unless otherwise directed by a Geotechnical Engineer, the material shall be placed at plus or minus 20% of optimum moisture content.

Table 2200.1	
Minimum Compaction Limits	
Location	**Density**
Beneath and within 25 feet of buildings	100% of the maximum dry density by ASTM D 698 (Standard Proctor), AASHTO T-99.
Areas under roadway pavement surfaces, shoulders, sidewalks, and curb and gutter	95% of the maximum dry density by ASTM D 698 (Standard Proctor), AASHTO T-99.
Under turf, sodded, planted, or seeded non-traffic areas	90% of the maximum dry density by ASTM D 698 (Standard Proctor), AASHTO T-99.

B. **Failure of Compactive Efforts**: If compaction efforts should fail to provide a stable subgrade, after subgrade materials have been shaped and brought to optimum moisture, such unstable materials shall be removed to the extent directed by either the Geotechnical Engineer or the City Engineer and replaced and compacted using new select material.

3.6 STRUCTURES: EXCAVATION, FILLING, AND BACKFILLING

See Section 02220 - *Trenching, Backfilling, and Compaction of Utilities* for excavation and backfilling for structures (manholes, etc.). See VDOT *Road and Bridge Specifications* for excavation and backfilling for retaining walls.

3.7 METHOD OF VOLUME MEASUREMENT

Contractors are required to furnish accurate counts of all excavation and/or fill moved which is to be paid for under the Contract unit price. The volumes shall be measured by either “truck tally” or by “cross-sectioning,” whichever method is approved by the City Engineer or stated in the proposal and/or bid documents. When a truck count is used, the City Engineer or their representative shall verify the count independently.

A. **Truck Tally Method**

Excavation: When regular excavation or undercut volumes are to be counted by the truck tally method, "swell" is to be incorporated into the truck volume in the amount of 15%. Unless otherwise agreed to or justified by a Geotechnical Engineer, the following pay volumes are to be used for either regular or undercut excavation:

Tandem: 13 CY
Tri-axle: 15 CY

Borrow: When either off-site or on-site borrow is to be counted by the truck tally method, "shrinkage" is to be incorporated into the truck volume in the amount of 15% (shrinkage of truck volume placed compared to compacted fill volume) utilizing the following pay volumes:

Tandem: 10 CY
Tri-axle: 12 CY

Loading Truck: A qualified truck load is one that is loaded up to within approximately 6 inches of the top of the dump bed, prior to dumping.

B. **Average-End-Method**

Excavation and fill can be computed using the average-end-method. When used, this method is to be employed using the existing contours shown on the Contract Drawings and the Contractor's actual surveyed finished contours (surveyed by a licensed Professional Surveyor). In so doing, the finished contours are to be plotted at the same scale as the original drawing and a transparency furnished to the Engineer for comparison to design grades. The volume computations are also to be submitted along with the Surveyor's seal and a certification as to the volumes measured.

The Contractor, at his discretion and with the prior approval of the Engineer, may survey the "stripped" site (the site after topsoil has been removed) and compute the volumes based on the stripped site and the "designed" finished grade as shown on the Contract Drawings. As before, a transparency to the same scale and the Surveyor's computations and certification are to be submitted to the Engineer for comparison and verification.

C. **Volume Formulas**

Unless otherwise approved, the following formulas are to be used in computing cut and fill:

Fill Formula

Net Fill = Raw Fill Vol. – Regular Excavation X (1 - Shrink Factor) + Strip Vol. - Undercut or waste Fill placed in Fill Slopes X (1 - Shrink Factor) - Pavement Section or Building Floor Pad

Cut Formula

Net Cut = Raw Cut - Strip Vol. + Pavement Section or Building Floor Pad

End of Section 02200

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02220 - TRENCHING, BACKFILLING AND COMPACTION OF UTILITIES

(Revised 12/29/12)

SELECTED LINKS TO SECTIONS WITHIN THIS SPECIFICATION

Part 1- General
Part 2 – Products
Part 3 – Execution
Backfilling Trenches
Bedding Definitions
Bedding for Structures
Bedding by Type of Pipe
Blasting
Clearing and Grubbing
Common Earth Backfill
Compaction – Min Require'ts
Construction Limits
Dewatering
Final Earth Backfill - Def
Flowable Fill Concrete
Initial Earth Backfill - Def
Minimum Pipe Cover
Select Earth Backfill
Trench Backfilling
Trench Preparation
Unclassified Trench Excavation

PART 1 – GENERAL

The Contractor shall furnish all labor, materials, tools, and equipment to perform all work and services necessary for or incidental to the completion of all underground utilities as shown on the drawings and as specified in the Contract Documents.

Contractor shall be responsible for coordination of work of all other trades.

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this specification.

B. Section 01000 – GENERAL REQUIREMENTS.

C. Section 02720 – STORM DRAINAGE.

D. Section 02730 – SANITARY SEWER.

E. Section 02660 – WATER DISTRIBUTION.

F. Section 02500 – BASE COURSE AND PAVING.

G. Section 02200 – EARTHWORK.

1.2 SUMMARY

A. This section includes:

1) Excavating and backfilling trenches for buried water, sewer, and storm drainage pipe systems, buried utility structures, and appurtenances.

2) Preparing subgrade for buried water, sewer, and storm drainage systems, buried utility structures and appurtenances.

B. Construction and materials related to this section but specified in other specification sections:

1) Section 01000 – *General Requirements*: Landscaping, Seeding and Groundcover, and Erosion Control.

2) Section 02200 – *Earthwork*: site clearing, grubbing, topsoil removal, tree protection, roadway, and paving.

1.3 DEFINITIONS

For the purposes of this specification, the following definitions refer to sanitary sewer, storm drainage and water distribution systems that come under the authority of the City of Lynchburg, Virginia as specified within this section and other sections of this manual.

A. **Backfill**: Soil materials used to fill an excavated trench:

1) **Initial Backfill** (Select Earth Backfill): Backfill placed beside and 12 inches over the top of the pipe in a trench, including haunches to support sides of pipe.

2) **Final Backfill** (Common Earth Backfill): Backfill placed over the initial backfill to fill a trench.

B. **Bedding Course**: Layer placed over the excavated subgrade in a trench before laying pipe.

C. **Foundation Stone**: Clean well-graded stone, authorized by the City Engineer, used to strengthen and/or provide support to an otherwise weak subgrade. Foundation stone is placed, and the subgrade improved before bedding stone is placed.

D. **Trench Rock Excavation**: Removal and satisfactory disposal of all unsuitable materials, which, in the opinion of the City Engineer, cannot be excavated except by drilling, blasting, wedging, jack hammering or hoe ramming. It shall consist of undecomposed stone, hard enough to ring under hammer. All boulders containing a volume of more than ½ cubic yard and/or solid ledges, bedded deposits, unstratified masses and conglomerations of material so firmly cemented as to possess the characteristics of solid rock which cannot be removed without systematic drilling, blasting, or hoe ramming will be classified as rock.

E. **Structures**: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

F. **Subgrade**: Surface or elevation remaining after completing the trench excavation or, the top surface of a backfill (stone or soil) immediately below the pipe conduit or pipe bedding, as applicable.

G. **Trench Borrow (Select)**: Trench borrow shall consist of approved material imported from off-site for use as fill or backfill required to be placed in trenches either as initial select earth backfill or final common earth backfill. Trench borrow shall not be used until all suitable trench excavation material has been placed in the trench, unless authorized by the City Engineer. The Contractor shall make his own arrangements for obtaining borrow and pay all costs involved, unless otherwise designated on the plans and in the contract documents. Borrow material must be approved by the City Engineer prior to use.

H. **Regular Excavation**: Removal and disposal of any and all material above subgrade elevation, except solid rock and undercut excavation, located within the limits of construction.

I. **Undercut Excavation**: Undercut excavation shall consist of the removal and satisfactory disposal of all unsuitable material located below subgrade elevation. Where excavation to the finished grade section results in a subgrade or slopes of muck, peat, matted roots, etc., the Contractor shall remove such material below the grade shown on the plans or as directed; and areas so excavated shall be backfilled with approved select earth borrow or stone as directed by the City Engineer.

1.4 SUBMITTALS

A. Submit product data for and a sample of the following in accordance with Section 01000, *General Requirements*. Fully document each with specific location or stationing information, date and other pertinent information.

1) Stabilization/Separation fabric

2) Drainage Fabric

3) Metallic locating tape

B. **Material Test Reports**: Provide from a qualified testing agency test results and interpretation for compliance of the following requirements indicated:

1) Classification according to ASTM D2487 of each on-site or borrow soil proposed for backfill, unless otherwise directed by the City Engineer.

2) Laboratory compaction curve according to ASTM D698 for each on-site or borrow soil material proposed for backfill.

C. **Blasting**: See Section 01000 – *General Requirements*.

D. **Bury Depth Computations**: Computations justifying pipe bury when bury depth exceeds the allowable depth shown in this specification. Provide method, applicable charts/graphs, print outs, assumptions, etc.

1.5 QUALITY ASSURANCE

A. **Geotechnical Testing Agency Qualifications**: An independent testing agency qualified according to ASTM E 329 to conduct soil materials and rock-definition testing as documented according to ASTM D 3740 and ASTM E 548.

B. Comply with all codes, laws, ordinances, and regulations of governmental authorities having jurisdiction over this part of the work.

C. The Contractor shall comply with the latest revision of the Virginia Occupational Safety and Health Standards for the Construction Industry as adopted by the Safety and Health Codes Commission of Virginia.

D. The Contractor shall comply with Virginia Department of Conservation and Recreation, Division of Soil and Water Conservation, "Virginia Erosion and Sedimentation Control Handbook," latest revision.

E. Comply with applicable requirements of NFPA 495, *"Explosive Materials Code."*

F. Comply with *"Gravity Sanitary Sewer Design and Construction*," ASCE Manuals and Reports on Engineering Practice – NO. 60, WPCF Manual of Practice NO. FD-5.

G. Comply with Uni-Bell PVC Pipe Association "*Handbook of PVC Pipe: Design and Construction,"* 3r ed. Dallas: UNI, 1991 for the installation of PVC piping, latest revision.

H. Materials and operations shall comply with the latest revision of the Codes and Standards listed below:

American Society for Testing and Materials

ASTM C 33	Concrete Aggregates.
ASTM D 698	Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3) (Standard Proctor).
ASTM D 1556	Standard Method of Test for Density of Soil in Place by the Sand-Cone Method.
ASTM D 1557	Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3) (Modified Proctor).
ASTM D 2049	Standard Method of Test for Relative Density of Cohesionless Soils.
ASTM D2167	Standard Method of Test for Density of Soil in Place by the Rubber-Balloon Method.
ASTM D 2487	Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System).

ASTM D 2922	Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
ASTM D 4253	Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.
ASTM D 4254	Test Method for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.
ASTM D 4318	Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

American Association of State Highway & Transportation Officials

AASHTO T99	The Moisture-Density Relations of Soils using a 5.5-pound Rammer and a 12-inch drop.
AASHTO T180	The Moisture Density Relations of Soils using a 10-pound Rammer and an 18-inch drop.
AASHTO M 145	The Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes.

American Water Works Association

AWWA C600	Installation of Ductile Iron Water Mains and Their Appurtenances.

1.6 STANDARD ABBREVIATIONS

ANSI	American National Standards Institute
AREA	American Railway Engineers Association
DEQ	Department of Environmental Quality
DIP	Ductile Iron Pipe
MSDS	Material Safety Data Sheets
OSHA	Occupational Safety and Health Administration
PVC	Polyvinyl Chloride Plastic Pipe
RCP	Reinforced Concrete Pipe
PCP	Plain Concrete Pipe (Non-Reinforced)
VDH	Virginia Department of Health
VDOT	Virginia Department of Transportation

1.7 TESTING SERVICES

A. The Testing Laboratory shall be selected by the Contractor/Developer and approved by the City Engineer and will be responsible for conducting and interpreting tests. The Testing Laboratory shall state in each report whether or not the test specimens conform to all requirements of the Contract Documents and specifically note any deviation.

B. Specific test and inspection requirements shall be as specified herein.

1.8 PROJECT CONDITIONS

A. **Demolition**: Demolish and completely remove from the site existing underground utilities indicated on the plans to be removed.

B. **Environmental**: Before crossing or entering into any jurisdictional wetlands, Contractor shall verify whether or not a wetlands permit has been obtained for the encroachment and whether special restrictions have been imposed. Care shall be taken to prevent draining or otherwise destroying non-permitted wetlands. Restore as stated on either the project drawings, the contract documents, and/or as noted in the permit.

1.9 COORDINATION

A. At the direction of the City Engineer, temporary pumping/bypass of sewerage flow may be required to be provided. See Section 02730 - *Sanitary Sewer* for bypass pumping requirements and procedures.

B. See Section 02660 – *Water Distribution* for valve operation requirements.

C. Coordinate tie-ins to municipal system with the City of Lynchburg.

D. When traffic signals or their appurtenances are likely to be damaged or interfered with as a result of the construction, coordinate temporary operation with the City of Lynchburg Traffic Engineer. Provide a minimum of 48 hours notice prior to anticipated disturbance or interruption.

PART 2 – PRODUCTS

2.1 BEDDING AND BACKFILL

A. **Backfill Around Structures**: Backfill shall be approved by the City Engineer and shall be free from large or frozen lumps, wood, or rocks more than 3 inches in their greatest dimension or other extraneous material. Porous backfill shall conform to the requirements of applicable sections of the VDOT *Road and Bridge Specifications.*

B. **Bedding Material**: VDOT #57, #68, or #78 stone.

C. **Coarse Aggregate Backfill**: See applicable VDOT *Road and Bridge Specifications* for properties and gradation of VDOT #57 stone.

D. **Common Earth Backfill**

1) **Satisfactory Soils**: ASTM D 2487 soil classification group (Unified Classification System) GW, GP, GM, SW, SW, SM, SC, ML, and CL or a combination of these group symbols; free of rock or gravel larger than 3 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.

2) **Unsatisfactory Soils**: ASTM D 2487 soil classification group CH, MH, OH, OL and PT; soils which contain rock or gravel larger than 3 inches in any dimension, debris, waste frozen materials, vegetation, and other deleterious matter. Unsatisfactory soils also include satisfactory soils not maintained within 20-percent of optimum moisture content at time of compaction, unless otherwise approved by the City Engineer.

E. **Dense Graded Aggregate Backfill**: VDOT #21A stone.

F. **Excavation**: All excavation material shall be classified as either Rock or Regular Earth Excavation.

G. **Flowable Fill Concrete Backfill**: Concrete strength shall be liquid enough to flow, be self-leveling, and have an ultimate minimum strength 225 psi (this product is a combination of sand and Portland cement).

H. **Foundation Stone**: Foundation/Trench Stabilization Material: VDOT #1 or #2 stone.

I. **Select Earth Backfill**: Select earth backfill shall be free of debris, roots, frozen materials, organic matter, rock, or gravel larger than 1 inch in any dimension, or other harmful matter and shall generally meet VDOT *Road and Bridge Specifications,* Section 207 – *Select Material* for properties and gradation. Sand and rock dust are acceptable materials.

J. **Topsoil**: Topsoil shall consist of friable clay loam, free from roots, stones, and other undesirable material and shall be capable of supporting a good growth of grass. Topsoil shall be free of material greater than 1 inch in any dimension.

2.2 MISCELLANEOUS

2.2.1 GEOTEXTILE FABRIC

See the Virginia Department of Conservation and Recreation, Division of Soil and Water Conservation, *Virginia Erosion and Sedimentation Control Handbook*, latest edition.

2.2.2 NON -METALLIC WARNING TAPE

Acid and alkali resistant polyethylene film tape manufactured for marking and identifying underground utilities, 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility, colored as follows:

Blue: Water Systems
Green: Sewer systems

2.2.3 METALLIC LOCATING WIRE

Locating wire shall be 12 gauge copper wire jacketed with an acid and alkali resistant high density polyethylene coating; colored as follows:

Blue: Water Systems
Green: Sewer systems

PART 3 – EXECUTION

3.1 PREPARATION

3.1.1 GENERAL REQUIREMENTS APPLYING TO ALL AREAS

A. Contractor shall plan construction to minimize disturbance to properties adjacent to the sewer, water, and storm lines.

B. The City Engineer reserves the right to limit the width of land to be disturbed and to designate on the drawings or in the field certain areas or items within this width to be protected from damage.

C. Any grading or excavation required for equipment travel during the course of construction as well as erosion control, access or haul road installation and removal, restoration, seeding and ground cover shall be provided by the Contractor at no additional cost.

