James City County
VIRGINIA
Jamestown 1607

# CERTIFICATE OF AUTHENTICITY

**THIS IS TO CERTIFY THAT THE FOLLOWING ELECTRONIC RECORDS ARE TRUE AND ACCURATE REPRODUCTIONS OF THE ORIGINAL RECORDS OF JAMES CITY COUNTY GENERAL SERVICES DEPARTMENT- STORMW ATER DIVISION; WERE SCANNED IN THE REGULAR COURSE OF BUSINESS PURSUANT TO GUIDELINES ESTABLISHED BY THE LIBRARY OF VIRGINIA AND ARCHIVES; AND HA VE BEEN VERIFIED IN THE CUSTODY OF THE INDIVIDUAL LISTED BELOW.**

**BMPNUMBER:** **WC092**

**DATE VERIFIED:** **December 13, 2016**

**QUALITY ASSURANCE TECHNICIAN:** **Charles E. Lovett II**

Charles E. Lovett II

**LOCATION: WILLIAMSBURG, VIRGINIA**

# Stormwater Division

# MEMORANDUM

**DATE:** December 13, 2016
**TO:** Virginia Correctional Enterprises Document Management Services
**FROM:** Charles Lovett II, Stormwater Administrative Assistant
**BMP:** WC092
**RE:** Files Approved for Scanning

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| | | | |
|---|---|---|---|
| **NAME PDF/SCANNED FILE:** | Stonehouse Glenn Section 1 and 2 | | |
| **BMP ID OR GEN FILE NUMBER:** | WC092 | **OWNER NAME :** | STONEHOUSE OWNERS FOUNDATION |
| **PIN:** | 0540400001C | **SITE ADDRESS:** | 9304 STONEHOUSE GLEN |
| | | **LEGAL DESCRIPTION:** | BMP 1, 2, 3 S-1 STONEHOUSE GLEN |

| | | | | | |
|---|---|---|---|---|---|
| **MAINTENANCE AGREEMENT IN FILE:** | YES | **BOOK/PAGE OR DOCUMENT NO:** | 050014036 | **OTHER DESCRIPTION:** | F2 - Dry ED |

| | | | |
|---|---|---|---|
| **BOX NO:** | N/A | **COMMENTS:** | Related BMPs WC091, WC092, WC094, WC095 |
| | | | |

# County Record Checklist

*Directions: Please check the type of file for scanning and check the documents enclosed in the file. Remove any budget documents, contractor financial statements or any documents with account numbers.

## ☐ Stormwater Projects, General Site/Subdivision (from ERP) and Stream Restoration Files

Order of Contents: File Name: _____

| | | |
|---|---|---|
| | a. | Certification of Authenticity (placed in the file at the time of certification) |
| | b. | Memorandum of files approved for scanning |
| | c. | This checklist |
| ☐ | 1. | Maintenance Agreement |
| ☐ | 2. | Deeds/Easements/Agreements/Property Records |
| ☐ | 3. | Record Drawings (As Builts) |
| ☐ | 4. | Construction Drawings |
| ☐ | 5. | Warranties |
| ☐ | 6. | Project development documentation |
| ☐ | 7. | Reports |
| ☐ | 8. | Specifications and engineering calculations |
| ☐ | 9. | Permitting (ex. wetlands permit, SWPPP) |
| ☐ | 10. | Inspections |
| ☐ | 11. | Correspondence |
| ☐ | 12. | Misc. (ex. photos) |

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## ☐ Stormwater Stormwater Mangement Facilities (BMP) Files

Order of Contents: File Name: WC 092

| | | |
|---|---|---|
| | a. | Certification of Authenticity (placed in the file at the time of certification) |
| | b. | Memorandum of files approved for scanning |
| | c. | This checklist |
| ☒ | 1. | Maintenance Agreement |
| ☐ | 2. | Deeds/Easements/Agreements/Property Records |
| ☒ | 3. | Construction Certificate |
| ☒ | 4. | Record Drawing (as-built plan) |
| ☒ | 5. | Construction Drawings |
| ☒ | 6. | Design Calculations |
| ☒ | 7. | Reports |
| ☒ | 8. | Correspondence |
| ☒ | 9. | Inspection Records |
| ☒ | 10. | Misc. (ex. photos) |

040030383 COPY

COUNTY OF JAMES CITY, VIRGINIA

DECLARATION OF COVENANTS

INSPECTION/MAINTENANCE OF DRAINAGE SYSTEM

THIS DECLARATION, made this 19th day of November, 2004, between Stonehouse Glen, L.L.C., and all successors in interest, ("COVENANTORS(S)"), owner(s) of the following property:

Street Address: 9101 Six Mount Zion Road, James City County
Legal Description: Parcel B-Stonehouse, Inc. and Parcel 18, LaGrange Tract
Project Name: Fieldstone Parkway Road Extension
Document Nos. 040010273 and 040010274, and the County of James City, Virginia ("COUNTY").

WITNESSETH:

We, the COVENANTOR (S), with full authority to execute deeds, mortgages, other covenants, and all rights, titles and interests in the property described above, do hereby covenant with the COUNTY as follows:

1. The COVENATOR(S) shall provide maintenance for the drainage system including any runoff control facilities, conveyance systems and associated easements, hereinafter referred to as the "SYSTEM," located on and serving the above-described property to ensure that the SYSTEM is and remains in proper working condition in accordance with approved design standards, and with the law and applicable executive regulations. The SYSTEM shall not include any elements located within any Virginia Department of Transportation rights-of-way.

2. If necessary, the COVENANTOR(S) shall levy regular or special assessments against all present or subsequent owners of property served by the SYSTEM to ensure that the SYSTEM is properly maintained.

3. The COVENANTOR(S) shall provide and maintain perpetual access from public right-of-ways to the SYSTEM for the COUNTY, its agent and its contractor.

4. The COVENANTOR(S) shall grant the COUNTY, its agent and its contractor a right of entry to the SYSTEM for the purpose of inspecting, operating, installing, constructing, reconstructing, maintaining or repairing the SYSTEM.

5. If, after reasonable notice by the COUNTY, the COVENANTOR(S) shall fail to maintain the SYSTEM in accordance with approved design standards and with the law and applicable executive regulations, the COUNTY may perform all necessary repair or maintenance work, and the COUNTY may asses the COVENANTOR(S) and/or all property served by the SYSTEM for the cost of the work and any applicable penalties.



3

6. The COVENANTOR(S) shall indemnify and save the COUNTY harmless from any and all claims for damages to persons or property arising from the installation, construction, maintenance, repair, operation or use of the SYSTEM.

7. The COVENANTOR(S) shall promptly notify the COUNTY when the COVENANTOR(S) legally transfers any of the COVENANTOR(S)' responsibilities for the SYSTEM. The COVENANTOR(S)' shall supply the COUNTY with a copy of any document of transfer, executed by both parties.

8. The covenants contained herein shall run with the land and shall bind the COVENANTOR(S) and the COVENANTOR(S)' heirs, executors, administrators, successors and assignees, and shall bind all present and subsequent owners of property served by the SYSTEM.

9. This COVENANT shall be recorded in the County Land Records.

IN WITNESS WHEREOF, the COVENANTOR(S) have executed this DECLARATION OF COVENANTS as of first above written.

COVENANTOR(S)

Kenneth G. McDermott

ATTEST:

Print Name/Title Kenneth G. McDermott, Manager

COMMONWEALTH OF VIRGINIA
CITY/COUNTY OF James City

I hereby certify that on this 19th day of November, 2004, before the subscribed, a Notary Public of the State of Virginia, and for the City/County of James City, aforesaid personally appeared Kenneth G. McDermott, and did acknowledge the aforegoing instrument to be their Act.

IN WITNESS WHEREOF, I have hereunto set my hand and official seal this 19th day of November, 2004.

Patricia M. Penci

Patricia M. Penci, Notary Public

My Commission expires: June 30, 2006

Approved as to form:

County Attorney

This Declaration of Covenants prepared by:

Patricia M. Penci
(Print Name)

Office Manager, The LandMark Design Group, Inc.
(Title)

4029 Ironbound Road, Suite 100
(Address)

Williamsburg, VA 23188
(City) (State) (Zip)

757-253-2975 (Phone)

VIRGINIA: CITY OF WILLIAMSBURG & COUNTY OF JAMES CITY
This document was admitted to record on 6 DEC. 04
at 9:37 AM The taxes imposed by Virginia Code
Section 58.1-801, 58.1-802 & 58.1-814 have been paid.

| STATE TAX | LOCAL TAX | ADDITIONAL TAX |
|---|---|---|
| — | — | — |
| $ | $ | $ |

TESTE: BETSY B. WOOLRIDGE, CLERK

BY: Betsy B. Woolridge Clerk

COUNTY OF JAMES CITY, VIRGINIA

COPY

DECLARATION OF COVENANTS

INSPECTION/MAINTENANCE OF DRAINAGE SYSTEM

THIS DECLARATION, made this 10th day of June, 2005, between Stonehouse Glen, L.L.C., and all successors in interest, ("COVENANTORS(S)"), owner(s) of the following property:

Street Address: 9101 and 9151 Six Mount Zion Road, Toano
Legal Description: Parcel 18, LaGrange Tract and Parcel 15, Hicks Tract
Project Name: Stonehouse Glen Section I
Document No. 040010274, and the County of James City, Virginia ("COUNTY").

WITNESSETH:

We, the COVENANTOR (S), with full authority to execute deeds, mortgages, other covenants, and all rights, titles and interests in the property described above, do hereby covenant with the COUNTY as follows:

1. The COVENATOR(S) shall provide maintenance for the drainage system including any runoff control facilities, conveyance systems and associated easements, hereinafter referred to as the "SYSTEM," located on and serving the above-described property to ensure that the SYSTEM is and remains in proper working condition in accordance with approved design standards, and with the law and applicable executive regulations. The SYSTEM shall not include any elements located within any Virginia Department of Transportation rights-of-way.

2. If necessary, the COVENANTOR(S) shall levy regular or special assessments against all present or subsequent owners of property served by the SYSTEM to ensure that the SYSTEM is properly maintained.

3. The COVENANTOR(S) shall provide and maintain perpetual access from public right-of-ways to the SYSTEM for the COUNTY, its agent and its contractor.

4. The COVENANTOR(S) shall grant the COUNTY, its agent and its contractor a right of entry to the SYSTEM for the purpose of inspecting, operating, installing, constructing, reconstructing, maintaining or repairing the SYSTEM.

5. If, after reasonable notice by the COUNTY, the COVENANTOR(S) shall fail to maintain the SYSTEM in accordance with approved design standards and with the law and applicable executive regulations, the COUNTY may perform all necessary repair or maintenance work, and the COUNTY may asses the COVENANTOR(S) and/or all property served by the SYSTEM for the cost of the work and any applicable penalties.

Instrument # 050014036
Recorded on June 24, 2005



Revised 06/04

6. The COVENANTOR(S) shall indemnify and save the COUNTY harmless from any and all claims for damages to persons or property arising from the installation, construction, maintenance, repair, operation or use of the SYSTEM.

7. The COVENANTOR(S) shall promptly notify the COUNTY when the COVENANTOR(S) legally transfers any of the COVENANTOR(S)' responsibilities for the SYSTEM. The COVENANTOR(S)' shall supply the COUNTY with a copy of any document of transfer, executed by both parties.

8. The covenants contained herein shall run with the land and shall bind the COVENANTOR(S) and the COVENANTOR(S)' heirs, executors, administrators, successors and assignees, and shall bind all present and subsequent owners of property served by the SYSTEM.

9. This COVENANT shall be recorded in the County Land Records.

IN WITNESS WHEREOF, the COVENANTOR(S) have executed this DECLARATION OF COVENANTS as of first above written.

COVENANTOR(S)

Kenneth G. McDermott, Manager

ATTEST:

Patricia M. Penci

Print Name/Title Kenneth G. McDermott, Manager

COMMONWEALTH OF VIRGINIA
CITY/COUNTY OF James City

I hereby certify that on this 10th day of June, 2005, before the subscribed, a Notary Public of the State of Virginia, and for the City/County of James City, aforesaid personally appeared Kenneth G. McDermott, and did acknowledge the aforegoing instrument to be their Act.

IN WITNESS WHEREOF, I have hereunto set my hand and official seal this 10th day of June, 2005.

Patricia M. Penci
Patricia M. Penci, Notary Public

My Commission expires: June 30, 2006

Approved as to form:

County Attorney

This Declaration of Covenants prepared by:

Patricia M. Penci
(Print Name)

Office Manager, The LandMark Design Group, Inc.
(Title)

4029 Ironbound Road, Suite 100
(Address)

Williamsburg, VA 23188
(City) (State) (Zip)

Environmental Division

JUL 19 2010

COPY

RECEIVED

# COUNTY/STATE AGREEMENT
# FOR
# INSPECTION AND MAINTENANCE
# OF COUNTY CONTROLLED GRADE SEPARATION STRUCTURE

THIS AGREEMENT FOR INSPECTION AND MAINTENANCE of a County controlled grade separation structure, made as of the date last signed below by and between (hereinafter "County"); and the Commonwealth of Virginia, Department of Transportation (hereinafter "Department");

WHEREAS, the Department considers structures that are crossed by public roads but are not required for the purposes of those using said road to be a County controlled grade separation structure, except as otherwise defined in 24 VAC 30-91-110.J, and to be ineligible for maintenance by the Department; and

WHEREAS, the County approved plans for a subdivision shown on a plat entitled "SUBDIVISION PLAT SHOWING STONEHOUSE GLEN, SECTIONS 1 & 2, AND RIGHT OF WAY OF FIELDSTONE PARKWAY, BEING A SUBDIVISION OF THE PROPERTY OF FIELDSTONE INVESTMENT, LLC AND STONEHOUSE GLEN, LLC, STONEHOUSE DISTRICT, JAMES CITY COUNTY, VIRGINIA that is recorded in the Clerk's Office of the Circuit Court in Instrument Number 060016179 a copy of which is incorporated herein as Exhibit A; and

WHEREAS, in accordance with the Code of Virginia, §15.2-2265, recording the described plat transferred title, in fee simple, to all portions set apart for streets, alley and areas for public use to the County; and

WHEREAS, said plat shows areas dedicated to the public, including a road named Fieldstone Parkway that passes over a structure that the Department deems to be a County controlled grade separation structure and is located in the area shown on the described plat as "EXISTING CART AND IRRIGATION EASEMENT (GOLF CLUB) PB 66, PG 80-88."

WHEREAS, the county, pursuant to authorities established in Title 15.2 and §33.1-229. Code of Virginia, consented to the grade separation and construction of the structure and, upon acceptance of the roadway for maintenance by the Department as a part of the secondary system of state highways, desires the Department to maintain the structure as though it did qualify for maintenance as an integral part of the roadway; and

WHEREAS, uniquely qualified personnel are required to perform periodic safety inspections of roadway structures to assure their structural integrity and the safety of those using the structure; and

Agreement of a County Controlled Grade Separation Structure
Name of County: James City County
Name of Street: Fieldstone Parkway, Golf Cart Tunnel

WHEREAS, the Department routinely inspects structures of the secondary system of state highways with appropriately qualified personnel in accordance with the National Bridge Safety Inspection Act; and

WHEREAS, the County desires the Department to assume the responsibilities for the inspection and maintenance of the structural integrity of the structure as though it otherwise qualified for maintenance as part of the secondary system of state highways maintained by the Department;

NOW, THEREFORE, THIS AGREEMENT FOR INSPECTION AND MAINTENANCE

In consideration of the covenants contained herein and the County's request that the roadway and structure be maintained by the Department as part of the secondary system of state highways under its operational jurisdiction; and

In consideration of the Department's acceptance of responsibility to maintain the roadway and the structure crossing;

I. The County agrees:

A. To bear all liability for any and all maintenance of the structure.

B. To bear all liability for any and all inspections and maintenance of any public safety security systems, including lighting that it may require for those using the structure other than those using the roadway, unless otherwise agreed to by the parties to this Agreement. Nothing herein shall preclude the County from obtaining contracts or indemnification from other persons or persons with respect to the performance of or liability for the maintenance of the structure.

C. To provide the Department with permanent copies of the 'as built' structure plans, specifications, and construction inspection records certified to the County by a competent, licensed professional engineer attesting to the proper construction of the facility.

D. That the Department, in its sole discretion, may inspect the structure at any time and perform any maintenance it deems necessary for the safety of the public.

E. To bear all reasonable costs associated with the periodic inspection of the structure and any and all subsequent maintenance, including that of any public safety security systems, such as lighting, and necessary reconstruction the structure, reimbursing the Department within thirty (30) days of being billed for the service performed by or for the Department.

F. With respect to the maintenance and operation responsibilities borne by the County as described in Paragraphs A and B above, the County further agrees:

1. That the Department has no maintenance, upkeep and/or repair responsibility or liability for the structure except as provided by the Code of Virginia in cases of physical damage resulting from road maintenance projects or road construction projects administered by the Department.

2. The County will not seek indemnification or contribution from the Department with respect to any claims or damages arising from improper maintenance of those items for which the County is responsible.

II. The partied hereto further acknowledge that:

A. To perform periodic inspections of the structure with appropriately qualified inspection personnel and to maintain he structural integrity of the facility as though it were a necessary part of the secondary system of state highways maintained by the Department, all in keeping with normal practices.

B. To endeavor to provide the County notice of maintenance activity that it anticipates will exceed $10,000 (ten thousand dollars) in cost before performing maintenance of a non-emergency nature.

C. To bear the liabilities and responsibilities normally associated with the preservation of the structural safety of the facility, effective with the date the roadway is accepted as part of the secondary system of state highways maintained by the Department.

III. The parties hereto further acknowledge that:

A. The Department in its sole discretion may close the road or the structure as it deems necessary for the safety of the public or for proper completion of work, and shall close the structure permanently upon the County's request accompanied by:

1. A resolution guaranteeing that the County shall reimburse the Department for all reasonable costs incurred in the closing of the structure, and

2. Documentation providing evidence that the County has the authority to close or require closure of the structure without obtaining consents from any other party.

B. This Agreement does not relieve the parties hereto of liability due to negligence or of their rights and obligations pursuant to any applicable federal or state laws or regulations.

Witness the following signature and seals:

APPROVED AS TO FORM

_____ By: _____
County Legal Officer (Name and Title) Sanford B. Wanner
County Administrator

**Commonwealth of Virginia, Department of Transportation**

_____ By: _____
Commonwealth Transportation Commissioner

COMMONWEALTH OF VIRGINIA, ~~CITY~~/COUNTY OF James City, to wit:

(Name) Sanford B. Wanner, County Administrator, acknowledged the foregoing instrument before me this 15th day of July, 2010.

Beth Klapper
Notary Public No.: 7182762
Commonwealth of Virginia
My Commission Expires:
December 31, 2012

_____
NOTARY PUBLIC
My commission expires: December 31, 2012

COMMONWEALTH OF VIRGINIA, CITY/COUNTY OF _____, to wit:

(Name) _____, "Commonwealth Transportation Commissioner", party of the second part, acknowledged the foregoing instrument before me this _____ day of _____ _____, _____ _____.

_____
NOTARY PUBLIC
My commission expires: _____

EXHIBIT A

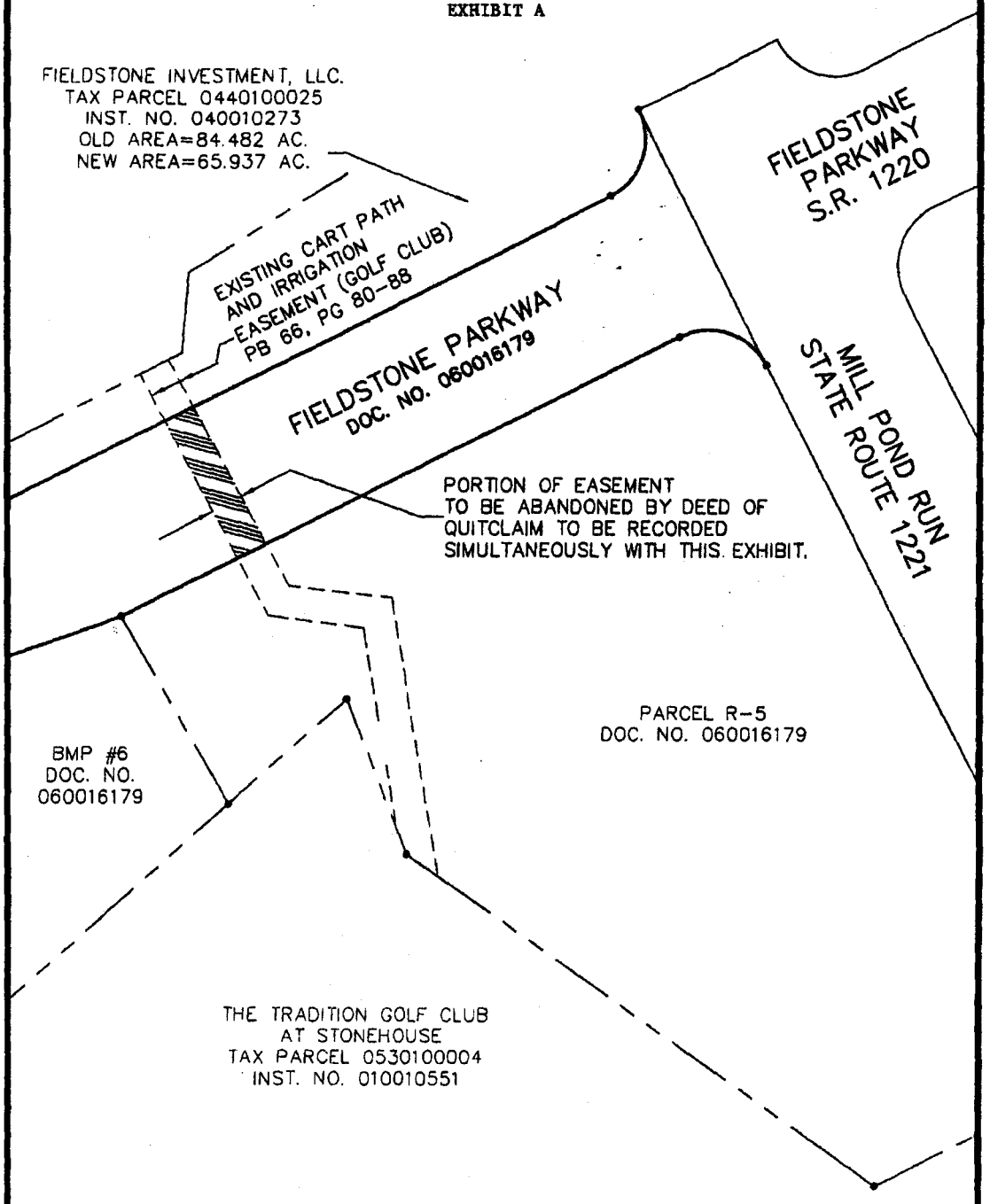


**EXHIBIT SHOWING**
**A PORTION OF EASEMENT**
**TO BE QUITCLAIMED**
**BY THE TRADITION GOLF CLUB AT**
**STONEHOUSE**

**FIELDSTONE PARKWAY**
**JAMES CITY COUNTY, VIRGINIA**
**SCALE: 1" = 100' DATE: 09/19/06**

LANDMARK
DESIGN GROUP
Engineers • Planners • Surveyors
Landscape Architects • Environmental Consultants

4029 Ironbound Road
Suite 100
Williamsburg, VA 23188
Tel. (757) 253-2975
Fax (757) 229-0049
Email: lmdg@landmarkdg.com



DWG. NO. : 17388W

**James City County, Virginia**
**Environmental Division**

# Stormwater Management / BMP Facilities
# Record Drawing and Construction Certification Forms

***( Note: In accordance with the requirements of the Chesapeake Bay Preservation Ordinance, Chapter 23, Section 23-10(4), BMP's shall be designed and constructed in accordance with the manual entitled James City County Guidelines for Design and Construction of Stormwater Management BMP's. Erosion and sediment control policy and approved plans generally require that at the completion of the project and prior to release of surety, an "as-built" plan prepared by a registered Professional Engineer or Certified Land Surveyor must be provided for the drainage system for the project, including any Best Management Practice (BMP) facilities. In addition, for BMP facilities involving the construction of an impounding structure or dam embankment, certification is required by a Professional Engineer who has inspected the structure during its construction. Currently there are over 20 water quality type BMP's accepted by the County. )***

**Section 1 - Site Information:**

Project Name: **Stonehouse Glen Section I**
Structure/BMP Name: **Bmp 1**
Project Location: Stonehouse District, James City County, Virginia
BMP Location: Ashlock Court
County Plan No.: S-098-03

PIN#0530700001A

Project Type: ☒ Residential ☐ Business ☐ Commercial ☐ Office ☐ Institutional ☐ Industrial ☐ Public ☐ Roadway ☐ Other _____

Tax Map/Parcel No.: Tax Map 06-04 Parcel 1-01 (Part)
BMP ID Code (if known): WC 092
Zoning District:: Pud-R
Land Use: Residential

Site Area (sf or acres): 85.4963 Ac.

Brief Description of Stormwater Management/BMP Facility: Detention Basin to function as temporary sediment basin until stabilization of all areas draining to it.

Nearest Visible Landmark to SWM/BMP Facility:
Six Mount Zion Road (S.R. 600) & Fieldstone Parkway
Nearest Vertical Ground Control ( if known ):
☒ JCC Geodetic Ground Control ☐ USGS ☐ Temporary ☐ Arbitrary ☐ Other
Station Number or Name: 340
Datum or Reference Elevation: Va. State Plane Nad 83
Control Description: Disk in concrete on Old Stage Road (S.R. 30 )
Near end of exit ramp at I-64 exit 227
Control Location from Subject Facility: Southeast 5000'+,-

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AUG 21 2006
ENVIRONMENTAL DIVISION

**Section 2 - Stormwater Management / BMP Facility Construction Information:**

PreConstruction Meeting Held for Construction of SWM/BMP Facility: ☐ Yes ☐ No ☒ Unknown
Approx. Construction Start Date for SWM/BMP Facility: 04/05
Facility Monitored by County Representative during Construction: ☐ Yes ☐ No ☒ Unknown
Name of Site Work Contractor Who Constructed Facility: Jack Massie Contractors
Name of Professional Firm Who Routinely Monitored Construction: Landmark Design Group
Date of Completion for SWM/BMP Facility: _July, 2005
Date of Record Drawing/Construction Certification Submittal: 08-14-06

***( Note: Record Drawing and Construction Certifications are required within thirty (30) days of the completion of Stormwater Management and/or BMP facility construction. Record Drawings and Construction Certifications must be reviewed and approved by the James City County Environmental Division prior to final inspection, acceptance and bond or surety release. )***

**Section 3 - Owner / Designer / Contractor Information:**

Owner/Developer: *(Note: Site Owner or Applicant responsible for development of the project.)*

Name: Stonehouse Glen, LLC
Mailing Address:15 Mendham Road, P.O. Box 704
Gladstone, New Jersey 07934
Business Phone: 908-234-2620 Fax: _____
Contact Person: Ken Mcdermott Title: Manager

Design Professional: *( Note: Professional Engineer or Certified Land Surveyor responsible for the design and preparation of plans and specifications for the Stormwater Management / BMP facility. )*

Firm Name: Landmark Design Group
Mailing Address:4029 Ironbound Road, Suite 100
Williamsburg, Va. 23188

Business Phone: 757-253-2975
Fax:757-229-0049
Responsible Plan Preparer: _James W. Brawley III, P.E.
Title: Senior Associate
Plan Name: Plan of Development Stonehouse Glen Section II
Firm's Project No. 2002261-504.04
Plan Date: 2-23-05
Sheet No.'s Applicable to SWM/BMP Facility: C-16

BMP Contractor: *(Note: Site Work Contractor directly responsible for construction of the Stormwater Management / BMP facility.)*

Name:Jack Massie Contractors
Mailing Address: 3900 Cokes Lane Williamsburg, Va.
Business Phone: 757-566-8643
Fax:
Contact Person: Joe Monk
Site Foreman/Supervisor: Rick Cook
Specialty Subcontractors & Purpose (for BMP Construction Only):_____

## Section 4 - Professional Certifications:

Certifying Professionals: *( Note: A Registered Professional Engineer or Certified Land Surveyor is responsible for preparation of a Record Drawing, sometimes referred to as an As-Built plan, for the drainage system for the project including any Stormwater Management/BMP Facilities. A Registered Professional Engineer is responsible for the inspection, monitoring and certification of Stormwater Management / BMP facilities during its construction. )*

### Record Drawing and Construction Certifications for Stormwater Management / BMP Facilities

#### Record Drawing Certification

Firm Name: Landmark Design Group
Mailing Address: 4029 Ironbound Road Suite 100
Williamsburg, Va. 23188

Business Phone: 757-253-2975
Fax: 757-229-0049

Name: Peter Farrell, L.S.
Title: Director of Surveys

Signature: Peter Farrell
Date: 8-17-06

I hereby certify to the best of my knowledge and belief that this record drawing represents the actual condition of the Stormwater Management / BMP facility. The facility appears to conform with the provisions of the approved design plan, specifications and stormwater management plan, except as specifically noted.

COMMONWEALTH OF VIRGINIA
PETER FARRELL
LAND SURVEYOR

_____ ( Seal )

Virginia Registered Professional Engineer
or Certified Land Surveyor

#### Construction Certification

Firm Name: ECS Mid-Atlantic, LLC

Mailing Address: 108 Ingram Rd, suite 1
Williamsburg, VA 23188

Business Phone: (757) 229-6677
Fax: (757) 229-9978

Name: Michael J. Galli, P.E.
Title: Vice President / Principal Engineer

Signature: Michael J. Galli
Date: 8-18-06

I hereby certify to the best of my knowledge and belief that this Stormwater Management/BMP facility was monitored and constructed in accordance with the provisions of the approved design plan, specifications and stormwater management plan, except as specifically noted.

MICHAEL J. GALLI
No. 030004
8/18/06
PROFESSIONAL ENGINEER

_____ ( Seal )

Virginia Registered
Professional Engineer

Environmental Division

MAY 16 2013

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**James City County, Virginia**
**Stormwater Division**

**Stormwater Facilities - BMP and Conveyance Systems**
**Record Drawing and Construction Certification Forms**

***Note: In accordance with the requirements of the Chesapeake Bay Preservation Ordinance, Chapter 23, Section 23-10(4), BMPs shall be designed and constructed in accordance with the manual entitled* James City County Guidelines for Design and Construction of Stormwater Management BMPs. *The Subdivision Ordinance, Chapter 19-62, the Zoning Ordinance, Chapter 24-159, and approved construction plans generally require that at the completion of the project and prior to release of surety, an "as-built" plan prepared by a registered Professional Engineer or Certified Land Surveyor must be provided for the drainage system for the project including any Best Management Practice (BMP) facilities. In addition, for BMP facilities, written construction certification is required by a Professional Engineer who inspected the structure during its construction. Currently there are over 20 water quality type BMPs accepted by the County.***

**Section 1 - Site Information:**

Project Name: STONEHOUSE GLEN

Structure/BMP Name: WC095, WC094, WC091, WC092 - DRY PONDS

Project Location: 9304 STONEHOUSE GLEN, TOANO, VIRGINIA

BMP Location: NEWLAND COURT, STONEHOUSE GLEN, OTTAWAY COURT, ASHLOCK COURT

County Plan No.: SP - 0058 - 2012, SP-116-03, SP-098-03

Project Type:
- ☑ Residential
- ☐ Business
- ☐ Commercial
- ☐ Office
- ☐ Institutional
- ☐ Industrial
- ☐ Public
- ☐ Roadway
- ☐ Other _____

Tax Map/Parcel No.: 0540400001C

BMP ID Code (if known): WC095, WC094, WC091, WC092

Zoning District: PR PUD RESIDENTIAL

Land Use: _____

Site Area (sf or acres): _____

Brief Description of Stormwater Management/BMP Facility: DETENTION PONDS PROVIDING STORMWATER MANAGEMENT QUALITY AND QUANTITY CONTROL FOR THE SUBJECT SUBDIVISION

Nearest Visible Landmark to SWM/BMP Facility: _____

Nearest Vertical Ground Control (if known):

☒ JCC Geodetic Ground Control ☐ USGS ☐ Temporary ☐ Arbitrary ☐ Other

Station Number or Name: 340

Datum or Reference Elevation: NGVD (29) 123.20

Control Description: JCC GEODETIC GROUND MONUMENT, DISK IN CONCRETE

Control Location from Subject Facility: 5,000' (FEET)

**Section 2 - Stormwater Management / BMP Facility Construction Information:**

Preconstruction Meeting Held for Construction of SWM/BMP Facility: ☑ Yes ☐ No ☐ Unknown

Approx. Construction Start Date for SWM/BMP Facility: DECEMBER 2012 (BMP OUTFALL WC092)

Facility Monitored by County Representative during Construction: ☑ Yes ☐ No ☐ Unknown

Name of Site Work Contractor Who Constructed Facility: CA BARRS (WC092 BMP OUTFALL)

Name of Professional Firm Who Routinely Monitored Construction: ES, VHB INC (WC092 BMP OUTFALL)

Date of Completion for SWM/BMP Facility: MAY 2013

Date of Record Drawing/Construction Certification Submittal: 05/15/13

***(Note: Record Drawing and Construction Certifications are required within thirty (30) days of the completion of construction of a Stormwater Facility – BMP or Conveyance system. Record Drawings and Construction Certifications must be reviewed and approved by the James City County Stormwater Division prior to final inspection, acceptance and surety release. )***

**Section 3 - Owner / Designer / Contractor Information:**

Owner/Developer: *(Note: Site Owner or Applicant responsible for development of the project.)*

Name: STONEHOUSE GLEN, L.L.C / GLEN VENTURE Mr. KEN McDERMOTT

Mailing Address: P.O. BOX 61, GLADSTONE, NJ 07934

Business Phone: 908 234 2620 x227 Fax: 908 2349508

Contact Person: KEN McDERMOTT Title:

Design Professional: *(Note: Professional Engineer or Certified Land Surveyor responsible for the design and preparation of plans and specifications for the Stormwater facilities.)*

Firm Name: VANASSE HANGEN BRUSTLIN, INC

Mailing Address: 351 McLAWS CIRCLE, SUITE 3, WILLIAMSBURG, VA

Business Phone: 757-220-0500 Fax: 757-220-8544

Responsible Plan Preparer: PIOTR SWIETUCHOWSKI, PE

Title: PROJECT MANAGER

Plan Name: STONEHOUSE GLEN BMP OUTFALL REPAIR

Firm's Project No. 33315.01 Plan Date: 07/24/12

Sheet No. Applicable to SWM/BMP Facility: C-2 / C-4 / C-6 / ____ / ____

Stormwater Facility Contractor: *(Note: Site Work Contractor directly responsible for construction of the Stormwater facilities.)* WC092 OUTFALL AND EROSION REPAIRS TO WC095, WC094 WC091

Name: CA. BARRS

Mailing Address: P.O. BOX 1489, YORKTOWN, VA 23692

Business Phone: 757 898 7282 Fax: 757-898-1282

Contact Person: M. Scott St. Clair

Site Foreman/Supervisor: M. Scott St. Clair

Specialty Subcontractors & Purpose (for BMP Construction Only):

**Section 4 - Professional Certifications:**

Certifying Professionals: *A Registered Professional Engineer or Certified Land Surveyor is responsible for preparation of a Record Drawing, sometimes referred to as an As-Built plan, for the stormwater facilities for the project including all BMP and conveyance systems. A Registered Professional Engineer is responsible for the inspection, monitoring and certification of all stormwater facilities – BMP and conveyance systems during their construction.*

**Record Drawing and Construction Certifications for Stormwater Facilities - BMP and Conveyance Systems**

**Record Drawing Certification**

Firm Name: VANASSE HANGEN BRUSTLIN, INC
Mailing Address: 351 McLAWS CIRCLE
WILLIAMSBURG, VA 23185
Business Phone: 757-220-0500
Fax: 757-220-8544

Name: STEPHEN ROMEO
Title: PRINCIPAL

Signature: Stephen Romeo
Date: 5/15/13

I hereby certify to the best of my knowledge and belief that this record drawing represents the actual condition of the Stormwater Facilities. The facilities appear to conform to the provisions of the approved construction plans and specifications except as specifically noted.

**Construction Certification**

Firm Name: _____
Mailing Address: _____
_____
Business Phone: _____
Fax: _____

Name: _____
Title: _____

Signature: _____
Date: _____

I hereby certify to the best of my knowledge and belief that these Stormwater Facilities were monitored and constructed in accordance with the provisions of the approved construction plans and specifications except as specifically noted.

COMMONWEALTH OF VIRGINIA
5/15/13
STEPHEN A. ROMEO
Lic. No. 1448-B
LAND SURVEYOR

_____ (Seal)
Virginia Registered Professional Engineer
or Certified Land Surveyor

_____ (Seal)
Virginia Registered
Professional Engineer

**Section 5 - Record Drawing and Construction Certification Requirements and Instructions:**

☑ Preconstruction Meeting - Provides an opportunity to review stormwater facilities construction, maintenance and operation plans, and address any questions regarding construction and/or monitoring of the structure. The certifying professionals, geotechnical engineer, Owner/Applicant, Contractor and County representative(s) are required to attend the preconstruction meeting. Advance notice to the Stormwater Division is required. Usually, this requirement can be met simultaneously with Erosion and Sediment Control preconstruction meeting held for the project.

☑ A fully completed ***Stormwater Facilities – BMP and Conveyance Systems, RECORD DRAWING and CONSTRUCTION CERTIFICATION FORM*** and ***RECORD DRAWING CHECKLIST***. All applicable sections shall be completed in their entirety and certification statements signed and sealed by the registered professional responsible for individual record drawing and/or construction certification.

☑ The Record Drawing shall be prepared by a Registered Professional Engineer or Certified Land Surveyor for the stormwater facilities including all BMPs and conveyance systems.

N/A ☐ Construction Certification. Construction of Stormwater BMP facilities which contain impoundments, embankments and related engineered appurtenances including subgrade preparation, compacted soils, structural fills, liners, geosynthetics, filters, seepage controls, cutoffs, toe drains, hydraulic flow control structures, etc. shall be visually observed and monitored by a Registered Professional Engineer or his/her authorized representative. The Engineer must certify that the structure, embankment and associated appurtenances were built in accordance with the approved construction plans and specifications, and standard accepted construction practice and shall submit a written certification and/or drawings to the Stormwater Division as required. Soil and compaction test reports, concrete test reports, inspection reports, logs and other required construction material or installation documentation shall be required by the Stormwater Division to substantiate the certification. The Engineer shall have the authority and responsibility to make minor changes to the approved plan, in coordination with the assigned County inspector, in order to compensate for unsafe or unusual conditions encountered during construction such as those related to bedrock, soils, groundwater, topography, etc. as long as changes do not adversely affect the integrity of the structure(s). Major changes to the approved design plan or structure must be reviewed and approved by the original design professional and the James City County Environmental Division with notification to the Stormwater Division.

☑ Record Drawing and Construction Certifications are required within **thirty (30) days** of the completion of any Stormwater Facility - BMP or conveyance system. Submittals must be reviewed and accepted by James City County Stormwater Division prior to final inspection, acceptance, surety release or issuance of a Certificate of Occupancy.

**Dual Purpose Facilities** - Completion of construction also includes any interim stage for Stormwater BMP facilities which serve a dual purpose as temporary sediment basins during construction and as permanent stormwater BMP facilities following completion of development and stabilization. For these dual purpose facilities, construction certification is required once the temporary sediment basin phase of construction is complete. Final record drawing and construction certification of additional permanent components is required once permanent facility construction is complete.

*Interim Construction Certification* is required for those dual purpose embankment-type facilities that are generally ten (10) feet or greater in dam height (*) and may not be converted, modified or begin function as a permanent SWM / BMP structure for a period generally ranging from six (6) to eighteen (18) months or more from issuance of a Land Disturbance permit for construction.

Interim or final record drawing and construction certifications are not required for temporary sediment basins which are designed and constructed in accordance with current minimum standards and specifications for temporary sediment basins per the Virginia Erosion and Sediment Control Handbook (VESCH); have a temporary service life of less than eighteen (18) months; and will be removed completely once associated disturbed areas are stabilized, unless a distinct hazard to the public's health, safety and welfare is determined by the Stormwater Division due to the size or presence of the structure or due to evidence of improper construction.

(*Note: Dam Height as referenced above is generally defined as the vertical distance from the natural bed of the stream or waterway at the downstream toe of the embankment to the top of the embankment structure in accordance with 4VAC50-20-30, Virginia Impoundment Structure Regulations and the Virginia Dam Safety Program.)

☑ Record Drawings shall provide, at a minimum, all information as shown within these requirements and the attached **RECORD DRAWING CHECKLIST** specific to the type of SWM/BMP facility being constructed. Other additional record data may be formally requested by the James City County Stormwater Division. *(Note: Refer to the current edition of the James City County Guidelines for Design and Construction of Stormwater Management BMP's manual for a complete list of acceptable BMP's. Currently there are over 20 acceptable water quality type BMP's accepted by the County.)*

☑ Record Drawings shall consist of blue/black line prints and a reproducible (mylar, sepia, diazo, etc.) set of the approved stormwater facilities construction plan including applicable plan views, profiles, sections, details, maintenance plans, etc. as related to the subject Stormwater Facility. The set shall indicate "**RECORD DRAWING**" in large text in the lower right hand corner of each sheet with record elevations, dimensions and data drawn in a clearly annotated format and/or boxed beside design values. Approved design plan values, dimensions and data shall not be removed or erased. Drawing sheet revision blocks shall be modified as required to indicate record drawing status. Elevations to the nearest 0.1' are sufficiently accurate except where higher accuracy is needed to show positive drainage. Certification statements as shown in Section 4 of the Record Drawing and Construction Certification Form, ***or similar forms thereof***, and professional signatures and seals, with dates matching that of the record drawing status in the revision or title block, are also required on all associated record drawing plans, prints or reproducibles.

☑ Submission Requirements. Initial and subsequent submissions for review shall consist of a minimum of one (1) blue/black line set for record drawings and one copy of the construction certification documents with appropriate transmittal. Under certain circumstances, it is understood that the record drawing and construction certification submissions may be performed by different professional firms. Therefore, record drawing submission may be in advance of construction certification or vice versa. Upon approval and prior to release of surety or a Certificate of Occupancy, final submission shall include one (1) reproducible set of the record drawings, one (1) blue/black line set of the record drawings and one (1) copy of the construction certification. Also for current and/or future incorporation into the County BMP database and GIS system, it is requested that the record drawings also be submitted to the Stormwater Division on a diskette or CD-ROM in an acceptable electronic file format such as *.dxf, *.dwg, etc. or in a standard scanned and readable format. The electronic file requirement can be discussed and coordinated with Stormwater Division staff at the time of final submission.

**STORMWATER FACILITY - BMP AND CONVEYANCE SYSTEM**
**RECORD DRAWING CHECKLIST**

***( Key for Checklist is as follows: XX Acceptable N/A Not Applicable Inc Incomplete )***

**I. Methods and Presentation:** *( Required for all Stormwater Management / BMP facilities.)*

XX 1. All constructed facilities meet approved design plans, unless otherwise shown. Record information or deviations from approved design plan shown in clearly annotated format and/or boxed beside design values.

XX 2. Elevations to the nearest 0.1' unless higher accuracy is needed to show positive drainage.

XX 3. All plan sheets labeled with "RECORD DRAWING" in large text in lower right hand corner. Include approved County Plan Number and BMP ID Code if known.

XX 4. All plan sheet revision blocks modified to indicate date and record drawing status.

XX 5. All plan sheets have certification statements and certifying professional's signature and seal.

**II. Minimum Standards:** *(Required for all Stormwater Management / BMP facilities, as applicable.)*

XX 1. All requirements of Section I (Methods and Presentation) apply to this section.

XX 2. Plan Views: Show general location, arrangement and dimensions. Location and alignment shall generally match approved design plans.

XX 3. Profile or elevations along top or berm of the facility. At a minimum, elevations are required at each end, at intervals not to exceed 50 feet and where low spots may be present. Top of embankment or berm elevations must be no less than design elevation plus any settlement allowances.

XX 4. Top widths, berm widths and embankment side slopes.

XX 5. Show length, width and depth of facility or grading, contours or spot elevations as required to verify permanent pool and design storage volumes were met or were reasonably close to the approved design. Evaluation of as-built grading, contours, spot elevations, or cross-sections, may be necessary by the professional to ensure approved design configurations, depths and volumes were closely maintained. If grading or elevations are significantly different from the approved plan, the Stormwater Division shall be contacted immediately to determine whether the variation is acceptable or whether further evidence will be required. Facilities which do not closely resemble approved plan grades, elevations or configurations may require regrading by the Contractor; check volumetric computations; and/or a check hydraulic routing to ensure approved design water surface elevations, discharges or freeboard were closely maintained.

____ 6. Cross-section of the embankment through the principal spillway or outlet barrel. Must extend at least 100 ft. downstream of the pipe outlet or to recorded site property line, whichever is closer. Proper correlation is required between principal spillway (control structure) crest, emergency spillway crest, orifice and weirs and the top of the dam or facility. All elevations and dimensions must reasonably match the design plan or be sequentially relative to each other and the facility must reflect the required design storage

volume(s) and/or design depth.

XX 7. Profile or elevations along the entire centerline of the emergency spillway. Emergency spillway may be steeper, but no flatter or narrower than design.

XX 8. Elevation of the principal spillway crest or outlet crest of the structure.

XX 9. Primary control structure (riser) diameter or dimensions, height, type of material and base size. Indicate provisions for access that are present such as steps, ladders, etc.

XX 10. Dimensions, locations and elevations of outlet orifices, weirs, slots and drains.

XX 11. Type and size of anti-vortex and trash rack device. Height, diameter, dimensions, bar spacings (if applicable) and elevations relative to the principal spillway crest. Indicate if lockable hatch is present or not.

N/A 12. Type, location, size and number of anti-seep collars or documentation of other methods utilized for seepage control. **May need to obtain this information during construction.**

N/A 13. Top of impervious core embankment, core trench limits and elevation of cut-off trench bottom. **May need to obtain this information during construction.**

XX 14. Elevation of the principal spillway barrel (outlet pipe) inlet and outlet invert.

XX 15. Outlet barrel diameter, length, slope, type and thickness class of material and type of flared end sections, headwall or endwall.

XX 16. Outfall protection dimension, type and depth of rock and if underlain filter fabric is present.

XX 17. BMP interior and periphery landscaping zones conform with arrangements and requirements of the approved design plan.

XX 18. Maintenance plan taken from approved design plan transposed onto record drawing set.

N/A 19. Fencing location and type, if applicable to facility.

XX 20. BMP vicinity properly cleaned of stockpiles and construction debris.

XX 21. No visual signs of erosion or channel degradation immediately downstream of facility.

XX 22. Any other information formally requested by the Stormwater Division specific to the constructed Stormwater BMP facility.

**STORMWATER FACILITY - BMP AND CONVEYANCE SYSTEM**
**RECORD DRAWING CHECKLIST**

N/A

***( Key for Checklist is as follows: XX Acceptable N/A Not Applicable Inc Incomplete )***

**III. Group A - Wet Ponds** *( Includes A-1 Small Wet Ponds; A-2 Wet Ponds; A-3 Wet Ext Det Ponds. )*

_____ A1. All requirements of Section II, Minimum Standards, apply to Group A facilities.

_____ A2. Principal spillway consists of reinforced concrete pipe with O-Ring gaskets for watertight joint construction.

_____ A3. Sediment forebays or pretreatment devices provided at inlets to pond. Generally 4 to 6 ft. deep.

_____ A4. Access for maintenance and equipment is provided to the forebay(s). Access corridors are at least 12 ft. wide, have a maximum slope of 15 percent and are adequately stabilized to withstand heavy equipment or vehicle use.

_____ A5. Adequate fixed vertical sediment depth markers installed in the forebay(s) for future sediment monitoring purposes.

_____ A6. Pond liner (if required) provided. Either clay liners, polyliners, bentonite liners or use of chemical soil additives based on requirements of the approved plan.

_____ A7. Minimum 6 percent slope safety bench extending a minimum of 15 feet outward from normal pool edge and/or an aquatic bench extending a minimum of 10 feet inward from the normal shoreline with a maximum depth of 12 inches below the normal pool elevation, if applicable, per the approved design plans. (Note: Safety benches may be waived if pond side slopes are no steeper than 4H:1V).

_____ A8. No trees are present within a zone 15 feet around the embankment toe and 25 feet from the principal spillway structure.

_____ A9. Wet permanent pool, typically 3 to 6 feet deep, is provided and maintains level within facility.

_____ A10. Low flow orifice has a non-clogging mechanism.

_____ A11. A pond drain pipe with valve was provided.

_____ A12. Pond side slopes are not steeper than 3H:1V, unless approved plan allowed for steeper slope.

_____ A13. End walls above barrels (outlet pipe) greater than 48 inch in diameter are fenced to prevent a fall hazard.

**STORMWATER FACILITY - BMP AND CONVEYANCE SYSTEM**
**RECORD DRAWING CHECKLIST**

N/A

***( Key for Checklist is as follows: XX Acceptable N/A Not Applicable Inc Incomplete )***

**IV. Group B – Wetlands** *( Includes B-1 Shallow Marsh; B-2 Ext Det Shallow Wetlands; B-3 Pond Wetland System and B-4 Pocket Wetland)*

_____ B1. Same requirements as Group A Wet Ponds.

_____ B2. Minimum 2:1 length to width flow path provided across the facility.

_____ B3. Micropool provided at or around outlet from BMP (generally 3 to 6 ft. deep).

_____ B4. Wetland type landscaping provided in accordance with approved plan. Includes correct pondscaping zones, plant species, planting arrangements, wetland beds, etc. Wetland plants include 5 to 7 emergent wetland species. Individual plants at 18 inches on center in clumps.

_____ B5. Adequate wetland buffer provided (Typically 25 ft. outward from maximum design water surface elevation and 15 ft. setback to structures).

_____ B6. No more than one-half (½) of the wetland surface area is planted.

_____ B7. Topsoil or wetland mulch provided to support vigorous growth of wetland plants.

_____ B8. Planting zones staked or flagged in field and locations subsequently established by appropriate field surveying methods for record drawing presentation.

**STORMWATER FACILITY - BMP AND CONVEYANCE SYSTEM**
**RECORD DRAWING CHECKLIST**

N/A

***( Key for Checklist is as follows: XX Acceptable N/A Not Applicable Inc Incomplete )***

**V. Group C - Infiltration Practices** *( Includes C-1 Infiltration Trench; C-2 Infiltration Trench; C-3 Infiltration Basin; and C-4 Infiltration Basin )*

_____ C1. All requirements of Section II, Minimum Standards, apply to Group C facilities as applicable.

_____ C2. Facility is not located on fill slopes or on natural ground in excess of six (6) percent.

_____ C3. Pretreatment devices provided prior to entry into the infiltration facility. Acceptable pretreatment devices include sediment forebays, sediment basins, sediment traps, sump pits or inlets, grass channels, plunge pools or other acceptable measures.

_____ C4. Three (3) or more of the following pretreatment devices provided to protect long term integrity of structure: grass channel; grass filter strip; bottom sand layer; upper filter fabric layer; use of washed bank run gravel aggregate.

_____ C5. Sides of infiltration practice lined with filter fabric.

_____ C6. Facility was not used for erosion and sediment control purposes and sediment was prevented from entering the facility to the greatest extent possible during construction.

_____ C7. Stabilization and acceptable vegetative cover established over contributing drainage area prior to conveyance of stormwater to the facility.

_____ C8. Minimum one hundred (100) foot separation horizontally from any known water supply well and minimum one hundred (100) foot separation upslope from any building.

_____ C9. Minimum twenty-five (25) foot separation down gradient from any structure.

_____ C10. Stormwater outfalls provided for overflow associated with larger design storms.

_____ C11. No visual signs of erosion or channel degradation immediately downstream of facility.

_____ C12. Facility does not currently cause any apparent surface or subsurface water problems to downgrade properties.

_____ C13. Observation well provided.

_____ C14. Adequate, direct access provided to the facility for future maintenance, operation and inspection.

**STORMWATER FACILITY - BMP AND CONVEYANCE SYSTEM**
**RECORD DRAWING CHECKLIST**

N/A

***( Key for Checklist is as follows: XX Acceptable N/A Not Applicable Inc Incomplete )***

**VI. Group D - Filtering Systems** *(Includes D-1 Bioretention Cells; D-2 Surface Sand Filters; D-3 Underground Sand Filters; D-4 Perimeter Sand Filters; D-5 Organic Filters; and D-6 Pocket Sand Filters )*

_____ D1. All requirements of Section II, Minimum Standards, apply to Group D facilities.

_____ D2. Sediment pretreatment devices provided.

_____ D3. For D-1 BMPs (Bioretention Cells), pretreatment consisting of a grass filter strip below level spreader (deflector); a gravel diaphragm; and mulch and planting soil layers were provided.

_____ D4. For D-1 BMPs (Bioretention Cells), plantings consist of native plant species; vegetation provided was based on zones of hydric tolerances; trees and understory of shrubs and herbaceous materials were provided; woody vegetation is absent from inflow locations; and trees are located around facility perimeter.

_____ D5. Facility was not used for erosion and sediment control purposes and sediment was prevented from entering the facility to the greatest extent possible during construction.

_____ D6. No visible signs of accumulated silt/sediment were present in the facility following construction or alternately, accumulated silt/sediment was properly removed .

_____ D7. Filtering system is off-line from storm drainage conveyance system.

_____ D8. Overflow outlet has adequate erosion protection.

_____ D9. Deflector, diversion, flow splitter or regulator structure provided to divert the water quality volume to the filtering structure.

_____ D10. Minimum four (4) inch perforated underdrain provided in a clean aggregate envelope layer beneath the facility.

_____ D11. Minimum fifty (50) foot separation from any slope fifteen (15) percent or greater. Minimum one hundred (100) foot separation horizontally from any known water supply well. Minimum one hundred (100) foot separation upslope and twenty-five (25) foot separation downslope from any building.

_____ D12. Stabilization and acceptable vegetative cover established over contributing drainage area prior to conveyance of stormwater to the facility.

_____ D13. No visual signs of erosion or channel degradation immediately downstream of facility.

_____ D14. Adequate, direct access provided to the pretreatment area and/or filter bed for future maintenance.

N/A

**STORMWATER FACILITY - BMP AND CONVEYANCE SYSTEM**
**AS-BUILT PLAN CHECKLIST**

***( Key for Checklist is as follows: XX Acceptable N/A Not Applicable Inc Incomplete )***

**VII. Group E - Open Channel Systems** *(Includes E-1 Wet Swales (Check Dams); E-2 Dry Swales;and E-3 Biofilters )*

_____E1. All requirements of Section II, Minimum Standards, apply to Group E facilities as applicable.

_____E2. Open channel system has constructed longitudinal slope of less than four (4) percent.

_____E3. No visual signs of erosion in the open channel system's soil and/or vegetative cover.

_____E4. Open channel side slopes are no steeper than 2H:1V at any location. Preferred channel sideslope is 3H:1V or flatter.

_____E5. No visual signs of ponding are present at any location in the open channel system, except at rock check dam locations for E-1 systems (Wet Swales).

_____E6. For E-2 BMPs (Dry Swales), an underdrain system was provided.

_____E7. Treated timber or rock check dams provided as pretreatment devices for the open channel system.

_____E8. Gravel diaphragm provided in areas where lateral sheet flow from impervious surfaces are directly connected to the open channel system.

_____E9. Grass cover/stabilization in the open channel system appears adaptable to the specific soils and hydric conditions for the site and along the channel system.

_____E10. Open channel system areas with grass covers higher than four (4) to six (6) inches were properly mowed.

_____E11. Facility was not used for erosion and sediment control purposes and sediment was prevented from entering the facility to the greatest extent possible during construction.

_____E12. No visible signs of accumulated silt/sediment were present in the facility following construction or alternately, accumulated silt/sediment was properly removed and no adverse affects to the function of the facility are anticipated.

_____E13. For E-3 BMPs (Biofilters), the bottom width is six (6) feet maximum at any location.

_____E14. For E-3 BMPs (Biofilters), sideslopes are 3H:1V maximum at any location.

_____E15. For E-3 BMPs (Biofilters), the constructed channel slope is less than or equal to three (3) percent at any location.

_____E16. For E-3 BMPs (Biofilters), the constructed grass channel is approximately equivalent to the constructed roadway length.

**STORMWATER FACILITY - BMP AND CONVEYANCE SYSTEM**
**RECORD DRAWING CHECKLIST**

***( Key for Checklist is as follows: XX Acceptable N/A Not Applicable Inc Incomplete )***

**VIII. Group F - Extended Dry Detention** *(Includes F-1 Timber Walls; and F-2 Dry Extended Detention with Forebay )*

XX F1. All requirements of Section II, Minimum Standards, apply to Group F facilities.

XX F2. Basin bottom has positive slope and drainage from all basin inflow points to the riser (or outflow) location.

N/A F3. Timber wall BMP used in intermittent stream only. (ie. Prohibited in perennial streams.)

N/A F4. Forebay provided approximately 20 ft. upstream of the facility. Forebays generally 4 to 6 feet in depth.

XX F5. A reverse slope pipe, vertical stand pipe or mini-barrel and riser was provided to prevent clogging.

XX F6. Principal spillway and outlet barrel provided consisting of reinforced concrete pipe with O-Ring gaskets for watertight joint construction.

N/A F7. Mini-barrel and riser, if used, contains a removable trash rack to reduce clogging.

XX F8. Low flow orifice, if used, has a minimum diameter of three (3) inches or two (2) inches if internal orifice control was utilized and a small, cage type external trash rack.

N/A F9. Timbers properly reinforced or concrete footing provided if soil conditions were prohibitive.

N/A F10. Timber wall cross members extended to a minimum depth of two (2) feet below ground elevation.

N/A F11. Protection against erosion and scour from the low flow orifice and weir-flow trajectory provided.

XX F12. Stilling basin or standard outlet protection provided at principal spillway outlet.

XX F13. Adequate, direct access provided to the facility. Access corridor to facility is at least ten (10) feet wide, slope is less than twenty (20) percent and appropriate stabilization provided for equipment and vehicle use. Access extends to forebay, standpipe and timber wall, as applicable.

XX F14. No visual signs of undercutting of timber walls or clogging of the low orifice were present.

XX F15. No visual signs of erosion or channel degradation immediately downstream of facility.

XX F16. No visible signs of accumulated silt/sediment were present in the facility following construction or alternately, accumulated silt/sediment was properly removed and no adverse affects to the function of the facility are anticipated.

N/A

**STORMWATER FACILITY - BMP AND CONVEYANCE SYSTEM**
**RECORD DRAWING CHECKLIST**

***( Key for Checklist is as follows: XX Acceptable N/A Not Applicable Inc Incomplete )***

**IX. Group G - Open Spaces** *(Includes All Open Space Types G-1; G-2; and G-3 )*

_____G1. All requirements of Section II, Minimum Standards, apply to Group G facilities as applicable.

_____G2. Constructed impervious areas appear to conform with locations indicated on the approved plan and appear less than sixty (60) percent impervious in accordance with the requirements of the James City County Chesapeake Bay Preservation Ordinance.

_____G3. Dedicated open space areas are in undisturbed common areas, conservation easements or are protected by other enforceable instruments that ensures perpetual protection.

_____G4. Provisions included to clearly specify how the natural vegetated areas utilized as dedicated open space will be managed and field identified (marked).

_____G5. Adequate protection measures were implemented during construction to protect the defined dedicated open space areas.

_____G6. Dedicated open space areas were not disturbed during construction (ie. cleared, grubbed or graded).

**STORMWATER FACILITY - BMP AND CONVEYANCE SYSTEM**
**RECORD DRAWING CHECKLIST**

N/A

***( Key for Checklist is as follows: XX Acceptable N/A Not Applicable Inc Incomplete )***

**X. Storm Drainage Systems, closed and open**

*(Includes all stormwater drainage conveyance systems such as onsite or offsite storm drains, open channels, inlets, manholes, junctions, outlet protections, deflectors, etc. The intent of this portion of the certification is toensure the drainage conveyance facilities are constructed in accordance with the construction plans and specifications so that they convey the desing flow levels and don not require excessive maintenance.)*

_____SD1. All requirements of Section II, Minimum Standards, apply to Storm Conveyance systems.

_____SD2. Horizontal location of all pipes, structures and channels relative to the approved plan.

_____SD3. Type, top elevation and invert elevation of all closed system access structures (inlets, manholes, etc.).

_____SD4. Material type, size or diameter, class, invert elevations, lengths and slopes for all closed pipe segments.

_____SD5. Channel cross-section and invert elevations at 100 foot intervals. Channel liners as specified on the construction plans.

_____SD6. Class, length, width and depth of riprap and outlet protections or dimensions of special energy dissipation structures.

**XII. Other Systems** *(Includes any non-typical, specialty, manufactured or innovative stormwater management BMP practices or systems generally accepted for use as or in conjunction with other acceptable stormwater management BMP practices. Requires evidence of prior satisfactory industry use and prior Environmental Division approval, waiver or exception.)*

_____O1. All requirements of Section II, Minimum Standards, apply to this section.

_____O2. Certification criteria to be determined on a case-by-case basis by the Stormwater Division specific to the proposed SWM/BMP facility.

**STORMWATER MANAGEMENT / BMP FACILITIES**
**RECORD DRAWING CHECKLIST**

**XIII. <u>References</u>** *(The James City County Record Drawing and Construction Certification Forms and Checklists for Stormwater Management / BMP facilities were developed using the following sources and references. )*


- ☐ Baltimore County, Maryland Soil Conservation District, As-Built Stormwater Management Pond Checklist.
- ☐ James City County, Virginia, Guidelines for Design and Construction of Stormwater Management BMP's (October 1999).
- ☐ James City County, Virginia, Stormwater Detention/Retention Basin Design Checklist and Erosion and Sediment Control and Stormwater Management Design Plan Checklists.
- ☐ James City County Stormwater Policy Framework, Final Report of the James City County BMP Policy Project, October 1998, The Center for Watershed Protection.
- ☐ Prince Georges County, Maryland, As-Built Requirements Retention or Detention Pond/Basin.
- ☐ Prince William County, Virginia, Stormwater Management Fact Sheet.
- ☐ Stafford County, Virginia, As-Built Plan Checklist.
- ☐ Stormwater Management Design Manual, NRCS Maryland Code No. 378, Pond Standards and Specifications.
- ☐ USEPA/Watershed Management Institute, Stormwater Management Inspection Forms.
- ☐ Virginia Impounding Structure Regulations (Dam Safety), Department of Conservation & Recreation, 1997.
- ☐ Virginia Erosion and Sediment Control Handbook, Third Edition 1992, Virginia Department of Conservation and Recreation, Division of Soil and Water Conservation.
- ☐ Virginia Stormwater Management Handbook, 1999 edition, Virginia Department of Conservation and Recreation, Division of Soil and Water Conservation.


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# Stormwater Management/BMP Facilities
# Record Drawing and Construction Certification Forms

***(Note: In accordance with the requirements of the Chesapeake Bay Preservation Ordinance, Chapter 23, Section 23-10(4), BMP's shall be designed and constructed in accordance with the manual entitled James City County Guidelines for Design and Construction of Stormwater Management BMP's. Erosion and sediment control policy and approved plans generally require that at the completion of the project and prior to release of surety, an "as-built" plan prepared by a registered Professional Engineer or Certified Land Surveyor must be provided for the drainage system for the project, including any Best Management Practice (BMP) facilities. In addition, for BMP facilities involving the construction of an impounding structure or dam embankment, certification is required by a Professional Engineer who has inspected the structure during its construction. Currently there are over 20 water quality BMP's accepted by the County.)***

Environmental Division

NOV 20 2013

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**Section 1 - Site Information:**

Project Name: Stonehouse Glen BMP Outfall Repair
Structure/BMP Name: WC092 - Ashcock Court
Project Location: 9304 Stonehouse Glen, Toano, Virginia
BMP Location: Ashcock Court
County Plan No.: SP-0058-2012

Project Type:
- [x] Residential
- [ ] Commercial
- [ ] Institutional
- [ ] Public
- [ ] Other
- [ ] Business
- [ ] Office
- [ ] Industrial
- [ ] Roadway

Tax Map/Parcel No.: 0540400001C
BMP ID Code (if known): WC092
Zoning District: PR PUD Residential
Land Use: BMP
Site Area (sf or acres):

Brief Description of Stormwater Management/BMP Facility:
The record drawings have been prepared for the the WC092 BMP outfall repair. The repair included the stilling basin and four step pool structures.

Nearest Visible Landmark to SWM/BMP Facility:

Nearest Vertical Ground Control (if known):

- [x] JCC Geodetic Ground Control
- [ ] USGS
- [ ] Temporary
- [ ] Arbitrary
- [ ] Other

Station Number or Name: 340
Datum or Reference Elevation: NGVD (29) 123.2
Control Description: JCC Geodetic Ground Monument, Disk in Concrete
Control Location from Subject Facility:
5,000' (feet)

**Section 2 - Stormwater Management/BMP Facility Construction Information:**

Pre-Construction Meeting Held for Construction of SWM/BMP Facility: ☑ Yes ☐ No ☐ Unknown
Approx. Construction Start Date for SWM/BMP Facility: 10/14/2013
Facility Monitored by County Representative during Construction: ☐ Yes ☑ No ☐ Unknown
Name of Site Work Contractor Who Constructed Facility: CA Barrs
Name of Professional Firm Who Routinely Monitored Construction: VHB, Inc.
Date of Completion for SWM/BMP Facility: 10/25/2013
Date of Record Drawing/Construction Certification Submittal: 11/13/2013

***(Note: Record Drawing and Construction Certifications are required within thirty (30) days of the completion of Stormwater Management and/or BMP facility construction. Record Drawings and Construction Certifications must be reviewed and approved by the James City County Engineering and Resource Protection Division prior to final inspection, acceptance and bond or surety release.)***

**Section 3 - Owner/Designer/Contractor Information:**

Owner/Developer: *(Note: Site Owner or Applicant responsible for development of the project.)*

Name: Stonehouse Glen, LLC / Glen Venture
Mailing Address: PO Box 61 Gladstone, NY 07934

Business Phone: 908 234 2620 x 227 Fax: 908 234 9508
Contact Person: Mr. Ken McDermott Title: _____

Design Professional: *(Note: Professional Engineer or Certified Land Surveyor responsible for the design and preparation of plans and specifications for the Stormwater Management / BMP facility.)*

Firm Name: Vanasse Hangen Brustlin, Inc.
Mailing Address: 351 McLaws Circle, Suite 3
Williamsburg, VA 23185
Business Phone: 757 220 0500
Fax: 757 220 8544
Responsible Plan Preparer: Joseph F. Caterino, Jr. PE
Title: Senior Water Resources Engineer
Plan Name: BMP Outfall Repair Record Drawings
Firm's Project No. 33315.01
Plan Date: 11/13/13
Sheet No.'s Applicable to SWM/BMP Facility: _____ / _____ / _____ / _____ / _____

BMP Contractor: *(Note: Site Work Contractor directly responsible for construction of the Stormwater Management/BMP facility.)*

Firm Name: CA Barrs
Mailing Address: PO Box 1489
Yorktown, VA 23692
Business Phone: 757 898 7282

Fax: 757 898 1282
Contact Person: Mr. Scott St. Clair
Site Foreman/Supervisor: Mr. Scott St. Clair
Specialty Subcontractors and Purpose (for BMP Construction Only):

**Section 4 - Professional Certifications:**

Certifying Professionals: *(Note: A Registered Professional Engineer or Certified Land Surveyor is responsible for preparation of a Record Drawing, sometimes referred to as an As-Built plan, for the drainage system for the project including any Stormwater Management/BMP Facilities. A Registered Professional Engineer is responsible for the inspection, monitoring and certification of Stormwater Management / BMP facilities during its construction.)*

**Record Drawing and Construction Certifications for Stormwater Management/BMP Facilities**

**Record Drawing Certification**

Firm Name: VHB, Inc
Mailing Address: 351 McLaws Circle
Williamsburg, VA 23185
Business Phone: 757 220 0500
Fax: 757 220 8544
Name: Stephen Romeo
Title: Principal
Signature: Stephen Romeo
Date: 11/19/13

I hereby certify to the best of my knowledge and belief that this record drawing represents the actual condition of the Stormwater Management/BMP facility. The facility appears to conform to the provisions of the approved design plan, specifications design, and stormwater management plan, except as specifically noted.

COMMONWEALTH OF VIRGINIA
11/19/13
STEPHEN A. ROMEO
Lic. No. 1448-B
Stephen Romeo
LAND SURVEYOR

(Seal)

Virginia Registered Professional Engineer or Certified Land Surveyor

**Construction Certification**

Firm Name: VHB, Inc.
Mailing Address: 351 McLaws Circle
Williamsburg, VA 23185
Business Phone: 757 220 0500
Fax: 757 220 8544
Name: Joseph F. Caterino, Jr. PE
Title: Senior Water Resources Engineer
Signature:
Date:

I hereby certify to the best of my knowledge and belief that this Stormwater Management/BMP facility was monitored and constructed in accordance with the provisions of the approved plan, specifications, and stormwater management plan, except as specifically noted.

*The lower step pool structures from Station 09+38 to Station 08+98, where we were not under contractual obligation to provide construction oversight, and while staff was not present during construction, visual observations reveal that to the best of my knowledge and understanding, materials and appurtenances appear to have been installed generally in accordance with the approved plans and specifications. VHB, Inc. provided the construction oversight for the rebuild of the stilling basin and upper step pool structures from Station 10+00 to 09+48 and based on visual observations these materials and appurtenances have been installed in accordance with the approved plans and specifications.*

COMMONWEALTH OF VIRGINIA
11/19/13
JOSEPH F. CATERINO JR.
No. 0[illegible]
PROFESSIONAL ENGINEER

(Seal)

Virginia Registered Professional Engineer

**Section 5 - Record Drawing and Construction Certification Requirements and Instructions:**

☑ Pre-Construction Meeting - Provides an opportunity to review SWM/BMP facility construction, maintenance and operation plans and addresses any questions regarding construction and/or monitoring of the structure. The design engineer, certifying professionals (if different), Owner/Applicant, Contractor and County representative(s) are encouraged to attend the preconstruction meeting. Advanced notice to the Engineering and Resource Protection Division is requested. Usually, this requirement can be met simultaneously with Erosion and Sediment Control preconstruction meetings held for the project.

☑ A fully completed ***STORMWATER MANAGEMENT / BMP FACILITIES, RECORD DRAWING and CONSTRUCTION CERTIFICATION FORM*** and ***RECORD DRAWING CHECKLIST***. All applicable sections shall be completed in their entirety and certification statements signed and sealed by the registered professional responsible for individual record drawing and/or construction certification.

☑ The Record Drawing shall be prepared by a Registered Professional Engineer or Certified Land Surveyor for the drainage system of the project including any Best Management Practices.

☐ Construction Certification - Construction of Stormwater Management / BMP facilities which contain impoundments, embankments and related engineered appurtenances including subgrade preparation, compacted soils, structural fills, liners, geosynthetics, filters, seepage controls, cutoffs, toe drains, hydraulic flow control structures, etc. shall be visually observed and monitored by a Registered Professional Engineer or his/her authorized representative. The Engineer must certify that the structure, embankment and associated appurtenances were built in accordance with the approved design plan, specifications and stormwater management plan and standard accepted construction practice and shall submit a written certification and/or drawings to the Engineering and Resource Protection Division as required. Soil and compaction test reports, concrete test reports, inspection reports, logs and other required construction material or installation documentation may be required by the Engineering and Resource Protection Division to substantiate the certification, if specifically requested. The Engineer shall have the authority and responsibility to make minor changes to the approved plan, in coordination with the assigned County inspector, in order to compensate for unsafe or unusual conditions encountered during construction such as those related to bedrock, soils, groundwater, topography, etc. as long as changes do not adversely affect the integrity of the structure(s). Major changes to the approved design plan or structure must be reviewed and approved by the original design professional and the James City County Environmental Division.

☑ Record Drawing and Construction Certifications are required within **thirty (30) days** of the completion of Stormwater Management / BMP facility construction. Submittals must be reviewed and accepted by James City County Engineering and Resource Protection Division prior to final inspection, acceptance and bond/surety release.

**Dual Purpose Facilities** - Completion of construction also includes an interim stage for Stormwater Management / BMP facilities which serve dual purpose as temporary sediment basins during construction and as permanent stormwater management / BMP facilities following construction, once development and stabilization are substantially complete. For these dual purpose facilities, construction certification is required once the temporary sediment basin phase of construction is complete. Final record drawing and construction certification of additional permanent components is required once permanent facility construction is complete.

*Interim Construction Certification* is required for those dual purpose embankment-type facilities that are generally ten (10) feet or greater in dam height (*) and may not be converted, modified or begin function as a permanent SWM / BMP structure for a period generally ranging from six (6) to eighteen (18) months or more from issuance of a Land Disturbance permit for construction.

Interim or final record drawing and construction certifications are not required for temporary sediment basins which are designed and constructed in accordance with current minimum standards and specifications for temporary sediment basins per the Virginia Erosion and Sediment Control Handbook (VESCH); have a temporary service life of less than eighteen (18) months; and will be removed completely once associated disturbed areas are stabilized, unless a distinct hazard to the public's health, safety and welfare is determined by the Engineering and Resource Protection Division due to the size or presence of the structure or due to evidence of improper construction.

(*Note: Dam Height as referenced above is generally defined as the vertical distance from the natural bed of the stream or waterway at the downstream toe of the embankment to the top of the embankment structure in accordance with 4VAC50-20-30, Virginia Impoundment Structure Regulations and the Virginia Dam Safety Program.)

☑ Record Drawings shall provide, at a minimum, all information as shown within these requirements and the attached **RECORD DRAWING CHECKLIST** specific to the type of SWM/BMP facility being constructed. Other additional record data may be formally requested by the James City County Engineering and Resource Protection Division. *(Note: Refer to the current edition of the James City County Guidelines for Design and Construction of Stormwater Management BMP's manual for a complete list of acceptable BMP's. Currently there are over 20 acceptable water quality type BMP's accepted by the County.)*

☑ Record Drawings shall consist of blue/black line prints and a reproducible (mylar, sepia, diazo, etc.) set of the approved stormwater management plan including applicable plan views, profiles, sections, details, maintenance plans, etc. as related to the subject SWM / BMP facility. The set shall indicate **"RECORD DRAWING "** in large text in the lower right hand corner of each sheet with record elevations, dimensions and data drawn in a clearly annotated format and/or boxed beside design values. Approved design plan values, dimensions and data shall not be removed or erased. Drawing sheet revision blocks shall be modified as required to indicate record drawing status. Elevations to the nearest 0.1' are sufficiently accurate except where higher accuracy is needed to show positive drainage. Certification statements as shown in Section 4 of the Record Drawing and Construction Certification Form, ***or similar forms thereof***, and professional signatures and seals, with dates matching that of the record drawing status in the revision or title block, are also required on all associated record drawing plans, prints or reproducibles.

☑ Submission Requirements - Initial and subsequent submissions for review shall consist of a minimum of one (1) blue/black line set for record drawings and one copy of the construction certification documents with appropriate transmittal. Under certain circumstances, it is understood that the record drawing and construction certification submissions may be performed by different professional firms. Therefore, record drawing submission may be in advance of construction certification or vice versa. Upon approval and prior to release of bond/surety, final submission shall include one (1) reproducible set of the record drawings, one (1) blue/black line set of the record drawings and one (1) copy of the construction certification. Also for current and/or future incorporation into the County BMP database and GIS system,

it is requested that the record drawings also be submitted to the Engineering and Resource Protection Division on a diskette or CD-ROM in an acceptable electronic file format such as *.dxf, *.dwg, etc. or in a standard scanned and readable format. The electronic file requirement can be discussed and coordinated with Engineering and Resource Protection Division staff at the time of final submission.