D. The Contractor shall be responsible for damage to areas or items designated by the City Engineer to be protected. Repairs to, replacement of, or reparations for areas or items damaged shall be made at the Contractor's expense to the satisfaction of the City Engineer before acceptance of the completed project.

E. The Contractor shall protect all buildings, structures, and existing utilities located along the utility line. Hand trenching, shoring, or other methods may be required at no additional cost.

F. Any fences disturbed by the Contractor shall be repaired to a condition equal to or better than their original condition or to the satisfaction of the City Engineer at no additional cost.

G. Contractor shall obtain written permission from property owners for use of any access other than ones located within rights-of-way. Written permission shall contain conditions for use and restoration agreements between property owner and Contractor. No additional compensation will be made for such access.

H. All areas disturbed shall be restored to a condition equal to or better than their original condition and shall be graded to drain.

I. The Contractor shall replace or repair all damaged or destroyed hedgerows and property corners. Protection of and restoration of damaged or destroyed property corners shall be in accordance with the requirements of Section 01000 – *General Requirements,* Construction Staking.

J. When a property owner requests that a tree(s) within construction limits remain, a waiver shall be signed between the property owner and the City.

3.1.2 CONSTRUCTION LIMITS

A. Contractor shall not disturb any areas outside the limits contained in this section without the express written permission from the City Engineer.

B. The following widths measured from the centerline of the sewer, water, and storm drainage lines shall be considered the allowable working area and be referred to as the "construction limits."

Pipe Size	Distance from C/L	Total Allowable Width
12" or smaller	15 feet	30 feet
15" to 18"	20 feet	40 feet
24" and larger	25 feet	50 feet

The Contractor shall protect all areas outside these construction limits unless written variations are granted by the City Engineer.

3.1.3 CLEARING AND GRUBBING

A. This work shall consist of clearing, grubbing, removing, and disposing of all vegetation and debris within the limits of construction, as designated on the plans or as required by the City Engineer. The work shall also include the preservation from injury or defacement of all vegetation or objects designated to remain.

B. The Contractor shall clear and grub the surface as required for the full length of the trench within the rights of way or easements or within the construction limits indicated on the drawings. The width shall not exceed that width as specified herein. The Contractor shall remove only those trees and shrubs absolutely necessary to allow for the construction.

C. Prior to commencement of clearing, Contractor shall notify the City Construction Coordinator 48 hours in advance.

D. The Contractor shall provide barricades, fences, coverings, or other types of protection necessary to prevent damage to existing improvements, not indicated to be removed, and improvements on adjoining property. All improvements damaged by this work shall be restored to their original condition or to a condition acceptable to the owner or other parties or authorities having jurisdiction.

E. **Protection of Trees and Vegetation**

Contractor shall protect existing tress and other vegetation indicated by the City Engineer to remain in place against cutting, breaking, or skinning of roots, skinning and bruising of bark, smothering of trees by stockpiling construction materials or excavated materials within drip line, excess foot or vehicular traffic, or parking of vehicles within drip line. Provide temporary fences or barricades as required to protect trees and vegetation to be left standing at no additional cost.

Trees and shrubs that are to remain within the construction limits will be indicated on the drawings or conspicuously marked on site.

Carefully and cleanly cut roots and branches of trees indicated to remain where the roots and branches obstruct construction of the utility line. If directed by the City Engineer, the Contractor shall provide protection for roots and branches over 1 ½ inches diameter that are cut during construction operations. Temporarily cover all exposed roots with wet burlap to prevent roots from drying out. Provide earth cover as soon as possible.

Damaged trees and vegetation designated to remain shall be repaired or replaced at Contractor's expense in a manner acceptable to the City Engineer if they are damaged by construction operations. Repair tree damage as directed by a qualified tree surgeon.

F. All brush, tree tops, stumps, and debris shall be hauled away and disposed of in accordance with applicable laws and regulations. The Contractor shall clean up debris resulting from clearing operations continuously with the progress of the work and remove promptly all salvageable material that becomes his property and is not to be reused in construction. Sale of material on the site is prohibited. Debris from the site shall be removed in such a manner as to prevent spillage. Keep pavement and area adjacent to site clean and free from mud, dirt, dust, and debris at all times. Unless otherwise noted, all trees with diameters of 6 inches or larger, measured at the base, cut on any project shall be cut into fireplace lengths, 24 inches, stacked within the "construction limits" at a location suitable to the property owner. Contractor shall not remove any wood from this project without written authorization from the City Engineer. No additional compensation shall be made if removal of trees from property is required.

G. The method of stripping, clearing, and grubbing the site shall be at the discretion of the Contractor. However, all stumps, roots and other debris protruding through the ground surface or in excavated areas shall be completely removed and disposed of off the site by the Contractor, at his expense.

H. Remove the existing topsoil to a depth of 6 inches or to the depth encountered from all areas in which excavation will occur. The topsoil shall be stored in stockpiles, separate from the excavated trench material, if the topsoil is to be respread. Otherwise, material shall be disposed of off-site at the Contractor's expense.

I. **Specific Requirements Applying to Developed Subdivision/Lots**

1) All trees located beyond 10 feet of the centerline of the sewer, water, or storm drainage line shall be protected by the Contractor. The City Engineer reserves the right to designate other trees located closer to the centerline for protection where possible.

2) All shrubs, hedges, or other ornamental plantings located along the line shall be protected or removed and replanted by the Contractor and guaranteed within the warranty period at no additional cost.

3) The Contractor shall protect septic systems, wells, or springs.

4) Damage to lawns shall be kept to the absolute minimum necessary for construction.

5) Excavated or blasted rock shall be removed from the site unless otherwise ordered by the City Engineer.

3.1.4 PROTECTION OF EXISTING UTILITIES

A. Contractor is responsible for protection of existing utilities in accordance with Section 01000 – *General Requirements*.

B. Should it become necessary to move the position of any underground structure, the Contractor may be required to do such work and shall be paid on a force account basis or on an extra work basis as specified in Section 01000 – *General Requirements*. Method of payment shall be agreed upon by the City Engineer and the Contractor prior to commencing work.

C. If existing utilities are found to interfere with the permanent facilities being constructed under this Section, immediately notify the City Engineer and secure instructions. Do not proceed with permanent relocation of utilities until instructions are received from the City Engineer.

3.1.5 PROTECTION OF SURFACE FEATURES

Refer to Section 01000 – *General Requirements*.

3.1.6 PROCEDURES FOR REPAIRING DAMAGED UTILITIES

Refer to Section 01000 – *General Requirements*.

3.1.7 PROTECTION OF PERSONS AND PROPERTY

Refer to Section 01000 – *General Requirements* for requirements relating to protection and restoration of property.

3.2 TRENCH EXCAVATION

3.2.1 GENERAL

A. **Pipe Cover**

Minimum Cover: Unless shown otherwise on the construction documents, provide minimum trench depth indicated to maintain a minimum cover over the top of the installed item. Minimum cover on pipe is measured from top of pipe to original ground or proposed finished grade as applicable and shall be per standard details. When minimum cover cannot be maintained, alternate construction shall be approved by the City Engineer. For minimum cover requirements, see Section 02730 – *Sanitary Sewer,* Section 02660 – *Water Distribution*, and Section 02720 – *Storm Drainage*, as applicable.

B. Remove all material from trench limits. Material of a compactible nature that can be re-used as trench backfill shall be re-installed and re-compacted to the requirements set forth in these specifications.

C. At the Contractor's expense, dispose of all unsatisfactory material, of what ever nature, to a site which legally can accept such material as fill. Adhere to all applicable laws and ordinances regarding permitting of waste site, erosion control, zoning, etc. as may be applicable.

D. Material of an uncompactable nature, material unsatisfactory for backfill, trash and excess material shall be removed from project site and disposed at the Contractor's expense. Where removal of unsatisfactory material is due to negligence on the part of the Contractor (i.e. resulting from inadequate shoring or bracing, failure to dewater, improper material storage exposing it to rain or flooding, or other failure to meet specified requirements), work shall be performed at no additional cost to the City. If additional material is required, the Contractor shall supply same from an approved borrow pit at no additional cost the City.

3.2.2 TRENCHING

A. Where the utility line is in an existing paved area, the pavement shall be saw cut in a straight line parallel to the pipe on each side. Saw cutting operations shall be performed prior excavation to avoid excessive removal of asphalt. Care shall also be taken during the installation of pipe to avoid damage to adjoining paved surfaces.

B. All trenches shall be excavated to the lines and grades as shown on the plans. Trenches for water lines may be curved within the limits of curvature of the pipe as allowed by AWWA C600.

1) **Trench Width**: The sides of trench shall be uniform and vertical. See **Standard Detail 27.01** for trench width for sanitary sewers and storm sewers and **Standard Detail 26.01** for water lines.

2) **Trench Depth**: All trenches shall be excavated to accommodate the bedding as required in Table 2220.1 and as shown in **Standard Details 27.01 and 26.01**, as applicable. No extra compensation will be made for stone bedding used to bring the trench up to grade other than that required in **Standard Details 27.01** and **26.01**, as applicable and specified in Table 2220.1.

   In excavating for the trench, it is essential that the trench bottom be uniform in grade and remains static during backfilling and under all subsequent trench conditions. The grade of the bottom of the trench shall be graded to within 0.04 foot (1/2-inch) of the plan specified grade. The stone shall be graded to the same tolerance.

   Care shall be taken not to over excavate the trench. Refer to paragraph 3.2.4 for over excavation specification.

3) **Open Trench Exposure**: Once trench is opened, proceed immediately to place specified materials in trench, or to otherwise utilize trench for intended purpose. Schedule work and order materials so that trenches are not left open for a longer period than is reasonably necessary and do not extend length limits specified in applicable specifications.

3.2.3 TRENCH ROCK

When rock is encountered in the trench, the City Construction Coordinator or City Engineer must be notified before any rock is blasted or removed. The City Engineer or his representative will measure the rock, after which, the rock shall be excavated. Rock shall be removed from the construction site unless otherwise approved by the City Engineer. See Section 01000 – *General Requirements* for blasting requirements.

3.2.4 PREPARATION OF FOUNDATION FOR PIPE LAYING

A. The bedding surface shall provide a firm, stable, and uniform support through the entire length of the pipe.

B. **Unsuitable Trench Subgrade/Foundation Improvement**: Notify the City when unstable materials are encountered and define by drawing station locations and limits where encountered. If the trench subgrade is found to be soft, spongy, excessively wet, unstable or in any other way unfit such that there is inadequate pipe support, when directed by the City Engineer or City Construction Coordinator, the material shall be removed for the full width of the trench, and the excavated area shall be strengthened for foundation purposes by furnishing and placing either approved crushed stone, a concrete cradle, concrete mud mat, concrete encasement or a combination of these materials. Whenever the bottom of the trench is such that it cannot be reasonably stabilized, the City Engineer may require the pipe to be laid in cradles supported on piles. These foundations shall be placed as directed by the City Engineer.

C. **Over Excavation**: Exercise care to avoid excavations below established grade where firm earth conditions exist. Unauthorized over-excavation consists of removal of material beyond indicated subgrade elevations or side dimensions, without specific approval of the City Engineer. Unauthorized excavation shall be replaced at Contractor's expense. Where unauthorized excavations have been carried beyond points required, restore these areas to the elevations and dimensions shown on the drawings with approved fill material and compact as specified. If over-excavation occurs, such over excavation shall be replaced with clean VDOT #57 stone.

3.2.5 DEWATERING

A. When ground water in encountered, the Contractor shall pump or otherwise remove any water that accumulates in the trenches or pits and shall perform all work necessary to keep the trenches or pits clear from water while pipe is being laid, masonry units are being placed, and structures are either being set or constructed. All water removed from the trench shall be conveyed in a proper manner to a suitable point of discharge and shall comply with applicable erosion and sediment control laws at no additional cost. If pumping is required between the hours of 8:00 p.m. and 6:00 a.m., engines shall be equipped as specified in Section 02730 - Sanitary Sewer, paragraph 3.5E, in order to keep noise to a minimum.

B. No pipe shall be constructed in water and water shall not be allowed to drain through the pipe. The open end of the pipe shall be kept closed with a tight fitting plug to prevent washing of any foreign matter into the line.

C. No structure shall be constructed in water and water shall not be allowed to flow over or rise upon any concrete or masonry structure until the work has been accepted.

D. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches. Reroute surface water runoff away from or around excavated areas.

3.2.6 TRENCH PREPARATION FOR PIPE

A. **Preparation of Trenches for Gravity Pipelines**

Depending upon the bedding class, the bottom of the trench for gravity pipelines shall be excavated to a minimum over depth as indicated in Table 2220.1 to provide for improved pipe bedding material for the entire length of the gravity pipeline, including sewer lateral connections, except in rock where bedding shall be a minimum of 6 inches deep (see **Standard Detail 27.01**). Rock larger than 3 inches shall be removed from the trench bottom and any voids filled with soil or clean stone. The bedding shall be shaped so that the bottom quadrant of the pipe rests on the bed. Bell holes and depressions as required of the joint shall be dug after the bedding has been graded and shaped, and shall be only of such length, depth, and width as required for properly making the particular type of joint. The trench for sanitary sewers, sanitary sewer lateral connections, and storm drainage lines shall then be backfilled as indicated in Section 3.4 - Backfilling.

B. **Preparation of Trenches for Water Mains**

When bedding is required, the bottom of the trench for pipe line shall be excavated to a minimum over depth as indicated in Table 02220.1. The trenches for water lines shall be graded to avoid local high points. Trenches shall be graded either level or on a continuous upslope to the high points designated on the drawings. Trenches shall be of such depth as to provide a minimum cover over the top of the pipe as noted in Section 1.8 – Project Conditions. Pipe shall not bridge any areas. Rock larger than 3 inches shall be removed from the trench bottom and any voids filled with soil or clean stone. Bell holes shall be provided at each joint to permit proper joint assembly and proper pipe support. Rock shall be removed 6 inches below pipe and bedding shall be a minimum of 6 inches. The trench for water lines shall then be backfilled as indicated in Section 3.4 – Backfilling.

3.2.7 TRENCHING IN FILLS

In areas where trenching for pipes will be in fills, the fills shall be brought to an elevation of at least 12 inches above the top of the pipe, and then the trench excavated in the compacted fill, as herein specified for trench excavation.

3.2.8 EXCAVATION FOR APPURTENANT STRUCTURES

A. Excavate for appurtenant structures to provide at least 12 inches (minimum) clear distance between outer surface of the structure and undisturbed earth.

B. Where rock is encountered so that a built-in-place manhole, precast structure (such as a manhole or vault), or other structure will bear over rock, remove the rock to a minimum of 12 inches below the foundation or footing of the structure and place an 12-inch cushion of VDOT #57 stone over the rock.

3.2.9 DEPOSITION OF EXCAVATED MATERIAL

All excavated material shall be placed in accordance with all applicable OHSA and State and local erosion and sedimentation regulations.

3.3 BEDDING

3.3.1 PIPE BEDDING CLASS DEFINITIONS

A. **Class D Bedding** is that condition existing when the ditch is excavated slightly above grade by excavation equipment and cut to finish grade by hand. Bell holes are dug, to prevent point loading the pipe bells, so that pipe bears uniformly upon the trench bottom. Existing soil should be shovel sliced or otherwise compacted under the haunching of the pipe to provide some uniform support. The backfill to the ground surface is to be compacted to the density specified in Table 02220.2. In poor soils, granular bedding material is generally a more practical, cost effective installation. The bedding factor for class D bedding is 1.1.

B. **Class C Bedding** is that condition where the pipe is bedded in compacted granular material. The granular bedding has a minimum thickness of one-eighth the outside pipe diameter, but not less than 4 inches or more than 6 inches, and shall extend up the sides of the pipe one-eighth of the pipe outside diameter. The backfill to ground surface is to be compacted to the density specified in Table 02220.2. The bedding factor for class C bedding is 1.5.

C. **Class B Bedding** is that condition where the pipe is bedded in carefully compacted granular material. The granular bedding has a minimum thickness of one-eighth the outside pipe diameter, but not less than 4 inches or more than 6 inches, between the barrel and the trench bottom, and covering the full width of the trench and shall extend to the spring line.