## STORMWATER MANAGEMENT/BMP FACILITIES
## RECORD DRAWING CHECKLIST

***(Key for Checklist is as follows: XX Acceptable N/A Not Applicable Inc Incomplete)***

**I. Methods and Presentation:** *(Required for all Stormwater Management/BMP facilities.)*

XX 1. All constructed facilities meet approved design plans, unless otherwise shown. Record information or deviations from approved design plan shown in clearly annotated format and/or boxed beside design values.

XX 2. Elevations to the nearest 0.1' unless higher accuracy is needed to show positive drainage.

XX 3. All plan sheets labeled with "RECORD DRAWING" in large text in lower right hand corner. (Approved County Plan Number and BMP ID Code can be included if known).

XX 4. All plan sheet revision blocks modified to indicate date and record drawing status.

XX 5. All plan sheets have certification statements and certifying professional's signature and seal.

**II. Minimum Standards:** *(Required for all Stormwater Management / BMP facilities, as applicable.)*

XX 1. All requirements of Section I (Methods and Presentation) apply to this section.

XX 2. Plan Views: Show general location, arrangement and dimensions. Location and alignment shall generally match approved design plans.

XX 3. Profile or elevations along top or berm of the facility. At a minimum, elevations are required at each end, at intervals not to exceed 50 feet and where low spots may be present. Top of embankment or berm elevations must be no less than design elevation plus any settlement allowances.

XX 4. Top widths, berm widths, and embankment side slopes.

XX 5. Show length, width and depth of facility or grading, contours or spot elevations as required to verify permanent pool and design storage volumes were met or were reasonably close to the approved design. Evaluation of as-built grading, contours, spot elevations, or cross-sections, may be necessary by the professional to ensure approved design configurations, depths and volumes were closely maintained. If grading or elevations are significantly different from the approved plan, the Engineering and Resource Protection Division shall be contacted immediately to determine whether the variation is acceptable or whether further evidence will be required. Facilities which do not closely resemble approved plan grades, elevations or configurations may require regrading by the Contractor; check volumetric computations; and/or a check hydraulic routing to ensure approved design water surface elevations, discharges or freeboard were closely maintained.

N/A 6. Cross-section of the embankment through the principal spillway or outlet barrel. Must extend at least 100 ft. downstream of the pipe outlet or to recorded site property line, whichever is closer. Proper correlation is required between principal spillway (control structure) crest, emergency spillway crest, orifice, and weirs and the top of the dam or facility. All elevations and dimensions must reasonably match the design plan or be sequentially relative to each other and the facility must reflect the required design storage volume(s) and/or design depth.

N/A 7. Profile or elevations along the entire centerline of the emergency spillway. Emergency spillway may be steeper, but no flatter or narrower than design.

N/A 8. Elevation of the principal spillway crest or outlet crest of the structure.

N/A 9. Primary control structure (riser) diameter or dimensions, height, type of material and base size. Indicate provisions for access that are present such as steps, ladders, etc.

N/A 10. Dimensions, locations and elevations of outlet orifices, weirs, slots and drains.

N/A 11. Type and size of anti-vortex and trash rack device. Height, diameter, dimensions, bar spacings (if applicable) and elevations relative to the principal spillway crest. Indicate if lockable hatch is present or not.

N/A 12. Type, location, size, and number of anti-seep collars or documentation of other methods utilized for seepage control. **May need to obtain this information during construction.**

N/A 13. Top of impervious core embankment, core trench limits and elevation of cut-off trench bottom. **May need to obtain this information during construction.**

N/A 14. Elevation of the principal spillway barrel (outlet pipe) inlet and outlet invert.

N/A 15. Outlet barrel diameter, length, slope, type, and thickness class of material and type of flared end sections, headwall or endwall.

XX 16. Outfall protection dimension, type and depth of rock and if underlain filter fabric is present.

XX 17. BMP interior and periphery landscaping zones conform with arrangements and requirements of the approved design plan.

N/A 18. Maintenance plan taken from approved design plan transposed onto record drawing set.

N/A 19. Fencing location and type, if applicable to facility.

XX 20. BMP vicinity properly cleaned of stockpiles and construction debris.

XX 21. No visual signs of erosion or channel degradation immediately downstream of facility.

XX 22. Any other information formally requested by the Environmental Division specific to the constructed SWM/BMP facility.

## STORMWATER MANAGEMENT/BMP FACILITIES RECORD DRAWING CHECKLIST

N/A

***(Key for Checklist is as follows: XX Acceptable N/A Not Applicable Inc Incomplete)***

**III. Group A - Wet Ponds** *(Includes A-1 Small Wet Ponds; A-2 Wet Ponds; A-3 Wet Ext Det Ponds.)*

_____ A1. All requirements of Section II, Minimum Standards, apply to Group A facilities.

_____ A2. Principal spillway consists of reinforced concrete pipe with O-Ring gaskets for watertight joint construction.

_____ 3. Sediment forebays or pretreatment devices provided at inlets to pond. Generally 4 to 6 ft. deep.

_____ A4. Access for maintenance and equipment is provided to the forebay(s). Access corridors are at least 12 ft. wide, have a maximum slope of 15 percent and are adequately stabilized to withstand heavy equipment or vehicle use.

_____ A5. Adequate fixed vertical sediment depth markers installed in the forebay(s) for future sediment monitoring purposes.

_____ A6. Pond liner (if required) provided. Either clay liners, polyliners, bentonite liners or use of chemical soil additives based on requirements of the approved plan.

_____ A7. Minimum 6 percent slope safety bench extending a minimum of 15 feet outward from normal pool edge and/or an aquatic bench extending a minimum of 10 feet inward from the normal shoreline with a maximum depth of 12 inches below the normal pool elevation, if applicable, per the approved design plans. (Note: Safety benches may be waived if pond side slopes are no steeper than 4H:1V).

_____ A8. No trees are present within a zone 15 feet around the embankment toe and 25 feet from the principal spillway structure.

_____ A9. Wet permanent pool, typically 3 to 6 feet deep, is provided and maintains level within facility.

_____ A10. Low flow orifice has a non-clogging mechanism.

_____ A11. A pond drain pipe with valve was provided.

_____ A12. Pond side slopes are not steeper than 3H:1V, unless approved plan allowed for steeper slope.

_____ A13. End walls above barrels (outlet pipe) greater than 48 inch in diameter are fenced to prevent a fall hazard.

**STORMWATER MANAGEMENT/BMP FACILITIES**
**RECORD DRAWING CHECKLIST**

N/A

***(Key for Checklist is as follows: XX Acceptable N/A Not Applicable Inc Incomplete)***

**IV. Group B – Wetlands** *(Includes B-1 Shallow Marsh; B-2 Ext Det Shallow Wetlands; B-3 Pond Wetland System and B-4 Pocket Wetland)*

_____ B1. Same requirements as Group A Wet Ponds.

_____ B2. Minimum 2:1 length to width flow path provided across the facility.

_____ B3. Micropool provided at or around outlet from BMP (generally 3 to 6 ft. deep).

_____ B4. Wetland type landscaping provided in accordance with approved plan. Includes correct pondscaping zones, plant species, planting arrangements, wetland beds, etc. Wetland plants include 5 to 7 emergent wetland species. Individual plants at 18 inches on center in clumps.

_____ B5. Adequate wetland buffer provided (Typically 25 ft. outward from maximum design water surface elevation and 15 ft. setback to structures).

_____ B6. No more than one-half (½) of the wetland surface area is planted.

_____ B7. Topsoil or wetland mulch provided to support vigorous growth of wetland plants.

_____ B8. Planting zones staked or flagged in field and locations subsequently established by appropriate field surveying methods for record drawing presentation.

**STORMWATER MANAGEMENT/BMP FACILITIES**
**RECORD DRAWING CHECKLIST**

N/A

***(Key for Checklist is as follows: XX Acceptable N/A Not Applicable Inc Incomplete)***

**V. Group C - Infiltration Practices** *(Includes C-1 Infiltration Trench; C-2 Infiltration Trench; C-3 Infiltration Basin; and C-4 Infiltration Basin)*

_____ C1. All requirements of Section II, Minimum Standards, apply to Group C facilities as applicable.

_____ C2. Facility is not located on fill slopes or on natural ground in excess of six (6) percent.

_____ C3. Pretreatment devices provided prior to entry into the infiltration facility. Acceptable pretreatment devices include sediment forebays, sediment basins, sediment traps, sump pits or inlets, grass channels, plunge pools or other acceptable measures.

_____ C4. Three (3) or more of the following pretreatment devices provided to protect long term integrity of structure: grass channel; grass filter strip; bottom sand layer; upper filter fabric layer; use of washed bank run gravel aggregate.

_____ C5. Sides of infiltration practice lined with filter fabric.

_____ C6. Facility was not used for erosion and sediment control purposes and sediment was prevented from entering the facility to the greatest extent possible during construction.

_____ C7. Stabilization and acceptable vegetative cover established over contributing drainage area prior to conveyance of stormwater to the facility.

_____ C8. Minimum one hundred (100) foot separation horizontally from any known water supply well and minimum one hundred (100) foot separation upslope from any building.

_____ C9. Minimum twenty-five (25) foot separation down gradient from any structure.

_____ C10. Stormwater outfalls provided for overflow associated with larger design storms.

_____ C11. No visual signs of erosion or channel degradation immediately downstream of facility.

_____ C12. Facility does not currently cause any apparent surface or subsurface water problems to downgrade properties.

_____ C13. Observation well provided.

_____ C14. Adequate, direct access provided to the facility for future maintenance, operation and inspection.

**STORMWATER MANAGEMENT/BMP FACILITIES**
**RECORD DRAWING CHECKLIST** N/A

***(Key for Checklist is as follows: XX Acceptable N/A Not Applicable Inc Incomplete)***

**VI. Group D - Filtering Systems** *(Includes D-1 Bioretention Cells; D-2 Surface Sand Filters; D-3 Underground Sand Filters; D-4 Perimeter Sand Filters; D-5 Organic Filters; and D-6 Pocket Sand Filters)*

_____ D1. All requirements of Section II, Minimum Standards, apply to Group D facilities.

_____ D2. Sediment pretreatment devices provided.

_____ D3. For D-1 BMPs (Bioretention Cells), pretreatment consisting of a grass filter strip below level spreader (deflector); a gravel diaphragm; and mulch and planting soil layers were provided.

_____ D4. For D-1 BMPs (Bioretention Cells), plantings consist of native plant species; vegetation provided was based on zones of hydric tolerances; trees and understory of shrubs and herbaceous materials were provided; woody vegetation is absent from inflow locations; and trees are located around facility perimeter.

_____ D5. Facility was not used for erosion and sediment control purposes and sediment was prevented from entering the facility to the greatest extent possible during construction.

_____ D6. No visible signs of accumulated silt/sediment were present in the facility following construction or alternately, accumulated silt/sediment was properly removed.

_____ D7. Filtering system is off-line from storm drainage conveyance system.

_____ D8. Overflow outlet has adequate erosion protection.

_____ D9. Deflector, diversion, flow splitter or regulator structure provided to divert the water quality volume to the filtering structure.

_____ D10. Minimum four (4) inch perforated underdrain provided in a clean aggregate envelope layer beneath the facility.

_____ D11. Minimum fifty (50) foot separation from any slope fifteen (15) percent or greater. Minimum one hundred (100) foot separation horizontally from any known water supply well. Minimum one hundred (100) foot separation upslope and twenty-five (25) foot separation downslope from any building.

_____ D12. Stabilization and acceptable vegetative cover established over contributing drainage area prior to conveyance of stormwater to the facility.

_____ D13. No visual signs of erosion or channel degradation immediately downstream of facility.

_____ D14. Adequate, direct access provided to the pretreatment area and/or filter bed for future maintenance.

**STORMWATER MANAGEMENT/BMP FACILITIES**
**AS-BUILT PLAN CHECKLIST** N/A

***(Key for Checklist is as follows: XX Acceptable N/A Not Applicable Inc Incomplete)***

**VII. Group E - Open Channel Systems** *(Includes E-1 Wet Swales (Check Dams); E-2 Dry Swales; and E-3 Biofilters)*

_____ E1. All requirements of Section II, Minimum Standards, apply to Group E facilities as applicable.

_____ E2. Open channel system has constructed longitudinal slope of less than four (4) percent.

_____ E3. No visual signs of erosion in the open channel system's soil and/or vegetative cover.

_____ E4. Open channel side slopes are no steeper than 2H:1V at any location. Preferred channel sideslope is 3H:1V or flatter.

_____ E5. No visual signs of ponding are present at any location in the open channel system, except at rock check dam locations for E-1 systems (Wet Swales).

_____ E6. For E-2 BMPs (Dry Swales), an underdrain system was provided.

_____ E7. Treated timber or rock check dams provided as pretreatment devices for the open channel system.

_____ E8. Gravel diaphragm provided in areas where lateral sheet flow from impervious surfaces are directly connected to the open channel system.

_____ E9. Grass cover/stabilization in the open channel system appears adaptable to the specific soils and hydric conditions for the site and along the channel system.

_____ E10. Open channel system areas with grass covers higher than four (4) to six (6) inches were properly mowed.

_____ E11. Facility was not used for erosion and sediment control purposes and sediment was prevented from entering the facility to the greatest extent possible during construction.

_____ E12. No visible signs of accumulated silt/sediment were present in the facility following construction or alternately, accumulated silt/sediment was properly removed and no adverse affects to the function of the facility are anticipated.

_____ E13. For E-3 BMPs (Biofilters), the bottom width is six (6) feet maximum at any location.

_____ E14. For E-3 BMPs (Biofilters), sideslopes are 3H:1V maximum at any location.

_____ E15. For E-3 BMPs (Biofilters), the constructed channel slope is less than or equal to three (3) percent at any location.

_____ E16. For E-3 BMPs (Biofilters), the constructed grass channel is approximately equivalent to the constructed roadway length.

## STORMWATER MANAGEMENT/BMP FACILITIES RECORD DRAWING CHECKLIST

N/A

*(Key for Checklist is as follows: XX Acceptable N/A Not Applicable Inc Incomplete)*

**VIII. Group F - Extended Dry Detention** *(Includes F-1 Timber Walls; and F-2 Dry Extended Detention with Forebay)*

_____ F1. All requirements of Section II, Minimum Standards, apply to Group F facilities.

_____ F2. Basin bottom has positive slope and drainage from all basin inflow points to the riser (or outflow) location.

_____ F3. Timber wall BMP used in intermittent stream only. (ie. Prohibited in perennial streams.)

_____ F4. Forebay provided approximately 20 ft. upstream of the facility. Forebays generally 4 to 6 feet in depth.

_____ F5. A reverse slope pipe, vertical stand pipe or mini-barrel and riser was provided to prevent clogging.

_____ F6. Principal spillway and outlet barrel provided consisting of reinforced concrete pipe with O-Ring gaskets for watertight joint construction.

_____ F7. Mini-barrel and riser, if used, contains a removable trash rack to reduce clogging.

_____ F8. Low flow orifice, if used, has a minimum diameter of three (3) inches or two (2) inches if internal orifice control was utilized and a small, cage type external trash rack.

_____ F9. Timbers properly reinforced or concrete footing provided if soil conditions were prohibitive.

_____ F10. Timber wall cross members extended to a minimum depth of two (2) feet below ground elevation.

_____ F11. Protection against erosion and scour from the low flow orifice and weir-flow trajectory provided.

_____ F12. Stilling basin or standard outlet protection provided at principal spillway outlet.

_____ F13. Adequate, direct access provided to the facility. Access corridor to facility is at least ten (10) feet wide; slope is less than twenty (20) percent and appropriate stabilization provided for equipment and vehicle use. Access extends to forebay, standpipe and timber wall, as applicable.

_____ F14. No visual signs of undercutting of timber walls or clogging of the low orifice were present.

_____ F15. No visual signs of erosion or channel degradation immediately downstream of facility.

_____ F16. No visible signs of accumulated silt/sediment were present in the facility following construction or alternately, accumulated silt/sediment was properly removed and no adverse affects to the function of the facility are anticipated.

**STORMWATER MANAGEMENT/BMP FACILITIES**
**RECORD DRAWING CHECKLIST**

N/A

***(Key for Checklist is as follows: XX Acceptable N/A Not Applicable Inc Incomplete)***

**IX. Group G - Open Spaces** *(Includes All Open Space Types G-1; G-2; and G-3)*

_____ G1. All requirements of Section II, Minimum Standards, apply to Group G facilities as applicable.

_____ G2. Constructed impervious areas appear to conform with locations indicated on the approved plan and appear less than sixty (60) percent impervious in accordance with the requirements of the James City County Chesapeake Bay Preservation Ordinance.

_____ G3. Dedicated open space areas are in undisturbed common areas, conservation easements or are protected by other enforceable instruments that ensure perpetual protection.

_____ G4. Provisions included to clearly specify how the natural vegetated areas utilized as dedicated open space will be managed and field identified (marked).

_____ G5. Adequate protection measures were implemented during construction to protect the defined dedicated open space areas.

_____ G6. Dedicated open space areas were not disturbed during construction (ie. cleared, grubbed or graded).

**STORMWATER MANAGEMENT/BMP FACILITIES**
**RECORD DRAWING CHECKLIST** N/A

***(Key for Checklist is as follows: XX Acceptable N/A Not Applicable Inc Incomplete)***

**X. Storm Drainage Systems (Associated with BMP's Only)**

*(Includes all incidental stormwater drainage conveyance systems associated with SWM/BMP facilities such as onsite or offsite storm drains, open channels, inlets, manholes, junctions, outlet protections, deflectors, etc. These facilities are external to the treatment function of, but are directly associated with drainage to and/or from a constructed SWM/BMP facility. The intent of this portion of the certification is to accurately identify the type and quantity of inflow or outflow points associated with the facility for future reference. The Professional may use his/her own discretion to determine inclusive facilities to meet the intent of this section. As a general rule, storm drainage systems would include incidental facilities to the nearest access structure upslope or downslope from the normal physical limits of the facility or 800 feet of storm drainage conveyance system length, whichever is less.)*

_____ SD1. All requirements of Section II, Minimum Standards, apply to Storm Drainage Systems.

_____ SD2. Horizontal location of all pipe and structures relative to the SWM/BMP facility.

_____ SD3. Type, top elevation and invert elevation of all access type structures (inlets, manholes, etc.).

_____ SD4. Material type, size or diameter, class, invert elevations, lengths and slopes for all pipe segments.

_____ SD5. Class, length, width and depth of riprap and outlet protections or dimensions of special energy dissipation structures.

**XI. Other Systems** *(Includes any non-typical, specialty, manufactured or innovative stormwater management/BMP practices or systems generally accepted for use as or in conjunction with other acceptable stormwater management/BMP practices. Requires evidence of prior satisfactory industry use and prior Environmental Division approval, waiver or exception.)*

_____ O1. All requirements of Section II, Minimum Standards, apply to this section.

_____ O2. Certification criteria to be determined on a case-by-case basis by the Engineering and Resource Protection Division specific to the proposed SWM/BMP facility.

**STORMWATER MANAGEMENT/BMP FACILITIES**
**RECORD DRAWING CHECKLIST**

**XII.** **References** *(The James City County Record Drawing and Construction Certification Forms and Checklists for Stormwater Management/BMP facilities were developed using the following sources and references.)*

☐ Baltimore County, Maryland Soil Conservation District, As-Built Stormwater Management Pond Checklist.

☐ James City County, Virginia, Guidelines for Design and Construction of Stormwater Management BMP's (October 1999).

☐ James City County, Virginia, Stormwater Detention/Retention Basin Design Checklist and Erosion and Sediment Control and Stormwater Management Design Plan Checklists.

☐ James City County Stormwater Policy Framework, Final Report of the James City County BMP Policy Project, October 1998, The Center for Watershed Protection.

☐ Prince Georges County, Maryland, As-Built Requirements Retention or Detention Pond/Basin.

☐ Prince William County, Virginia, Stormwater Management Fact Sheet.

☐ Stafford County, Virginia, As-Built Plan Checklist.

☐ Stormwater Management Design Manual, NRCS Maryland Code No. 378, Pond Standards and Specifications.

☐ USEPA/Watershed Management Institute, Stormwater Management Inspection Forms.

☐ Virginia Impounding Structure Regulations (Dam Safety), Department of Conservation & Recreation, 1997.

☐ Virginia Erosion and Sediment Control Handbook, Third Edition 1992, Virginia Department of Conservation and Recreation, Division of Soil and Water Conservation.

☐ Virginia Stormwater Management Handbook, 1999 edition, Virginia Department of Conservation and Recreation, Division of Soil and Water Conservation.

**James City County Environmental Division**
**Stormwater Management/BMP Record Drawing & Construction Certification Review**
**Tracking Form**

Project Name: Stonehouse Glen Sec 1
County Plan No.: S-98-03
Stormwater Management Facility: Dry Pond #1
BMP Phase #: ☐ I ☑ II ☐ III

- ☐ Information Package Received. Date/By: _____
- ☐ Completeness Check:
  - ☑ Record Drawing Date/By: 8/17/06 P. FATTELL
  - ☑ Construction Certification Date/By: 8/18/06 M. GALLI
  - ☐ RD/CC Standard Forms (Required for all BMPs after Feb 1st 2001Only)
  - ☑ Insp/Maint Agreement # / Date: 6/10/05
  - ☑ BMP Maintenance Plan Location: ON AS-BUILT DRAWINGS
  - ☐ Other: _____
- ☐ Standard E&SC Note on Approved Plan Requiring RD/CC or County comment in plan review
  - ☑ Yes ☐ No Location: PLAN REVIEW COMMENTS
- ☐ Assign **County BMP ID Code #**: Code: WC 092
- ☑ Preliminary Input/Log into Division's "As-Built Tracking Log"
- ☑ Add Location to GIS Map. Obtain basic site information (GPIN, Owner, Address, etc.)
- ☑ Preliminary Log into Access Database (BMP ID #, Plan No., GPIN, Project Name, etc.)
- ☑ Active Project File Review (correspondence, H&H, design computations, etc.).
- ☑ Initial As-Built File setup (File label, folder, copy plan/details/design information, etc.).
- ☑ Inspector Check of RD/CC (forward to Inspector using transmittal for cursory review).
- ☑ Pre-Inspection Drawing Review of Approved Plan (Quick look prior to Field Inspection).
- ☐ Final Inspection (FI) Performed Date: 1/7/14
- ☑ Record Drawing (RD) Review Date: 11/20/13
- ☑ Construction Certification (CC) Review Date: _____
- ☐ Actions:
  - ☑ No comments.
  - ☐ Comments. Letter Forwarded. Date: _____
  - ☐ Record Drawing (RD)
  - ☐ Construction Certification (CC)
  - ☐ Construction-Related (CR)
  - ☐ Site Issues (SI)
  - ☐ Other : _____
- ☐ Second Submission: _____
- ☐ Reinspection (if necessary): _____
- ☑ Acceptable for SWM Purposes (RD/CC/CR/Other). Ok to proceed with bond release.
- ☑ Complete "Surety Request Form".
- ☑ Check/Clean active file of any remaining material and finish "As-Built" file.
- ☐ Add to County BMP Inventory/Inspection schedule (Phase I, II or III).
- ☑ Copy Final Inspection Report into County BMP Inspection Program file.
- ☑ Obtain Digital Photographs of BMP and save into County BMP Inventory.
- ☑ Request mylar/reproducible from As-Built plan preparer. (LD)
- ☑ Complete "As-built Tracking Log".
- ☐ Last check of BMP Access Database (County BMP Inventory).
- ☐ Add BMP to JCC Hydrology & Hydraulic database (optional).
- ☐ Add BMP to Municipal BMP list (if a County-owned facility)
- ☐ Add BMP to PRIDE BMP ratings database.

***Final Sign-Off***

Plan Reviewer: _____ Date: _____

*** See separate checklist, if needed.

Nina Creech 1/7/14

# BMP OUTFALL REPAIR RECORD DRAWINGS

# STONEHOUSE GLEN

## SECTION I

# STONEHOUSE GLEN, L.L.C.

JAMES CITY COUNTY, VIRGINIA

NOVEMBER 19, 2013


VHB

*Vanasse Hangen Brustlin, Inc.*

Transportation
Land Development
Environmental Services

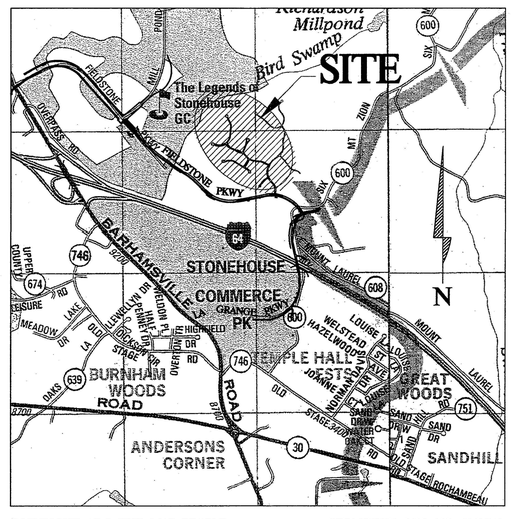
351 McLaws Circle, Suite 3
Williamsburg, Virginia 23185-6316
757 220 0500 • FAX 757 220 8544



Environmental Division
NOV 20 2013
RECEIVED


## SHEET INDEX


| SHEET. NO. | DESCRIPTION |
|---|---|
| R-1 | COVER SHEET |
| R-2 | POND 1 OUTFALL REPAIR |


COPYRIGHT ADC THE MAP PEOPLE PERMITTED USE NO. 20605142

## VICINITY MAP

SCALE: 1"=2,000'

## STATISTICAL DATA

| | |
|---|---|
| TAX MAP AND PARCEL: | TAX MAP (06-04) PARCEL 1-01 (PART) |
| ZONING: | PUD-R |
| PROJECT AREA: | 85.4963 AC. |
| AREA DISTURBED: | 10.0 ± AC. |
| F.E.M.A. PANEL NUMBER: | 510201 0010B<br>ZONE X - AREA OUTSIDE OF 500 YR. FLOOD PLAN |
| WATERSHED: | THIS PROJECT IS SITUATED IN THE WARE CREEK WATERSHED, DRAINING TO RICHARDSON'S MILL POND, COUNTY BMP ID CODE WC 059. |
| OWNER\DEVELOPER: | STONEHOUSE AT WILLIAMSBURG, L.L.C.<br>KEN MCDERMOTT, MANAGER<br>15 MENDHAM ROAD<br>P. O. BOX 704<br>GLADSTONE, NJ 07934<br>(908) 234-2620 |

### GENERAL NOTES

1. MERIDIAN SOURCE: VIRGINIA STATE PLANE COORDINATE SYSTEM – SOUTH ZONE (NAD 83)
2. ELEVATIONS HEREON ARE IN FEET AND ARE BASED ON NATIONAL GEODETIC VERTICAL DATUM OF 1929 (NGVD 29)
3. THIS SURVEY DOES NOT IMPLY IN ANY WAY THAT:
   (1) INSPECTIONS WERE MADE DURING THE CONSTRUCTION
   (2) TO THE QUALITY OF THE WORK, OR
   (3) TO ANY ELEMENT OR STRUCTURE NOT VISIBLE OR DEPICTED ON THE SURVEY.
4. RECORD INFORMATION SHOWN ON THIS PLAN ARE BASED UPON AN ACTUAL ON-THE-GROUND INSTRUMENT SURVEY PERFORMED BY VHB, INC. DURING APRIL 2013 AND UPDATED NOVEMBER 2013.
5. HORIZONTAL AND VERTICAL DATUM BASED ON JAMES CITY COUNTY GEODETIC CONTROL NETWORK MONUMENT #340.

SURVEY PERFORMED BY VHB 4/2013 AND 11/2013

I HEREBY CERTIFY TO THE BEST OF MY KNOWLEDGE AND BELIEF THAT THIS RECORD DRAWING REPRESENTS THE ACTUAL CONDITION THIS STORM WATER MANAGEMENT MEASURES AND MEETS THE MINIMUM ACCURACY STANDARDS PUBLISHED IN 18VAC10-20-382.

COMMONWEALTH OF VIRGINIA
11/20/13
STEPHEN A. ROMEO
Lic. No. 1448-B
Stephen Romeo
LAND SURVEYOR

FOR RECORD DRAWING INFORMATION ONLY

| No. | Revision | Date | Appvd. |
|---|---|---|---|
| | | | |

Designed by | Drawn by | Checked by
CAD checked by | Approved by
Scale | Date Nov. 13, 2013

Project Title
Stonehouse Glen
Section I
Stonehouse Glen, LLC.
James City County, Virginia

Issued for
James City County
Environmental Division
JCC Case#: S-98-2003

Drawing Title
Final Record Drawings
BMP 1 Outlet Repair

Drawing Number
R-1

Sheet 1 of 2

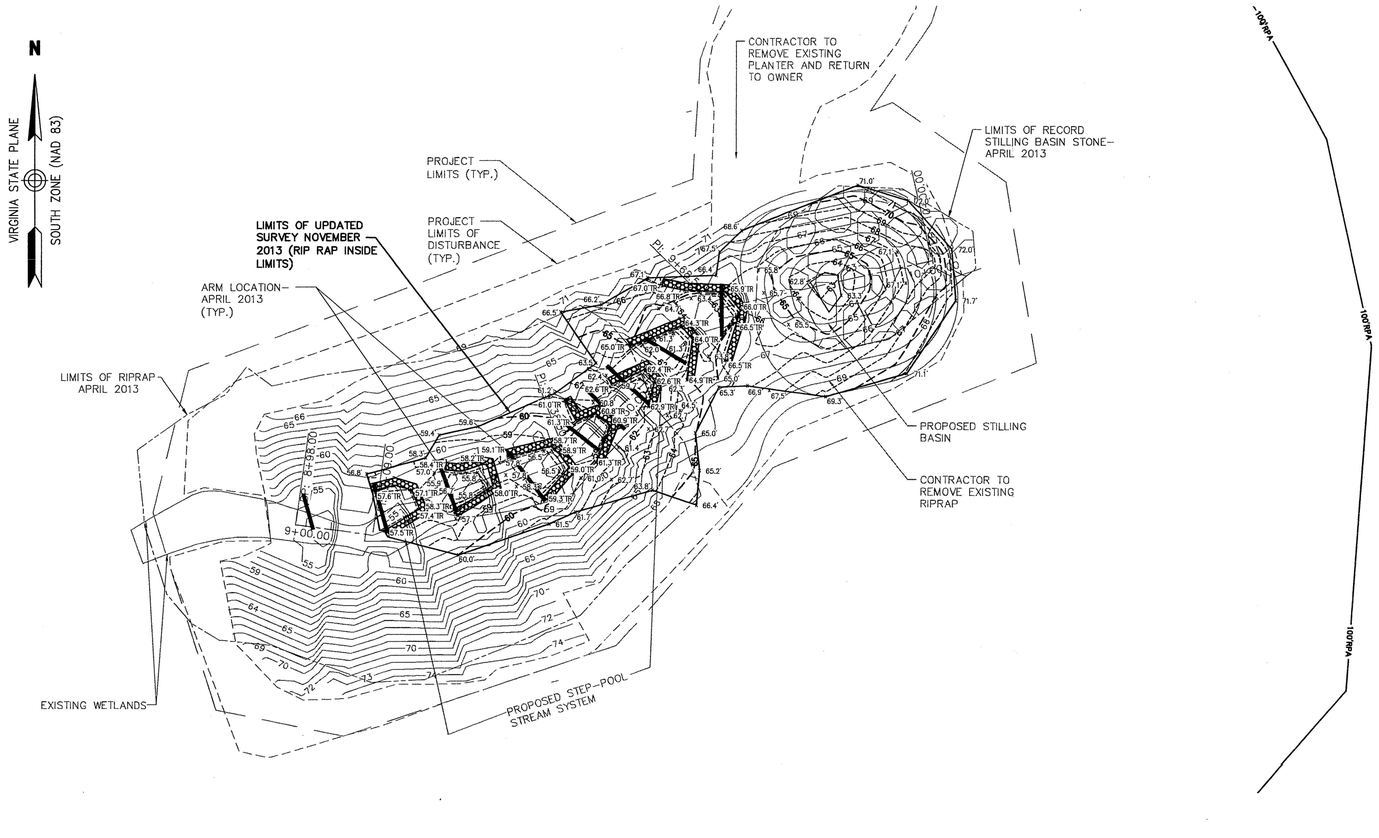
Project Number
33315.01

P:\33315.01 STONEHOUSE GLEN BMP OUTF\CAD\SR\PLANSET\PHASE I\R-1-REV-13-1112.DWG

**Vanasse Hangen Brustlin, Inc.**

Transportation
Land Development
Environmental Services

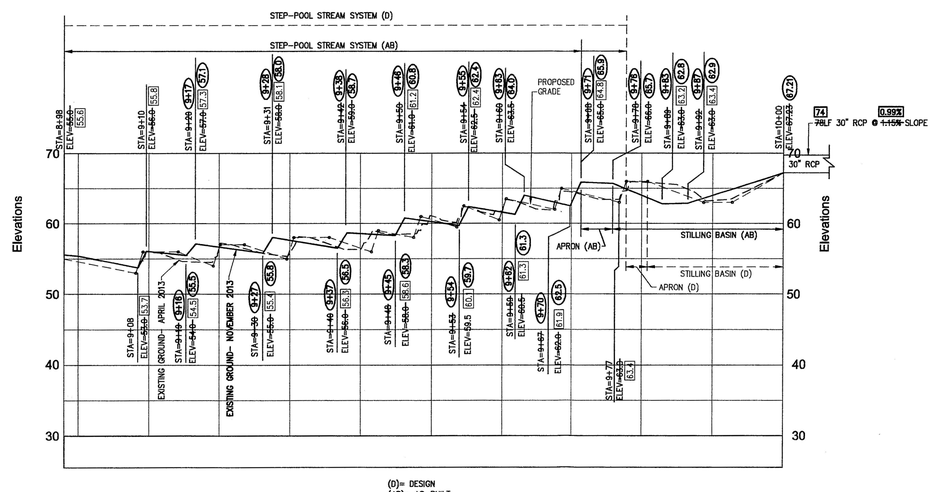
351 McLaws Circle, Suite 3
Williamsburg, Virginia 23185-6316
757 220 0500 ⅊ FAX 757 220 8544




10 0 10 20
SCALE IN FEET

SURVEY PERFORMED BY VHB 4/2013 AND 11/2013

56.3 FIELD LOCATION 4–2013
60.8 FIELD LOCATION 11–2013




(D)= DESIGN
(AB)= AS–BUILT

HORIZONTAL
10 0 10 20
10 0 10 20
VERTICAL
SCALE IN FEET

JCC CASE SP–0058–2012

| Revision | Date | Appvd. |
|---|---|---|
| | | |

Designed by | Drawn by | Checked by
CAD checked by | Approved by
1"=10' | Date Nov. 19, 2013

Project Title
Stonehouse Glen
Section I
Stonehouse Glen, LLC.
James City County, Virginia

Issued for
James City County
Environmental Division
JCC Case#: S-98-2003

Drawing Title
Final Record Drawings
BMP Outfall Repair

COMMONWEALTH OF VIRGINIA
11/20/13
STEPHEN A. ROMEO
Lic. No. 1448-B
LAND SURVEYOR
FOR RECORD DRAWING INFORMATION ONLY

Drawing Number
R-2

Sheet 2 of 2

Project Number
33315.01

# BMP RECORD DRAWINGS
# STONEHOUSE GLEN

## SECTION II

## STONEHOUSE GLEN, L.L.C.

JAMES CITY COUNTY, VIRGINIA

MAY 15, 2013


VHB

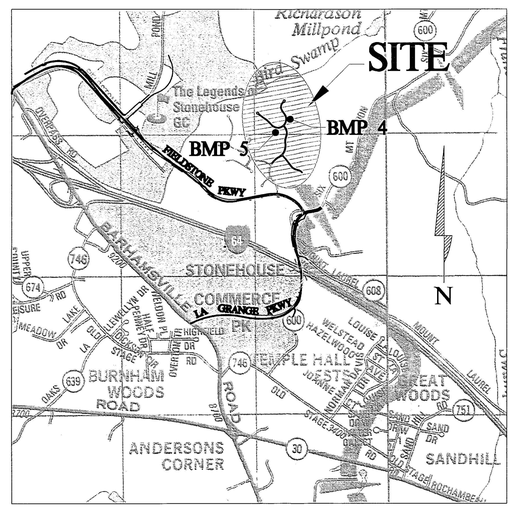
*Vanasse Hangen Brustlin, Inc.*

Transportation
Land Development
Environmental Services

351 McLaws Circle, Suite 3
Williamsburg, Virginia 23185-6316
757 220 0500 • FAX 757 220 8544


## SHEET INDEX


| SHEET. NO. | DESCRIPTION |
|---|---|
| R-1 | COVER SHEET |
| R-2 | POND 4 |
| R-3 | POND 5 |


COPYRIGHT ADC THE MAP PEOPLE PERMITTED USE NO. 20605142

## VICINITY MAP

SCALE: 1"=2,000'

## STATISTICAL DATA

| | |
|---|---|
| TAX PARCEL ID: | 0540100003 |
| ZONING: | PUD-R |
| PROJECT AREA: | 96.3105 AC. |
| AREA DISTURBED: | 9.26 ± AC. |
| F.E.M.A. PANEL NUMBER: | 510201 0010B<br>ZONE X - AREA OUTSIDE OF 500 YR. FLOOD PLAN |
| WATERSHED: | THIS PROJECT IS SITUATED IN THE WARE CREEK WATERSHED, DRAINING TO RICHARDSON'S MILL POND, COUNTY BMP ID CODE WC 059. |
| OWNER\DEVELOPER: | STONEHOUSE GLEN, L.L.C.<br>KEN MCDERMOTT, MANAGER<br>15 MENDHAM ROAD<br>P. O. BOX 704<br>GLADSTONE, NJ 07934<br>(908) 234-2620 |

### GENERAL NOTES

1. MERIDIAN SOURCE: VIRGINIA STATE PLANE COORDINATE SYSTEM – SOUTH ZONE (NAD 83)
2. ELEVATIONS HEREON ARE IN FEET AND ARE BASED ON NATIONAL GEODETIC VERTICAL DATUM OF 1929 (NGVD 29)
3. THIS SURVEY DOES NOT IMPLY IN ANY WAY THAT:
   (1) INSPECTIONS WERE MADE DURING THE CONSTRUCTION
   (2) TO THE QUALITY OF THE WORK, OR
   (3) TO ANY ELEMENT OR STRUCTURE NOT VISIBLE OR DEPICTED ON THE SURVEY.
4. RECORD INFORMATION SHOWN ON THIS PLAN ARE BASED UPON AN ACTUAL ON-THE-GROUND INSTRUMENT SURVEY PERFORMED BY VHB, INC. DURING APRIL 2013.
5. HORIZONTAL AND VERTICAL DATUM BASED ON JAMES CITY COUNTY GEODETIC CONTROL NETWORK MONUMENT #340.

SURVEY PERFORMED BY VHB 4/2013

THE UNDERSIGNED HEREBY CERTIFIES THAT, TO THE BEST OF HIS KNOWLEDGE AND BELIEF, 1) THE DRAINAGE FACILITIES DEPICTED HEREON HAVE BEEN INSTALLED GENERALLY IN ACCORDANCE WITH THE APPROVED SITE PLAN; 2) PURSUANT TO LIMITED VISUAL OBSERVATION OF RELEVANT COMPONENTS, THE SYSTEM APPEARS TO BE FUNCTIONING; AND 3) THE INFORMATION PROVIDED HAS BEEN FIELD VERIFIED.

COMMONWEALTH OF VIRGINIA
5/15/13
STEPHEN A. ROMEO
Lic. No. 1448-B
Stephen Romeo
LAND SURVEYOR

FOR RECORD DRAWING INFORMATION ONLY

| No. | Revision | Date | Appvd. |
|---|---|---|---|
| | | | |

Designed by | Drawn by | Checked by
CAD checked by | Approved by
Scale | Date May 15, 2013

Project Title
Stonehouse Glen
Section II
Stonehouse Glen, LLC.
James City County, Virginia

Issued for
James City County
Environmental Division
JCC Case#: S-116-2003

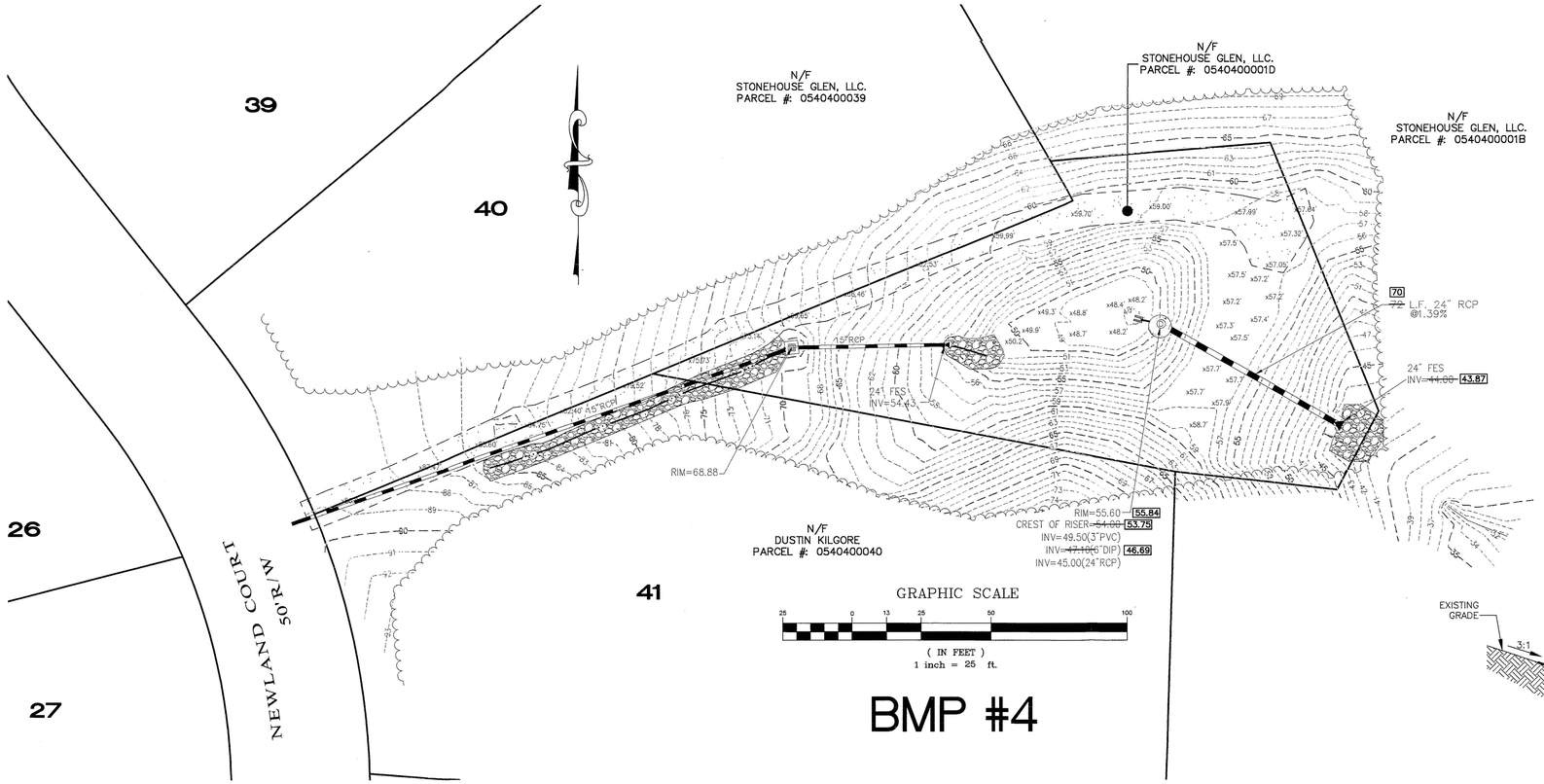
Drawing Title
Final Record Drawings
BMP 4 & 5

Drawing Number
R-1

Sheet 1 of 3

Project Number
33315.01

P:\33315.01 STONEHOUSE GLEN BMP OUTF\CAD\SR\PLANSET\PHASE II\R-1.DWG




# BMP #4

SURVEY PERFORMED BY VHB 4/2013

TOP OF DAM: ~~57.00~~ 57.2

100 YEAR WSE: 54.69

25 YEAR WSE: 54.57

10 YEAR WSE: 54.53

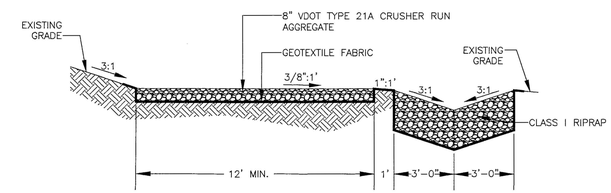
2 YEAR WSE: 53.69

1 YEAR WSE: 51.36

CREST OF PRINCIPAL SPILLWAY: ~~54.00~~ 53.86

INV. 6"ø VERT. ORIFICE: 47.50

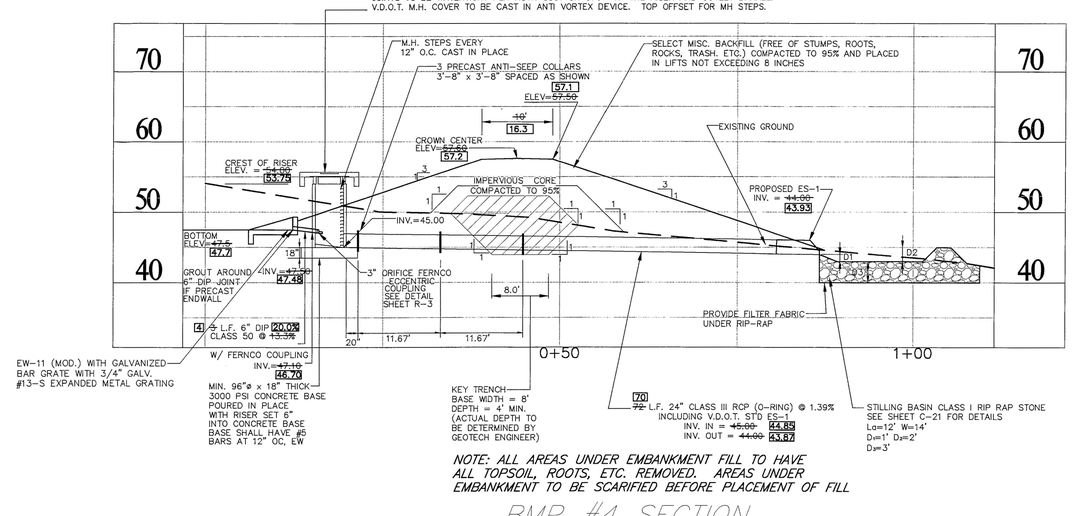
NOTE: DETENTION BASIN TO FUNCTION AS TEMPORARY SEDIMENT BASIN UNTIL STABILIZATION OF ALL AREAS DRAINING TO IT. A 3" DEWATERING DEVICE, IN ACCORDANCE WITH STANDARD 3.14 OF THE VESCH, IS TO BE PLACED AT ELEVATION 49.50 – SEDIMENT CLEANOUT LEVEL IS 48.48 6" DUCTILE IRON PIPE TO BE CAPPED UNTIL FUNCTION AS A SEDIMENT BASIN IS NO LONGER REQUIRED.
NOTE:
SEE SHEET R–3 FOR "BMP MAINTENANCE" AND "INSPECTION AND MAINTENANCE" NOTES.




BMP ACCESS ROAD DETAIL

N.T.S.

RISER STRUCTURE:
48" PRECAST CONCRETE RISER PIPE WITH EXTENDED BASE, FLAT TOP, AND 84" ANTI–VORTEX DEVICE. CREST OF RISER ELEV. = ~~54.00~~ 53.75 TOP OF BASE ELEV = 45.00. 6" DIP AT 46.69 ELEV. ~~47.50~~ TO BE PLUGGED WHILE BASIN IS BEING USED AS A SEDIMENT BASIN. ALL JOINTS TO BE WATERTIGHT PER ASTM C361 OR C76 FOR THE RISER AND OUTLET BARREL. V.D.O.T. M.H. COVER TO BE CAST IN ANTI VORTEX DEVICE. TOP OFFSET FOR MH STEPS.




NOTE: ALL AREAS UNDER EMBANKMENT FILL TO HAVE ALL TOPSOIL, ROOTS, ETC. REMOVED. AREAS UNDER EMBANKMENT TO BE SCARIFIED BEFORE PLACEMENT OF FILL

BMP #4 SECTION

GRAPHIC SCALE

( IN FEET )
1 inch = 10 ft.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351 McLaws Circle, Suite 3
Williamsburg, Virginia 23185-6316
757 220 0500 • FAX 757 220 8544


| No. | Revision | Date | Appvd. |
|---|---|---|---|

Designed by | Drawn by | Checked by
CAD checked by | Approved by
Scale As Noted | Date May 15, 2013

Project Title
Stonehouse Glen
Section II
Stonehouse Glen, LLC.
James City County, Virginia

Issued for
James City County
Environmental Division
JCC Case#: S-116-2003

Drawing Title
Final Record Drawings
BMP 4 Plan & Profile

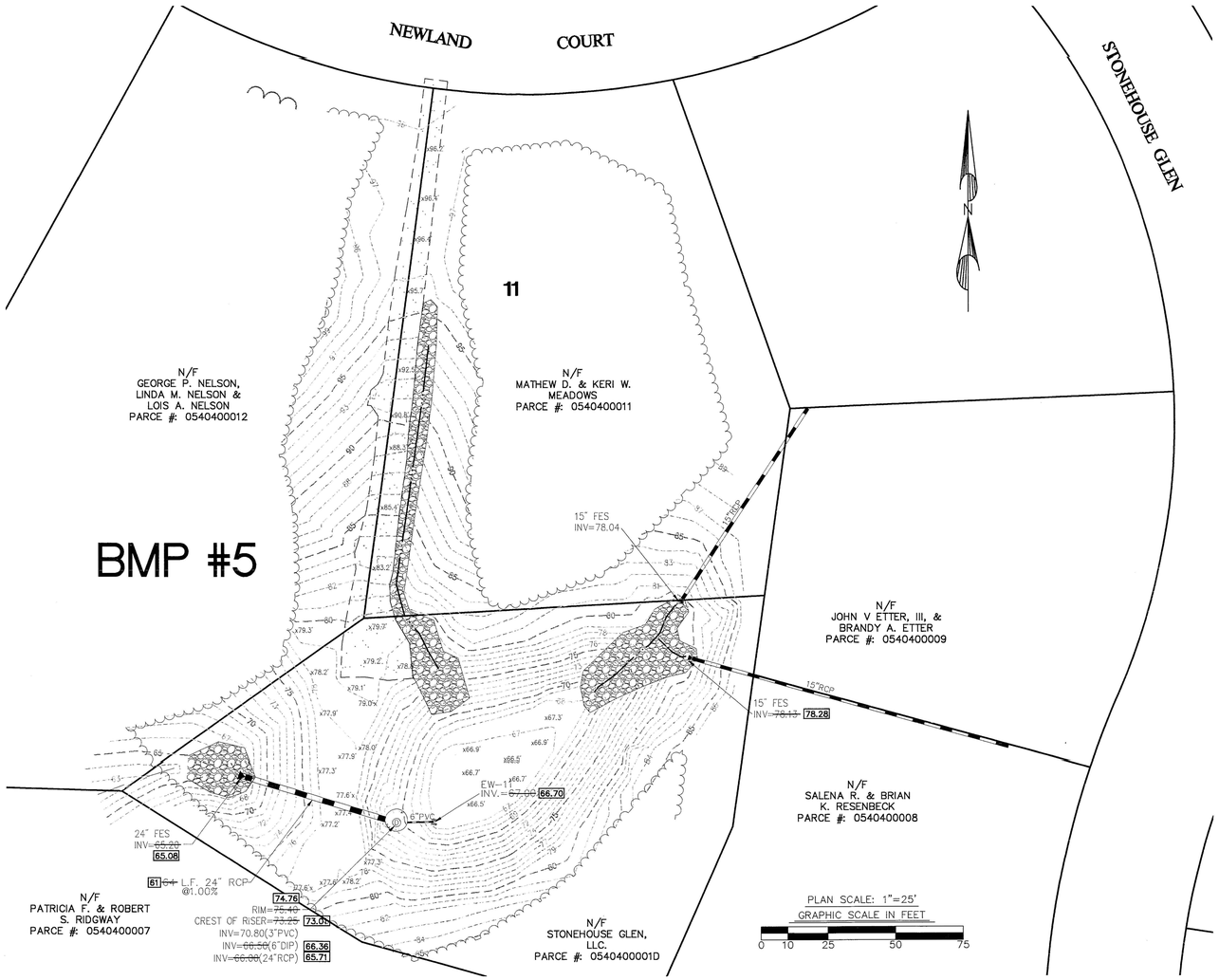
COMMONWEALTH OF VIRGINIA
5/15/13
STEPHEN A. ROMEO
Lic. No. 1448-B
LAND SURVEYOR
FOR RECORD DRAWING INFORMATION ONLY

Drawing Number
R-2

Sheet 2 of 3

Project Number
33315.01

P:\33315.01 STONEHOUSE GLEN BMP OUTF\CAD\SR\PLANSET\PHASE II\R–2.DWG



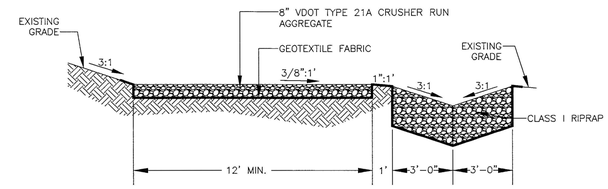

PLAN SCALE: 1"=25'

GRAPHIC SCALE IN FEET

0 10 25 50 75

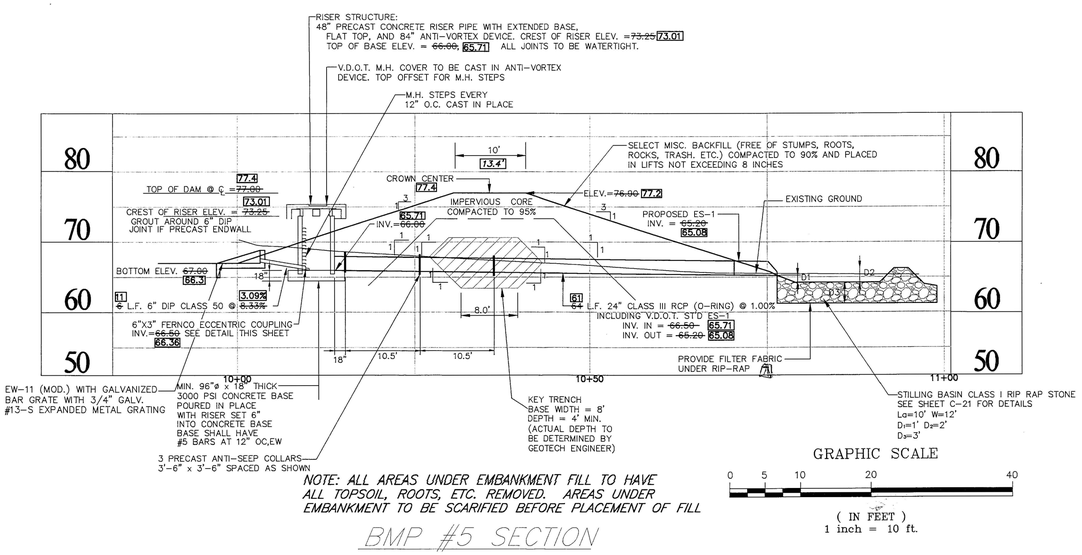
SURVEY PERFORMED BY VHB 4/2013

TOP OF DAM: ~~77.00~~ 77.4
100 YEAR WSE: 74.02
25 YEAR WSE: 73.89
10 YEAR WSE: 73.78
2 YEAR WSE: 72.45
1 YEAR WSE: 70.96
CREST OF PRINCIPAL SPILLWAY: ~~73.25~~ 73.01
INV. 6"Ø VERT. ORIFICE: ~~67.00~~ 66.70




## BMP ACCESS ROAD DETAIL

N.T.S.




NOTE: ALL AREAS UNDER EMBANKMENT FILL TO HAVE ALL TOPSOIL, ROOTS, ETC. REMOVED. AREAS UNDER EMBANKMENT TO BE SCARIFIED BEFORE PLACEMENT OF FILL

## BMP #5 SECTION

GRAPHIC SCALE

0 5 10 20 40

( IN FEET )
1 inch = 10 ft.

BMP MAINTENANCE REQUIREMENTS

THE OWNER OR ITS DESIGNATED REPRESENTATIVE WILL INSPECT THE SWM/BMP STRUCTURES AFTER EACH SIGNIFICANT RAINFALL EVENT OR THE FOLLOWING WORKING DAY IF A WEEKEND OR HOLIDAY OCCURS. A SIGNIFICANT RAINFALL FOR THIS STRUCTURE IS DEFINED AS ONE (1) INCH OR MORE OF GAUGED RAINFALL WITHIN A 24-HOUR PERIOD. ONCE PER YEAR, A REPRESENTATIVE OF THE COUNTY MAY JOINTLY INSPECT THE STRUCTURE.

INSPECTION AND MAINTENANCE OF THE FACILITY WILL CONSIST OF THE FOLLOWING ADDITIONAL MEASURES:

- INSPECT FOR SEDIMENT BUILDUP BY VISUAL OBSERVATION AND A PHYSICAL DETERMINATION OF SEDIMENT DEPTH WITHIN THE POND STORAGE AREAS. IF THE DEPTH OF THE SEDIMENT REACHES THE DEPTH OF 4" FOR BMP#5 AND 2" FOR BMP#4 ABOVE THE BOTTOM OF THE POND, REMOVAL IS REQUIRED. AT THE SAME TIME, OR AT LEAST ONCE PER YEAR, CLEAN THE RISER BOTTOMS AND OUTLET PIPES OF ACCUMULATED SEDIMENTS. DISPOSE OF SEDIMENTS REMOVED FROM THE FACILITY AT AN ACCEPTABLE DISPOSAL AREA.

- PERFORM MAINTENANCE MOWING OF POND GRASSES AT LEAST TWICE EACH YEAR. GRASSES SUCH AS TALL FESCUE SHOULD BE MOWED IN EARLY SUMMER AFTER EMERGENCE OF THE HEADS OF COOL SEASON GRASSES AND IN LATE FALL TO PREVENT SEEDS OF ANNUAL WEEDS FROM MATURING. MOWING OF LEGUMES CAN BE LESS FREQUENT. TREES, SHRUBS AND WOODY VEGETATION ARE NOT PERMITTED TO GROW ALONG OR ON ANY PART OF THE EMBANKMENT THAT WAS CONSTRUCTED USING ENGINEERED (COMPACTED) FILLS.

- PERFORM SOIL SAMPLING ON STABILIZED POND SOIL AREAS AT LEAST ONCE EVERY 4 YEARS. SOIL SAMPLING AND TESTING SHOULD BE PERFORMED BY A QUALIFIED SOIL TESTING LABORATORY SUCH AS VPI&SU. CONTACT THE LOCAL OFFICE OF THE VIRGINIA COOPERATIVE EXTENSION FOR FURTHER INFORMATIONS. APPLY ADDITIONAL LIME AND FERTILIZER IN ACCORDANCE WITH TEST RECOMMENDATIONS.

- IN STABILIZED POND AREAS, IF VEGETATION COVERS LESS THAN 40% OF SOIL SURFACES, LIME, FERTILIZE AND SEED IN ACCORDANCE WITH RECOMMENDATIONS FOR NEW SEEDLINGS. IF VEGETATION COVERS MORE THAN 40% BUT LESS THAN 70% OF SOIL SURFACES, LIME, FERTILIZE AND OVER SEED IN ACCORDANCE WITH CURRENT SEEDING RECOMMENDATIONS OR REQUIREMENTS OF THE VESCH.

- PERFORM QUARTERLY INSPECTIONS OF THE RISER SECTION FOR THE OBSERVANCE OF COLLECTED TRASH AND DEBRIS. IMMEDIATELY REMOVE ANY TRASH OR DEBRIS THAT PREVENTS THE MOVEMENT OF WATER. REMOVE ANY TRASH AND LITTER DOWNSTREAM AND AT STORM DRAIN OR CHANNEL INFLOW LOCATIONS TO MAINTAIN THE INTEGRITY OF THE STRUCTURE AND PROVIDE AN ATTRACTIVE APPEARANCE.

- PERFORM ANNUAL INSPECTIONS OF THE FACILITY FOR DAMAGE. STRUCTURAL INSPECTION SHALL BE PERFORMED ON THE CONCRETE RISER, ANTI-VORTEX DEVICE, TRASH RACK, ORIFICES/WEIRS, OUTLET BARREL AND POND EMBANKMENT. IF DAMAGE IS EVIDENT, FURTHER INVESTIGATION BY A PROFESSIONAL ENGINEER MAY BE REQUIRED TO ASSESS THE INTEGRITY OF THE STRUCTURE.

- PERFORM QUARTERLY INSPECTIONS OF THE GRADED SIDE SLOPES OF THE FACILITY FOR SIGNS OF ANIMAL/RODENT BURROWS OR SLOPE EROSION. IMMEDIATELY PERFORM NECESSARY REPAIRS, REFILLING OR RESEEDING.

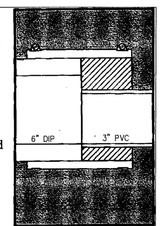
- PERFORM ANNUAL OBSERVATIONS OF PERIMETER AREAS SURROUNDING THE FACILITY TO ENSURE CHANGES IN LAND USE, TOPOGRAPHY OR ACCESS HAVE NOT OCCURRED AND DO NOT AFFECT THE OPERATION, MAINTENANCE, ACCESS OR SAFETY FEATURES AS PROVIDED. APPROPRIATE ACTION IS REQUIRED TO ENSURE ADEQUACY AND TO PROVIDE A CLEAR, SAFE PASSAGE FOR MAINTENANCE VEHICLES TO THE ENGINEERED EMBANKMENT AND PRINCIPAL FLOW CONTROL STRUCTURES.

RECORD KEEPING. THE OWNER OR DESIGNATED REPRESENTATIVE SHALL KEEP REASONABLE, ACCURATE WRITTEN RECORDS OF INSPECTIONS PERFORMED FOR THE STRUCTURE. RECORDS SHALL DOCUMENT ROUTINE MAINTENANCE AND/OR REPAIRS PERFORMED. COPIES SHALL BE PROVIDED TO THE COUNTY UPON REQUEST.

THE FACILITY SHALL NOT ACCEPT ADDITIONAL DRAINAGE OR BE MODIFIED IN ANY WAY WITHOUT PRIOR CONSENT OR APPROVAL BY THE ENVIRONMENTAL DIVISION OF JAMES CITY COUNTY.


**FERNCO ECCENTRIC COUPLINGS help maintain an even, continuous flowline in critical grade conditions. They're easy to install and available to fit all common sewer pipe size combinations. Made of tough, flexible elastomeric PVC, Eccentric Couplings seal reliably against infiltration and exfiltration. Eccentric bushings fit one end of Fernco Standard Flexible Couplings.**

**Available for all common sewer pipe materials.**




| | |
|---|---|
| Clay to Clay<br>Clay to Cl/Plastic<br>Clay to A-C/Ductile<br>Concrete to Concrete | Concrete to Cl/Plastic<br>A-C/Ductile to Cl/Plastic<br>A-C/Ductile to A-C/Ductile<br>Cl/Plastic to Cl/Plastic |
| When ordering, please provide size and piping materials to be connected. | |


NOTE: DETENTION BASIN TO FUNCTION AS TEMPORARY SEDIMENT BASIN UNTIL STABILIZATION OF ALL AREAS DRAINING TO IT. A 3" DEWATERING DEVICE, IN ACCORDANCE WITH STANDARD 3.14 OF THE VESCH, IS TO BE PLACED AT ELEVATION 70.80 - SEDIMENT CLEANOUT LEVEL IS 69.30. 6" DUCTILE IRON PIPE TO BE CAPPED UNTIL FUNCTION AS A SEDIMENT BASIN IS NO LONGER REQUIRED.


VHB

*Vanasse Hangen Brustlin, Inc.*

Transportation
Land Development
Environmental Services

351 McLaws Circle, Suite 3
Williamsburg, Virginia 23185-6316
757 220 0500 • FAX 757 220 8544


| No. | Revision | Date | Appvd. |
|---|---|---|---|

Designed by | Drawn by | Checked by
CAD checked by | Approved by
Scale As Noted | Date May 15, 2013

Project Title

Stonehouse Glen
Section II
Stonehouse Glen, LLC.
James City County, Virginia

Issued for

James City County
Environmental Division
JCC Case#: S-116-2003

Drawing Title

Final Record Drawings
BMP 5 Plan & Profile

COMMONWEALTH OF VIRGINIA
5/15/13
STEPHEN A. ROMEO
Lic. No. 1448-B
AND SURVEYOR

FOR RECORD DRAWING INFORMATION ONLY

Drawing Number
R-3

Sheet 3 of 3

Project Number
33315.01

P:\33315.01 STONEHOUSE GLEN BMP OUTF\CAD\SR\PLANSET\PHASE II\R-3.DWG

# Site Plans

Issued for: **Site Plan Approval**

Date Issued: June 22, 2012

Latest Issue: February 4, 2013

## Sheet Index

| Number | Drawing Title | Latest Issue |
|---|---|---|
| ~~C-1~~ | ~~Legend and General Notes~~ | ~~7/24/2012~~ |
| C-2 | Grading Plan | 2/4/2013 |
| ~~C-3~~ | ~~Environmental Inventory~~ | ~~7/24/2012~~ |
| ~~C-4~~ | ~~Erosion Control Plan~~ | ~~7/24/2012~~ |
| ~~C-5~~ | ~~Site Detail 1~~ | ~~7/24/2012~~ |
| ~~C-6~~ | ~~Site Detail 2~~ | ~~7/24/2012~~ |

**Reference Drawings**

| Number | Drawing Title | Latest Issue |
|---|---|---|
| ~~SV-1~~ | ~~Existing Condition Plan of Land~~ | ~~4/13/2012~~ |

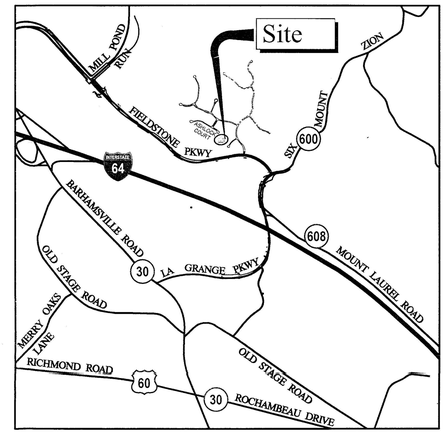
**THE PURPOSE OF THIS SITE PLAN AMENDMENT IS TO UPDATE THE EXTENSE OF LIMITS OF DISTURBANCE LINE THAT HAS BEEN REVISED IN ORDER TO PROVIDE SAFE ACCESS AND WORKING CONDITIONS FOR WORKERS TO INSTALL STEP-POOL STRUCTURES**

P:\33315.01 STONEHOUSE GLEN BMP OUTF\CAD\LD\PLANSET\333501-COV 3 December 2006

**AMENDMENT TO JCC CASE NO. SP-0058-2012**

# Stonehouse Glen BMP Outfall Repair

## 9304 Stonehouse Glen (Located South of Ashlock Court) Toano, Virginia




Site Location Map

0 1000 2000 Feet

## Property Owners

| | |
|---|---|
| Owner: | Stonehouse Glen, LLC |
| Contact: | Mr. Ken McDermott |
| **Company Name:** | **Glen Venture** |
| Address 1 | P.O. BOX 61 |
| Address 2 | GLADSTONE, NJ 07934 |
| Phone · Fax | 908.234.2620 x227 · 908.234.9508 |
| Applicant: | Piotr Swietuchowski |
| **Company Name:** | **Vanasse Hangen Brustlin, Inc.** |
| Address 1 | 351 McLaws Circle, Suite 3 |
| Address 2 | Williamsburg, VA 23185 |
| Phone · Fax | 757-220-0500 757-220-8544 |

**Site Plan Amendment to JCC Case # S-0098-2003 (Stonehouse Glen, Section 1)**

NOTE:
RECORD DRAWING AND CONSTRUCTION CERTIFICATION. THE STORMWATER MANAGEMENT/BMP FACILITY AND ASSOCIATED STORMWATER CONVEYANCE SYSTEMS AS PROPOSED FOR THIS PROJECT WILL REQUIRE SUBMISSION, REVIEW, AND APPROVAL OF A RECORD DRAWING (AS-BUILT) AND CONSTRUCTION CERTIFICATION PRIOR TO RELEASE OF THE POSTED BOND/SURETY.

## Site Summary

### Site Statistics

| | |
|---|---|
| PARCEL ID NUMBER: | 0540400001C |
| ADDRESS: | 9304 STONEHOUSE GLEN |
| ZONING: | PR PUD RESIDENTIAL |
| PROPOSED USE: | BMP |
| TOTAL AREA OF PARCEL: | 0.9320 AC |
| PROJECT AREA: | 8,246 SQ.FT. (0.19 AC.) |
| REFERENCE INSTR. #'S: | ... |
| FLOOD ZONE: | ZONE X (FEMA COMMUNITY PANEL NO. 51095C 0045 C, DATED SEPTEMBER 28, 2007 |
| EXISTING IMPERVIOUS COVER: | 2,366 SQ.FT (0.054 AC.) |
| PROPOSED IMPERVIOUS COVER : | 2,317 SQ.FT (0.053 AC.) |
| IMPERVIOUS COVER DECREASE: | 49 SQ.FT. (0.001 AC.) |
| TOTAL CLEARING AREA: | SELECT CLEARING < 1 ACRE |
| TOTAL DISTURBED AREA: | 5750 SQ.FT. (0.13 ACRES) |
| HYDROLOGIC UNIT CODE: | (HUC12) 020801070101 (VAHU6) Y062 WARE CREEK |
| WATERSHED: | IT APPEARS THIS PROJECT IS SITUATED IN THE WARE CREEK WATERSHED, DRAINING TO RICHARDSON'S MILL POND, COUNTY BMP ID CODE WC 059. |

COUNTY OF JAMES CITY
FINAL SITE PLAN
APPROVALS — DATE
Dept. JB Ller 2/7/13
Health Dept.
VDOT
Planning CM 2-14-13
Environ. SIT Ller 2/12/13
Zoning Adm. JP 4/14/13
JCSA
County Eng.
HRA
Other

PLANNING DIVISION
FEB 05 2013
RECEIVED

VHB

*Vanasse Hangen Brustlin, Inc.*
Transportation
Land Development
Environmental Services

101 Walnut Street, P.O. Box 9151
Watertown, Massachusetts 02471
617.924.1770 • FAX 617.924.2286

COMMONWEALTH OF VIRGINIA
PIOTR SWIETUCHOWSKI
Lic. No. 044606
02/04/2013
PROFESSIONAL ENGINEER

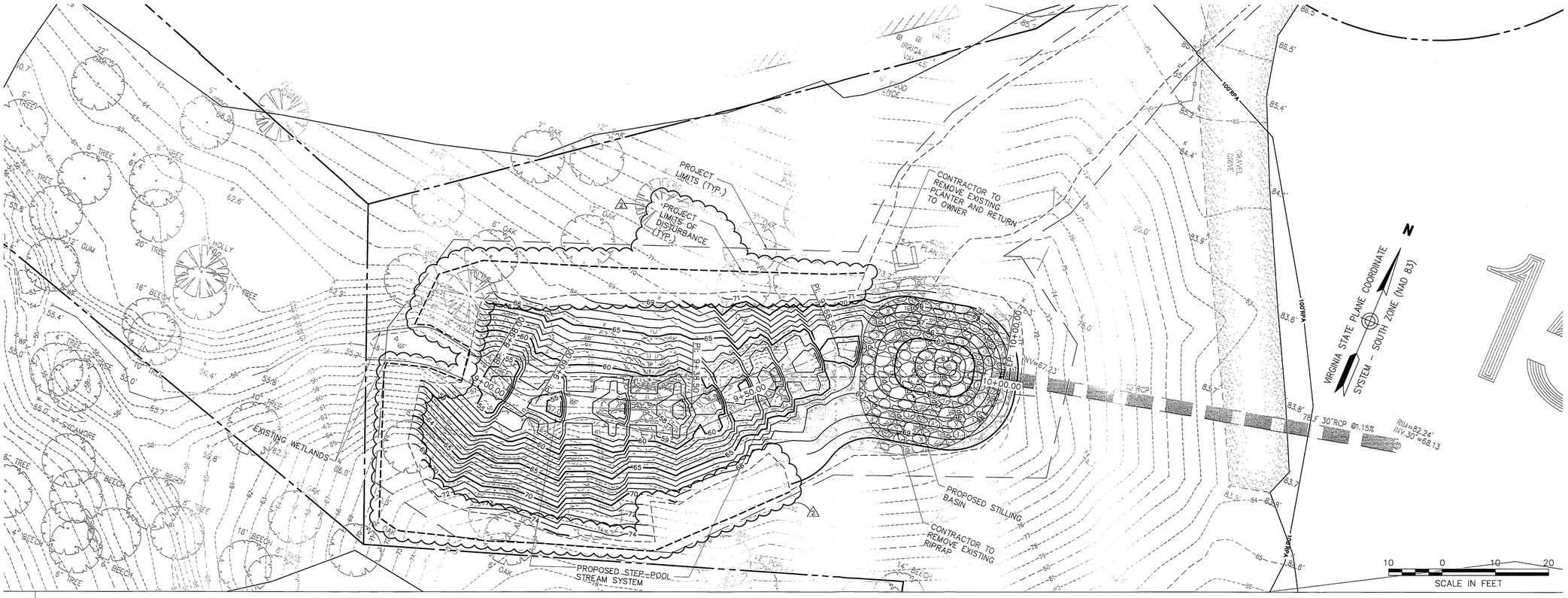
RESPONSIBLE LAND DISTURBER
PIOTR SWIETUCHOWSKI, PROFESSIONAL ENGINEER (LIC. NO. 044606), VANASSE HANGEN BRUSTLIN, INC., WILLIAMSBURG, VIRGINIA WILL SERVE AS RESPONSIBLE LAND DISTURBER FOR THE DURATION OF THE REVIEW PROCESS ONLY. THE OWNER WILL PROVIDE A QUALIFIED RLD UPON ISSUANCE OF A LAND DISTURBANCE PERMIT OR SITE APPROVAL, WHICH EVER COMES FIRST.