The haunch area of the pipe must be fully supported; therefore, the granular material should be shovel sliced or otherwise compacted under the pipe haunch to the springline of the pipe. Both granular haunching (to the springline) and initial backfill to a minimum depth of 12 inches over the top of the sewer pipe should be placed and compacted. The remainder backfill to the ground surface is to be compacted to the density specified in Table 02220.2. The bedding factor for class B bedding is 1.9.

D) **Class B-1 Bedding** (*PVC pipe applications*) is the same as Class B Bedding except that granular backfill is placed to the top of the pipe rather than to the springline of the pipe. The backfill to the ground surface is to be compacted to the density specified in Table 02220.2.

E) **Class A Bedding** is that condition when the pipe is bedded in a cast-in-place cradle of either plain or reinforced concrete having a thickness equal to one-fourth the inside pipe diameter, with a minimum of 4 inches and a maximum of 15 inches under the pipe barrel and extending up the sides for a height equal to one-fourth the outside pipe diameter. The cradle width shall have a width at least equal to the outside diameter of the sewer pipe barrel plus 8 inches. The bedding factor for class A bedding is 2.2.

The haunching and initial backfill material above the concrete cradle should be crushed stone or a well graded granular material and carefully compacted to 12 inches above the crown of the pipe. The backfill to the ground surface is to be compacted to the density specified in Table 02220.2.

3.3.2 MINIMUM BEDDING REQUIREMENTS (by application and type of pipe)

Table 2220.1			
Minimum Bedding Class			
Application	**Pipe Material**	**Pipe Size**	**Minimum Bedding Class**
Sewer			
	PVC	6-inches or smaller	Class B-1[a] (stone to top of pipe)
	PVC	8-inch thru 15-inch	Class B-1[a] (stone to top of pipe)
	DIP	4-inch thru 24-inch	Class B
	RCP	>24-inch	Class B
Water			
	DIP	Up to 16 inches	Class D
	DIP	≥ 16 inches	Class C
Storm			
	RCP	Thru 36 inches	Class B
	RCP	> 36 inches	Class B
	DIP	15 thru 24 inches	Class B
	ADS N-12 HP/PP Inside R/W	Thru 36 inches	Class B-1[a] MODIFIED (stone to top of trench)
	ADS N-12 HP/PP Outside R/W	Thru 36 inches	Class B-1[a] (stone to top of pipe)

[a]The approximate long-term deflection in different burial conditions (bedding classes, depth, degree of compaction, type backfill soil, etc.) generally can be calculated using the Modified Iowa Formula developed by Spangler and Watkins.

Bedding requirements when rock is encountered: When rock is encountered excavate to a depth of 6 inches below pipe and provide granular pipe bedding at a depth of 6 inches between pipe barrel and trench bottom. The bedding shall extend up the sides of the pipe 1/8 of the pipe outside diameter.

3.3.3 BEDDING FOR STRUCTURES

The bottom of structure excavations shall be excavated to minimum over depth of 12 inches below the bottom of the structure to provide for stone bedding. Bedding material shall be shaped and graded so that the entire bottom of the structure rests on the material for its entire area.

3.4 BACKFILLING

A. **General**

1) Reopen trenches that have been improperly backfilled, to a depth as required for proper compaction. Refill and compact as specified, or otherwise correct to the approval of the City Engineer and at no additional cost to the City.

2) Should any of the work be so enclosed or covered up before it has been approved, uncover all such work and, after approvals have been made, refill and compact as specified, all at no additional cost to the City.

3) Observe specific pipe manufacturer's recommendations regarding methods of backfilling and compaction.

4) Insure compaction of each lift to requirements stated in these specifications.

5) All trenches shall be backfilled prior to the completion of the day's work unless otherwise directed or permitted by the City Engineer.

6) Exercise extreme care in backfilling operations to avoid displacing joints and appurtenances or causing any horizontal or vertical misalignment, separation, or distortion. Repair damages, distortions, or misalignments to full satisfaction of the City Engineer.

B. **Methods**

1) **Select Earth Backfill**: Furnish select earth backfill where indicated on drawings and specified for compacted backfill conditions up to 12 inches above top of pipe. Comply with the following:

Care shall be taken to prevent any disturbance to the pipe or damage to newly made joints. The filling of the trench shall be carried on simultaneously on both sides of the pipe in such a manner that injurious side pressures do not occur such that the pipe could be displaced or dislodged. Do not backfill on muddy or frozen soil.

Sheeting and shoring generally should be removed only when the trench below it has become substantially filled, and every precaution shall be taken to prevent any slides of material from the sides of the trench onto or against the pipe.

a. Hand place, shovel slice, and pneumatically tamp all select earth backfill.

b. Place backfill in lifts not exceeding 6 inches (loose thickness).

2) **Common Earth Backfill**: Comply with the following:

a. Unless otherwise specified or approved by the City Engineer, backfill the remainder of the trench, from 1 foot above the pipe to grade, with common earth fill. Before placing any backfill, all rubbish, forms, blocks, wires, or other unsuitable material shall be removed from excavation. The backfilling shall be placed in layers not over 6 inches.

b. All areas within the limits designated on the drawings, including adjacent transition areas, shall be uniformly graded. The Contractor shall finish surfaces within the specified tolerances with uniform levels or slopes between points where elevations or existing grades are shown.

i. Finish subgrade areas that are to receive topsoil. Bring such areas to within 0.10 foot of required subgrade elevations.

ii. Shape subgrade under sidewalks to line, grade, and cross-section. Subgrade is to be brought to within 0.10 foot of required subgrade elevations.

iii. Shape subgrade under pavement to line, grade, and cross-section. Bring to within ½ inch of required subgrade elevations.

c. The Contractor shall protect newly graded areas from traffic and erosion and repair and re-establish grade in settled, eroded, or rutted areas. Where compacted areas are disturbed by subsequent construction or adverse weather, the Contractor shall scarify the surface, reshape, and re-compact to the required density. If the Contractor shall fail to maintain any trench within 2 days after receipt of written notice from the City Engineer, the City Engineer may refill the said depressions and the cost of such work may be retained from monies due the Contractor or billed directly to the Contractor. In case of emergency, the City Engineer may refill any dangerous depressions without prior notice to the Contractor.

3) **Structure Backfill**: Take care to prevent wedging action of the backfill against structure by carrying the material uniformly around the structure so approximately the same elevation is maintained in each lift. The Contractor shall refill all excavations as rapidly as practical after completion of the structural work therein, or after the excavations have served their purpose.

4) **Aggregate Backfill**

a. **Dense Graded Aggregate Backfill**: When select earth backfill/borrow cannot be obtained, dense graded aggregate may be substituted with the City Engineer's approval.

b. **Coarse Aggregate Backfill**: In confined areas where compaction cannot be achieved, coarse aggregate may be substituted with the City Engineer's approval.

3.5 COMPACTION/DENSITY

A. **Quality Assurance (QA)**: In the course of backfilling trenches for utility installations, the City Engineer may require "Field Density Determinations" or compaction tests. When compaction tests are called for, the City Engineer will determine the location of the tests and the Developer (Owner) shall engage a qualified testing firm to perform the test. Field density determinations shall be performed in accordance with AASHTO T191, T205, and T214, modified to include material sizes used in the laboratory determination of density with nuclear field density testing device or by other approved methods. A representative of the City Engineer will observe tests and a copy of the test results and inspection report will be submitted by the testing firm directly to the City Engineer or his/her representative. When the test results indicate that the density is less than the percent specified, the Contractor shall excavate and re-compact the areas that have failed at no expense to the City. Payment for failed compaction test shall be made by the Contractor by deducting the cost from the forthcoming retainage or billed directly to the Contractor.

B. Soil shall be compacted using equipment suitable for the material and the work area location.

C. **Compaction Requirements**: Unless noted otherwise on drawings or more stringently by other sections of these specifications, place and insure backfill and fill materials achieve an equal or "higher" degree of compaction than undisturbed materials adjacent to the work; however, in no case shall degree of compaction fall below the following percentages of the maximum density at optimum moisture content. Tolerance is to be within +/- 20 percent of the optimum moisture content.

Table 2220.2	
Minimum Compaction Limits	
Location	**Density**
Beneath and within 25 feet of buildings	100% of the maximum dry density by ASTM D 698 (Standard Proctor), AASHTO T-99.
Areas under roadway pavement surfaces, shoulders, sidewalks, and curb and gutter	95% of the maximum dry density by ASTM D 698 (Standard Proctor), AASHTO T-99.
Under turf, sodded, planted, or seeded non-traffic areas	90% of the maximum dry density by ASTM D 698 (Standard Proctor), AASHTO T-99.

D. **Minimum Compaction Testing Frequency**: Refer to Section 02200 – *Earthwork*, paragraph 3.4 – Subgrade Compaction Testing and Control.

3.6 SERVICE CUTS, DIRECTIONAL BORED OR PUNCHED SERVICES

A. **Open Trenches**: Sewer lateral and water service connections that cross paved streets shall be installed by saw cutting the pavement and opening the trench.

Lateral and service connection trenches shall be backfilled as specified for gravity sewers and for water lines, as applicable. See Section 1.8 – Project Conditions of this specification.

B. **Directional Boring or Punching**: At the direction of the City Engineer, service pipes may be required to be “punched” or “directional bored” beneath the pavement.

3.7 PAVEMENT REPAIR AND REPLACEMENT

Refer to specification Section 02500 – *Base Coarse and Paving*.

3.8 HIGHWAY CROSSING

Refer to specification Section 02730 – *Sanitary Sewer* and Section 02660 – *Water Distribution*.

3.9 MISCELLANEOUS

3.9.1 IDENTIFICATION OF NEW LINES (Non-Metallic Warning Tape & Metallic Locating Wire)

A. **SANITARY SEWER LINES**
Placement of locating tape and wire during backfill operations shall be required on all newly installed non-metallic mains and service laterals. All new metallic mains and laterals will only require the installation of the warning tape. The non-metallic warning tape and metallic locating wire shall be per paragraph 2.2.2 and paragraph 2.2.3 of this specification. The warning tape shall be installed between 12 and 18 inches below the final grade. There shall be a minimum of 6 inches of separation between the warning tape and locating wire. The locating wire shall be installed along the crown of the pipe. Locater wire shall be connected to manhole frames on mains within streets, daylighted to surface grade immediately adjacent to manholes on offroad mains, and daylighted to surface grade adjacent to cleanouts on service laterals.

B. **WATER LINES**
Placement of warning tape during backfill operations shall be required on all newly installed mains. The non-metallic warning tape shall be per paragraph 2.2.2 of this specification and located between 12 and 18 inches below the final grade.

C. **STORM LINES**
Placement of warning tape and locating wire during backfill operations shall be required on all newly installed non-metallic mains. All new metallic mains will only require the installation of the warning tape. The non-metallic warning tape and metallic locating wire shall be per paragraph 2.2.2 and paragraph 2.2.3 of this specification. The warning tape shall be installed between 12 and 18 inches below the final grade. There shall be a minimum of 6 inches of separation between the warning tape and locating wire. The locating wire shall be installed along the crown of the pipe. Locater wire shall be connected to manhole frames on mains within streets, daylighted to surface grade immediately adjacent to manholes on offroad mains, and daylighted to surface grade adjacent to cleanouts on service laterals. If storm line is a culvert under a city street or street entrance with no connecting structures, warning tape and locating wire are not required.

3.9.2 FLOWABLE FILL CONCRETE BACKFILL

When directed by the City Engineer, the Contractor shall backfill trenches or undercut areas with flowable fill concrete plant mix. Except for structural applications, traffic can be placed on mixture within an hour or two after placement. Final surfacing of pavements; however, should be delayed if possible at least 24 hours to allow for shrinkage and hydration of concrete. Settlement of 2 to 3 inches is to be expected.

3.9.3 SALVAGE OF USEABLE MATERIALS

Useable materials include paving blocks, Belgium blocks, Bluestone, brick, castings, and pipe etc., removed during excavation that are useable on this project or future projects as determined by the City Engineer. Such material shall be stockpiled on site or as directed by the City Construction Coordinator at no additional cost to the City. Unnecessary abuse and damage to these items shall be the Contractor's responsibility and the cost of replacement may be deducted from the retainage.

End of Section 02220

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02400 - CURB & GUTTER, DRIVEWAYS & SIDEWALKS

(Revised 10/25/04)

SELECTED LINKS TO SECTIONS WITHIN THIS SPECIFICATION

Part 1- General	Curing	Sidewalk
Part 2 – Products	Curb and Gutter	Reinforcement
Part 3 – Execution	Facedown Sidewalk	Testing
Concrete	Flumes & Ditches	Welded Wire Fabric

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this specification.

B. Section 01000 – GENERAL REQUIREMENTS.

C. Section 02200 – EARTHWORK.

D. Any Specifications or details not covered herein shall be per Virginia Department of Transportation, *Road and Bridge Specifications*, 2002 or latest revision.

1.2 SUMMARY

This section includes concrete curbs, combination curb and gutters, ramps, sidewalks, driveways, flumes, valley gutters, median strips, islands, retaining walls, steps, and headwalls on municipal roadways and its appurtenances.

1.3 DEFINITIONS

For the purposes of this specification, the following definitions refer to the streets and roadway system that comes under the authority of the City of Lynchburg, Virginia as specified within this section and other sections of this manual.

Street or Roadway: A publicly dedicated street or roadway right-of-way maintained by the City of Lynchburg Virginia

1.4 SUBMITTALS

Submit product data and shop drawings for the following in accordance with Section 01000, *General Requirements*:

A. Air Entrainment
B. Concrete cylinder break tests.
C. Concrete admixtures
D. Joint Sealants and expansion joint material
E. Job mix formula
F. Other embedded items

1.5 QUALITY ASSURANCE

Materials and operations shall comply with the latest revision of all applicable Codes and Standards.

1.6 STANDARD ABBREVIATIONS

AASHTO	American Association of State Highway Transportation Officials
ACI	American Concrete Institute
ANSI	American National Standards Institute
ASCE	American Society of Civil Engineers
ASTM	American Society for Testing and Materials
C&G	Concrete Curb and Gutter
CRSI	Concrete Reinforcing Steel Institute
FS	Federal Specifications
MSDS	Material Safety Data Sheets
VDOT	Virginia Department of Transportation
WWF	Welded Wire Fabric

1.7 PRODUCT DELIVERY, STORAGE AND HANDLING

A. **Concrete Handling/Transportation**

1) Hydraulic cement concrete plant operations shall comply with the latest revision of VDOT *Road and Bridge Specifications*.

2) Time limitations and intervals between deliveries shall be in accordance with Section 217.09 of the VDOT *Road and Bridge Specifications* or latest revision.

3) Forms required to be accompanied with delivery shall be in accordance with Section 217.09 of VDOT *Road and Bridge Specifications*.

4) See Part 3 - EXECUTION of these specifications for handling of materials during placement of hydraulic cement concrete.

B. **Steel Handling/Examination**

1) **Steel Reinforcing Storage**:
Reinforcing steel shall be stored on platforms, skids, or other supports that will keep the steel above ground, well drained, and protected against deformation. Upon deliver to site, epoxy coated steel shall be covered with an opaque covering. Coverings shall be placed to provide air circulation and prevent condensation.

2) **Steel Reinforcing Inspection**

a. **Plain Steel Reinforcing**: The Contractor shall be responsible for inspecting materials thoroughly upon arrival. Examine materials for damage or excessive rust. Remove damaged or rejected materials from site. A light coat of rust is permitted to develop on steel bars and fabric; however, rust scaling and flaking is not permitted.

b. **Coated Steel Reinforcing**: Handling and storage of coated bars shall conform to the requirements of AASHTO M284. Visible damage to the coating shall be patched or repaired with materials compatible to the existing coating in accordance with AASHTO M284.

3) **Pre-Installation Inspection**: Prior to being installed, inspect each bar of steel reinforcing for the presence of dirt, paint, oil, rust scaling, flaking or other foreign matter. Remove such matter with appropriate methods and to the satisfaction of the City Engineer.

C. Observe manufacturer's directions for delivery and storage of materials and accessories.

D. Hydraulic cement concrete plant shall be certified by Virginia Department of Transportation.

1.8 PROJECT CONDITIONS

1.8.1 PROTECTION OF STREAMS

Do not discharge excess concrete into a drainage pipe, catchbasin, ditch, stream, river, pond, lake, or on City property without the approval of the City Construction Engineer.

1.8.2 PROTECTION OF ROADWAYS

Do not discharge or allow concrete to spill onto any roadway or appurtenances either during placement or while in transit. Remove spills immediately or otherwise repair street as directed by the City Engineer. The contractor shall be responsible for cleanup of all waste/excess of concrete.

1.8.3 PROTECTION OF PROPERTY

Do not discharge excess concrete without written permission of the property owner.

1.9 COORDINATION

Coordinate placement of sidewalk and driveway connections to municipal streets and roadways with the City Engineer.

PART 2 – PRODUCTS

2.1 HYDRAULIC CEMENT CONCRETE

Ready mixed concrete shall comply with ASTM C94, *Standard Specification for Ready-Mixed Concrete.* Cement concrete shall meet the requirements of Section 217, VDOT *Road and Bridge Specifications* or latest revision. Concrete strength shall be as specified on Standard Details and drawings. Concrete class for combined curb and gutter, curbs, sidewalks, driveways, flumes, ditches, steps, headwalls, and islands shall be a minimum of A3, 3000 psi or as designated in the specifications or drawings. Unless otherwise specified, all concrete shall be Class A3, minimum.

All exposed concrete shall be air entrained with an air content conforming to the requirements of Table II-17, Section 217 of the VDOT *Road and Bridge Specifications*, latest revision. Air entrained admixtures for use in portland cement concrete shall meet the requirements of AASHTO designation M154. Only those admixtures shall be used which have been approved by the City Engineer.

Calcium chloride may be used as an admixture if approved by the City Engineer. Calcium chloride shall conform to AASHTO M144, type 2. The use of calcium chloride is not permitted in reinforced concrete construction.

Concrete admixtures, when specified, shall conform to Section 215 of VDOT *Road and Bridge Specifications*.

Concrete Classes (VDOT) to Design Compressive Strength at 28 days (f'c):

Class A4.5	General	4,500-psi
Class A4	General	4,000-psi
Class A3	General	3,000-psi
Class B2	Massive or Lightly Reinforced	2,200-psi

2.2 MISCELLANEOUS

2.2.1 HANDRAILS

Handrails shall conform to requirements of Section 410 of the VDOT *Road and Bridge Specifications.*

2.2.2 ASPHALT EXPANSION JOINT FILLER

Asphalt expansion joint filler material shall be in accordance with Section 212.02(c) of the VDOT *Road and Bridge Specifications*, latest revision. Material shall be approximately ½ inch in thickness and a width and depth equal to those of the incidental structure.

2.2.3 CURING MATERIALS

White pigmented liquid membrane curing compound, PE film, or water for curing shall meet the requirements of Section 220 of the VDOT *Road and Bridge Specifications*.

2.2.4 INSULATION BLANKET

In cold weather operations, insulated blankets must retain or supply moisture and maintain the temperature at the outermost surfaces of concrete above 50º F for at least 72 hours and above 32º F for at least an additional 48 hours.

2.2.5 POROUS BACKFILL AND WEEP HOLES

Porous backfill material and drain pipes for weep holes for retaining walls shall conform to requirements of Section 506 of the VDOT *Road and Bridge Specifications.*

2.2.6 PORTLAND CEMENT

Type I, CSA normal, ASTM C150 *Standard Specification for Portland Cement*.

2.2.7 REINFORCEMENT

A. **Reinforcing Bars**

Reinforcing bars shall conform to the requirements Section 223, Grade 40 or 60 of the VDOT *Road and Bridge Specifications*, latest revision.

B. **Welded Wire Fabric**

Wire mesh reinforcement shall be minimum 6 x 6, 10 Ga. shall conform to the requirements of Section 223 of VDOT *Road and Bridge Specifications*, latest revision.

2.2.8 AGGREGATE BASE MATERIAL

Aggregate base materials for foundation support shall be VDOT 21A, compacted, and in compliance with Section 208 of the VDOT *Road and Bridge Specifications*, latest revision.

PART 3 – EXECUTION

3.1 CONSTRUCTION – ALL CONCRETE ITEMS

3.1.1 CONSTRUCTION OF SUBGRADE

A. **Subgrade Preparation**: Excavation and subgrade preparation shall be in strict compliance with Section 02200, *Earthwork*. The subgrade upon which this work is to be placed shall be shaped and compacted to a firm, even surface conforming to the elevation and cross-sections shown on the plans, the Standard Details or as directed by the Engineer. All soft, frozen, and unsuitable material shall be removed and replaced with approved material. The subgrade shall be moist when the concrete is placed.

B. **Subgrade Fine Grading (Trimming)**: When forms have been set to exact grade and secured, fine grading to exact sub-grade elevation shall be completed by hand. Before pouring operations begin, the Contractor shall have forms set and grade tested and approved by the Construction Coordinator ahead of pouring operations. Subgrade fine grading shall be the responsibility of the Contractor to insure that the subgrade conforms to the Standard Details.

3.1.2 FORMS

Forms for this work shall be of wood, metal, or other approved material, shall extend to the full depth of the concrete and shall be straight, free from warps and of sufficient strength to withstand the pressure of the concrete without springing. Bracing and staking of the forms shall be such that the forms will remain in both horizontal and vertical alignment until their removal. Forms shall be cleaned of foreign matter and oiled before concrete is placed. No concrete shall be poured into forms that have not been checked and approved by the City Construction Coordinator.

3.1.3 CURING

A. **Curing – Year Round**

The following method of curing is required year round:

1) **Liquid Membrane Compound**: Apply membrane–curing compound for curing, sealing, and moisture retention. The entire surface of the concrete shall be sprayed uniformly with a white pigmented membrane-forming compound immediately following the texturing operation.

   Perform application in accordance with manufacturer's directions but at a minimum rate of 100 to 150 square feet per gallon and not more than 350 square feet per gallon. Application shall be by a sprayer or long-nap roller and shall be an even, continuous membrane produced on the concrete surface. No puddling shall be produced. At the time of use, the compound shall be in a thoroughly mixed condition, with pigment uniformly dispersed through the vehicle.

The membrane shall harden 30 minutes after application. Personnel and equipment shall be kept off the freshly applied material to prevent damage to the seal for a minimum of 72 hours. If the membrane becomes damaged within the initial 72 hours, damaged portions shall be repaired immediately with additional compound. Other requirements for protection of the structural integrity of concrete from pedestrians, vehicular traffic, and equipment shall be per these specifications as stated in applicable sections.

If removal of forms is required, exposed sections shall be protected immediately to provide a curing treatment equal to that provided for the surface.

2) **PE Film**: Concrete shall be covered with PE film. Color of film shall be white. However, from November 1 to April 1, clear or opaque PE film will be permitted. Film shall be installed immediately after liquid membrane compound has obtained a sufficient set so that it is not damaged. Apply film so that marks from application are not produced.

3) No extra compensation will be made for curing of any type.

B. **Cold Weather Curing – Additional Requirements**

No concrete is to be poured when the outside ambient temperature is 40 degrees and falling. Cold weather curing shall be applied when the outside temperature is 50 degrees and falling.

1) **Concrete Temperature**: Conform to the requirements of paragraph 217.10 *Placement Limitation* of the VDOT *Road and Bridge Specifications*, latest revision for the required temperatures of concrete.

2) **Cold Subgrade**: No concrete is to be placed on a frozen subgrade.

3) In addition to year round curing, install insulated blankets that will retain or supply moisture and maintain the temperature of concrete at the outermost surfaces above 50º F for at least 72 hours and above 32º F for at least an additional 48 hours. Blankets shall be left in place for a minimum of 7 days.

4) In cold weather applications, calcium chloride may be used as an admixture, if approved by the City Engineer

C. **Hot Weather Curing – Additional Requirements**

Hot weather curing shall be applied when the outside temperature is 75 degrees and rising. Care shall be taken in hot, dry, or windy weather to protect the concrete from shrinkage cracking by applying at a minimum, liquid membrane compound and PE film as described in Section 3.1.3 A, above.

Routine hot weather measures shall include cooling forms and wetting subgrade in addition to any other measures as required by the City Engineer.

Other measures for curing may be required by the City Engineer, such as: fog spraying, sprinkling, ponding, windbreaks, shading, or wet covering with an approved light colored material.

Hot weather curing shall remain in place for a minimum of 7 days.

D. **Improper Curing**

Any work damaged due to improper curing, freezing, or rain, shall be replaced at the Contractor's expense.

3.1.4 PROTECTION OF CONCRETE

A. Protect new concrete sidewalks and appurtenances from pedestrian traffic for a minimum of 24 hours and driveway surfaces and curb and gutter from vehicular traffic for minimum of 7 days, unless otherwise approved by the City Engineer. Erect and maintain warning signs, lights, and watchmen to protect pedestrians and to direct traffic as needed.

B. No equipment shall be driven or moved across newly concreted surfaces unless such equipment is rubber-tired and only if concrete surface is designed for and capable of sustaining loads imposed by the equipment.

C. Protect new concrete from graffiti.

D. Protection of concrete shall meet requirements of Section 404.03 of the VDOT *Road and Bridge Specifications*, latest revision.

3.1.5 TESTING

Testing shall be in accordance with the requirements of Section 217.08 – *Acceptance* of the VDOT *Road and Bridge Specifications*, latest revision.

3.1.6 COORDINATION OF POURS

It will be the responsibility of the Contractor to coordinate the times of pours with the City Construction Coordinator. For miscellaneous concrete pours (i.e. sidewalk, curb & gutter, collars, etc), a minimum of 24 hours notice shall be given to the City Construction Coordinator so that he/she can check all aspects of the work before the pouring operations begin. For structural pours (i.e. retaining walls, bridge decks, box culverts, etc.), a minimum of 48 hours notice shall be given to the City Construction Coordinator. Under no circumstances shall the Contractor pour concrete until the Construction Coordinator has had time to make checks of the work.

3.1.7 PLACING AND FINISHING – ALL CONCRETE ITEMS

The concrete shall be placed in the forms in such a manner as to prevent the segregation of the mortar and the aggregate. The concrete shall be spaded, tamped, or vibrated sufficiently to bring the mortar to the surface.

Prior to and during pouring operations, the Contractor's foreman or formsetter shall carefully watch all alignment and grades to detect any errors in grade or misalignment. In the event any of the work is damaged from any cause or proves defective in any way, or is out of alignment or grade, the Contractor shall remove such work and replace at his own expense. The detection of poor subgrade shall also be his responsibility.

When sufficient concrete has been placed in the forms, it shall be well spaded along all areas in contact with the forms in order to eliminate all honeycombing. Concrete shall be floated to the proper grade and alignment, free from depressions or other irregularities, after which the exposed surfaces shall then be screeded with a straight edge and finished with a steel or wooden trowel.

The concrete shall be troweled smooth and, before the concrete obtains full set, very lightly brushed with a brush moistened with clear water. No mortar shall be used in the finishing. Immediately following finishing operations, the finished concrete shall be cured and protected in accordance with these specifications.

3.1.8 DEFECTIVE WORK

The City will require the removal and replacement of any concrete items where they have been broken, cracked, chipped, have become misaligned, grades are incorrect, does not meet dimensions as shown in the Standard Details, improperly cured, or of a substandard or non-approved product. Such areas designated by the City Engineer shall be replaced at no cost to the City. Items replaced shall conform to the requirements for new work as to strength and construction. During removal of defective work, an amount equal to the required lengths of construction joints for each item or the amount as directed by the City Engineer must be removed and replaced.

The Engineer may drill cores from the completed slab to make depth measurements. Sections showing a deficiency of more than 3/8 inch shall be removed and replaced to the specified depth at the Contractor's expense.

3.1.9 PLACEMENT LIMITATIONS

Conform to the requirements of paragraph 217.10 of the VDOT *Road and Bridge Specifications*, latest revision for concrete temperature.

3.1.10 REINFORCING STEEL OR WIRE MESH

Wire mesh or reinforcing steel will be used if recommended by the City Engineer, stated in the specifications, shown on plans, or Standard Details. For installation of mesh or steel, see the applicable Sections of the VDOT *Road and Bridge Specifications or Standards.* All wire mesh or steel shall be properly spaced and thoroughly tied, and approved by the City Construction Coordinator before concrete is placed.

3.2 STANDARD CONCRETE CURB AND COMBINED CURB AND GUTTER

3.2.1 GENERAL REQUIREMENTS – COMBINED CURB & GUTTER

This work shall consist of a single course of portland cement concrete, constructed on a prepared subgrade in accordance with these specifications. It shall have the dimensions, cross-section, and location as shown on the plans or as directed by the City Engineer. See **Standard Detail 25.04** for standard concrete curb, combined curb and gutter, and valley gutter sections.

Horizontal alignment of curbs and combined curb and gutter shall be in reasonably close conformity to the lines shown on the plans. Vertical alignment shall not exceed +/- 3/8 inch in 10 feet from plan grade.

Before concrete obtains full set, all exposed surfaces shall be finished with a brush moistened with clear water.

When constructing curb and gutter, the Contractor will be responsible for filling and compacting material in the space left behind the curb and gutter after the forms are removed. This shall take place within 3 to 7 days from pour and the material shall be compacted to the grade of the back of the curb. No extra compensation shall be made for this work.

When tying curb and gutter into inlets, dowels shall be placed in the throat plate, to tie gutter to plate as required in the use of conventional forms.

3.2.2 JOINTS FOR CURB AND GUTTER

A. **Transverse Joints**

1) Transverse joints for crack control for fixed forms shall be provided at the following locations:

   a. At approximately 10 foot intervals;

   b. At the gutter where the curb and gutter ties to the gutter apron of drop inlets;

   c. When time elapsing between consecutive concrete placements exceeds 45 minutes; and

   d. Where no section shall be less than 6 feet in length.

2) Transverse joints for crack control may be formed by using one of the following methods:

   a. Removable 1/8 inch thick templates;

   b. Scoring or sawing for a depth of not less than 3/4 inch when using curb machine; or

c. Approved “leave-in” type insert or may be formed or created using other approved methods which will successfully induce and control the location and shape of the transverse cracks. Approval by the City Engineer is required.

If templates are used for transverse joints, templates shall be removed by stages, but not entirely until the concrete has become thoroughly hard. After removal of the templates, there must be a clear division throughout between these sections. Edging tools will be used to form an edge along the back and front form and at each template.

B. **Expansion Joints**: See PRODUCTS, Section 2.2.3 of these specifications for approved expansion materials.

Expansion joints shall be formed at intervals of approximately 90 feet, at all radii points at concrete entrances and curb returns, at locations no less than 6 feet and no more then 10 feet from drop inlets, at the end of days work, and or all cold joints.

3.2.3 FORMS – COMBINED CURB & GUTTER

A. **Fixed Forms**

Fixed forms shall be straight, free from warp, and of such construction that there will be no interference with the inspection of grade and alignment. Forms shall extend the entire depth of the item and shall be braced and secured so that no deflection from alignment or grade will occur during concrete placement. Radial forms shall be sufficiently flexible or otherwise designed to provide a smooth, uniform, curved surface of the required radius. When sufficient concrete has been placed in the forms, it shall be well spaded along all areas in contact with the forms in order to eliminate all honeycombing. Face forms shall be removed as soon as concrete has attained sufficient set for the curb to stand without slumping. The exposed surface shall then be smoothed by the use of a suitable finishing tool.

B. **Slip Forms**

The contractor will be permitted to slipform combined curb & gutter provided that he has obtained approval by the City Engineer and that all slipform requirements stated in the VDOT, *Road and Bridge Specifications*, Section 502.03 (b), or latest revision are adhered to.

3.3 STANDARD PORTLAND CEMENT CONCRETE SIDEWALK AND DRIVEWAY ENTRANCES

3.3.1 GENERAL REQUIREMENTS

This work shall consist of the construction of portland cement concrete sidewalk 4 inches thick and in accordance with these specifications. Sidewalks crossing driveways entrances and the driveway entrances shall be constructed 7 inches thick. See **Standard Details 25.05** and **25.06** for sidewalk and **Standard Details 25.10, 25.11,** and **25.12** for driveway entrance openings.

Curb cuts for driveways and handicap ramps shall be constructed as shown on the Standard Details for the type driveway or ramp specified on the plans or as directed by the City Engineer.

Handicap ramps shall be constructed at all street intersection corners. The ramps shall be constructed as shown on the Standard Details for the type shown on the plans or as directed by the City Engineer.

Sidewalks shall not be opened to pedestrian traffic for the first 24 hours. Vehicular traffic shall be excluded for the first 7 days or until the minimum design compressive strength is attained, whichever is the lesser time.

Tolerances: Horizontal alignment of sidewalks shall be to the lines and grades as shown on the plans and details. Vertical alignment shall not exceed +/- 3/8 inch in 10 feet from the plan grade.