Environmental Division
FEB 20 2013
RECEIVED

VHB Project No. 33315.01
Ashlock Court, James City County, USA
Issued for: Site Plan Approval

SP-0007-2013
~~JCC CASE SP-0058-2012~~

Saved Tuesday, July 24, 2012 11:19:11 AM BGREENE Plotted Monday, February 04, 2013 2:46:02 PM Greene, Scott




VHB
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Land Development
Environmental Services
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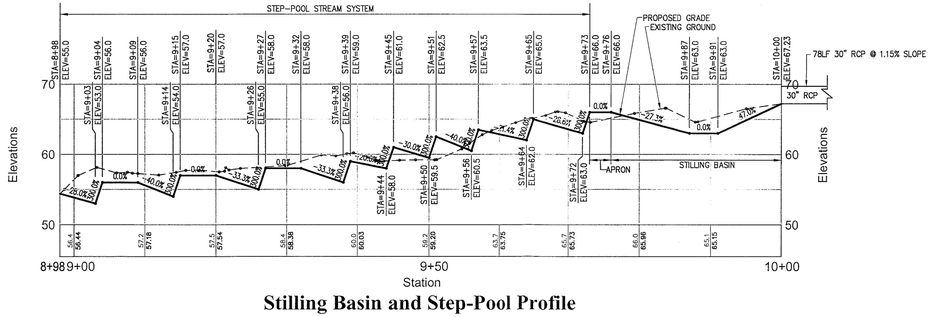
Williamsburg, Virginia 23185
757.220.0500 • FAX 757.220.8544




**Stilling Basin and Step-Pool Profile**

| No. | Revision | Date | Appvd. |
|---|---|---|---|
| 2 | Amended Site Plan | 02/04/2013 | PS |
| 1 | Revised Per County Comments | 07/23/2012 | PS |

Designed by CRS | Drawn by BSG | Checked by PS
CAD checked by | Approved by
Scale 1"=10' | Date June 22, 2012

Project Title
Stonehouse Glen, LLC
Stonehouse Glen
BMP Outfall Repair
9304 Stonehouse Glen
Toano, Virginia

Issued for
Not Approved for Construction

Drawing Title
Grading Plan

AMENDMENT TO JCC CASE NO. SP-0058-2012

COMMONWEALTH OF VIRGINIA
PIOTR SWIETUCHOWSKI
Lic. No. 044606
02/04/2013
PROFESSIONAL ENGINEER

Drawing Number
C-2
Sheet 1 of
Project Number 33315.01

HORIZONTAL
10 0 10 20
VERTICAL
SCALE IN FEET

JCC CASE SP-0058-2012

3331501-GD.DWG

SP-0058-2012

# Site Plans

Issued for: **Site Plan Approval**

Date Issued: June 22, 2012

Latest Issue: July 24, 2012

## Sheet Index

| Number | Drawing Title | Latest Issue |
|---|---|---|
| C-1 | Legend and General Notes | 7/24/2012 |
| C-2 | Grading Plan | 7/24/2012 |
| C-3 | Environmental Inventory | 7/24/2012 |
| C-4 | Erosion Control Plan | 7/24/2012 |
| C-5 | Site Detail 1 | 7/24/2012 |
| C-6 | Site Detail 2 | 7/24/2012 |

**Reference Drawings**

| Number | Drawing Title | Latest Issue |
|---|---|---|
| SV-1 | Existing Condition Plan of Land | 4/13/2012 |

# Stonehouse Glen BMP Outfall Repair

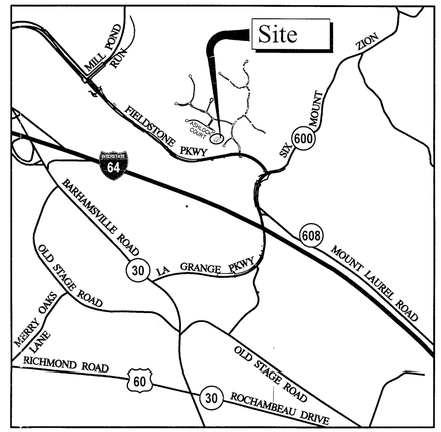
SECTION 1

(COUNTY BMP ID CODE WC-092)

## 9304 Stonehouse Glen (Located South of Ashlock Court) Toano, Virginia

RECEIVED PLANNING DIVISION JUL 26 2012 RECEIVED

Environmental Division JUL 30 2012 RECEIVED




Site Location Map ↑ 0 1000 2000 Feet

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| **Company Name:** | **Glen Venture** |
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| Phone · Fax | 908.234.2620 x227 · 908.234.9508 |
| Applicant: | Piotr Swietuchowski |
| **Company Name:** | **Vanasse Hangen Brustlin, Inc.** |
| Address 1 | 351 McLaws Circle, Suite 3 |
| Address 2 | Williamsburg, VA 23185 |
| Phone · Fax | 757-220-0500 757-220-8544 |

COUNTY OF JAMES CITY FINAL SITE PLAN

| APPROVALS | DATE |
|---|---|
| Fire Dept. JB/JC | 7/30/12 |
| Health Dept. | |
| VDOT | |
| Planning CAJ | 8/3/12 |
| Environ. ST/JC | 8/2/12 |
| Zoning Adm. DJP | 8/3/12 |
| JCSA CP/JC | 7/30/12 |
| County Eng. | |
| REA | |
| Other | |

**Site Plan Amendment to JCC Case # S-0098-2003 (Stonehouse Glen, Section 1)**

NOTE:
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| IMPERVIOUS COVER DECREASE: | 49 SQ.FT. (0.001 AC.) |
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| TOTAL DISTURBED AREA: | 5750 SQ.FT. (0.13 ACRES) |
| HYDROLOGIC UNIT CODE: | (HUC12) 020801070101 (VAHU6) Y062 WARE CREEK |
| WATERSHED: | IT APPEARS THIS PROJECT IS SITUATED IN THE WARE CREEK WATERSHED, DRAINING TO RICHARDSON'S MILL POND, COUNTY BMP ID CODE WC 059. |

BMP WC092


VHB

*Vanasse Hangen Brustlin, Inc.*
Transportation
Land Development
Environmental Services

101 Walnut Street, P.O. Box 9151
Watertown, Massachusetts 02471
617.924.1770 • FAX 617.924.2286


COMMONWEALTH OF VIRGINIA
PIOTR SWIETUCHOWSKI
Lic. No. 044606
07/24/12
PROFESSIONAL ENGINEER

RESPONSIBLE LAND DISTURBER
PIOTR SWIETUCHOWSKI, PROFESSIONAL ENGINEER (LIC. NO. 044606), VANASSE HANGEN BRUSTLIN, INC., WILLIAMSBURG, VIRGINIA WILL SERVE AS RESPONSIBLE LAND DISTURBER FOR THE DURATION OF THE REVIEW PROCESS ONLY. THE OWNER WILL PROVIDE A QUALIFIED RLD UPON ISSUANCE OF A LAND DISTURBANCE PERMIT OR SITE APPROVAL, WHICH EVER COMES FIRST.

VHB Project No. 33315.01
Ashlock Court, James City County, USA
Issued for: Site Plan Approval

P:\33315.01 STONEHOUSE GLEN BMP OUTF\CAD\LD\PLANSET\333150I-COV 3 December 2006

JCC CASE SP-0058-2012

Saved Sunday, June 24, 2012 11:53:09 AM BGREENE Plotted Tuesday, July 24, 2012 12:26:49 PM Greene, Scott

# Legend

| Exist. | Prop. | |
|---|---|---|
| L=43.84' | | PROPERTY LINE |
| | | PROJECT LIMIT LINE |
| | | RIGHT-OF-WAY/PROPERTY LINE |
| | | EASEMENT |
| | | BUILDING SETBACK |
| 10+00 | 10+00 | BASELINE |
| | | CONSTRUCTION LAYOUT |
| | | ZONING LINE |
| TL | | TOWN LINE |
| | | LIMIT OF DISTURBANCE |
| | | WETLAND LINE WITH FLAG |
| | | FLOODPLAIN |
| BLSF | | BORDERING LAND SUBJECT TO FLOODING |
| BZ | | WETLAND BUFFER ZONE |
| RMA | | RMA - RESOURCE MANAGEMENT AREA |
| RPA | | RPA - RESOURCE PROTECTION AREA |
| | | GRAVEL ROAD |
| EOP | EOP | EDGE OF PAVEMENT |
| MS-3, 3A | MS-3, 3A | ASPHALT CONCRETE CURB AND MEDIAN |
| CG-2 | CG-2 | STANDARD 6" CURB |
| CG-3 | CG-3 | STANDARD 4" CURB |
| CG-6 | CG-6 | COMBINATION 6" CURB & GUTTER |
| CG-7 | CG-7 | COMBINATION 4" CURB & GUTTER |
| | | FIRE LANE STRIPING |
| | | LIMIT OF CURB TYPE |
| | | SAWCUT |
| | | BUILDING |
| | EN | BUILDING ENTRANCE |
| | LD | LOADING DOCK |
| | | BOLLARD |
| D | D | DUMPSTER PAD |
| | | SIGN |
| | | DOUBLE SIGN |
| | | STEEL GUARDRAIL |
| | | WOOD GUARDRAIL |
| | | PATH |
| | | TREE LINE |
| | | WIRE FENCE |
| | | FENCE |
| | | STOCKADE FENCE |
| | | CHAIN LINK FENCE |
| | | STONE WALL |
| | | RETAINING WALL |
| | | STREAM / POND / WATER COURSE |
| | | DETENTION BASIN |
| | | HAY BALES |
| | | SILT FENCE |
| 4 | 4 | MINOR CONTOUR |
| 20 | 20 | MAJOR CONTOUR |
| 10 | 10 | PARKING COUNT |
| | C10 | COMPACT PARKING STALLS |
| DYL | DYL | DOUBLE YELLOW LINE |
| SL | SL | STOP LINE |
| | | CROSSWALK |
| | | ACCESSIBLE CURB RAMP |
| | | HANDICAP PARKING |
| VAN | VAN | VAN-ACCESSIBLE HANDICAP PARKING |

| Exist. | Prop. | |
|---|---|---|
| | | CONCRETE PAVEMENT |
| | | STANDARD DUTY PAVEMENT |
| | | HEAVY DUTY PAVEMENT |
| | | RIPRAP |
| | | CONSTRUCTION ENTRANCE |
| 27.35 TC x | TC27.35 x | TOP OF CURB ELEVATION |
| 26.85 BC x | BC26.85 x | BOTTOM OF CURB ELEVATION |
| 26.85 FL x | FL26.85 x | FLOW LINE ELEVATION |
| 26.85 EP x | EP26.85 x | EDGE OF PAVEMENT ELEVATION |
| 132.75 x | 132.75 x | SPOT ELEVATION |
| 45.0 TW x, 35.5 BW x | 45.0 TW x, 35.5 BW x | TOP & BOTTOM OF WALL ELEVATION |
| | | BORING LOCATION |
| | | TEST PIT LOCATION |
| MW | MW | MONITORING WELL |
| UD | UD | UNDERDRAIN |
| 12"D | 12"D | DRAINAGE LINE |
| 6"RD | 6"RD | ROOF DRAIN |
| 12"S | 12"S | SEWER LINE |
| CHW | CHW | OVERHEAD WIRE |
| 6"W | 6"W | WATER LINE |
| 4"FP | 4"FP | FIRE PROTECTION LINE |
| 2"DW | 2"DW | DOMESTIC WATER LINE |
| 3"G | G | GAS LINE |
| UGE | UGE | UNDERGROUND ELECTRIC |
| T | T | TELEPHONE LINE |
| FA | FA | FIRE ALARM |
| CATV | CATV | CABLE TV |
| | DI | DRAIN INLET (VDOT DI-1 OR DI-7) |
| | | DRAIN INLET (VDOT DI-3B) |
| | | DRAIN INLET (VDOT DI-3C) |
| | | DRAIN MANHOLE |
| TD | | TRENCH DRAIN |
| | | PLUG OR STUB |
| | | FLARED END SECTION |
| | | HEADWALL |
| | | SEWER MANHOLE |
| | | SEWER CLEANOUT |
| CS | CS | CURB STOP & BOX |
| WV | WV | WATER VALVE & BOX |
| TSV | TSV | TAPPING SLEEVE, VALVE & BOX |
| | | SIAMESE CONNECTION |
| HYD | HYD | FIRE HYDRANT |
| WM | WM | WATER METER |
| PIV | PIV | POST INDICATOR VALVE |
| W | W | WATER WELL |
| GS | GS | GAS GATE |
| GM | GM | GAS METER |
| E | | ELECTRIC MANHOLE |
| EM | EM | ELECTRIC METER |
| | | LIGHT POLE |
| T | | TELEPHONE MANHOLE |
| T | T | TRANSFORMER PAD |
| | | UTILITY POLE |
| | | GUY POLE |
| | | GUY WIRE & ANCHOR |
| HH | HH | HAND HOLE |
| PB | PB | PULL BOX |
| Matchline | | MATCHLINE |

# Abbreviations

## General

| | |
|---|---|
| ABAN | ABANDON |
| ACR | ACCESSIBLE CURB RAMP |
| ADJ | ADJUST |
| APPROX | APPROXIMATE |
| BIT | BITUMINOUS |
| BS | BOTTOM OF SLOPE |
| BWLL | BROKEN WHITE LANE LINE |
| CONC | CONCRETE |
| DYCL | DOUBLE YELLOW CENTER LINE |
| EL | ELEVATION |
| ELEV | ELEVATION |
| EXIST | EXISTING |
| FDN | FOUNDATION |
| GRAN | GRANITE |
| GTD | GRADE TO DRAIN |
| LA | LANDSCAPE AREA |
| LOD | LIMIT OF DISTURBANCE |
| MAX | MAXIMUM |
| MIN | MINIMUM |
| NIC | NOT IN CONTRACT |
| NTS | NOT TO SCALE |
| PERF | PERFORATED |
| PROP | PROPOSED |
| REM | REMOVE |
| RET | RETAIN |
| R&D | REMOVE AND DISPOSE |
| R&R | REMOVE AND RESET |
| SWEL | SOLID WHITE EDGE LINE |
| SWLL | SOLID WHITE LANE LINE |
| TS | TOP OF SLOPE |
| TYP | TYPICAL |

## Utility

| | |
|---|---|
| CB | CATCH BASIN |
| CMP | CORRUGATED METAL PIPE |
| CO | CLEAN OUT |
| DCB | DOUBLE CATCH BASIN |
| DMH | DRAIN MANHOLE |
| DI | DRAIN INLET |
| CIP | CAST IRON PIPE |
| COND | CONDUIT |
| DIP | DUCTILE IRON PIPE |
| ES | END SECTION |
| EW | END WALL |
| FES | FLARED END SECTION |
| F&G | FRAME AND GRATE |
| F&C | FRAME AND COVER |
| FM | FORCE MAIN |
| GT | GREASE TRAP |
| GI | GUTTER INLET |
| HDPE | HIGH DENSITY POLYETHYLENE PIPE |
| HH | ELECTRIC HANDHOLE |
| HW | HEADWALL |
| HYD | HYDRANT |
| MES | METAL END SECTION |
| INV | INVERT ELEVATION |
| I= | INVERT ELEVATION |
| PWW | PAVED WATER WAY |
| PVC | POLYVINYLCHLORIDE PIPE |
| RCP | REINFORCED CONCRETE PIPE |
| R= | RIM ELEVATION |
| SMH | SEWER MANHOLE |
| TSV | TAPPING SLEEVE, VALVE AND BOX |
| UP | UTILITY POLE |

# Notes:

## General

1. ALL WORK SHALL BE IN ACCORDANCE WITH THE CURRENT EDITIONS OF THE VIRGINIA WORK AREA PROTECTION MANUAL, V.D.O.T. ROAD AND BRIDGE STANDARDS, SPECIFICATIONS, AND SOIL AND AGGREGATE COMPACTION MANUAL, HAMPTON ROADS PLANNING DISTRICT (HRPDC) REGIONAL CONSTRUCTION STANDARDS, AND JAMES CITY COUNTY PRIVATE STREET STANDARDS AND SPECIFICATIONS..
2. THE "MISS UTILITY LAW" REQUIRES FOR THE CONTRACTOR TO CALL 811 AT LEAST 3 WORKING DAYS IN ADVANCE OF THE PLANNED WORK TO ALLOW TIME FOR MARKING, THAT THE MARKS BE RESPECTED AND PROTECTED, AND THAT EXCAVATION BE COMPLETED CAREFULLY.
3. CONTRACTOR SHALL BE RESPONSIBLE FOR SITE SECURITY AND JOB SAFETY. CONSTRUCTION ACTIVITIES SHALL BE IN ACCORDANCE WITH OSHA STANDARDS AND LOCAL REQUIREMENTS.
4. AREAS DISTURBED DURING CONSTRUCTION AND NOT RESTORED WITH IMPERVIOUS SURFACES (BUILDINGS, PAVEMENTS, WALKS, ETC.) SHALL FOLLOW DETAIL PROVIDED BY VIRGINIA EROSION AND SEDIMENT CONTROL HANDBOOK FOR SITE SPECIFIC SEEDING MIXTURES IN ACCORDANCE WITH STANDARD & SPECIFICATION 3.32.
5. CONTRACTOR SHALL MAKE NECESSARY CONSTRUCTION NOTIFICATIONS AND APPLY FOR AND OBTAIN NECESSARY PERMITS ASSOCIATED WITH THE WORK INDICATED ON THE DRAWINGS.
6. TRAFFIC SIGNAGE AND PAVEMENT MARKINGS SHALL CONFORM TO THE MANUAL OF UNIFORM TRAFFIC CONTROL DEVICES.
7. IN THE EVENT THAT SUSPECTED CONTAMINATED SOIL, GROUNDWATER, AND/OR OTHER MEDIA ARE ENCOUNTERED DURING EXCAVATION AND CONSTRUCTION ACTIVITIES BASED ON VISUAL, OLFACTORY, OR OTHER EVIDENCE, THE CONTRACTOR SHALL STOP WORK IN THE VICINITY OF THE SUSPECT MATERIAL TO AVOID FURTHER SPREADING OF THE MATERIAL, AND SHALL NOTIFY THE OWNER IMMEDIATELY SO THAT THE APPROPRIATE TESTING AND SUBSEQUENT ACTION CAN BE TAKEN.
8. CONTRACTOR SHALL PREVENT DUST, SEDIMENT, AND DEBRIS FROM EXITING THE SITE AND SHALL BE RESPONSIBLE FOR CLEANUP, REPAIRS AND CORRECTIVE ACTION IF SUCH OCCURS.
9. CONTRACTOR SHALL CONTROL STORMWATER RUNOFF DURING CONSTRUCTION TO PREVENT ADVERSE IMPACTS TO OFF SITE AREAS, AND SHALL BE RESPONSIBLE TO REPAIR RESULTING DAMAGES, IF ANY, AT NO COST TO OWNER.
10. THIS PROJECT DISTURBS MORE THAN 2500 SQUARE FEET OF LAND AND FALLS WITHIN THE VIRGINIA STORMWATER MANAGEMENT PROGRAM (VSMP). GENERAL CONSTRUCTION PERMIT (GCP) PROGRAM AS ADMINISTERED BY THE VIRGINIA DEPARTMENT OF CONSERVATION AND RECREATION (DCR) UNDER THE JURISDICTION OF THE EPA.
11. THE EXISTING CONDITIONS ON THIS PLAN ARE A RESULT OF AN ON THE GROUND SURVEY PERFORMED BY VHB, SUCCESSOR TO LANDMARK DESIGN GROUP, DURING FEBRUARY 2012.
    A. THE LOCATIONS OF EXISTING UNDERGROUND UTILITIES SHOWN ON THIS PLAN ARE BASED ON FIELD OBSERVATIONS AND INFORMATION OF RECORD. THEY ARE NOT WARRANTED TO BE EXACTLY LOCATED, NOR IS IT WARRANTED THAT ALL UNDERGROUND UTILITIES OR OTHER STRUCTURES ARE SHOWN ON THIS PLAN.
    A. DELINEATION OF THE WETLANDS ARE FROM PLANS OF RECORD
    B. FLAGS MARKING THE WETLANDS WERE LOCATED BY: N/A
12. TOPOGRAPHY:
    A. HORIZONTAL DATUM BASED ON SITE CONTROL. VIRGINIA STATE PLANE SOUTH ZONE (NAD 83).
    B. VERTICAL DATUM BASED ON RECORD DRAWINGS FOR BMP PREPARED BY LANDMARK DESIGN GROUP, INC. NOW VHB.

## Utilities

1. THE LOCATIONS, SIZES, AND TYPES OF EXISTING UTILITIES ARE SHOWN AS AN APPROXIMATE REPRESENTATION ONLY. THE OWNER OR IT'S REPRESENTATIVE(S) HAVE NOT INDEPENDENTLY VERIFIED THIS INFORMATION AS SHOWN ON THE PLANS. THE UTILITY INFORMATION SHOWN DOES NOT GUARANTEE THE ACTUAL EXISTENCE, SERVEABILITY, OR OTHER DATA CONCERNING THE UTILITIES, NOR DOES IT GUARANTEE AGAINST THE POSSIBILITY THAT ADDITIONAL UTILITIES MAY BE PRESENT THAT ARE NOT SHOWN ON THE PLANS. PRIOR TO ORDERING MATERIALS AND BEGINNING CONSTRUCTION, THE CONTRACTOR SHALL VERIFY AND DETERMINE THE EXACT LOCATIONS, SIZES, AND ELEVATIONS OF THE POINTS OF CONNECTIONS TO EXISTING UTILITIES AND, SHALL CONFIRM THAT THERE ARE NO INTERFERENCES WITH EXISTING UTILITIES AND THE PROPOSED UTILITY ROUTES, INCLUDING ROUTES WITHIN THE PUBLIC RIGHTS OF WAY.
2. WHERE AN EXISTING UTILITY IS FOUND TO CONFLICT WITH THE PROPOSED WORK, OR EXISTING CONDITIONS DIFFER FROM THOSE SHOWN SUCH THAT THE WORK CANNOT BE COMPLETED AS INTENDED, THE LOCATION, ELEVATION, AND SIZE OF THE UTILITY SHALL BE ACCURATELY DETERMINED WITHOUT DELAY BY THE CONTRACTOR, AND THE INFORMATION FURNISHED IN WRITING TO THE OWNER'S REPRESENTATIVE FOR THE RESOLUTION OF THE CONFLICT AND CONTRACTOR'S FAILURE TO NOTIFY PRIOR TO PERFORMING ADDITIONAL WORK RELEASES OWNER FROM OBLIGATIONS FOR ADDITIONAL PAYMENTS WHICH OTHERWISE MAY BE WARRANTED TO RESOLVE THE CONFLICT.
3. SET CATCH BASIN RIMS, AND INVERTS OF SEWERS, DRAINS, AND DITCHES IN ACCORDANCE WITH ELEVATIONS ON THE GRADING AND UTILITY PLANS.
4. CONTRACTOR SHALL MAKE ARRANGEMENTS FOR ALL UTILITY RELOCATIONS.

## Layout and Materials

1. ANY PROPERTY LINE MONUMENTATION DISTURBED DURING CONSTRUCTION SHALL BE SET OR RESET BY A VIRGINIA LICENSED LAND SURVEYOR.
2. PRIOR TO START OF CONSTRUCTION, CONTRACTOR SHALL VERIFY EXISTING PAVEMENT ELEVATIONS AT INTERFACE WITH PROPOSED PAVEMENTS, AND EXISTING GROUND ELEVATIONS ADJACENT TO DRAINAGE OUTLETS TO ASSURE PROPER TRANSITIONS BETWEEN EXISTING AND PROPOSED FACILITIES.
3. SYMBOLS AND LEGENDS OF PROJECT FEATURES ARE GRAPHIC REPRESENTATIONS AND ARE NOT NECESSARILY SCALED TO THEIR ACTUAL DIMENSIONS OR LOCATIONS ON THE DRAWINGS. THE CONTRACTOR SHALL REFER TO THE DETAIL SHEET DIMENSIONS, MANUFACTURERS' LITERATURE, SHOP DRAWINGS AND FIELD MEASUREMENTS OF SUPPLIED PRODUCTS FOR LAYOUT OF THE PROJECT FEATURES.
4. CONTRACTOR SHALL NOT RELY ON ELECTRONIC VERSIONS OF PLANS, SPECIFICATIONS, AND DATA FILES THAT ARE OBTAINED FROM THE DESIGNERS, BUT SHALL VERIFY LOCATION OF PROJECT FEATURES IN ACCORDANCE WITH THE PAPER COPIES OF THE PLANS AND SPECIFICATIONS THAT ARE SUPPLIED AS PART OF THE CONTRACT DOCUMENTS.

## Stormwater General Permit Notes

*THE CONTRACTOR SHALL ENSURE COMPLIANCE WITH THE REQUIREMENTS OF VR 680-14-19 -- VIRGINIA* STORMWATER MANAGEMENT PROGRAM (VSMP) GENERAL PERMIT FOR STORM WATER DISCHARGES FROM CONSTRUCTION SITES, INCLUDING BUT NOT LIMITED TO THE FOLLOWING ITEMS:

IMPLEMENTATION, DOCUMENTATION, AND INSPECTIONS NECESSARY FOR COMPLIANCE WITH STORM WATER GENERAL PERMIT

1. IMPLEMENTATION OF THE STORM WATER POLLUTION PREVENTION PLAN AS DEVELOPED FOR THE SITE AND IN ACCORDANCE WITH THE GENERAL PERMIT REQUIREMENTS WITH REGARD TO EROSION AND SEDIMENT CONTROL, POST-CONSTRUCTION STORM WATER MANAGEMENT, AND OTHER CONTROLS REGARDING SOLID MATERIALS, SEDIMENTS AND DUST, AND THE DEMONSTRATED COMPLIANCE WITH APPLICABLE STATE AND/OR LOCAL WASTE DISPOSAL, SANITARY SEWER OR SEPTIC SYSTEM REGULATIONS.
2. RETENTION OF THE STORM WATER POLLUTION PREVENTION PLAN AT THE CONSTRUCTION SITE. THE PLAN AND OTHER RELATED DOCUMENTS SHALL BE MADE AVAILABLE UPON REQUEST TO AUTHORIZED LOCAL, STATE, OR FEDERAL REPRESENTATIVES.
3. AMENDMENT OF THE STORM WATER POLLUTION PREVENTION PLAN WHENEVER THERE IS A CHANGE IN DESIGN, CONSTRUCTION, OPERATION, OR MAINTENANCE, WHICH HAS A SIGNIFICANT EFFECT ON THE POTENTIAL FOR THE DISCHARGE OF POLLUTANTS TO THE SURFACE WATERS OF THE STATE, OR IF THE STORM WATER POLLUTION PREVENTION PLAN PROVES TO BE INEFFECTIVE IN ELIMINATING OR SIGNIFICANTLY MINIMIZING POLLUTANTS FROM THE CONSTRUCTION ACTIVITY.
4. DOCUMENTATION OF THE DATES WHEN MAJOR GRADING ACTIVITIES OCCUR, WHEN CONSTRUCTION ACTIVITIES TEMPORARILY OR PERMANENTLY CEASE ON A PORTION OF THE SITE, AND WHEN STABILIZATION MEASURES ARE IMPLEMENTED.
5. INSPECTIONS OF DISTURBED AREAS OF THE CONSTRUCTION SITE AND AREAS USED FOR STORAGE OF MATERIALS THAT ARE EXPOSED TO PRECIPITATION THAT HAVE NOT BEEN FINALLY STABILIZED, STRUCTURAL CONTROL MEASURES, AND LOCATIONS WHERE VEHICLES ENTER OR EXIT THE SITE SHALL BE CONDUCTED AT LEAST ONCE EVERY SEVEN CALENDAR DAYS AND WITHIN 24 HOURS OF THE END OF A STORM EVENT THAT PRODUCES SURFACE RUNOFF AS REQUIRED BY THE GENERAL PERMIT REGULATIONS. REPORTS SUMMARIZING THE INSPECTIONS SHALL BE MADE IN ACCORDANCE TO THE REGULATIONS AND RETAINED AS PART OF THE STORM WATER POLLUTION PREVENTION PLAN.
6. ALL CONTRACTORS AND SUBCONTRACTORS SHALL SIGN A COPY OF THE CERTIFICATION STATEMENT AS DESCRIBED IN THE GENERAL PERMIT BEFORE CONDUCTING ANY PROFESSIONAL SERVICES AT THE SITE IDENTIFIED IN THE POLLUTION PREVENTION PLAN. ALL CERTIFICATIONS SHALL BE INCLUDED IN THE STORM WATER POLLUTION PREVENTION PLAN.
7. ALL DOCUMENTS, RECORDS, REPORTS, AND OTHER INFORMATION RELEVANT TO THE GENERAL PERMIT REGULATIONS SHALL BE GIVEN TO THE OWNER FOLLOWING FINAL STABILIZATION OF THE SITE.
8. WHERE THE SITE HAS BEEN FINALLY STABILIZED AND ALL STORM WATER DISCHARGES FROM CONSTRUCTION ACTIVITIES THAT ARE AUTHORIZED BY THE GENERAL PERMIT ARE ELIMINATED, A NOTICE OF TERMINATION SHALL BE PREPARED FOR THE OWNER TO SIGN AND SUBMIT TO THE VIRGINIA DEPARTMENT OF ENVIRONMENTAL QUALITY, WATER DIVISION.
9. THE STRUCTURAL STABILITY OF THE PERMITTED FACILITIES SHALL BE ENSURED.

## Demolition

1. CONTRACTOR SHALL REMOVE AND DISPOSE OF EXISTING MANMADE SURFACE FEATURES WITHIN THE LIMIT OF WORK INCLUDING BUILDINGS, STRUCTURES, PAVEMENTS, SLABS, CURBING, FENCES, UTILITY POLES, SIGNS, ETC. UNLESS INDICATED OTHERWISE ON THE DRAWINGS. REMOVE AND DISPOSE OF EXISTING UTILITIES, FOUNDATIONS AND UNSUITABLE MATERIAL BENEATH AND FOR A DISTANCE OF 10 FEET BEYOND THE PROPOSED BUILDING FOOTPRINT INCLUDING EXTERIOR COLUMNS.
2. EXISTING UTILITIES SHALL BE TERMINATED, UNLESS OTHERWISE NOTED, IN CONFORMANCE WITH LOCAL, STATE AND INDIVIDUAL UTILITY COMPANY STANDARD SPECIFICATIONS AND DETAILS. THE CONTRACTOR SHALL COORDINATE UTILITY SERVICE DISCONNECTS WITH THE UTILITY REPRESENTATIVES.
3. CONTRACTOR SHALL DISPOSE OF DEMOLITION DEBRIS IN ACCORDANCE WITH APPLICABLE FEDERAL, STATE AND LOCAL REGULATIONS, ORDINANCES AND STATUTES.
4. THE ENGINEER HAS NOT PREPARED DESIGNS FOR AND SHALL HAVE NO RESPONSIBILITY FOR THE PRESENCE, DISCOVERY, REMOVAL, ABATEMENT OR DISPOSAL OF HAZARDOUS MATERIALS, TOXIC WASTES OR POLLUTANTS AT THE PROJECT SITE. THE ENGINEER SHALL NOT BE RESPONSIBLE FOR ANY CLAIMS OF LOSS, DAMAGE, EXPENSE, DELAY, INJURY OR DEATH ARISING FROM THE PRESENCE OF HAZARDOUS MATERIAL AND CONTRACTOR SHALL INDEMNIFY AND HOLD HARMLESS THE ENGINEER FROM ANY CLAIMS MADE IN CONNECTION THEREWITH. MOREOVER, THE ENGINEER SHALL HAVE NO ADMINISTRATIVE OBLIGATIONS OF ANY TYPE WITH REGARD TO ANY CONTRACTOR AMENDMENT INVOLVING THE ISSUES OF PRESENCE, DISCOVERY, REMOVAL, ABATEMENT OR DISPOSAL OF ASBESTOS OR OTHER HAZARDOUS MATERIALS.

## Suggested Sequence of Contruction

1. Notify James City County Engineering and Resource Protection Division (E&RPD) and Virginia Department of Conservation and Recreation (DCR) minimum 48-hours in advance of commencement of construction operations.
2. Conduct pre-construction meeting on-site between contractor, the owner, the engineer and James City County E&RPD inspector.
3. Flag the limits of construction as indicated on the E&SC Plan.
4. Install Erosion and Sediment Control measures as indicated on the plans.
5. Clearing, demolition and grading activities may proceed only upon inspection and approval of the construction entrance and all erosion and sediment control measures, indicated on the E&SC Plan, by the JCCE&RPD inspector.
6. Clear, grub and grade as indicated on the plans.
7. Install stilling basin and series of step-pools per approved plans.
8. Proceed with fine grading.
9. Installation planting per mitigation tables and approved shop drawings.
10. Complete permanent seeding, fertilize and mulch as required.
11. After final site stabilization and upon receiving authorization from the assigned JCCE&RPD inspector remove temporary erosion and sediment control measures.
12. During all phases of construction, contractor shall perform daily inspections of the receiving drainage channel. Erosion and sediment control devices shall be inspected and repaired or replaced as necessary after each storm event.
13. Contractor shall be responsible for any additional sediment controls and removal of sediment caused by construction.

**James City County Engineering and Resource Protection Division Standard Erosion and Sediment Control Notes Revised October 1, 2009**

The following standard erosion and sediment control (E&SC) notes shall become part of approved erosion and sediment control plans for all plans of development projects in James City County, Virginia.

1. All the provisions of Virginia Erosion and Sediment Control Law and Regulations, Minimum Standards, Handbooks, and Technical Bulletins as published by the Virginia Soil & Water Conservation Board and/or the Virginia Department of Conservation and Recreation, Division of Soil & Water Conservation shall apply to the project.
2. Minimum Standards # 1 through # 19 of the Virginia Erosion and Sediment Control Regulations (4VAC50-30-40) shall apply to the project.
3. The Owner or Applicant shall be responsible to register for coverage under the General Permit for Discharge of Stormwater from Construction Activities, in accordance with current requirements of the Virginia Stormwater Management Program (VSMP) and the Virginia Department of Conservation and Recreation.
4. The Owner or Applicant shall provide the name of an individual holding a valid Responsible Land Disturber (RLD) certificate of competence who will be responsible for the land-disturbing activity prior to engaging in the land-disturbing activity. This will be necessary prior to issuance of a land-disturbing permit for the project. The RLD is required to attend the preconstruction conference for the project.
5. The Contractor is responsible to contact Miss Utility (Dial 811 in VA or 1-800-552-7001) prior to any utility or site work excavations.
6. All erosion and sediment control measures shall be planned, designed, implemented, installed and maintained in accordance with the provisions of the latest edition of the Virginia Erosion and Sediment Control Handbook (VESCH). The Contractor shall maintain, inspect and repair all erosion and sediment control measures as needed throughout the life of the project to ensure continued acceptable performance.
7. A preconstruction conference (meeting) shall be held on site between the County Engineering and Resource Protection Division, the Owner-Applicant, the Responsible Land-Disturber (RLD), the Contractor and other responsible agencies, as applicable, prior to issuance of a land-disturbing permit. The Owner or Applicant is required to coordinate scheduling of the preconstruction conference between all applicable parties. The Contractor shall submit a Sequence of Construction to the County Engineering and Resource Protection Division for review and approval prior to the preconstruction meeting.
9. Additional safety fence or dust control measures, in accordance with the provisions of Minimum Standards & Specs. 3.01 and 3.39 of the Virginia Erosion and Sediment Control Handbook (VESCH), may be required to be implemented in addition to that shown on the approved plan in order to ensure adequate protection of the health, safety and welfare of the public or if site conditions change, become apparent or alter significantly following the date of plan approval.
10. Erosion and sediment control measures may require minor field adjustments at or following time of construction to ensure their intended purpose is accomplished, to ensure adequate protection of the health, safety and welfare of the public, or if site conditions change, become apparent or alter significantly following the date of plan approval. County Environmental Division approval shall be required for any deviation of erosion and sediment control measures from the approved plan.
11. Off-site waste or borrow areas shall be approved by the County Environmental Division prior to the import of any borrow or export of any waste to or from the project site.
12. Culvert and storm drain inlet protections, in accordance with the provisions of Minimum Standards & Specs. 3.07 & 3.08 of the Virginia Erosion and Sediment Control Handbook (VESCH), may be removed at the discretion of the assigned County Environmental Division inspector should placement of the measure result in excessive road flooding or traffic hazard or result in the redirection of drainage onto or toward existing lots, driveways or structures. Decisions shall be made on a case-by-case basis based on field situations encountered.
13. Drainage facilities shall be installed and functional within 30 days following completion of rough grading at any point within the project.
14. No more than 300 feet of trench may be open at one time for underground utility lines, including storm water conveyances. All other provisions of Minimum Standard # 16 of the Virginia Erosion and Sediment Control regulations apply.
15. If disturbed area stabilization is to be accomplished during the months of December, January or February, stabilization shall consist of Mulching in accordance with Minimum Standard & Spec. 3.35 of the Virginia Erosion and Sediment Control Handbook (VESCH). Seeding will then take place as soon as the season permits.
16. The term seeding, final vegetative cover or stabilization on the approved plan shall mean the successful germination and establishment of a stable grass cover from a properly prepared seedbed, in accordance with Minimum Standards & Specs. 3.29 through 3.37 of the Virginia Erosion and Sediment Control Handbook (VESCH), as applicable. Irrigation, if necessary, shall comply with all applicable outdoor water use restrictions of the James City Service Authority.
17. Temporary erosion and sediment control measures shall not be removed until all disturbed areas are stabilized. Removal shall not occur without authorization by the County Environmental Division. Disturbances associated with the removal of temporary erosion and sediment control measures shall be properly stabilized.
18. No sediment trap or sediment basin shall be removed until a) at least 75 percent of the single-family lots within the drainage area to the trap or basin have been sold to a third party for the construction of homes (unrelated to the developer); and/or, b) 60 percent of the single-family lots within the drainage area to the trap or basin are completed and stabilized. A bulk sale of the lots to another builder does not satisfy this provision. Sediment traps and sediment basins shall not be removed without authorization of the County Environmental Division.
19. Applicable provisions of the County BMP Manual (James City County Guidelines for Design and Construction of Stormwater Management BMPs) and the Virginia Stormwater Management Handbook (VSMH) apply to the project.
20. Design and construction of private-type storm drainage systems, outside VDOT right-of-way, shall be performed in accordance with the current version of the James City County Environmental Division, Stormwater Drainage Conveyance Systems (Non-BMP related), General Design and Construction Guidelines.
21. Record Drawings (Asbuilts) and Construction Certifications are required for all stormwater facilities including stormwater management/BMP facilities and storm drainage conveyance systems. Record drawings and construction certifications must meet established program requirements of both the County Environmental and Stormwater Divisions.
22. All stormwater facilities including BMPs, storm drainage pipes, stormwater conveyances, inlets, manholes, outfalls and roadside and other open channels shall be inspected by the County Stormwater Division and geotechnical engineer in accordance with established County Stormwater Division program requirements.

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Transportation
Land Development
Environmental Services
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Williamsburg, Virginia 23185
757.220.0500 • FAX 757.220.8544

| No. | Revision | Date | Apprvd. |
|---|---|---|---|
| 1 | Revised Per County Comments | 07/23/2012 | PS |

Designed by CRS | Drawn by BSG | Checked by PS
CAD checked by | Approved by
Scale As Noted | Date June 22, 2012

Project Title
Stonehouse Glen, LLC
Stonehouse Glen
BMP Outfall Repair
9304 Stonehouse Glen
Toano, Virginia

Issued for
Not Approved for Construction

Drawing Title
Legend and General Notes

COMMONWEALTH OF VIRGINIA
PETER SWIETLICHOWSKI
Lic. No. 044606
07/24/12
PROFESSIONAL ENGINEER

Drawing Number
C-1
Sheet of
Project Number
33315.01

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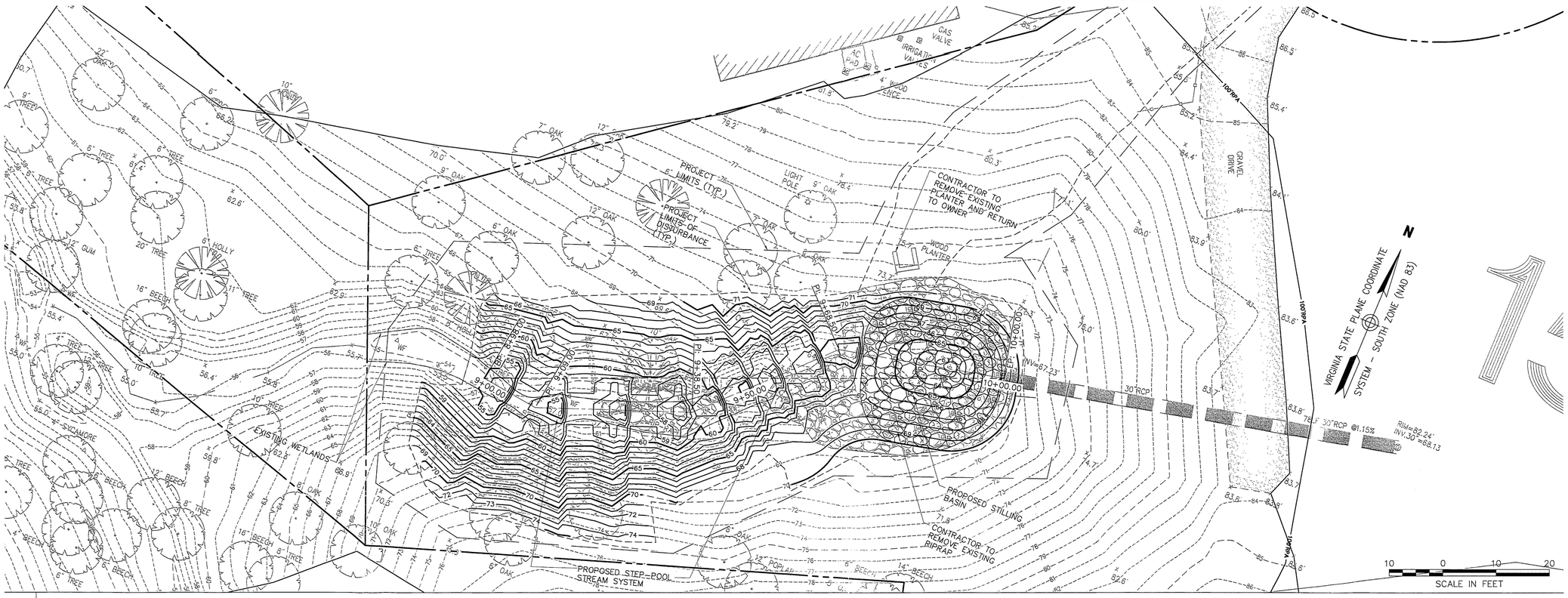


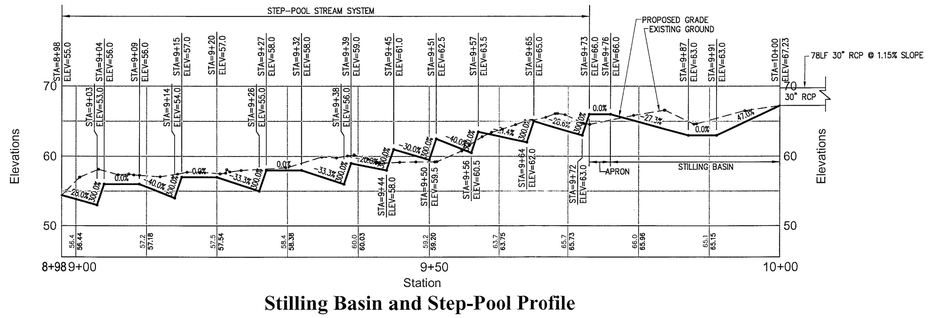


**Stilling Basin and Step-Pool Profile**

HORIZONTAL
10 0 10 20
10 0 10 20
VERTICAL
SCALE IN FEET

JCC CASE SP-0058-2012

Vanasse Hangen Brustlin, Inc.

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Land Development
Environmental Services

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9304 Stonehouse Glen
Toano, Virginia

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Drawing Title
Grading Plan

COMMONWEALTH OF VIRGINIA
PIOTR SWIETUCHOWSKI
Lic. No. 044606
06/22/12
PROFESSIONAL ENGINEER

Drawing Number
C-2

Sheet 1 of 1

Project Number
33315.01

3331501-GD.DWG

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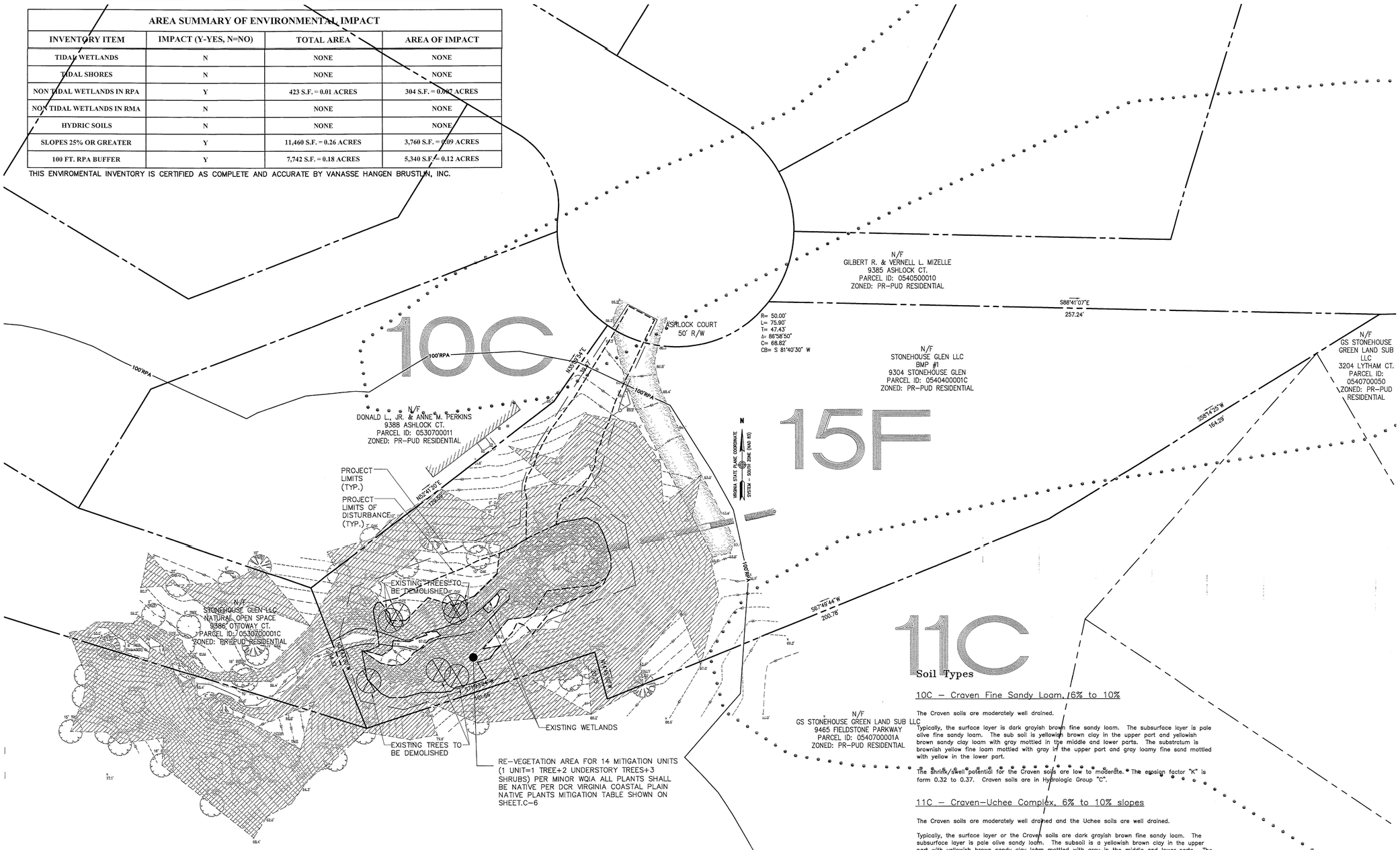
## AREA SUMMARY OF ENVIRONMENTAL IMPACT

| INVENTORY ITEM | IMPACT (Y-YES, N=NO) | TOTAL AREA | AREA OF IMPACT |
|---|---|---|---|
| TIDAL WETLANDS | N | NONE | NONE |
| TIDAL SHORES | N | NONE | NONE |
| NON TIDAL WETLANDS IN RPA | Y | 423 S.F. = 0.01 ACRES | 304 S.F. = 0.007 ACRES |
| NON TIDAL WETLANDS IN RMA | N | NONE | NONE |
| HYDRIC SOILS | N | NONE | NONE |
| SLOPES 25% OR GREATER | Y | 11,460 S.F. = 0.26 ACRES | 3,760 S.F. = 0.09 ACRES |
| 100 FT. RPA BUFFER | Y | 7,742 S.F. = 0.18 ACRES | 5,340 S.F. = 0.12 ACRES |

THIS ENVIROMENTAL INVENTORY IS CERTIFIED AS COMPLETE AND ACCURATE BY VANASSE HANGEN BRUSTLIN, INC.




LEGEND

- SOIL LIMITS — 8B
- EX. CONTOURS
- APPROXIMATE LIMIT OF 25% AND GREATER SLOPES
- NONTIDAL WETLANDS
- PHASE 2 R/W
- PHASE 2 LOTS

ENVIRONMENTAL INVENTORY
STONEHOUSE GLEN SECTION 1

1. TIDAL WETLANDS: THERE ARE NO TIDAL WETLANDS IN THE AREA OF STONEHOUSE GLEN SECTION 1.
2. TIDAL SHORES: THERE ARE NO TIDAL SHORES IN THE AREA OF STONEHOUSE GLEN SECTION 1.
3. NON-TIDAL WETLANDS IN RPA ARE SHOWN
4. THE 100 FOOT BUFFER AREA IS SHOWN
5. NON-TIDAL WETLANDS IN RMA ARE SHOWN
6. SLOPES 25 PERCENT OR GREATER ARE GENERALLY SHOWN ON THIS SHEET. FIELD SURVEYED LOCATIONS ON LOTS.

## Soil Types

### 10C – Craven Fine Sandy Loam, 6% to 10%

The Craven soils are moderately well drained.

Typically, the surface layer is dark grayish brown fine sandy loam. The subsurface layer is pale olive fine sandy loam. The sub soil is yellowish brown clay in the upper part and yellowish brown sandy clay loam with gray mottled in the middle and lower parts. The substratum is brownish yellow fine loam mottled with gray in the upper part and gray loamy fine sand mottled with yellow in the lower part.

The shrink/swell potential for the Craven soils are low to moderate. The erosion factor "K" is form 0.32 to 0.37. Craven soils are in Hydrologic Group "C".

### 11C – Craven–Uchee Complex, 6% to 10% slopes

The Craven soils are moderately well drained and the Uchee soils are well drained.

Typically, the surface layer or the Craven soils are dark grayish brown fine sandy loam. The subsurface layer is pale olive sandy loam. The subsoil is a yellowish brown clay in the upper part with yellowish brown sandy clay loam mottled with gray in the middle and lower parts. The substratum is brownish yellow fine sandy loam mottled with gray in the upper part and gray loamy fine sand with yellow mottles in the lower part.

Typically, the surface layer of the Uchee soil are dark grayish brown loamy fine sand. The subsurface layer is light yellowish brown and very pale brown loamy fine sand. The subsurface layer is light yellowish brown and very pale brown loamy fine sand. The subsoil is strong brown sandy clay loam in the upper part and strong brown sandy clay loam and clay mottled with gray and red in the lower part. The substratum is variegated red, brown and gray stratified sandy loam and sandy clay loam.

The shrink/swell potential for the Craven and Uchee soils are low to moderate. The erosion factor "K" is from 0.32 to 0.37 for the Craven soil and 0.20 to 0.28 for the Uchee soil. Craven soils are in hydrologic soils, Group "C", Uchee soils are in hydrologic soils Group "A".

### 15F – Emporia Complex, 25% to 50% slopes

The Emporia soil is well drained.

Typically, the surface layer is dark grayish brown fine sandy loam. The subsurface layer is pale brown loam. The subsoil is yellowish brown loam with mostly strong brown mottles in the upper part; yellowish brown, firm sandy loam with strong brown and gray mottles in the middle part; and mottled gray and brown, firm sandy clay loam in the lower part. The substratum is variegated gray, brown and red firm sandy clay loam.

The shrink/swell potential for the Emporia soils are low to moderate. The erosion factor "K" is from 0.20 to 0.28. Emporia soils are in hydrologic group "C".

20 0 20 40
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9304 Stonehouse Glen
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Not Approved for Construction

Drawing Title
Environmental Inventory

COMMONWEALTH OF VIRGINIA
PIOTR SWIETOCHOWSKI
Lic. No. 044606
07/24/12
PROFESSIONAL ENGINEER

Drawing Number
C-3
Sheet of
Project Number
33315.01

3331501-ENVIN.DWG

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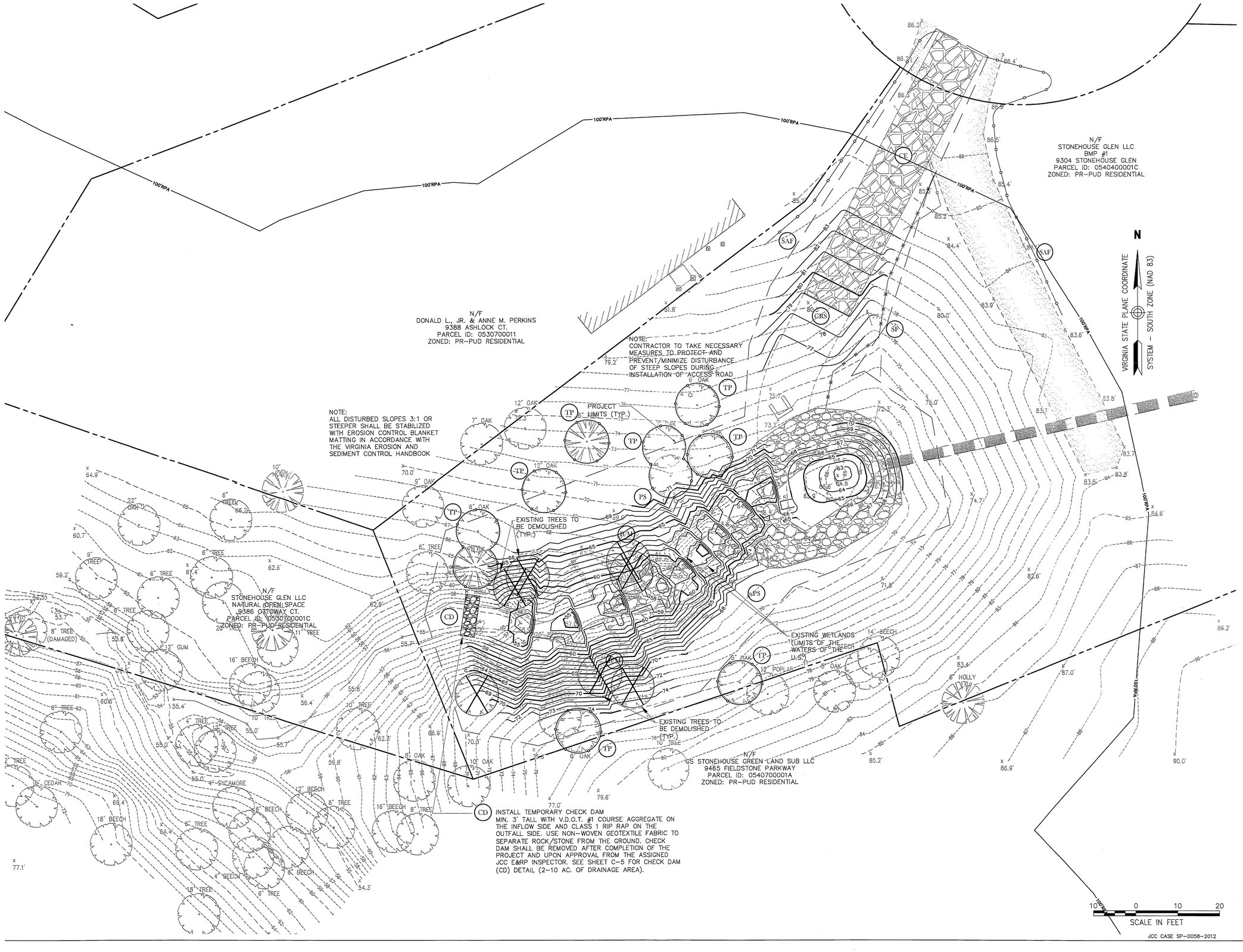


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Project Title
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Stonehouse Glen
BMP Outfall Repair
9304 Stonehouse Glen
Toano, Virginia

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Not Approved for Construction

Drawing Title
Erosion & Sediment Control Plan

COMMONWEALTH OF VIRGINIA
PIOTR SWIETOCHOWSKI
Lic. No. 044606
07/24/12
PROFESSIONAL ENGINEER

Drawing Number
C-4
Sheet of
Project Number
33315.01

3331501-ER.DWG

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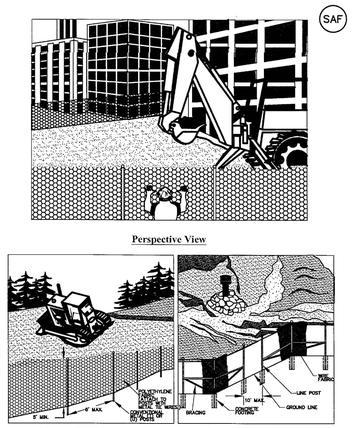
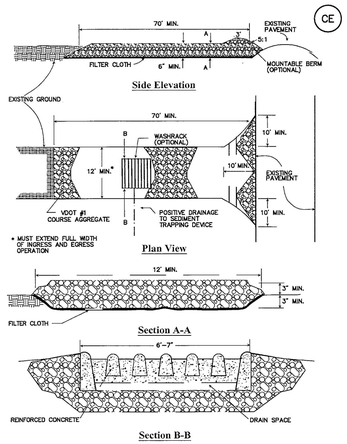



## Safety Fence

6/08

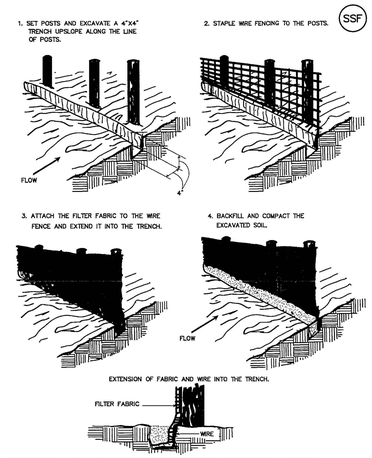
N.T.S. Source: Virginia Erosion And Sediment Control Handbook Plate 3.01-1




## Stone Construction Entrance

6/08

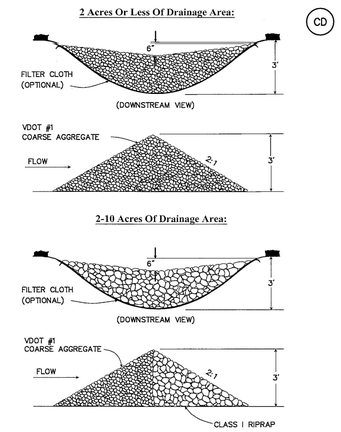
N.T.S. Source: Virginia Erosion And Sediment Control Handbook Plate 3.02-1




## Construction Of A Silt Fence (With Wire Support)

6/08

N.T.S. Source: Virginia Erosion And Sediment Control Handbook Plate 3.05-1

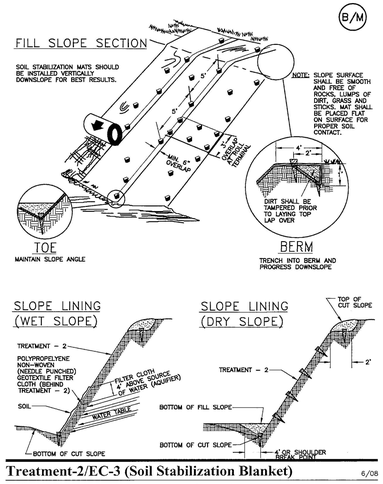



## Rock Check Dam

6/08

N.T.S. Source: Virginia Erosion And Sediment Control Handbook Plate 3.20-1

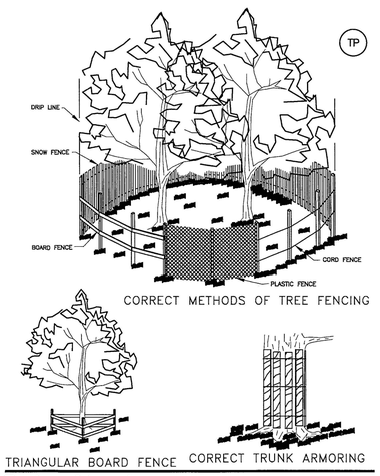
VHB
Vanasse Hangen Brustlin, Inc.
Transportation
Land Development
Environmental Services
351 McLaws Circle, Suite 3
Williamsburg, Virginia 23185
757.220.0500 • FAX 757.220.8544




## Treatment-2/EC-3 (Soil Stabilization Blanket)

6/08

N.T.S. Source: Virginia Erosion And Sediment Control Handbook PL 3.36.5




## Fencing and Armoring

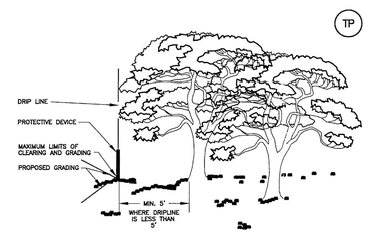
6/08

N.T.S. Source: Virginia Erosion And Sediment Control Handbook PL 3.38.2

**BMP SUMMARY**

| EVENT | OUTFLOW (CFS) | ELEVATION (FEET) |
|---|---|---|
| 1 YEAR | 0.72 | 79.88 |
| 2 YEAR | 2.57 | 80.63 |
| 10 YEAR | 46.86 | 81.46 |
| 100 YEAR | 86.74 | 81.94 |

SUMMARY BASED ON RECORD INFORMATION




## Construction Operations for Locating Protected Trees

6/08

N.T.S. Source: Virginia Erosion And Sediment Control Handbook PL 3.38.1

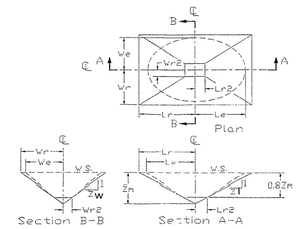
COMPUTATION SHEET
Design Note No. 6

U.S. DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

STATE PROJECT
BY PS DATE CHECKED BY DATE JOB NO. 33315.01
SUBJECT SHEET 2 of 2

**PLUNGE POOL DIMENISONS:**

| | |
|---|---|
| Depth at Center of Pool | 3.0 ft |
| Le = | 11.0 ft |
| We = | 7.2 ft |
| Lr2 = | 2.0 ft |
| Wr2 = | 1.5 ft |
| Z/ = | 3.7:1 |
| Lr = | 11.3 ft |
| Zw = | 1.5 |
| Wr = | 8.0 ft |
| Check Lr | OK |




107.3-106.823

| AREAS: | |
|---|---|
| A1 = | 364.2006 sqft |
| A2 = | 9.1 sqft |
| A1a1 = | 1546.488 sqft |
| A2a1 = | 20.19588 sqft |
| A1a2 = | 2000.152 sqft |
| A2a2 = | 23.86985 sqft |

| VOLUMES: | |
|---|---|
| Va1 = | 150.0706 cyds |
| Va2 = | 220.7191 cyds |
| Vao= | 17.13512 cyds |
| **Riprap =** | **132.9355** cyds |
| **Filter =** | **70.6485** cyds |

1992 3.32

**TABLE 3.32-D** (PS)

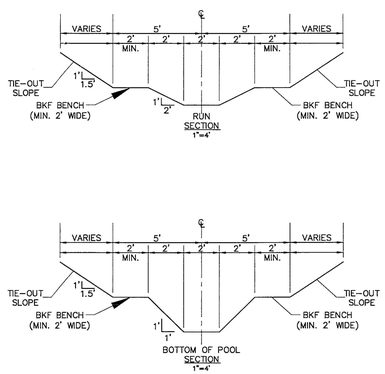
**SITE SPECIFIC SEEDING MIXTURES FOR COASTAL PLAIN AREA**

| | Total Lbs. Per Acre |
|---|---|
| Minimum Care Lawn | |
| - Commercial or Residential | |
| - Kentucky 31 or Turf-Type Tall Fescue | 175-200 lbs. |
| or | |
| - Common Bermudagrass ** | 75 lbs. |
| High-Maintenance Lawn | |
| - Kentucky 31 or Turf-Type Tall Fescue | 200-250 lbs. |
| or | |
| - Hybrid Bermudagrass (seed) ** | 40 lbs. (unhulled) 30 lbs. (hulled) |
| or | |
| - Hybrid Bermudagrass (by other vegetative establishment method, see Std. & Spec. 3.34) | |
| General Slope (3:1 or less) | |
| - Kentucky 31 Fescue | 128 lbs. |
| - Red Top Grass | 2 lbs. |
| - Seasonal Nurse Crop * | 20 lbs. |
| | 150 lbs. |
| Low Maintenance Slope (Steeper than 3:1) | |
| - Kentucky 31 Tall Fescue | 93-108 lbs. |
| - Common Bermudagrass ** | 0-15 lbs. |
| - Red Top Grass | 2 lbs. |
| - Seasonal Nurse Crop * | 20 lbs. |
| - Sericea Lespedeza ** | 20 lbs. |
| | 150 lbs. |

* Use seasonal nurse crop in accordance with seeding dates as stated below:
February, March through April ..... Annual Rye
May 1st through August ..... Foxtail Millet
September, October through November 15th ..... Annual Rye
November 16th through January ..... Winter Rye

** May through October, use hulled seed. All other seeding periods, use unhulled seed. Weeping Lovegrass may be added to any slope or low-maintenance mix during warmer seeding periods; add 10-20 lbs./acre in mixes.

III - 304

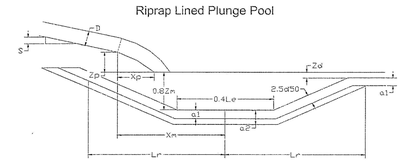



COMPUTATION SHEET
Design Note No. 6

U.S. DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

| STATE | VA | PROJECT: | | Stonehouse Glen BMP Outfall Repair | | |
|---|---|---|---|---|---|---|
| BY | PS | DATE: 4/13/2012 | CHECKED BY | DATE | JOB NO. | 33315.01 |
| SUBJECT: | BMP Outfall | | | SHEET | 1 of | 2 |

Riprap Lined Plunge Pool




| GIVEN: | | | |
|---|---|---|---|
| Flow Rate "Q" | 86.74 cfs | Riprap stone Density | 2.64 |
| Pipe Diameter "D" | 2.5 ft | Pipe slope | 0.012 ft/ft |
| Drop from pipe to w.s. "Zp" | 1 ft | Median Stone size "d50" | 1.5 ft |
| Depth of Tail water "Zd" | 0 ft | Filter Thickness | 1 ft |

| Solution: | | | |
|---|---|---|---|
| Pipe Velocity "Vo" | 17.7 fps | Projection Velocity "Vp" | 21.4 fps |
| Horizontal Velocity "Vh" | 17.7 fps | Impact Distance "Xp" | 6.5 ft |
| Vertical Velocity "Vv" | 12.0 fps | Froude Number | 2.40 |
| Punge Pool Depth "Zm" | | 4.23 ft | |
| Distance from Outlet end of pipe to center of Pool "Xm" | | 11.0 ft | |
| Riprap Size Check | | Adequate | |

(STILLING BASIN DESIGN DATA)

| No. | Revision | Date | Appvd. |
|---|---|---|---|
| 1 | Revised Per County Comments | 07/23/2012 | PS |

Designed by CRS | Drawn by BSG | Checked by PS
CAD checked by | Approved by
Scale | Date June 22, 2012

Project Title
Stonehouse Glen, LLC
Stonehouse Glen
BMP Outfall Repair
9304 Stonehouse Glen
Toano, Virginia

Issued for
Not Approved for Construction

Drawing Title
Details

COMMONWEALTH OF VIRGINIA
PETER SWIELUCHOWSKI
Lic. No. 044606
07/24/12
PROFESSIONAL ENGINEER

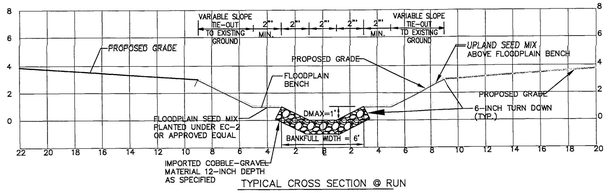
Drawing Number
C-5

Sheet 1 of

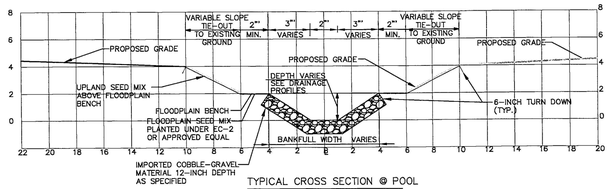
Project Number
33315.01

Saved: Tuesday, July 24, 2012 12:28:11 PM BGREENE Plotted Wednesday, July 25, 2012 9:12:57 AM Greene, Scott

## TYPICAL STEP-POOL SECTIONS

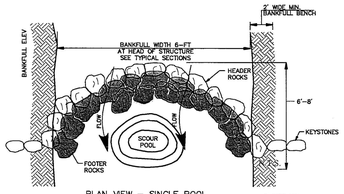



TYPICAL CROSS SECTION @ RUN

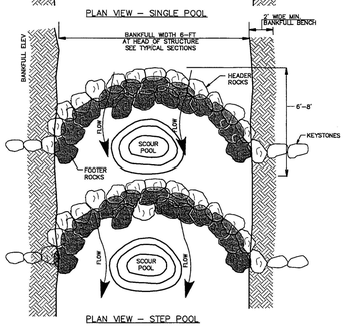



TYPICAL CROSS SECTION @ POOL

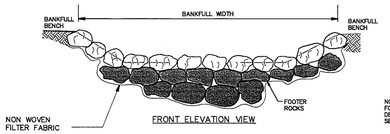
## GRADE CONTROL-HABITAT STRUCTURE DETAILS




PLAN VIEW - SINGLE POOL

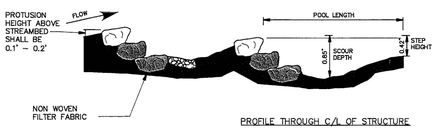



PLAN VIEW - STEP POOL




FRONT ELEVATION VIEW

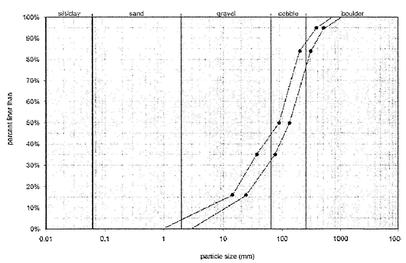
NOTE:
FOR POOL LENGTH, SCOUR DEPTH AND STEP HEIGHT SEE STEP-POOL PROFILE.




PROFILE THROUGH C/L OF STRUCTURE

STEP-POOL
NTS

**Cobble - Gravel - Sand Streambed Material**
**Gradation Curve / Envelope**




## STREAM RESTORATION CORRIDOR (MITIGATION) PLANTING SUMMARY AND NOTES

| SCIENTIFIC NAME | COMMON NAME | STOCK SIZE/ PLANT CALIPER | TOTAL NUMBER OF PLANTS |
|---|---|---|---|
| Trees | | | Total = 93 |
| Acer rubrum | Red Maple | TUBELINGS 0.5" TO 1.5" ● | 1 |
| Carpinus caroliniana | Iron Wood | TUBELINGS 0.5" TO 1.5" ● | 6 |
| Fraxinus pennsylvanica | Green Ash | TUBELINGS 0.5" TO 1.5" ● | 1 |
| Nyssa sylvatica | Black Gum | TUBELINGS 0.5" TO 1.5" ● | 15 |
| Platanus occidentalis | Sycamore | TUBELINGS 0.5" TO 1.5" ● | 1 |
| Quercus alba | White Oak | TUBELINGS 0.5" TO 1.5" ● | 1 |
| Quercus coccinea | Scarlet Oak | TUBELINGS 0.5" TO 1.5" ● | 1 |
| Quercus stellata | Post Oak | TUBELINGS 0.5" TO 1.5" ● | 1 |
| Quercus velutina | Black Oak | TUBELINGS 0.5" TO 1.5" ● | 1 |
| Robinia pseudoacacia | Black Locust | TUBELINGS 0.5" TO 1.5" ● | 4 |
| Cornus amomum | Silky Dogwood | TUBELINGS 0.5" TO 1.5" ● | 4 |
| Ulmus americana | American Elm | TUBELINGS 0.5" TO 1.5" ● | 15 |
| Shrubs | | | |
| Clethra alnifolia | Sweet Pepperbush | TUBELINGS – CONTAINER #2 ▲ | 10 |
| Lindera benzoin | Spicebush | TUBELINGS – CONTAINER #2 ▲ | 12 |
| Viburnum dentatum | Arrowwood | TUBELINGS – CONTAINER #2 ▲ | 10 |
| Viburnum prunifolium | Black Haw | TUBELINGS – CONTAINER #2 ▲ | 10 |

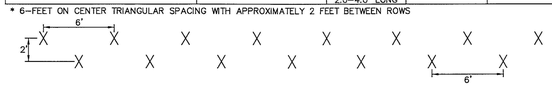
● SPLIT THE TOTAL NUMBER OF EACH PLANT SPECIES INTO EQUAL THIRDS OF TUBELINGS 0.5" CALIPER AND 1.5" CALIPER.

▲ SPLIT THE TOTAL NUMBER OF EACH PLANT SPECIES INTO EQUAL HALVES OF TUBELINGS AND CONTAINER #2.

## BANKFULL BENCH AREAS

| SCIENTIFIC NAME | COMMON NAME | SIZE | SPACING* | PLANT |
|---|---|---|---|---|
| Cornus stolonifrea | Red stem dogwood | 0.5–2.0" DIA. 2.0–4.0' LONG | 6' O.C. | LIVE STAKE |
| Cornus amomum | Silky dogwood | 0.5–2.0" DIA. 2.0–4.0' LONG | 6' O.C | LIVE STAKE |
| Salix nigra | Black willow | 0.5–2.0" DIA. 2.0–4.0' LONG | 6' O.C | LIVE STAKE |

* 6-FEET ON CENTER TRIANGULAR SPACING WITH APPROXIMATELY 2 FEET BETWEEN ROWS




**Planting Notes:**

CONTAINER DEFINED AS IN AMERICAN NURSERY STANDARD FOR NURSERY STOCK BY THE AMERICAN ASSOCIATION OF NURSERYMEN, INC.

BALLED AND BURLAPPED TREES CAN SERVE AS SUBSTITUTE STOCK WITH THE APPROVAL OF THE ENGINEER.

STREAM EDGE/BENCH AREAS TO BE PLANTED WITH LIVE STAKES USING 6' ON CENTER TRIANGULAR SPACING WITH 2-FT SPACING BETWEEN ROWS.

TREES AND LIVE STAKES SHALL NOT BE PLANTED UNTIL AFTER SEPEMBER 20th IN ORDER TO MAXIMIZE SURVIVABILITY.

A MINIMUM OF 60 DAYS PRIOR TO COMMENCING PLANTING OPERATIONS, THE CONTRACTOR SHALL SUBMIT A PLANTING PLAN THAT ILLUSTRATES NATURAL PLACEMENT AND CLUSTERING OF THE PROPOSED SPECIES. THIS PLAN MUST BE APPROVED BY THE ENGINEER 15 DAYS PRIOR TO DELIVERY OF PLANT MATERIALS TO THE SITE. FINAL PLACEMENT AND CLUSTERING OF TREES SHALL BE IN ACCORDANCE WITH THE ENGINEER.

## STREAM RESTORATION CORRIDOR SEED MIXTURE FOR UPLAND AREA

| SCIENTIFIC NAME | COMMON NAME |
|---|---|
| Agrostis perennas | Autumn Bentgrass |
| Chasmanthium latifolium (=Uniola latifolia) | River Oats |
| Elymus virginicus | Virginia Wild Rye |
| Lolium multiflorum | Annual Ryegrass |
| Panicum clandestinum | Tioga Deer Tongue |
| Panicum virgatum | Switch Grass |
| Tridens flavus | Purpletop |
| Asclepias tuberosa | Butterfly Milkweed |
| Chamaecrista fasciculata | Partridge Pea |
| Conoclinium coelestinum | Mistflower |
| Euthamia graminifolia | Grass Leaved Goldenrod |
| Geum canadense | White Avens |
| Solidago rugosa | Wrinkleaf Goldenrod |

* TOTAL SEEDING AREA = 0.06 ACRES
CONTRACTORS TO PROVIDE SEEDING RATE PER ACRE AND SEED BY WEIGHT PER SPECIES FOR APPROVAL BY THE ENGINEER PRIOR TO SEEDING

## STREAM RESTORATION CORRIDOR SEED MIXTURE FOR BANKFULL BENCH

| SCIENTIFIC NAME | COMMON NAME |
|---|---|
| Carex crinita | long hair sedge |
| Dichanthelium clandestinum | deer-tongue |
| Elymus virginicus | Virginia wild rye |
| Juncus effusus | soft rush |
| Panicum virgatum | Switch Grass |
| Scirpus cyperinus | woolgrass bulrush |

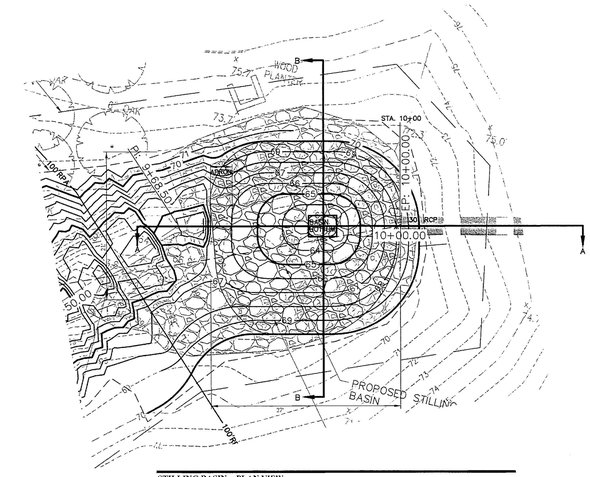
* TOTAL SEEDING AREA = 0.009 ACRES
CONTRACTORS TO PROVIDE SEEDING RATE PER ACRE AND SEED BY WEIGHT PER SPECIES FOR APPROVAL BY THE ENGINEER PRIOR TO SEEDING

**COBBLE-GRAVEL STREAMBED MATERIAL**

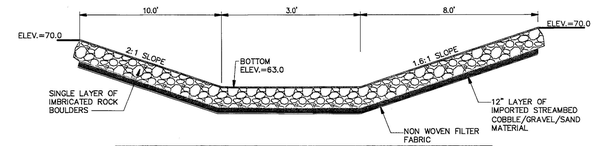
THE COBBLE-GRAVEL MATERIAL SPECIFIED BELOW MUST BE APPROVED BY THE ENGINEER AT THE CONTRACTOR'S PROPOSED SOURCE PRIOR TO BEING PLACED IN THE STREAM CHANNEL.

| Cumulative Percent of particles finer than indicated particle size | PARTICLE SIZE (mm/inches) | PARTICLE TYPE |
|---|---|---|
| D16 | 13–25mm/0.5–1.0in | sand |
| D35 | 38–76mm/1.5–3.0in | gravel–cobble |
| D50 | 89–140mm/3.5–5.5in | gravel–cobble |
| D84 | 203–305mm/8.0–12.0in | cobble–boulder |
| D95 | 381–508mm/15–20in | boulder |

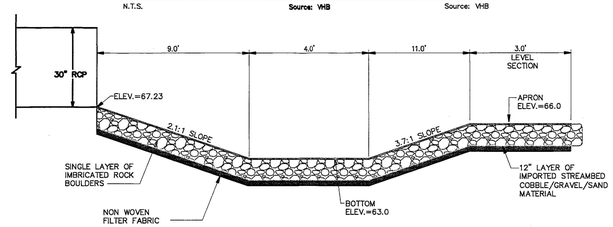
ALL IMPORTED BEDDING MATERIAL SHALL CONSIST OF FIELD STONE OR NATURAL RIVER ROCK SIMILAR IN COLOR AND APPEARANCE TO IN-SITU MATERIALS.
CRUSHED STONE SHALL NOT BE PERMITTED.
THE GRADATION OF IMPORTED MATERIALS SHALL FALL WITHIN THE ENVELOPE DEFINED BY THE GRADIATION CURVES AS INDICATED ON THIS SHEET.




STILLING BASIN - PLAN VIEW
STA. 10+00
N.T.S. Source: VHB Source: VHB 4/04



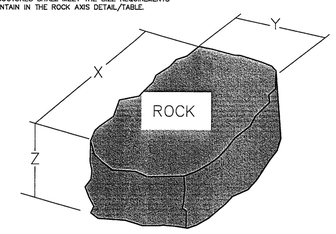

STILLING BASIN B-B SECTION
N.T.S. Source: VHB Source: VHB 4/04




STILLING BASIN A-A SECTION
N.T.S. Source: VHB Source: VHB 4/04

**Notes:**

ROCKS FOR THE STILLING BASIN AND STEP-POOL STRUCTURES SHALL MEET THE SIZE REQUIREMENTS CONTAIN IN THE ROCK AXIS DETAIL/TABLE.




| STRUCTURE TYPE | DIMENSION X | DIMENSION Y | DIMENSION Z |
|---|---|---|---|
| STILLING BASIN | 2.5' – 4' | 1.5' – 2.5' | 1' – 2' |
| STEP POOLS | 2.5' – 4' | 1.5' – 2.5' | 1' – 2' |

ROCK AXIS DETAIL/TABLE

NOTES:
BOULDERS FOR STILLING BASIN AND STEP POOL STRUCTURES SHALL BE A QUARRIED BLASTED ROCK PRODUCT. INDIVIDUAL ROCK FRAGMENTS SHALL BE BLOCKY IN SHAPE AND MEET THE MINIMUM/MAXIMUM SIZE REQUIREMENTS INDICATED IN THE ROCK AXIS DETAIL/TABLE ON THIS SHEET. THE LEAST DIMENSION OF ANY INDIVIDUAL ROCK FRAGMENT SHALL NOT BE LESS THAN 35% OF THE MAXIMUM DIMENSION.

THE CONTRACTOR AND ENGINEER SHALL JOINTLY VISIT THE CONTRACTOR'S PROPOSED MATERIAL SOURCE PRIOR TO DELIVERY OF ANY BOULDER MATERIAL TO PROTECT SITE. DURING THE QUARRY SITE VISIT, THE ENGINEER SHALL IDENTIFY AND MARK INDIVIDUAL BOULDERS REPRESENTATIVE OF MATERIALS MEETING THE SIZE AND SHAPE REQUIREMENTS AS SPECIFIED.

VHB
Vanasse Hangen Brustlin, Inc.
Transportation
Land Development
Environmental Services
351 McLaws Circle, Suite 3
Williamsburg, Virginia 23185
757.220.0500 • FAX 757.220.8544

| No. | Revision | Date | Appvd. |
|---|---|---|---|
| 1 | Revised Per County Comments | 07/23/2012 | PS |

Designed by CRS | Drawn by BSG | Checked by PS
CAD checked by | Approved by
Scale | Date June 22, 2012

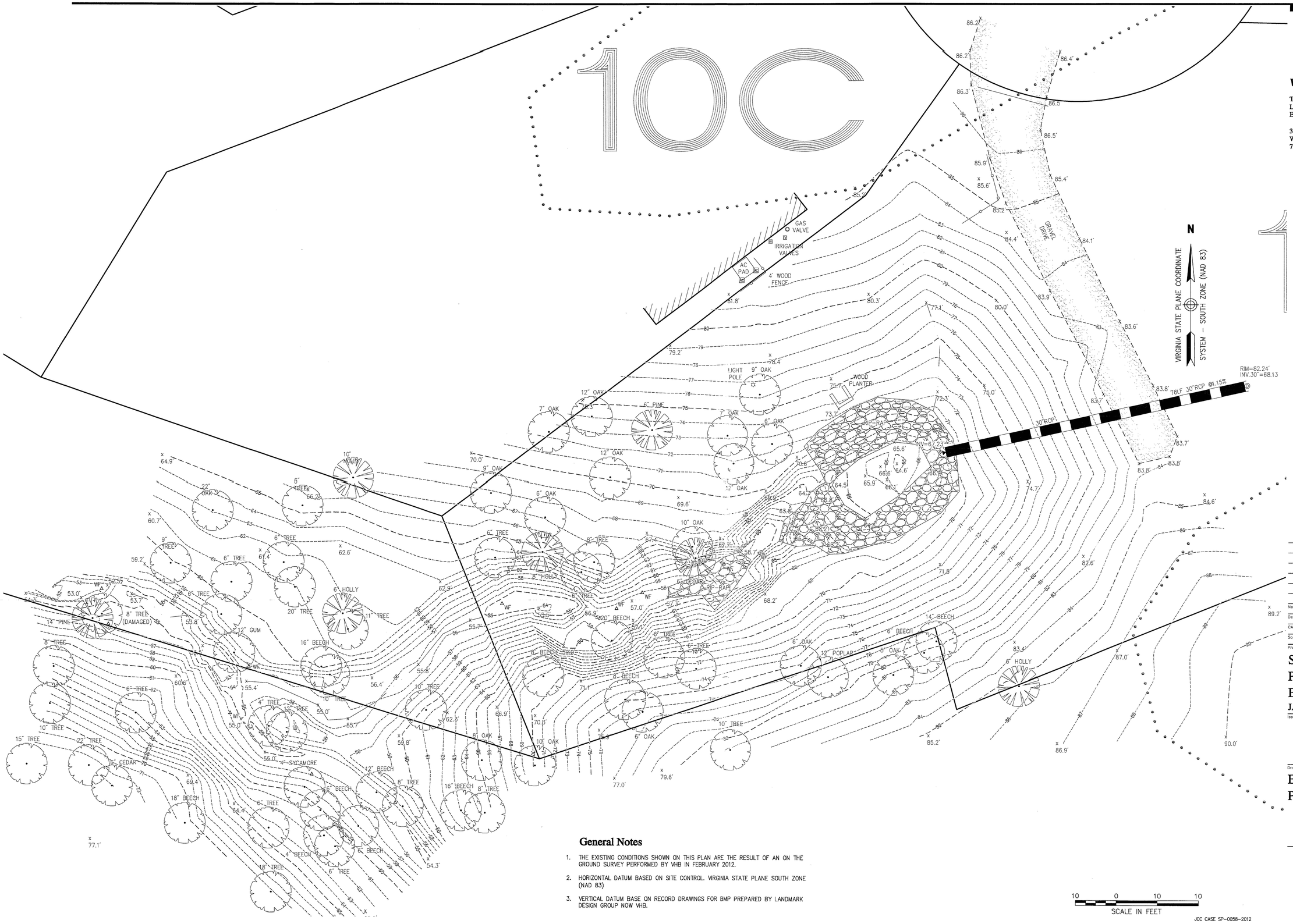
Project Title
Stonehouse Glen, LLC
Stonehouse Glen
BMP Outfall Repair
9304 Stonehouse Glen
Toano, Virginia

Issued for
Not Approved for Construction

Drawing Title
Details

COMMONWEALTH OF VIRGINIA
PIOTR SWIECICHOWSKI
Lic. No. 044606
07/24/12
PROFESSIONAL ENGINEER

Drawing Number
C-6
Sheet 1 of
Project Number
33315.01





**VHB**

***Vanasse Hangen Brustlin, Inc.***

Transportation
Land Development
Environmental Services

351 McLaws Circle, Suite 3
Williamsburg, Virginia 23185-6316
757 220 0500 • FAX 757 220 8544


## General Notes

1. THE EXISTING CONDITIONS SHOWN ON THIS PLAN ARE THE RESULT OF AN ON THE GROUND SURVEY PERFORMED BY VHB IN FEBRUARY 2012.
2. HORIZONTAL DATUM BASED ON SITE CONTROL. VIRGINIA STATE PLANE SOUTH ZONE (NAD 83)
3. VERTICAL DATUM BASE ON RECORD DRAWINGS FOR BMP PREPARED BY LANDMARK DESIGN GROUP NOW VHB.

| No. | Revision | Date | Appvd. |
|---|---|---|---|

| | | | |
|---|---|---|---|
| Designed by | Drawn by CRO | Checked by SAR | |
| CAD checked by SAR | | Approved by | |
| Scale 1"=10' | | Date 4/13/2012 | |

Project Title

# STONEHOUSE GLEN PHASE 1 BMP OUTFALL

## JAMES CITY COUNTY

Issued for

Drawing Title

## Existing Conditions Plan of Land

Drawing Number

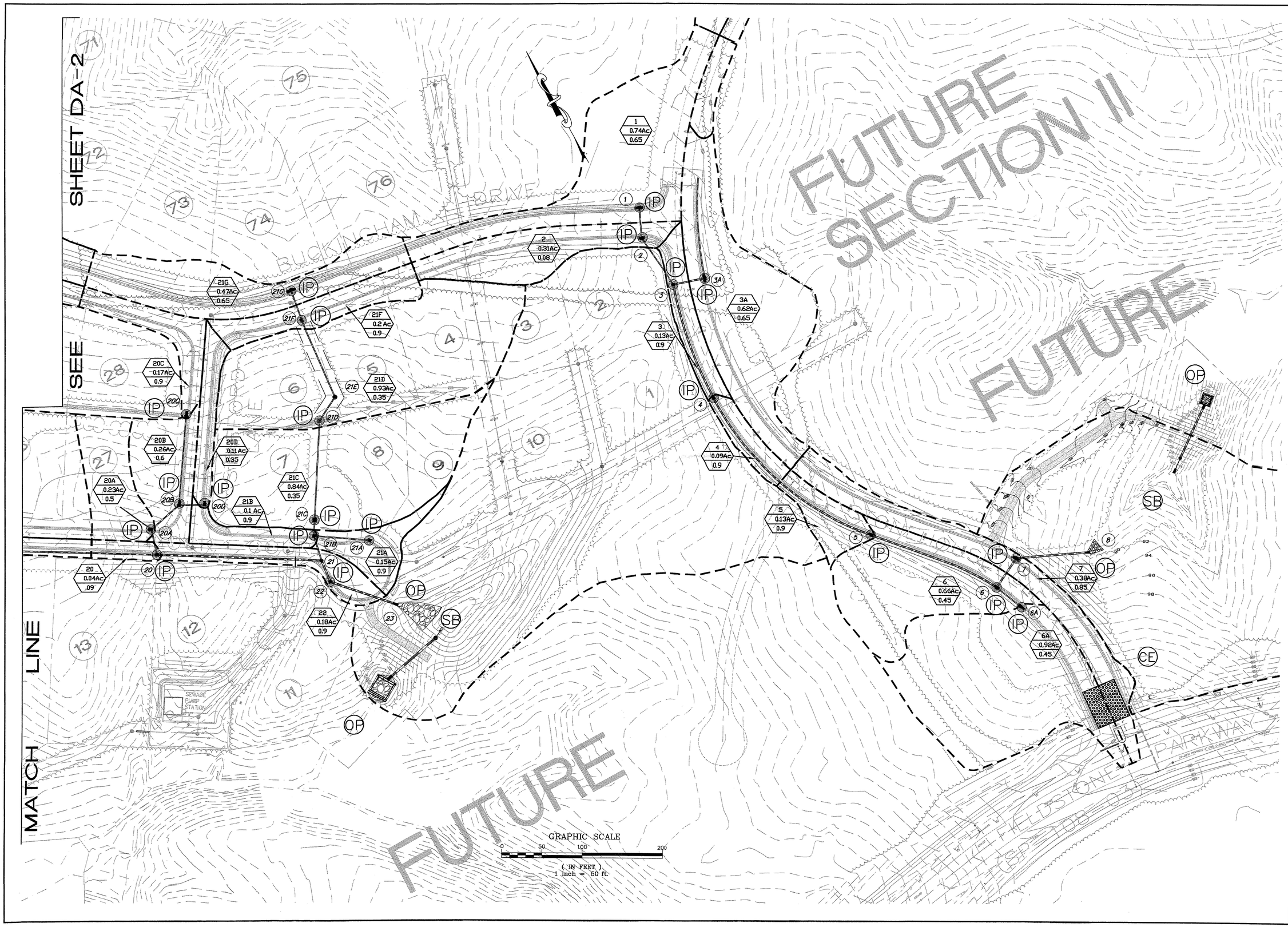
**SV-1**

Sheet 1 of 1

Project Number

JCC CASE SP-0058-2012

P:\33315.01 STONEHOUSE GLEN BMP OUTF\CAD\LD\PLANSET\3331501-SV.DWG

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Engineers • Planners • Surveyors
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REVISIONS:

| No. | Date | Comment | By |
|---|---|---|---|
| | | | |

DRAWING STATUS
- Interoffice Review
- Client for Review
- Pre Approval Bidding

COUNTY APPROVAL
- 1st Submittal
- 2nd Submittal
- 3rd Submittal
- Approved

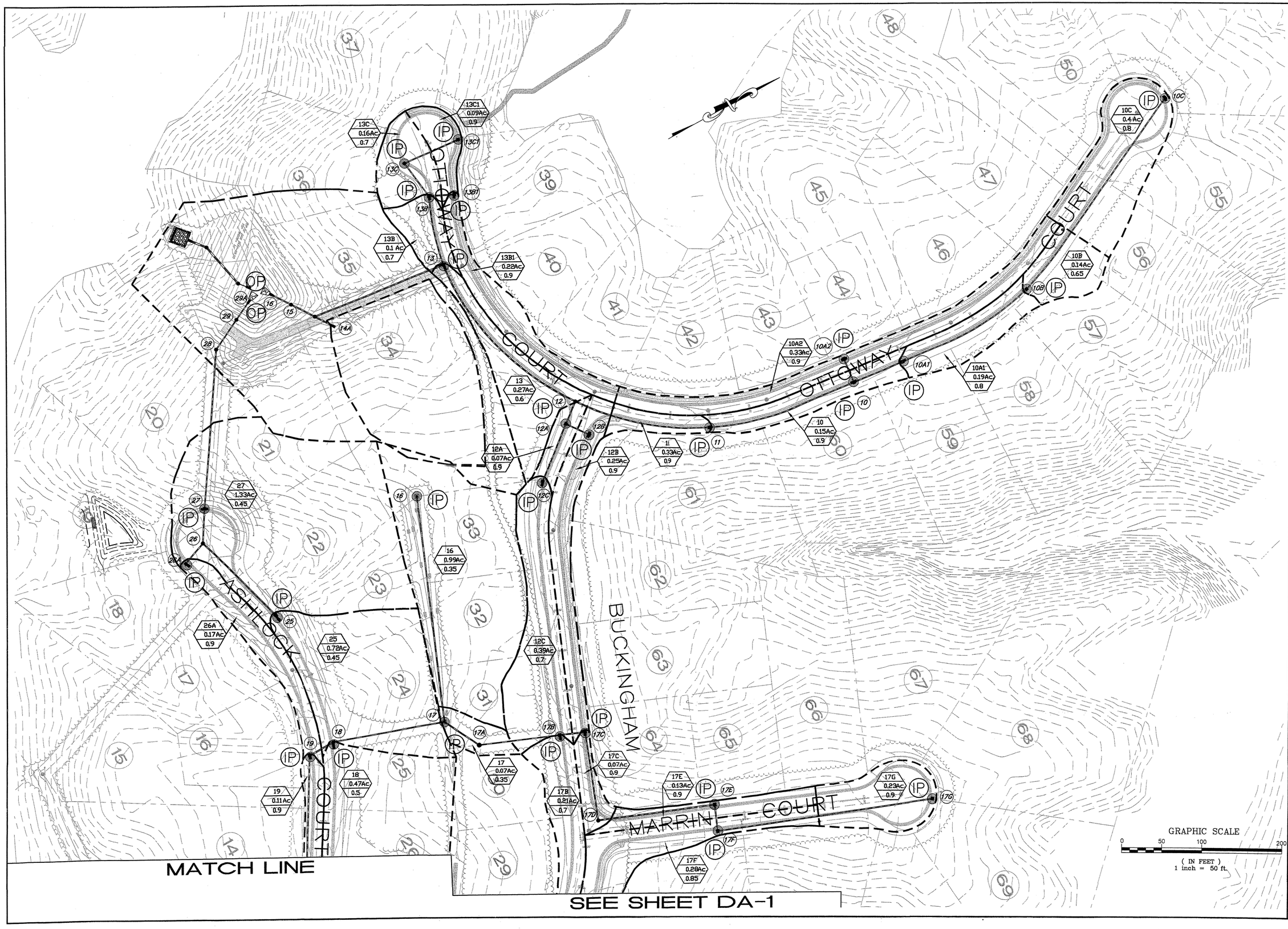
# DRAINAGE AREA MAP
# STONEHOUSE GLEN
## SECTION I
## STONEHOUSE AT WILLIAMSBURG, L.L.C.

JAMES CITY COUNTY VIRGINIA

| | |
|---|---|
| Designed: LMDG | Date: 10/27/04 |
| Checked: CRO | Scale: 1"=50' |
| File Mgr./Drawn: RMJ | CADD File name: DA-1.dwg |
| Project Number: 2002261-504.04 | Dwg. File No.: 14777W |

Drawing Number DA-1

1 OF 2

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| REVISIONS: | | | |
|---|---|---|---|
| No. | Date | Comment | By |

DRAWING STATUS
- Preliminary Review
- Client for Review
- Pre Approval Bidding

COUNTY APPROVAL
- 1st Submittal
- 2nd Submittal
- 3rd Submittal
- Approved

# DRAINAGE AREA MAP
## STONEHOUSE GLEN
### SECTION I
STONEHOUSE AT WILLIAMSBURG, L.L.C.
JAMES CITY COUNTY VIRGINIA

| | |
|---|---|
| Designed: LMDG | Date: 10/27/04 |
| Checked: CRO | Scale: 1"=50' |
| File Mgr./Drawn: RMJ | CADD File name: DA-2.dwg |
| Project Number: 2002261-50404 | Dwg. File No.: 14776W |
| Drawing Number: DA-2 2 OF 2 | |

# Supporting Engineering Documents
# For
# Stonehouse Glen Subdivision
# Section I

MAY 2005
RECEIVED
PLANNING DEPARTMENT

## James City County, Virginia

October 28, 2003
Revised February 10, 2004
Revised May 20, 2004
Revised November 1, 2004
Revised February 23, 2005
Revised April 18, 2005
**Revised May 11, 2005**

COMMONWEALTH OF VIRGINIA
JAMES W. BRAWLEY III
No. 024305
04-18-05
PROFESSIONAL ENGINEER

**Prepared for:**
**Mr. Ken McDermott, Manager**
**Stonehouse at Williamsburg, L.L.C.**
**15 Mendham Road**
**P.O. Box 704**
**Gladstone, New Jersey 07934**
**(908) 234-2620**

LANDMARK DESIGN GROUP

**LMDG Project No.**
**2002261-504.04**

# Supporting Engineering Documents

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1. Erosion and Sediment Control and Stormwater Management Design Plan Checklist

2. Project Description / Existing Site Conditions / Adjacent Area Description

3. Erosion and Sediment Control Narrative, Calculations and Drainage Area Maps

4. Stormwater Management Narrative and Calculations, including Channel Adequacy

5. Drainage Calculations
   a. Storm Drain Design
   b. Ditch Calculations
   c. Hydraulic Gradeline Calculation

6. Road Pavement Calculations

1 Erosion and Sediment Control and Stormwater Management Design Plan Checklist

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7

8

9

10

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**James City County, Virginia**
**Environmental Division**

# Erosion and Sediment Control and Stormwater Management Design Plan Checklists

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GENERAL INFORMATION

Project Name: Stonehouse Glen
Owner / Applicant: Stonehouse @ Williamsburg, LLC
Plan Preparer: LandMark Design Group Email: ronnieo@landmarkdg.com
Project Location: Stonehouse
Tax Map / Parcel: 0640 100001
County Plan No. (if known): _____
County BMP Type: Flow Attenuation ( - )

Other information submitted in addition to this checklist (Check all that apply):

- ☑ Design or Construction Drawings (Plans, Profiles, Details, etc.).
- ☑ Erosion & Sediment Control Plan (Plans, Details, etc.).
- ☑ Erosion & Sediment Control Plan Design Report.
- ☑ Stormwater Management Design Plan (Plans, Profiles, Details, etc.).
- ☑ Stormwater Management Design Report.
- ☐ Other, List: _____

***Issue Date***
***March 1, 2001***

*JAMES CITY COUNTY, VIRGINIA*
*ENVIRONMENTAL DIVISION*

# *EROSION AND SEDIMENT CONTROL PLAN CHECKLIST*

## I. *GENERAL:*

| Yes | No | N/A | |
|---|---|---|---|
| ☑ | ☐ | ☐ | *FAMILIARITY* with current versions of Chapter 8, Erosion and Sedimentation Control and Chapter 23, Chesapeake Bay Preservation ordinances of the Code of James City County, Virginia and the Virginia Erosion and Sediment Control Handbook (VESCH). |
| ☑ | ☐ | ☐ | *LAND DISTURBING PERMIT AND SILTATION AGREEMENT* with surety are required for the project. |
| ☐ | ☐ | ☑ | *VARIANCE* if necessary, requested in writing, for the plan approving authority to waive or modify any of the minimum standards and specifications of the VESCH deemed inappropriate based on site conditions specific to this review case only. Variances which are approved shall be properly documented in the plan and become part of the approved erosion and sediment control plan for the site. |

## II. *SITE PLAN:*

| Yes | No | N/A | |
|---|---|---|---|
| ☑ | ☐ | ☐ | *VICINITY MAP* locating the site in relation to the surrounding area. Include any major landmarks which might assist in physically locating the site. |
| ☑ | ☐ | ☐ | *INDICATE NORTH* direction in relation to the site. |
| ☑ | ☐ | ☐ | *LIMITS OF CLEARING AND GRADING* for the site including that required for implementation of erosion and sediment controls, stockpile areas and utilities. |
| ☑ | ☐ | ☐ | *DISTURBED AREA ESTIMATES* in acres or square feet for the project. |
| ☑ | ☐ | ☐ | *EXISTING TOPOGRAPHY* or contours for the site at no more than 5 foot contour interval. |
| ☑ | ☐ | ☐ | *FINAL TOPOGRAPHY*, contours or proposed site grading in accordance with the design plan which indicates changes to existing topography and drainage patterns at no more than 2 foot contour interval (or 1 foot contours where required). |
| ☑ | ☐ | ☐ | *EXISTING AND PROPOSED SPOT ELEVATIONS* to supplement existing and proposed contours, topography or site grading information. Spot elevations may replace final contours in some instances, especially if terrain is in a low lying area or relatively flat. |
| ☑ | ☐ | ☐ | *EXISTING VEGETATION* including existing tree lines, grassed or unique vegetation areas. |

| Yes | No | N/A | |
|---|---|---|---|
| ☑ | ☐ | ☐ | *EXISTING SITE FEATURES* including roads, buildings, homes, utilities, streams, fences, structures and other important surface features of the site. |
| ☑ | ☐ | ☐ | *SOILS MAP* with soil symbols, boundaries and legend in accordance with the current Soil Survey of James City and York Counties and the City of Williamsburg, Virginia. |
| ☐ | ☐ | ☐ | *ENVIRONMENTAL INVENTORY* in accordance with Section 23-10(2) of the Chesapeake Bay Preservation Ordinance of James City County. Inventory generally includes: tidal shores and wetlands, non-tidal wetlands, resource protection area, hydric soils and slopes steeper than 25 percent. For wetlands, provide a copy of issued permits or satisfactory evidence that appropriate permits are being pursued for the entire project. Wetland limits shown on BMP Plan Sheet |
| ☐ | ☐ | ☑ | *100-YEAR FLOODPLAIN LIMITS* or any special flood hazard areas or flood zones based on appropriate Federal Management Agency Flood Insurance Rate Maps (FIRMs) or Flood Hazard Boundary Maps (FHBMs) of James City County, Virginia. |
| ☑ | ☐ | ☐ | *DRAINAGE AREAS* for offsite and onsite areas, existing or proposed as applicable. Include drainage divides and directional labels for all subareas at points of interest and size (in acres), weighted runoff coefficient or curve number and times of concentration for each subarea. |
| ☐ | ☐ | ☑ | *CRITICAL EROSION AREAS* which require special consideration or unique erosion and sediment control measures. Refer to the VESCH, Chapter 6 for criteria. |
| ☑ | ☐ | ☐ | *DEVELOPMENT PLAN* for the site showing all improvements such as buildings, structures, parking areas, access roadways, above and below ground utilities, stormwater management and drainage facilities, trails or sidewalks, proposed vegetation and landscaping, amenities, etc. |
| ☑ | ☐ | ☐ | *LOCATION OF PRACTICES* proposed for erosion and sediment control, tree protection and temporary stormwater management due to land disturbance activities at the site. Use standard abbreviations, labels and symbols consistent for plan views based on minimum standards and specifications in Chapter 3 of the VESCH. |
| ☑ | ☐ | ☐ | *TEMPORARY STOCKPILE AREAS* or staging and equipment storage areas as required for onsite or offsite construction activities or indicate that none are anticipated for this project. |
| ☐ | ☐ | ☑ | *OFFSITE LAND DISTURBING AREAS* including borrow sites, waste areas, utility extensions, etc. and required erosion and sediment controls. If none are anticipated for the project, then indicate on the plans by general or erosion and sediment control notes. |
| ☑ | ☐ | ☐ | *DETAILS* or alternately, appropriate reference to current minimum standards and specifications of the VESCH for each measure proposed for the project. Non-modified, standard duplicated details (silt fence, diversion dikes, etc.) may be referenced to the current version of the VESCH. Specific dimensional or modified standards (basins, traps, outlet protections, check dams, etc.) require presentation on detail sheets. Schedules or tables may be used for multiple site measures such as sediment traps, basins, channels, slope drains, etc. Any modification to standard details should be clearly defined, explained and illustrated. |

| Yes | No | N/A | |
|---|---|---|---|
| ☑ | ☐ | ☐ | *MAINTENANCE PLAN* or alternately, appropriate reference to current minimum standards and specifications of the VESCH, outlining the inspection frequency and maintenance requirements for all erosion and sediment control measures proposed for the project. |
| ☐ | ☐ | ☑ | *TRENCH DEWATERING* methods and erosion and sediment controls, if anticipated for the project. |
| ☑ | ☐ | ☐ | *CONSTRUCTION SEQUENCE* outlining the anticipated sequence for installation of erosion and sediment controls and site, grading and utility work to be performed for the project by the site contractor. |
| ☐ | ☐ | ☑ | *PHASING PLAN* if required for larger project sites that are to be developed in stages or phases. |
| ☑ | ☐ | ☐ | *STANDARD COUNTY NOTES* are required to be placed on the erosion and sediment control plan. Refer to the standard James City County Erosion and Sediment Control Notes dated May 5, 1999. |
| ☑ | ☐ | ☐ | *PROFESSIONAL SEAL AND SIGNATURE* required on final and complete approved plans, drawings, technical reports and specifications. |

## III. *NARRATIVE:*

| Yes | No | N/A | |
|---|---|---|---|
| ☑ | ☐ | ☐ | *PROJECT DESCRIPTION* briefly describing the nature and purpose of the land disturbing activity and the acreage to be disturbed. |
| ☑ | ☐ | ☐ | *EXISTING SITE CONDITIONS* description of existing topography, land use, cover and drainage patterns at the site. |
| ☑ | ☐ | ☐ | *ADJACENT AREA* descriptions of neighboring onsite or offsite areas such as streams, lakes, property, roads, etc. and potential impacts due to concentrated flow or runoff from the land disturbing activity. |
| ☐ | ☐ | ☑ | *OFFSITE DISTURBED AREA* descriptions of proposed borrow sites, waste or surplus areas, utility extensions and erosion and sediment controls to be implemented. |
| ☑ | ☐ | ☐ | *SOILS DESCRIPTION* briefly summarizing site, disturbed area and drainage basin soils including name, unit, hydrologic soil group (HSG) classification, surface runoff potential, erodibility, permeability, depth, texture, structure, erosion hazards, shrink-swell potential, limitations for use and anticipated depths to bedrock and the seasonal water table, as applicable. |
| ☐ | ☐ | ☑ | *CRITICAL AREAS* on the site which many have potentially serious erosion and sediment control problems and special considerations required (ie. steep slopes, hydric soils, channels, springs, sinkholes, water supply reservoirs, groundwater recharge areas, etc.) |

Yes No N/A

☑ ☐ ☐ *PROPOSED EROSION & SEDIMENT CONTROL MEASURES* inclusive to the specific erosion and sediment control plan as proposed for the land disturbing activity. Measures should be consistent with those proposed on the site drawings. Address general use, installation, limitations, sequencing and maintenance requirements for each control measure.

☑ ☐ ☐ *STABILIZATION MEASURES* required for the site, either temporary or permanent, and during and following construction including temporary and permanent seeding and mulching, paving, stone, soil stabilization blankets and matting, sodding, landscaping or special stabilization techniques to be utilized at the site.

☑ ☐ ☐ *STORMWATER MANAGEMENT CONSIDERATIONS* for the site, either of temporary or permanent nature, and strategies, sequences and measures required for control. May reference the stormwater management plan for the site, if prepared, for permanent stormwater management facilities and control of drainage once the site is stabilized.

## IV. *CALCULATIONS:*

Yes No N/A

☑ ☐ ☐ *CALCULATIONS AND COMPUTATIONS* associated with hydrology, hydraulics and design of proposed temporary and permanent erosion and sediment control measures including: sediment traps and basins, diversions, stormwater conveyance channels, culverts, slope drains, outlet protections, etc. Computations are not required on the construction plan and may be attached in a supplemental erosion and sediment control plan design report, if presented in a clear and organized format.

☑ ☐ ☐ *TEMPORARY SEDIMENT BASIN DESIGN DATA SHEET* submitted for each basin along with schematic or sketch cross-section showing applicable design and construction data, storage volumes (wet-dry), dimensions and elevations. Peak design runoff to be based on the 2- or 25-year design storm event based on maximum disturbed site conditions (existing, interim or proposed conditions) in accordance with Minimum Standard 3.14 of the VESCH.

*JAMES CITY COUNTY, VIRGINIA*
*ENVIRONMENTAL DIVISION*

# *STORMWATER MANAGEMENT DESIGN PLAN CHECKLIST*

## I. *GENERAL:*

| Yes | No | N/A | |
|---|---|---|---|
| ☑ | ☐ | ☐ | *FAMILIARITY* with current versions of the James City County Guidelines for Design and Construction of Stormwater Management BMPs manual; Chapter 8, Erosion and Sediment Control and Chapter 23, Chesapeake Bay Preservation ordinances of the Code of James City County, Virginia; the Virginia Erosion and Sediment Control Handbook (VESCH); and the Virginia Stormwater Management Handbook (VSMH). |
| ☐ | ☐ | ☑ | *WAIVER OR EXCEPTION* if necessary, requested in writing, for the plan approving authority to waive or except the requirements of Chapter 23, Chesapeake Bay Preservation ordinance in accordance with procedure established in Sections 23-14 through 23-17 of the ordinance. Applies to this review case only. |
| ☐ | ☐ | ☑ | *VARIANCE REQUEST* if necessary, requested in writing for the plan approving authority to waive or modify any of the minimum standards and specifications of the VESCH deemed inappropriate based on site conditions specific to this review case only. Variances which are approved shall be properly documented in the plan and become part of the approved erosion and sediment control plan for the site. |
| ☑ | ☐ | ☐ | *PROFESSIONAL SEAL AND SIGNATURE* required on final and complete approved stormwater management plans, drawings, technical reports and specifications. |
| ☐ | ☐ | ☑ | *WORKSHEET FOR BMP POINT SYSTEM* to ensure the stormwater management plan for the project attains at least 10 BMP points (New Development) or traditional pollutant load reduction computations per the Chesapeake Bay Local Assistance Manual (Redevelopment Only). |
| ☐ | ☐ | ☑ | *PROPOSED CONSERVATION EASEMENT AREAS* for any natural open space points claimed in the BMP worksheet. |
| ☑ | ☐ | ☐ | *INSPECTION/MAINTENANCE AGREEMENT* is required to be prepared and executed with the County for the project. |
| ☐ | ☐ | ☑ | *FEMA FIRM PANEL* reference with designated special flood hazard areas or zone designations associated with the site, as applicable. |
| ☑ | ☐ | ☐ | *DRAINAGE AREA MAP* at a maximum scale of 1"=200' scale showing drainage area boundaries for pre- and postdevelopment conditions and associated time of concentration flow paths. Labels to include drainage area size, runoff coefficient or curve number and time of concentration for each subarea shown on the map. |

| Yes | No | N/A | |
|---|---|---|---|
| ☑ | ☐ | ☐ | *SOILS MAP* with soil symbols, boundaries and legend in accordance with the current Soil Survey of James City and York Counties and the City of Williamsburg, Virginia with approximate locations of the project site, BMPs and applicable drainage basins. |
| ☑ | ☐ | ☐ | *STORMWATER MANAGEMENT NARRATIVE* in a brief and simple format which describes the project; location; site and drainage basin soil characteristics; receiving water or drainage facility; existing site and drainage basin conditions (topography, land use, cover, slopes, etc.); proposed site development; proposed stormwater management and drainage plan including County BMP type selected; summary of hydrology and hydraulics; maintenance program; and any special assumptions utilized for development of the stormwater management and drainage design plan or computations. |
| ☑ | ☐ | ☐ | *TEMPORARY STORMWATER MANAGEMENT* (if applicable) for control of stormwater runoff encountered during construction activities in addition to measures provided in the erosion and sediment control plan or stormwater management/drainage plan for the site. Adequate protection measures or sequencing provided. |
| ☑ | ☐ | ☐ | *MODIFICATION PLAN* clearly defined for temporary sediment control structures which will be converted to permanent SWM/BMP structures. Includes appropriate hydrologic and hydraulic computations, conversions, sequencing and cleanout information or details. Normally related to primary control structures associated with dry detention or wet retention ponds. Normally not permitted for Group C or D categories such as bioretention, infiltration and filtering system facilities. |
| ☑ | ☐ | ☐ | *STORMWATER MANAGEMENT and DRAINAGE DESIGN REPORT* in a bound 8-1/2 x 11 inch size format. Report shall generally include a title sheet, date, project identification, owner and preparer information, table of contents, narrative, summaries and computations as required. Computations may include: backwater, closed conduit, headwater, hydraulic, hydraulic grade line, hydrology, inlet, open channel, storm sewer, water quality, extended detention or stream channel protection and muti-stage storm routing calculations, as applicable, for the project. Computation data may include hand or computer generated computations, maps or schematics. All information should be presented in a clear, easy to follow format and should closely match construction plan information. |
| ☐ | ☐ | ☐ | *PLAN VIEW* at 1 inch = 50 ft. scale or less (1" = 40', 1" = 30', etc.) |
| ☑ | ☐ | ☐ | North arrow and plan legend. |
| ☑ | ☐ | ☐ | Property lines. |
| ☑ | ☐ | ☐ | Adjacent property information. |
| ☑ | ☐ | ☐ | Existing site features and existing impervious cover areas. |
| ☑ | ☐ | ☐ | Impervious cover tabulations. |
| ☑ | ☐ | ☐ | Existing drainage facilities (natural or manmade). |
| ☑ | ☐ | ☐ | Existing environmentally sensitive areas (RPA, wetlands, floodplain, steep slopes, critical soils, buffers, etc.). |
| ☑ | ☐ | ☐ | Existing and proposed contours (1' or 2' contour interval) and spot elevations as necessary to define high and low topography. |
| ☑ | ☐ | ☐ | Existing and proposed easement locations. |

See existing site conditions narrative also.

| Yes | No | N/A | |
|---|---|---|---|
| ☑ | ☐ | ☐ | Proposed site improvements and proposed impervious cover areas. |
| ☑ | ☐ | ☐ | Proposed stormwater conveyance, drainage and management facilities with appropriate labeled construction data and information. |
| ☑ | ☐ | ☐ | Proposed landscaping and seeding plans (disturbed areas, pond interior, etc.). |
| ☑ | ☐ | ☐ | Proposed slope stabilization areas (riprap, blankets, mattings, walls, etc.). |
| ☑ | ☐ | ☐ | Delineation of permanent pools and the 1-, 2-, 10- and 100-year Design Water Surface Elevations. |
| ☐ | ☐ | ☑ | Delineation of ponding, headwater, surcharge or backwater areas which may affect adjacent existing or proposed buildings, structures or upstream adjacent properties. |
| ☐ | ☑ | ☐ | Test boring locations with reference surface elevations (if known). |
| ☑ | ☐ | ☐ | Risers, barrels, underdrains, overflows and outlet protections. |
| ☑ | ☐ | ☐ | Emergency spillway level section and outlet channel. |
| ☑ | ☐ | ☐ | Existing and proposed site utilities and protection measures. |
| ☑ | ☐ | ☐ | Erosion and sediment control measures (for site or BMP). |
| ☑ | ☐ | ☐ | Maintenance or access corridors to permanent stormwater management, BMP or drainage facilities. |

## II. *STORMWATER CONVEYANCE SYSTEMS:*

| Yes | No | N/A | |
|---|---|---|---|
| ☑ | ☐ | ☐ | *PLAN VIEWS* |
| | | | ☑ ☐ ☐ Storm drain lengths, sizes, types, classes and slopes for all segments. Label directly on plan or use structure/pipe schedule. |
| | | | ☑ ☐ ☐ Access structure (inlets, manholes, junctions, etc.) rim elevations, inverts, type and required grate or top unit and lengths labeled. |
| | | | ☑ ☐ ☐ All structure numbers labeled. |
| | | | ☑ ☐ ☐ Adequate horizontal clearance from other site utilities or structures. |
| ☑ | ☐ | ☐ | *PROFILES* generally are not required but are encouraged to expedite review. If not provided, ensure all pipe segments have adequate minimum cover, do not exceed maximum depths of cover for the type/class of pipe specified and do not conflict with other site utilities or excavation areas. |
| ☑ | ☐ | ☐ | *DETAILS* |
| | | | ☑ ☐ ☐ Typical storm drain bedding details or reference note. |
| | | | ☑ ☐ ☐ Standard details or reference note for all proposed access structure types (inlets, manholes, junctions, etc.). |
| | | | ☑ ☐ ☐ Inlet shaping detail or applicable reference note. |
| | | | ☑ ☐ ☐ Step detail or applicable reference note (if depth 4 ft. or more). |
| | | | ☑ ☐ ☐ Typical open channel details with designation, location, shape, type, bottom width, top width, lining, slope, length, side slope, and installation depth required for construction. Channel design data as necessary may also be included. |
| | | | ☑ ☐ ☐ Outlet protections at all pipe outfalls. |

Yes No N/A

☐ ☐ ☐ *STORMWATER CONVEYANCE SYSTEM COMPUTATIONS*

- ☑ ☐ ☐ Storm Sewer Design computations based on 10-year design event.
- ☑ ☐ ☐ Hydraulic Grade Line computations based on 10-year design event.
- ☑ ☐ ☐ Inlet computations based on current VDOT procedure for spread, ponding depth and grate size required.
- ☐ ☐ ☑ Culvert Headwater computations. Design based on 10-year design storm event and check only for 100-year storm event.
- ☐ ☐ ☑ Open Channel computations based on 2-year design event for velocity and 10-year design event for capacity.
- ☑ ☐ ☐ Standard outlet protection or special energy dissipators.
- ☐ ☑ ☐ Pipe thickness design computations, as required, for selected pipe type (live load, minimum cover, maximum height of cover, etc.).
- ☐ ☐ ☑ Adequate channel computations for receiving channels (based on field measured channel section data).

## III. *STORMWATER MANAGEMENT / BMP FACILITIES:*

Yes No N/A

☑ ☐ ☐ *HYDROLOGY* - An SCS based methodology is required for the design of stormwater management/BMP facilities with watersheds exceeding 20 acres. Under 20 acres, other generally accepted methodologies such as the modified rational, critical storm are allowable. Refer to Chapter 5 of the VESCH or Chapter 5 of the VSMH.

- ☑ ☐ ☐ Runoff Curve Number or Coefficient determinations: predeveloped and ultimate development land use scenarios.
- ☑ ☐ ☐ Time of concentration: predeveloped and ultimate development indicating overland, shallow concentrated, and channel flow components (200 ft. maximum length for overland flow).
- ☑ ☐ ☐ Hydrograph generation (tabular or graphical): pre- and postdevelopment conditions for the ~~1-~~, 2-, 10-, and 100-year design storm events.

For 2yr only - Pre-Dev.

☑ ☐ ☐ *FACILITY CONFIGURATION and MINIMUM SEPARATIONS*

- ☐ ☐ ☑ Screening and layout consistent with Section 24-98(d) of the Chapter 24 Zoning ordinance (landscaping, screening, visibility, etc.).
- ☐ ☐ ☑ Basic considerations for safety and unauthorized entry.
- ☑ ☐ ☐ Proper length to width ratio (Typically 2H:1V).
- ☐ ☐ ☑ Facilities with deep pools (4 feet or more in depth) provided with two benches. Fifteen (15) ft. safety bench outward from normal pool at maximum 6 percent slope and aquatic bench inward from normal shoreline below normal pool. Narrower widths may be considered on a case-by-case basis.
- ☐ ☐ ☑ Pond buffer minimum 25 feet outward from maximum design WSEL. Additional setbacks may be required to permanent structures.
- ☑ ☐ ☐ No trees, shrubs or woody plants within 15 feet of embankment toe or 25 feet from principal spillway structure.

| Yes | No | N/A | |
|---|---|---|---|
| ☐ | ☐ | ☑ | Infiltration and filtering system facilities generally located at least 100 feet horizontally from any water supply well; 100 feet from any downslope building; and 25 feet from any upslope buildings, unless site specific investigation allows for reduced separation. |

| Yes | No | N/A | |
|---|---|---|---|
| ☑ | ☐ | ☐ | *HYDRAULIC COMPUTATIONS* |
| ☑ | ☐ | ☐ | Elevation- or Stage- Storage curve and/or tabular data. |
| ☐ | ☐ | ☑ | Weir / Orifice Control - Extended Detention. |
| ☐ | ☐ | ☑ | Weir / Orifice Control - riser 1-year control for channel protection. |
| ☐ | ☐ | ☑ | Weir / Orifice Control - riser 2-year control for quantity (if required). |
| ☐ | ☐ | ☑ | Weir / Orifice Control - riser 10-year control for quantity (if required). |
| ☑ | ☐ | ☐ | Inlet / Outlet (barrel) control - (All Storms). |
| ☑ | ☐ | ☐ | Check for barrel control prior to riser orifice flow to prevent slug flow-water hammer conditions. |
| ☑ | ☐ | ☐ | Emergency spillway capacity and depth of flow. |
| ☑ | ☐ | ☐ | Elevation - Discharge (Outlet Rating) curve and/or table. Provide all supporting calculations and/or design assumptions. |
| ☐ | ☐ | ☑ | Adequate channel computations for receiving channel. May be waived if facility is designed based on current Stream Channel Protection criteria. |
| ☑ | ☐ | ☐ | *POND or RESERVOIR ROUTING* |
| ☑ | ☐ | ☐ | Storage-Indication Routing of postdeveloped inflow hydrographs for the 1-, 2-, 10-, and 100-year design storms. Preference is for structure to discharge up to the 10-year storm through the principal spillway and pass the 100-year storm with a minimum 1 foot of freeboard through a combination principal and emergency spillways. If no emergency spillway is provided, riser must be large enough to pass the design high water flow and trash without overtopping the facility, have 3 square feet or more of cross-sectional area, contain a hood type inlet and have a minimum freeboard of 2 feet. Token spillways with minimum 8 ft. width are also recommended at or above the design 100-year storm elevation. |
| ☑ | ☐ | ☐ | Downstream hydrographs at established study points, if conditions warrant (ie. facility discharge combined with uncontrolled bypass). |
| ☐ | ☐ | ☐ | *MISCELLANEOUS COMPUTATIONS* |
| ☐ | ☐ | ☑ | Water quality volume for permanent pool based on selected BMP treatment volume (WQv). |
| ☐ | ☐ | ☑ | Water quality volume for extended detention based on selected BMP treatment volume (WQv) with drawdown computations. |
| ☐ | ☐ | ☑ | Drawdown computations for the 1-year, 24 hour detention for stream channel protection criteria. |
| ☐ | ☐ | ☑ | Pond drain computations (within 24 hours). |
| ☑ | ☐ | ☐ | Anti-seep collar design (concrete preferred) or match material type. |
| ☑ | ☐ | ☐ | Filter diaphragm design (or alternative method of controlling seepage). |

| Yes | No | N/A | |
|---|---|---|---|
| ☐ | ☐ | ☑ | Riser / base structure flotation analyses. FS = 1.25 minimum. |
| ☐ | ☐ | ☑ | Downstream danger reach study and/or emergency action plan (if conditions warrant). |
| ☐ | ☐ | ☑ | Upstream backwater analyses onto offsite adjacent property (if conditions warrant). |
| ☐ | ☐ | ☑ | 100 year floodplain impacts (if conditions warrant). |

| Yes | No | N/A | |
|---|---|---|---|
| ☐ | ☐ | ☐ | *GEOTECHNICAL REQUIREMENTS* |
| ☐ | ☑ | ☐ | Geotechnical Report with recommendations specific to BMP facility type selected. Report prepared by a registered professional engineer. Requires submission, review and approval prior to issuance of Land Disturbance Permit. |
| ☐ | ☑ | ☐ | Initial Feasibility Testing requirements satisfied as per Appendix E of the James City County Guidelines for Design and Construction of Stormwater Management BMPs manual. (Infiltration, Bioretention and Filtering System BMP types only). |
| ☐ | ☑ | ☐ | Concept Design Testing requirements satisfied as per Appendix E of the James City County Guidelines for Design and Construction of Stormwater Management BMPs manual. (Infiltration, Bioretention and Filtering System BMP types only). |
| ☐ | ☑ | ☐ | Minimum Boring locations: borrow area, pool area, principal control structure, top of facility near one abutment and emergency spillway if provided. |
| ☐ | ☑ | ☐ | Boring logs with Unified Soil Classification (ASTM D2487), soils descriptions and depths to bedrock and the seasonal water table indicated. |
| ☑ | ☐ | ☐ | Standard County Record Drawing/Construction Certification note provided on plan. *Note: It is understood that preparation of record drawings and construction certifications as required for project facilities may not necessarily be performed by the plan preparer. These components may be performed by others.* |
| See C-26 | | | |
| ☐ | ☐ | ☐ | *PRINCIPAL SPILLWAY PROFILE AND ASSOCIATED DETAILS* |
| ☐ | ☐ | ☐ | *EXISTING GROUND AND PROPOSED GRADE* |
| ☑ | ☐ | ☐ | Embankment or excavation side slopes labeled (3H:1V maximum). |
| ☑ | ☐ | ☐ | Minimum top width labeled (per VESCH or VSMH requirements). |
| ☑ | ☐ | ☐ | Removal of unsuitable material under proposed facility (per Geotechnical Report requirements). |

| Yes | No | N/A | |
|---|---|---|---|
| ☐ | ☐ | ☐ | *CORE TRENCH* |
| ☑ | ☐ | ☐ | Material (per plan or Geotechnical Report). |
| ☐ | ☐ | ☐ | Bottom width (4' minimum or greater as dictated by Geotechnical Report recommendations). |
| ☑ | ☐ | ☐ | Side slopes (1:1 maximum steepness) |
| ☑ | ☐ | ☐ | Depth (4' minimum or greater as dictated by Geotechnical Report). |
| ☐ | ☐ | ☐ | *PRINCIPAL CONTROL STRUCTURE. RISER OR SIMILAR STRUCTURE (DETAILS REQUIRED FOR ALL ITEMS)* |
| ☑ | ☐ | ☐ | Durable, watertight, resistant material (concrete preferred). |
| ☑ | ☐ | ☐ | Riser diameter is at least 1.25 times larger than barrel diameter. |
| ☑ | ☐ | ☐ | All pertinent dimensions and elevations shown. |
| ☑ | ☐ | ☐ | Control orifice or weir dimensions and elevations shown. |
| ☐ | ☐ | ☑ | Trash rack - removable - for each release. |
| ☑ | ☐ | ☐ | Anti-vortex device, baffle or plate. |
| ☑ | ☐ | ☐ | Riser base structure with dimensions and embedment specifications (concrete preferred). |
| ☑ | ☐ | ☐ | Interior access (steps, ladders, etc.) for maintenance for structures over 4 feet in height. Excessively high risers may need some form of exterior access on top portion. |
| ☑ | ☐ | ☐ | Low flow orifice with trash rack device. |
| ☐ | ☐ | ☐ | *PRINCIPAL CONTROL STRUCTURE OUTLET BARREL* |
| ☑ | ☐ | ☐ | Material (ASTM C-361 reinforced concrete pipe) with watertight joints. Prior approval required for all other pipe material (other RCP types, CMP, CPP, PVC, etc.). |
| ☑ | ☐ | ☐ | Support and bedding requirements for barrel - concrete cradles, etc. or as recommended by the Geotechnical Report. |
| ☑ | ☐ | ☐ | Pipe inverts, length, size, class and slope shown. |
| ☑ | ☐ | ☐ | Flared end section or endwall provided on barrel outlet. |
| ☐ | ☐ | ☐ | *SEEPAGE CONTROL* |
| ☐ | ☐ | ☑ | Phreatic line shown (4:1 slope measured from the intersection of the embankment and the principal spillway design high water). |
| ☑ | ☐ | ☐ | *ANTI-SEEP COLLARS* |
| ☑ | ☐ | ☐ | Anti-seep collar, concrete preferred. |
| ☑ | ☐ | ☐ | Size - 15 percent increase in length of saturation using outside pipe diameter. |
| ☑ | ☐ | ☐ | Spacing and location on barrel (located at least 2 feet from a pipe joint). |

☐ ☐ ☐ *FILTER DIAPHRAGMS*

☐ ☐ ☑ Design based on latest NRCS design methods and certified by a professional engineer.

Yes No N/A

☑ ☐ ☐ *ELEVATION AND DIMENSIONAL DESIGN DATA*

- ☑ ☐ ☐ Top of facility - construction height and settled height (10 percent settlement).
- ☑ ☐ ☐ Crest of principal control structure spillway at least one (1) foot below crest of emergency spillway, if provided.
- ☑ ☐ ☐ Minimum freeboard of one (1) foot above the 100-year design high water elevation for facilities <u>with</u> an emergency spillway.
- ☐ ☐ ☑ Minimum freeboard of two (2) feet above the 100-year design high water elevation for facilities <u>without</u> an emergency spillway or in accordance with the SCS National Engineering Handbook (prior approval required).
- ☐ ☐ ☑ Basin Sediment Clean-Out elevation (permanent mode). Typically 10 to 25 percent of water quality volume.

☐ ☐ ☐ *CROSS SECTION THROUGH FACILITY*

- ☐ ☐ ☑ Existing Ground.
- ☑ ☐ ☐ Proposed grade.
- ☑ ☐ ☐ Top of facility - constructed and settled.
- ☑ ☐ ☐ Location of emergency spillway with side slopes labeled (emergency spillway in cut).
- ☑ ☐ ☐ Bottom of core trench (4' minimum).
- ☐ ☑ ☐ Location of each soil boring.
- ☑ ☐ ☐ Barrel location.
- ☐ ☐ ☑ Existing and proposed utility location/protection.

☐ ☐ ☐ *EMERGENCY SPILLWAY PROFILE*

- ☑ ☐ ☐ Existing ground.
- ☐ ☐ ☑ Inlet, level (control) and outlet sections per SCS.
- ☑ ☐ ☐ Spillway and crest elevations.

☐ ☐ ☑ *PRETREATMENT DEVICES* of adequate depth and properly designed using required pretreatment volumes for the selected County BMP facility type. Including, but not limited to: sediment forebays, sediment basins, sumps, grass channels, gravel diaphragms, plunge pools, chamber separators, manufactured systems or other acceptable methods.

| Yes | No | N/A | |
|---|---|---|---|
| ☑ | ☐ | ☐ | *CONSTRUCTION SPECIFICATIONS and NOTES* |
| ☑ | ☐ | ☐ | Anticipated sequence of construction for BMP (consistent with erosion and sediment control plan). |
| ☐ | ☑ | ☐ | Provisions to control base stream or storm flow conditions encountered during construction. |
| ☑ | ☐ | ☐ | Site and subgrade preparation requirements. |
| ☑ | ☐ | ☐ | Embankment, fill and backfill material soil and placement (lift) thickness requirements. |
| ☑ | ☐ | ☐ | Compaction ~~and soil moisture~~ content requirements. |
| ☐ | ☐ | ☑ | Geosynthetics for drainage, filtration, moisture barrier, separation, and reinforcement purposes. |
| ☐ | ☐ | ☑ | Clay or synthetic (PVC or HDPE) pond liners. |
| ☐ | ☐ | ☑ | Storm drain, underdrain and pipe conduit requirements. |
| ☐ | ☐ | ☑ | Minimum depth of pipe cover for temporary (construction) and final cover conditions. |
| ☐ | ☐ | ☑ | Permanent shutoff valve and pond drain. |
| ☑ | ☐ | ☐ | Concrete requirements for structural components. |
| ☑ | ☐ | ☐ | Riprap and slope protection. |
| ☑ | ☐ | ☐ | Access or maintenance road surface, base, subbase. |
| ☑ | ☐ | ☐ | Temporary and permanent stabilization measures. |
| ☐ | ☐ | ☑ | Temporary or permanent safety fencing. |
| ☐ | ☐ | ☑ | BMP Landscaping (deep, shallow, fringe, perimeter,etc.) |
| ☐ | ☐ | ☑ | Dust and traffic control (if warranted). |
| ☐ | ☐ | ☐ | Construction monitoring and certification by professional. |
| ☐ | ☐ | ☐ | Other: _____ |
| ☐ | ☐ | ☐ | Other: _____. |
| ☐ | ☐ | ☐ | *MAINTENANCE PROVISIONS* |
| Contractor unknown | ☑ | ☐ | Entity responsible for maintenance identified.. |
| To be provided. | ☑ | ☐ | Maintenance Plan which outlines the long-term schedule for inspection/maintenance of the facility and forebays |
| ☑ | ☐ | ☐ | Maintenance access from public right-of-way or publicly traveled road. |
| ☐ | ☐ | ☑ | Maintenance easement provided encompassing high water pool and buffer, principal and emergency spillways, outlet structures, forebays, embankment area and possible sediment-removal stockpile areas. |
| ☐ | ☐ | ☑ | Minimum 6 foot wide public safety shelf (landing) or alternative fencing. |

## IV. *OUTLET PROTECTIONS:*

| Yes | No | N/A | |
|---|---|---|---|
| ☑ | ☐ | ☐ | Sized for maximum design release (generally 10-year storm). |
| ☑ | ☐ | ☐ | Flared end section or endwall. |
| ☑ | ☐ | ☐ | Dimensions. |
| ☑ | ☐ | ☐ | Rock or riprap size, quantity and placement thickness. |
| ☐ | ☑ | ☐ | Slope at 0 percent (Level Grade). |
| ☐ | ☐ | ☑ | Geotextiles (nonwoven). |
| ☐ | ☐ | ☑ | Special energy dissipators are required for design discharge velocities that exceed eighteen (18) feet per second; or if use of standard outlet protection would result in velocities exceeding permissible channel velocities; or if space restricts or limits their use. |

## V. *ADDITIONAL COMMENTS OR INFORMATION SPECIFIC TO THE PLAN:*

Plan Preparer: LandMark Design Group

Date: 10/29/03

SWMProg/BMP/Checklist/ChkList

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Stonehouse Glen Subdivision

October 28, 2003

PROJECT DESCRIPTION:

Section 1 of the Stonehouse Glen Subdivision proposes the construction of 76 single-family detached residential homesites, two park areas totaling 2 acres of land, a pump station site and a stormwater management facility designed for flow attenuation only. To effect this plan, disturbance to approximately 9 acres of land will be required for construction of proposed public streets, on-site public utilities and the pump station, the stormwater management facility and other erosion and sediment control devices.

EXISTING SITE CONDITIONS:

Existing topography is characterized by relatively narrow ridgetops with intervening ravine systems. Elevations range from approximately 50 feet above MSL to approximately 115 feet above MSL. The existing land use is vacant. The existing cover is forested with a combination of mixed deciduous and evergreen species; the majority of the site has been repeatedly timbered over the past 50+ years. Surface drainage flows generally from the south to the north through a series of ravines which coalesce at Bird Swamp, and thereafter, flows enter the Ware Creek and ultimately the York River.

ADJACENT AREA DESCRIPTION:

Adjacent on-site areas (Land Bays 19, 20 and 22) are characterized by the same topographic features and drainage patterns, with surface drainage flowing along the same path as described above. All land east, west, north and south of the subject site is undeveloped, wooded and characterized by ridgetops dissected by ravines. The floodplain of Bird Swamp is broad with a braided channel; all other ravine systems are restricted in width and depth and with fairly direct flow lines. Substantial undisturbed land separates the proposed land disturbance activities associated with the subject project and the receiving waters; concentrated flow is being purposefully limited across the project with the majority of post-development flow being directed to the many ravine systems, well below erosive velocities. Potential impacts to receiving waters are expected to be negligible given structural E&S practices and the sequence of construction proposed.

3

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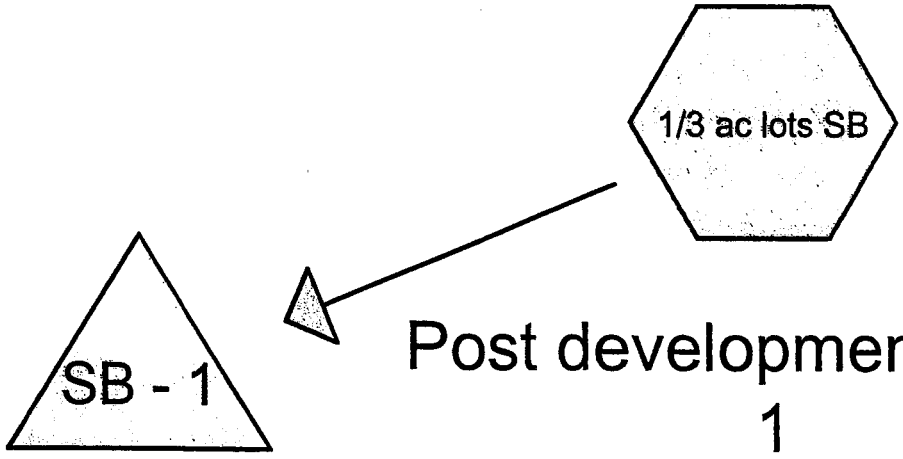
**STONEHOUSE GLEN**
**SEDIMENT AND EROSION CONTROL NARRATIVE**

The erosion and sediment control plan utilizes various methods to contain sediment and minimize erosion. The methods include silt fence, diversion dikes, temporary drains, sediment traps, sediment basins, inlet protection, etc.

Where the upslope drainage area is within the allowable parameters for silt fence, it is used. Other areas, exceeding these limits, utilize sediment traps and sediment basins below construction areas. Sediment traps and sediment basins are used in four different locations. The permanent detention basins are to function as temporary sediment basins during construction, until areas draining to them are stabilized.

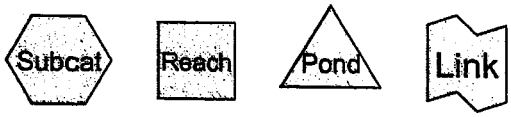
Sediment trap #1 on Lot 19 will collect runoff for the road construction at the east end of Ashlock Court. The runoff from the wooded area above the sediment trap will be diverted with diversion dikes through a temporary pipe system. The temporary pipe will be filled with flowable fill after stabilization.

Three permanent detention basins will function as temporary sediment basins until all areas draining to them are stabilized. The design and construction for all erosion and sediment control measures can be found on Sheets C-16, C-16A, C-16B, C-24, C-25 and C-26.




Post development to SB 1

Sediment Basin #1




**Drainage Diagram for bmp 1 temp sed basin Revised**
Prepared by Landmark Design Group 10/27/2004
HydroCAD® 7.00 s/n 001765 © 1986-2003 Applied Microcomputer Systems

# TEMPORARY SEDIMENT BASIN DESIGN DATA SHEET

(with or without an emergency spillway)

Project STONEHOUSE GLEN SECTION I

Basin # BMP#1 Location SOUTH EAST ASLOCK COURT

Total area draining to basin: 11.05 acres.

## Basin Volume Design

**Wet Storage:**

1. Minimum required volume = 67 cu. yds. x Total Drainage Area (acres).

   67 cu. yds. x 11.05 acres = 740.4 cu. yds.

2. Available basin volume = 743.2 cu. yds. at elevation 78.15. (From storage - elevation curve)

3. Excavate _____ cu. yds. to obtain required volume*.

   * Elevation corresponding to required volume = invert of the dewatering orifice.

4. Available volume before cleanout required.

   33 cu. yds. x 11.05 acres = 364.7 cu. yds.

5. Elevation corresponding to cleanout level = 76.14.

   (From Storage - Elevation Curve)

6. Distance from invert of the dewatering orifice to cleanout level = 2 ft. (Min. = 1.0 ft.)

**Dry Storage:**

7. Minimum required volume = 67 cu. yds. x Total Drainage Area (acres).

   67 cu. yds. x 11.05 acres = 740.4 cu. yds.

8. Total available basin volume at crest of riser* = 1486.3 cu. yds. at elevation 80.64 (From Storage - Elevation Curve)

* Minimum = 134 cu. yds./acre of total drainage area.

9. Diameter of dewatering orifice = 6 in.

10. Diameter of flexible tubing = 8 in. (diameter of dewatering orifice plus 2 inches).

Preliminary Design Elevations

11. Crest of Riser = 80.64

Top of Dam = 83.82

Design High Water = 81.57 (25 yr) 81.82 (100 yr)

Upstream Toe of Dam = 67.00

Basin Shape

12. Length of Flow / Effective Width — L / We = _____

If > 2, baffles are not required _____

If < 2, baffles are required YES

Runoff

13. $Q_2$ = 20.80 cfs (From Chapter 5)

14. $Q_{25}$ = 51.61 cfs (From Chapter 5)

Principal Spillway Design

15. With emergency spillway, required spillway capacity $Q_p = Q_2$ = _____ cfs. (riser and barrel)

Without emergency spillway, required spillway capacity $Q_p = Q_{25}$ = 51.61 cfs. (riser and barrel)

16. With emergency spillway:

Assumed available head (h) = N/A ft. (Using $Q_2$)

h = Crest of Emergency Spillway Elevation - Crest of Riser Elevation

Without emergency spillway:

Assumed available head (h) = 1.0' ft. (Using $Q_{25}$)

h = Design High Water Elevation - Crest of Riser Elevation

17. Riser diameter ($D_r$) = 60 in. Actual head (h) = ____ ft.

(From Plate 3.14-8.)

Note: Avoid orifice flow conditions.

18. Barrel length (l) = 84 ft.

Head (H) on barrel through embankment = 13.80 ft.

(From Plate 3.14-7).

19. Barrel diameter = 30" in.

(From Plate 3.14-B [concrete pipe] or Plate 3.14-A [corrugated pipe]).

20. Trash rack and anti-vortex device

Diameter = 96" inches.

Height = 24 inches.

(From Table 3.14-D).

Emergency Spillway Design

21. Required spillway capacity $Q_e = Q_{25} - Q_p$ = N/A cfs.

22. Bottom width (b) = N/A ft.; the slope of the exit channel (s) = ____ ft./foot; and the minimum length of the exit channel (x) = ____ ft.
(From Table 3.14-C).

Anti-Seep Collar Design

23. Depth of water at principal spillway crest (Y) = 8.64 ft.

Slope of upstream face of embankment (Z) = 3 :1.

Slope of principal spillway barrel ($S_b$) = 1.0 %

Length of barrel in saturated zone ($L_s$) = 62 ft.

24. Number of collars required = 4 dimensions = 4'X4'

(from Plate 3.14-12).

Final Design Elevations

25. Top of Dam = 83.82

Design High Water = 81.57 (25 year)

Emergency Spillway Crest = N.A.