3.3.2 JOINTS FOR CONCRETE SIDEWALK AND DRIVEWAY ENTRANCES

Transverse expansion joints shall be constructed at intervals of approximately 30 feet. Slabs shall be separated by transverse preformed joint filler, 1/2 inch in thickness, that extends from the bottom of the slab to approximately 1/4 inch below the top surface.

The slab between expansion joints shall be divided into sections approximately 5 feet in length by transverse score joints formed by a jointing tool, trowel, or other approved means. Transverse control joints shall also be provided when the time period between consecutive concrete placements is more than 45 minutes. Control joints shall extend into concrete for at least 1/4 of the depth and shall be approximately 1/8 inch in width. Where slabs are more than 7 feet in width, control joints shall be formed longitudinally to obtain secure uniform blocks that are approximately square. Transverse control joints shall also be installed where the corners of the drop inlets project into the sidewalk.

Construction joints shall be formed around appurtenances extending into and through the sidewalk. Preformed joint filler 1/4-inch thick shall be installed in these joints except that joint filler shall not be used adjacent to drop inlets. Preformed joint filler shall be securely fastened. An expansion joint shall be formed and filled with 1/4 inch preformed joint filler no less than 6 feet and no more than 10 feet from drop inlets. Preformed joint filler shall also be installed between concrete sidewalk and any adjacent fixed structure which is not tied to the sidewalk with steel dowels.

3.3.3 PLACING AND FINISHING CONCRETE

The foundation shall be thoroughly moistened immediately prior to concrete placement. Concrete shall be placed in forms by methods that will prevent segregation. Concrete shall be spread to the full depth and brought to grade by screeding and straightedging. Concrete shall be spaded adjacent to forms to prevent a honeycomb appearance, and the surface shall be floated with a wooden float to produce a surface free from irregularities. The final finish shall be obtained with an approved hand float that will produce a uniform surface texture. Light brooming shall be used to hide trowel marks. Outside edges of the sidewalk slab and joints shall be edged with an edging tool having a radius of 1/4 inch.

See paragraph 3.1.3 *Curing* for requirements for curing concrete.

3.3.4 FORMS

A. **Fixed Forms**

See paragraph 3.2.3 A *Fixed Forms*, of these specifications.

B. **Slip Forms**

Slip form pouring shall be allowed with approval of the City Engineer. All portions of paragraph 3.2.3 B, *Slip Forms*, of these specifications, concerning pouring operations with slip forms shall apply.

3.4 FACEDOWN PORTLAND CEMENT CONCRETE SIDEWALK

This type of sidewalk construction shall consist of standard sidewalk as specified in above paragraph *3.3 - Standard Portland Cement Concrete Sidewalk and Driveway Entrances*, of these specifications, poured monolithically with a 12-inch curb as shown on **Standard Detail 25.06**. See also **Standard Details 25.10, 25.11,** and **25.12** for driveway entrance openings.

The methods of construction for facedown sidewalk shall be the same specified in paragraph 3.3 - *Standard Portland Cement Concrete Sidewalk and Driveway Entrances* of these specifications with the following additions:

A. A joint shall be cut with an approved edging tool 6 inches from the face of the curb and parallel thereto.

B. All expansion joints in the sidewalk shall extend across the top and face of the curb.

C. The final finish for the top of the curb shall be made with a brush dampened with water, to match the finish of the adjoining structure.

3.5 MISCELLANEOUS PORTLAND CEMENT CONCRETE STRUCTURES AND APPURTANCES

This work shall consist of portland cement concrete retaining walls, headwalls, steps, piers for stream crossings, flumes and ditches, median barriers, median strips, islands, etc. constructed in accordance with these specifications. Any specifications or details pertaining to these items that are not covered herein shall be per VDOT *Road and Bridge Specifications and Standards*, latest revision. These structures shall be constructed to the dimensions, cross-sections, and locations as shown on the plans, shown on the Standard Details, or as directed by the City Engineer.

END OF SECTION 02400

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02500 – BASE COURSE AND PAVING

(Revised 11/10/09)

SELECTED LINKS TO SECTIONS WITHIN THIS SPECIFICATION

Part 1 – General
Part 2 – Products
Part 3 – Execution
Agg. Base Course Mat'l.
Agg. Base Course Const.
Asphalt Concrete Pavement
Asphalt Conc. Pavement Const.
Paving Operations
Pavement Profiling
Pavement Repair
Seal Coat
Slurry Seal, Construction
Slurry Seal, Materials
Tack Coat

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this specification.

B. Section 01000 – GENERAL REQUIREMENTS.

C. Section 02200 – EARTHWORK.

D. Section 02220 – TRENCHING, BACKFILLING AND COMPACTION OF UTILITIES.

E. Section 02400 – CURB & GUTTER, DRIVEWAYS AND SIDEWALKS.

F. Any Specifications or details not covered herein shall be per Virginia Department of Transportation, *Road and Bridge Specifications*, 2002 or latest revision.

1.2 SUMMARY

This section includes all equipment, labor, material, and services required for complete installation of aggregate base courses and asphalt concrete pavement structures and specialties for municipal street systems.

1.3 DEFINITIONS

For the purposes of this specification, the following definitions refer to roadway and street systems that come under the authority of the City of Lynchburg, Virginia as specified within this section and other sections of this manual.

A. **Aggregate Base Course**: A layer of material of a specified thickness placed between the subbase and asphalt paving.

B. **Base Course**: A layer of material of a specified thickness placed between the subbase or aggregate base course and the intermediate or surface course.

C. **Public Road System**: Roadway, streets, and their appurtenances required for the conveyance of the motoring public that are maintained by either the City of Lynchburg or the Virginia Department of Transportation.

D. **Subbase Course**: A layer of material of a specified thickness that is placed on a subgrade to support a base course.

E. **Subgrade**: The top surface of a roadbed shaped to conform to the typical section on which the pavement structure and shoulders are constructed.

F. **Subgrade Stabilization**: The modification of roadbed soils by admixing with stabilizing or chemical agents that will increase the load bearing capacity, firmness, and resistance to weathering or displacement.

G. **Suitable Subgrade**: A subgrade that consists of a material type and density that is approved by the City Engineer for placing a subsequent layer of material.

H. **Surface Course/Wearing Surface**: The top layer of a pavement structure that resists skidding, traffic abrasion, and disintegrating effects of weather.

1.4 SUBMITTALS

A. Submit job-mix formula for each mixture to be supplied within 30 days after contract is awarded.

B. Submit product data and shop drawings for manhole, lampstack, and valve box adjustment rings in accordance with Section 01000, *General Requirements*.

1.5 QUALITY ASSURANCE

A. Asphalt concrete pavement thickness and density shall conform to the requirements of Section 315 of VDOT *Road and Bridge Specifications*, or latest revision. Asphalt concrete pavement coring sample thickness and density test reports shall be submitted at completion of project in accordance with the requirements of Section 315 of VDOT *Road and Bridge Specifications*, or latest revision.

B. Aggregate base course density shall conform to the requirements of Secton 308 and 309 of VDOT *Road and Bridge Specifications*, or latest revision.

C. Materials and operations shall comply with the latest revision of all applicable codes and standards.

1.6 STANDARD ABBREVIATIONS

AASHTO	American Association of State Highway Transportation Officials
ANSI	American National Standards Institute
AREA	American Railway Engineers Association

ASTM	American Society for Testing and Materials
BM	Base Mix
FS	Federal Specifications
HMA	Hot Mix Asphalt
IM	Intermediate Mix
MSDS	Material Safety Data Sheets
OSHA	Occupational Safety and Health Administration
RAP	Recycled Asphalt Pavement
SM	Surface Mix
VDOT	Virginia Department of Transportation

1.7 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Plant operations shall be in accordance with Section 211 *Asphalt Concrete* of the VDOT *Road and Bridge Specifications*, latest revision.

B. Shipping and storing shall be in accordance with Section 210 *Asphalt Materials* of the VDOT *Road and Bridge Specifications*, latest revision.

C. Hauling equipment shall be in accordance with Section 315.03 *Equipment* of the VDOT *Road and Bridge Specifications*, latest revision.

D. **Delivery**

1) Hauling equipment shall be loaded in a manner to minimize segregation of the mix.

2) Haul trucks shall park in a designated area to minimize tracking of tack coats.

3) Once loaded, haul trucks shall proceed immediately to the job site.

1.8 PROJECT CONDITIONS

1.8.1 PROTECTION OF STREAMS

Do not discharge excess concrete into a drainage pipe, catchbasin, ditch, stream, river, pond, lake, or on City property without the approval of the City Construction Engineer.

1.8.2 PROTECTION OF ROADWAYS

Do not discharge or allow concrete to spill onto any roadway or appurtenances either during placement or while in transit. Remove spills immediately or otherwise repair street as directed by the City Engineer. The contractor shall be responsible for cleanup of all waste/excess of concrete.

1.8.3 PROTECTION OF PROPERTY

Do not discharge excess concrete without written permission of the property owner.

1.9 COORDINATION

A. Coordinate manhole, lampstack, and valve box adjusting with the City of Lynchburg, City Engineer.

B. Coordinate tie-in to municipal roadways with the City of Lynchburg, City Engineer.

PART 2 – PRODUCTS

2.1 AGGREGATE BASE COURSE

Aggregate base material shall be designated as Type 1 size 21A or 21B in accordance with Section 208 *Subbase and Aggregate Base Material* of the VDOT *Road and Bridge Specifications*, latest revision.

2.2 HYDRAULIC CEMENT STABILIZATION

Hydraulic cement stabilization shall be in accordance with Section 307 *Hydraulic Cement Stabilization* of the VDOT *Road and Bridge Specifications*, latest revision.

2.3 ASPHALT CONCRETE PAVEMENTS

Asphalt concrete pavements shall be in accordance with Section 211 *Asphalt Concrete Materials* of the VDOT *Road and Bridge Specifications*, latest revision.

The use of reclaimed asphalt pavement shall be in accordance with Section 211 *Asphalt Concrete Materials* of the VDOT *Road and Bridge Specifications*, latest revision.

The use of aggregate from Blue Ridge Stone Corporation, Lawyers Road Plant, Lynchburg, Virginia will be restricted from use in asphalt surface courses where the ADT exceeds 14,999 vehicles per day.

2.4 TACK COAT

Tack coat shall be in accordance with Section 310 *Tack Coat* of the VDOT *Road and Bridge Specifications*, latest revision.

2.5 ASPHALT SEAL COAT

Asphalt seal coat shall be in accordance with Section 312 *Seal Coat* of the VDOT *Road and Bridge Specifications*, latest revision.

2.6 EMULSIFIED ASPHALT SLURRY SEAL SURFACES

Emulsified asphalt slurry seal surfaces shall be in accordance with VDOT *Special Provision for Emulsified Asphalt Slurry Seal* dated October 14, 1994 or latest revision.

2.7 PAVEMENT REINFORCING FABRIC

Pavement reinforcing fabric shall be A/oMat C040 or equal and meet or exceed AASHTO M288-00, Paving Fabric requirements and conform under AASHTO National Transportation Product Evaluation program. The fabric is needle punched, non-woven and heat treated on one side. This fabric shall conform to the following:

Physical Properties			
Fabric Property	**Test Method**	**Units**	**C040**
Weight	ASTM D 3776	oz/yd^2	≥4.2 (142gm/m^2)
Grab tensile elongation	ASTM D 4632	Lbs.	102 (453N)
Grab elongation	ASTM D 4632	%	50
Trap tear	ASTM D 4533	Lbs.	45(.220 kN)
Puncture	ASTM D 4833	Lbs.	60 (.267kN)
Mullen burst	ASTM D 3786	psi	200(1378 kPa)
Asphalt retention	ASTM D 6140	Gal/yd^2	0.23 (1.04l/m^2)
Melting point	ASTM D 276	Degrees F	325 F (163 C)
Thickness	ASTM D 1777	Mils	30
Ultraviolet Degradation	ASTM D 4355	%Strength Retained @ 150 Hrs	70%

PART 3 – EXECUTION

3.1 GENERAL

Construction and testing shall conform to these specifications and standard drawings as well as any specifications or details not covered herein shall be per the applicable sections of Divisions I, II, III, V, and VII of the *Virginia Department of Transportation Road and Bridge Specifications*, latest revision and on the Standard Details shown in the VDOT *Road and Bridge Standards*, latest revision.

3.2 PAVEMENT, PATCHES, REPAIR AND REPLACEMENT (PERMANENT & TEMPORARY)

A. **General**: This work shall consist of replacing subbase stone, and asphalt material in the street in areas where it becomes necessary to remove the original pavement such as for roadway failures, sewer trenches, water main trenches, drainage pipe ditches, etc. Pavement repair depths shall be the type to match the existing street pavement as shown on the drawings or as determined by the City Engineer.

B. **Cutting Pavement**: For all areas that are patched, the edges of the pavement shall be cut in a straight line revealing a vertical face for the patch to abut against. Care shall be taken during excavation and construction to avoid damage to adjoining paved surfaces. If patching is performed as part of piping installations, perform cutting operations prior to installation of line to avoid excessive removal of pavement.

C. **Surface Tolerances**: The asphalt patched surface shall be tested using a 10-foot straightedge. The variation of the surface from the testing edge of the straightedge between any two contacts with the surface shall not exceed ½ -inch allowing for the contours of the existing pavement. All humps or depressions exceeding the specified tolerance shall be corrected or the defective work removed and replaced with new material. Any deviation from this standard will be at the discretion of the City Engineer.

D. **Excavation**: Excavation of the existing pavement and subbase shall be made to a depth as shown on the applicable **Standard Details 25.18 through 25.22**. Before the placement of any stone, concrete or asphalt material, a representative of the City Engineer shall inspect the underlying subgrade. The Contractor shall be responsible for correcting any ruts or soft yielding places to a depth of approved suitable subgrade before placing of the asphalt material. Any depths below 4 inches shall be paid as extra work.

3.2.1 PERMANENT PAVEMENT REPAIR

A. **Asphalt Pavement Repair**

Aggregate Base Stone: The aggregate base shall be installed in accordance with **Standard Detail 25.18** and compacted to the density specified in VDOT *Road and Bridge Specifications*, Section 309 *Aggregate Base Course*, latest revision.

Asphalt Concrete Pavement: The asphalt concrete pavement shall be installed in accordance with **Standard Detail 25.18**. Compact to the density specified in VDOT *Road and Bridge Specifications,* Section 315 *Asphalt Concrete Pavement,* latest revision.

Lift thickness shall not exceed those as referenced within these specifications. Before placing any asphalt material, all sides of the existing pavement and subbase shall be thoroughly tacked at the rate of 0.3 Gal/SY. The finished surface shall abut the existing pavement with no overlap allowed.

B. **Concrete Pavement Repair**

Aggregate Base Stone: The aggregate base shall installed in accordance with **Standard Detail 25.19** and compacted to the density specified in VDOT *Road and Bridge Specifications*, Section 309 *Aggregate Base Course*, latest revision.

Hydraulic Cement Concrete Pavement: The concrete pavement shall be installed in accordance with **Standard Detail 25.19** using a minimum 3000 psi concrete at 28 days. The City Engineer reserves the right to require that the Contractor pull concrete test cylinders for verifying concrete strength. Concrete shall meet VDOT *Road and Bridge Specifications*, Section 217 *Hydraulic Cement Concrete* and Section 316, *Hydraulic Cement Pavement*.

C. **Historical District with Asphalt Pavement Overlay or without Asphalt Overlay**

Sand: Four inches of sand shall be placed to the depth shown on **Standard Details 25.21 or 25.22**, as applicable. Sand shall be Unified Soil Classification type SW compacted in accordance with Table 2220.1 of this specification.

Aggregate Base Stone: The aggregate base shall be installed in accordance with **Standard Detail 25.21 or 25.22,** as applicable and compacted to the density specified in VDOT *Road and Bridge Specifications*, Section 309 *Aggregate Base Course*, latest revision.

Belgium Block, Cobble or Brick: The pavers shall be installed in accordance with **Standard Detail 25.21 or 25.22** as applicable. Before placing an asphalt mix over pavers (**Standard Detail 25.21**), fill joints between pavers with like material.

Asphalt Surface Course: **Standard Detail 25.21** specifies a finished surface course of asphalt mix over the pavers. Cut back the existing asphalt pavement as shown on **Standard Detail 25.21**. Care shall be taken to insure a uniform grade between the existing pavement and the new surface.