Principal Spillway Crest = 80.64

Dewatering Orifice Invert = 78.15

Cleanout Elevation = 76.14

Elevation of Upstream Toe of Dam or Excavated Bottom of "Wet Storage Area" (if excavation was performed) = 72.00

Subject _____

Computed _____ Checked _____

LANDMARK DESIGN GROUP

Project # _____

Client _____

Date _____ Sheet # _____

Engineers • Planners • Surveyors • Landscape Architects • Environmental Scientists

LENGTH OF PIPE IN SATURATED ZONE

BMP # 1

CREST OF RISER = 80.64
BOTTOM OF POND = 72.00

$$L_S = Y(z+4)\left(1+\frac{S}{0.25-S}\right)$$

$Y = 8.64'$

$Z = 3:1$ SLOPE

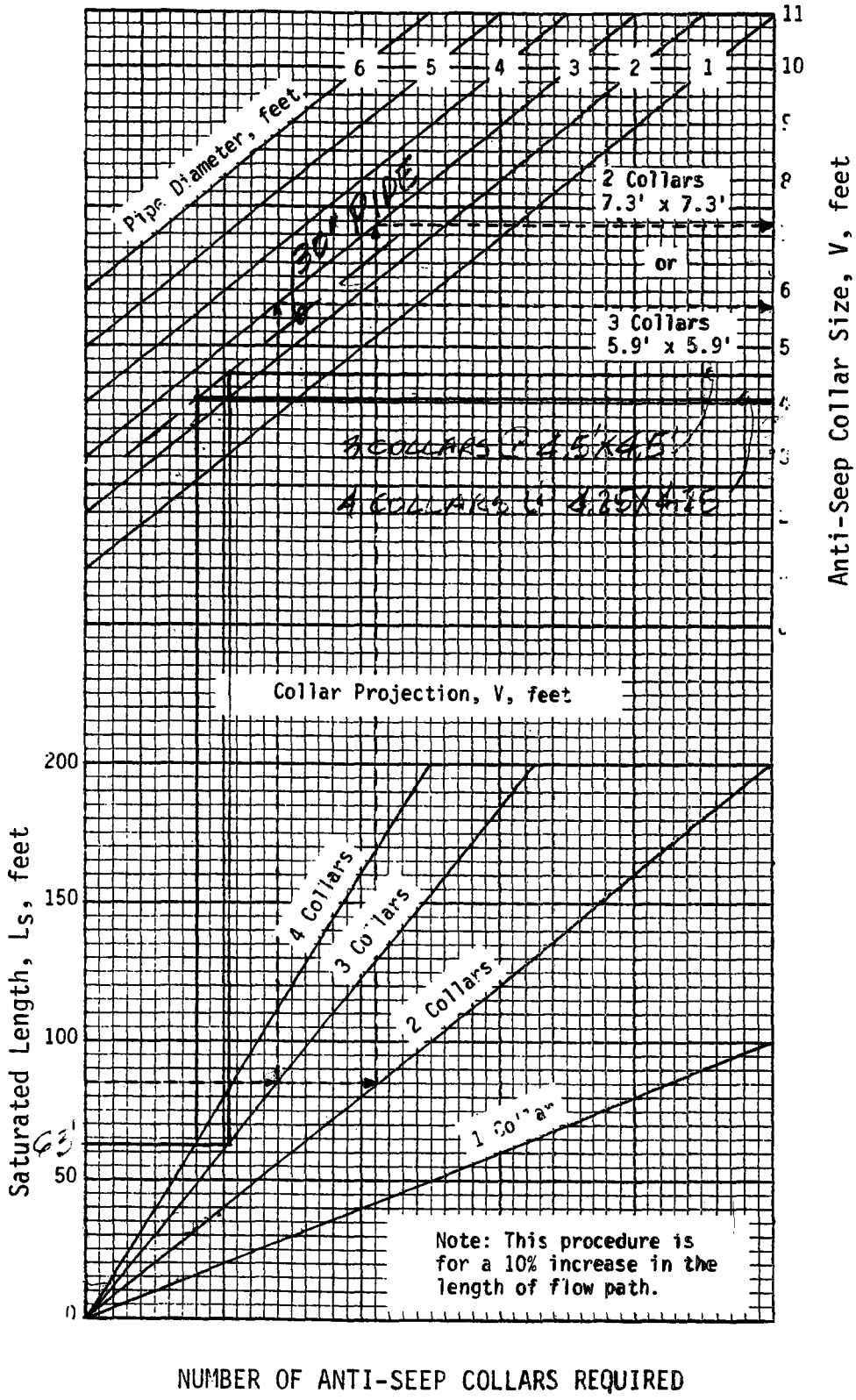
$S = 1.0\%$

$$L_S = 8.64(3+4)\left(1+\frac{0.01}{0.25-0.01}\right)$$

$L_S = 8.64 \times 7 \times 1.0417$

$L_S = 63.0'$

USE 4 COLLARS 4.25' X 4.25'




NUMBER OF ANTI-SEEP COLLARS REQUIRED

Source: USDA-SCS

BMP # 1

Plate 3.14-12

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment 1/3 ac lots SB: Post development to SB 1** Runoff Area=11.050 ac Runoff Depth=1.70"
Tc=20.0 min CN=81 Runoff=20.80 cfs 1.565 af

**Pond SB - 1: Sediment Basin #1** Peak Elev=80.52' Storage=38,954 cf Inflow=20.80 cfs 1.565 af
Outflow=1.40 cfs 1.022 af

**Total Runoff Area = 11.050 ac Runoff Volume = 1.565 af Average Runoff Depth = 1.70"**

## Subcatchment 1/3 ac lots SB: Post development to SB 1

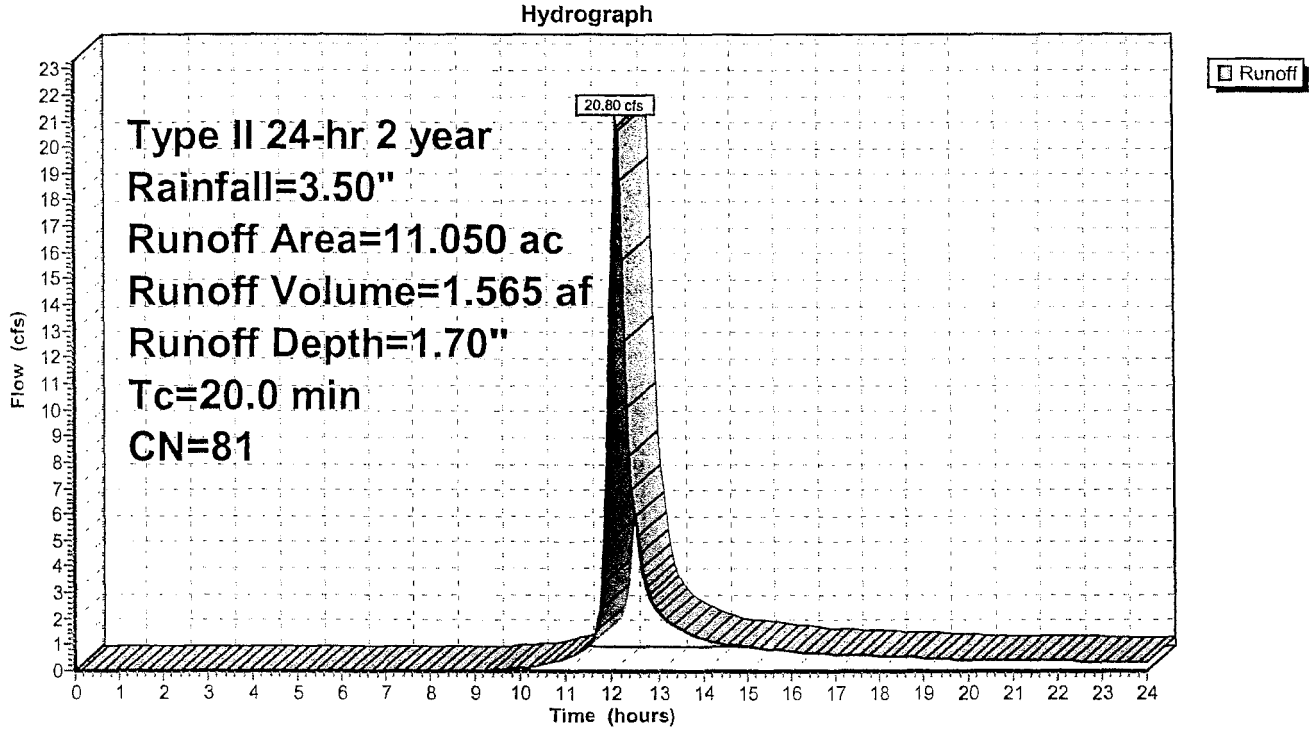
Runoff = 20.80 cfs @ 12.13 hrs, Volume= 1.565 af, Depth= 1.70"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 year Rainfall=3.50"

| Area (ac) | CN | Description |
|---|---|---|
| 11.050 | 81 | 1/3 acre lots, 30% imp, HSG C |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 20.0 | | | | | **Direct Entry,** |

## Subcatchment 1/3 ac lots SB: Post development to SB 1



## Hydrograph for Subcatchment 1/3 ac lots SB: Post development to SB 1

| Time (hours) | Precip. (inches) | Excess (inches) | Runoff (cfs) | Time (hours) | Precip. (inches) | Excess (inches) | Runoff (cfs) |
|---|---|---|---|---|---|---|---|
| 0.00 | 0.00 | 0.00 | 0.00 | 13.00 | 2.70 | 1.09 | 2.27 |
| 0.25 | 0.01 | 0.00 | 0.00 | 13.25 | 2.75 | 1.13 | 1.86 |
| 0.50 | 0.02 | 0.00 | 0.00 | 13.50 | 2.80 | 1.16 | 1.62 |
| 0.75 | 0.03 | 0.00 | 0.00 | 13.75 | 2.84 | 1.19 | 1.42 |
| 1.00 | 0.04 | 0.00 | 0.00 | 14.00 | 2.87 | 1.21 | 1.27 |
| 1.25 | 0.05 | 0.00 | 0.00 | 14.25 | 2.90 | 1.24 | 1.13 |
| 1.50 | 0.06 | 0.00 | 0.00 | 14.50 | 2.93 | 1.26 | 1.06 |
| 1.75 | 0.07 | 0.00 | 0.00 | 14.75 | 2.96 | 1.28 | 1.01 |
| 2.00 | 0.08 | 0.00 | 0.00 | 15.00 | 2.99 | 1.30 | 0.96 |
| 2.25 | 0.09 | 0.00 | 0.00 | 15.25 | 3.01 | 1.32 | 0.91 |
| 2.50 | 0.10 | 0.00 | 0.00 | 15.50 | 3.04 | 1.34 | 0.86 |
| 2.75 | 0.11 | 0.00 | 0.00 | 15.75 | 3.06 | 1.36 | 0.81 |
| 3.00 | 0.12 | 0.00 | 0.00 | 16.00 | 3.08 | 1.38 | 0.76 |
| 3.25 | 0.13 | 0.00 | 0.00 | 16.25 | 3.10 | 1.39 | 0.71 |
| 3.50 | 0.14 | 0.00 | 0.00 | 16.50 | 3.12 | 1.41 | 0.68 |
| 3.75 | 0.16 | 0.00 | 0.00 | 16.75 | 3.14 | 1.42 | 0.67 |
| 4.00 | 0.17 | 0.00 | 0.00 | 17.00 | 3.16 | 1.43 | 0.65 |
| 4.25 | 0.18 | 0.00 | 0.00 | 17.25 | 3.17 | 1.45 | 0.63 |
| 4.50 | 0.19 | 0.00 | 0.00 | 17.50 | 3.19 | 1.46 | 0.61 |
| 4.75 | 0.21 | 0.00 | 0.00 | 17.75 | 3.21 | 1.47 | 0.59 |
| 5.00 | 0.22 | 0.00 | 0.00 | 18.00 | 3.22 | 1.49 | 0.58 |
| 5.25 | 0.23 | 0.00 | 0.00 | 18.25 | 3.24 | 1.50 | 0.56 |
| 5.50 | 0.25 | 0.00 | 0.00 | 18.50 | 3.25 | 1.51 | 0.54 |
| 5.75 | 0.26 | 0.00 | 0.00 | 18.75 | 3.27 | 1.52 | 0.52 |
| 6.00 | 0.28 | 0.00 | 0.00 | 19.00 | 3.28 | 1.53 | 0.50 |
| 6.25 | 0.30 | 0.00 | 0.00 | 19.25 | 3.30 | 1.54 | 0.48 |
| 6.50 | 0.31 | 0.00 | 0.00 | 19.50 | 3.31 | 1.55 | 0.47 |
| 6.75 | 0.33 | 0.00 | 0.00 | 19.75 | 3.32 | 1.56 | 0.45 |
| 7.00 | 0.35 | 0.00 | 0.00 | 20.00 | 3.33 | 1.57 | 0.43 |
| 7.25 | 0.36 | 0.00 | 0.00 | 20.25 | 3.34 | 1.58 | 0.41 |
| 7.50 | 0.38 | 0.00 | 0.00 | 20.50 | 3.35 | 1.59 | 0.40 |
| 7.75 | 0.40 | 0.00 | 0.00 | 20.75 | 3.37 | 1.60 | 0.40 |
| 8.00 | 0.42 | 0.00 | 0.00 | 21.00 | 3.38 | 1.61 | 0.39 |
| 8.25 | 0.44 | 0.00 | 0.00 | 21.25 | 3.39 | 1.62 | 0.39 |
| 8.50 | 0.46 | 0.00 | 0.00 | 21.50 | 3.40 | 1.63 | 0.39 |
| 8.75 | 0.49 | 0.00 | 0.00 | 21.75 | 3.41 | 1.64 | 0.38 |
| 9.00 | 0.51 | 0.00 | 0.01 | 22.00 | 3.42 | 1.64 | 0.38 |
| 9.25 | 0.54 | 0.00 | 0.04 | 22.25 | 3.43 | 1.65 | 0.38 |
| 9.50 | 0.57 | 0.00 | 0.07 | 22.50 | 3.44 | 1.66 | 0.37 |
| 9.75 | 0.60 | 0.01 | 0.10 | 22.75 | 3.45 | 1.67 | 0.37 |
| 10.00 | 0.63 | 0.01 | 0.14 | 23.00 | 3.46 | 1.68 | 0.37 |
| 10.25 | 0.67 | 0.02 | 0.19 | 23.25 | 3.47 | 1.68 | 0.36 |
| 10.50 | 0.71 | 0.02 | 0.26 | 23.50 | 3.48 | 1.69 | 0.36 |
| 10.75 | 0.76 | 0.03 | 0.35 | 23.75 | 3.49 | 1.70 | 0.36 |
| 11.00 | 0.82 | 0.05 | 0.48 | 24.00 | **3.50** | **1.71** | 0.35 |
| 11.25 | 0.90 | 0.07 | 0.66 | | | | |
| 11.50 | 0.99 | 0.09 | 0.99 | | | | |
| 11.75 | 1.35 | 0.24 | 2.37 | | | | |
| 12.00 | 2.32 | 0.82 | **13.74** | | | | |
| 12.25 | 2.47 | 0.92 | **15.72** | | | | |
| 12.50 | 2.57 | 0.99 | 5.96 | | | | |
| 12.75 | 2.64 | 1.05 | 3.21 | | | | |

## Pond SB - 1: Sediment Basin #1

Inflow Area = 11.050 ac, Inflow Depth = 1.70" for 2 year event
Inflow = 20.80 cfs @ 12.13 hrs, Volume= 1.565 af
Outflow = 1.40 cfs @ 13.79 hrs, Volume= 1.022 af, Atten= 93%, Lag= 99.5 min
Primary = 1.40 cfs @ 13.79 hrs, Volume= 1.022 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 80.52' @ 13.79 hrs Surf.Area= 9,467 sf Storage= 38,954 cf
Plug-Flow detention time= 301.0 min calculated for 1.022 af (65% of inflow)
Center-of-Mass det. time= 192.5 min ( 1,034.2 - 841.7 )

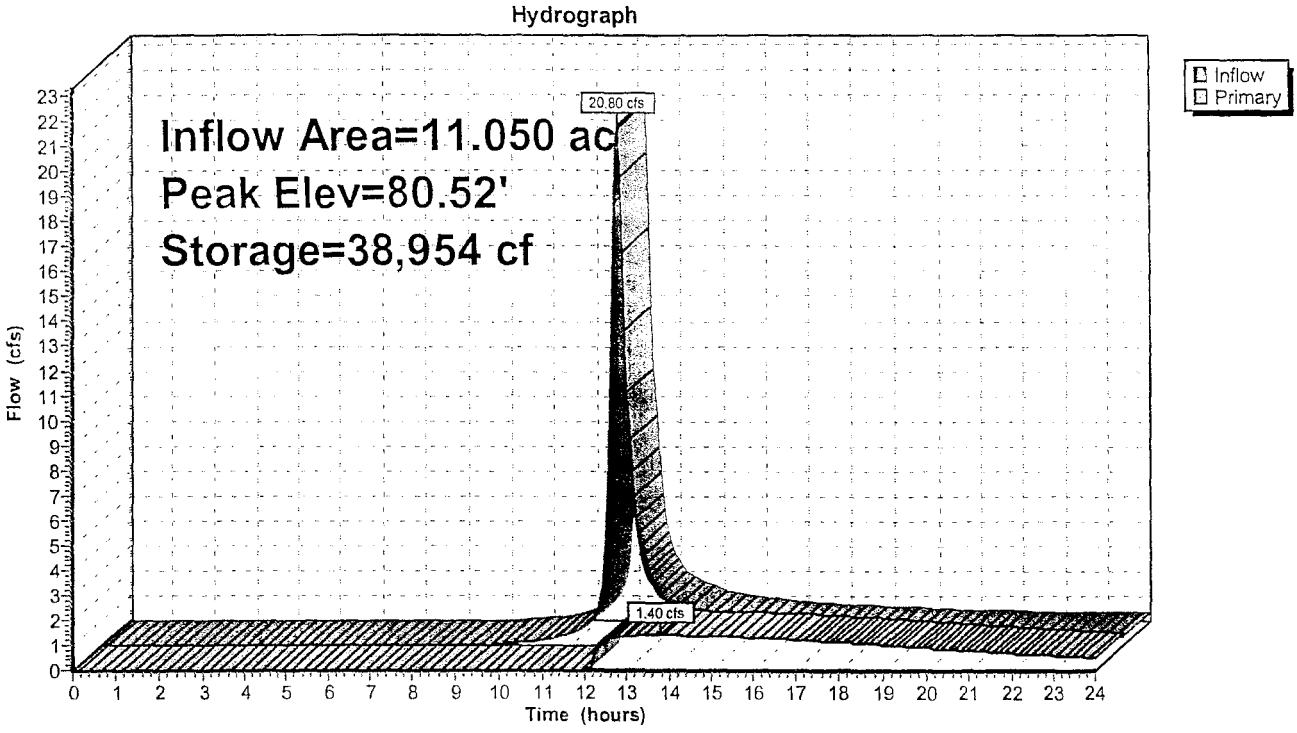
| # | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| 1 | 72.00' | 67,503 cf | **Custom Stage Data (Prismatic)** Listed below |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 72.00 | 978 | 0 | 0 |
| 74.00 | 2,170 | 3,148 | 3,148 |
| 76.00 | 3,836 | 6,006 | 9,154 |
| 78.00 | 5,977 | 9,813 | 18,967 |
| 80.00 | 8,661 | 14,638 | 33,605 |
| 82.00 | 11,732 | 20,393 | 53,998 |
| 83.00 | 15,277 | 13,505 | 67,503 |

| # | Routing | Invert | Outlet Devices |
|---|---|---|---|
| 1 | Primary | 67.84' | **30.0" x 84.0' long Culvert** RCP, end-section conforming to fill, Ke= 0.500<br>Outlet Invert= 67.00' S= 0.0100 '/' n= 0.013 Cc= 0.900 |
| 2 | Device 1 | 78.09' | **6.0" Vert. 6" Dewatering Device** C= 0.600 |
| 3 | Device 1 | 80.64' | **60.0" Horiz. Orifice/Grate** Limited to weir flow C= 0.600 |

**Primary OutFlow** Max=1.40 cfs @ 13.79 hrs HW=80.52' (Free Discharge)
└**1=Culvert** (Passes 1.40 cfs of 79.92 cfs potential flow)
├**2=6" Dewatering Device** (Orifice Controls 1.40 cfs @ 7.1 fps)
└**3=Orifice/Grate** ( Controls 0.00 cfs)

## Pond SB - 1: Sediment Basin #1



## Hydrograph for Pond SB - 1: Sediment Basin #1

| Time (hours) | Inflow (cfs) | Storage (cubic-feet) | Elevation (feet) | Primary (cfs) |
|---|---|---|---|---|
| 0.00 | 0.00 | 0 | 72.00 | 0.00 |
| 0.25 | 0.00 | 0 | 72.00 | 0.00 |
| 0.50 | 0.00 | 0 | 72.00 | 0.00 |
| 0.75 | 0.00 | 0 | 72.00 | 0.00 |
| 1.00 | 0.00 | 0 | 72.00 | 0.00 |
| 1.25 | 0.00 | 0 | 72.00 | 0.00 |
| 1.50 | 0.00 | 0 | 72.00 | 0.00 |
| 1.75 | 0.00 | 0 | 72.00 | 0.00 |
| 2.00 | 0.00 | 0 | 72.00 | 0.00 |
| 2.25 | 0.00 | 0 | 72.00 | 0.00 |
| 2.50 | 0.00 | 0 | 72.00 | 0.00 |
| 2.75 | 0.00 | 0 | 72.00 | 0.00 |
| 3.00 | 0.00 | 0 | 72.00 | 0.00 |
| 3.25 | 0.00 | 0 | 72.00 | 0.00 |
| 3.50 | 0.00 | 0 | 72.00 | 0.00 |
| 3.75 | 0.00 | 0 | 72.00 | 0.00 |
| 4.00 | 0.00 | 0 | 72.00 | 0.00 |
| 4.25 | 0.00 | 0 | 72.00 | 0.00 |
| 4.50 | 0.00 | 0 | 72.00 | 0.00 |
| 4.75 | 0.00 | 0 | 72.00 | 0.00 |
| 5.00 | 0.00 | 0 | 72.00 | 0.00 |
| 5.25 | 0.00 | 0 | 72.00 | 0.00 |
| 5.50 | 0.00 | 0 | 72.00 | 0.00 |
| 5.75 | 0.00 | 0 | 72.00 | 0.00 |
| 6.00 | 0.00 | 0 | 72.00 | 0.00 |
| 6.25 | 0.00 | 0 | 72.00 | 0.00 |
| 6.50 | 0.00 | 0 | 72.00 | 0.00 |
| 6.75 | 0.00 | 0 | 72.00 | 0.00 |
| 7.00 | 0.00 | 0 | 72.00 | 0.00 |
| 7.25 | 0.00 | 0 | 72.00 | 0.00 |
| 7.50 | 0.00 | 0 | 72.00 | 0.00 |
| 7.75 | 0.00 | 0 | 72.00 | 0.00 |
| 8.00 | 0.00 | 0 | 72.00 | 0.00 |
| 8.25 | 0.00 | 0 | 72.00 | 0.00 |
| 8.50 | 0.00 | 0 | 72.00 | 0.00 |
| 8.75 | 0.00 | 0 | 72.00 | 0.00 |
| 9.00 | 0.01 | 6 | 72.00 | 0.00 |
| 9.25 | 0.04 | 30 | 72.02 | 0.00 |
| 9.50 | 0.07 | 79 | 72.05 | 0.00 |
| 9.75 | 0.10 | 152 | 72.10 | 0.00 |
| 10.00 | 0.14 | 256 | 72.16 | 0.00 |
| 10.25 | 0.19 | 400 | 72.25 | 0.00 |
| 10.50 | 0.26 | 598 | 72.38 | 0.00 |
| 10.75 | 0.35 | 869 | 72.55 | 0.00 |
| 11.00 | 0.48 | 1,238 | 72.79 | 0.00 |
| 11.25 | 0.66 | 1,746 | 73.11 | 0.00 |
| 11.50 | 0.99 | 2,480 | 73.58 | 0.00 |
| 11.75 | 2.37 | 3,743 | 74.20 | 0.00 |
| 12.00 | **13.74** | 9,681 | 76.11 | 0.00 |
| 12.25 | **15.72** | 26,134 | 78.98 | 0.76 |
| 12.50 | 5.96 | 33,970 | 80.04 | 1.23 |
| 12.75 | 3.21 | 36,737 | 80.31 | 1.33 |
| 13.00 | 2.27 | 37,925 | 80.42 | 1.36 |
| 13.25 | 1.86 | 38,532 | 80.48 | 1.38 |
| 13.50 | 1.62 | 38,841 | 80.51 | 1.39 |
| 13.75 | 1.42 | **38,952** | **80.52** | **1.40** |
| 14.00 | 1.27 | **38,904** | **80.52** | **1.40** |
| 14.25 | 1.13 | 38,729 | 80.50 | 1.39 |
| 14.50 | 1.06 | 38,465 | 80.48 | 1.38 |
| 14.75 | 1.01 | 38,155 | 80.45 | 1.37 |
| 15.00 | 0.96 | 37,810 | 80.41 | 1.36 |
| 15.25 | 0.91 | 37,431 | 80.38 | 1.35 |
| 15.50 | 0.86 | 37,019 | 80.33 | 1.34 |
| 15.75 | 0.81 | 36,575 | 80.29 | 1.32 |
| 16.00 | 0.76 | 36,100 | 80.24 | 1.30 |
| 16.25 | 0.71 | 35,594 | 80.20 | 1.29 |
| 16.50 | 0.68 | 35,071 | 80.14 | 1.27 |
| 16.75 | 0.67 | 34,544 | 80.09 | 1.25 |
| 17.00 | 0.65 | 34,017 | 80.04 | 1.23 |
| 17.25 | 0.63 | 33,491 | 79.98 | 1.21 |
| 17.50 | 0.61 | 32,971 | 79.91 | 1.19 |
| 17.75 | 0.59 | 32,458 | 79.84 | 1.16 |
| 18.00 | 0.58 | 31,954 | 79.77 | 1.13 |
| 18.25 | 0.56 | 31,457 | 79.71 | 1.11 |
| 18.50 | 0.54 | 30,969 | 79.64 | 1.08 |
| 18.75 | 0.52 | 30,488 | 79.57 | 1.05 |
| 19.00 | 0.50 | 30,016 | 79.51 | 1.02 |
| 19.25 | 0.48 | 29,553 | 79.45 | 0.99 |
| 19.50 | 0.47 | 29,098 | 79.38 | 0.97 |
| 19.75 | 0.45 | 28,652 | 79.32 | 0.94 |
| 20.00 | 0.43 | 28,214 | 79.26 | 0.91 |
| 20.25 | 0.41 | 27,787 | 79.21 | 0.88 |
| 20.50 | 0.40 | 27,374 | 79.15 | 0.85 |
| 20.75 | 0.40 | 26,982 | 79.10 | 0.82 |
| 21.00 | 0.39 | 26,612 | 79.04 | 0.79 |
| 21.25 | 0.39 | 26,264 | 79.00 | 0.77 |
| 21.50 | 0.39 | 25,938 | 78.95 | 0.74 |
| 21.75 | 0.38 | 25,631 | 78.91 | 0.71 |
| 22.00 | 0.38 | 25,344 | 78.87 | 0.69 |
| 22.25 | 0.38 | 25,077 | 78.83 | 0.66 |
| 22.50 | 0.37 | 24,827 | 78.80 | 0.64 |
| 22.75 | 0.37 | 24,595 | 78.77 | 0.62 |
| 23.00 | 0.37 | 24,380 | 78.74 | 0.60 |
| 23.25 | 0.36 | 24,180 | 78.71 | 0.58 |
| 23.50 | 0.36 | 23,995 | 78.69 | 0.56 |
| 23.75 | 0.36 | 23,826 | 78.66 | 0.54 |
| 24.00 | 0.35 | 23,670 | 78.64 | 0.52 |

## Stage-Area-Storage for Pond SB - 1: Sediment Basin #1

| Elevation (feet) | Surface (sq-ft) | Storage (cubic-feet) |
|---|---|---|
| 72.00 | 978 | 0 |
| 72.15 | 1,067 | 236 |
| 72.30 | 1,157 | 472 |
| 72.45 | 1,246 | 708 |
| 72.60 | 1,336 | 944 |
| 72.75 | 1,425 | 1,181 |
| 72.90 | 1,514 | 1,417 |
| 73.05 | 1,604 | 1,653 |
| 73.20 | 1,693 | 1,889 |
| 73.35 | 1,783 | 2,125 |
| 73.50 | 1,872 | 2,361 |
| 73.65 | 1,961 | 2,597 |
| 73.80 | 2,051 | 2,833 |
| 73.95 | 2,140 | 3,069 |
| 74.10 | 2,253 | 3,448 |
| 74.25 | 2,378 | 3,899 |
| 74.40 | 2,503 | 4,349 |
| 74.55 | 2,628 | 4,800 |
| 74.70 | 2,753 | 5,250 |
| 74.85 | 2,878 | 5,701 |
| 75.00 | 3,003 | 6,151 |
| 75.15 | 3,128 | 6,601 |
| 75.30 | 3,253 | 7,052 |
| 75.45 | 3,378 | 7,502 |
| 75.60 | 3,503 | 7,953 |
| 75.75 | 3,628 | 8,403 |
| 75.90 | 3,753 | 8,854 |
| 76.05 | 3,890 | 9,399 |
| 76.20 | 4,050 | 10,135 |
| 76.35 | 4,211 | 10,871 |
| 76.50 | 4,371 | 11,607 |
| 76.65 | 4,532 | 12,343 |
| 76.80 | 4,692 | 13,079 |
| 76.95 | 4,853 | 13,815 |
| 77.10 | 5,014 | 14,551 |
| 77.25 | 5,174 | 15,287 |
| 77.40 | 5,335 | 16,023 |
| 77.55 | 5,495 | 16,759 |
| 77.70 | 5,656 | 17,495 |
| 77.85 | 5,816 | 18,231 |
| 78.00 | 5,977 | 18,967 |
| 78.15 | 6,178 | 20,065 |
| 78.30 | 6,380 | 21,163 |
| 78.45 | 6,581 | 22,261 |
| 78.60 | 6,782 | 23,358 |
| 78.75 | 6,984 | 24,456 |
| 78.90 | 7,185 | 25,554 |
| 79.05 | 7,386 | 26,652 |
| 79.20 | 7,587 | 27,750 |
| 79.35 | 7,789 | 28,848 |
| 79.50 | 7,990 | 29,946 |
| 79.65 | 8,191 | 31,043 |
| 79.80 | 8,393 | 32,141 |
| 79.95 | 8,594 | 33,239 |
| 80.10 | 8,815 | 34,625 |
| 80.25 | 9,045 | 36,154 |
| 80.40 | 9,275 | 37,684 |
| 80.55 | 9,506 | 39,213 |
| 80.70 | 9,736 | 40,743 |
| 80.85 | 9,966 | 42,272 |
| 81.00 | 10,197 | 43,802 |
| 81.15 | 10,427 | 45,331 |
| 81.30 | 10,657 | 46,860 |
| 81.45 | 10,887 | 48,390 |
| 81.60 | 11,118 | 49,919 |
| 81.75 | 11,348 | 51,449 |
| 81.90 | 11,578 | 52,978 |
| 82.05 | 11,909 | 54,673 |
| 82.20 | 12,441 | 56,699 |
| 82.35 | 12,973 | 58,725 |
| 82.50 | 13,505 | 60,750 |
| 82.65 | 14,036 | 62,776 |
| 82.80 | 14,568 | 64,802 |
| 82.95 | **15,100** | **66,827** |

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment 1/3 ac lots SB: Post development to SB 1** Runoff Area=11.050 ac Runoff Depth=4.23"
Tc=20.0 min CN=81 Runoff=51.61 cfs 3.896 af

**Pond SB - 1: Sediment Basin #1** Peak Elev=81.57' Storage=49,656 cf Inflow=51.61 cfs 3.896 af
Outflow=48.07 cfs 3.183 af

**Total Runoff Area = 11.050 ac Runoff Volume = 3.896 af Average Runoff Depth = 4.23"**

## Subcatchment 1/3 ac lots SB: Post development to SB 1

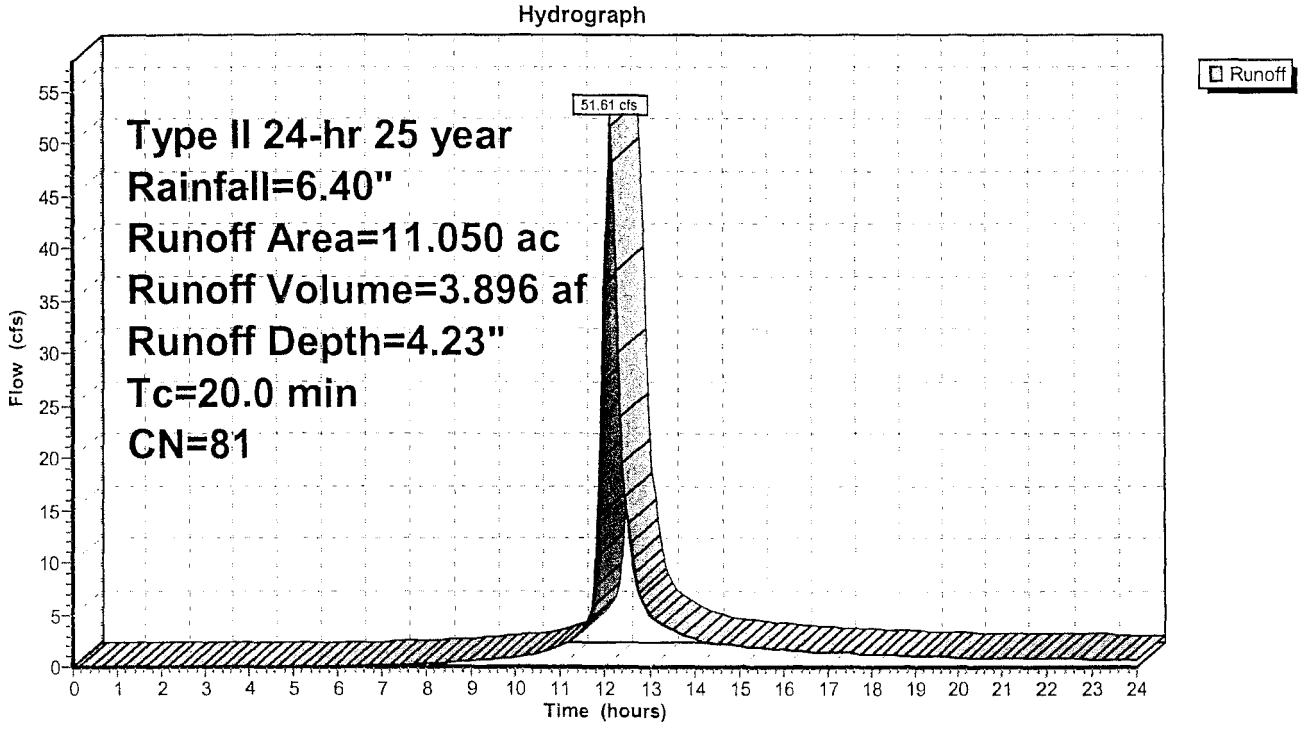
Runoff = 51.61 cfs @ 12.12 hrs, Volume= 3.896 af, Depth= 4.23"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 year Rainfall=6.40"

| Area (ac) | CN | Description |
|---|---|---|
| 11.050 | 81 | 1/3 acre lots, 30% imp, HSG C |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 20.0 | | | | | **Direct Entry,** |

## Subcatchment 1/3 ac lots SB: Post development to SB 1



## Hydrograph for Subcatchment 1/3 ac lots SB: Post development to SB 1

| Time (hours) | Precip. (inches) | Excess (inches) | Runoff (cfs) |
|---|---|---|---|
| 0.00 | 0.00 | 0.00 | 0.00 |
| 0.25 | 0.02 | 0.00 | 0.00 |
| 0.50 | 0.03 | 0.00 | 0.00 |
| 0.75 | 0.05 | 0.00 | 0.00 |
| 1.00 | 0.07 | 0.00 | 0.00 |
| 1.25 | 0.08 | 0.00 | 0.00 |
| 1.50 | 0.10 | 0.00 | 0.00 |
| 1.75 | 0.12 | 0.00 | 0.00 |
| 2.00 | 0.14 | 0.00 | 0.00 |
| 2.25 | 0.16 | 0.00 | 0.00 |
| 2.50 | 0.18 | 0.00 | 0.00 |
| 2.75 | 0.20 | 0.00 | 0.00 |
| 3.00 | 0.22 | 0.00 | 0.00 |
| 3.25 | 0.24 | 0.00 | 0.00 |
| 3.50 | 0.26 | 0.00 | 0.00 |
| 3.75 | 0.28 | 0.00 | 0.00 |
| 4.00 | 0.31 | 0.00 | 0.00 |
| 4.25 | 0.33 | 0.00 | 0.00 |
| 4.50 | 0.35 | 0.00 | 0.00 |
| 4.75 | 0.38 | 0.00 | 0.00 |
| 5.00 | 0.40 | 0.00 | 0.00 |
| 5.25 | 0.43 | 0.00 | 0.00 |
| 5.50 | 0.46 | 0.00 | 0.00 |
| 5.75 | 0.48 | 0.00 | 0.00 |
| 6.00 | 0.51 | 0.00 | 0.01 |
| 6.25 | 0.54 | 0.00 | 0.04 |
| 6.50 | 0.57 | 0.00 | 0.07 |
| 6.75 | 0.60 | 0.01 | 0.10 |
| 7.00 | 0.63 | 0.01 | 0.14 |
| 7.25 | 0.67 | 0.02 | 0.17 |
| 7.50 | 0.70 | 0.02 | 0.21 |
| 7.75 | 0.73 | 0.03 | 0.25 |
| 8.00 | 0.77 | 0.03 | 0.29 |
| 8.25 | 0.81 | 0.04 | 0.33 |
| 8.50 | 0.85 | 0.05 | 0.39 |
| 8.75 | 0.89 | 0.06 | 0.48 |
| 9.00 | 0.94 | 0.08 | 0.57 |
| 9.25 | 0.99 | 0.10 | 0.67 |
| 9.50 | 1.04 | 0.11 | 0.74 |
| 9.75 | 1.10 | 0.13 | 0.81 |
| 10.00 | 1.16 | 0.16 | 0.94 |
| 10.25 | 1.23 | 0.19 | 1.11 |
| 10.50 | 1.31 | 0.22 | 1.35 |
| 10.75 | 1.40 | 0.26 | 1.64 |
| 11.00 | 1.50 | 0.32 | 2.05 |
| 11.25 | 1.64 | 0.39 | 2.61 |
| 11.50 | 1.81 | 0.49 | 3.57 |
| 11.75 | 2.48 | 0.93 | 7.63 |
| 12.00 | 4.24 | 2.33 | **36.47** |
| 12.25 | 4.52 | 2.56 | **37.76** |
| 12.50 | 4.70 | 2.73 | 13.74 |
| 12.75 | 4.83 | 2.84 | 7.19 |
| 13.00 | 4.94 | 2.93 | 5.01 |
| 13.25 | 5.03 | 3.01 | 4.08 |
| 13.50 | 5.11 | 3.09 | 3.53 |
| 13.75 | 5.18 | 3.15 | 3.09 |
| 14.00 | 5.25 | 3.21 | 2.74 |
| 14.25 | 5.31 | 3.26 | 2.45 |
| 14.50 | 5.36 | 3.31 | 2.28 |
| 14.75 | 5.41 | 3.35 | 2.16 |
| 15.00 | 5.46 | 3.40 | 2.06 |
| 15.25 | 5.51 | 3.44 | 1.95 |
| 15.50 | 5.55 | 3.48 | 1.84 |
| 15.75 | 5.59 | 3.52 | 1.73 |
| 16.00 | 5.63 | 3.55 | 1.62 |
| 16.25 | 5.67 | 3.58 | 1.51 |
| 16.50 | 5.70 | 3.61 | 1.45 |
| 16.75 | 5.74 | 3.65 | 1.41 |
| 17.00 | 5.77 | 3.68 | 1.37 |
| 17.25 | 5.80 | 3.71 | 1.33 |
| 17.50 | 5.83 | 3.73 | 1.29 |
| 17.75 | 5.87 | 3.76 | 1.25 |
| 18.00 | 5.89 | 3.79 | 1.22 |
| 18.25 | 5.92 | 3.81 | 1.18 |
| 18.50 | 5.95 | 3.84 | 1.14 |
| 18.75 | 5.98 | 3.86 | 1.10 |
| 19.00 | 6.00 | 3.89 | 1.06 |
| 19.25 | 6.03 | 3.91 | 1.02 |
| 19.50 | 6.05 | 3.93 | 0.98 |
| 19.75 | 6.07 | 3.95 | 0.94 |
| 20.00 | 6.09 | 3.97 | 0.90 |
| 20.25 | 6.11 | 3.99 | 0.86 |
| 20.50 | 6.13 | 4.01 | 0.84 |
| 20.75 | 6.15 | 4.02 | 0.83 |
| 21.00 | 6.17 | 4.04 | 0.83 |
| 21.25 | 6.19 | 4.06 | 0.82 |
| 21.50 | 6.21 | 4.08 | 0.81 |
| 21.75 | 6.23 | 4.10 | 0.80 |
| 22.00 | 6.25 | 4.11 | 0.79 |
| 22.25 | 6.27 | 4.13 | 0.79 |
| 22.50 | 6.29 | 4.15 | 0.78 |
| 22.75 | 6.31 | 4.17 | 0.77 |
| 23.00 | 6.33 | 4.18 | 0.76 |
| 23.25 | 6.35 | 4.20 | 0.75 |
| 23.50 | 6.36 | 4.22 | 0.75 |
| 23.75 | 6.38 | 4.23 | 0.74 |
| 24.00 | **6.40** | **4.25** | 0.73 |

## Pond SB - 1: Sediment Basin #1

| | | | | | |
|---|---|---|---|---|---|
| Inflow Area = | 11.050 ac, | Inflow Depth = | 4.23" | for | 25 year event |
| Inflow = | 51.61 cfs @ | 12.12 hrs, | Volume= | 3.896 af | |
| Outflow = | 48.07 cfs @ | 12.18 hrs, | Volume= | 3.183 af, | Atten= 7%, Lag= 3.7 min |
| Primary = | 48.07 cfs @ | 12.18 hrs, | Volume= | 3.183 af | |

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 81.57' @ 12.18 hrs Surf.Area= 11,078 sf Storage= 49,656 cf
Plug-Flow detention time= 147.3 min calculated for 3.176 af (82% of inflow)
Center-of-Mass det. time= 72.7 min ( 888.8 - 816.1 )

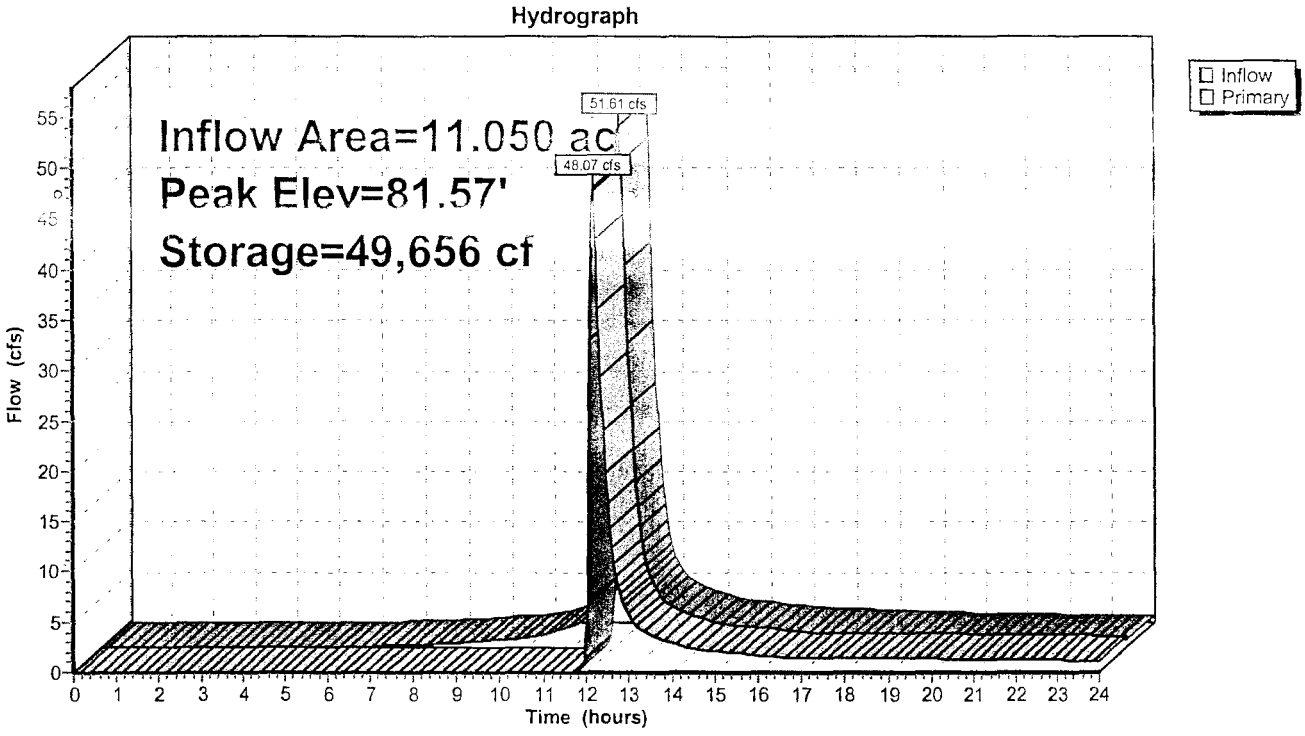
| # | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| 1 | 72.00' | 67,503 cf | **Custom Stage Data (Prismatic)** Listed below |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 72.00 | 978 | 0 | 0 |
| 74.00 | 2,170 | 3,148 | 3,148 |
| 76.00 | 3,836 | 6,006 | 9,154 |
| 78.00 | 5,977 | 9,813 | 18,967 |
| 80.00 | 8,661 | 14,638 | 33,605 |
| 82.00 | 11,732 | 20,393 | 53,998 |
| 83.00 | 15,277 | 13,505 | 67,503 |

| # | Routing | Invert | Outlet Devices |
|---|---|---|---|
| 1 | Primary | 67.84' | **30.0" x 84.0' long Culvert** RCP, end-section conforming to fill, Ke= 0.500<br>Outlet Invert= 67.00' S= 0.0100 '/' n= 0.013 Cc= 0.900 |
| 2 | Device 1 | 78.09' | **6.0" Vert. 6" Dewatering Device** C= 0.600 |
| 3 | Device 1 | 80.64' | **60.0" Horiz. Orifice/Grate** Limited to weir flow C= 0.600 |

**Primary OutFlow** Max=47.42 cfs @ 12.18 hrs HW=81.57' (Free Discharge)
└**1=Culvert** (Passes 47.42 cfs of 83.48 cfs potential flow)
  ├**2=6" Dewatering Device** (Orifice Controls 1.70 cfs @ 8.6 fps)
  └**3=Orifice/Grate** (Weir Controls 45.73 cfs @ 3.1 fps)

## Pond SB - 1: Sediment Basin #1

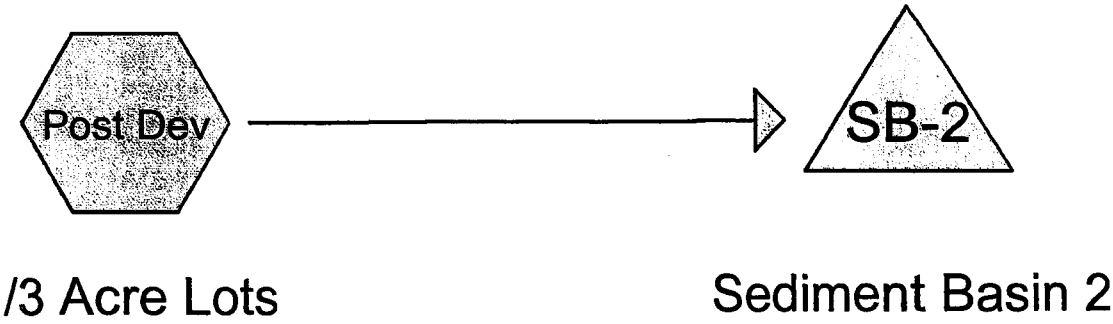


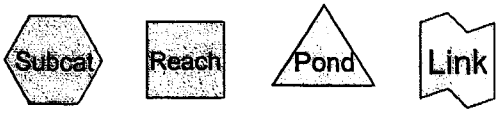
## Hydrograph for Pond SB - 1: Sediment Basin #1

| Time (hours) | Inflow (cfs) | Storage (cubic-feet) | Elevation (feet) | Primary (cfs) |
|---|---|---|---|---|
| 0.00 | 0.00 | 0 | 72.00 | 0.00 |
| 0.25 | 0.00 | 0 | 72.00 | 0.00 |
| 0.50 | 0.00 | 0 | 72.00 | 0.00 |
| 0.75 | 0.00 | 0 | 72.00 | 0.00 |
| 1.00 | 0.00 | 0 | 72.00 | 0.00 |
| 1.25 | 0.00 | 0 | 72.00 | 0.00 |
| 1.50 | 0.00 | 0 | 72.00 | 0.00 |
| 1.75 | 0.00 | 0 | 72.00 | 0.00 |
| 2.00 | 0.00 | 0 | 72.00 | 0.00 |
| 2.25 | 0.00 | 0 | 72.00 | 0.00 |
| 2.50 | 0.00 | 0 | 72.00 | 0.00 |
| 2.75 | 0.00 | 0 | 72.00 | 0.00 |
| 3.00 | 0.00 | 0 | 72.00 | 0.00 |
| 3.25 | 0.00 | 0 | 72.00 | 0.00 |
| 3.50 | 0.00 | 0 | 72.00 | 0.00 |
| 3.75 | 0.00 | 0 | 72.00 | 0.00 |
| 4.00 | 0.00 | 0 | 72.00 | 0.00 |
| 4.25 | 0.00 | 0 | 72.00 | 0.00 |
| 4.50 | 0.00 | 0 | 72.00 | 0.00 |
| 4.75 | 0.00 | 0 | 72.00 | 0.00 |
| 5.00 | 0.00 | 0 | 72.00 | 0.00 |
| 5.25 | 0.00 | 0 | 72.00 | 0.00 |
| 5.50 | 0.00 | 0 | 72.00 | 0.00 |
| 5.75 | 0.00 | 0 | 72.00 | 0.00 |
| 6.00 | 0.01 | 4 | 72.00 | 0.00 |
| 6.25 | 0.04 | 27 | 72.02 | 0.00 |
| 6.50 | 0.07 | 76 | 72.05 | 0.00 |
| 6.75 | 0.10 | 153 | 72.10 | 0.00 |
| 7.00 | 0.14 | 261 | 72.17 | 0.00 |
| 7.25 | 0.17 | 400 | 72.25 | 0.00 |
| 7.50 | 0.21 | 572 | 72.36 | 0.00 |
| 7.75 | 0.25 | 777 | 72.49 | 0.00 |
| 8.00 | 0.29 | 1,016 | 72.65 | 0.00 |
| 8.25 | 0.33 | 1,292 | 72.82 | 0.00 |
| 8.50 | 0.39 | 1,616 | 73.03 | 0.00 |
| 8.75 | 0.48 | 2,007 | 73.28 | 0.00 |
| 9.00 | 0.57 | 2,478 | 73.57 | 0.00 |
| 9.25 | 0.67 | 3,037 | 73.93 | 0.00 |
| 9.50 | 0.74 | 3,674 | 74.17 | 0.00 |
| 9.75 | 0.81 | 4,367 | 74.41 | 0.00 |
| 10.00 | 0.94 | 5,149 | 74.67 | 0.00 |
| 10.25 | 1.11 | 6,069 | 74.97 | 0.00 |
| 10.50 | 1.35 | 7,175 | 75.34 | 0.00 |
| 10.75 | 1.64 | 8,516 | 75.79 | 0.00 |
| 11.00 | 2.05 | 10,171 | 76.21 | 0.00 |
| 11.25 | 2.61 | 12,249 | 76.63 | 0.00 |
| 11.50 | 3.57 | 14,998 | 77.19 | 0.00 |
| 11.75 | 7.63 | 19,299 | 78.05 | 0.00 |
| 12.00 | **36.47** | **35,714** | **80.21** | **1.29** |
| 12.25 | **37.76** | **48,938** | **81.50** | **42.98** |
| 12.50 | 13.74 | 44,642 | 81.08 | 16.77 |
| 12.75 | 7.19 | 42,817 | 80.90 | 8.49 |
| 13.00 | 5.01 | 41,993 | 80.82 | 5.58 |
| 13.25 | 4.08 | 41,623 | 80.79 | 4.43 |
| 13.50 | 3.53 | 41,356 | 80.76 | 3.78 |
| 13.75 | 3.09 | 41,158 | 80.74 | 3.29 |
| 14.00 | 2.74 | 40,999 | 80.73 | 2.90 |
| 14.25 | 2.45 | 40,868 | 80.71 | 2.58 |
| 14.50 | 2.28 | 40,777 | 80.70 | 2.36 |
| 14.75 | 2.16 | 40,720 | 80.70 | 2.22 |
| 15.00 | 2.06 | 40,674 | 80.69 | 2.11 |
| 15.25 | 1.95 | 40,628 | 80.69 | 2.01 |
| 15.50 | 1.84 | 40,557 | 80.68 | 1.93 |
| 15.75 | 1.73 | 40,471 | 80.67 | 1.83 |
| 16.00 | 1.62 | 40,379 | 80.66 | 1.72 |
| 16.25 | 1.51 | 40,286 | 80.66 | 1.61 |
| 16.50 | 1.45 | 40,209 | 80.65 | 1.52 |
| 16.75 | 1.41 | 40,156 | 80.64 | 1.46 |
| 17.00 | 1.37 | 40,111 | 80.64 | 1.43 |
| 17.25 | 1.33 | 40,040 | 80.63 | 1.43 |
| 17.50 | 1.29 | 39,936 | 80.62 | 1.43 |
| 17.75 | 1.25 | 39,800 | 80.61 | 1.42 |
| 18.00 | 1.22 | 39,633 | 80.59 | 1.42 |
| 18.25 | 1.18 | 39,435 | 80.57 | 1.41 |
| 18.50 | 1.14 | 39,208 | 80.55 | 1.41 |
| 18.75 | 1.10 | 38,951 | 80.52 | 1.40 |
| 19.00 | 1.06 | 38,667 | 80.50 | 1.39 |
| 19.25 | 1.02 | 38,355 | 80.47 | 1.38 |
| 19.50 | 0.98 | 38,016 | 80.43 | 1.37 |
| 19.75 | 0.94 | 37,651 | 80.40 | 1.36 |
| 20.00 | 0.90 | 37,262 | 80.36 | 1.34 |
| 20.25 | 0.86 | 36,848 | 80.32 | 1.33 |
| 20.50 | 0.84 | 36,423 | 80.28 | 1.32 |
| 20.75 | 0.83 | 35,999 | 80.23 | 1.30 |
| 21.00 | 0.83 | 35,581 | 80.19 | 1.29 |
| 21.25 | 0.82 | 35,168 | 80.15 | 1.27 |
| 21.50 | 0.81 | 34,761 | 80.11 | 1.26 |
| 21.75 | 0.80 | 34,360 | 80.07 | 1.24 |
| 22.00 | 0.79 | 33,964 | 80.04 | 1.23 |
| 22.25 | 0.79 | 33,573 | 80.00 | 1.22 |
| 22.50 | 0.78 | 33,192 | 79.94 | 1.20 |
| 22.75 | 0.77 | 32,820 | 79.89 | 1.18 |
| 23.00 | 0.76 | 32,458 | 79.84 | 1.16 |
| 23.25 | 0.75 | 32,106 | 79.80 | 1.14 |
| 23.50 | 0.75 | 31,764 | 79.75 | 1.12 |
| 23.75 | 0.74 | 31,432 | 79.70 | 1.10 |
| 24.00 | 0.73 | 31,108 | 79.66 | 1.09 |

## Stage-Area-Storage for Pond SB - 1: Sediment Basin #1

| Elevation (feet) | Surface (sq-ft) | Storage (cubic-feet) |
|---|---|---|
| 72.00 | 978 | 0 |
| 72.15 | 1,067 | 236 |
| 72.30 | 1,157 | 472 |
| 72.45 | 1,246 | 708 |
| 72.60 | 1,336 | 944 |
| 72.75 | 1,425 | 1,181 |
| 72.90 | 1,514 | 1,417 |
| 73.05 | 1,604 | 1,653 |
| 73.20 | 1,693 | 1,889 |
| 73.35 | 1,783 | 2,125 |
| 73.50 | 1,872 | 2,361 |
| 73.65 | 1,961 | 2,597 |
| 73.80 | 2,051 | 2,833 |
| 73.95 | 2,140 | 3,069 |
| 74.10 | 2,253 | 3,448 |
| 74.25 | 2,378 | 3,899 |
| 74.40 | 2,503 | 4,349 |
| 74.55 | 2,628 | 4,800 |
| 74.70 | 2,753 | 5,250 |
| 74.85 | 2,878 | 5,701 |
| 75.00 | 3,003 | 6,151 |
| 75.15 | 3,128 | 6,601 |
| 75.30 | 3,253 | 7,052 |
| 75.45 | 3,378 | 7,502 |
| 75.60 | 3,503 | 7,953 |
| 75.75 | 3,628 | 8,403 |
| 75.90 | 3,753 | 8,854 |
| 76.05 | 3,890 | 9,399 |
| 76.20 | 4,050 | 10,135 |
| 76.35 | 4,211 | 10,871 |
| 76.50 | 4,371 | 11,607 |
| 76.65 | 4,532 | 12,343 |
| 76.80 | 4,692 | 13,079 |
| 76.95 | 4,853 | 13,815 |
| 77.10 | 5,014 | 14,551 |
| 77.25 | 5,174 | 15,287 |
| 77.40 | 5,335 | 16,023 |
| 77.55 | 5,495 | 16,759 |
| 77.70 | 5,656 | 17,495 |
| 77.85 | 5,816 | 18,231 |
| 78.00 | 5,977 | 18,967 |
| 78.15 | 6,178 | 20,065 |
| 78.30 | 6,380 | 21,163 |
| 78.45 | 6,581 | 22,261 |
| 78.60 | 6,782 | 23,358 |
| 78.75 | 6,984 | 24,456 |
| 78.90 | 7,185 | 25,554 |
| 79.05 | 7,386 | 26,652 |
| 79.20 | 7,587 | 27,750 |
| 79.35 | 7,789 | 28,848 |
| 79.50 | 7,990 | 29,946 |
| 79.65 | 8,191 | 31,043 |
| 79.80 | 8,393 | 32,141 |
| 79.95 | 8,594 | 33,239 |
| 80.10 | 8,815 | 34,625 |
| 80.25 | 9,045 | 36,154 |
| 80.40 | 9,275 | 37,684 |
| 80.55 | 9,506 | 39,213 |
| 80.70 | 9,736 | 40,743 |
| 80.85 | 9,966 | 42,272 |
| 81.00 | 10,197 | 43,802 |
| 81.15 | 10,427 | 45,331 |
| 81.30 | 10,657 | 46,860 |
| 81.45 | 10,887 | 48,390 |
| 81.60 | 11,118 | 49,919 |
| 81.75 | 11,348 | 51,449 |
| 81.90 | 11,578 | 52,978 |
| 82.05 | 11,909 | 54,673 |
| 82.20 | 12,441 | 56,699 |
| 82.35 | 12,973 | 58,725 |
| 82.50 | 13,505 | 60,750 |
| 82.65 | 14,036 | 62,776 |
| 82.80 | 14,568 | 64,802 |
| 82.95 | **15,100** | **66,827** |




**Drainage Diagram for SED BASIN 2**
Prepared by LANDMARK DESIGN GROUP 10/26/2004
HydroCAD® 7.00 s/n 001765 © 1986-2003 Applied Microcomputer Systems

# TEMPORARY SEDIMENT BASIN DESIGN DATA SHEET

(with or without an emergency spillway)

Project STONE HOUSE GLEN PHASE I

Basin # #2 Location JAMES CITY COUNTY

Total area draining to basin: 6.1 acres.

## Basin Volume Design

**Wet Storage:**

1. Minimum required volume = 67 cu. yds. x Total Drainage Area (acres).

   67 cu. yds. x 6.1 acres = 414.8 cu. yds.

2. Available basin volume = 417.2 cu. yds. at elevation 78.05. (From storage - elevation curve)

3. Excavate _____ cu. yds. to obtain required volume*.

   * Elevation corresponding to required volume = invert of the dewatering orifice.

4. Available volume before cleanout required.

   33 cu. yds. x 6.1 acres = 201.3 cu. yds.

5. Elevation corresponding to cleanout level = 75.80.

   (From Storage - Elevation Curve)

6. Distance from invert of the dewatering orifice to cleanout level = 1.6 ft. (Min. = 1.0 ft.)

**Dry Storage:**

7. Minimum required volume = 67 cu. yds. x Total Drainage Area (acres).

   67 cu. yds. x 6.1 acres = 414.8 cu. yds.

8. Total available basin volume at crest of riser* = 848.7 cu. yds. at elevation 80.55. (From Storage - Elevation Curve)

* Minimum = 134 cu. yds./acre of total drainage area.

9. Diameter of dewatering orifice = 6 in.

10. Diameter of flexible tubing = 8 in. (diameter of dewatering orifice plus 2 inches).

Preliminary Design Elevations

11. Crest of Riser = 80.55

Top of Dam = 83.55

Design High Water = 81.07 (25YR)

Upstream Toe of Dam = 68.00

Basin Shape

12. Length of Flow / Effective Width — L / We = 76 / 35

If > 2, baffles are not required 2.1

If < 2, baffles are required _____

Runoff

13. $Q_2$ = 8.10 cfs (From Chapter 5)

14. $Q_{25}$ = 24.51 cfs (From Chapter 5)

Principal Spillway Design

15. With emergency spillway, required spillway capacity $Q_p = Q_2$ = 8.10 cfs. (riser and barrel)

Without emergency spillway, required spillway capacity $Q_p = Q_{25}$ = 24.51 cfs. (riser and barrel)

16. With emergency spillway:

Assumed available head (h) = _____ ft. (Using $Q_2$)

h = Crest of Emergency Spillway Elevation - Crest of Riser Elevation

Without emergency spillway:

Assumed available head (h) = 0.52 ft. (Using $Q_{25}$)

h = Design High Water Elevation - Crest of Riser Elevation

17. Riser diameter ($D_r$) = 48 in. Actual head (h) = 0.52 ft.

(From Plate 3.14-8.)

Note: Avoid orifice flow conditions.

18. Barrel length (l) = 90 ft.

Head (H) on barrel through embankment = 17.9 ft.

(From Plate 3.14-7).

19. Barrel diameter = 24 in.

(From Plate 3.14-B [concrete pipe] or Plate 3.14-A [corrugated pipe]).

20. Trash rack and anti-vortex device

Diameter = 72 inches.

Height = 21 inches.

(From Table 3.14-D).

Emergency Spillway Design

21. Required spillway capacity $Q_e = Q_{25} - Q_p$ = N/A cfs.

22. Bottom width (b) = _____ ft.; the slope of the exit channel (s) = _____ ft./foot; and the minimum length of the exit channel (x) = _____ ft.
(From Table 3.14-C).

Anti-Seep Collar Design

23. Depth of water at principal spillway crest (Y) = 13.3 ft.

Slope of upstream face of embankment (Z) = 3. :1.

Slope of principal spillway barrel ($S_b$) = 1.00 %

Length of barrel in saturated zone ($L_s$) = 95. ft.

24. Number of collars required = 3. dimensions = 5.0'

(from Plate 3.14-12).

Final Design Elevations

25. Top of Dam = 83.5

Design High Water = 81.07 (25 YR)

Emergency Spillway Crest = N/A.

Principal Spillway Crest = 80.55

Dewatering Orifice Invert = 78.05

Cleanout Elevation = 75.80

Elevation of Upstream Toe of Dam or Excavated Bottom of "Wet Storage Area" (if excavation was performed) = _____

Subject _____

Computed _____ Checked _____

LANDMARK DESIGN GROUP

Project # _____

Client _____

Date _____ Sheet # _____

Engineers • Planners • Surveyors • Landscape Architects • Environmental Scientists

LENGTH OF PIPE IN SATURATED ZONE

BMP #2

CREST OF RISER = 80.55
BOTTOM OF POND = 68.00

$$LS = Y(Z+4)\left(1+\frac{S}{0.25-S}\right)$$

$Y = 12.55$

$Z = 3:1$ SLOPE

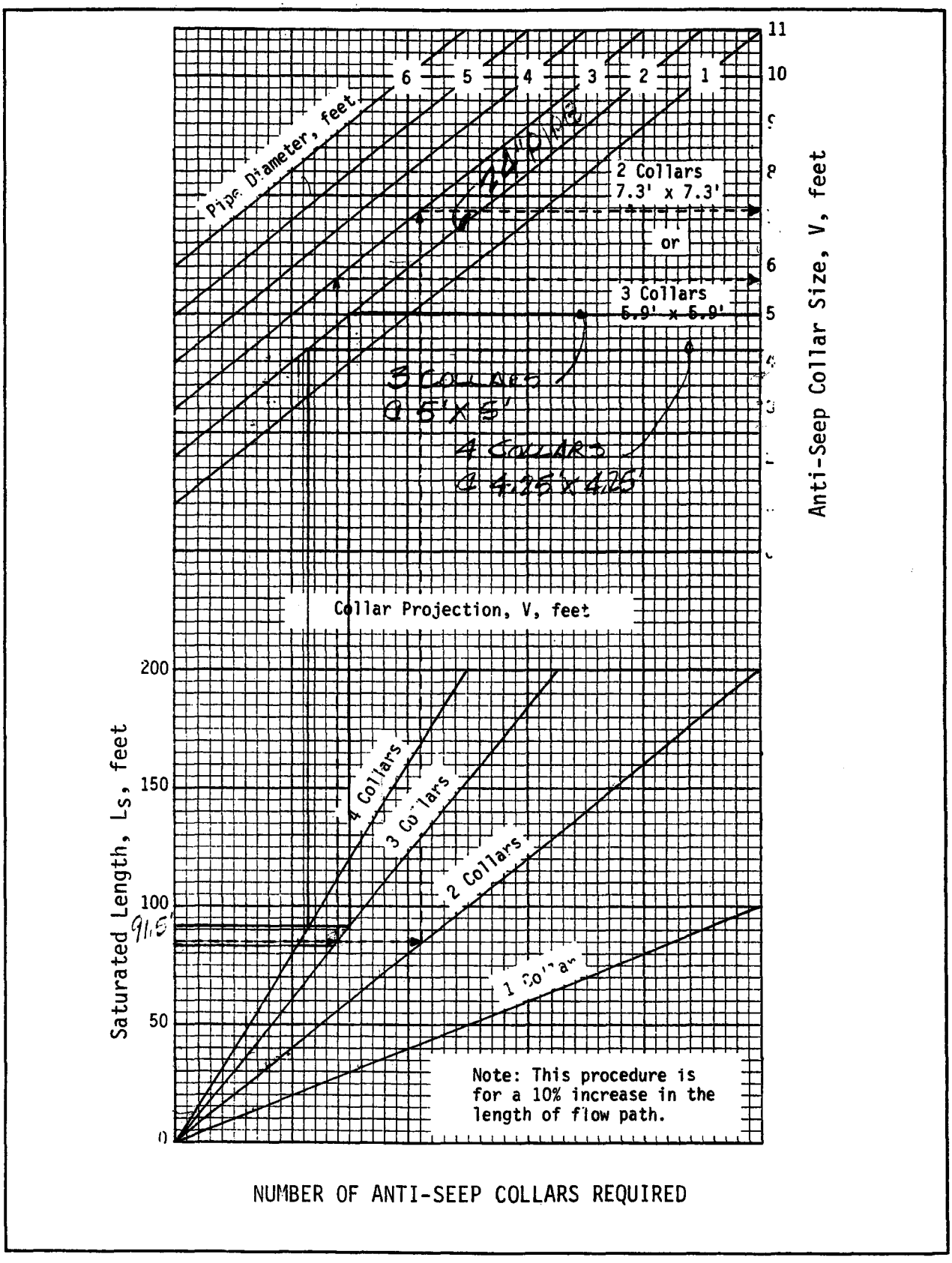
$S = 1.0\%$

$$LS = 12.55(3+4)\left(1+\frac{0.01}{0.25-0.01}\right)$$

$LS = 12.55 \times 7 \times 1.0417$

$LS = 91.51$

USE 4 COLLARS 4.25'X4.25'




Source: USDA-SCS

BMP #2

Plate 3.14-12

Time span=5.00-25.00 hrs, dt=0.05 hrs, 401 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment Post Dev: 1/3 Acre Lots** Runoff Area=6.100 ac Runoff Depth=1.18"
Tc=18.0 min CN=73 Runoff=8.10 cfs 0.600 af

**Pond SB-2: Sediment Basin 2** Peak Elev=78.74' Storage=13,865 cf Inflow=8.10 cfs 0.600 af
Outflow=0.63 cfs 0.327 af

**Total Runoff Area = 6.100 ac Runoff Volume = 0.600 af Average Runoff Depth = 1.18"**

## Subcatchment Post Dev: 1/3 Acre Lots

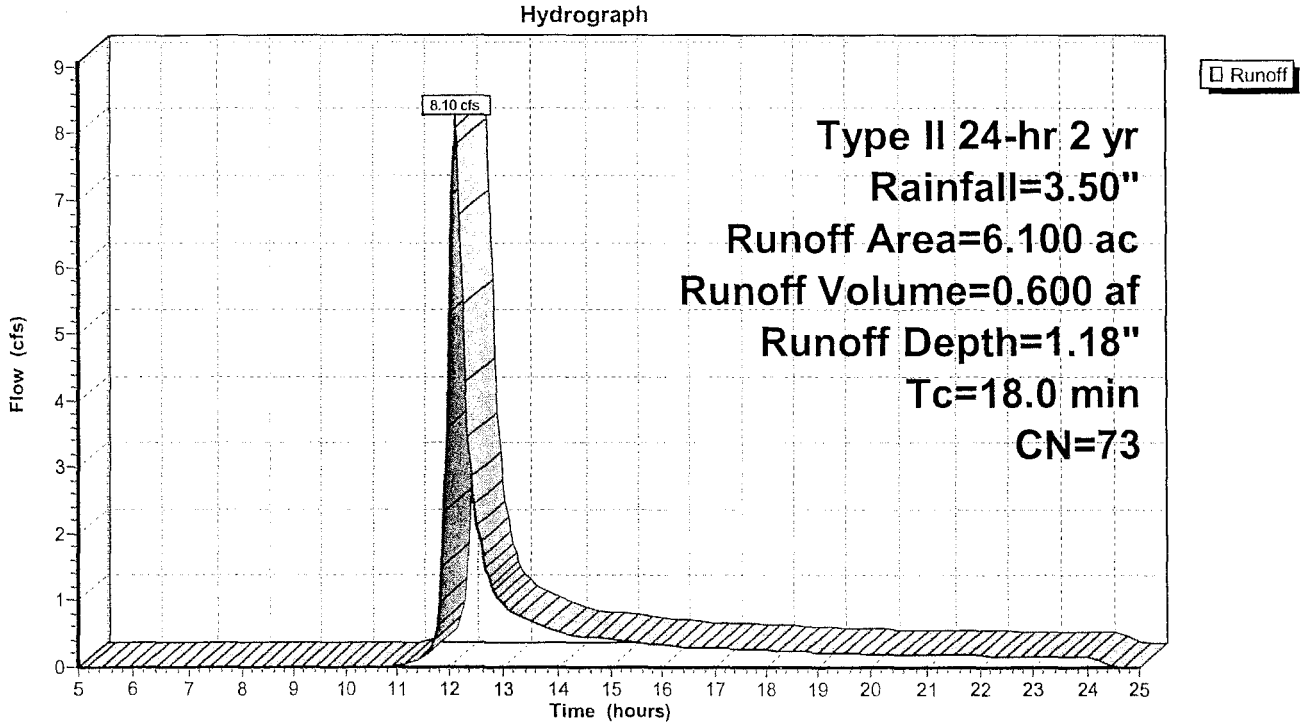
Runoff = 8.10 cfs @ 12.12 hrs, Volume= 0.600 af, Depth= 1.18"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-25.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 yr Rainfall=3.50"

| Area (ac) | CN | Description |
|---|---|---|
| 1.900 | 55 | Woods, Good, HSG B |
| 4.200 | 81 | 1/3 acre lots, 30% imp, HSG C |
| 6.100 | 73 | Weighted Average |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 18.0 | | | | | **Direct Entry,** |

## Subcatchment Post Dev: 1/3 Acre Lots



## Hydrograph for Subcatchment Post Dev: 1/3 Acre Lots

| Time (hours) | Precip. (inches) | Excess (inches) | Runoff (cfs) |
|---|---|---|---|
| 5.00 | 0.22 | 0.00 | 0.00 |
| 5.25 | 0.23 | 0.00 | 0.00 |
| 5.50 | 0.25 | 0.00 | 0.00 |
| 5.75 | 0.26 | 0.00 | 0.00 |
| 6.00 | 0.28 | 0.00 | 0.00 |
| 6.25 | 0.30 | 0.00 | 0.00 |
| 6.50 | 0.31 | 0.00 | 0.00 |
| 6.75 | 0.33 | 0.00 | 0.00 |
| 7.00 | 0.35 | 0.00 | 0.00 |
| 7.25 | 0.36 | 0.00 | 0.00 |
| 7.50 | 0.38 | 0.00 | 0.00 |
| 7.75 | 0.40 | 0.00 | 0.00 |
| 8.00 | 0.42 | 0.00 | 0.00 |
| 8.25 | 0.44 | 0.00 | 0.00 |
| 8.50 | 0.46 | 0.00 | 0.00 |
| 8.75 | 0.49 | 0.00 | 0.00 |
| 9.00 | 0.51 | 0.00 | 0.00 |
| 9.25 | 0.54 | 0.00 | 0.00 |
| 9.50 | 0.57 | 0.00 | 0.00 |
| 9.75 | 0.60 | 0.00 | 0.00 |
| 10.00 | 0.63 | 0.00 | 0.00 |
| 10.25 | 0.67 | 0.00 | 0.00 |
| 10.50 | 0.71 | 0.00 | 0.00 |
| 10.75 | 0.76 | 0.00 | 0.00 |
| 11.00 | 0.82 | 0.00 | 0.02 |
| 11.25 | 0.90 | 0.01 | 0.07 |
| 11.50 | 0.99 | 0.02 | 0.16 |
| 11.75 | 1.35 | 0.09 | 0.61 |
| 12.00 | 2.32 | 0.47 | **5.33** |
| 12.25 | 2.47 | 0.55 | **5.45** |
| 12.50 | 2.57 | 0.61 | 2.13 |
| 12.75 | 2.64 | 0.65 | 1.23 |
| 13.00 | 2.70 | 0.68 | 0.93 |
| 13.25 | 2.75 | 0.71 | 0.78 |
| 13.50 | 2.80 | 0.74 | 0.69 |
| 13.75 | 2.84 | 0.76 | 0.61 |
| 14.00 | 2.87 | 0.78 | 0.54 |
| 14.25 | 2.90 | 0.80 | 0.49 |
| 14.50 | 2.93 | 0.82 | 0.46 |
| 14.75 | 2.96 | 0.83 | 0.44 |
| 15.00 | 2.99 | 0.85 | 0.42 |
| 15.25 | 3.01 | 0.87 | 0.40 |
| 15.50 | 3.04 | 0.88 | 0.38 |
| 15.75 | 3.06 | 0.89 | 0.36 |
| 16.00 | 3.08 | 0.91 | 0.33 |
| 16.25 | 3.10 | 0.92 | 0.31 |
| 16.50 | 3.12 | 0.93 | 0.30 |
| 16.75 | 3.14 | 0.94 | 0.30 |
| 17.00 | 3.16 | 0.95 | 0.29 |
| 17.25 | 3.17 | 0.97 | 0.28 |
| 17.50 | 3.19 | 0.98 | 0.27 |
| 17.75 | 3.21 | 0.99 | 0.27 |
| 18.00 | 3.22 | 1.00 | 0.26 |
| 18.25 | 3.24 | 1.01 | 0.25 |
| 18.50 | 3.25 | 1.02 | 0.24 |
| 18.75 | 3.27 | 1.03 | 0.23 |
| 19.00 | 3.28 | 1.04 | 0.23 |
| 19.25 | 3.30 | 1.04 | 0.22 |
| 19.50 | 3.31 | 1.05 | 0.21 |
| 19.75 | 3.32 | 1.06 | 0.20 |
| 20.00 | 3.33 | 1.07 | 0.19 |
| 20.25 | 3.34 | 1.08 | 0.19 |
| 20.50 | 3.35 | 1.08 | 0.18 |
| 20.75 | 3.37 | 1.09 | 0.18 |
| 21.00 | 3.38 | 1.10 | 0.18 |
| 21.25 | 3.39 | 1.10 | 0.18 |
| 21.50 | 3.40 | 1.11 | 0.18 |
| 21.75 | 3.41 | 1.12 | 0.17 |
| 22.00 | 3.42 | 1.13 | 0.17 |
| 22.25 | 3.43 | 1.13 | 0.17 |
| 22.50 | 3.44 | 1.14 | 0.17 |
| 22.75 | 3.45 | 1.15 | 0.17 |
| 23.00 | 3.46 | 1.15 | 0.17 |
| 23.25 | 3.47 | 1.16 | 0.17 |
| 23.50 | 3.48 | 1.17 | 0.16 |
| 23.75 | 3.49 | 1.17 | 0.16 |
| 24.00 | **3.50** | **1.18** | 0.16 |
| 24.25 | 3.50 | 1.18 | 0.08 |
| 24.50 | 3.50 | 1.18 | 0.01 |
| 24.75 | 3.50 | 1.18 | 0.00 |
| 25.00 | 3.50 | 1.18 | 0.00 |

## Pond SB-2: Sediment Basin 2

Inflow Area = 6.100 ac, Inflow Depth = 1.18" for 2 yr event
Inflow = 8.10 cfs @ 12.12 hrs, Volume= 0.600 af
Outflow = 0.63 cfs @ 13.68 hrs, Volume= 0.327 af, Atten= 92%, Lag= 93.9 min
Primary = 0.63 cfs @ 13.68 hrs, Volume= 0.327 af

Routing by Stor-Ind method, Time Span= 5.00-25.00 hrs, dt= 0.05 hrs
Peak Elev= 78.74' @ 13.68 hrs Surf.Area= 3,988 sf Storage= 13,865 cf
Plug-Flow detention time= 292.4 min calculated for 0.327 af (55% of inflow)
Center-of-Mass det. time= 158.8 min ( 1,026.3 - 867.5 )

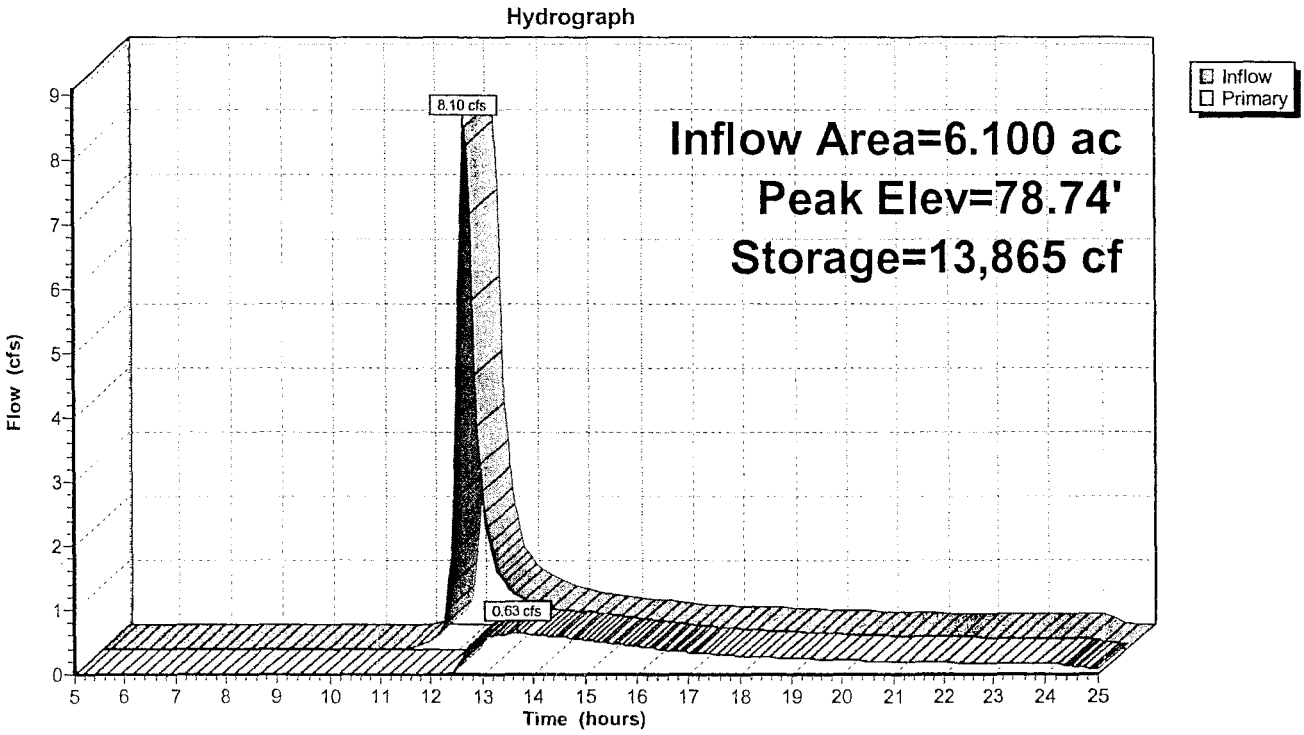
| # | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| 1 | 68.00' | 33,029 cf | **Custom Stage Data (Prismatic)** Listed below |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 68.00 | 0 | 0 | 0 |
| 70.00 | 95 | 95 | 95 |
| 71.00 | 305 | 200 | 295 |
| 72.00 | 667 | 486 | 781 |
| 73.00 | 944 | 806 | 1,587 |
| 74.00 | 1,267 | 1,106 | 2,692 |
| 75.00 | 1,590 | 1,429 | 4,121 |
| 76.00 | 1,954 | 1,772 | 5,893 |
| 77.00 | 2,570 | 2,262 | 8,155 |
| 78.00 | 3,275 | 2,923 | 11,077 |
| 79.00 | 4,236 | 3,756 | 14,833 |
| 80.00 | 5,320 | 4,778 | 19,611 |
| 81.00 | 6,700 | 6,010 | 25,621 |
| 82.00 | 8,117 | 7,409 | 33,029 |

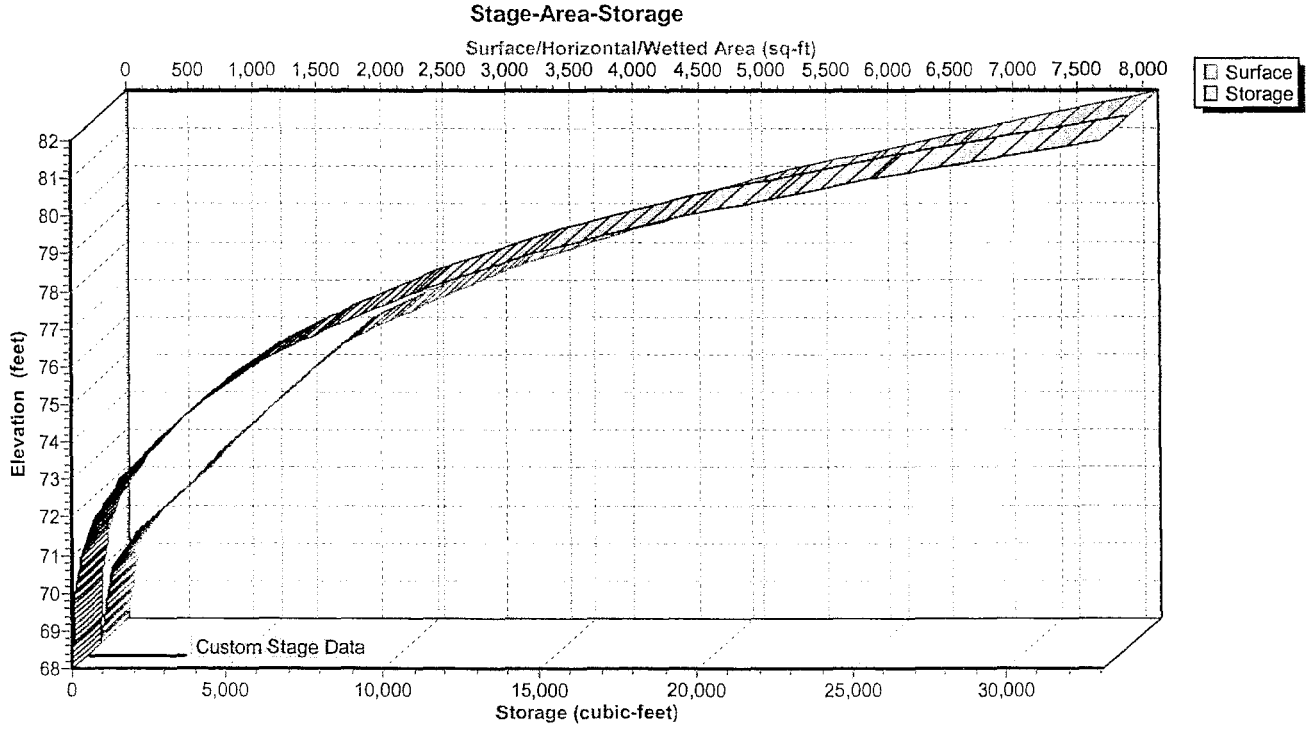
| # | Routing | Invert | Outlet Devices |
|---|---|---|---|
| 1 | Primary | 66.50' | **24.0" x 90.0' long Culvert** CMP, square edge headwall, Ke= 0.500<br>Outlet Invert= 65.60' S= 0.0100 '/' n= 0.013 Cc= 0.900 |
| 2 | Device 1 | 78.05' | **6.0" Vert. Orifice/Grate** C= 0.600 |
| 3 | Device 1 | 80.50' | **48.0" Horiz. Orifice/Grate** Limited to weir flow C= 0.600 |

**Primary OutFlow** Max=0.63 cfs @ 13.68 hrs HW=78.74' (Free Discharge)
└─**1=Culvert** (Passes 0.63 cfs of 50.72 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 0.63 cfs @ 3.2 fps)
  └─**3=Orifice/Grate** ( Controls 0.00 cfs)

## Pond SB-2: Sediment Basin 2




## Pond SB-2: Sediment Basin 2



## Hydrograph for Pond SB-2: Sediment Basin 2

| Time (hours) | Inflow (cfs) | Storage (cubic-feet) | Elevation (feet) | Primary (cfs) |
|---|---|---|---|---|
| 5.00 | 0.00 | 0 | 68.00 | 0.00 |
| 5.50 | 0.00 | 0 | 68.00 | 0.00 |
| 6.00 | 0.00 | 0 | 68.00 | 0.00 |
| 6.50 | 0.00 | 0 | 68.00 | 0.00 |
| 7.00 | 0.00 | 0 | 68.00 | 0.00 |
| 7.50 | 0.00 | 0 | 68.00 | 0.00 |
| 8.00 | 0.00 | 0 | 68.00 | 0.00 |
| 8.50 | 0.00 | 0 | 68.00 | 0.00 |
| 9.00 | 0.00 | 0 | 68.00 | 0.00 |
| 9.50 | 0.00 | 0 | 68.00 | 0.00 |
| 10.00 | 0.00 | 0 | 68.00 | 0.00 |
| 10.50 | 0.00 | 0 | 68.00 | 0.00 |
| 11.00 | 0.02 | 6 | 68.12 | 0.00 |
| 11.50 | 0.16 | 138 | 70.22 | 0.00 |
| 12.00 | **5.33** | 2,442 | 73.77 | 0.00 |
| 12.50 | **2.13** | 11,794 | 78.19 | 0.07 |
| 13.00 | 0.93 | 13,499 | 78.64 | 0.55 |
| 13.50 | 0.69 | **13,845** | **78.74** | **0.62** |
| 14.00 | 0.54 | **13,818** | **78.73** | **0.62** |
| 14.50 | 0.46 | 13,626 | 78.68 | 0.58 |
| 15.00 | 0.42 | 13,412 | 78.62 | 0.53 |
| 15.50 | 0.38 | 13,210 | 78.57 | 0.49 |
| 16.00 | 0.33 | 13,017 | 78.52 | 0.44 |
| 16.50 | 0.30 | 12,841 | 78.47 | 0.39 |
| 17.00 | 0.29 | 12,720 | 78.44 | 0.34 |
| 17.50 | 0.27 | 12,635 | 78.41 | 0.31 |
| 18.00 | 0.26 | 12,569 | 78.40 | 0.29 |
| 18.50 | 0.24 | 12,512 | 78.38 | 0.27 |
| 19.00 | 0.23 | 12,461 | 78.37 | 0.25 |
| 19.50 | 0.21 | 12,411 | 78.36 | 0.24 |
| 20.00 | 0.19 | 12,360 | 78.34 | 0.22 |
| 20.50 | 0.18 | 12,310 | 78.33 | 0.21 |
| 21.00 | 0.18 | 12,274 | 78.32 | 0.20 |
| 21.50 | 0.18 | 12,249 | 78.31 | 0.19 |
| 22.00 | 0.17 | 12,231 | 78.31 | 0.18 |
| 22.50 | 0.17 | 12,216 | 78.30 | 0.18 |
| 23.00 | 0.17 | 12,203 | 78.30 | 0.17 |
| 23.50 | 0.16 | 12,192 | 78.30 | 0.17 |
| 24.00 | 0.16 | 12,181 | 78.29 | 0.17 |
| 24.50 | 0.01 | 12,058 | 78.26 | 0.13 |
| 25.00 | 0.00 | 11,880 | 78.21 | 0.08 |

## Stage-Area-Storage for Pond SB-2: Sediment Basin 2

| Elevation (feet) | Surface (sq-ft) | Storage (cubic-feet) |
|---|---|---|
| 68.00 | 0 | 0 |
| 68.15 | 7 | 7 |
| 68.30 | 14 | 14 |
| 68.45 | 21 | 21 |
| 68.60 | 28 | 28 |
| 68.75 | 36 | 36 |
| 68.90 | 43 | 43 |
| 69.05 | 50 | 50 |
| 69.20 | 57 | 57 |
| 69.35 | 64 | 64 |
| 69.50 | 71 | 71 |
| 69.65 | 78 | 78 |
| 69.80 | 85 | 85 |
| 69.95 | 93 | 93 |
| 70.10 | 116 | 115 |
| 70.25 | 148 | 145 |
| 70.40 | 179 | 175 |
| 70.55 | 210 | 205 |
| 70.70 | 242 | 235 |
| 70.85 | 273 | 265 |
| 71.00 | 305 | 295 |
| 71.15 | 359 | 368 |
| 71.30 | 414 | 441 |
| 71.45 | 468 | 514 |
| 71.60 | 522 | 587 |
| 71.75 | 577 | 660 |
| 71.90 | 631 | 732 |
| 72.05 | 681 | 821 |
| 72.20 | 722 | 942 |
| 72.35 | 764 | 1,063 |
| 72.50 | 806 | 1,184 |
| 72.65 | 847 | 1,305 |
| 72.80 | 889 | 1,425 |
| 72.95 | 930 | 1,546 |
| 73.10 | 976 | 1,697 |
| 73.25 | 1,025 | 1,863 |
| 73.40 | 1,073 | 2,029 |
| 73.55 | 1,122 | 2,195 |
| 73.70 | 1,170 | 2,360 |
| 73.85 | 1,219 | 2,526 |
| 74.00 | 1,267 | 2,692 |
| 74.15 | 1,315 | 2,906 |
| 74.30 | 1,364 | 3,121 |
| 74.45 | 1,412 | 3,335 |
| 74.60 | 1,461 | 3,549 |
| 74.75 | 1,509 | 3,763 |
| 74.90 | 1,558 | 3,978 |
| 75.05 | 1,608 | 4,209 |
| 75.20 | 1,663 | 4,475 |
| 75.35 | 1,717 | 4,741 |
| 75.50 | 1,772 | 5,007 |
| 75.65 | 1,827 | 5,272 |
| 75.80 | 1,881 | 5,538 |
| 75.95 | 1,936 | 5,804 |
| 76.10 | 2,016 | 6,119 |
| 76.25 | 2,108 | 6,458 |
| 76.40 | 2,200 | 6,797 |
| 76.55 | 2,293 | 7,137 |
| 76.70 | 2,385 | 7,476 |
| 76.85 | 2,478 | 7,815 |
| 77.00 | 2,570 | 8,155 |
| 77.15 | 2,676 | 8,593 |
| 77.30 | 2,781 | 9,031 |
| 77.45 | 2,887 | 9,470 |
| 77.60 | 2,993 | 9,908 |
| 77.75 | 3,099 | 10,346 |
| 77.90 | 3,205 | 10,785 |
| 78.05 | 3,323 | 11,265 |
| 78.20 | 3,467 | 11,828 |
| 78.35 | 3,611 | 12,391 |
| 78.50 | 3,756 | 12,955 |
| 78.65 | 3,900 | 13,518 |
| 78.80 | 4,044 | 14,081 |
| 78.95 | 4,188 | 14,645 |
| 79.10 | 4,344 | 15,310 |
| 79.25 | 4,507 | 16,027 |
| 79.40 | 4,670 | 16,744 |
| 79.55 | 4,832 | 17,460 |
| 79.70 | 4,995 | 18,177 |
| 79.85 | 5,157 | 18,894 |
| 80.00 | 5,320 | 19,611 |
| 80.15 | 5,527 | 20,512 |
| 80.30 | 5,734 | 21,413 |
| 80.45 | 5,941 | 22,315 |
| 80.60 | 6,148 | 23,216 |
| 80.75 | 6,355 | 24,118 |
| 80.90 | 6,562 | 25,020 |
| 81.05 | 6,771 | 25,991 |
| 81.20 | 6,983 | 27,102 |
| 81.35 | 7,196 | 28,213 |
| 81.50 | 7,409 | 29,325 |
| 81.65 | 7,621 | 30,436 |
| 81.80 | 7,834 | 31,547 |
| 81.95 | **8,046** | **32,659** |

Time span=5.00-25.00 hrs, dt=0.05 hrs, 401 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment Post Dev: 1/3 Acre Lots** Runoff Area=6.100 ac Runoff Depth=3.42"
Tc=18.0 min CN=73 Runoff=24.51 cfs 1.740 af

**Pond SB-2: Sediment Basin 2** Peak Elev=81.07' Storage=26,122 cf Inflow=24.51 cfs 1.740 af
Outflow=18.99 cfs 1.461 af

**Total Runoff Area = 6.100 ac Runoff Volume = 1.740 af Average Runoff Depth = 3.42"**

## Subcatchment Post Dev: 1/3 Acre Lots

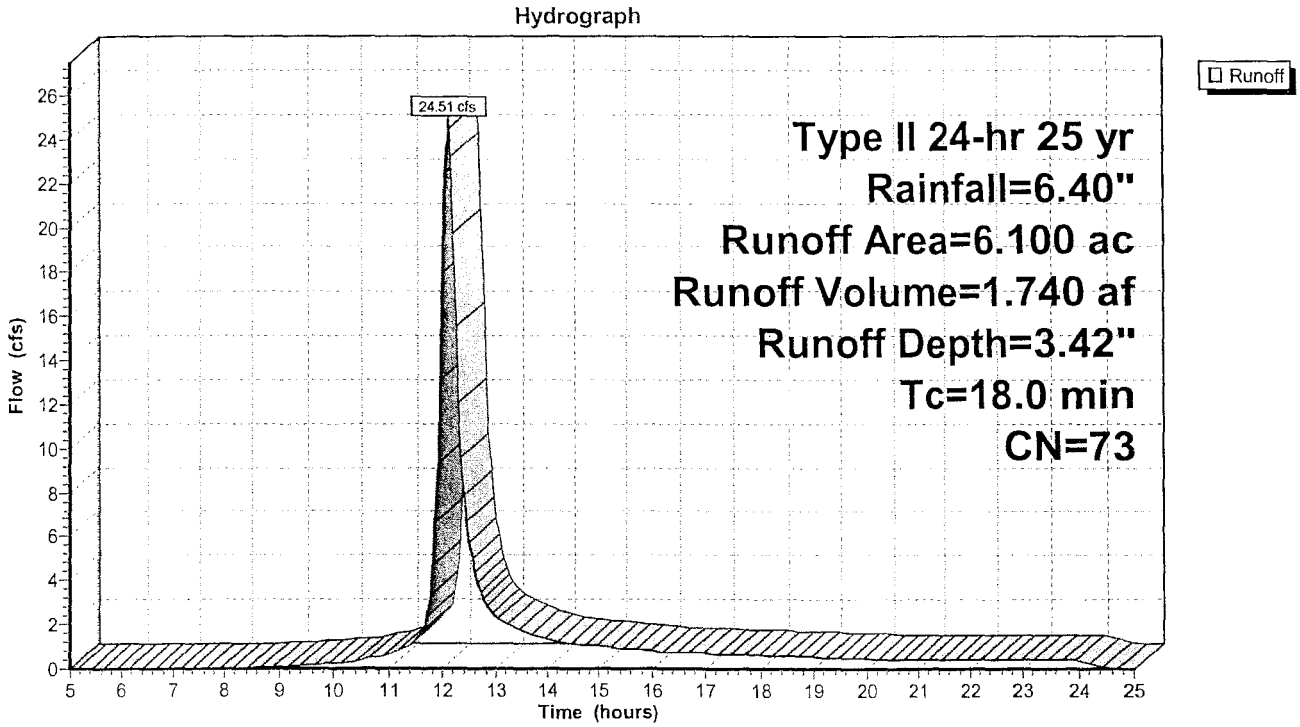
Runoff = 24.51 cfs @ 12.11 hrs, Volume= 1.740 af, Depth= 3.42"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-25.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 yr Rainfall=6.40"

| Area (ac) | CN | Description |
|---|---|---|
| 1.900 | 55 | Woods, Good, HSG B |
| 4.200 | 81 | 1/3 acre lots, 30% imp, HSG C |
| 6.100 | 73 | Weighted Average |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 18.0 | | | | | **Direct Entry,** |

## Subcatchment Post Dev: 1/3 Acre Lots



## Hydrograph for Subcatchment Post Dev: 1/3 Acre Lots

| Time (hours) | Precip. (inches) | Excess (inches) | Runoff (cfs) |
|---|---|---|---|
| 5.00 | 0.40 | 0.00 | 0.00 |
| 5.25 | 0.43 | 0.00 | 0.00 |
| 5.50 | 0.46 | 0.00 | 0.00 |
| 5.75 | 0.48 | 0.00 | 0.00 |
| 6.00 | 0.51 | 0.00 | 0.00 |
| 6.25 | 0.54 | 0.00 | 0.00 |
| 6.50 | 0.57 | 0.00 | 0.00 |
| 6.75 | 0.60 | 0.00 | 0.00 |
| 7.00 | 0.63 | 0.00 | 0.00 |
| 7.25 | 0.67 | 0.00 | 0.00 |
| 7.50 | 0.70 | 0.00 | 0.00 |
| 7.75 | 0.73 | 0.00 | 0.00 |
| 8.00 | 0.77 | 0.00 | 0.00 |
| 8.25 | 0.81 | 0.00 | 0.01 |
| 8.50 | 0.85 | 0.00 | 0.03 |
| 8.75 | 0.89 | 0.01 | 0.06 |
| 9.00 | 0.94 | 0.01 | 0.09 |
| 9.25 | 0.99 | 0.02 | 0.12 |
| 9.50 | 1.04 | 0.02 | 0.15 |
| 9.75 | 1.10 | 0.03 | 0.18 |
| 10.00 | 1.16 | 0.04 | 0.23 |
| 10.25 | 1.23 | 0.06 | 0.30 |
| 10.50 | 1.31 | 0.08 | 0.39 |
| 10.75 | 1.40 | 0.10 | 0.50 |
| 11.00 | 1.50 | 0.13 | 0.67 |
| 11.25 | 1.64 | 0.18 | 0.89 |
| 11.50 | 1.81 | 0.24 | 1.30 |
| 11.75 | 2.48 | 0.56 | 3.27 |
| 12.00 | 4.24 | 1.70 | **17.98** |
| 12.25 | 4.52 | 1.91 | **15.56** |
| 12.50 | 4.70 | 2.05 | 5.70 |
| 12.75 | 4.83 | 2.15 | 3.16 |
| 13.00 | 4.94 | 2.23 | 2.34 |
| 13.25 | 5.03 | 2.31 | 1.95 |
| 13.50 | 5.11 | 2.37 | 1.70 |
| 13.75 | 5.18 | 2.43 | 1.49 |
| 14.00 | 5.25 | 2.48 | 1.33 |
| 14.25 | 5.31 | 2.52 | 1.19 |
| 14.50 | 5.36 | 2.57 | 1.12 |
| 14.75 | 5.41 | 2.61 | 1.06 |
| 15.00 | 5.46 | 2.65 | 1.01 |
| 15.25 | 5.51 | 2.69 | 0.96 |
| 15.50 | 5.55 | 2.72 | 0.91 |
| 15.75 | 5.59 | 2.75 | 0.85 |
| 16.00 | 5.63 | 2.79 | 0.80 |
| 16.25 | 5.67 | 2.82 | 0.75 |
| 16.50 | 5.70 | 2.84 | 0.72 |
| 16.75 | 5.74 | 2.87 | 0.70 |
| 17.00 | 5.77 | 2.90 | 0.68 |
| 17.25 | 5.80 | 2.93 | 0.66 |
| 17.50 | 5.83 | 2.95 | 0.65 |
| 17.75 | 5.87 | 2.98 | 0.63 |
| 18.00 | 5.89 | 3.00 | 0.61 |
| 18.25 | 5.92 | 3.02 | 0.59 |
| 18.50 | 5.95 | 3.05 | 0.57 |
| 18.75 | 5.98 | 3.07 | 0.55 |
| 19.00 | 6.00 | 3.09 | 0.53 |
| 19.25 | 6.03 | 3.11 | 0.51 |
| 19.50 | 6.05 | 3.13 | 0.49 |
| 19.75 | 6.07 | 3.15 | 0.47 |
| 20.00 | 6.09 | 3.17 | 0.45 |
| 20.25 | 6.11 | 3.18 | 0.43 |
| 20.50 | 6.13 | 3.20 | 0.42 |
| 20.75 | 6.15 | 3.22 | 0.42 |
| 21.00 | 6.17 | 3.23 | 0.42 |
| 21.25 | 6.19 | 3.25 | 0.41 |
| 21.50 | 6.21 | 3.27 | 0.41 |
| 21.75 | 6.23 | 3.28 | 0.40 |
| 22.00 | 6.25 | 3.30 | 0.40 |
| 22.25 | 6.27 | 3.32 | 0.40 |
| 22.50 | 6.29 | 3.33 | 0.39 |
| 22.75 | 6.31 | 3.35 | 0.39 |
| 23.00 | 6.33 | 3.36 | 0.39 |
| 23.25 | 6.35 | 3.38 | 0.38 |
| 23.50 | 6.36 | 3.39 | 0.38 |
| 23.75 | 6.38 | 3.41 | 0.37 |
| 24.00 | **6.40** | **3.42** | 0.37 |
| 24.25 | 6.40 | 3.42 | 0.19 |
| 24.50 | 6.40 | 3.42 | 0.02 |
| 24.75 | 6.40 | 3.42 | 0.00 |
| 25.00 | 6.40 | 3.42 | 0.00 |

## Pond SB-2: Sediment Basin 2

Inflow Area = 6.100 ac, Inflow Depth = 3.42" for 25 yr event
Inflow = 24.51 cfs @ 12.11 hrs, Volume= 1.740 af
Outflow = 18.99 cfs @ 12.22 hrs, Volume= 1.461 af, Atten= 23%, Lag= 7.1 min
Primary = 18.99 cfs @ 12.22 hrs, Volume= 1.461 af

Routing by Stor-Ind method, Time Span= 5.00-25.00 hrs, dt= 0.05 hrs
Peak Elev= 81.07' @ 12.22 hrs Surf.Area= 6,796 sf Storage= 26,122 cf
Plug-Flow detention time= 161.7 min calculated for 1.457 af (84% of inflow)
Center-of-Mass det. time= 90.1 min ( 926.3 - 836.2 )

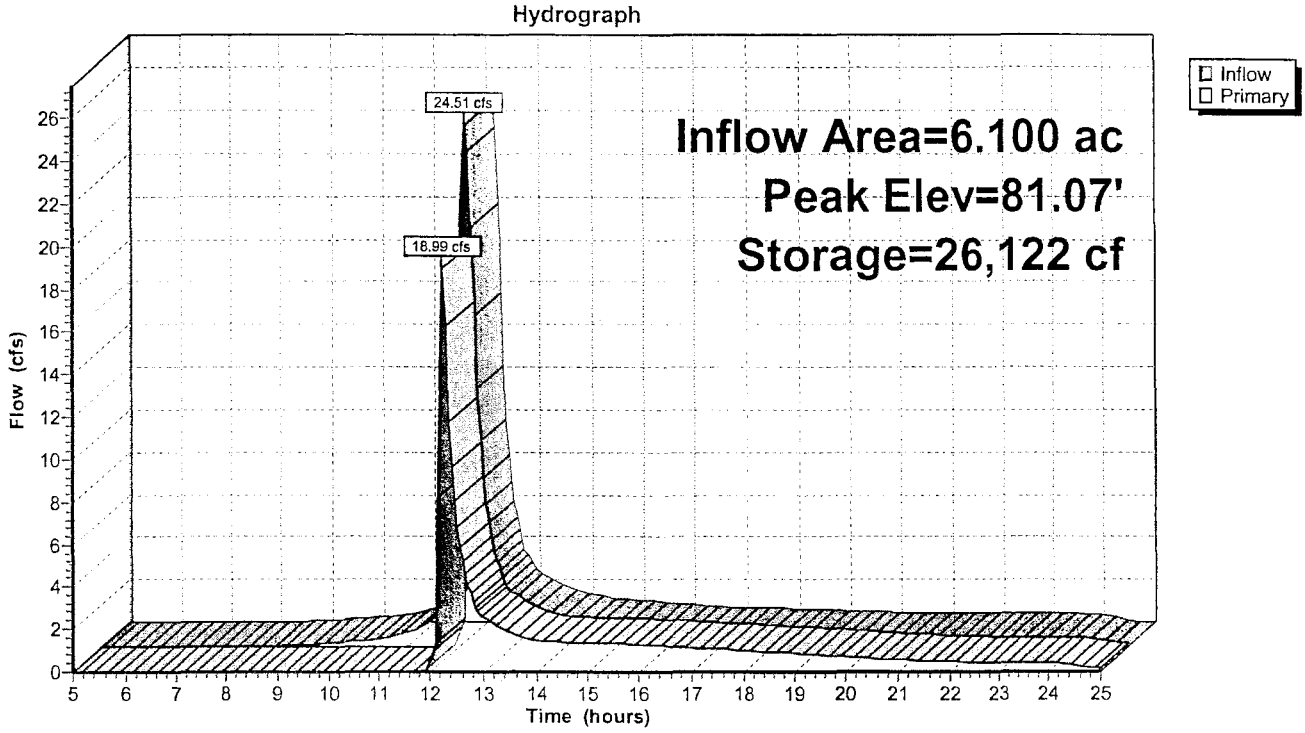
| # | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| 1 | 68.00' | 33,029 cf | **Custom Stage Data (Prismatic)** Listed below |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 68.00 | 0 | 0 | 0 |
| 70.00 | 95 | 95 | 95 |
| 71.00 | 305 | 200 | 295 |
| 72.00 | 667 | 486 | 781 |
| 73.00 | 944 | 806 | 1,587 |
| 74.00 | 1,267 | 1,106 | 2,692 |
| 75.00 | 1,590 | 1,429 | 4,121 |
| 76.00 | 1,954 | 1,772 | 5,893 |
| 77.00 | 2,570 | 2,262 | 8,155 |
| 78.00 | 3,275 | 2,923 | 11,077 |
| 79.00 | 4,236 | 3,756 | 14,833 |
| 80.00 | 5,320 | 4,778 | 19,611 |
| 81.00 | 6,700 | 6,010 | 25,621 |
| 82.00 | 8,117 | 7,409 | 33,029 |

| # | Routing | Invert | Outlet Devices |
|---|---|---|---|
| 1 | Primary | 66.50' | **24.0" x 90.0' long Culvert** CMP, square edge headwall, Ke= 0.500<br>Outlet Invert= 65.60' S= 0.0100 '/' n= 0.013 Cc= 0.900 |
| 2 | Device 1 | 78.05' | **6.0" Vert. Orifice/Grate** C= 0.600 |
| 3 | Device 1 | 80.50' | **48.0" Horiz. Orifice/Grate** Limited to weir flow C= 0.600 |

**Primary OutFlow** Max=17.72 cfs @ 12.22 hrs HW=81.04' (Free Discharge)
└─**1=Culvert** (Passes 17.72 cfs of 55.65 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 1.56 cfs @ 8.0 fps)
  └─**3=Orifice/Grate** (Weir Controls 16.16 cfs @ 2.4 fps)

## Pond SB-2: Sediment Basin 2

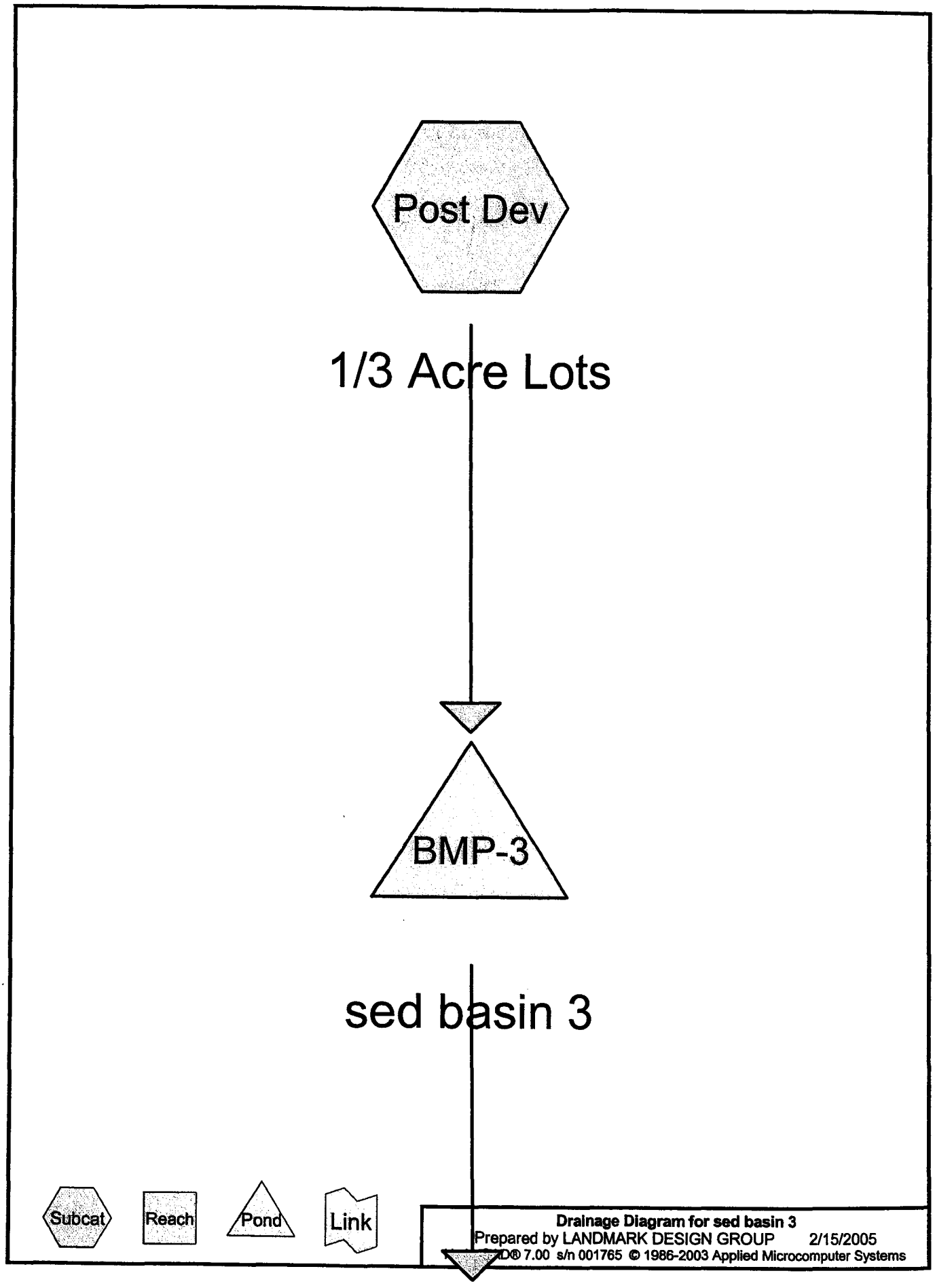


## Hydrograph for Pond SB-2: Sediment Basin 2

| Time (hours) | Inflow (cfs) | Storage (cubic-feet) | Elevation (feet) | Primary (cfs) |
|---|---|---|---|---|
| 5.00 | 0.00 | 0 | 68.00 | 0.00 |
| 5.50 | 0.00 | 0 | 68.00 | 0.00 |
| 6.00 | 0.00 | 0 | 68.00 | 0.00 |
| 6.50 | 0.00 | 0 | 68.00 | 0.00 |
| 7.00 | 0.00 | 0 | 68.00 | 0.00 |
| 7.50 | 0.00 | 0 | 68.00 | 0.00 |
| 8.00 | 0.00 | 0 | 68.00 | 0.00 |
| 8.50 | 0.03 | 25 | 68.52 | 0.00 |
| 9.00 | 0.09 | 128 | 70.16 | 0.00 |
| 9.50 | 0.15 | 345 | 71.10 | 0.00 |
| 10.00 | 0.23 | 682 | 71.80 | 0.00 |
| 10.50 | 0.39 | 1,230 | 72.56 | 0.00 |
| 11.00 | 0.67 | 2,150 | 73.51 | 0.00 |
| 11.50 | 1.30 | 3,817 | 74.79 | 0.00 |
| 12.00 | **17.98** | **13,433** | **78.63** | **0.54** |
| 12.50 | **5.70** | **24,137** | **80.75** | **6.76** |
| 13.00 | 2.34 | 23,149 | 80.59 | 2.58 |
| 13.50 | 1.70 | 22,807 | 80.53 | 1.83 |
| 14.00 | 1.33 | 22,621 | 80.50 | 1.41 |
| 14.50 | 1.12 | 22,277 | 80.44 | 1.38 |
| 15.00 | 1.01 | 21,728 | 80.35 | 1.35 |
| 15.50 | 0.91 | 21,049 | 80.24 | 1.32 |
| 16.00 | 0.80 | 20,253 | 80.11 | 1.27 |
| 16.50 | 0.72 | 19,369 | 79.95 | 1.21 |
| 17.00 | 0.68 | 18,510 | 79.77 | 1.15 |
| 17.50 | 0.65 | 17,704 | 79.60 | 1.08 |
| 18.00 | 0.61 | 16,951 | 79.44 | 1.01 |
| 18.50 | 0.57 | 16,249 | 79.30 | 0.94 |
| 19.00 | 0.53 | 15,598 | 79.16 | 0.88 |
| 19.50 | 0.49 | 14,995 | 79.03 | 0.81 |
| 20.00 | 0.45 | 14,449 | 78.90 | 0.73 |
| 20.50 | 0.42 | 13,987 | 78.77 | 0.65 |
| 21.00 | 0.42 | 13,636 | 78.68 | 0.58 |
| 21.50 | 0.41 | 13,379 | 78.61 | 0.53 |
| 22.00 | 0.40 | 13,199 | 78.57 | 0.48 |
| 22.50 | 0.39 | 13,072 | 78.53 | 0.45 |
| 23.00 | 0.39 | 12,977 | 78.51 | 0.43 |
| 23.50 | 0.38 | 12,908 | 78.49 | 0.41 |
| 24.00 | 0.37 | 12,860 | 78.47 | 0.39 |
| 24.50 | 0.02 | 12,572 | 78.40 | 0.29 |
| 25.00 | 0.00 | 12,181 | 78.29 | 0.17 |

## Stage-Area-Storage for Pond SB-2: Sediment Basin 2

| Elevation (feet) | Surface (sq-ft) | Storage (cubic-feet) |
|---|---|---|
| 68.00 | 0 | 0 |
| 68.15 | 7 | 7 |
| 68.30 | 14 | 14 |
| 68.45 | 21 | 21 |
| 68.60 | 28 | 28 |
| 68.75 | 36 | 36 |
| 68.90 | 43 | 43 |
| 69.05 | 50 | 50 |
| 69.20 | 57 | 57 |
| 69.35 | 64 | 64 |
| 69.50 | 71 | 71 |
| 69.65 | 78 | 78 |
| 69.80 | 85 | 85 |
| 69.95 | 93 | 93 |
| 70.10 | 116 | 115 |
| 70.25 | 148 | 145 |
| 70.40 | 179 | 175 |
| 70.55 | 210 | 205 |
| 70.70 | 242 | 235 |
| 70.85 | 273 | 265 |
| 71.00 | 305 | 295 |
| 71.15 | 359 | 368 |
| 71.30 | 414 | 441 |
| 71.45 | 468 | 514 |
| 71.60 | 522 | 587 |
| 71.75 | 577 | 660 |
| 71.90 | 631 | 732 |
| 72.05 | 681 | 821 |
| 72.20 | 722 | 942 |
| 72.35 | 764 | 1,063 |
| 72.50 | 806 | 1,184 |
| 72.65 | 847 | 1,305 |
| 72.80 | 889 | 1,425 |
| 72.95 | 930 | 1,546 |
| 73.10 | 976 | 1,697 |
| 73.25 | 1,025 | 1,863 |
| 73.40 | 1,073 | 2,029 |
| 73.55 | 1,122 | 2,195 |
| 73.70 | 1,170 | 2,360 |
| 73.85 | 1,219 | 2,526 |
| 74.00 | 1,267 | 2,692 |
| 74.15 | 1,315 | 2,906 |
| 74.30 | 1,364 | 3,121 |
| 74.45 | 1,412 | 3,335 |
| 74.60 | 1,461 | 3,549 |
| 74.75 | 1,509 | 3,763 |
| 74.90 | 1,558 | 3,978 |
| 75.05 | 1,608 | 4,209 |
| 75.20 | 1,663 | 4,475 |
| 75.35 | 1,717 | 4,741 |
| 75.50 | 1,772 | 5,007 |
| 75.65 | 1,827 | 5,272 |
| 75.80 | 1,881 | 5,538 c/o ELEV. |
| 75.95 | 1,936 | 5,804 |
| 76.10 | 2,016 | 6,119 |
| 76.25 | 2,108 | 6,458 |
| 76.40 | 2,200 | 6,797 |
| 76.55 | 2,293 | 7,137 |
| 76.70 | 2,385 | 7,476 |
| 76.85 | 2,478 | 7,815 |
| 77.00 | 2,570 | 8,155 |
| 77.15 | 2,676 | 8,593 |
| 77.30 | 2,781 | 9,031 |
| 77.45 | 2,887 | 9,470 |
| 77.60 | 2,993 | 9,908 |
| 77.75 | 3,099 | 10,346 |
| 77.90 | 3,205 | 10,785 |
| 78.05 | 3,323 | 11,265 WET STORAGE. |
| 78.20 | 3,467 | 11,828 |
| 78.35 | 3,611 | 12,391 |
| 78.50 | 3,756 | 12,955 |
| 78.65 | 3,900 | 13,518 |
| 78.80 | 4,044 | 14,081 |
| 78.95 | 4,188 | 14,645 |
| 79.10 | 4,344 | 15,310 |
| 79.25 | 4,507 | 16,027 |
| 79.40 | 4,670 | 16,744 |
| 79.55 | 4,832 | 17,460 |
| 79.70 | 4,995 | 18,177 |
| 79.85 | 5,157 | 18,894 |
| 80.00 | 5,320 | 19,611 |
| 80.15 | 5,527 | 20,512 |
| 80.30 | 5,734 | 21,413 |
| 80.45 | 5,941 | 22,315 ← 80.55 = 22915. |
| 80.60 | 6,148 | 23,216 |
| 80.75 | 6,355 | 24,118 (848.7) |
| 80.90 | 6,562 | 25,020 |
| 81.05 | 6,771 | 25,991 |
| 81.20 | 6,983 | 27,102 |
| 81.35 | 7,196 | 28,213 |
| 81.50 | 7,409 | 29,325 |
| 81.65 | 7,621 | 30,436 |
| 81.80 | 7,834 | 31,547 |
| 81.95 | **8,046** | **32,659** |


Post Dev
1/3 Acre Lots
BMP-3
sed basin 3
Subcat
Reach
Pond
Link
Drainage Diagram for sed basin 3
Prepared by LANDMARK DESIGN GROUP 2/15/2005
D® 7.00 s/n 001765 © 1986-2003 Applied Microcomputer Systems

# TEMPORARY SEDIMENT BASIN DESIGN DATA SHEET

(with or without an emergency spillway)

Project Stonehouse Glen Section I

Basin # 3. Location James City County

Total area draining to basin: 5.3 acres.

## Basin Volume Design

**Wet Storage:**

1. Minimum required volume = 67 cu. yds. x Total Drainage Area (acres).

   67 cu. yds. x 5.3 acres = 355.1 cu. yds.

2. Available basin volume = 370.4 cu. yds. at elevation 62.0. (From storage - elevation curve)

3. Excavate N/A cu. yds. to obtain required volume*.

   * Elevation corresponding to required volume = invert of the dewatering orifice.

4. Available volume before cleanout required.

   33 cu. yds. x 5.3 acres = 174.9 cu. yds.

5. Elevation corresponding to cleanout level = 60.

   (From Storage - Elevation Curve)

6. Distance from invert of the dewatering orifice to cleanout level = 2' ft. (Min. = 1.0 ft.)

**Dry Storage:**

7. Minimum required volume = 67 cu. yds. x Total Drainage Area (acres).

   67 cu. yds. x 5.3 acres = 355.1 cu. yds.

8. Total available basin volume at crest of riser* = 1130 cu. yds. at elevation 66.50. (From Storage - Elevation Curve)

* Minimum = 134 cu. yds./acre of total drainage area.

9. Diameter of dewatering orifice = 6 in.

10. Diameter of flexible tubing = 8 in. (diameter of dewatering orifice plus 2 inches).

Preliminary Design Elevations

11. Crest of Riser = 66.50.

Top of Dam = 69.50.

Design High Water = 66.98

Upstream Toe of Dam = 56.00.

Basin Shape

12. Length of Flow / Effective Width — L / We = _____

If > 2, baffles are not required _____

If < 2, baffles are required YES

Runoff

13. $Q_2$ = 8.74 cfs (From Chapter 5)

14. $Q_{25}$ = 22.21 cfs (From Chapter 5)

Principal Spillway Design

15. With emergency spillway, required spillway capacity $Q_p = Q_2$ = _____ cfs. (riser and barrel)

Without emergency spillway, required spillway capacity $Q_p = Q_{25}$ = 22.21 cfs. (riser and barrel)

16. With emergency spillway:

Assumed available head (h) = _____ ft. (Using $Q_2$)

h = Crest of Emergency Spillway Elevation - Crest of Riser Elevation

Without emergency spillway:

Assumed available head (h) = _____ ft. (Using $Q_{25}$)

h = Design High Water Elevation - Crest of Riser Elevation

17. Riser diameter ($D_r$) = 48 in. Actual head (h) = 0.33 ft.

(From Plate 3.14-8.)

Note: Avoid orifice flow conditions.

18. Barrel length (l) = _____ ft.

Head (H) on barrel through embankment = _____ft.

(From Plate 3.14-7).

19. Barrel diameter = _____ in.

(From Plate 3.14-B [concrete pipe] or Plate 3.14-A [corrugated pipe]).

20. Trash rack and anti-vortex device

Diameter = _____ inches.

Height = _____ inches.

(From Table 3.14-D).

Emergency Spillway Design

21. Required spillway capacity $Q_e = Q_{25} - Q_p$ = _____cfs.

22. Bottom width (b) = _____ ft.; the slope of the exit channel (s) = _____ ft./foot; and the minimum length of the exit channel (x) = _____ ft.
(From Table 3.14-C).

Anti-Seep Collar Design

23. Depth of water at principal spillway crest (Y) = ____ ft.

Slope of upstream face of embankment (Z) = _____:1.

Slope of principal spillway barrel ($S_b$) = _____%

Length of barrel in saturated zone ($L_s$) = _____ ft.

24. Number of collars required = _____ dimensions = _____

(from Plate 3.14-12).

Final Design Elevations

25. Top of Dam = _____

Design High Water = _____

Emergency Spillway Crest = _____

Principal Spillway Crest = _____

Dewatering Orifice Invert = _____

Cleanout Elevation = _____

Elevation of Upstream Toe of Dam or Excavated Bottom of "Wet Storage Area" (if excavation was performed) = _____

Subject _____

Computed _____ Checked _____

LANDMARK DESIGN GROUP

Project # _____

Client _____

Date _____ Sheet # _____

Engineers • Planners • Surveyors • Landscape Architects • Environmental Scientists

LENGTH OF PIPE IN SATURATED ZONE

BMP #3

CREST OF RISER = 59.60
BOTTOM OF POND = 50.00

$$LS = Y(Z+4)\left(1+\frac{S}{0.25-S}\right)$$

$Y = 9.60$

$Z = 3:1$ SLOPE

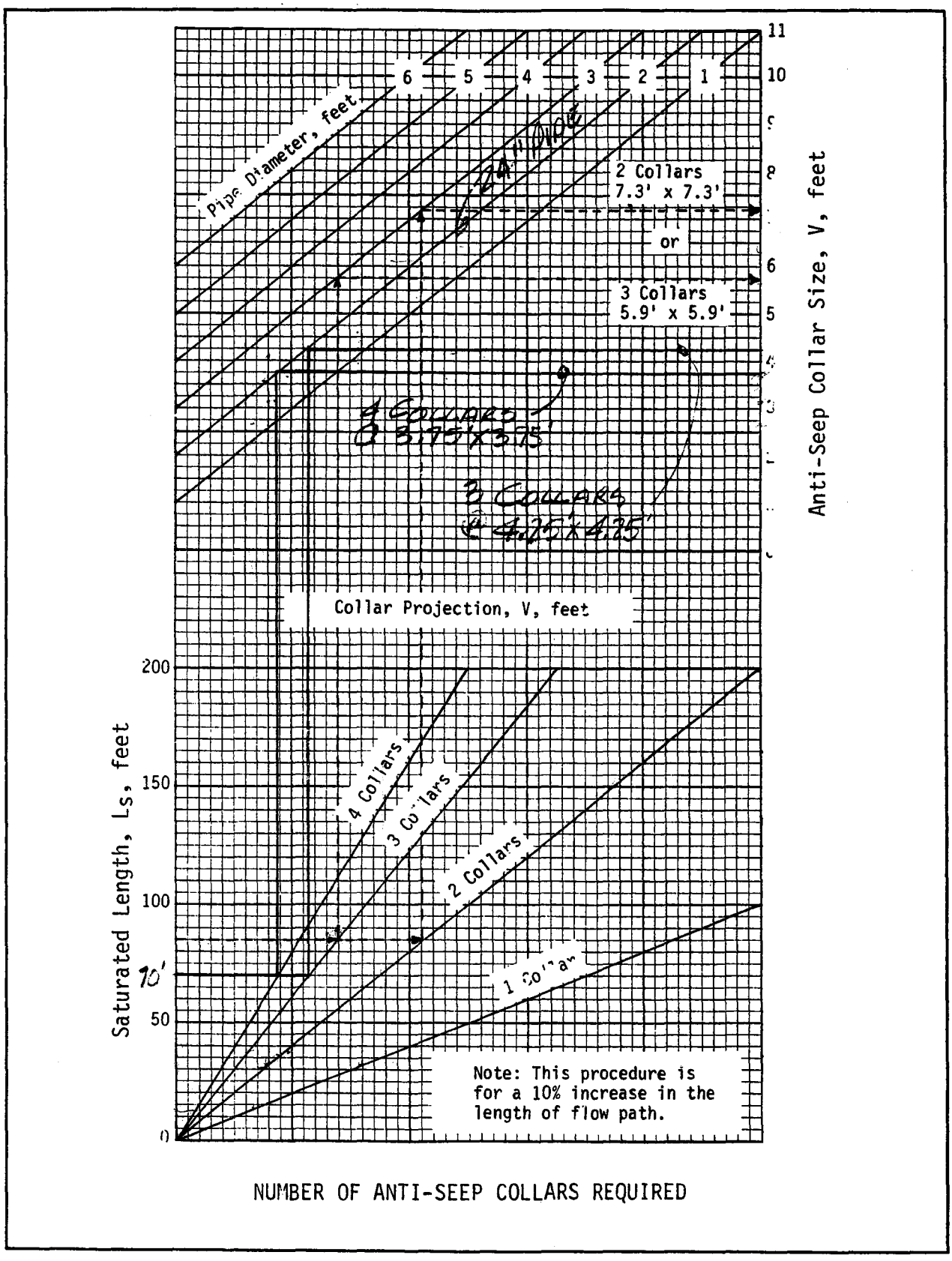
$S = 1.0\%$

$$LS = 9.60\,(3+4)\left(1+\frac{0.01}{0.25-0.01}\right)$$

$LS = 9.60 \times 7 \times 1.0417$

$LS = 70.00$

USE 4 COLLARS 3.75' X 3.75'




Source: USDA-SCS

Plate 3.14-12

BMP # 3

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment Post Dev: 1/3 Acre Lots** Runoff Area=5.300 ac Runoff Depth=1.56"
Tc=25.0 min CN=81 Runoff=8.74 cfs 0.689 af

**Pond BMP-3: sed basin 3** Peak Elev=63.87' Storage=16,801 cf Inflow=8.74 cfs 0.689 af
Outflow=1.20 cfs 0.434 af

**Total Runoff Area = 5.300 ac Runoff Volume = 0.689 af Average Runoff Depth = 1.56"**

## Subcatchment Post Dev: 1/3 Acre Lots

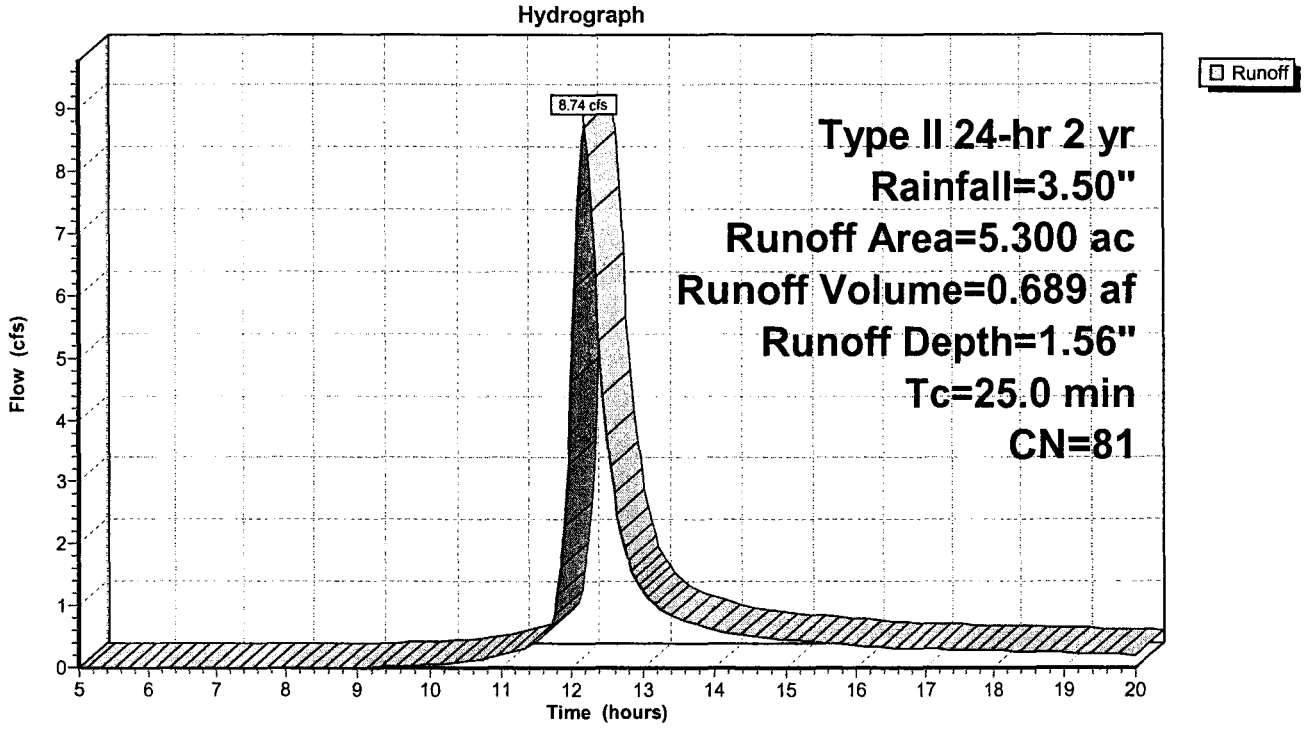
Runoff = 8.74 cfs @ 12.19 hrs, Volume= 0.689 af, Depth= 1.56"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 yr Rainfall=3.50"

| Area (ac) | CN | Description |
|---|---|---|
| 5.300 | 81 | 1/3 acre lots, 30% imp, HSG C |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 25.0 | | | | | **Direct Entry,** |

## Subcatchment Post Dev: 1/3 Acre Lots



## Hydrograph for Subcatchment Post Dev: 1/3 Acre Lots

| Time (hours) | Precip. (inches) | Excess (inches) | Runoff (cfs) | Time (hours) | Precip. (inches) | Excess (inches) | Runoff (cfs) |
|---|---|---|---|---|---|---|---|
| 5.00 | 0.22 | 0.00 | 0.00 | 7.60 | 0.39 | 0.00 | 0.00 |
| 5.05 | 0.22 | 0.00 | 0.00 | 7.65 | 0.39 | 0.00 | 0.00 |
| 5.10 | 0.23 | 0.00 | 0.00 | 7.70 | 0.40 | 0.00 | 0.00 |
| 5.15 | 0.23 | 0.00 | 0.00 | 7.75 | 0.40 | 0.00 | 0.00 |
| 5.20 | 0.23 | 0.00 | 0.00 | 7.80 | 0.40 | 0.00 | 0.00 |
| 5.25 | 0.23 | 0.00 | 0.00 | 7.85 | 0.41 | 0.00 | 0.00 |
| 5.30 | 0.24 | 0.00 | 0.00 | 7.90 | 0.41 | 0.00 | 0.00 |
| 5.35 | 0.24 | 0.00 | 0.00 | 7.95 | 0.42 | 0.00 | 0.00 |
| 5.40 | 0.24 | 0.00 | 0.00 | 8.00 | 0.42 | 0.00 | 0.00 |
| 5.45 | 0.25 | 0.00 | 0.00 | 8.05 | 0.42 | 0.00 | 0.00 |
| 5.50 | 0.25 | 0.00 | 0.00 | 8.10 | 0.43 | 0.00 | 0.00 |
| 5.55 | 0.25 | 0.00 | 0.00 | 8.15 | 0.43 | 0.00 | 0.00 |
| 5.60 | 0.26 | 0.00 | 0.00 | 8.20 | 0.44 | 0.00 | 0.00 |
| 5.65 | 0.26 | 0.00 | 0.00 | 8.25 | 0.44 | 0.00 | 0.00 |
| 5.70 | 0.26 | 0.00 | 0.00 | 8.30 | 0.44 | 0.00 | 0.00 |
| 5.75 | 0.26 | 0.00 | 0.00 | 8.35 | 0.45 | 0.00 | 0.00 |
| 5.80 | 0.27 | 0.00 | 0.00 | 8.40 | 0.45 | 0.00 | 0.00 |
| 5.85 | 0.27 | 0.00 | 0.00 | 8.45 | 0.46 | 0.00 | 0.00 |
| 5.90 | 0.27 | 0.00 | 0.00 | 8.50 | 0.46 | 0.00 | 0.00 |
| 5.95 | 0.28 | 0.00 | 0.00 | 8.55 | 0.47 | 0.00 | 0.00 |
| 6.00 | 0.28 | 0.00 | 0.00 | 8.60 | 0.47 | 0.00 | 0.00 |
| 6.05 | 0.28 | 0.00 | 0.00 | 8.65 | 0.48 | 0.00 | 0.00 |
| 6.10 | 0.29 | 0.00 | 0.00 | 8.70 | 0.48 | 0.00 | 0.00 |
| 6.15 | 0.29 | 0.00 | 0.00 | 8.75 | 0.49 | 0.00 | 0.00 |
| 6.20 | 0.29 | 0.00 | 0.00 | 8.80 | 0.49 | 0.00 | 0.00 |
| 6.25 | 0.30 | 0.00 | 0.00 | 8.85 | 0.50 | 0.00 | 0.00 |
| 6.30 | 0.30 | 0.00 | 0.00 | 8.90 | 0.50 | 0.00 | 0.00 |
| 6.35 | 0.30 | 0.00 | 0.00 | 8.95 | 0.51 | 0.00 | 0.00 |
| 6.40 | 0.31 | 0.00 | 0.00 | 9.00 | 0.51 | 0.00 | 0.00 |
| 6.45 | 0.31 | 0.00 | 0.00 | 9.05 | 0.52 | 0.00 | 0.01 |
| 6.50 | 0.31 | 0.00 | 0.00 | 9.10 | 0.53 | 0.00 | 0.01 |
| 6.55 | 0.32 | 0.00 | 0.00 | 9.15 | 0.53 | 0.00 | 0.01 |
| 6.60 | 0.32 | 0.00 | 0.00 | 9.20 | 0.54 | 0.00 | 0.01 |
| 6.65 | 0.32 | 0.00 | 0.00 | 9.25 | 0.54 | 0.00 | 0.02 |
| 6.70 | 0.33 | 0.00 | 0.00 | 9.30 | 0.55 | 0.00 | 0.02 |
| 6.75 | 0.33 | 0.00 | 0.00 | 9.35 | 0.55 | 0.00 | 0.02 |
| 6.80 | 0.33 | 0.00 | 0.00 | 9.40 | 0.56 | 0.00 | 0.02 |
| 6.85 | 0.34 | 0.00 | 0.00 | 9.45 | 0.56 | 0.00 | 0.03 |
| 6.90 | 0.34 | 0.00 | 0.00 | 9.50 | 0.57 | 0.00 | 0.03 |
| 6.95 | 0.34 | 0.00 | 0.00 | 9.55 | 0.58 | 0.00 | 0.03 |
| 7.00 | 0.35 | 0.00 | 0.00 | 9.60 | 0.58 | 0.01 | 0.03 |
| 7.05 | 0.35 | 0.00 | 0.00 | 9.65 | 0.59 | 0.01 | 0.04 |
| 7.10 | 0.35 | 0.00 | 0.00 | 9.70 | 0.59 | 0.01 | 0.04 |
| 7.15 | 0.36 | 0.00 | 0.00 | 9.75 | 0.60 | 0.01 | 0.04 |
| 7.20 | 0.36 | 0.00 | 0.00 | 9.80 | 0.61 | 0.01 | 0.04 |
| 7.25 | 0.36 | 0.00 | 0.00 | 9.85 | 0.61 | 0.01 | 0.05 |
| 7.30 | 0.37 | 0.00 | 0.00 | 9.90 | 0.62 | 0.01 | 0.05 |
| 7.35 | 0.37 | 0.00 | 0.00 | 9.95 | 0.63 | 0.01 | 0.06 |
| 7.40 | 0.38 | 0.00 | 0.00 | 10.00 | 0.63 | 0.01 | 0.06 |
| 7.45 | 0.38 | 0.00 | 0.00 | 10.05 | 0.64 | 0.01 | 0.06 |
| 7.50 | 0.38 | 0.00 | 0.00 | 10.10 | 0.65 | 0.01 | 0.07 |
| 7.55 | 0.39 | 0.00 | 0.00 | 10.15 | 0.66 | 0.01 | 0.07 |

## Hydrograph for Subcatchment Post Dev: 1/3 Acre Lots (continued)

| Time (hours) | Precip. (inches) | Excess (inches) | Runoff (cfs) | Time (hours) | Precip. (inches) | Excess (inches) | Runoff (cfs) |
|---|---|---|---|---|---|---|---|
| 10.20 | 0.66 | 0.01 | 0.08 | 12.80 | 2.66 | 1.05 | 1.75 |
| 10.25 | 0.67 | 0.02 | 0.08 | 12.85 | 2.67 | 1.06 | 1.59 |
| 10.30 | 0.68 | 0.02 | 0.09 | 12.90 | 2.68 | 1.07 | 1.46 |
| 10.35 | 0.69 | 0.02 | 0.09 | 12.95 | 2.69 | 1.08 | 1.35 |
| 10.40 | 0.70 | 0.02 | 0.10 | 13.00 | 2.70 | 1.09 | 1.26 |
| 10.45 | 0.71 | 0.02 | 0.11 | 13.05 | 2.71 | 1.10 | 1.19 |
| 10.50 | 0.71 | 0.02 | 0.11 | 13.10 | 2.72 | 1.10 | 1.12 |
| 10.55 | 0.72 | 0.02 | 0.12 | 13.15 | 2.73 | 1.11 | 1.07 |
| 10.60 | 0.73 | 0.03 | 0.13 | 13.20 | 2.74 | 1.12 | 1.01 |
| 10.65 | 0.74 | 0.03 | 0.14 | 13.25 | 2.75 | 1.13 | 0.97 |
| 10.70 | 0.75 | 0.03 | 0.14 | 13.30 | 2.76 | 1.13 | 0.93 |
| 10.75 | 0.76 | 0.03 | 0.15 | 13.35 | 2.77 | 1.14 | 0.89 |
| 10.80 | 0.77 | 0.04 | 0.16 | 13.40 | 2.78 | 1.15 | 0.86 |
| 10.85 | 0.79 | 0.04 | 0.17 | 13.45 | 2.79 | 1.15 | 0.84 |
| 10.90 | 0.80 | 0.04 | 0.19 | 13.50 | 2.80 | 1.16 | 0.81 |
| 10.95 | 0.81 | 0.04 | 0.20 | 13.55 | 2.80 | 1.17 | 0.79 |
| 11.00 | 0.82 | 0.05 | 0.21 | 13.60 | 2.81 | 1.17 | 0.77 |
| 11.05 | 0.84 | 0.05 | 0.22 | 13.65 | 2.82 | 1.18 | 0.75 |
| 11.10 | 0.85 | 0.05 | 0.24 | 13.70 | 2.83 | 1.18 | 0.73 |
| 11.15 | 0.86 | 0.06 | 0.25 | 13.75 | 2.84 | 1.19 | 0.71 |
| 11.20 | 0.88 | 0.06 | 0.27 | 13.80 | 2.84 | 1.19 | 0.69 |
| 11.25 | 0.90 | 0.07 | 0.29 | 13.85 | 2.85 | 1.20 | 0.68 |
| 11.30 | 0.91 | 0.07 | 0.31 | 13.90 | 2.86 | 1.20 | 0.66 |
| 11.35 | 0.93 | 0.08 | 0.34 | 13.95 | 2.86 | 1.21 | 0.65 |
| 11.40 | 0.95 | 0.08 | 0.36 | 14.00 | 2.87 | 1.21 | 0.63 |
| 11.45 | 0.97 | 0.09 | 0.39 | 14.05 | 2.88 | 1.22 | 0.62 |
| 11.50 | 0.99 | 0.09 | 0.43 | 14.10 | 2.88 | 1.22 | 0.60 |
| 11.55 | 1.02 | 0.11 | 0.46 | 14.15 | 2.89 | 1.23 | 0.59 |
| 11.60 | 1.07 | 0.12 | 0.50 | 14.20 | 2.90 | 1.23 | 0.58 |
| 11.65 | 1.15 | 0.15 | 0.57 | 14.25 | 2.90 | 1.24 | 0.56 |
| 11.70 | 1.24 | 0.19 | 0.67 | 14.30 | 2.91 | 1.24 | 0.55 |
| 11.75 | 1.35 | 0.24 | 0.86 | 14.35 | 2.91 | 1.25 | 0.54 |
| 11.80 | 1.51 | 0.32 | 1.17 | 14.40 | 2.92 | 1.25 | 0.53 |
| 11.85 | 1.72 | 0.43 | 1.63 | 14.45 | 2.93 | 1.26 | 0.53 |
| 11.90 | 1.99 | 0.60 | 2.31 | 14.50 | 2.93 | 1.26 | 0.52 |
| 11.95 | 2.22 | 0.75 | 3.29 | 14.55 | 2.94 | 1.27 | 0.51 |
| 12.00 | 2.32 | 0.82 | 4.61 | 14.60 | 2.94 | 1.27 | 0.51 |
| 12.05 | 2.35 | 0.84 | 6.15 | 14.65 | 2.95 | 1.27 | 0.50 |
| 12.10 | 2.39 | 0.86 | 7.59 | 14.70 | 2.95 | 1.28 | 0.50 |
| 12.15 | 2.42 | 0.88 | 8.52 | 14.75 | 2.96 | 1.28 | 0.49 |
| 12.20 | 2.45 | 0.90 | **8.72** | 14.80 | 2.97 | 1.29 | 0.49 |
| 12.25 | 2.47 | 0.92 | 8.26 | 14.85 | 2.97 | 1.29 | 0.48 |
| 12.30 | 2.50 | 0.94 | 7.37 | 14.90 | 2.98 | 1.30 | 0.48 |
| 12.35 | 2.52 | 0.96 | 6.31 | 14.95 | 2.98 | 1.30 | 0.47 |
| 12.40 | 2.54 | 0.97 | 5.27 | 15.00 | 2.99 | 1.30 | 0.47 |
| 12.45 | 2.56 | 0.98 | 4.42 | 15.05 | 2.99 | 1.31 | 0.46 |
| 12.50 | 2.57 | 0.99 | 3.77 | 15.10 | 3.00 | 1.31 | 0.46 |
| 12.55 | 2.59 | 1.01 | 3.26 | 15.15 | 3.00 | 1.32 | 0.45 |
| 12.60 | 2.60 | 1.02 | 2.84 | 15.20 | 3.01 | 1.32 | 0.45 |
| 12.65 | 2.62 | 1.03 | 2.49 | 15.25 | 3.01 | 1.32 | 0.44 |
| 12.70 | 2.63 | 1.04 | 2.20 | 15.30 | 3.02 | 1.33 | 0.44 |
| 12.75 | 2.64 | 1.05 | 1.95 | 15.35 | 3.02 | 1.33 | 0.43 |

## Hydrograph for Subcatchment Post Dev: 1/3 Acre Lots (continued)

| Time (hours) | Precip. (inches) | Excess (inches) | Runoff (cfs) |
|---|---|---|---|
| 15.40 | 3.03 | 1.33 | 0.43 |
| 15.45 | 3.03 | 1.34 | 0.42 |
| 15.50 | 3.04 | 1.34 | 0.42 |
| 15.55 | 3.04 | 1.35 | 0.41 |
| 15.60 | 3.05 | 1.35 | 0.41 |
| 15.65 | 3.05 | 1.35 | 0.41 |
| 15.70 | 3.05 | 1.36 | 0.40 |
| 15.75 | 3.06 | 1.36 | 0.40 |
| 15.80 | 3.06 | 1.36 | 0.39 |
| 15.85 | 3.07 | 1.37 | 0.39 |
| 15.90 | 3.07 | 1.37 | 0.38 |
| 15.95 | 3.08 | 1.37 | 0.38 |
| 16.00 | 3.08 | 1.38 | 0.37 |
| 16.05 | 3.08 | 1.38 | 0.37 |
| 16.10 | 3.09 | 1.38 | 0.36 |
| 16.15 | 3.09 | 1.38 | 0.36 |
| 16.20 | 3.10 | 1.39 | 0.35 |
| 16.25 | 3.10 | 1.39 | 0.35 |
| 16.30 | 3.10 | 1.39 | 0.34 |
| 16.35 | 3.11 | 1.40 | 0.34 |
| 16.40 | 3.11 | 1.40 | 0.34 |
| 16.45 | 3.12 | 1.40 | 0.33 |
| 16.50 | 3.12 | 1.41 | 0.33 |
| 16.55 | 3.12 | 1.41 | 0.33 |
| 16.60 | 3.13 | 1.41 | 0.33 |
| 16.65 | 3.13 | 1.41 | 0.33 |
| 16.70 | 3.13 | 1.42 | 0.32 |
| 16.75 | 3.14 | 1.42 | 0.32 |
| 16.80 | 3.14 | 1.42 | 0.32 |
| 16.85 | 3.15 | 1.43 | 0.32 |
| 16.90 | 3.15 | 1.43 | 0.32 |
| 16.95 | 3.15 | 1.43 | 0.32 |
| 17.00 | 3.16 | 1.43 | 0.31 |
| 17.05 | 3.16 | 1.44 | 0.31 |
| 17.10 | 3.16 | 1.44 | 0.31 |
| 17.15 | 3.17 | 1.44 | 0.31 |
| 17.20 | 3.17 | 1.45 | 0.31 |
| 17.25 | 3.17 | 1.45 | 0.30 |
| 17.30 | 3.18 | 1.45 | 0.30 |
| 17.35 | 3.18 | 1.45 | 0.30 |
| 17.40 | 3.18 | 1.46 | 0.30 |
| 17.45 | 3.19 | 1.46 | 0.30 |
| 17.50 | 3.19 | 1.46 | 0.30 |
| 17.55 | 3.19 | 1.46 | 0.29 |
| 17.60 | 3.20 | 1.47 | 0.29 |
| 17.65 | 3.20 | 1.47 | 0.29 |
| 17.70 | 3.20 | 1.47 | 0.29 |
| 17.75 | 3.21 | 1.47 | 0.29 |
| 17.80 | 3.21 | 1.48 | 0.29 |
| 17.85 | 3.21 | 1.48 | 0.28 |
| 17.90 | 3.22 | 1.48 | 0.28 |
| 17.95 | 3.22 | 1.49 | 0.28 |
| 18.00 | 3.22 | 1.49 | 0.28 |
| 18.05 | 3.23 | 1.49 | 0.28 |
| 18.10 | 3.23 | 1.49 | 0.28 |
| 18.15 | 3.23 | 1.49 | 0.27 |
| 18.20 | 3.24 | 1.50 | 0.27 |
| 18.25 | 3.24 | 1.50 | 0.27 |
| 18.30 | 3.24 | 1.50 | 0.27 |
| 18.35 | 3.25 | 1.50 | 0.27 |
| 18.40 | 3.25 | 1.51 | 0.26 |
| 18.45 | 3.25 | 1.51 | 0.26 |
| 18.50 | 3.25 | 1.51 | 0.26 |
| 18.55 | 3.26 | 1.51 | 0.26 |
| 18.60 | 3.26 | 1.52 | 0.26 |
| 18.65 | 3.26 | 1.52 | 0.26 |
| 18.70 | 3.27 | 1.52 | 0.25 |
| 18.75 | 3.27 | 1.52 | 0.25 |
| 18.80 | 3.27 | 1.53 | 0.25 |
| 18.85 | 3.27 | 1.53 | 0.25 |
| 18.90 | 3.28 | 1.53 | 0.25 |
| 18.95 | 3.28 | 1.53 | 0.25 |
| 19.00 | 3.28 | 1.53 | 0.24 |
| 19.05 | 3.28 | 1.54 | 0.24 |
| 19.10 | 3.29 | 1.54 | 0.24 |
| 19.15 | 3.29 | 1.54 | 0.24 |
| 19.20 | 3.29 | 1.54 | 0.24 |
| 19.25 | 3.30 | 1.54 | 0.23 |
| 19.30 | 3.30 | 1.55 | 0.23 |
| 19.35 | 3.30 | 1.55 | 0.23 |
| 19.40 | 3.30 | 1.55 | 0.23 |
| 19.45 | 3.31 | 1.55 | 0.23 |
| 19.50 | 3.31 | 1.55 | 0.23 |
| 19.55 | 3.31 | 1.56 | 0.22 |
| 19.60 | 3.31 | 1.56 | 0.22 |
| 19.65 | 3.32 | 1.56 | 0.22 |
| 19.70 | 3.32 | 1.56 | 0.22 |
| 19.75 | 3.32 | 1.56 | 0.22 |
| 19.80 | 3.32 | 1.57 | 0.22 |
| 19.85 | 3.33 | 1.57 | 0.21 |
| 19.90 | 3.33 | 1.57 | 0.21 |
| 19.95 | 3.33 | 1.57 | 0.21 |
| 20.00 | **3.33** | **1.57** | 0.21 |

## Pond BMP-3: sed basin 3

Inflow Area = 5.300 ac, Inflow Depth = 1.56" for 2 yr event
Inflow = 8.74 cfs @ 12.19 hrs, Volume= 0.689 af
Outflow = 1.20 cfs @ 13.04 hrs, Volume= 0.434 af, Atten= 86%, Lag= 51.2 min
Primary = 1.20 cfs @ 13.04 hrs, Volume= 0.434 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 63.87' @ 13.04 hrs Surf.Area= 4,192 sf Storage= 16,801 cf
Plug-Flow detention time= 175.1 min calculated for 0.432 af (63% of inflow)
Center-of-Mass det. time= 103.1 min ( 907.0 - 803.9 )

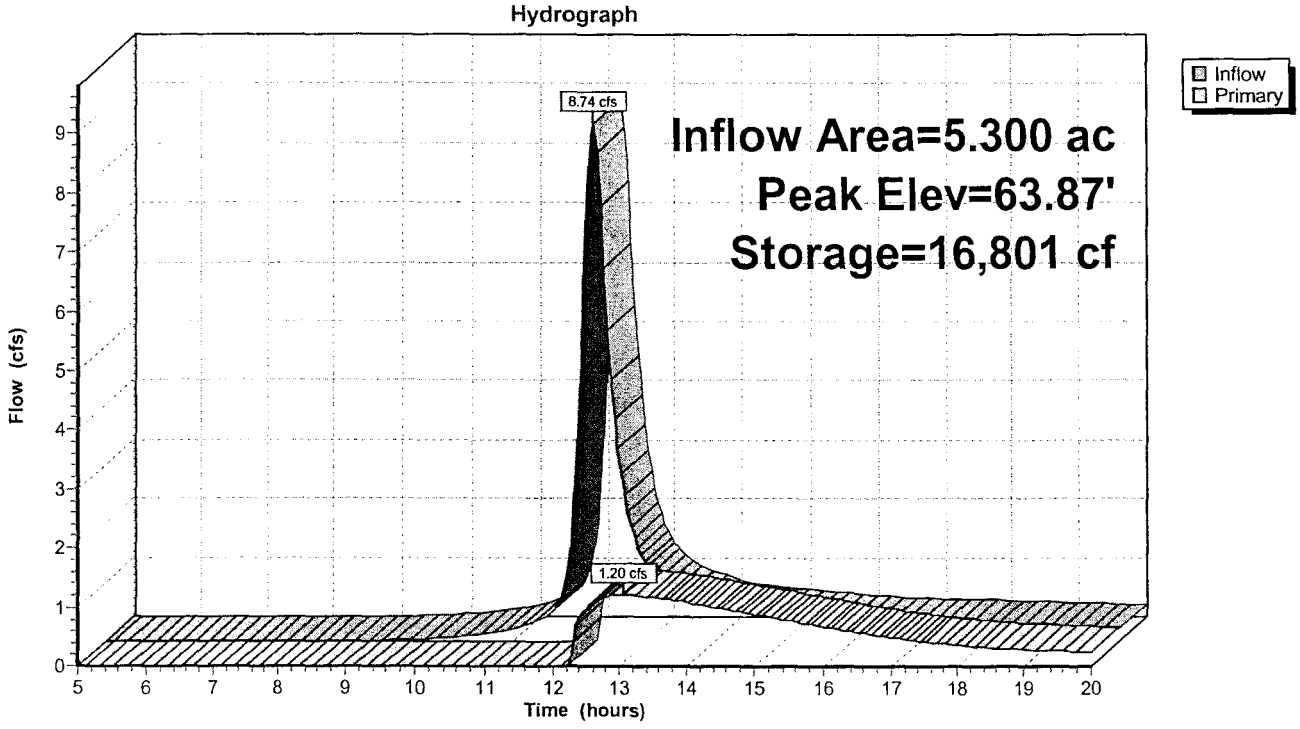
| # | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| 1 | 56.00' | 77,692 cf | **Custom Stage Data (Pyramidal)** Listed below |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) | Wet.Area (sq-ft) |
|---|---|---|---|---|
| 56.00 | 600 | 0 | 0 | 600 |
| 59.50 | 1,800 | 4,012 | 4,012 | 1,888 |
| 60.00 | 2,020 | 954 | 4,967 | 2,125 |
| 62.00 | 3,050 | 5,035 | 10,002 | 3,230 |
| 64.00 | 4,275 | 7,291 | 17,292 | 4,547 |
| 66.00 | 5,720 | 9,960 | 27,252 | 6,098 |
| 68.00 | 7,375 | 13,060 | 40,312 | 7,874 |
| 70.00 | 9,300 | 16,638 | 56,950 | 9,933 |
| 72.00 | 11,480 | 20,742 | 77,692 | 12,260 |

| # | Routing | Invert | Outlet Devices |
|---|---|---|---|
| 1 | Primary | 53.00' | **24.0" x 80.0' long Culvert** RCP, square edge headwall, Ke= 0.500<br>Outlet Invert= 45.30' S= 0.0963 '/' n= 0.012 Cc= 0.900 |
| 2 | Device 1 | 62.00' | **6.0" Vert. Orifice/Grate** C= 0.600 |
| 3 | Device 1 | 66.50' | **48.0" Horiz. Orifice/Grate** Limited to weir flow C= 0.600 |

**Primary OutFlow** Max=1.20 cfs @ 13.04 hrs HW=63.86' (Free Discharge)
└─**1=Culvert** (Passes 1.20 cfs of 47.51 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 1.20 cfs @ 6.1 fps)
  └─**3=Orifice/Grate** ( Controls 0.00 cfs)