3.2.2 TEMPORARY PAVEMENT REPAIR

A. **Asphalt Pavement Repair**

When shown on the plans, during winter months when asphalt concrete is unavailable, or when directed by the City Engineer, temporary pavement patches conforming to **Standard Detail 25.20** shall be installed. The Contractor shall maintain the temporary repair to the satisfaction of the City Engineer until the permanent pavement repair is made.

Cold patch material shall be installed in accordance with manufacturer's recommendations.

Density shall conform to the applicable sections referenced above under permanent pavement repair for each particular product (i.e. aggregate base course).

B. Once hot asphalt mix is available, all temporary patch material shall be removed and replaced with a permanent hot asphalt patch within thirty calendar days.

3.3 AGGREGATE BASE COURSE

A. Subgrade Approval

The underlying course upon which the aggregate base course is to be placed shall be prepared in accordance with the requirements of Section 02200, *Earthwork*, of these specifications and applicable sections of VDOT *Road and Bridge Specifications,* Section 304, *Constructing Density Control Strips* and Section 305, *Subgrade and Shoulders,* latest revision. Prior to any spreading operations, the underlying course shall be checked and accepted by the City Engineer. Any ruts or soft yielding places shall be corrected and rolled before the base course is applied.

B. Installation of Aggregate Base Course

The aggregate base course shall be mixed in an approved central mixing plant of the pugmill type and water added during mixing operations in the amount necessary to provide the optimum moisture content for compacting. After mixing, the material shall be transported to the job site and placed on the roadbed by means of an approved aggregate spreader.

The aggregate base course shall be constructed in layers not less than 3 inches or more than 6 inches of compacted thickness. When vibrating with other approved types of special compacting equipment, the compacted depth of a single layer of the aggregate base course may be increased to 8 inches upon approval by the City Engineer. The aggregate, as spread, shall be uniform in gradation with no segregation or pockets of fine or course material.

C. Compaction Operations and Density Requirements

After mixing and spreading, the aggregate base course shall be thoroughly compacted at optimum moisture within +/- 20-percent of optimum. Rolling shall progress gradually from the sides to the center and shall continue until the entire area of the course has been rolled by the rear wheels. Rolling shall continue until the material has been compacted to not less than 100 percent density when tested in accordance with AASHTO T191, latest revision.

D. Grading Tolerances of Final Surface

After final rolling, the surface shall be inspected and any irregularities in excess of ½ inch shall be corrected. Aggregate base course shall conform to the lines, grades, and typical cross sections shown on the plans, details or as established by the City Engineer within a tolerance of +/- ½ inch. Any irregularities in the surface shall be corrected by scarifying, remixing, reshaping, and recompacting until a smooth surface is obtained. If directed by the City Engineer, the aggregate base shall be opened to public traffic for at least 2 weeks before being surfaced. During this time, the surface shall be protected against loss of shape, required grades, and material by the addition of moisture and any re-working as necessary. This shall be at no additional cost to the City.

3.4 HYDRAULIC CEMENT STABILIZATION

Placement of hydraulic cement stabilization shall be in accordance with VDOT *Road and Bridge Specifications,* Section 307, latest revision.

3.5 ASPHALT CONCRETE PAVEMENT

3.5.1 CONDITIONING EXISTING SURFACE

Preparation of Surface: Prior to beginning paving operations, the existing areas to be resurfaced shall be thoroughly cleaned by the contractor to the satisfaction of the City Engineer. This cleaning shall include sweeping of the streets with a power operated broom, cutting excess debris with a grader, washing with a water truck, and hand cleaning any debris left after this operation is complete. Cleaning operations shall commence just prior to the resurfacing of streets. In addition, the contractor shall expose any existing paving areas, which have been covered by soil, grass, or debris. These areas shall be thoroughly cleaned and tacked before resurfacing. Any excess material left over after this operation shall be removed or spread out to the satisfaction of the City Engineer. No additional payment shall be made for this work.

When the surface of the existing pavement or base is irregular, it shall be brought to a uniform grade and cross section as directed by the City Engineer. The surface on which the asphalt concrete is to be applied shall be prepared in accordance with the requirements of the applicable specifications.

When specified, prior to placement of asphalt concrete, longitudinal and transverse joints and cracks in hydraulic cement concrete shall be sealed by the application of an approved joint sealing compound.

Any surface casting such as water boxes, manholes, grates, cleanouts, etc. shall be set to grade prior to beginning of paving operation. All telephone manholes and gas boxes are to be adjusted by the utility companies or contractor if approved by the City Engineer. All such castings shall be adjusted within a tolerance of 1/8 inch below or flush with the asphalt finished elevation. See **Standard Details 25.08** and **25.09**. A maximum of three 2-inch riser rings will be allowed for adjusting to grade. Adjustments more than 6 inches above original grade will require excavation and frame adjustment. The contractor shall be required to coat the top of any such casting with a suitable coating material to prevent adhesion of the asphalt material to the casting. A tack coat of asphalt material, conforming to the requirements of these specifications, shall be applied prior to resurfacing operations.

A. **Tack Coat**

A tack coat of liquid asphalt shall be applied between the existing surface and each asphalt course placed thereafter. The tack coat shall conform to the applicable requirements of VDOT *Road and Bridge Specifications* Section 310.

Tack material shall be uniformly applied with a pressure distributor conforming to VDOT requirements. Hand spray equipment shall not be used except in areas inaccessible by a pressure distributor. Undiluted asphalt shall be applied at a rate of 0.05 to 0.10 gallons per square yard. Diluted asphalt shall be applied at a rate of 0.10 to 0.15 gallons per square yard. The time interval between applying the tack coat and placing the paving mixture shall be sufficient to ensure a tacky residue providing maximum adhesion of the paving mixture to the base. On rich sections or those that have been repaired by the extensive use of asphalt patching mixtures, the tack coat shall be eliminated only if approved by the City Engineer.

Application of tack at joints, adjacent to curbs, gutters, or other appurtenances shall be applied with a hand wand at the rate of 0.20 gallons per square yard. At joints, the hand wand applied tack shall be 2 feet in width with 4 to 6 inches protruding beyond the joint for the first pass. Tack for the adjacent pass shall completely cover the vertical face of the mat edge, so that slight puddling of asphalt occurs at the joint, and extends a minimum of 1 foot into the lane to be paved. Milled faces that are to remain in place shall be tacked as above for the adjacent pass. Use of tack at longitudinal joint vertical faces will not be required when paving in echelon. Care shall be taken to prevent spattering of adjacent pavement, structures, trees, and private property. Any spattering shall be cleaned up by the contractor at no cost to the City.

Tack shall be applied in such a manner as to offer the least inconvenience to traffic and to permit a minimum of one way traffic without pickup or tracking. Traffic shall be excluded from the any pavement that has received tack. New asphalt shall not be placed on tack or prime coats that have been damaged by traffic or contaminated by foreign material.

B. **Removing Depressions/Irregularities**

Where irregularities in the existing surface would result in a course more than 3 inches in thickness after compaction, the surface shall be brought to a uniform grade by scratching with a thin layer of asphalt concrete not exceeding the minimum thickness as recommended for that type of mix. Then the material shall be thoroughly compacted until it conforms to the surrounding surface. The mixture used shall be the same as that specified for the surface mix to be placed.

3.5.2 PAVEMENT PROFILING

The work included in this item shall consist of the removal of existing asphalt surfaces of in place pavements on various streets within the City of Lynchburg, to produce the desired profile, cross-section, and surface conditions as specified by the City Engineer. All removed material shall become the property of the Contractor.

The contractor shall plan and prosecute a schedule of operations so that milled roadways will be overlaid with asphalt concrete asphalt as soon as possible, and, in no instance, shall the time lapse exceed 7 days after the milling operations, unless otherwise specified. The milled areas of the roadway shall be kept free of irregularities and obstructions that may create a hazard or annoyance to traffic in accordance with the requirements of VDOT *Road and Bridge Specifications* Section 104, latest revision.

The Contractor shall plan and prosecute the milling operation to avoid trapping of water on the roadway. At the discretion of the City Engineer, cutting drainage slots in roadway shoulders or inlets may be required, at no additional cost. The Contractor shall also restore the cut drainage slots afterwards, at no additional cost.

Where asphalt pavement extends into the existing curb and gutter, the contractor shall be required to plane at different slopes. The first cuts shall remove the material existing above the gutter line. These cuts shall be made at the appropriate gutter slope (1/2”:1’) for 2-foot curb and gutter and (1”:1’) for 2.5-foot curb and gutter. Any curb and gutter with a different slope shall be planed at the existing curb and gutter slope. The last cuts shall remove the material to a depth of 1inch below the gutter line with a street cross-section slope of 1/4”:1’ or to slope of existing street.

Where curb and gutter exists but the pavement is at or below the existing gutter line, the pavement shall be cut to a depth of the thickness of overlay below the gutter line while adjusting street cross-section to 1/4”:1’ toward the centerline of the street.

Where existing straight curbing has pavement built up to expose less than 6 inches of curbing, the pavement shall be planed down on grade of 1/4":1’ or whatever the existing grade of the street back to the street centerline until a desired height of curbing is exposed.

Where center of pavement has correct crown but pavement has rutting or ripples (possibly caused by vehicular braking), the pavement shall be planed to the depth necessary to remove all such defects.
Additional Procedures shall be in accordance with the requirements of VDOT *Road and Bridge Specifications* Section 515, latest revision.

3.5.3 PAVING OPERATIONS

A. **Asphalt Concrete Pavement Equipment**

Bituminous concrete pavement equipment shall be in accordance with Section 315.03 of the VDOT *Road and Bridge Specifications*, latest revision.

B. **Placing and Finishing**

Asphalt concrete asphalt shall not be placed until the surface upon which it is to be placed has been approved by the City Engineer.

The edge of the pavement shall be marked by means of a continuous line placed and maintained a sufficient distance ahead of the paving operation to provide proper control of the pavement width and horizontal alignment.

An asphalt paver shall be used to distribute the asphalt mix over the widest pavement width practicable. Wherever practicable and when the capacity of sustained production and delivery is such that more than one paver can be operated, pavers shall be used in echelon to place the wearing course in adjacent lanes. Crossovers, as well as areas containing manholes or other obstacles that prohibit the practical use of mechanical spreading and finishing equipment, may be constructed using hand tools. However, care shall be taken to obtain the required thickness, jointing, compaction, and surface smoothness.

The longitudinal joint in one layer shall offset that in the layer immediately below by approximately 6 inches. However, the joint in the wearing surface shall be at the centerline of the pavement if the roadway comprises two traffic lanes or at lane lines if the roadway is more than two lanes in width. Offsetting layers will not be required when adjoining lanes are paved in echelon and the rolling of both lanes occurs within 15 minutes after laydown.

The contractor shall have a certified Asphalt Concrete Paving Technician present during paving operations. Immediately after placement and screeding, the surface and edges of each layer shall be inspected and straightedged by the technician and necessary corrections performed prior to compaction. The finished pavement shall be uniform and smooth.

The placement of asphalt concrete shall be as continuous as possible and shall be scheduled such that the interruption occurring at the completion of each day's work will not detrimentally affect the partially completed work. Material that cannot be spread and finished in daylight shall not be dispatched from the plant unless the use of artificial lighting has been approved. When paving is performed at night, sufficient light shall be provided to properly perform and thoroughly inspect every phase of the operation. Such phases include cleaning planed surfaces, tack application, paving, compacting, and testing. Lighting shall be provided and positioned such as to not create a blinding hazard to the traveling public.

During paving operations, the Contractor shall be responsible for furnishing and erecting temporary "no parking" signs on each street that is to be paved. The signs shall be erected at least 24 hours prior to paving operations and on each side of the street as necessary.

C. **Layer Thickness**

Asphalt concrete SUPERPAVE pavement courses shall be placed in layers not exceeding 4.0 times the nominal maximum size aggregate in the asphalt mixture. The maximum thickness may be reduced if the mixture cannot be adequately placed in a single lift and compacted to required uniform density and smoothness. The minimum thickness for a pavement course shall be no less than 2.5 times the nominal maximum size aggregate in the asphalt mixture. Nominal maximum size aggregate for each mix shall be defined as one sieve size larger than the first sieve to retain more than 10 percent aggregate as shown in the design range specified in Section 211.03, table II-13 of VDOT *Road and Bridge Specifications*, latest revision.

Recommended Thickness Chart	
Mix Type	**Minimum Thickness (inches)**
SM 9.5	1.5
SM 12.5	2
IM 19.0	2
BM 25.0	4

D. **Joints**

Care shall be exercised when tying into curb and gutter and newly overlaid travel lanes to ensure a uniform grade and joint.

The contractor shall construct the final riding surface to tie into the existing surface by cutting a notch 1 inch deep by 1 inch wide for all tie-ins to existing pavement, including driveways and ramps. Suitable guidelines or devices shall be used to ensure cutting of the joint on a true line. The joint shall be thoroughly cleaned and dried prior to being sealed. This work shall be done at no additional cost to the City.

Method of temporary joints at the end of each workday shall be approved by the City of Lynchburg City Engineer.

E. **Compaction**

Immediately after the asphalt mixture is placed and struck off and surface irregularities are corrected, the mixture shall be thoroughly and uniformly compacted by rolling.

During compaction of asphalt concrete asphalt, the roller shall not pass over the end of freshly placed material except when a construction joint is to be formed. Edges shall be finished true and uniform.

The surface shall be rolled when the mixture is in the proper condition. Rolling shall not cause undue displacement, cracking, or shoving.

The number, weight, and type of rollers furnished shall be sufficient to obtain the required compaction while the mixture is in a workable condition. The sequence of rolling operations and the selection of roller types shall provide the specified pavement density.

Immediately after the hot mixture is placed, it shall be sealed with rollers. Thereafter, rolling shall be a continuous process, insofar as practicable, and all parts of the pavement shall receive uniform compaction.

Rolling shall begin at the sides and proceed longitudinally parallel to the center of the pavement, each trip overlapping at least ½ the roller width, gradually progressing to the crown of the pavement. When abutting a previously placed lane, the longitudinal joint shall be rolled first, followed by the regular rolling procedure. On superelevated curves, rolling shall begin at the low side and progress to the high side by overlapping of longitudinal trips parallel to the centerline.

Displacements occurring as a result of reversing the direction of a roller, or from other causes, shall be corrected at once by the use of rakes or lutes and addition of fresh mixture when required. Care shall be taken in rolling not to displace the line and grade of the edges of the asphalt mixture. All roller marks shall be eliminated.

To prevent adhesion of the mixture to the rollers, the wheels shall be kept properly moistened with water or water mixed with a very small quantity of detergent or other approved material. Excess liquid will not be permitted.

Along forms, curbs, headers, walls, and other places not accessible to rollers, the mixture shall be thoroughly compacted with hot hand tampers, smoothing irons, or mechanical tampers. On depressed areas, a trench roller may be used or cleated compression strips may be used under the roller to transmit compression to the depressed area.

Edges of asphalt pavement surfaces shall be true curves or tangents. Irregularities shall be corrected.

The surface of the compacted course shall be protected until the material has cooled sufficiently to support normal traffic without marring.

F. **Density**

Density requirements shall be in accordance with Section 315.05 (d) of the VDOT *Road and Bridge Specifications*, latest revision.

G. **Pavement Samples**

If requested by the City Engineer, the Contractor shall cut samples for testing depth and density. Samples shall be taken for full depth at the locations as selected by the City Engineer. The removed pavement shall be replaced with new mixture and refinished. No additional compensation will be made for such work.

H. **Placement Limitations**

Placement limitations, to include but not limited to, mixture temperatures, and cold weather paving shall be in accordance with Section 315.04 of the VDOT *Road and Bridge Specifications*, latest revision. Surface mix applications for A and D mixes shall not be placed until the ambient air temperature and the base surface temperature is 50 degrees and rising without prior approval from the City Engineer. Base mix applications shall not be placed until the ambient air temperature and the surface temperature is 40 degrees and rising.

I. **Pavement Tolerance**

The surface will be tested by using a 10-foot straightedge. The variation of the surface from the testing edge of the straightedge between any two contacts with the surface shall not be more than 1/4 inch. Humps and depressions exceeding the specified tolerance shall be corrected, or the defective work shall be removed and replaced with new material.

3.6 PRIME COAT

When a prime coat is required, it shall conform to the applicable requirements of VDOT *Road and Bridge Specifications* Section 311.

When asphalt concrete to be placed has a total thickness of 4 inches or more, priming with liquid asphalt material will not be required on aggregate subbase or base material.