## Pond BMP-3: sed basin 3



## Hydrograph for Pond BMP-3: sed basin 3

| Time (hours) | Inflow (cfs) | Storage (cubic-feet) | Elevation (feet) | Primary (cfs) |
|---|---|---|---|---|
| 5.00 | 0.00 | 0 | 56.00 | 0.00 |
| 5.05 | 0.00 | 0 | 56.00 | 0.00 |
| 5.10 | 0.00 | 0 | 56.00 | 0.00 |
| 5.15 | 0.00 | 0 | 56.00 | 0.00 |
| 5.20 | 0.00 | 0 | 56.00 | 0.00 |
| 5.25 | 0.00 | 0 | 56.00 | 0.00 |
| 5.30 | 0.00 | 0 | 56.00 | 0.00 |
| 5.35 | 0.00 | 0 | 56.00 | 0.00 |
| 5.40 | 0.00 | 0 | 56.00 | 0.00 |
| 5.45 | 0.00 | 0 | 56.00 | 0.00 |
| 5.50 | 0.00 | 0 | 56.00 | 0.00 |
| 5.55 | 0.00 | 0 | 56.00 | 0.00 |
| 5.60 | 0.00 | 0 | 56.00 | 0.00 |
| 5.65 | 0.00 | 0 | 56.00 | 0.00 |
| 5.70 | 0.00 | 0 | 56.00 | 0.00 |
| 5.75 | 0.00 | 0 | 56.00 | 0.00 |
| 5.80 | 0.00 | 0 | 56.00 | 0.00 |
| 5.85 | 0.00 | 0 | 56.00 | 0.00 |
| 5.90 | 0.00 | 0 | 56.00 | 0.00 |
| 5.95 | 0.00 | 0 | 56.00 | 0.00 |
| 6.00 | 0.00 | 0 | 56.00 | 0.00 |
| 6.05 | 0.00 | 0 | 56.00 | 0.00 |
| 6.10 | 0.00 | 0 | 56.00 | 0.00 |
| 6.15 | 0.00 | 0 | 56.00 | 0.00 |
| 6.20 | 0.00 | 0 | 56.00 | 0.00 |
| 6.25 | 0.00 | 0 | 56.00 | 0.00 |
| 6.30 | 0.00 | 0 | 56.00 | 0.00 |
| 6.35 | 0.00 | 0 | 56.00 | 0.00 |
| 6.40 | 0.00 | 0 | 56.00 | 0.00 |
| 6.45 | 0.00 | 0 | 56.00 | 0.00 |
| 6.50 | 0.00 | 0 | 56.00 | 0.00 |
| 6.55 | 0.00 | 0 | 56.00 | 0.00 |
| 6.60 | 0.00 | 0 | 56.00 | 0.00 |
| 6.65 | 0.00 | 0 | 56.00 | 0.00 |
| 6.70 | 0.00 | 0 | 56.00 | 0.00 |
| 6.75 | 0.00 | 0 | 56.00 | 0.00 |
| 6.80 | 0.00 | 0 | 56.00 | 0.00 |
| 6.85 | 0.00 | 0 | 56.00 | 0.00 |
| 6.90 | 0.00 | 0 | 56.00 | 0.00 |
| 6.95 | 0.00 | 0 | 56.00 | 0.00 |
| 7.00 | 0.00 | 0 | 56.00 | 0.00 |
| 7.05 | 0.00 | 0 | 56.00 | 0.00 |
| 7.10 | 0.00 | 0 | 56.00 | 0.00 |
| 7.15 | 0.00 | 0 | 56.00 | 0.00 |
| 7.20 | 0.00 | 0 | 56.00 | 0.00 |
| 7.25 | 0.00 | 0 | 56.00 | 0.00 |
| 7.30 | 0.00 | 0 | 56.00 | 0.00 |
| 7.35 | 0.00 | 0 | 56.00 | 0.00 |
| 7.40 | 0.00 | 0 | 56.00 | 0.00 |
| 7.45 | 0.00 | 0 | 56.00 | 0.00 |
| 7.50 | 0.00 | 0 | 56.00 | 0.00 |
| 7.55 | 0.00 | 0 | 56.00 | 0.00 |

## Hydrograph for Pond BMP-3: sed basin 3 (continued)

| Time (hours) | Inflow (cfs) | Storage (cubic-feet) | Elevation (feet) | Primary (cfs) |
|---|---|---|---|---|
| 7.60 | 0.00 | 0 | 56.00 | 0.00 |
| 7.65 | 0.00 | 0 | 56.00 | 0.00 |
| 7.70 | 0.00 | 0 | 56.00 | 0.00 |
| 7.75 | 0.00 | 0 | 56.00 | 0.00 |
| 7.80 | 0.00 | 0 | 56.00 | 0.00 |
| 7.85 | 0.00 | 0 | 56.00 | 0.00 |
| 7.90 | 0.00 | 0 | 56.00 | 0.00 |
| 7.95 | 0.00 | 0 | 56.00 | 0.00 |
| 8.00 | 0.00 | 0 | 56.00 | 0.00 |
| 8.05 | 0.00 | 0 | 56.00 | 0.00 |
| 8.10 | 0.00 | 0 | 56.00 | 0.00 |
| 8.15 | 0.00 | 0 | 56.00 | 0.00 |
| 8.20 | 0.00 | 0 | 56.00 | 0.00 |
| 8.25 | 0.00 | 0 | 56.00 | 0.00 |
| 8.30 | 0.00 | 0 | 56.00 | 0.00 |
| 8.35 | 0.00 | 0 | 56.00 | 0.00 |
| 8.40 | 0.00 | 0 | 56.00 | 0.00 |
| 8.45 | 0.00 | 0 | 56.00 | 0.00 |
| 8.50 | 0.00 | 0 | 56.00 | 0.00 |
| 8.55 | 0.00 | 0 | 56.00 | 0.00 |
| 8.60 | 0.00 | 0 | 56.00 | 0.00 |
| 8.65 | 0.00 | 0 | 56.00 | 0.00 |
| 8.70 | 0.00 | 0 | 56.00 | 0.00 |
| 8.75 | 0.00 | 0 | 56.00 | 0.00 |
| 8.80 | 0.00 | 0 | 56.00 | 0.00 |
| 8.85 | 0.00 | 0 | 56.00 | 0.00 |
| 8.90 | 0.00 | 1 | 56.00 | 0.00 |
| 8.95 | 0.00 | 1 | 56.00 | 0.00 |
| 9.00 | 0.00 | 2 | 56.00 | 0.00 |
| 9.05 | 0.01 | 3 | 56.00 | 0.00 |
| 9.10 | 0.01 | 4 | 56.00 | 0.00 |
| 9.15 | 0.01 | 6 | 56.01 | 0.00 |
| 9.20 | 0.01 | 8 | 56.01 | 0.00 |
| 9.25 | 0.02 | 11 | 56.01 | 0.00 |
| 9.30 | 0.02 | 14 | 56.01 | 0.00 |
| 9.35 | 0.02 | 17 | 56.01 | 0.00 |
| 9.40 | 0.02 | 21 | 56.02 | 0.00 |
| 9.45 | 0.03 | 25 | 56.02 | 0.00 |
| 9.50 | 0.03 | 30 | 56.03 | 0.00 |
| 9.55 | 0.03 | 36 | 56.03 | 0.00 |
| 9.60 | 0.03 | 42 | 56.04 | 0.00 |
| 9.65 | 0.04 | 48 | 56.04 | 0.00 |
| 9.70 | 0.04 | 55 | 56.05 | 0.00 |
| 9.75 | 0.04 | 62 | 56.05 | 0.00 |
| 9.80 | 0.04 | 70 | 56.06 | 0.00 |
| 9.85 | 0.05 | 78 | 56.07 | 0.00 |
| 9.90 | 0.05 | 87 | 56.08 | 0.00 |
| 9.95 | 0.06 | 97 | 56.08 | 0.00 |
| 10.00 | 0.06 | 107 | 56.09 | 0.00 |
| 10.05 | 0.06 | 118 | 56.10 | 0.00 |
| 10.10 | 0.07 | 130 | 56.11 | 0.00 |
| 10.15 | 0.07 | 142 | 56.12 | 0.00 |

## Hydrograph for Pond BMP-3: sed basin 3 (continued)

| Time (hours) | Inflow (cfs) | Storage (cubic-feet) | Elevation (feet) | Primary (cfs) |
|---|---|---|---|---|
| 10.20 | 0.08 | 156 | 56.14 | 0.00 |
| 10.25 | 0.08 | 170 | 56.15 | 0.00 |
| 10.30 | 0.09 | 185 | 56.16 | 0.00 |
| 10.35 | 0.09 | 202 | 56.18 | 0.00 |
| 10.40 | 0.10 | 219 | 56.19 | 0.00 |
| 10.45 | 0.11 | 237 | 56.21 | 0.00 |
| 10.50 | 0.11 | 257 | 56.22 | 0.00 |
| 10.55 | 0.12 | 278 | 56.24 | 0.00 |
| 10.60 | 0.13 | 300 | 56.26 | 0.00 |
| 10.65 | 0.14 | 324 | 56.28 | 0.00 |
| 10.70 | 0.14 | 349 | 56.30 | 0.00 |
| 10.75 | 0.15 | 376 | 56.33 | 0.00 |
| 10.80 | 0.16 | 405 | 56.35 | 0.00 |
| 10.85 | 0.17 | 435 | 56.38 | 0.00 |
| 10.90 | 0.19 | 467 | 56.41 | 0.00 |
| 10.95 | 0.20 | 502 | 56.44 | 0.00 |
| 11.00 | 0.21 | 538 | 56.47 | 0.00 |
| 11.05 | 0.22 | 577 | 56.50 | 0.00 |
| 11.10 | 0.24 | 619 | 56.54 | 0.00 |
| 11.15 | 0.25 | 663 | 56.58 | 0.00 |
| 11.20 | 0.27 | 710 | 56.62 | 0.00 |
| 11.25 | 0.29 | 761 | 56.66 | 0.00 |
| 11.30 | 0.31 | 815 | 56.71 | 0.00 |
| 11.35 | 0.34 | 873 | 56.76 | 0.00 |
| 11.40 | 0.36 | 936 | 56.82 | 0.00 |
| 11.45 | 0.39 | 1,004 | 56.88 | 0.00 |
| 11.50 | 0.43 | 1,078 | 56.94 | 0.00 |
| 11.55 | 0.46 | 1,157 | 57.01 | 0.00 |
| 11.60 | 0.50 | 1,244 | 57.09 | 0.00 |
| 11.65 | 0.57 | 1,340 | 57.17 | 0.00 |
| 11.70 | 0.67 | 1,452 | 57.27 | 0.00 |
| 11.75 | 0.86 | 1,590 | 57.39 | 0.00 |
| 11.80 | 1.17 | 1,772 | 57.55 | 0.00 |
| 11.85 | 1.63 | 2,023 | 57.76 | 0.00 |
| 11.90 | 2.31 | 2,377 | 58.07 | 0.00 |
| 11.95 | 3.29 | 2,881 | 58.51 | 0.00 |
| 12.00 | 4.61 | 3,592 | 59.13 | 0.00 |
| 12.05 | 6.15 | 4,560 | 59.79 | 0.00 |
| 12.10 | 7.59 | 5,796 | 60.33 | 0.00 |
| 12.15 | 8.52 | 7,246 | 60.91 | 0.00 |
| 12.20 | **8.72** | 8,799 | 61.52 | 0.00 |
| 12.25 | 8.26 | 10,325 | 62.09 | 0.03 |
| 12.30 | 7.37 | 11,691 | 62.46 | 0.43 |
| 12.35 | 6.31 | 12,823 | 62.77 | 0.68 |
| 12.40 | 5.27 | 13,729 | 63.02 | 0.83 |
| 12.45 | 4.42 | 14,443 | 63.22 | 0.93 |
| 12.50 | 3.77 | 15,006 | 63.37 | 1.00 |
| 12.55 | 3.26 | 15,453 | 63.50 | 1.05 |
| 12.60 | 2.84 | 15,808 | 63.59 | 1.10 |
| 12.65 | 2.49 | 16,087 | 63.67 | 1.13 |
| 12.70 | 2.20 | 16,304 | 63.73 | 1.15 |
| 12.75 | 1.95 | 16,469 | 63.77 | 1.17 |

## Hydrograph for Pond BMP-3: sed basin 3 (continued)

| Time (hours) | Inflow (cfs) | Storage (cubic-feet) | Elevation (feet) | Primary (cfs) |
|---|---|---|---|---|
| 12.80 | 1.75 | 16,591 | 63.81 | 1.18 |
| 12.85 | 1.59 | 16,679 | 63.83 | 1.19 |
| 12.90 | 1.46 | 16,739 | 63.85 | 1.20 |
| 12.95 | 1.35 | 16,777 | 63.86 | 1.20 |
| 13.00 | 1.26 | 16,796 | 63.86 | 1.20 |
| 13.05 | 1.19 | **16,801** | **63.87** | **1.20** |
| 13.10 | 1.12 | 16,793 | 63.86 | 1.20 |
| 13.15 | 1.07 | 16,774 | 63.86 | 1.20 |
| 13.20 | 1.01 | 16,746 | 63.85 | 1.20 |
| 13.25 | 0.97 | 16,709 | 63.84 | 1.19 |
| 13.30 | 0.93 | 16,665 | 63.83 | 1.19 |
| 13.35 | 0.89 | 16,616 | 63.81 | 1.18 |
| 13.40 | 0.86 | 16,561 | 63.80 | 1.18 |
| 13.45 | 0.84 | 16,503 | 63.78 | 1.17 |
| 13.50 | 0.81 | 16,442 | 63.77 | 1.16 |
| 13.55 | 0.79 | 16,377 | 63.75 | 1.16 |
| 13.60 | 0.77 | 16,310 | 63.73 | 1.15 |
| 13.65 | 0.75 | 16,241 | 63.71 | 1.14 |
| 13.70 | 0.73 | 16,169 | 63.69 | 1.14 |
| 13.75 | 0.71 | 16,096 | 63.67 | 1.13 |
| 13.80 | 0.69 | 16,020 | 63.65 | 1.12 |
| 13.85 | 0.68 | 15,943 | 63.63 | 1.11 |
| 13.90 | 0.66 | 15,865 | 63.61 | 1.10 |
| 13.95 | 0.65 | 15,785 | 63.59 | 1.09 |
| 14.00 | 0.63 | 15,704 | 63.56 | 1.08 |
| 14.05 | 0.62 | 15,622 | 63.54 | 1.07 |
| 14.10 | 0.60 | 15,539 | 63.52 | 1.07 |
| 14.15 | 0.59 | 15,456 | 63.50 | 1.06 |
| 14.20 | 0.58 | 15,372 | 63.47 | 1.05 |
| 14.25 | 0.56 | 15,287 | 63.45 | 1.04 |
| 14.30 | 0.55 | 15,202 | 63.43 | 1.02 |
| 14.35 | 0.54 | 15,117 | 63.40 | 1.01 |
| 14.40 | 0.53 | 15,032 | 63.38 | 1.00 |
| 14.45 | 0.53 | 14,947 | 63.36 | 0.99 |
| 14.50 | 0.52 | 14,863 | 63.33 | 0.98 |
| 14.55 | 0.51 | 14,780 | 63.31 | 0.97 |
| 14.60 | 0.51 | 14,698 | 63.29 | 0.96 |
| 14.65 | 0.50 | 14,616 | 63.27 | 0.95 |
| 14.70 | 0.50 | 14,536 | 63.24 | 0.94 |
| 14.75 | 0.49 | 14,456 | 63.22 | 0.93 |
| 14.80 | 0.49 | 14,377 | 63.20 | 0.92 |
| 14.85 | 0.48 | 14,299 | 63.18 | 0.91 |
| 14.90 | 0.48 | 14,223 | 63.16 | 0.90 |
| 14.95 | 0.47 | 14,147 | 63.14 | 0.89 |
| 15.00 | 0.47 | 14,072 | 63.12 | 0.88 |
| 15.05 | 0.46 | 13,998 | 63.10 | 0.87 |
| 15.10 | 0.46 | 13,926 | 63.08 | 0.86 |
| 15.15 | 0.45 | 13,854 | 63.06 | 0.85 |
| 15.20 | 0.45 | 13,783 | 63.04 | 0.84 |
| 15.25 | 0.44 | 13,713 | 63.02 | 0.83 |
| 15.30 | 0.44 | 13,645 | 63.00 | 0.82 |
| 15.35 | 0.43 | 13,577 | 62.98 | 0.81 |

## Hydrograph for Pond BMP-3: sed basin 3 (continued)

| Time (hours) | Inflow (cfs) | Storage (cubic-feet) | Elevation (feet) | Primary (cfs) |
|---|---|---|---|---|
| 15.40 | 0.43 | 13,510 | 62.96 | 0.80 |
| 15.45 | 0.42 | 13,445 | 62.94 | 0.79 |
| 15.50 | 0.42 | 13,380 | 62.93 | 0.78 |
| 15.55 | 0.41 | 13,316 | 62.91 | 0.77 |
| 15.60 | 0.41 | 13,253 | 62.89 | 0.76 |
| 15.65 | 0.41 | 13,191 | 62.88 | 0.75 |
| 15.70 | 0.40 | 13,130 | 62.86 | 0.74 |
| 15.75 | 0.40 | 13,070 | 62.84 | 0.73 |
| 15.80 | 0.39 | 13,011 | 62.83 | 0.72 |
| 15.85 | 0.39 | 12,954 | 62.81 | 0.71 |
| 15.90 | 0.38 | 12,896 | 62.79 | 0.70 |
| 15.95 | 0.38 | 12,840 | 62.78 | 0.69 |
| 16.00 | 0.37 | 12,785 | 62.76 | 0.68 |
| 16.05 | 0.37 | 12,731 | 62.75 | 0.67 |
| 16.10 | 0.36 | 12,677 | 62.73 | 0.66 |
| 16.15 | 0.36 | 12,625 | 62.72 | 0.65 |
| 16.20 | 0.35 | 12,573 | 62.71 | 0.64 |
| 16.25 | 0.35 | 12,522 | 62.69 | 0.63 |
| 16.30 | 0.34 | 12,473 | 62.68 | 0.62 |
| 16.35 | 0.34 | 12,424 | 62.66 | 0.61 |
| 16.40 | 0.34 | 12,377 | 62.65 | 0.60 |
| 16.45 | 0.33 | 12,331 | 62.64 | 0.59 |
| 16.50 | 0.33 | 12,286 | 62.63 | 0.58 |
| 16.55 | 0.33 | 12,243 | 62.61 | 0.57 |
| 16.60 | 0.33 | 12,201 | 62.60 | 0.56 |
| 16.65 | 0.33 | 12,160 | 62.59 | 0.55 |
| 16.70 | 0.32 | 12,120 | 62.58 | 0.54 |
| 16.75 | 0.32 | 12,081 | 62.57 | 0.53 |
| 16.80 | 0.32 | 12,043 | 62.56 | 0.53 |
| 16.85 | 0.32 | 12,007 | 62.55 | 0.52 |
| 16.90 | 0.32 | 11,972 | 62.54 | 0.51 |
| 16.95 | 0.32 | 11,939 | 62.53 | 0.50 |
| 17.00 | 0.31 | 11,907 | 62.52 | 0.49 |
| 17.05 | 0.31 | 11,876 | 62.51 | 0.48 |
| 17.10 | 0.31 | 11,846 | 62.51 | 0.47 |
| 17.15 | 0.31 | 11,818 | 62.50 | 0.46 |
| 17.20 | 0.31 | 11,790 | 62.49 | 0.46 |
| 17.25 | 0.30 | 11,764 | 62.48 | 0.45 |
| 17.30 | 0.30 | 11,739 | 62.48 | 0.44 |
| 17.35 | 0.30 | 11,714 | 62.47 | 0.43 |
| 17.40 | 0.30 | 11,691 | 62.46 | 0.43 |
| 17.45 | 0.30 | 11,668 | 62.46 | 0.42 |
| 17.50 | 0.30 | 11,647 | 62.45 | 0.42 |
| 17.55 | 0.29 | 11,626 | 62.45 | 0.41 |
| 17.60 | 0.29 | 11,605 | 62.44 | 0.40 |
| 17.65 | 0.29 | 11,586 | 62.43 | 0.40 |
| 17.70 | 0.29 | 11,567 | 62.43 | 0.39 |
| 17.75 | 0.29 | 11,549 | 62.42 | 0.39 |
| 17.80 | 0.29 | 11,531 | 62.42 | 0.38 |
| 17.85 | 0.28 | 11,514 | 62.41 | 0.38 |
| 17.90 | 0.28 | 11,497 | 62.41 | 0.37 |
| 17.95 | 0.28 | 11,481 | 62.41 | 0.37 |

## Hydrograph for Pond BMP-3: sed basin 3 (continued)

| Time (hours) | Inflow (cfs) | Storage (cubic-feet) | Elevation (feet) | Primary (cfs) |
|---|---|---|---|---|
| 18.00 | 0.28 | 11,465 | 62.40 | 0.36 |
| 18.05 | 0.28 | 11,450 | 62.40 | 0.36 |
| 18.10 | 0.28 | 11,436 | 62.39 | 0.35 |
| 18.15 | 0.27 | 11,422 | 62.39 | 0.35 |
| 18.20 | 0.27 | 11,409 | 62.39 | 0.34 |
| 18.25 | 0.27 | 11,396 | 62.38 | 0.34 |
| 18.30 | 0.27 | 11,384 | 62.38 | 0.34 |
| 18.35 | 0.27 | 11,372 | 62.38 | 0.33 |
| 18.40 | 0.26 | 11,360 | 62.37 | 0.33 |
| 18.45 | 0.26 | 11,349 | 62.37 | 0.32 |
| 18.50 | 0.26 | 11,339 | 62.37 | 0.32 |
| 18.55 | 0.26 | 11,328 | 62.36 | 0.32 |
| 18.60 | 0.26 | 11,318 | 62.36 | 0.31 |
| 18.65 | 0.26 | 11,309 | 62.36 | 0.31 |
| 18.70 | 0.25 | 11,299 | 62.36 | 0.31 |
| 18.75 | 0.25 | 11,290 | 62.35 | 0.30 |
| 18.80 | 0.25 | 11,282 | 62.35 | 0.30 |
| 18.85 | 0.25 | 11,273 | 62.35 | 0.30 |
| 18.90 | 0.25 | 11,265 | 62.35 | 0.29 |
| 18.95 | 0.25 | 11,256 | 62.34 | 0.29 |
| 19.00 | 0.24 | 11,248 | 62.34 | 0.29 |
| 19.05 | 0.24 | 11,241 | 62.34 | 0.28 |
| 19.10 | 0.24 | 11,233 | 62.34 | 0.28 |
| 19.15 | 0.24 | 11,226 | 62.34 | 0.28 |
| 19.20 | 0.24 | 11,218 | 62.33 | 0.28 |
| 19.25 | 0.23 | 11,211 | 62.33 | 0.27 |
| 19.30 | 0.23 | 11,204 | 62.33 | 0.27 |
| 19.35 | 0.23 | 11,197 | 62.33 | 0.27 |
| 19.40 | 0.23 | 11,190 | 62.33 | 0.27 |
| 19.45 | 0.23 | 11,184 | 62.32 | 0.26 |
| 19.50 | 0.23 | 11,177 | 62.32 | 0.26 |
| 19.55 | 0.22 | 11,171 | 62.32 | 0.26 |
| 19.60 | 0.22 | 11,164 | 62.32 | 0.26 |
| 19.65 | 0.22 | 11,158 | 62.32 | 0.26 |
| 19.70 | 0.22 | 11,152 | 62.32 | 0.25 |
| 19.75 | 0.22 | 11,145 | 62.31 | 0.25 |
| 19.80 | 0.22 | 11,139 | 62.31 | 0.25 |
| 19.85 | 0.21 | 11,133 | 62.31 | 0.25 |
| 19.90 | 0.21 | 11,127 | 62.31 | 0.24 |
| 19.95 | 0.21 | 11,121 | 62.31 | 0.24 |
| 20.00 | 0.21 | 11,116 | 62.31 | 0.24 |

## Stage-Discharge for Pond BMP-3: sed basin 3

| Elevation (feet) | Primary (cfs) | Elevation (feet) | Primary (cfs) | Elevation (feet) | Primary (cfs) | Elevation (feet) | Primary (cfs) |
|---|---|---|---|---|---|---|---|
| 56.00 | 0.00 | 58.08 | 0.00 | 60.16 | 0.00 | 62.24 | 0.16 |
| 56.04 | 0.00 | 58.12 | 0.00 | 60.20 | 0.00 | 62.28 | 0.20 |
| 56.08 | 0.00 | 58.16 | 0.00 | 60.24 | 0.00 | 62.32 | 0.26 |
| 56.12 | 0.00 | 58.20 | 0.00 | 60.28 | 0.00 | 62.36 | 0.31 |
| 56.16 | 0.00 | 58.24 | 0.00 | 60.32 | 0.00 | 62.40 | 0.36 |
| 56.20 | 0.00 | 58.28 | 0.00 | 60.36 | 0.00 | 62.44 | 0.41 |
| 56.24 | 0.00 | 58.32 | 0.00 | 60.40 | 0.00 | 62.48 | 0.46 |
| 56.28 | 0.00 | 58.36 | 0.00 | 60.44 | 0.00 | 62.52 | 0.49 |
| 56.32 | 0.00 | 58.40 | 0.00 | 60.48 | 0.00 | 62.56 | 0.53 |
| 56.36 | 0.00 | 58.44 | 0.00 | 60.52 | 0.00 | 62.60 | 0.56 |
| 56.40 | 0.00 | 58.48 | 0.00 | 60.56 | 0.00 | 62.64 | 0.59 |
| 56.44 | 0.00 | 58.52 | 0.00 | 60.60 | 0.00 | 62.68 | 0.62 |
| 56.48 | 0.00 | 58.56 | 0.00 | 60.64 | 0.00 | 62.72 | 0.65 |
| 56.52 | 0.00 | 58.60 | 0.00 | 60.68 | 0.00 | 62.76 | 0.68 |
| 56.56 | 0.00 | 58.64 | 0.00 | 60.72 | 0.00 | 62.80 | 0.70 |
| 56.60 | 0.00 | 58.68 | 0.00 | 60.76 | 0.00 | 62.84 | 0.73 |
| 56.64 | 0.00 | 58.72 | 0.00 | 60.80 | 0.00 | 62.88 | 0.75 |
| 56.68 | 0.00 | 58.76 | 0.00 | 60.84 | 0.00 | 62.92 | 0.77 |
| 56.72 | 0.00 | 58.80 | 0.00 | 60.88 | 0.00 | 62.96 | 0.80 |
| 56.76 | 0.00 | 58.84 | 0.00 | 60.92 | 0.00 | 63.00 | 0.82 |
| 56.80 | 0.00 | 58.88 | 0.00 | 60.96 | 0.00 | 63.04 | 0.84 |
| 56.84 | 0.00 | 58.92 | 0.00 | 61.00 | 0.00 | 63.08 | 0.86 |
| 56.88 | 0.00 | 58.96 | 0.00 | 61.04 | 0.00 | 63.12 | 0.88 |
| 56.92 | 0.00 | 59.00 | 0.00 | 61.08 | 0.00 | 63.16 | 0.90 |
| 56.96 | 0.00 | 59.04 | 0.00 | 61.12 | 0.00 | 63.20 | 0.92 |
| 57.00 | 0.00 | 59.08 | 0.00 | 61.16 | 0.00 | 63.24 | 0.94 |
| 57.04 | 0.00 | 59.12 | 0.00 | 61.20 | 0.00 | 63.28 | 0.96 |
| 57.08 | 0.00 | 59.16 | 0.00 | 61.24 | 0.00 | 63.32 | 0.98 |
| 57.12 | 0.00 | 59.20 | 0.00 | 61.28 | 0.00 | 63.36 | 1.00 |
| 57.16 | 0.00 | 59.24 | 0.00 | 61.32 | 0.00 | 63.40 | 1.01 |
| 57.20 | 0.00 | 59.28 | 0.00 | 61.36 | 0.00 | 63.44 | 1.03 |
| 57.24 | 0.00 | 59.32 | 0.00 | 61.40 | 0.00 | 63.48 | 1.05 |
| 57.28 | 0.00 | 59.36 | 0.00 | 61.44 | 0.00 | 63.52 | 1.07 |
| 57.32 | 0.00 | 59.40 | 0.00 | 61.48 | 0.00 | 63.56 | 1.08 |
| 57.36 | 0.00 | 59.44 | 0.00 | 61.52 | 0.00 | 63.60 | 1.10 |
| 57.40 | 0.00 | 59.48 | 0.00 | 61.56 | 0.00 | 63.64 | 1.11 |
| 57.44 | 0.00 | 59.52 | 0.00 | 61.60 | 0.00 | 63.68 | 1.13 |
| 57.48 | 0.00 | 59.56 | 0.00 | 61.64 | 0.00 | 63.72 | 1.15 |
| 57.52 | 0.00 | 59.60 | 0.00 | 61.68 | 0.00 | 63.76 | 1.16 |
| 57.56 | 0.00 | 59.64 | 0.00 | 61.72 | 0.00 | 63.80 | 1.18 |
| 57.60 | 0.00 | 59.68 | 0.00 | 61.76 | 0.00 | 63.84 | 1.19 |
| 57.64 | 0.00 | 59.72 | 0.00 | 61.80 | 0.00 | 63.88 | 1.21 |
| 57.68 | 0.00 | 59.76 | 0.00 | 61.84 | 0.00 | 63.92 | 1.22 |
| 57.72 | 0.00 | 59.80 | 0.00 | 61.88 | 0.00 | 63.96 | 1.24 |
| 57.76 | 0.00 | 59.84 | 0.00 | 61.92 | 0.00 | 64.00 | 1.25 |
| 57.80 | 0.00 | 59.88 | 0.00 | 61.96 | 0.00 | 64.04 | 1.26 |
| 57.84 | 0.00 | 59.92 | 0.00 | 62.00 | 0.00 | 64.08 | 1.28 |
| 57.88 | 0.00 | 59.96 | 0.00 | 62.04 | 0.01 | 64.12 | 1.29 |
| 57.92 | 0.00 | 60.00 | 0.00 | 62.08 | 0.02 | 64.16 | 1.31 |
| 57.96 | 0.00 | 60.04 | 0.00 | 62.12 | 0.04 | 64.20 | 1.32 |
| 58.00 | 0.00 | 60.08 | 0.00 | 62.16 | 0.07 | 64.24 | 1.33 |
| 58.04 | 0.00 | 60.12 | 0.00 | 62.20 | 0.11 | 64.28 | 1.35 |

## Stage-Discharge for Pond BMP-3: sed basin 3 (continued)

| Elevation (feet) | Primary (cfs) | Elevation (feet) | Primary (cfs) | Elevation (feet) | Primary (cfs) | Elevation (feet) | Primary (cfs) |
|---|---|---|---|---|---|---|---|
| 64.32 | 1.36 | 66.40 | 1.93 | 68.48 | 57.56 | 70.56 | 61.56 |
| 64.36 | 1.37 | 66.44 | 1.94 | 68.52 | 57.64 | 70.60 | 61.63 |
| 64.40 | 1.39 | 66.48 | 1.94 | 68.56 | 57.72 | 70.64 | 61.71 |
| 64.44 | 1.40 | 66.52 | 2.07 | 68.60 | 57.80 | 70.68 | 61.78 |
| 64.48 | 1.41 | 66.56 | 2.57 | 68.64 | 57.88 | 70.72 | 61.85 |
| 64.52 | 1.42 | 66.60 | 3.27 | 68.68 | 57.96 | 70.76 | 61.93 |
| 64.56 | 1.44 | 66.64 | 4.13 | 68.72 | 58.04 | 70.80 | 62.00 |
| 64.60 | 1.45 | 66.68 | 5.13 | 68.76 | 58.11 | 70.84 | 62.07 |
| 64.64 | 1.46 | 66.72 | 6.24 | 68.80 | 58.19 | 70.88 | 62.15 |
| 64.68 | 1.47 | 66.76 | 7.46 | 68.84 | 58.27 | 70.92 | 62.22 |
| 64.72 | 1.49 | 66.80 | 8.77 | 68.88 | 58.35 | 70.96 | 62.30 |
| 64.76 | 1.50 | 66.84 | 10.17 | 68.92 | 58.43 | 71.00 | 62.37 |
| 64.80 | 1.51 | 66.88 | 11.66 | 68.96 | 58.51 | 71.04 | 62.44 |
| 64.84 | 1.52 | 66.92 | 13.23 | 69.00 | 58.59 | 71.08 | 62.52 |
| 64.88 | 1.53 | 66.96 | 14.87 | 69.04 | 58.66 | 71.12 | 62.59 |
| 64.92 | 1.54 | 67.00 | 16.59 | 69.08 | 58.74 | 71.16 | 62.66 |
| 64.96 | 1.56 | 67.04 | 18.38 | 69.12 | 58.82 | 71.20 | 62.73 |
| 65.00 | 1.57 | 67.08 | 20.23 | 69.16 | 58.90 | 71.24 | 62.81 |
| 65.04 | 1.58 | 67.12 | 22.15 | 69.20 | 58.97 | 71.28 | 62.88 |
| 65.08 | 1.59 | 67.16 | 24.13 | 69.24 | 59.05 | 71.32 | 62.95 |
| 65.12 | 1.60 | 67.20 | 26.17 | 69.28 | 59.13 | 71.36 | 63.03 |
| 65.16 | 1.61 | 67.24 | 28.27 | 69.32 | 59.21 | 71.40 | 63.10 |
| 65.20 | 1.62 | 67.28 | 30.43 | 69.36 | 59.28 | 71.44 | 63.17 |
| 65.24 | 1.63 | 67.32 | 32.64 | 69.40 | 59.36 | 71.48 | 63.24 |
| 65.28 | 1.65 | 67.36 | 34.91 | 69.44 | 59.44 | 71.52 | 63.32 |
| 65.32 | 1.66 | 67.40 | 37.23 | 69.48 | 59.52 | 71.56 | 63.39 |
| 65.36 | 1.67 | 67.44 | 39.60 | 69.52 | 59.59 | 71.60 | 63.46 |
| 65.40 | 1.68 | 67.48 | 42.03 | 69.56 | 59.67 | 71.64 | 63.53 |
| 65.44 | 1.69 | 67.52 | 44.50 | 69.60 | 59.75 | 71.68 | 63.60 |
| 65.48 | 1.70 | 67.56 | 47.02 | 69.64 | 59.82 | 71.72 | 63.68 |
| 65.52 | 1.71 | 67.60 | 49.59 | 69.68 | 59.90 | 71.76 | 63.75 |
| 65.56 | 1.72 | 67.64 | 52.21 | 69.72 | 59.98 | 71.80 | 63.82 |
| 65.60 | 1.73 | 67.68 | 54.88 | 69.76 | 60.05 | 71.84 | 63.89 |
| 65.64 | 1.74 | 67.72 | 56.03 | 69.80 | 60.13 | 71.88 | 63.96 |
| 65.68 | 1.75 | 67.76 | 56.11 | 69.84 | 60.20 | 71.92 | 64.03 |
| 65.72 | 1.76 | 67.80 | 56.19 | 69.88 | 60.28 | 71.96 | 64.11 |
| 65.76 | 1.77 | 67.84 | 56.27 | 69.92 | 60.36 | 72.00 | **64.18** |
| 65.80 | 1.78 | 67.88 | 56.36 | 69.96 | 60.43 | | |
| 65.84 | 1.79 | 67.92 | 56.44 | 70.00 | 60.51 | | |
| 65.88 | 1.80 | 67.96 | 56.52 | 70.04 | 60.58 | | |
| 65.92 | 1.81 | 68.00 | 56.60 | 70.08 | 60.66 | | |
| 65.96 | 1.82 | 68.04 | 56.68 | 70.12 | 60.73 | | |
| 66.00 | 1.83 | 68.08 | 56.76 | 70.16 | 60.81 | | |
| 66.04 | 1.84 | 68.12 | 56.84 | 70.20 | 60.88 | | |
| 66.08 | 1.85 | 68.16 | 56.92 | 70.24 | 60.96 | | |
| 66.12 | 1.86 | 68.20 | 57.00 | 70.28 | 61.03 | | |
| 66.16 | 1.87 | 68.24 | 57.08 | 70.32 | 61.11 | | |
| 66.20 | 1.88 | 68.28 | 57.16 | 70.36 | 61.18 | | |
| 66.24 | 1.89 | 68.32 | 57.24 | 70.40 | 61.26 | | |
| 66.28 | 1.90 | 68.36 | 57.32 | 70.44 | 61.33 | | |
| 66.32 | 1.91 | 68.40 | 57.40 | 70.48 | 61.41 | | |
| 66.36 | 1.92 | 68.44 | 57.48 | 70.52 | 61.48 | | |

## Stage-Area-Storage for Pond BMP-3: sed basin 3

| Elevation (feet) | Surface (sq-ft) | Storage (cubic-feet) | Elevation (feet) | Surface (sq-ft) | Storage (cubic-feet) |
|---|---|---|---|---|---|
| 56.00 | 600 | 0 | 58.08 | 1,313 | 2,385 |
| 56.04 | 614 | 46 | 58.12 | 1,327 | 2,430 |
| 56.08 | 627 | 92 | 58.16 | 1,341 | 2,476 |
| 56.12 | 641 | 138 | 58.20 | 1,354 | 2,522 |
| 56.16 | 655 | 183 | 58.24 | 1,368 | 2,568 |
| 56.20 | 669 | 229 | 58.28 | 1,382 | 2,614 |
| 56.24 | 682 | 275 | 58.32 | 1,395 | 2,660 |
| 56.28 | 696 | 321 | 58.36 | 1,409 | 2,706 |
| 56.32 | 710 | 367 | 58.40 | 1,423 | 2,751 |
| 56.36 | 723 | 413 | 58.44 | 1,437 | 2,797 |
| 56.40 | 737 | 459 | 58.48 | 1,450 | 2,843 |
| 56.44 | 751 | 504 | 58.52 | 1,464 | 2,889 |
| 56.48 | 765 | 550 | 58.56 | 1,478 | 2,935 |
| 56.52 | 778 | 596 | 58.60 | 1,491 | 2,981 |
| 56.56 | 792 | 642 | 58.64 | 1,505 | 3,027 |
| 56.60 | 806 | 688 | 58.68 | 1,519 | 3,072 |
| 56.64 | 819 | 734 | 58.72 | 1,533 | 3,118 |
| 56.68 | 833 | 780 | 58.76 | 1,546 | 3,164 |
| 56.72 | 847 | 825 | 58.80 | 1,560 | 3,210 |
| 56.76 | 861 | 871 | 58.84 | 1,574 | 3,256 |
| 56.80 | 874 | 917 | 58.88 | 1,587 | 3,302 |
| 56.84 | 888 | 963 | 58.92 | 1,601 | 3,348 |
| 56.88 | 902 | 1,009 | 58.96 | 1,615 | 3,393 |
| 56.92 | 915 | 1,055 | 59.00 | 1,629 | 3,439 |
| 56.96 | 929 | 1,101 | 59.04 | 1,642 | 3,485 |
| 57.00 | 943 | 1,146 | 59.08 | 1,656 | 3,531 |
| 57.04 | 957 | 1,192 | 59.12 | 1,670 | 3,577 |
| 57.08 | 970 | 1,238 | 59.16 | 1,683 | 3,623 |
| 57.12 | 984 | 1,284 | 59.20 | 1,697 | 3,669 |
| 57.16 | 998 | 1,330 | 59.24 | 1,711 | 3,714 |
| 57.20 | 1,011 | 1,376 | 59.28 | 1,725 | 3,760 |
| 57.24 | 1,025 | 1,422 | 59.32 | 1,738 | 3,806 |
| 57.28 | 1,039 | 1,467 | 59.36 | 1,752 | 3,852 |
| 57.32 | 1,053 | 1,513 | 59.40 | 1,766 | 3,898 |
| 57.36 | 1,066 | 1,559 | 59.44 | 1,779 | 3,944 |
| 57.40 | 1,080 | 1,605 | 59.48 | 1,793 | 3,990 |
| 57.44 | 1,094 | 1,651 | 59.52 | 1,809 | 4,051 |
| 57.48 | 1,107 | 1,697 | 59.56 | 1,826 | 4,127 |
| 57.52 | 1,121 | 1,743 | 59.60 | 1,844 | 4,203 |
| 57.56 | 1,135 | 1,788 | 59.64 | 1,862 | 4,280 |
| 57.60 | 1,149 | 1,834 | 59.68 | 1,879 | 4,356 |
| 57.64 | 1,162 | 1,880 | 59.72 | 1,897 | 4,432 |
| 57.68 | 1,176 | 1,926 | 59.76 | 1,914 | 4,509 |
| 57.72 | 1,190 | 1,972 | 59.80 | 1,932 | 4,585 |
| 57.76 | 1,203 | 2,018 | 59.84 | 1,950 | 4,661 |
| 57.80 | 1,217 | 2,064 | 59.88 | 1,967 | 4,738 |
| 57.84 | 1,231 | 2,109 | 59.92 | 1,985 | 4,814 |
| 57.88 | 1,245 | 2,155 | 59.96 | 2,002 | 4,891 |
| 57.92 | 1,258 | 2,201 | 60.00 | 2,020 | 4,967 |
| 57.96 | 1,272 | 2,247 | 60.04 | 2,041 | 5,068 |
| 58.00 | 1,286 | 2,293 | 60.08 | 2,061 | 5,168 |
| 58.04 | 1,299 | 2,339 | 60.12 | 2,082 | 5,269 |

## Stage-Area-Storage for Pond BMP-3: sed basin 3 (continued)

| Elevation (feet) | Surface (sq-ft) | Storage (cubic-feet) | Elevation (feet) | Surface (sq-ft) | Storage (cubic-feet) |
|---|---|---|---|---|---|
| 60.16 | 2,102 | 5,370 | 62.24 | 3,197 | 10,877 |
| 60.20 | 2,123 | 5,470 | 62.28 | 3,222 | 11,022 |
| 60.24 | 2,144 | 5,571 | 62.32 | 3,246 | 11,168 |
| 60.28 | 2,164 | 5,672 | 62.36 | 3,270 | 11,314 |
| 60.32 | 2,185 | 5,772 | 62.40 | 3,295 | 11,460 |
| 60.36 | 2,205 | 5,873 | 62.44 | 3,319 | 11,606 |
| 60.40 | 2,226 | 5,974 | 62.48 | 3,344 | 11,751 |
| 60.44 | 2,247 | 6,075 | 62.52 | 3,369 | 11,897 |
| 60.48 | 2,267 | 6,175 | 62.56 | 3,393 | 12,043 |
| 60.52 | 2,288 | 6,276 | 62.60 | 3,418 | 12,189 |
| 60.56 | 2,308 | 6,377 | 62.64 | 3,442 | 12,335 |
| 60.60 | 2,329 | 6,477 | 62.68 | 3,467 | 12,480 |
| 60.64 | 2,350 | 6,578 | 62.72 | 3,491 | 12,626 |
| 60.68 | 2,370 | 6,679 | 62.76 | 3,515 | 12,772 |
| 60.72 | 2,391 | 6,779 | 62.80 | 3,540 | 12,918 |
| 60.76 | 2,411 | 6,880 | 62.84 | 3,565 | 13,064 |
| 60.80 | 2,432 | 6,981 | 62.88 | 3,589 | 13,210 |
| 60.84 | 2,453 | 7,082 | 62.92 | 3,614 | 13,355 |
| 60.88 | 2,473 | 7,182 | 62.96 | 3,638 | 13,501 |
| 60.92 | 2,494 | 7,283 | 63.00 | 3,663 | 13,647 |
| 60.96 | 2,514 | 7,384 | 63.04 | 3,687 | 13,793 |
| 61.00 | 2,535 | 7,484 | 63.08 | 3,711 | 13,939 |
| 61.04 | 2,556 | 7,585 | 63.12 | 3,736 | 14,084 |
| 61.08 | 2,576 | 7,686 | 63.16 | 3,760 | 14,230 |
| 61.12 | 2,597 | 7,786 | 63.20 | 3,785 | 14,376 |
| 61.16 | 2,617 | 7,887 | 63.24 | 3,810 | 14,522 |
| 61.20 | 2,638 | 7,988 | 63.28 | 3,834 | 14,668 |
| 61.24 | 2,659 | 8,088 | 63.32 | 3,859 | 14,813 |
| 61.28 | 2,679 | 8,189 | 63.36 | 3,883 | 14,959 |
| 61.32 | 2,700 | 8,290 | 63.40 | 3,907 | 15,105 |
| 61.36 | 2,720 | 8,391 | 63.44 | 3,932 | 15,251 |
| 61.40 | 2,741 | 8,491 | 63.48 | 3,957 | 15,397 |
| 61.44 | 2,762 | 8,592 | 63.52 | 3,981 | 15,543 |
| 61.48 | 2,782 | 8,693 | 63.56 | 4,006 | 15,688 |
| 61.52 | 2,803 | 8,793 | 63.60 | 4,030 | 15,834 |
| 61.56 | 2,823 | 8,894 | 63.64 | 4,055 | 15,980 |
| 61.60 | 2,844 | 8,995 | 63.68 | 4,079 | 16,126 |
| 61.64 | 2,865 | 9,095 | 63.72 | 4,103 | 16,272 |
| 61.68 | 2,885 | 9,196 | 63.76 | 4,128 | 16,417 |
| 61.72 | 2,906 | 9,297 | 63.80 | 4,152 | 16,563 |
| 61.76 | 2,926 | 9,397 | 63.84 | 4,177 | 16,709 |
| 61.80 | 2,947 | 9,498 | 63.88 | 4,202 | 16,855 |
| 61.84 | 2,968 | 9,599 | 63.92 | 4,226 | 17,001 |
| 61.88 | 2,988 | 9,700 | 63.96 | 4,251 | 17,146 |
| 61.92 | 3,009 | 9,800 | 64.00 | 4,275 | 17,292 |
| 61.96 | 3,029 | 9,901 | 64.04 | 4,304 | 17,491 |
| 62.00 | 3,050 | 10,002 | 64.08 | 4,333 | 17,691 |
| 62.04 | 3,074 | 10,147 | 64.12 | 4,362 | 17,890 |
| 62.08 | 3,099 | 10,293 | 64.16 | 4,391 | 18,089 |
| 62.12 | 3,123 | 10,439 | 64.20 | 4,420 | 18,288 |
| 62.16 | 3,148 | 10,585 | 64.24 | 4,448 | 18,487 |
| 62.20 | 3,173 | 10,731 | 64.28 | 4,477 | 18,687 |

## Stage-Area-Storage for Pond BMP-3: sed basin 3 (continued)

| Elevation (feet) | Surface (sq-ft) | Storage (cubic-feet) | Elevation (feet) | Surface (sq-ft) | Storage (cubic-feet) |
|---|---|---|---|---|---|
| 64.32 | 4,506 | 18,886 | 66.40 | 6,051 | 29,864 |
| 64.36 | 4,535 | 19,085 | 66.44 | 6,084 | 30,125 |
| 64.40 | 4,564 | 19,284 | 66.48 | 6,117 | 30,387 |
| 64.44 | 4,593 | 19,483 | 66.52 | 6,150 | 30,648 |
| 64.48 | 4,622 | 19,683 | 66.56 | 6,183 | 30,909 |
| 64.52 | 4,651 | 19,882 | 66.60 | 6,216 | 31,170 |
| 64.56 | 4,680 | 20,081 | 66.64 | 6,250 | 31,431 |
| 64.60 | 4,708 | 20,280 | 66.68 | 6,283 | 31,693 |
| 64.64 | 4,737 | 20,479 | 66.72 | 6,316 | 31,954 |
| 64.68 | 4,766 | 20,679 | 66.76 | 6,349 | 32,215 |
| 64.72 | 4,795 | 20,878 | 66.80 | 6,382 | 32,476 |
| 64.76 | 4,824 | 21,077 | 66.84 | 6,415 | 32,737 |
| 64.80 | 4,853 | 21,276 | 66.88 | 6,448 | 32,999 |
| 64.84 | 4,882 | 21,475 | 66.92 | 6,481 | 33,260 |
| 64.88 | 4,911 | 21,675 | 66.96 | 6,514 | 33,521 |
| 64.92 | 4,940 | 21,874 | 67.00 | 6,548 | 33,782 |
| 64.96 | 4,969 | 22,073 | 67.04 | 6,581 | 34,043 |
| 65.00 | 4,998 | 22,272 | 67.08 | 6,614 | 34,305 |
| 65.04 | 5,026 | 22,471 | 67.12 | 6,647 | 34,566 |
| 65.08 | 5,055 | 22,671 | 67.16 | 6,680 | 34,827 |
| 65.12 | 5,084 | 22,870 | 67.20 | 6,713 | 35,088 |
| 65.16 | 5,113 | 23,069 | 67.24 | 6,746 | 35,349 |
| 65.20 | 5,142 | 23,268 | 67.28 | 6,779 | 35,611 |
| 65.24 | 5,171 | 23,467 | 67.32 | 6,812 | 35,872 |
| 65.28 | 5,200 | 23,667 | 67.36 | 6,845 | 36,133 |
| 65.32 | 5,229 | 23,866 | 67.40 | 6,879 | 36,394 |
| 65.36 | 5,258 | 24,065 | 67.44 | 6,912 | 36,655 |
| 65.40 | 5,287 | 24,264 | 67.48 | 6,945 | 36,917 |
| 65.44 | 5,315 | 24,463 | 67.52 | 6,978 | 37,178 |
| 65.48 | 5,344 | 24,663 | 67.56 | 7,011 | 37,439 |
| 65.52 | 5,373 | 24,862 | 67.60 | 7,044 | 37,700 |
| 65.56 | 5,402 | 25,061 | 67.64 | 7,077 | 37,961 |
| 65.60 | 5,431 | 25,260 | 67.68 | 7,110 | 38,223 |
| 65.64 | 5,460 | 25,459 | 67.72 | 7,143 | 38,484 |
| 65.68 | 5,489 | 25,659 | 67.76 | 7,176 | 38,745 |
| 65.72 | 5,518 | 25,858 | 67.80 | 7,209 | 39,006 |
| 65.76 | 5,547 | 26,057 | 67.84 | 7,243 | 39,267 |
| 65.80 | 5,575 | 26,256 | 67.88 | 7,276 | 39,529 |
| 65.84 | 5,604 | 26,455 | 67.92 | 7,309 | 39,790 |
| 65.88 | 5,633 | 26,655 | 67.96 | 7,342 | 40,051 |
| 65.92 | 5,662 | 26,854 | 68.00 | 7,375 | 40,312 |
| 65.96 | 5,691 | 27,053 | 68.04 | 7,414 | 40,645 |
| 66.00 | 5,720 | 27,252 | 68.08 | 7,452 | 40,978 |
| 66.04 | 5,753 | 27,513 | 68.12 | 7,491 | 41,311 |
| 66.08 | 5,786 | 27,775 | 68.16 | 7,529 | 41,643 |
| 66.12 | 5,819 | 28,036 | 68.20 | 7,568 | 41,976 |
| 66.16 | 5,852 | 28,297 | 68.24 | 7,606 | 42,309 |
| 66.20 | 5,886 | 28,558 | 68.28 | 7,645 | 42,642 |
| 66.24 | 5,919 | 28,819 | 68.32 | 7,683 | 42,974 |
| 66.28 | 5,952 | 29,081 | 68.36 | 7,721 | 43,307 |
| 66.32 | 5,985 | 29,342 | 68.40 | 7,760 | 43,640 |
| 66.36 | 6,018 | 29,603 | 68.44 | 7,798 | 43,973 |

## Stage-Area-Storage for Pond BMP-3: sed basin 3 (continued)

| Elevation (feet) | Surface (sq-ft) | Storage (cubic-feet) |
|---|---|---|
| 68.48 | 7,837 | 44,305 |
| 68.52 | 7,875 | 44,638 |
| 68.56 | 7,914 | 44,971 |
| 68.60 | 7,952 | 45,304 |
| 68.64 | 7,991 | 45,636 |
| 68.68 | 8,030 | 45,969 |
| 68.72 | 8,068 | 46,302 |
| 68.76 | 8,107 | 46,635 |
| 68.80 | 8,145 | 46,967 |
| 68.84 | 8,184 | 47,300 |
| 68.88 | 8,222 | 47,633 |
| 68.92 | 8,261 | 47,966 |
| 68.96 | 8,299 | 48,298 |
| 69.00 | 8,338 | 48,631 |
| 69.04 | 8,376 | 48,964 |
| 69.08 | 8,414 | 49,297 |
| 69.12 | 8,453 | 49,629 |
| 69.16 | 8,491 | 49,962 |
| 69.20 | 8,530 | 50,295 |
| 69.24 | 8,568 | 50,628 |
| 69.28 | 8,607 | 50,960 |
| 69.32 | 8,645 | 51,293 |
| 69.36 | 8,684 | 51,626 |
| 69.40 | 8,723 | 51,959 |
| 69.44 | 8,761 | 52,292 |
| 69.48 | 8,800 | 52,624 |
| 69.52 | 8,838 | 52,957 |
| 69.56 | 8,877 | 53,290 |
| 69.60 | 8,915 | 53,623 |
| 69.64 | 8,954 | 53,955 |
| 69.68 | 8,992 | 54,288 |
| 69.72 | 9,030 | 54,621 |
| 69.76 | 9,069 | 54,954 |
| 69.80 | 9,107 | 55,286 |
| 69.84 | 9,146 | 55,619 |
| 69.88 | 9,184 | 55,952 |
| 69.92 | 9,223 | 56,285 |
| 69.96 | 9,262 | 56,617 |
| 70.00 | 9,300 | 56,950 |
| 70.04 | 9,344 | 57,365 |
| 70.08 | 9,387 | 57,780 |
| 70.12 | 9,431 | 58,195 |
| 70.16 | 9,474 | 58,609 |
| 70.20 | 9,518 | 59,024 |
| 70.24 | 9,562 | 59,439 |
| 70.28 | 9,605 | 59,854 |
| 70.32 | 9,649 | 60,269 |
| 70.36 | 9,692 | 60,684 |
| 70.40 | 9,736 | 61,098 |
| 70.44 | 9,780 | 61,513 |
| 70.48 | 9,823 | 61,928 |
| 70.52 | 9,867 | 62,343 |
| 70.56 | 9,910 | 62,758 |
| 70.60 | 9,954 | 63,173 |
| 70.64 | 9,998 | 63,587 |
| 70.68 | 10,041 | 64,002 |
| 70.72 | 10,085 | 64,417 |
| 70.76 | 10,128 | 64,832 |
| 70.80 | 10,172 | 65,247 |
| 70.84 | 10,216 | 65,662 |
| 70.88 | 10,259 | 66,076 |
| 70.92 | 10,303 | 66,491 |
| 70.96 | 10,346 | 66,906 |
| 71.00 | 10,390 | 67,321 |
| 71.04 | 10,434 | 67,736 |
| 71.08 | 10,477 | 68,151 |
| 71.12 | 10,521 | 68,566 |
| 71.16 | 10,564 | 68,980 |
| 71.20 | 10,608 | 69,395 |
| 71.24 | 10,652 | 69,810 |
| 71.28 | 10,695 | 70,225 |
| 71.32 | 10,739 | 70,640 |
| 71.36 | 10,782 | 71,055 |
| 71.40 | 10,826 | 71,469 |
| 71.44 | 10,870 | 71,884 |
| 71.48 | 10,913 | 72,299 |
| 71.52 | 10,957 | 72,714 |
| 71.56 | 11,000 | 73,129 |
| 71.60 | 11,044 | 73,544 |
| 71.64 | 11,088 | 73,958 |
| 71.68 | 11,131 | 74,373 |
| 71.72 | 11,175 | 74,788 |
| 71.76 | 11,218 | 75,203 |
| 71.80 | 11,262 | 75,618 |
| 71.84 | 11,306 | 76,033 |
| 71.88 | 11,349 | 76,447 |
| 71.92 | 11,393 | 76,862 |
| 71.96 | 11,436 | 77,277 |
| 72.00 | **11,480** | **77,692** |

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment Post Dev: 1/3 Acre Lots** Runoff Area=5.300 ac Runoff Depth=4.03"
Tc=25.0 min CN=81 Runoff=22.21 cfs 1.778 af

**Pond BMP-3: sed basin 3** Peak Elev=66.98' Storage=33,625 cf Inflow=22.21 cfs 1.778 af
Outflow=15.69 cfs 1.455 af

**Total Runoff Area = 5.300 ac Runoff Volume = 1.778 af Average Runoff Depth = 4.03"**

## Subcatchment Post Dev: 1/3 Acre Lots

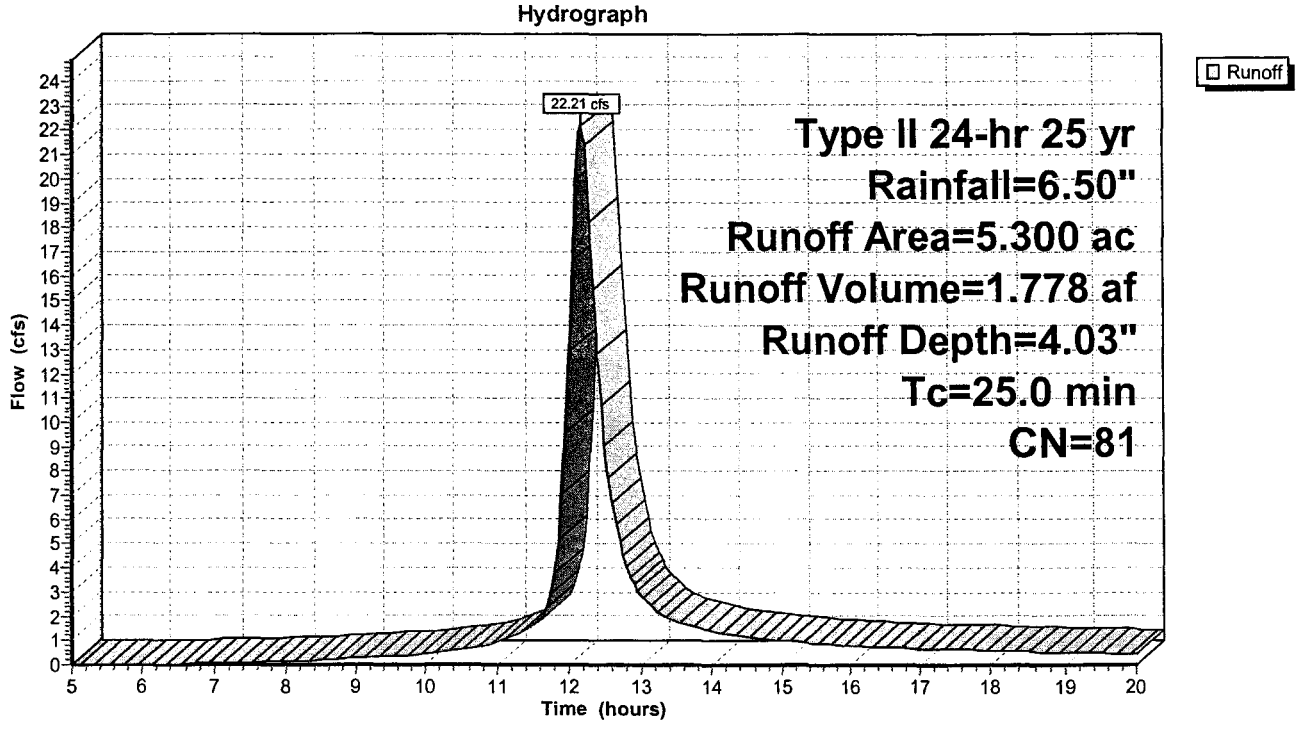
Runoff = 22.21 cfs @ 12.18 hrs, Volume= 1.778 af, Depth= 4.03"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 yr Rainfall=6.50"

| Area (ac) | CN | Description |
|---|---|---|
| 5.300 | 81 | 1/3 acre lots, 30% imp, HSG C |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 25.0 | | | | | **Direct Entry,** |

## Subcatchment Post Dev: 1/3 Acre Lots



## Hydrograph for Subcatchment Post Dev: 1/3 Acre Lots

| Time (hours) | Precip. (inches) | Excess (inches) | Runoff (cfs) | Time (hours) | Precip. (inches) | Excess (inches) | Runoff (cfs) |
|---|---|---|---|---|---|---|---|
| 5.00 | 0.41 | 0.00 | 0.00 | 7.60 | 0.72 | 0.02 | 0.11 |
| 5.05 | 0.41 | 0.00 | 0.00 | 7.65 | 0.73 | 0.03 | 0.11 |
| 5.10 | 0.42 | 0.00 | 0.00 | 7.70 | 0.74 | 0.03 | 0.12 |
| 5.15 | 0.43 | 0.00 | 0.00 | 7.75 | 0.74 | 0.03 | 0.12 |
| 5.20 | 0.43 | 0.00 | 0.00 | 7.80 | 0.75 | 0.03 | 0.12 |
| 5.25 | 0.44 | 0.00 | 0.00 | 7.85 | 0.76 | 0.03 | 0.13 |
| 5.30 | 0.44 | 0.00 | 0.00 | 7.90 | 0.77 | 0.03 | 0.13 |
| 5.35 | 0.45 | 0.00 | 0.00 | 7.95 | 0.77 | 0.03 | 0.13 |
| 5.40 | 0.45 | 0.00 | 0.00 | 8.00 | 0.78 | 0.04 | 0.14 |
| 5.45 | 0.46 | 0.00 | 0.00 | 8.05 | 0.79 | 0.04 | 0.14 |
| 5.50 | 0.46 | 0.00 | 0.00 | 8.10 | 0.79 | 0.04 | 0.15 |
| 5.55 | 0.47 | 0.00 | 0.00 | 8.15 | 0.80 | 0.04 | 0.15 |
| 5.60 | 0.47 | 0.00 | 0.00 | 8.20 | 0.81 | 0.04 | 0.15 |
| 5.65 | 0.48 | 0.00 | 0.00 | 8.25 | 0.82 | 0.05 | 0.16 |
| 5.70 | 0.49 | 0.00 | 0.00 | 8.30 | 0.83 | 0.05 | 0.16 |
| 5.75 | 0.49 | 0.00 | 0.00 | 8.35 | 0.83 | 0.05 | 0.17 |
| 5.80 | 0.50 | 0.00 | 0.00 | 8.40 | 0.84 | 0.05 | 0.17 |
| 5.85 | 0.50 | 0.00 | 0.00 | 8.45 | 0.85 | 0.05 | 0.18 |
| 5.90 | 0.51 | 0.00 | 0.00 | 8.50 | 0.86 | 0.06 | 0.19 |
| 5.95 | 0.51 | 0.00 | 0.00 | 8.55 | 0.87 | 0.06 | 0.20 |
| 6.00 | 0.52 | 0.00 | 0.01 | 8.60 | 0.88 | 0.06 | 0.20 |
| 6.05 | 0.53 | 0.00 | 0.01 | 8.65 | 0.89 | 0.06 | 0.21 |
| 6.10 | 0.53 | 0.00 | 0.01 | 8.70 | 0.90 | 0.07 | 0.22 |
| 6.15 | 0.54 | 0.00 | 0.01 | 8.75 | 0.91 | 0.07 | 0.23 |
| 6.20 | 0.54 | 0.00 | 0.02 | 8.80 | 0.92 | 0.07 | 0.23 |
| 6.25 | 0.55 | 0.00 | 0.02 | 8.85 | 0.93 | 0.07 | 0.24 |
| 6.30 | 0.56 | 0.00 | 0.02 | 8.90 | 0.94 | 0.08 | 0.25 |
| 6.35 | 0.56 | 0.00 | 0.02 | 8.95 | 0.95 | 0.08 | 0.26 |
| 6.40 | 0.57 | 0.00 | 0.03 | 9.00 | 0.96 | 0.08 | 0.27 |
| 6.45 | 0.57 | 0.00 | 0.03 | 9.05 | 0.97 | 0.09 | 0.28 |
| 6.50 | 0.58 | 0.01 | 0.03 | 9.10 | 0.98 | 0.09 | 0.29 |
| 6.55 | 0.59 | 0.01 | 0.04 | 9.15 | 0.99 | 0.09 | 0.30 |
| 6.60 | 0.59 | 0.01 | 0.04 | 9.20 | 1.00 | 0.10 | 0.31 |
| 6.65 | 0.60 | 0.01 | 0.04 | 9.25 | 1.01 | 0.10 | 0.32 |
| 6.70 | 0.61 | 0.01 | 0.05 | 9.30 | 1.02 | 0.10 | 0.33 |
| 6.75 | 0.61 | 0.01 | 0.05 | 9.35 | 1.03 | 0.11 | 0.34 |
| 6.80 | 0.62 | 0.01 | 0.05 | 9.40 | 1.04 | 0.11 | 0.34 |
| 6.85 | 0.62 | 0.01 | 0.06 | 9.45 | 1.05 | 0.11 | 0.35 |
| 6.90 | 0.63 | 0.01 | 0.06 | 9.50 | 1.06 | 0.12 | 0.36 |
| 6.95 | 0.64 | 0.01 | 0.06 | 9.55 | 1.07 | 0.12 | 0.36 |
| 7.00 | 0.64 | 0.01 | 0.07 | 9.60 | 1.08 | 0.13 | 0.37 |
| 7.05 | 0.65 | 0.01 | 0.07 | 9.65 | 1.09 | 0.13 | 0.38 |
| 7.10 | 0.66 | 0.01 | 0.07 | 9.70 | 1.10 | 0.13 | 0.38 |
| 7.15 | 0.66 | 0.01 | 0.08 | 9.75 | 1.11 | 0.14 | 0.39 |
| 7.20 | 0.67 | 0.02 | 0.08 | 9.80 | 1.13 | 0.14 | 0.40 |
| 7.25 | 0.68 | 0.02 | 0.08 | 9.85 | 1.14 | 0.15 | 0.41 |
| 7.30 | 0.68 | 0.02 | 0.09 | 9.90 | 1.15 | 0.15 | 0.42 |
| 7.35 | 0.69 | 0.02 | 0.09 | 9.95 | 1.16 | 0.16 | 0.43 |
| 7.40 | 0.70 | 0.02 | 0.09 | 10.00 | 1.18 | 0.16 | 0.45 |
| 7.45 | 0.70 | 0.02 | 0.10 | 10.05 | 1.19 | 0.17 | 0.46 |
| 7.50 | 0.71 | 0.02 | 0.10 | 10.10 | 1.20 | 0.17 | 0.48 |
| 7.55 | 0.72 | 0.02 | 0.10 | 10.15 | 1.22 | 0.18 | 0.49 |

## Hydrograph for Subcatchment Post Dev: 1/3 Acre Lots (continued)

| Time (hours) | Precip. (inches) | Excess (inches) | Runoff (cfs) | Time (hours) | Precip. (inches) | Excess (inches) | Runoff (cfs) |
|---|---|---|---|---|---|---|---|
| 10.20 | 1.23 | 0.19 | 0.51 | 12.80 | 4.93 | 2.93 | 4.05 |
| 10.25 | 1.25 | 0.19 | 0.53 | 12.85 | 4.95 | 2.95 | 3.66 |
| 10.30 | 1.26 | 0.20 | 0.54 | 12.90 | 4.98 | 2.96 | 3.34 |
| 10.35 | 1.28 | 0.21 | 0.57 | 12.95 | 5.00 | 2.98 | 3.08 |
| 10.40 | 1.29 | 0.21 | 0.59 | 13.00 | 5.02 | 3.00 | 2.87 |
| 10.45 | 1.31 | 0.22 | 0.61 | 13.05 | 5.04 | 3.02 | 2.69 |
| 10.50 | 1.33 | 0.23 | 0.63 | 13.10 | 5.06 | 3.04 | 2.53 |
| 10.55 | 1.34 | 0.24 | 0.66 | 13.15 | 5.08 | 3.05 | 2.40 |
| 10.60 | 1.36 | 0.25 | 0.68 | 13.20 | 5.09 | 3.07 | 2.28 |
| 10.65 | 1.38 | 0.25 | 0.71 | 13.25 | 5.11 | 3.08 | 2.17 |
| 10.70 | 1.40 | 0.26 | 0.74 | 13.30 | 5.13 | 3.10 | 2.07 |
| 10.75 | 1.42 | 0.27 | 0.77 | 13.35 | 5.15 | 3.11 | 1.99 |
| 10.80 | 1.44 | 0.28 | 0.80 | 13.40 | 5.16 | 3.13 | 1.92 |
| 10.85 | 1.46 | 0.29 | 0.83 | 13.45 | 5.18 | 3.14 | 1.86 |
| 10.90 | 1.48 | 0.31 | 0.87 | 13.50 | 5.19 | 3.16 | 1.81 |
| 10.95 | 1.50 | 0.32 | 0.91 | 13.55 | 5.21 | 3.17 | 1.76 |
| 11.00 | 1.53 | 0.33 | 0.95 | 13.60 | 5.22 | 3.18 | 1.71 |
| 11.05 | 1.55 | 0.34 | 0.99 | 13.65 | 5.24 | 3.20 | 1.66 |
| 11.10 | 1.58 | 0.36 | 1.04 | 13.70 | 5.25 | 3.21 | 1.62 |
| 11.15 | 1.60 | 0.37 | 1.09 | 13.75 | 5.27 | 3.22 | 1.58 |
| 11.20 | 1.63 | 0.39 | 1.14 | 13.80 | 5.28 | 3.23 | 1.54 |
| 11.25 | 1.66 | 0.40 | 1.20 | 13.85 | 5.29 | 3.25 | 1.50 |
| 11.30 | 1.70 | 0.42 | 1.26 | 13.90 | 5.31 | 3.26 | 1.46 |
| 11.35 | 1.73 | 0.44 | 1.34 | 13.95 | 5.32 | 3.27 | 1.43 |
| 11.40 | 1.76 | 0.46 | 1.42 | 14.00 | 5.33 | 3.28 | 1.39 |
| 11.45 | 1.80 | 0.48 | 1.51 | 14.05 | 5.34 | 3.29 | 1.36 |
| 11.50 | 1.84 | 0.51 | 1.61 | 14.10 | 5.35 | 3.30 | 1.33 |
| 11.55 | 1.90 | 0.54 | 1.72 | 14.15 | 5.37 | 3.31 | 1.30 |
| 11.60 | 1.99 | 0.60 | 1.84 | 14.20 | 5.38 | 3.32 | 1.27 |
| 11.65 | 2.13 | 0.69 | 2.03 | 14.25 | 5.39 | 3.33 | 1.24 |
| 11.70 | 2.30 | 0.80 | 2.35 | 14.30 | 5.40 | 3.34 | 1.21 |
| 11.75 | 2.52 | 0.95 | 2.92 | 14.35 | 5.41 | 3.35 | 1.19 |
| 11.80 | 2.80 | 1.16 | 3.82 | 14.40 | 5.42 | 3.36 | 1.17 |
| 11.85 | 3.19 | 1.46 | 5.15 | 14.45 | 5.43 | 3.37 | 1.16 |
| 11.90 | 3.69 | 1.86 | 7.02 | 14.50 | 5.44 | 3.38 | 1.14 |
| 11.95 | 4.12 | 2.22 | 9.59 | 14.55 | 5.46 | 3.39 | 1.13 |
| 12.00 | 4.31 | 2.38 | 12.91 | 14.60 | 5.47 | 3.40 | 1.11 |
| 12.05 | 4.37 | 2.44 | 16.62 | 14.65 | 5.48 | 3.41 | 1.10 |
| 12.10 | 4.43 | 2.49 | 19.94 | 14.70 | 5.49 | 3.42 | 1.09 |
| 12.15 | 4.49 | 2.54 | 21.93 | 14.75 | 5.50 | 3.43 | 1.08 |
| 12.20 | 4.54 | 2.58 | **22.09** | 14.80 | 5.51 | 3.44 | 1.06 |
| 12.25 | 4.59 | 2.63 | 20.67 | 14.85 | 5.52 | 3.45 | 1.05 |
| 12.30 | 4.63 | 2.66 | 18.26 | 14.90 | 5.53 | 3.46 | 1.04 |
| 12.35 | 4.68 | 2.70 | 15.48 | 14.95 | 5.54 | 3.47 | 1.03 |
| 12.40 | 4.71 | 2.73 | 12.84 | 15.00 | 5.55 | 3.47 | 1.02 |
| 12.45 | 4.75 | 2.76 | 10.69 | 15.05 | 5.56 | 3.48 | 1.01 |
| 12.50 | 4.78 | 2.79 | 9.05 | 15.10 | 5.57 | 3.49 | 1.00 |
| 12.55 | 4.81 | 2.81 | 7.76 | 15.15 | 5.58 | 3.50 | 0.99 |
| 12.60 | 4.83 | 2.84 | 6.71 | 15.20 | 5.59 | 3.51 | 0.98 |
| 12.65 | 4.86 | 2.86 | 5.84 | 15.25 | 5.60 | 3.52 | 0.97 |
| 12.70 | 4.88 | 2.88 | 5.13 | 15.30 | 5.60 | 3.52 | 0.96 |
| 12.75 | 4.91 | 2.90 | 4.54 | 15.35 | 5.61 | 3.53 | 0.95 |

## Hydrograph for Subcatchment Post Dev: 1/3 Acre Lots (continued)

| Time (hours) | Precip. (inches) | Excess (inches) | Runoff (cfs) |
|---|---|---|---|
| 15.40 | 5.62 | 3.54 | 0.94 |
| 15.45 | 5.63 | 3.55 | 0.92 |
| 15.50 | 5.64 | 3.56 | 0.91 |
| 15.55 | 5.65 | 3.56 | 0.90 |
| 15.60 | 5.66 | 3.57 | 0.89 |
| 15.65 | 5.66 | 3.58 | 0.88 |
| 15.70 | 5.67 | 3.59 | 0.87 |
| 15.75 | 5.68 | 3.59 | 0.86 |
| 15.80 | 5.69 | 3.60 | 0.85 |
| 15.85 | 5.70 | 3.61 | 0.84 |
| 15.90 | 5.70 | 3.62 | 0.83 |
| 15.95 | 5.71 | 3.62 | 0.82 |
| 16.00 | 5.72 | 3.63 | 0.81 |
| 16.05 | 5.73 | 3.64 | 0.80 |
| 16.10 | 5.73 | 3.64 | 0.78 |
| 16.15 | 5.74 | 3.65 | 0.77 |
| 16.20 | 5.75 | 3.66 | 0.76 |
| 16.25 | 5.76 | 3.66 | 0.75 |
| 16.30 | 5.76 | 3.67 | 0.75 |
| 16.35 | 5.77 | 3.68 | 0.74 |
| 16.40 | 5.78 | 3.68 | 0.73 |
| 16.45 | 5.79 | 3.69 | 0.72 |
| 16.50 | 5.79 | 3.70 | 0.72 |
| 16.55 | 5.80 | 3.70 | 0.71 |
| 16.60 | 5.81 | 3.71 | 0.71 |
| 16.65 | 5.81 | 3.71 | 0.70 |
| 16.70 | 5.82 | 3.72 | 0.70 |
| 16.75 | 5.83 | 3.73 | 0.70 |
| 16.80 | 5.83 | 3.73 | 0.69 |
| 16.85 | 5.84 | 3.74 | 0.69 |
| 16.90 | 5.85 | 3.75 | 0.68 |
| 16.95 | 5.85 | 3.75 | 0.68 |
| 17.00 | 5.86 | 3.76 | 0.68 |
| 17.05 | 5.87 | 3.76 | 0.67 |
| 17.10 | 5.87 | 3.77 | 0.67 |
| 17.15 | 5.88 | 3.78 | 0.66 |
| 17.20 | 5.89 | 3.78 | 0.66 |
| 17.25 | 5.89 | 3.79 | 0.66 |
| 17.30 | 5.90 | 3.79 | 0.65 |
| 17.35 | 5.91 | 3.80 | 0.65 |
| 17.40 | 5.91 | 3.80 | 0.65 |
| 17.45 | 5.92 | 3.81 | 0.64 |
| 17.50 | 5.93 | 3.82 | 0.64 |
| 17.55 | 5.93 | 3.82 | 0.63 |
| 17.60 | 5.94 | 3.83 | 0.63 |
| 17.65 | 5.94 | 3.83 | 0.63 |
| 17.70 | 5.95 | 3.84 | 0.62 |
| 17.75 | 5.96 | 3.84 | 0.62 |
| 17.80 | 5.96 | 3.85 | 0.61 |
| 17.85 | 5.97 | 3.86 | 0.61 |
| 17.90 | 5.97 | 3.86 | 0.61 |
| 17.95 | 5.98 | 3.87 | 0.60 |
| 18.00 | 5.99 | 3.87 | 0.60 |
| 18.05 | 5.99 | 3.88 | 0.60 |
| 18.10 | 6.00 | 3.88 | 0.59 |
| 18.15 | 6.00 | 3.89 | 0.59 |
| 18.20 | 6.01 | 3.89 | 0.58 |
| 18.25 | 6.02 | 3.90 | 0.58 |
| 18.30 | 6.02 | 3.90 | 0.58 |
| 18.35 | 6.03 | 3.91 | 0.57 |
| 18.40 | 6.03 | 3.91 | 0.57 |
| 18.45 | 6.04 | 3.92 | 0.56 |
| 18.50 | 6.04 | 3.92 | 0.56 |
| 18.55 | 6.05 | 3.93 | 0.56 |
| 18.60 | 6.05 | 3.93 | 0.55 |
| 18.65 | 6.06 | 3.94 | 0.55 |
| 18.70 | 6.06 | 3.94 | 0.55 |
| 18.75 | 6.07 | 3.95 | 0.54 |
| 18.80 | 6.07 | 3.95 | 0.54 |
| 18.85 | 6.08 | 3.96 | 0.53 |
| 18.90 | 6.09 | 3.96 | 0.53 |
| 18.95 | 6.09 | 3.97 | 0.53 |
| 19.00 | 6.10 | 3.97 | 0.52 |
| 19.05 | 6.10 | 3.98 | 0.52 |
| 19.10 | 6.11 | 3.98 | 0.51 |
| 19.15 | 6.11 | 3.98 | 0.51 |
| 19.20 | 6.12 | 3.99 | 0.51 |
| 19.25 | 6.12 | 3.99 | 0.50 |
| 19.30 | 6.12 | 4.00 | 0.50 |
| 19.35 | 6.13 | 4.00 | 0.49 |
| 19.40 | 6.13 | 4.01 | 0.49 |
| 19.45 | 6.14 | 4.01 | 0.49 |
| 19.50 | 6.14 | 4.01 | 0.48 |
| 19.55 | 6.15 | 4.02 | 0.48 |
| 19.60 | 6.15 | 4.02 | 0.48 |
| 19.65 | 6.16 | 4.03 | 0.47 |
| 19.70 | 6.16 | 4.03 | 0.47 |
| 19.75 | 6.17 | 4.04 | 0.46 |
| 19.80 | 6.17 | 4.04 | 0.46 |
| 19.85 | 6.18 | 4.04 | 0.46 |
| 19.90 | 6.18 | 4.05 | 0.45 |
| 19.95 | 6.18 | 4.05 | 0.45 |
| 20.00 | **6.19** | **4.06** | 0.44 |