3.7 SEAL COAT

Seal coat shall be in accordance with Section 312, *Seal Coat* of the *VDOT Road and Bridge Specifications*, latest revision.

3.8 EMULSIFIED ASPHALT SLURRY SEAL

Emulsified asphalt slurry seal shall be in accordance with *VDOT Special Provision for Emulsified Asphalt Slurry Seal* dated October 14, 1994, or latest revision.

3.9 PAVEMENT REINFORCING FABRIC

A. **Asphalt Distributor**

The distributor truck shall be metered and capable of spraying tack coat at a specified uniform application rate. The applicator shall provide uniform coverage without gaps, partial overlaps, or otherwise create heavy streaking. The truck shall be equipped with a hand spray nozzle to distribute tack coat in locations inaccessible by the truck.

B. **Fabric Laydown Equipment**

The fabric can be installed with a mechanical unit mounted on the front of a tractor or on the back of the distributor truck. Manual units can be used for small jobs. Provide stiff bristle brooms or pneumatic rollers to smooth fabric. Provide all tools such as scissors or blades for cutting fabric.
Do not permit traffic directly on fabric.

C. **Surface Preparation**

Air and pavement temperatures during installation shall be warm enough for the tack coat to remain tacky after placement. Ambient temperatures shall be at least 50ºF and rising for bituminous cement tack coat or 60ºF and rising for asphalt emulsions.

Clean old pavement of dirt, water, oil, and foreign materials. Fill cracks as directed by the City Engineer, with suitable filler (such as asphalt cement or rubberized asphalt). Repair larger cracks and potholes with a properly compacted hot mix or other similar filler as directed by the City Engineer.

Badly broken pavement is an indication of a failed subgrade and shall be dug out and replaced before overlaying. If the surface is rough but stable, the City Engineer may require milling or placement of a leveling course before installation of the pavement reinforcing fabric. The surface shall be dry prior to tack coat and fabric placement.

D. **Application of Tack**

The tack coat shall be applied uniformly at the specified rate with calibrated distributor truck. The application temperature shall be high enough to assure uniform distribution (290ºF to 325ºF for asphalt cements, up to 160ºF for heavier grade emulsions). The tack coat shall be applied 2 to 3 inches wider than the edge of the fabric.

Fully saturate the fabric and provide a bond to the overlay without providing excess tack coat that could mix with the overlay of the asphalt. The optimum amount depends on the porosity of the old pavement, fabric weight, tack coat material, and other variables. Typically, 0.2 to 0.3 gal/yd^2 of pure asphalt cement tack coat is used with the fabric. Emulsion tack coat application rates are greater to provide the same amount of residual asphalt cement. Verify the applications rates with the geotextile manufacturer and coordinate with the City Engineer prior to application.

If asphalt emulsions are used, the water in the emulsion must be allowed to evaporate completely before the fabric is placed. Verify the cure times with the Geotextile manufacturer and coordinate with the City Engineer prior to application.

E. **Fabric Placement**

Place the fabric on the pavement surface, smooth side up, while the tack coat is still tacky. Drive the vehicle straight to avoid wrinkling. Turns shall be made gradually. For sharp curves or corners, cut fabric to size and place by hand. Hand broom or pneumatic roll to eliminate small wrinkles. Large wrinkles (with a height of 1 inch or more) shall be slit and laid flat in the direction of paving. Overlap joints 2 to 4 inches. Apply additional tack coat to joints and overlapped fabric layers to ensure proper fabric saturation. The tack coat temperature shall not exceed 325ºF when the fabric is placed.

F. **Hot Mix Overlay**

Standard paving operations shall closely follow fabric laydown. All areas in which paving fabric has been placed shall be paved during the same day. If the fabric becomes wet, allow to dry before paving. Unless directed otherwise by the City of Engineer, a minimum compacted asphalt thickness of 1.5 inches shall be placed to provide adequate heat and pressure to bond the systems.

END OF SECTION 02500

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02720 – STORM DRAINAGE

(Revised 11/20/14)

SELECTED LINKS TO SECTIONS WITHIN THIS SPECIFICATION

Part 1 – General	Construction of Manholes/DI's	Manhole Frame & Cover Spec
Part 2 – Products	DIP Spec	Plain Concrete Pipe Spec
Part 3 – Execution	Drop Inlet Specs	Precast Structures Spec
		Reinforced Concrete Pipe Spec

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this specification.

B. Section 01000 – GENERAL REQUIREMENTS.

C. Section 02220 – TRENCHING, BACKFILLING, AND COMPACTION OF UTILITIES.

D. Section 02730 – SANITARY SEWER.

E. Any Specifications or details not covered herein shall be per Virginia Department of Transportation, *Road and Bridge Specifications*, 2002 or latest revision.

1.2 SUMMARY

This section includes all equipment, labor, material, appurtenances, and services required for complete installation of storm drainage piping, ditches, structures, and specialties for municipal drainage systems.

1.3 DEFINITIONS

For the purposes of this specification, the following definitions refer to storm water drainage systems and structures that come under the authority of the City of Lynchburg, Virginia as specified within this section and other sections of this manual.

Public Storm Drainage System: Drainage systems and their appurtenances required for the conveyance of public storm water from and across publicly maintained streets, roads, highways, and other public property and located within public rights-of-way and/or easements.

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1.4 SUBMITTALS

A. Submit shop drawings on all non-standard products/materials.

B. Submit product data and shop drawings for the following in accordance with Section 01000*, General Requirements*.

1) Drop/curb inlets
2) Frame and covers
3) Head/end walls
4) Inlet grates
5) Pipe and piping specialties
6) Precast concrete manhole castings

1.5 QUALITY ASSURANCE

A. Materials and operations shall comply with the latest revision of all applicable Codes and Standards.

B. Piping materials shall be marked clearly and legibly.

1) Reinforced Concrete Pipe shall be marked as follows:

a. Pipe Class,
b. Manufacturer

2) Plain Concrete Pipe shall be marked as follows:

a. Pipe Class,
b. Manufacturer

3) Ductile Iron Pipe shall show identification marks on or near bell as follows:

a. Weight,
b. Class or nominal thickness,
c. The letters “DI” or “Ductile,”
d. Manufacturer’s identifying mark,
e. Year in which pipe was made,
f. Casting period.

4) Polypropylene Pipe shall be marked as follows:
a. ASTM Designation
b. Nominal Size
c. The Legend PP (as required per ASTM F2736 and ASTM F2764)
d. Manufacturer’s name, trade name or trademark
e. Originating Plant Location
f. Date of Manufacture

1.6 STANDARD ABBREVIATIONS

AASHTO	American Association of State Highway Transportation Officials
ACI	American Concrete Institute
ACPA	American Concrete Pipe Association
ANSI	American National Standards Institute
AREA	American Railway Engineers Association
ASCE	American Society of Civil Engineers
ASTM	American Society for Testing and Materials
CRSI	Concrete Reinforcing Steel Institute
DIP	Ductile Iron Pipe
FS	Federal Specifications
MSDS	Material Safety Data Sheets
NCMA	National Concrete Masonry Association
OSHA	Occupational Safety and Health Administration
PCP	Plain Concrete Pipe
PE	Polyethylene
PP	Polypropylene Pipe
RCP	Reinforced Concrete Pipe
VDOT	Virginia Department of Transportation

1.7 PRODUCT DELIVERY, STORAGE AND HANDLING

A. **Pipe Condition/Pipe Examination**

1) **New Pipe Inspection**: Inspect materials thoroughly upon arrival. Examine materials for damage. Remove damaged or rejected materials from site. Pipe shall be protected during handling against impact shocks and free fall. Pipe shall be kept clean at all times, and no pipe shall be used in the work that does not conform to the appropriate ASTM Specifications. Check bells and spigots closely for smoothness, roundness, and honeycombing (concrete pipe), which may be a source of infiltration. Check for cracks, chips, etc. on both ends. Reject any pipe that will not provide watertight seal or is otherwise structurally deficient.

2) **Pre-Installation Inspection**: Prior to being installed, each section of the pipe shall be carefully examined for damage and conformity with these

specifications. All pipe damaged or deemed not to conform to these specifications shall be rejected and removed from site. All pipe in which the spigots and bells cannot be made to fit properly, or pipe, which has chipped bells or spigots, will be rejected. The faces of all spigots ends and of all shoulders on the bells must be true.

B. Protect pipe coating during handling using methods recommended by the manufacturer. Use of bare cables, chains, hooks, metal bars, or narrow skids in contact with coated pipe is not permitted.

C. Observe manufacturer's directions for delivery and storage of materials and accessories.

D. Protect stored piping from entry of water or dirt into pipe. Protect bells and flanges of special fittings from entry of moisture and dirt.

E. Handle precast concrete manholes and other structures according to manufacturer's written rigging instructions.

1.8 COORDINATION

Coordinate tie-in to municipal drainage systems with the City of Lynchburg City Engineer.

PART 2 – PRODUCTS

2.1 PIPE & FITTINGS

~~2.1.1 DUCTILE IRON PIPE~~

~~A. **Ductile Iron Pipe**~~

~~Ductile iron pipe shall be manufactured in accordance with all applicable requirements of AWWA C151/ANSI A21.51 and ASTM A746, *Standard Specification for Ductile Iron Gravity Sewer Pipe* for 4-inch and larger diameter pipe, thickness class rated, class 50 minimum. The thickness of Ductile Iron Pipe shall be determined by considering trench load in accordance with ANSI/AWWA C150/A21.50. Minimum laying length shall be 18 feet except for tie-in at a structure.~~

~~The ductile iron pipe shall be cement mortar lined with a seal coat in accordance with ANSI/AWWA C104/21.4. Outside coat shall be a minimum of 1 mil bituminous paint according to ANSI/AWWA C151/A21.21 Section 51-8.1.~~

~~Push-on and mechanical joint pipe shall be as manufactured by the American Cast Iron Pipe Company, United States Pipe and Foundry Company, Griffin Pipe Products Company, or McWane Cast Iron Pipe Company.~~

~~B. **Ductile Iron Joints**~~

~~Pipe joints may be either push-on or mechanical joint pipe sizes 4 inches through 48 inches in diameter. Rubber Gasket Joints and Mechanical Joints shall comply with AWWA C111/ANSI A21.11, ASTM A536 *Standard Specification for Ductile Iron Castings*. Acceptable pipe joints are as follows:~~

1) **Push-on Joint** Ductile Iron Pipe shall conform to AWWA C151/ANSI A21.51 (such as *"Fastite"* or *"Tyton"*). The dimensions of the bell, socket, and plain end shall be in accordance with the manufacturer's standard design dimensions and tolerances. The gasket shall be of such size and shape to provide an adequate compressive force against the plain end and socket after assembly to affect a positive seal. Gaskets shall be vulcanized natural or vulcanized synthetic rubber, and comply with AWWA C111/ANSI A21.11.

2) **Mechanical Joint, Ductile Iron Pipe** shall be used only at the specific locations indicated on the drawings or as approved by the City Engineer.

a. The mechanical joint shall consist of:

i. A bell cast integrally with the pipe or fitting and provided with an exterior flange having cored or drilled bolt holes and interior annular recesses for the sealing gasket and the spigot of the pipe or fitting;

ii. A pipe or fitting spigot;

iii. A sealing gasket;

iv. Separate ductile iron follower gland having cored or drilled bolt holes; and

v. Ductile iron tee head bolts and hexagon nuts.

b. The joint shall be designed to permit normal expansion, contraction, and deflection of the pipe or fitting while maintaining a leak proof joint connection. The mechanical joint shall conform to the requirements of Federal Specification WW-P-421, AWWA C111/ANSI A21.11, and ASTM A 536 Standard Specification of Ductile Iron Castings.

2.1.2 PLAIN CONCRETE PIPE

PCP shall be a minimum of Class III, Wall B. Concrete pipe joints shall be tongue and groove type unless otherwise specified. PCP pipe shall conform to the requirements of applicable sections of the latest revisions of the VDOT Road and Bridge Specifications.

PCP shall also meet ASTM C14, *Standard Specification for Concrete Sewer, Storm Drain, and Culvert Pipe,* Extra Strength.

Gasketed Joints in Concrete Pipe shall meet ASTM C990, *Standard Specification for Joints in Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants*, latest revision.

2.1.3 REINFORCED CONCRETE PIPE

RCP shall be a minimum of Class III, Wall B. Concrete pipe joints shall be tongue and groove type unless otherwise specified. RCP shall conform to the requirements of applicable sections of the latest revision of the VDOT *Road and Bridge Specifications*.

RCP Class III or IV shall also meet ASTM C76*, Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe*.

Gasketed Joints in Concrete Pipe shall meet ASTM C990, *Standard Specification for Joints in Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants*, latest revision.

~~2.1.4 Polypropylene Pipe~~

~~PP shall conform to the requirements of ASTM F2736-10, *Standard Specification for 6 to 30 in. (152 to 762mm) Polypropylene (PP) Corrugated Single Wall Pipe and Double Wall Pipe* and ASTM F2764-10, *Standard Specificiation for 30 to 60 in (750 to 1500 mm) Polypropylene (PP) Triple Wall Pipe and Fittings for Non-Pressure Sanitary Sewer Applications*. Gasketed joints for HP pipe shall meet ASTM F477, *Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe* and ASTM D3212, *Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Elastomeric Seals*; latest revision.~~

2.1.5 Polyethylene Pipe

Corrugated PE Drainage Pipe and Fittings NPS 3 to NPS 10: AASHTO M 252M, Type S, with smooth waterway for coupling joints. Pipe shall be dual wall, watertight meeting or exceeding ASTM D3212 and ASTM F1417 requirements.

2.2 MISCELLANEOUS APPURTENANCES

2.2.1 BEDDING

See Section 02220, *Trenching, Backfilling, and Compaction of Utilities*.

2.2.2 CONCRETE BLOCK

Concrete block shall conform to the requirements of ASTM C139, *Standard Specification for Concrete Masonry Units for Construction of Catch Basins and Manholes*.

2.2.3 BRICK

Brick shall be hard clay, grade SM, ASTM C 32, *Standard Specification for Sewer and Manhole Brick (Made From Clay or Shale)* and AASHTO M91.

2.2.4 MORTAR FOR CONCRETE BLOCK & BRICK

Mortar shall be type M, ASTM C 270, *Standard Specification for Mortar for Unit Masonry* and ASTM C 144, *Standard Specification for Aggregate for Masonry Mortar.* Mortar shall be prepared from cement in perfect condition and shall be prepared in boxes for that purpose. No mortar that has stood beyond forty-five minutes shall be used. Proportion by volume for the different types of application shall be as follows:

Brick masonry = 1 part cement to 2 parts sand

Pointing = 1 part cement to 1 part sand

2.2.5 MISCELLANEOUS CONCRETE

Concrete Classes (VDOT) to Design Compressive Strength at 28 days (f'c):

Class A4.5	General	4,500-psi
Class A4	General	4,000-psi
Class A3	General	3,000-psi
Class B2	Massive or Lightly Reinforced	2,200-psi

Ready mixed concrete shall comply with ASTM C94, *Standard Specification for Ready-Mixed Concrete.* All exposed concrete shall be air entrained. Concrete strength shall be as specified on standard details and drawings. Unless otherwise specified, all concrete shall be Class A3, minimum.

2.2.6 PORTLAND CEMENT

Type I, CSA normal, ASTM C150 *Standard Specification for Portland Cement*.

2.2.7 PRECAST REINFORCED CONCRETE STRUCTURES

Manholes of precast reinforced concrete shall be designed and manufactured in accordance with ASTM C478, *Standard Specification for Precast Reinforced Concrete Manhole Sections*, or latest revision. Manhole diameters shall be 4-foot minimum. The wall shall be a minimum of 5 inches thick and have a 6-inch minimum base. Manholes shall be of precast concrete manhole risers with a tongue and groove joint and a monolithic precast bottom, except where doghouse bases are to be used when placing manholes over existing mains. Joints shall be sealed with a minimum of butile mastic in conformance with AASHTO M 198, latest revision.

Manhole steps are not permitted.

Unless otherwise approved by the City Engineer, manholes will be precast reinforced concrete.

Manholes over 12 feet in depth, as measured from top of casting to effluent invert, shall have extended bases with appropriate reinforcing.

2.2.8 MANHOLE FRAMES AND COVERS

Standard Frames and Covers: Manhole frames and covers shall be manufactured from Class 30 gray iron, meeting the requirements of ASTM A48*, Standard Specification for Gray Iron Castings*. Standard manhole frames and covers shall be manufactured to the dimensions and configurations shown on **Standard Details 27.10 and 27.11** and shall have a minimum of 4 1-inch diameter holes in the flange of the frame*.* Minimum inside diameter of the opening shall be 24 inches. Manholes castings may be either bituminous coated or plain. The bearing surface of the frames and covers shall be machined and the cover shall seat firmly into the frame without rocking. Covers are to be embossed along the perimeter with the words "Storm." Approved castings are the US Foundry 710 ring and DP cover, East Jordan Iron Works 2027 frame and cover, or approved equal. (See **Standard Details 27.10 & 27.11**).A Vulcan V-1883 is to be used with flat top manholes.

2.2.9 DROP INLETS

A. Drop inlet tops shall be precast and shall conform to the requirements of all applicable sections of the latest revision of VDOT *Road and Bridge Specifications and Standards*.

B. Drop inlet bases shall be precast and shall conform to the requirements of all applicable sections of the latest revisions of the VDOT *Road and Bridge Specifications and Standards*.

C. Unless otherwise approved by the City Engineer, all drop inlet tops and bases will be precast reinforced concrete.

D. Inlet Grates shall conform to the requirements of all applicable sections of the latest revision of the VDOT *Road and Bridge Specifications and Standards*.

E. All storm drain inlets shall be labeled with a message such as "No Dumping, Drains to River" either by attached labels or by letters cast into the manhole cover or grate. Attached labels shall be at least four inches in diameter. Labels shall be stainless steel or aluminum as manufactured by Almetek Industries or approved equal. If a cast message is used, cast letters must be at least one inch in height.

2.2.10 MISCELLANEOUS STORMWATER APPURTENANCES

All miscellaneous stormwater appurtenances including but not limited to endwalls, headwalls, and flared end sections shall conform to all applicable sections of the latest revision of VDOT *Road and Bridge Specifications and Standards*.

PART 3 – EXECUTION

3.1 PIPE INSTALLATION - GENERAL

3.1.1 CONSTRUCTION – ALL PIPE

A. **Trench Width**: Trench width shall be per **Standard Detail 27.01.**

B. **Minimum Bury Requirements**: Minimum cover shall be in accordance with manufacturer's recommendations.

C. **Pipe Laying Direction**: Place piping beginning at low point and progress uphill. Place on grade, with unbroken continuity in invert, horizontally and vertically, and on alignment as indicated on plans. Place bell ends of piping facing upstream. Install gaskets, seals, sleeve, and couplings according to manufacturer's written instructions for using lubricants, cements, and other installation requirements.

D. **Directional Changes in Gravity Lines**: Use manholes for changes in direction of gravity lines.

E. **Stringing out Pipe**: When pipe is strung out during unloading, it shall be set on high ground and in a position to prevent silt deposits, storm water, or other matter from entering the pipe prior to its placement in the trench.

F. **Pipe Laying**: Pipe shall be bedded per Section 02220 – *Trenching, Backfilling and Compaction of Utilities*. The pipe and fittings shall be laid in the trench so that its interior surface shall conform to the grade and alignment as shown on the plans. Pipe laying shall be done in such a way as to disturb as little as possible the pipe that has already been laid. The alignment and grade of the storm main may be field adjusted whenever, in the opinion of the City Engineer, it is necessary, so long as the changes are consistent with the City of Lynchburg policy in affect at the time of the change. Changes in either grade or alignment may only occur at manholes.

Before laying, the bell and spigot will be wiped free from any dirt or other foreign matter. All surfaces of the portion of the pipe to be joined, and the factory-made jointing material, shall be clean and dry. Jointing material shall be used as recommended by the pipe or joint manufacturer's specifications. The jointing material or factory-fabricated joints shall then be placed, fitted, and adjusted in such workmanlike manner as to obtain the degrees of water tightness required.

Trenches shall be kept as dry as possible during bedding, laying and jointing and for as long a period as required until the trench is backfilled. As soon as possible after the joint is made, sufficient backfill material shall be placed along each side of the pipe to offset conditions that might tend to move the pipe off line or grade.

The greatest care shall be used to secure water tightness and to prevent damage to or disturbing of the joints during the backfilling process, or at any other time.

After the trench foundation has been properly graded to receive the pipe, the pipe shall be carefully lowered into the trench with approved methods. Under no circumstances shall the pipe or accessories be dropped or dumped into the trench. All damaged pipe shall be replaced at the Contractor's expense.

At least 4 joints shall be left exposed for inspection purposes during the working day and a suitable ladder affording easy and safe access for such inspection shall be furnished.

Any defects due to settlement shall be made good by the Contractor at his own expense.

G. **Temporary Suspension of Work**: When the trench is left for the night or if pipe laying is suspended, the upper end of the pipe shall be plugged to keep out dirt, water, animals and other foreign matter or substances. This plug shall be kept in the end of the pipe line at all times when laying is not in actual progress.

H. **Cutting or Fitting Pipe**: Whenever a pipe requires cutting to bring a pipe to the required location, the work shall be done in a satisfactory manner with an approved cutting tool or tools which will leave a smooth end at right angles to the axis of the pipe and not otherwise damage the pipe. The method of cutting pipe shall be in accordance with manufacturer's recommendations. Such cuts shall be made by the Contractor without extra compensation.

3.1.2 DUCTILE IRON PIPE

A. Bury limitations shall govern as follows based on the type laying condition:

Table 27.1			
Bury Limitations on DIP			
Pipe	**Maximum Bury to Invert of Pipe[a]**		
	Type 2 Laying Condition – Equivalent to Class D Bedding	**Type 4 Laying Condition - Equivalent to Class C Bedding (See Detail 27.01)**	**Type 5 Laying Condition - Equivalent to Class B Bedding (See Detail 27.01)**
8-inch DIP, Class 50	20 feet	34 feet	50 feet
10-inch DIP, Class 50	15 feet	28 feet	45 feet
12-inch DIP, Class 50	15 feet	28 feet	44 feet
14-inch DIP, Class 50	14 feet	27 feet	44 feet
16-inch DIP, Class 50	15 feet	28 feet	44 feet

[a]Laying condition **Type 2** is a flat bottom trench with backfill lightly compacted to centerline of pipe (equivalent to Class D). Laying condition **Type 4** is a 4-inch bed of stone with pipe embedded to 1/8 pipe diameter (equivalent to Class C bedding). **Type 5** laying condition is also a 4-inch bed of stone with pipe embedded to the spring line of the pipe (equivalent to a Class B).

B. Ductile Iron Pipe is approved for all storm uses within City Right-of-Way/Easements.

3.1.3 REINFORCED CONCRETE PIPE

A. Pipe support for pipe shall provide uniform bearing for the pipe barrel along its entire length.

B. **Minimum Pipe Bedding Class**: See Section 02220*, Trenching, Backfilling and Compaction of Utilities*, paragraph 3.3.2 for minimum bedding requirements.

C. Pipe with varying wall class must not be mixed between manholes or boxes.

D. **Bury Limitations**: **Table 27.2** shall govern as the maximum allowable bury for concrete storm pipe:

Table 27.2				
Bury Limitations on RCP (15 through 60 inches)				
Pipe Class	**Maximum Depth of Bury[a]**			
	Class III (feet)	**Class IV** (feet)	**Class V** (feet)	**Max Trench Width** (feet)
15-inch	9.5	14.5	23.0	4.0
18-inch	9.5	15.0	32.5	4.0
24-inch	11.5	23.0	50.0	4.0
30-inch	11.0	19.5	44.5	5.0
36-inch	10.5	18.0	35.0	6.0
42-inch	11.0	19.0	36.5	6.5
48-inch	11.5	19.5	37.5	7.0
54-inch	12.0	20.0	38.5	7.5
60-inch	12.0	20.5	38.5	8.0

[a] Based on saturated clay weighing 120 pcf, trench width as specified, class C stone bedding, 1350 plf per ft of internal diameter for class III and 2000 plf per ft of internal diameter for class IV, 3000 plf per ft of internal diameter for class V, $D-_{0.01\ crack}$

E. Join concrete pipe using bitumastic material to seal joint.

F. As each joint is laid, visually inspect to be certain that no jointing compound gasket, or trash is protruding from the joint or lying inside the pipe.

3.1.4 PLAIN CONCRETE PIPE

A. Plain Concrete Pipe is approved for storm uses in non-traffic bearing situations only.

B. Pipe support for pipe shall provide uniform bearing for the pipe barrel along its entire length.

C. Minimum pipe bedding class: *see 3.1.3, paragraph B, above*.

D. Pipe with varying wall class must not be mixed between manholes or boxes.

E. **Bury Limitations**: *See **Table 27.3**, below*.

Table 27.3 Bury Limitations on PCP (12 through 24 inches)	
Pipe Diameter	**Maximum Depth of Bury Non Reinforced** (feet)
12-inch	9.5
15-inch	9.5
18-inch	10.5
21-inch	11.0
24-inch	11.5

F. Join concrete pipe using bitumastic material to seal joint.

G. As each joint is laid, visually inspect to be certain that no jointing compound, gasket, or trash is protruding from the joint or lying inside the pipe.

3.1.5 POLYPROPYLENE PIPE

A. PP pipe is approved for storm use in traffic and non-traffic bearing situations.

B. Pipe support for pipe shall provide uniform bearing for the pipe barrel along its entire length.

C. Minimum pipe bedding class: See **Standard Detail 27.01A**. Alternate bedding class may be used only with the approval of the City Engineer as per 3.1.3, paragraph B, above.

D. **Bury Limitations**: *See **Table 27.4**, below*.

Table 27.4 Bury Limitations on HPP PP (12 through 60 inches)	
Pipe Diameter	**Maximum Depth of Bury HPP PP** (feet)
12-inch	21
15-inch	22
18-inch	19
24-inch	16
30-inch	16
36-inch	14
48-inch	12
60-inch	16

E. Join HP Pipe using gaskets to seal joint. PP pipe joints shall be double gasketed unless otherwise specified.

F. As each joint is laid, visually inspect to be certain that no gaskets have dislodged, rolled or trash is protruding from the joint or lying inside the pipe.

3.2 MANHOLE CONSTRUCTION FOR STANDARD MANHOLES AND DROP INLET BASES

A. **Standard Manholes and Drop Inlet Bases**: Manholes shall be constructed in accordance with **Standard Details 27.02** and **27.03** with the following exceptions:

Flexible boots and precast concrete inverts will not be required.

Joints will be as specified in the product section of this specification.

The pipe opening in precast units shall be at least 4 but not more than 8 inches larger than the outside diameter of the pipe. Pipe openings shall be formed, drilled, or neatly cut as approved by the Engineer.

The contractor may use brick and masonry block or concrete pipe cutoffs in conjunction with mortar to fill the void between pipe culverts and precast structures. Such materials shall be thoroughly wetted and bonded with mortar. The remaining exterior and interior void shall be filled and sealed/slicked with mortar to the contour of the precast structure.

The standard joint shall be sealed on the interior of the structure, after installation, with a non-shrink hydraulic cement mortar per VDOT *Road and Bridge Specifications*, Section 218.

Plug all weep holes with mortar.

Pour concrete inverts in all structures. Concrete shall be in compliance with products section for miscellaneous concrete of these specifications. Shape manhole channel with a smooth semicircular bottom matching inside diameter of the connecting pipe/pipes. Change directions of flow with a smooth curve of as large a radius as the manhole size will permit. Change size and grade of channels gradually and evenly. Shape the shelf to provide a slope between 1 and 2 inches per foot towards the invert.

Manholes shall be installed plumb.

B. **Grade Rings/Adjustments**: The contractor shall exercise care in the ordering of structures so that the use of grade rings or brick for leveling and adjustments can be minimized. Where adjustment of a manhole is required, grade rings shall be used unless otherwise approved by the City Engineer. Where adjustment of the inlet is required, the use of bricks or grade rings is approved, provided that the entire void between the flat-top and inlet is also filled with brick and mortar to uniformly distribute loading of the inlet. The combination of grade rings or depth of bricks shall not exceed 12 inches before removal of the cone or flat-top is necessary for adjustment.

On all storm manholes, a mastic joint material shall be placed between the frame and cover and the cone or grade ring.

When applicable, during the installation of manholes, if frame and cover is near or within wheel path in roadway, turn cone to place the frame out of wheel path.

C. **Replacement/Rehabilitation of Existing Manholes**

When a new manhole is necessary, the old manhole must be completely removed and a new precast manhole constructed in its place. Where the old manhole is of satisfactory quality, the Contractor will make connection thereto as directed by the City Engineer at no additional cost even if it is necessary to modify the bottom of the manhole to meet the new grade. Such extras are considered to be incidental to the manhole connection cost.

3.3 INLET CONSTRUCTION AND MISCELLANEOUS APPURTENANCES

Construct inlets, end walls, and other storm drainage items as detailed in the latest edition of the VDOT *Road and Bridge Specifications and Standards*.

Adjusting inlet tops and/or miscellaneous appurtenances shall follow same guidelines as prescribed in 3.2, *Manhole Construction for Standard Manholes and Drop Inlet Bases*, paragraph B. *Grade Rings/Adjustments*, above.

All storm drain inlets shall be labeled with a message such as "No Dumping, Drains to River" either by attached labels or by letters cast into the manhole cover or grate. If attached labels are used, they shall be permanently attached by either manufacturer recommended glue or bolt. Label shall be on the top horizontal surface of inlets so it can be clearly read when looking down at the inlet.

3.4 ABANDONING STORM LINES & MANHOLES

A. **Storm Lines**: When an existing storm line is designated to be abandoned in place, the low end of the line is to be plugged and lean concrete grout (flowable fill) pumped into the line until line is completely filled.

B. **Manholes**: When an existing manhole, either partially or wholly, is designated to be abandoned and the storm lines, either entering or exiting the manhole, have been abandoned according to the preceding paragraph, the upper portion of the manhole shall be removed to a minimum of 18 inches below the proposed finished grade, or as determined by the City Construction Coordinator, VDOT #57 stone dumped into the manhole, and the stone vibrated to consolidate the stone. The remainder of the fill between the top of the manhole and the finished subgrade is to be backfilled as follows. Where the manhole is located within a roadway right of way, backfill with VDOT # 57 Stone and consolidate. Outside roadway right of ways, filter fabric shall be placed over the stone, suitable material of a compactable nature shall be placed over the top of the manhole, and the material tamped.

3.5 SLOPE ANCHORS

All lines on slopes equal to or greater than 20% slope shall have concrete anchors placed around the pipe directly below the bell end of the line. The anchors shall be spaced every other joint unless otherwise shown on the plans and constructed to the dimensions shown in **Standard Detail 27.21**.

3.6 EXCAVATION OF DRAINAGE CHANNELS

A. Open storm drainage channels and ditches shall be graded and shaped in accordance with the elevations, slopes, widths, and lengths indicated on the plans. The outfall elevation of the new channels and ditches shall be graded to match the flow elevations of all existing or natural channels, unless indicated or specified otherwise.

B. The drainage channels shaped with fill materials shall be compacted within the limits and in accordance with the related backfill work specified elsewhere.

C. The drainage channels shall be prepared, seeded, and mulched in accordance with the related work specified elsewhere. Where indicated or specified, erosions control measures, such as temporary liners, rip rap, concrete, etc., shall be provided.

3.7 INSPECTION

Upon completion of entire pipe installation, the City Engineer may inspect the work in part or as a whole as will satisfy himself/herself that every portion of the contract has been faithfully carried out.

If, in the opinion of the City Engineer, a defect exists in the pipeline or its appurtenances, in some place not accessible except by uncovering, the City Engineer may order the line to be uncovered. If it is found that after the pipe has been uncovered at the order of the City Engineer, no defect exists or that the defects were not the fault of the contractor, then the expense so incurred by the contractor shall be borne by the City.

Flush all sand, dirt, and debris from the lines prior to inspection. Provide lights and mirrors and inspect lines in the presence of the Construction Coordinator.

Inspect the system for conformance with line and grades shown on the plans and provide record drawing measurements on record drawings.

Visual Inspection: All sewer lines and manholes shall be visually inspected by the contractor/developer in the presence of the City Construction Coordinator from every manhole by use of mirrors and television cameras and in accordance with Section 02760 - Television Inspection of Sewer Lines. The lines shall exhibit a fully circular pattern when viewed from one manhole to the next. Lines that do not exhibit a true and correct line and grade, have obstruction or structural defects, shall be corrected to meet these specifications and the sewer barrel left clean for its entire length.

END OF SECTION 02720

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