## Pond BMP-3: sed basin 3

| | | | | | | |
|---|---|---|---|---|---|---|
| Inflow Area = | 5.300 ac, | Inflow Depth = | 4.03" | for | 25 yr event | |
| Inflow = | 22.21 cfs @ | 12.18 hrs, | Volume= | | 1.778 af | |
| Outflow = | 15.69 cfs @ | 12.36 hrs, | Volume= | | 1.455 af, | Atten= 29%, Lag= 11.1 min |
| Primary = | 15.69 cfs @ | 12.36 hrs, | Volume= | | 1.455 af | |

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 66.98' @ 12.36 hrs Surf.Area= 6,528 sf Storage= 33,625 cf
Plug-Flow detention time= 149.7 min calculated for 1.455 af (82% of inflow)
Center-of-Mass det. time= 100.1 min ( 883.4 - 783.3 )

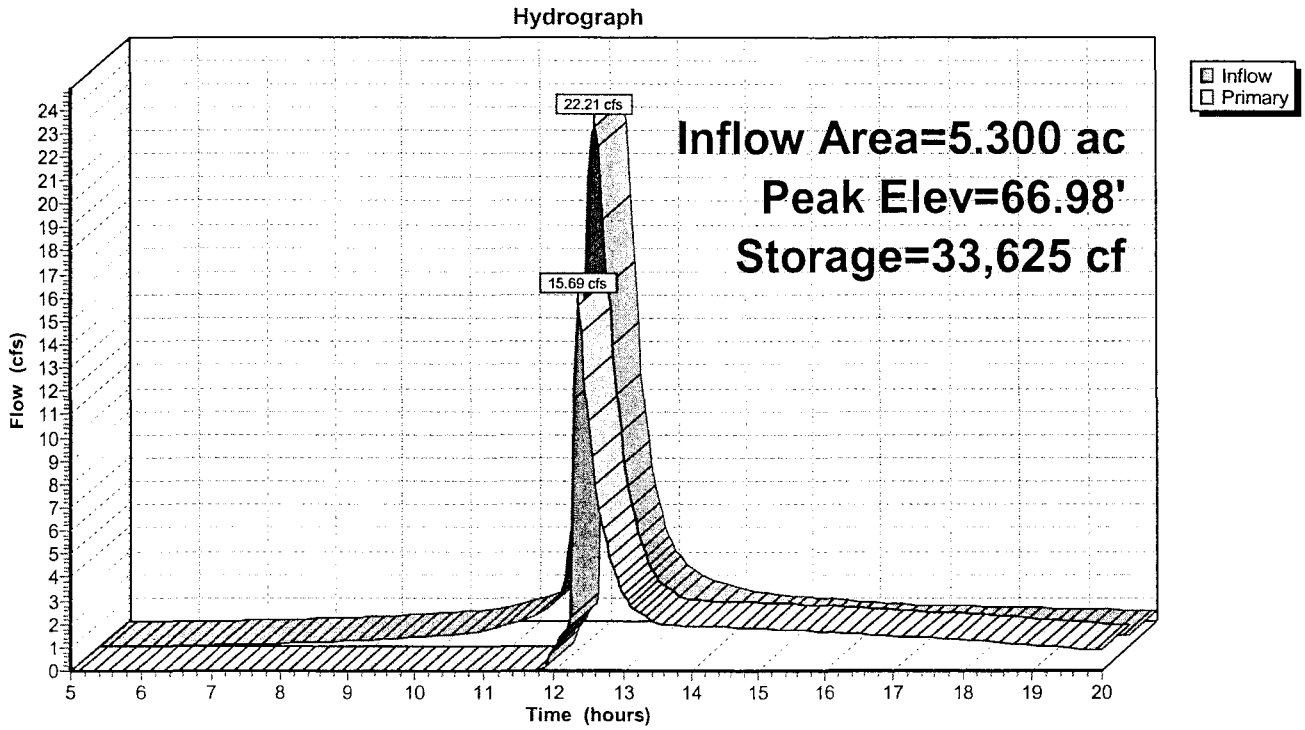
| # | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| 1 | 56.00' | 77,692 cf | **Custom Stage Data (Pyramidal)** Listed below |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) | Wet.Area (sq-ft) |
|---|---|---|---|---|
| 56.00 | 600 | 0 | 0 | 600 |
| 59.50 | 1,800 | 4,012 | 4,012 | 1,888 |
| 60.00 | 2,020 | 954 | 4,967 | 2,125 |
| 62.00 | 3,050 | 5,035 | 10,002 | 3,230 |
| 64.00 | 4,275 | 7,291 | 17,292 | 4,547 |
| 66.00 | 5,720 | 9,960 | 27,252 | 6,098 |
| 68.00 | 7,375 | 13,060 | 40,312 | 7,874 |
| 70.00 | 9,300 | 16,638 | 56,950 | 9,933 |
| 72.00 | 11,480 | 20,742 | 77,692 | 12,260 |

| # | Routing | Invert | Outlet Devices |
|---|---|---|---|
| 1 | Primary | 53.00' | **24.0" x 80.0' long Culvert** RCP, square edge headwall, Ke= 0.500<br>Outlet Invert= 45.30' S= 0.0963 '/' n= 0.012 Cc= 0.900 |
| 2 | Device 1 | 62.00' | **6.0" Vert. Orifice/Grate** C= 0.600 |
| 3 | Device 1 | 66.50' | **48.0" Horiz. Orifice/Grate** Limited to weir flow C= 0.600 |

**Primary OutFlow** Max=15.04 cfs @ 12.36 hrs HW=66.96' (Free Discharge)
└─**1=Culvert** (Passes 15.04 cfs of 54.46 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 2.05 cfs @ 10.5 fps)
  └─**3=Orifice/Grate** (Weir Controls 12.99 cfs @ 2.2 fps)

## Pond BMP-3: sed basin 3



## Hydrograph for Pond BMP-3: sed basin 3

| Time (hours) | Inflow (cfs) | Storage (cubic-feet) | Elevation (feet) | Primary (cfs) |
|---|---|---|---|---|
| 5.00 | 0.00 | 0 | 56.00 | 0.00 |
| 5.05 | 0.00 | 0 | 56.00 | 0.00 |
| 5.10 | 0.00 | 0 | 56.00 | 0.00 |
| 5.15 | 0.00 | 0 | 56.00 | 0.00 |
| 5.20 | 0.00 | 0 | 56.00 | 0.00 |
| 5.25 | 0.00 | 0 | 56.00 | 0.00 |
| 5.30 | 0.00 | 0 | 56.00 | 0.00 |
| 5.35 | 0.00 | 0 | 56.00 | 0.00 |
| 5.40 | 0.00 | 0 | 56.00 | 0.00 |
| 5.45 | 0.00 | 0 | 56.00 | 0.00 |
| 5.50 | 0.00 | 0 | 56.00 | 0.00 |
| 5.55 | 0.00 | 0 | 56.00 | 0.00 |
| 5.60 | 0.00 | 0 | 56.00 | 0.00 |
| 5.65 | 0.00 | 0 | 56.00 | 0.00 |
| 5.70 | 0.00 | 0 | 56.00 | 0.00 |
| 5.75 | 0.00 | 0 | 56.00 | 0.00 |
| 5.80 | 0.00 | 0 | 56.00 | 0.00 |
| 5.85 | 0.00 | 0 | 56.00 | 0.00 |
| 5.90 | 0.00 | 1 | 56.00 | 0.00 |
| 5.95 | 0.00 | 1 | 56.00 | 0.00 |
| 6.00 | 0.01 | 2 | 56.00 | 0.00 |
| 6.05 | 0.01 | 4 | 56.00 | 0.00 |
| 6.10 | 0.01 | 5 | 56.00 | 0.00 |
| 6.15 | 0.01 | 8 | 56.01 | 0.00 |
| 6.20 | 0.02 | 10 | 56.01 | 0.00 |
| 6.25 | 0.02 | 13 | 56.01 | 0.00 |
| 6.30 | 0.02 | 17 | 56.01 | 0.00 |
| 6.35 | 0.02 | 21 | 56.02 | 0.00 |
| 6.40 | 0.03 | 26 | 56.02 | 0.00 |
| 6.45 | 0.03 | 31 | 56.03 | 0.00 |
| 6.50 | 0.03 | 37 | 56.03 | 0.00 |
| 6.55 | 0.04 | 43 | 56.04 | 0.00 |
| 6.60 | 0.04 | 50 | 56.04 | 0.00 |
| 6.65 | 0.04 | 57 | 56.05 | 0.00 |
| 6.70 | 0.05 | 65 | 56.06 | 0.00 |
| 6.75 | 0.05 | 74 | 56.06 | 0.00 |
| 6.80 | 0.05 | 83 | 56.07 | 0.00 |
| 6.85 | 0.06 | 93 | 56.08 | 0.00 |
| 6.90 | 0.06 | 103 | 56.09 | 0.00 |
| 6.95 | 0.06 | 114 | 56.10 | 0.00 |
| 7.00 | 0.07 | 126 | 56.11 | 0.00 |
| 7.05 | 0.07 | 138 | 56.12 | 0.00 |
| 7.10 | 0.07 | 151 | 56.13 | 0.00 |
| 7.15 | 0.08 | 165 | 56.14 | 0.00 |
| 7.20 | 0.08 | 179 | 56.16 | 0.00 |
| 7.25 | 0.08 | 193 | 56.17 | 0.00 |
| 7.30 | 0.09 | 209 | 56.18 | 0.00 |
| 7.35 | 0.09 | 225 | 56.20 | 0.00 |
| 7.40 | 0.09 | 241 | 56.21 | 0.00 |
| 7.45 | 0.10 | 258 | 56.23 | 0.00 |
| 7.50 | 0.10 | 276 | 56.24 | 0.00 |
| 7.55 | 0.10 | 295 | 56.26 | 0.00 |

## Hydrograph for Pond BMP-3: sed basin 3 (continued)

| Time (hours) | Inflow (cfs) | Storage (cubic-feet) | Elevation (feet) | Primary (cfs) |
|---|---|---|---|---|
| 7.60 | 0.11 | 314 | 56.27 | 0.00 |
| 7.65 | 0.11 | 334 | 56.29 | 0.00 |
| 7.70 | 0.12 | 354 | 56.31 | 0.00 |
| 7.75 | 0.12 | 375 | 56.33 | 0.00 |
| 7.80 | 0.12 | 397 | 56.35 | 0.00 |
| 7.85 | 0.13 | 420 | 56.37 | 0.00 |
| 7.90 | 0.13 | 443 | 56.39 | 0.00 |
| 7.95 | 0.13 | 467 | 56.41 | 0.00 |
| 8.00 | 0.14 | 491 | 56.43 | 0.00 |
| 8.05 | 0.14 | 517 | 56.45 | 0.00 |
| 8.10 | 0.15 | 543 | 56.47 | 0.00 |
| 8.15 | 0.15 | 569 | 56.50 | 0.00 |
| 8.20 | 0.15 | 597 | 56.52 | 0.00 |
| 8.25 | 0.16 | 625 | 56.55 | 0.00 |
| 8.30 | 0.16 | 654 | 56.57 | 0.00 |
| 8.35 | 0.17 | 684 | 56.60 | 0.00 |
| 8.40 | 0.17 | 715 | 56.62 | 0.00 |
| 8.45 | 0.18 | 747 | 56.65 | 0.00 |
| 8.50 | 0.19 | 780 | 56.68 | 0.00 |
| 8.55 | 0.20 | 815 | 56.71 | 0.00 |
| 8.60 | 0.20 | 850 | 56.74 | 0.00 |
| 8.65 | 0.21 | 887 | 56.77 | 0.00 |
| 8.70 | 0.22 | 926 | 56.81 | 0.00 |
| 8.75 | 0.23 | 966 | 56.84 | 0.00 |
| 8.80 | 0.23 | 1,008 | 56.88 | 0.00 |
| 8.85 | 0.24 | 1,051 | 56.92 | 0.00 |
| 8.90 | 0.25 | 1,095 | 56.96 | 0.00 |
| 8.95 | 0.26 | 1,142 | 57.00 | 0.00 |
| 9.00 | 0.27 | 1,190 | 57.04 | 0.00 |
| 9.05 | 0.28 | 1,239 | 57.08 | 0.00 |
| 9.10 | 0.29 | 1,291 | 57.13 | 0.00 |
| 9.15 | 0.30 | 1,344 | 57.17 | 0.00 |
| 9.20 | 0.31 | 1,399 | 57.22 | 0.00 |
| 9.25 | 0.32 | 1,455 | 57.27 | 0.00 |
| 9.30 | 0.33 | 1,514 | 57.32 | 0.00 |
| 9.35 | 0.34 | 1,573 | 57.37 | 0.00 |
| 9.40 | 0.34 | 1,635 | 57.43 | 0.00 |
| 9.45 | 0.35 | 1,697 | 57.48 | 0.00 |
| 9.50 | 0.36 | 1,761 | 57.54 | 0.00 |
| 9.55 | 0.36 | 1,826 | 57.59 | 0.00 |
| 9.60 | 0.37 | 1,892 | 57.65 | 0.00 |
| 9.65 | 0.38 | 1,959 | 57.71 | 0.00 |
| 9.70 | 0.38 | 2,028 | 57.77 | 0.00 |
| 9.75 | 0.39 | 2,097 | 57.83 | 0.00 |
| 9.80 | 0.40 | 2,168 | 57.89 | 0.00 |
| 9.85 | 0.41 | 2,241 | 57.95 | 0.00 |
| 9.90 | 0.42 | 2,315 | 58.02 | 0.00 |
| 9.95 | 0.43 | 2,392 | 58.09 | 0.00 |
| 10.00 | 0.45 | 2,471 | 58.16 | 0.00 |
| 10.05 | 0.46 | 2,553 | 58.23 | 0.00 |
| 10.10 | 0.48 | 2,637 | 58.30 | 0.00 |
| 10.15 | 0.49 | 2,724 | 58.38 | 0.00 |

## Hydrograph for Pond BMP-3: sed basin 3 (continued)

| Time (hours) | Inflow (cfs) | Storage (cubic-feet) | Elevation (feet) | Primary (cfs) |
|---|---|---|---|---|
| 10.20 | 0.51 | 2,814 | 58.45 | 0.00 |
| 10.25 | 0.53 | 2,907 | 58.54 | 0.00 |
| 10.30 | 0.54 | 3,003 | 58.62 | 0.00 |
| 10.35 | 0.57 | 3,103 | 58.71 | 0.00 |
| 10.40 | 0.59 | 3,207 | 58.80 | 0.00 |
| 10.45 | 0.61 | 3,314 | 58.89 | 0.00 |
| 10.50 | 0.63 | 3,426 | 58.99 | 0.00 |
| 10.55 | 0.66 | 3,542 | 59.09 | 0.00 |
| 10.60 | 0.68 | 3,663 | 59.19 | 0.00 |
| 10.65 | 0.71 | 3,788 | 59.30 | 0.00 |
| 10.70 | 0.74 | 3,918 | 59.42 | 0.00 |
| 10.75 | 0.77 | 4,054 | 59.52 | 0.00 |
| 10.80 | 0.80 | 4,195 | 59.60 | 0.00 |
| 10.85 | 0.83 | 4,342 | 59.67 | 0.00 |
| 10.90 | 0.87 | 4,495 | 59.75 | 0.00 |
| 10.95 | 0.91 | 4,655 | 59.84 | 0.00 |
| 11.00 | 0.95 | 4,823 | 59.92 | 0.00 |
| 11.05 | 0.99 | 4,998 | 60.01 | 0.00 |
| 11.10 | 1.04 | 5,181 | 60.09 | 0.00 |
| 11.15 | 1.09 | 5,373 | 60.16 | 0.00 |
| 11.20 | 1.14 | 5,573 | 60.24 | 0.00 |
| 11.25 | 1.20 | 5,783 | 60.32 | 0.00 |
| 11.30 | 1.26 | 6,005 | 60.41 | 0.00 |
| 11.35 | 1.34 | 6,239 | 60.51 | 0.00 |
| 11.40 | 1.42 | 6,487 | 60.60 | 0.00 |
| 11.45 | 1.51 | 6,751 | 60.71 | 0.00 |
| 11.50 | 1.61 | 7,032 | 60.82 | 0.00 |
| 11.55 | 1.72 | 7,332 | 60.94 | 0.00 |
| 11.60 | 1.84 | 7,652 | 61.07 | 0.00 |
| 11.65 | 2.03 | 8,000 | 61.20 | 0.00 |
| 11.70 | 2.35 | 8,393 | 61.36 | 0.00 |
| 11.75 | 2.92 | 8,868 | 61.55 | 0.00 |
| 11.80 | 3.82 | 9,474 | 61.79 | 0.00 |
| 11.85 | 5.15 | 10,280 | 62.08 | 0.02 |
| 11.90 | 7.02 | 11,344 | 62.37 | 0.32 |
| 11.95 | 9.59 | 12,749 | 62.75 | 0.67 |
| 12.00 | 12.91 | 14,628 | 63.27 | 0.95 |
| 12.05 | 16.62 | 17,089 | 63.94 | 1.23 |
| 12.10 | 19.94 | 20,138 | 64.57 | 1.44 |
| 12.15 | 21.93 | 23,629 | 65.27 | 1.64 |
| 12.20 | **22.09** | 27,277 | 66.00 | 1.83 |
| 12.25 | 20.67 | 30,752 | 66.54 | 2.32 |
| 12.30 | 18.26 | 32,997 | 66.88 | 11.65 |
| 12.35 | 15.48 | **33,592** | **66.97** | **15.47** |
| 12.40 | 12.84 | 33,442 | 66.95 | 14.51 |
| 12.45 | 10.69 | 33,129 | 66.90 | 12.50 |
| 12.50 | 9.05 | 32,816 | 66.85 | 10.71 |
| 12.55 | 7.76 | 32,533 | 66.81 | 9.24 |
| 12.60 | 6.71 | 32,287 | 66.77 | 7.97 |
| 12.65 | 5.84 | 32,080 | 66.74 | 6.89 |
| 12.70 | 5.13 | 31,902 | 66.71 | 6.06 |
| 12.75 | 4.54 | 31,734 | 66.69 | 5.47 |

## Hydrograph for Pond BMP-3: sed basin 3 (continued)

| Time (hours) | Inflow (cfs) | Storage (cubic-feet) | Elevation (feet) | Primary (cfs) |
|---|---|---|---|---|
| 12.80 | 4.05 | 31,574 | 66.66 | 4.90 |
| 12.85 | 3.66 | 31,430 | 66.64 | 4.40 |
| 12.90 | 3.34 | 31,307 | 66.62 | 3.97 |
| 12.95 | 3.08 | 31,204 | 66.61 | 3.60 |
| 13.00 | 2.87 | 31,118 | 66.59 | 3.30 |
| 13.05 | 2.69 | 31,046 | 66.58 | 3.05 |
| 13.10 | 2.53 | 30,986 | 66.57 | 2.84 |
| 13.15 | 2.40 | 30,935 | 66.56 | 2.66 |
| 13.20 | 2.28 | 30,889 | 66.56 | 2.53 |
| 13.25 | 2.17 | 30,839 | 66.55 | 2.46 |
| 13.30 | 2.07 | 30,786 | 66.54 | 2.37 |
| 13.35 | 1.99 | 30,732 | 66.53 | 2.29 |
| 13.40 | 1.92 | 30,680 | 66.52 | 2.20 |
| 13.45 | 1.86 | 30,631 | 66.52 | 2.13 |
| 13.50 | 1.81 | 30,585 | 66.51 | 2.06 |
| 13.55 | 1.76 | 30,542 | 66.50 | 1.99 |
| 13.60 | 1.71 | 30,500 | 66.50 | 1.95 |
| 13.65 | 1.66 | 30,454 | 66.49 | 1.95 |
| 13.70 | 1.62 | 30,399 | 66.48 | 1.94 |
| 13.75 | 1.58 | 30,337 | 66.47 | 1.94 |
| 13.80 | 1.54 | 30,268 | 66.46 | 1.94 |
| 13.85 | 1.50 | 30,192 | 66.45 | 1.94 |
| 13.90 | 1.46 | 30,110 | 66.44 | 1.93 |
| 13.95 | 1.43 | 30,022 | 66.42 | 1.93 |
| 14.00 | 1.39 | 29,929 | 66.41 | 1.93 |
| 14.05 | 1.36 | 29,830 | 66.39 | 1.92 |
| 14.10 | 1.33 | 29,726 | 66.38 | 1.92 |
| 14.15 | 1.30 | 29,616 | 66.36 | 1.92 |
| 14.20 | 1.27 | 29,503 | 66.34 | 1.91 |
| 14.25 | 1.24 | 29,384 | 66.33 | 1.91 |
| 14.30 | 1.21 | 29,262 | 66.31 | 1.90 |
| 14.35 | 1.19 | 29,136 | 66.29 | 1.90 |
| 14.40 | 1.17 | 29,008 | 66.27 | 1.90 |
| 14.45 | 1.16 | 28,876 | 66.25 | 1.89 |
| 14.50 | 1.14 | 28,743 | 66.23 | 1.89 |
| 14.55 | 1.13 | 28,608 | 66.21 | 1.88 |
| 14.60 | 1.11 | 28,471 | 66.19 | 1.88 |
| 14.65 | 1.10 | 28,333 | 66.17 | 1.87 |
| 14.70 | 1.09 | 28,194 | 66.14 | 1.87 |
| 14.75 | 1.08 | 28,053 | 66.12 | 1.86 |
| 14.80 | 1.06 | 27,912 | 66.10 | 1.86 |
| 14.85 | 1.05 | 27,769 | 66.08 | 1.85 |
| 14.90 | 1.04 | 27,625 | 66.06 | 1.84 |
| 14.95 | 1.03 | 27,480 | 66.03 | 1.84 |
| 15.00 | 1.02 | 27,334 | 66.01 | 1.83 |
| 15.05 | 1.01 | 27,187 | 65.99 | 1.83 |
| 15.10 | 1.00 | 27,040 | 65.96 | 1.82 |
| 15.15 | 0.99 | 26,892 | 65.93 | 1.81 |
| 15.20 | 0.98 | 26,743 | 65.90 | 1.81 |
| 15.25 | 0.97 | 26,594 | 65.87 | 1.80 |
| 15.30 | 0.96 | 26,444 | 65.84 | 1.79 |
| 15.35 | 0.95 | 26,293 | 65.81 | 1.78 |

## Hydrograph for Pond BMP-3: sed basin 3 (continued)

| Time (hours) | Inflow (cfs) | Storage (cubic-feet) | Elevation (feet) | Primary (cfs) |
|---|---|---|---|---|
| 15.40 | 0.94 | 26,142 | 65.78 | 1.78 |
| 15.45 | 0.92 | 25,991 | 65.75 | 1.77 |
| 15.50 | 0.91 | 25,839 | 65.72 | 1.76 |
| 15.55 | 0.90 | 25,686 | 65.69 | 1.75 |
| 15.60 | 0.89 | 25,533 | 65.65 | 1.74 |
| 15.65 | 0.88 | 25,379 | 65.62 | 1.74 |
| 15.70 | 0.87 | 25,225 | 65.59 | 1.73 |
| 15.75 | 0.86 | 25,071 | 65.56 | 1.72 |
| 15.80 | 0.85 | 24,915 | 65.53 | 1.71 |
| 15.85 | 0.84 | 24,760 | 65.50 | 1.70 |
| 15.90 | 0.83 | 24,604 | 65.47 | 1.70 |
| 15.95 | 0.82 | 24,447 | 65.44 | 1.69 |
| 16.00 | 0.81 | 24,290 | 65.41 | 1.68 |
| 16.05 | 0.80 | 24,133 | 65.37 | 1.67 |
| 16.10 | 0.78 | 23,975 | 65.34 | 1.66 |
| 16.15 | 0.77 | 23,817 | 65.31 | 1.65 |
| 16.20 | 0.76 | 23,659 | 65.28 | 1.65 |
| 16.25 | 0.75 | 23,500 | 65.25 | 1.64 |
| 16.30 | 0.75 | 23,341 | 65.21 | 1.63 |
| 16.35 | 0.74 | 23,183 | 65.18 | 1.62 |
| 16.40 | 0.73 | 23,024 | 65.15 | 1.61 |
| 16.45 | 0.72 | 22,866 | 65.12 | 1.60 |
| 16.50 | 0.72 | 22,709 | 65.09 | 1.59 |
| 16.55 | 0.71 | 22,552 | 65.06 | 1.58 |
| 16.60 | 0.71 | 22,396 | 65.02 | 1.57 |
| 16.65 | 0.70 | 22,240 | 64.99 | 1.57 |
| 16.70 | 0.70 | 22,086 | 64.96 | 1.56 |
| 16.75 | 0.70 | 21,932 | 64.93 | 1.55 |
| 16.80 | 0.69 | 21,779 | 64.90 | 1.54 |
| 16.85 | 0.69 | 21,627 | 64.87 | 1.53 |
| 16.90 | 0.68 | 21,476 | 64.84 | 1.52 |
| 16.95 | 0.68 | 21,326 | 64.81 | 1.51 |
| 17.00 | 0.68 | 21,176 | 64.78 | 1.50 |
| 17.05 | 0.67 | 21,028 | 64.75 | 1.49 |
| 17.10 | 0.67 | 20,880 | 64.72 | 1.49 |
| 17.15 | 0.66 | 20,734 | 64.69 | 1.48 |
| 17.20 | 0.66 | 20,588 | 64.66 | 1.47 |
| 17.25 | 0.66 | 20,443 | 64.63 | 1.46 |
| 17.30 | 0.65 | 20,299 | 64.60 | 1.45 |
| 17.35 | 0.65 | 20,156 | 64.58 | 1.44 |
| 17.40 | 0.65 | 20,014 | 64.55 | 1.43 |
| 17.45 | 0.64 | 19,873 | 64.52 | 1.42 |
| 17.50 | 0.64 | 19,732 | 64.49 | 1.41 |
| 17.55 | 0.63 | 19,593 | 64.46 | 1.41 |
| 17.60 | 0.63 | 19,455 | 64.43 | 1.40 |
| 17.65 | 0.63 | 19,317 | 64.41 | 1.39 |
| 17.70 | 0.62 | 19,180 | 64.38 | 1.38 |
| 17.75 | 0.62 | 19,045 | 64.35 | 1.37 |
| 17.80 | 0.61 | 18,910 | 64.32 | 1.36 |
| 17.85 | 0.61 | 18,776 | 64.30 | 1.35 |
| 17.90 | 0.61 | 18,643 | 64.27 | 1.34 |
| 17.95 | 0.60 | 18,511 | 64.24 | 1.33 |

## Hydrograph for Pond BMP-3: sed basin 3 (continued)

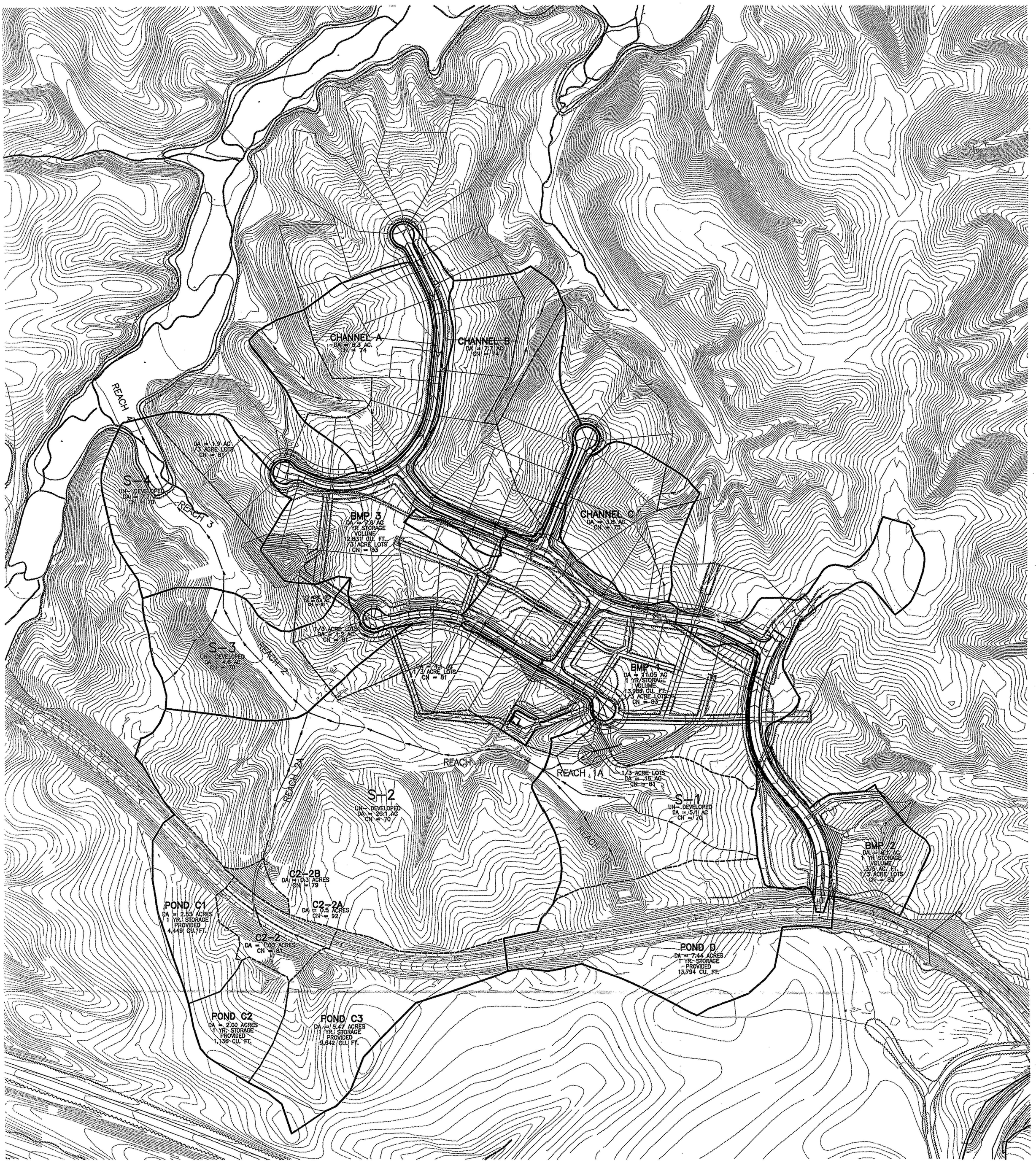
| Time (hours) | Inflow (cfs) | Storage (cubic-feet) | Elevation (feet) | Primary (cfs) |
|---|---|---|---|---|
| 18.00 | 0.60 | 18,379 | 64.22 | 1.33 |
| 18.05 | 0.60 | 18,249 | 64.19 | 1.32 |
| 18.10 | 0.59 | 18,119 | 64.17 | 1.31 |
| 18.15 | 0.59 | 17,991 | 64.14 | 1.30 |
| 18.20 | 0.58 | 17,863 | 64.11 | 1.29 |
| 18.25 | 0.58 | 17,736 | 64.09 | 1.28 |
| 18.30 | 0.58 | 17,611 | 64.06 | 1.27 |
| 18.35 | 0.57 | 17,486 | 64.04 | 1.26 |
| 18.40 | 0.57 | 17,362 | 64.01 | 1.26 |
| 18.45 | 0.56 | 17,238 | 63.99 | 1.25 |
| 18.50 | 0.56 | 17,117 | 63.95 | 1.23 |
| 18.55 | 0.56 | 16,996 | 63.92 | 1.22 |
| 18.60 | 0.55 | 16,878 | 63.89 | 1.21 |
| 18.65 | 0.55 | 16,760 | 63.85 | 1.20 |
| 18.70 | 0.55 | 16,644 | 63.82 | 1.19 |
| 18.75 | 0.54 | 16,530 | 63.79 | 1.17 |
| 18.80 | 0.54 | 16,417 | 63.76 | 1.16 |
| 18.85 | 0.53 | 16,305 | 63.73 | 1.15 |
| 18.90 | 0.53 | 16,195 | 63.70 | 1.14 |
| 18.95 | 0.53 | 16,086 | 63.67 | 1.13 |
| 19.00 | 0.52 | 15,979 | 63.64 | 1.11 |
| 19.05 | 0.52 | 15,873 | 63.61 | 1.10 |
| 19.10 | 0.51 | 15,769 | 63.58 | 1.09 |
| 19.15 | 0.51 | 15,666 | 63.55 | 1.08 |
| 19.20 | 0.51 | 15,564 | 63.53 | 1.07 |
| 19.25 | 0.50 | 15,464 | 63.50 | 1.06 |
| 19.30 | 0.50 | 15,365 | 63.47 | 1.04 |
| 19.35 | 0.49 | 15,267 | 63.44 | 1.03 |
| 19.40 | 0.49 | 15,171 | 63.42 | 1.02 |
| 19.45 | 0.49 | 15,076 | 63.39 | 1.01 |
| 19.50 | 0.48 | 14,983 | 63.37 | 1.00 |
| 19.55 | 0.48 | 14,890 | 63.34 | 0.99 |
| 19.60 | 0.48 | 14,800 | 63.32 | 0.98 |
| 19.65 | 0.47 | 14,710 | 63.29 | 0.96 |
| 19.70 | 0.47 | 14,622 | 63.27 | 0.95 |
| 19.75 | 0.46 | 14,535 | 63.24 | 0.94 |
| 19.80 | 0.46 | 14,450 | 63.22 | 0.93 |
| 19.85 | 0.46 | 14,366 | 63.20 | 0.92 |
| 19.90 | 0.45 | 14,283 | 63.17 | 0.91 |
| 19.95 | 0.45 | 14,201 | 63.15 | 0.90 |
| 20.00 | 0.44 | 14,121 | 63.13 | 0.89 |

## Stage-Area-Storage for Pond BMP-3: Basin 3

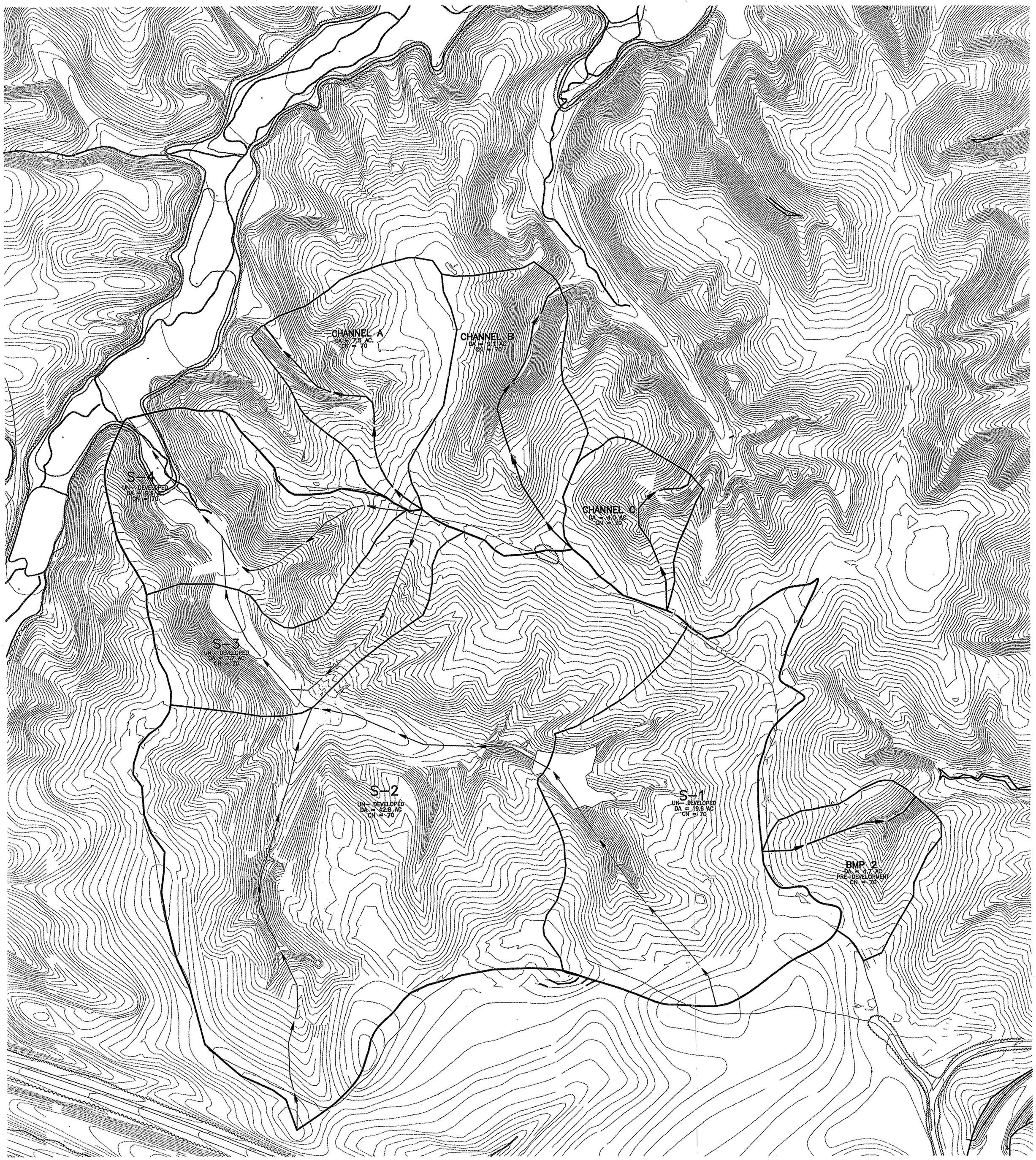
| Elevation (feet) | Surface (sq-ft) | Storage (cubic-feet) |
|---|---|---|
| 56.00 | 600 | 0 |
| 56.20 | 669 | 229 |
| 56.40 | 737 | 459 |
| 56.60 | 806 | 688 |
| 56.80 | 874 | 917 |
| 57.00 | 943 | 1,146 |
| 57.20 | 1,011 | 1,376 |
| 57.40 | 1,080 | 1,605 |
| 57.60 | 1,149 | 1,834 |
| 57.80 | 1,217 | 2,064 |
| 58.00 | 1,286 | 2,293 |
| 58.20 | 1,354 | 2,522 |
| 58.40 | 1,423 | 2,751 |
| 58.60 | 1,491 | 2,981 |
| 58.80 | 1,560 | 3,210 |
| 59.00 | 1,629 | 3,439 |
| 59.20 | 1,697 | 3,669 |
| 59.40 | 1,766 | 3,898 |
| 59.60 | 1,844 | 4,203 |
| 59.80 | 1,932 | 4,585 |
| c/s 60.00 | 2,020 | 4,967 |
| 60.20 | 2,123 | 5,470 |
| 60.40 | 2,226 | 5,974 |
| 60.60 | 2,329 | 6,477 |
| 60.80 | 2,432 | 6,981 |
| 61.00 | 2,535 | 7,484 |
| 61.20 | 2,638 | 7,988 |
| 61.40 | 2,741 | 8,491 |
| 61.60 | 2,844 | 8,995 |
| 61.80 | 2,947 | 9,498 |
| WET 62.00 | 3,050 | 10,002 |
| 62.20 | 3,173 | 10,731 |
| 62.40 | 3,295 | 11,460 |
| 62.60 | 3,418 | 12,189 |
| 62.80 | 3,540 | 12,918 |
| 63.00 | 3,663 | 13,647 |
| 63.20 | 3,785 | 14,376 |
| 63.40 | 3,907 | 15,105 |
| 63.60 | 4,030 | 15,834 |
| 63.80 | 4,152 | 16,563 |
| 64.00 | 4,275 | 17,292 |
| 64.20 | 4,420 | 18,288 |
| 64.40 | 4,564 | 19,284 |
| DRY 64.60 | 4,708 | 20,280 |
| 64.80 | 4,853 | 21,276 |
| 65.00 | 4,998 | 22,272 |
| 65.20 | 5,142 | 23,268 |
| 65.40 | 5,287 | 24,264 |
| 65.60 | 5,431 | 25,260 |
| 65.80 | 5,575 | 26,256 |
| 66.00 | 5,720 | 27,252 |
| 66.20 | 5,886 | 28,558 |
| 66.40 | 6,051 | 29,864 |
| 66.60 | 6,216 | 31,170 |
| 66.80 | 6,382 | 32,476 |
| 67.00 | 6,548 | 33,782 |
| 67.20 | 6,713 | 35,088 |
| 67.40 | 6,879 | 36,394 |
| 67.60 | 7,044 | 37,700 |
| 67.80 | 7,209 | 39,006 |
| 68.00 | 7,375 | 40,312 |
| 68.20 | 7,568 | 41,976 |
| 68.40 | 7,760 | 43,640 |
| 68.60 | 7,952 | 45,304 |
| 68.80 | 8,145 | 46,967 |
| 69.00 | 8,338 | 48,631 |
| 69.20 | 8,530 | 50,295 |
| 69.40 | 8,723 | 51,959 |
| 69.60 | 8,915 | 53,623 |
| 69.80 | 9,107 | 55,286 |
| 70.00 | 9,300 | 56,950 |
| 70.20 | 9,518 | 59,024 |
| 70.40 | 9,736 | 61,098 |
| 70.60 | 9,954 | 63,173 |
| 70.80 | 10,172 | 65,247 |
| 71.00 | 10,390 | 67,321 |
| 71.20 | 10,608 | 69,395 |
| 71.40 | 10,826 | 71,469 |
| 71.60 | 11,044 | 73,544 |
| 71.80 | 11,262 | 75,618 |
| 72.00 | **11,480** | **77,692** |

## Stage-Area-Storage for Pond 1P: (new Pond)

| Elevation (feet) | Surface (sq-ft) | Storage (cubic-feet) | Elevation (feet) | Surface (sq-ft) | Storage (cubic-feet) | |
|---|---|---|---|---|---|---|
| 60.00 | 790 | 0 | 62.60 | 1,540 | 3,110 | |
| 60.05 | 803 | 52 | 62.65 | 1,560 | 3,195 | WET. |
| 60.10 | 816 | 105 | 62.70 | 1,580 | 3,280 | |
| 60.15 | 828 | 157 | 62.75 | 1,600 | 3,365 | |
| 60.20 | 841 | 209 | 62.80 | 1,620 | 3,450 | |
| 60.25 | 854 | 261 | 62.85 | 1,640 | 3,535 | |
| 60.30 | 866 | 313 | 62.90 | 1,660 | 3,620 | |
| 60.35 | 879 | 366 | 62.95 | 1,680 | 3,705 | |
| 60.40 | 892 | 418 | 63.00 | 1,700 | 3,790 | |
| 60.45 | 905 | 470 | 63.05 | 1,720 | 3,875 | |
| 60.50 | 918 | 523 | 63.10 | 1,740 | 3,960 | |
| 60.55 | 930 | 575 | 63.15 | 1,760 | 4,045 | |
| 60.60 | 943 | 627 | 63.20 | 1,780 | 4,130 | |
| 60.65 | 956 | 679 | 63.25 | 1,800 | 4,215 | |
| 60.70 | 969 | 732 | 63.30 | 1,820 | 4,300 | |
| 60.75 | 981 | 784 | 63.35 | 1,840 | 4,385 | |
| 60.80 | 994 | 836 | 63.40 | 1,860 | 4,470 | |
| 60.85 | 1,007 | 888 | 63.45 | 1,880 | 4,555 | |
| 60.90 | 1,019 | 940 | 63.50 | 1,900 | 4,640 | |
| 60.95 | 1,032 | 993 | 63.55 | 1,920 | 4,725 | |
| 61.00 | 1,045 | 1,045 | 63.60 | 1,940 | 4,810 | |
| 61.05 | 1,058 | 1,097 | 63.65 | 1,960 | 4,895 | |
| 61.10 | 1,071 | 1,150 | 63.70 | 1,980 | 4,980 | |
| 61.15 | 1,083 | 1,202 | 63.75 | 2,000 | 5,065 | |
| 61.20 | 1,096 | 1,254 | 63.80 | 2,020 | 5,150 | |
| 61.25 | 1,109 | 1,306 | 63.85 | 2,040 | 5,235 | |
| 61.30 | 1,121 | 1,358 | 63.90 | 2,060 | 5,320 | |
| 61.35 | 1,134 | 1,411 | 63.95 | 2,080 | 5,405 | |
| 61.40 | 1,147 | 1,463 | 64.00 | 2,100 | 5,490 | |
| 61.45 | 1,160 | 1,515 | 64.05 | 2,115 | 5,602 | |
| 61.50 | 1,173 | 1,568 | 64.10 | 2,130 | 5,715 | |
| 61.6 61.55 | 1,185 | 1,620 | 64.15 | 2,145 | 5,828 | |
| 61.60 | 1,198 | 1,672 | 64.20 | 2,160 | 5,940 | |
| 61.65 | 1,211 | 1,724 | 64.25 | 2,175 | 6,053 | |
| 61.70 | 1,224 | 1,777 | 64.30 | 2,190 | 6,165 | |
| 61.75 | 1,236 | 1,829 | 64.35 | 2,205 | 6,277 | |
| 61.80 | 1,249 | 1,881 | 64.40 | 2,220 | 6,390 | |
| 61.85 | 1,262 | 1,933 | 64.45 | 2,235 | 6,503 | |
| 61.90 | 1,274 | 1,985 | 64.50 | 2,250 | 6,615 | |
| 61.95 | 1,287 | 2,038 | 64.55 | 2,265 | 6,727 | |
| 62.00 | 1,300 | 2,090 | 64.60 | 2,280 | 6,840 | |
| 62.05 | 1,320 | 2,175 | 64.65 | 2,295 | 6,953 | |
| 62.10 | 1,340 | 2,260 | 64.70 | 2,310 | 7,065 | |
| 62.15 | 1,360 | 2,345 | 64.75 | 2,325 | 7,178 | |
| 62.20 | 1,380 | 2,430 | 64.80 | 2,340 | 7,290 | |
| 62.25 | 1,400 | 2,515 | 64.85 | 2,355 | 7,402 | |
| 62.30 | 1,420 | 2,600 | 64.90 | 2,370 | 7,515 | |
| 62.35 | 1,440 | 2,685 | 64.95 | 2,385 | 7,628 | |
| 62.40 | 1,460 | 2,770 | 65.00 | **2,400** | **7,740** | DRY. |
| 62.45 | 1,480 | 2,855 | | | | |
| 62.50 | 1,500 | 2,940 | | | | |
| 62.55 | 1,520 | 3,025 | | | | |




*DRAINAGE AREAS FOR*
*POST-DEVELOPMENT FLOW CALCULATIONS*




*EXISTING CONDITIONS*
*DRAINAGE AREAS FOR*
*PRE-DEVELOPMENT FLOW CALCULATIONS*

**STONEHOUSE GLEN**
**PHASE I**
**STONEHOUSE AT WILLIAMSBURG L.L.C.**
**DRAINAGE AREA EXHIBIT**

SCALE: 1" = 200'  DATE: 10/29/04

4

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**STORMWATER MANAGEMENT NARRATIVE**
**STONEHOUSE GLEN SECTION I**

Stonehouse Glen Section I is proposed as an 85.47-acre single-family subdivision that will be developed into 76 home sites and two recreational park sites.

Of the 85.47 acres, 6.5 acres will be contained within the road right of ways, 1.9 acres will be developed into 2 recreational parks. The 76 lots will contain 44.7 acres, open spaces provided will consist of approximately 30 acres and a residual area of 2.5 acres will contain the pump station and 3 BMP sites. Lot areas will typically be 0.3 acre in size with some lots exceeding one acre on the cul-de-sacs and on lots with unique landforms and parcel lines.

Stonehouse Glen lies within the Richardson Mill Pond watershed, which provides water quanity as well as water quality protection under the Chesapeake Bay Preservation Ordinance. As this development drains to several different ravine systems, we are proposing to manage the storm water run-off as follows:

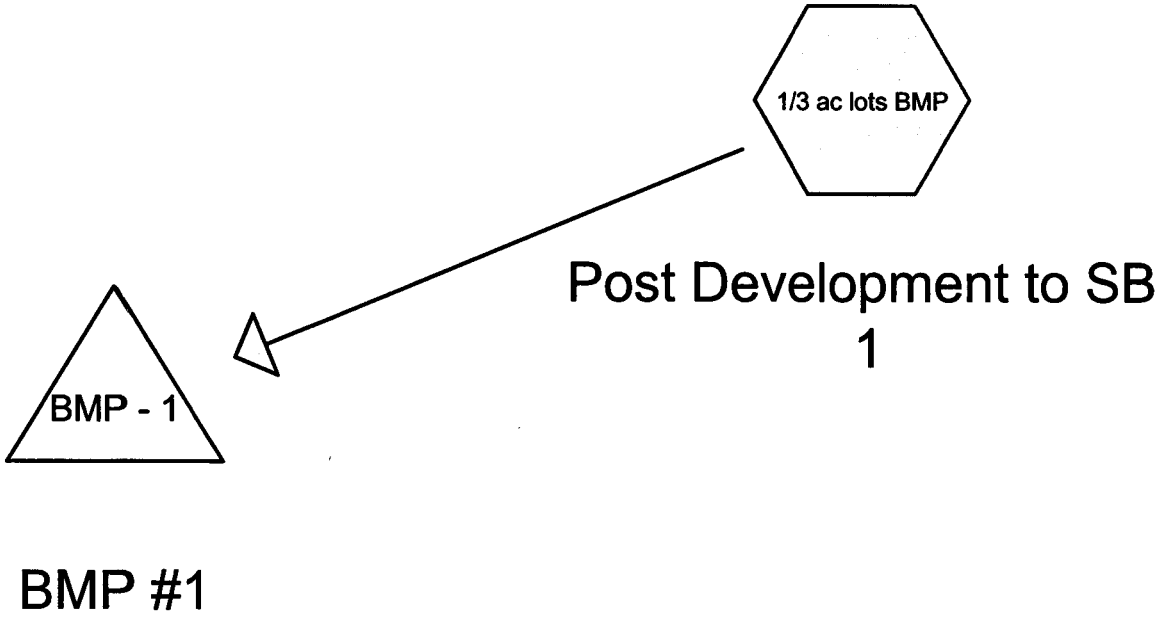
1. provide storm water management to maintain approximately the same 2-year post-development peak flows as the 2-year pre-development peak flows. This will be accomplished using three extended detention BMPs to provide attenuation of the 1-year storm, and stream channel protection.
2. intercept runoff from all proposed road construction impervious.

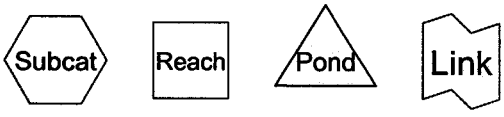
BMP 1 and BMP 3 will intercept runoff from approximately 5 acres of roadway drainage and 13.6 acres of lot drainage. This runoff will be released into the major ravine between Fiedstone Parkway and Stonehouse Glen, which flows into Bird Swamp and eventually Richardson Mill Pond. Calculations and drainage maps showing the Fieldstone Parkway development in relation to the Stonehouse Glen project have been provided to show pre- and post development runoff associated with the major ravine leading to Bird Swamp.

BMP 2 will intercept runoff from approximately 1.5 acres of roadway drainage, and 4.6 acres of lot drainage. This runoff will be released into a smaller ravine, which eventually intersects with Bird Swamp downstream of the other outfalls.

The remaining drainage from Stonehouse Glen Phase I will continue to flow in its pre-developed state. Ravines that have the potential to receive concentrated runoff from future lot development have been analyzed for channel adequacy. Calculations have been provided to show MS-19 compliance for all existing receiving channels deemed necessary by James City County.

As a final stage of the construction of the site's storm water management system, as described above, all existing drainage swales/outfalls will be visually inspected for erosion problems and/or blockage and repairs will be completed as required.




**Drainage Diagram for bmp 1 temp sed basin Revised**
Prepared by Landmark Design Group 05/10/2005
HydroCAD® 7.00 s/n 001765 © 1986-2003 Applied Microcomputer Systems

## Subcatchment 1/3 ac lots BMP: Post Development to SB 1

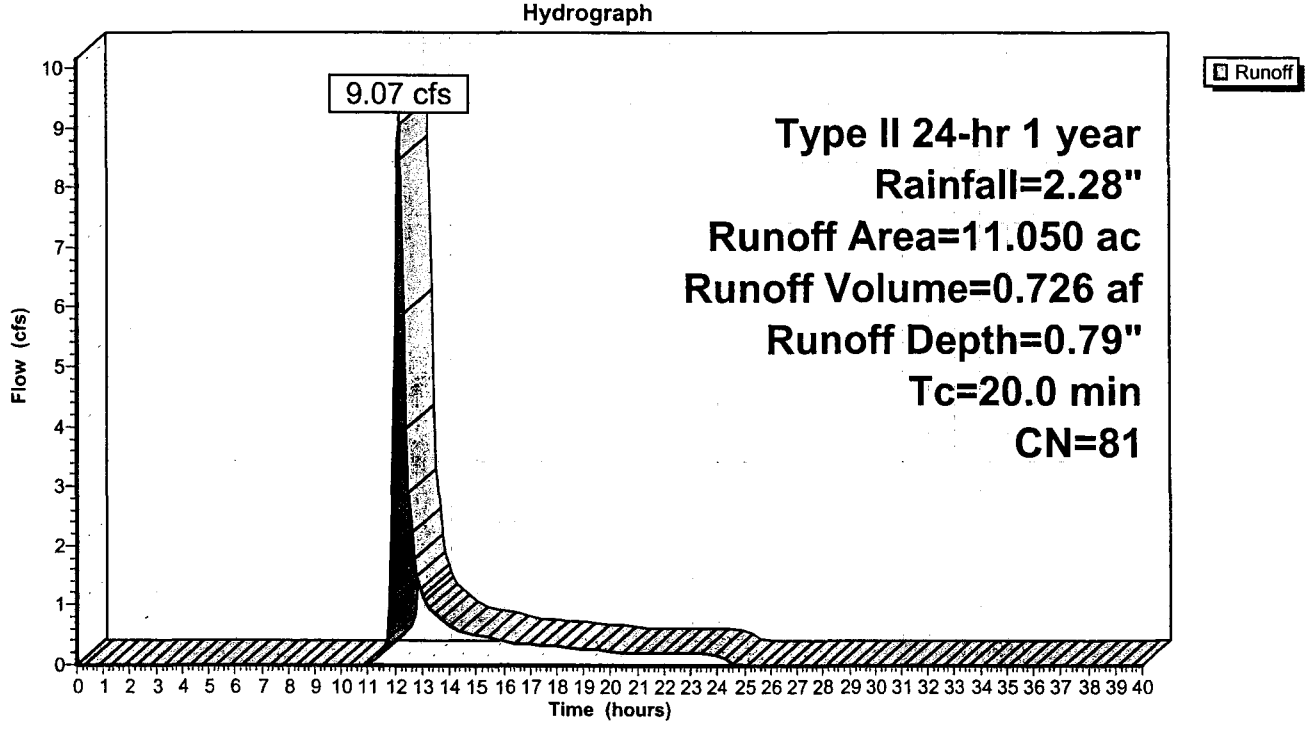
Runoff = 9.07 cfs @ 12.14 hrs, Volume= 0.726 af, Depth= 0.79"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-40.00 hrs, dt= 0.10 hrs
Type II 24-hr 1 year Rainfall=2.28"

| Area (ac) | CN | Description |
|---|---|---|
| 11.050 | 81 | 1/3 acre lots, 30% imp, HSG C |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 20.0 | | | | | **Direct Entry,** |

## Subcatchment 1/3 ac lots BMP: Post Development to SB 1



## Pond BMP - 1: BMP #1

| | | | | | |
|---|---|---|---|---|---|
| Inflow Area = | 11.050 ac, | Inflow Depth = | 0.79" | for | 1 year event |
| Inflow = | 9.07 cfs @ | 12.14 hrs, | Volume= | 0.726 af | |
| Outflow = | 0.52 cfs @ | 14.87 hrs, | Volume= | 0.726 af, | Atten= 94%, Lag= 164.0 min |
| Primary = | 0.52 cfs @ | 14.87 hrs, | Volume= | 0.726 af | |

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.10 hrs
Peak Elev= 77.54' @ 14.87 hrs Surf.Area= 5,488 sf Storage= 16,724 cf
Plug-Flow detention time= 387.9 min calculated for 0.724 af (100% of inflow)
Center-of-Mass det. time= 388.7 min ( 1,256.4 - 867.7 )

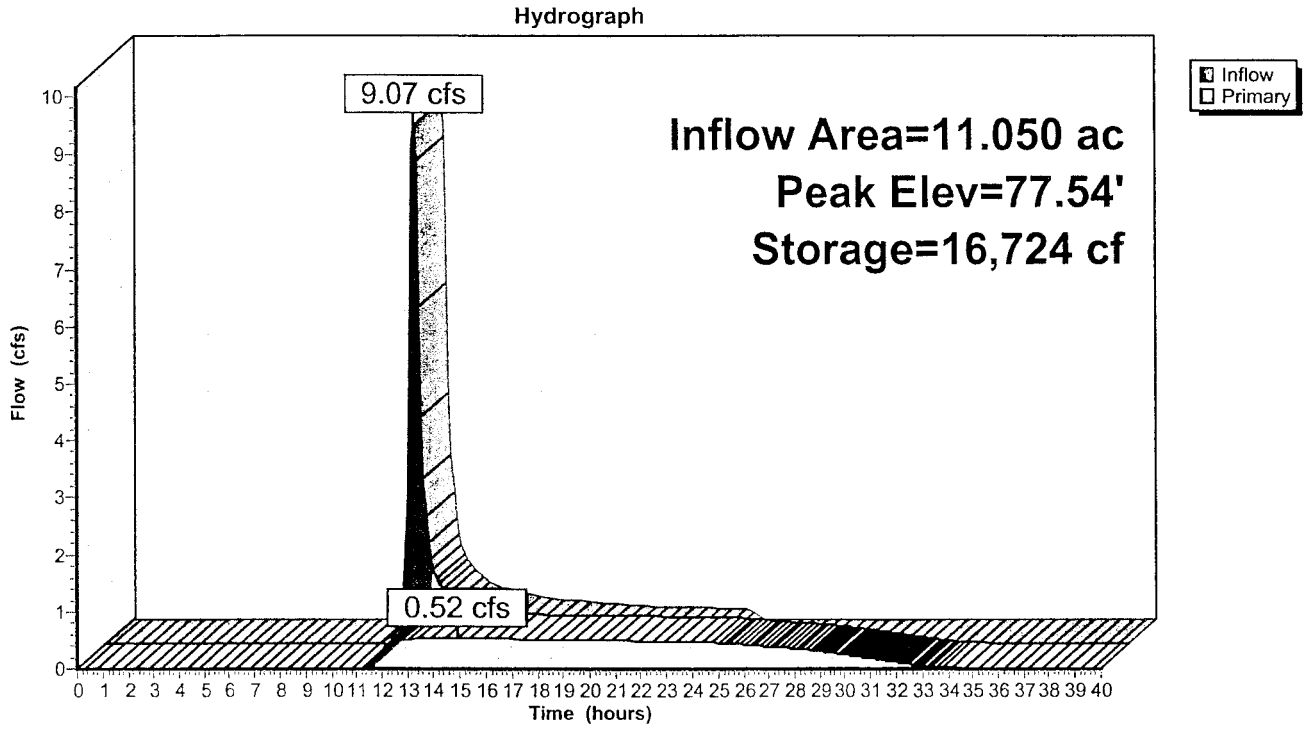
| # | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| 1 | 72.00' | 67,503 cf | **Custom Stage Data (Prismatic)** Listed below |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 72.00 | 978 | 0 | 0 |
| 74.00 | 2,170 | 3,148 | 3,148 |
| 76.00 | 3,836 | 6,006 | 9,154 |
| 78.00 | 5,977 | 9,813 | 18,967 |
| 80.00 | 8,661 | 14,638 | 33,605 |
| 82.00 | 11,732 | 20,393 | 53,998 |
| 83.00 | 15,277 | 13,505 | 67,503 |

| # | Routing | Invert | Outlet Devices |
|---|---|---|---|
| 1 | Primary | 67.84' | **30.0" x 84.0' long Culvert** RCP, end-section conforming to fill, Ke= 0.500<br>Outlet Invert= 67.00' S= 0.0100 '/' n= 0.013 Cc= 0.900 |
| 2 | Device 1 | 72.00' | **3.0" x 16.0' long Culvert** RCP, square edge headwall, Ke= 0.500<br>Outlet Invert= 70.00' S= 0.1250 '/' n= 0.012 Cc= 0.900 |
| 3 | Device 1 | 80.64' | **60.0" Horiz. Orifice** Limited to weir flow C= 0.600 |

**Primary OutFlow** Max=0.52 cfs @ 14.87 hrs HW=77.54' (Free Discharge)
└─**1=Culvert** (Passes 0.52 cfs of 68.72 cfs potential flow)
  ├─**2=Culvert** (Barrel Controls 0.52 cfs @ 10.6 fps)
  └─**3=Orifice** ( Controls 0.00 cfs)

## Pond BMP - 1: BMP #1



## Subcatchment 1/3 ac lots BMP: Post Development to SB 1

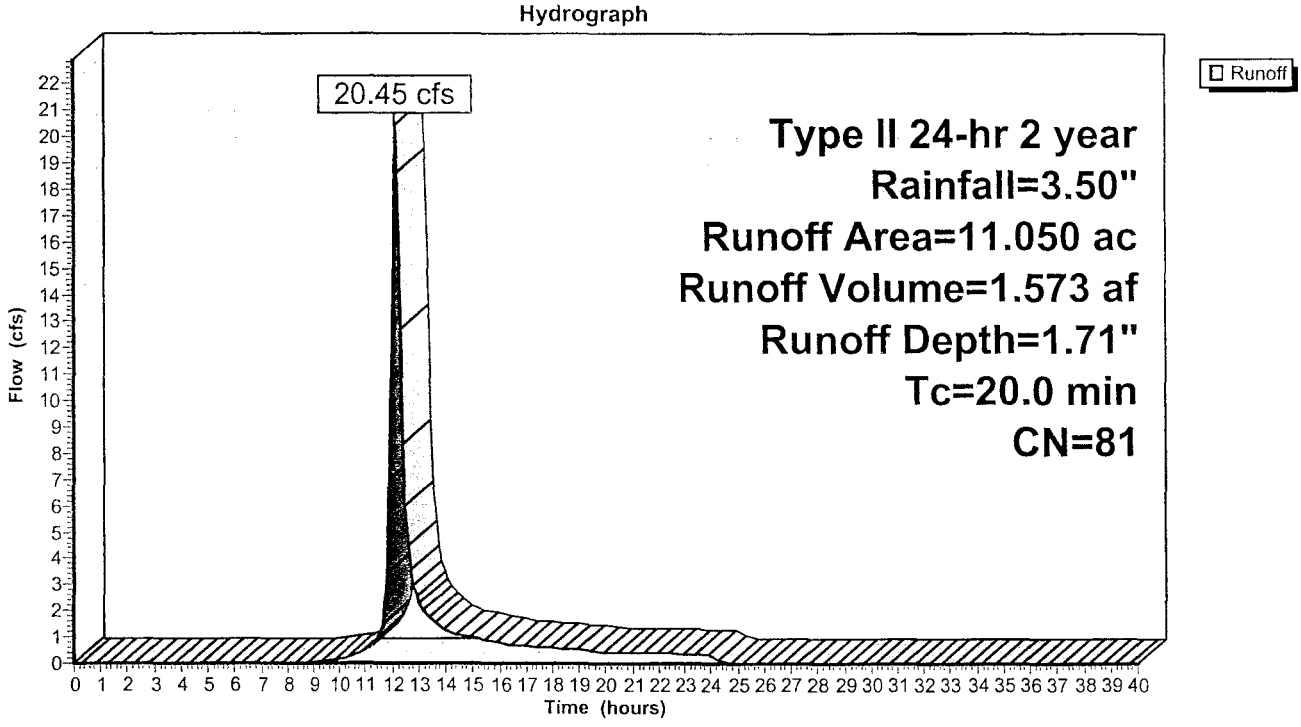
Runoff = 20.45 cfs @ 12.13 hrs, Volume= 1.573 af, Depth= 1.71"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-40.00 hrs, dt= 0.10 hrs
Type II 24-hr 2 year Rainfall=3.50"

| Area (ac) | CN | Description |
|---|---|---|
| 11.050 | 81 | 1/3 acre lots, 30% imp, HSG C |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 20.0 | | | | | **Direct Entry,** |

## Subcatchment 1/3 ac lots BMP: Post Development to SB 1



## Pond BMP - 1: BMP #1

| | | | | | |
|---|---|---|---|---|---|
| Inflow Area = | 11.050 ac, | Inflow Depth = | 1.71" | for | 2 year event |
| Inflow = | 20.45 cfs @ | 12.13 hrs, | Volume= | 1.573 af | |
| Outflow = | 1.36 cfs @ | 13.87 hrs, | Volume= | 1.439 af, | Atten= 93%, Lag= 104.3 min |
| Primary = | 1.36 cfs @ | 13.87 hrs, | Volume= | 1.439 af | |

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.10 hrs
Peak Elev= 80.70' @ 13.87 hrs Surf.Area= 9,731 sf Storage= 40,707 cf
Plug-Flow detention time= 652.1 min calculated for 1.435 af (91% of inflow)
Center-of-Mass det. time= 608.5 min ( 1,453.4 - 844.9 )

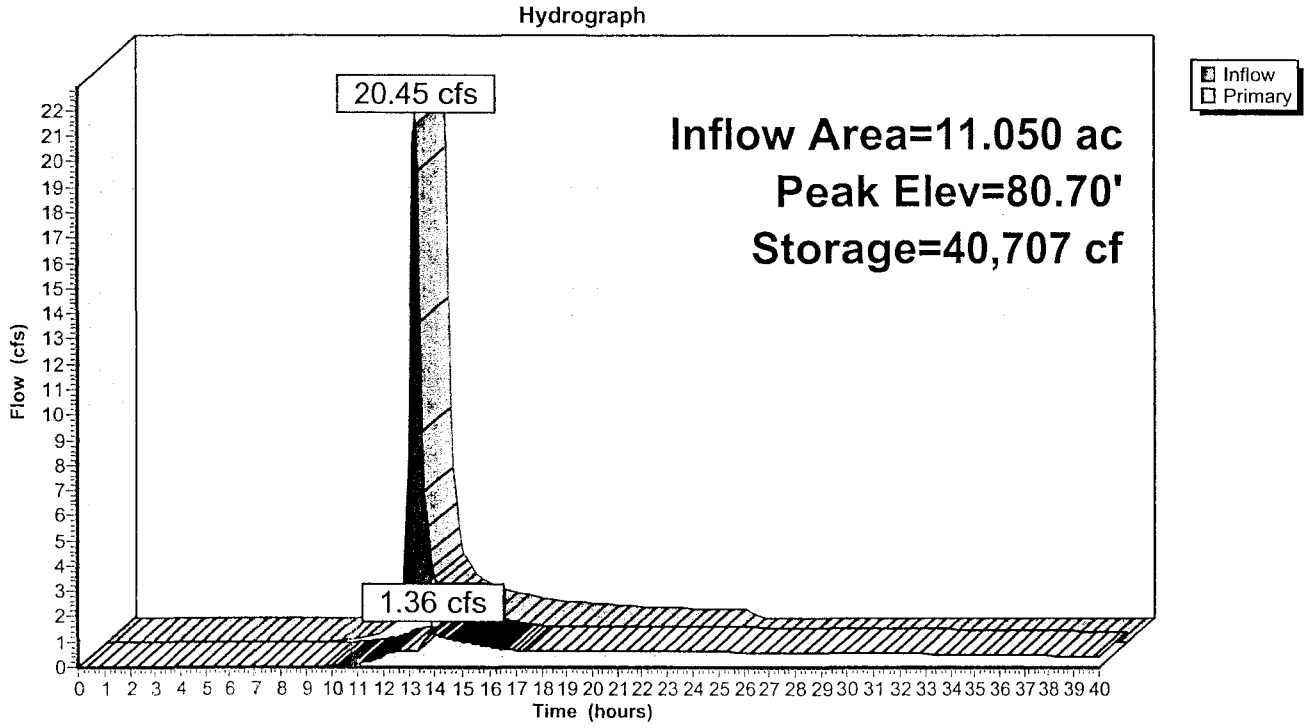
| # | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| 1 | 72.00' | 67,503 cf | **Custom Stage Data (Prismatic)** Listed below |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 72.00 | 978 | 0 | 0 |
| 74.00 | 2,170 | 3,148 | 3,148 |
| 76.00 | 3,836 | 6,006 | 9,154 |
| 78.00 | 5,977 | 9,813 | 18,967 |
| 80.00 | 8,661 | 14,638 | 33,605 |
| 82.00 | 11,732 | 20,393 | 53,998 |
| 83.00 | 15,277 | 13,505 | 67,503 |

| # | Routing | Invert | Outlet Devices |
|---|---|---|---|
| 1 | Primary | 67.84' | **30.0" x 84.0' long Culvert** RCP, end-section conforming to fill, Ke= 0.500<br>Outlet Invert= 67.00' S= 0.0100 '/' n= 0.013 Cc= 0.900 |
| 2 | Device 1 | 72.00' | **3.0" x 16.0' long Culvert** RCP, square edge headwall, Ke= 0.500<br>Outlet Invert= 70.00' S= 0.1250 '/' n= 0.012 Cc= 0.900 |
| 3 | Device 1 | 80.64' | **60.0" Horiz. Orifice** Limited to weir flow C= 0.600 |

**Primary OutFlow** Max=1.31 cfs @ 13.87 hrs HW=80.70' (Free Discharge)
└**1=Culvert** (Passes 1.31 cfs of 80.52 cfs potential flow)
  ├**2=Culvert** (Barrel Controls 0.62 cfs @ 12.6 fps)
  └**3=Orifice** (Weir Controls 0.69 cfs @ 0.8 fps)

## Pond BMP - 1: BMP #1



## Subcatchment 1/3 ac lots BMP: Post Development to SB 1

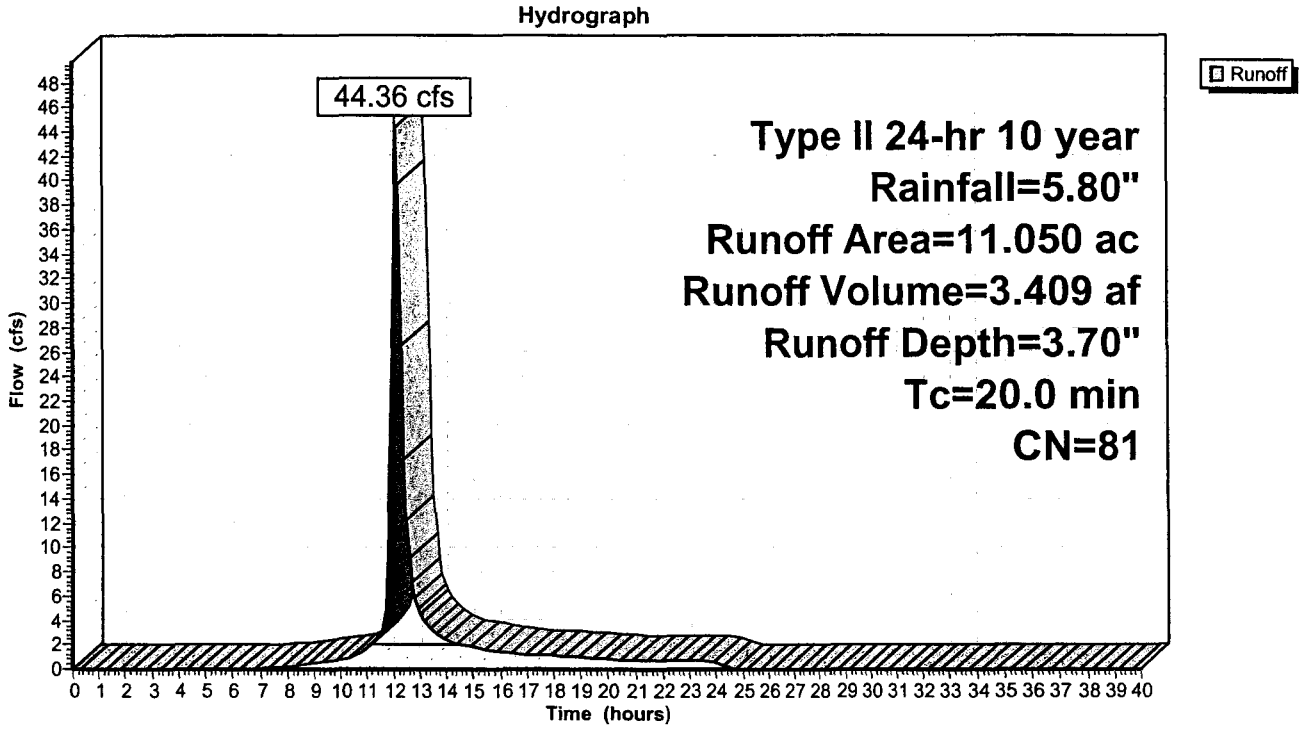
Runoff = 44.36 cfs @ 12.12 hrs, Volume= 3.409 af, Depth= 3.70"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-40.00 hrs, dt= 0.10 hrs
Type II 24-hr 10 year Rainfall=5.80"

| Area (ac) | CN | Description |
|---|---|---|
| 11.050 | 81 | 1/3 acre lots, 30% imp, HSG C |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 20.0 | | | | | **Direct Entry,** |

## Subcatchment 1/3 ac lots BMP: Post Development to SB 1



## Pond BMP - 1: BMP #1

| | | | | | |
|---|---|---|---|---|---|
| Inflow Area = | 11.050 ac, | Inflow Depth = | 3.70" | for | 10 year event |
| Inflow = | 44.36 cfs @ | 12.12 hrs, | Volume= | 3.409 af | |
| Outflow = | 39.52 cfs @ | 12.24 hrs, | Volume= | 3.202 af, | Atten= 11%, Lag= 7.0 min |
| Primary = | 39.52 cfs @ | 12.24 hrs, | Volume= | 3.202 af | |

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.10 hrs
Peak Elev= 81.51' @ 12.24 hrs Surf.Area= 10,975 sf Storage= 48,972 cf
Plug-Flow detention time= 316.2 min calculated for 3.202 af (94% of inflow)
Center-of-Mass det. time= 282.3 min ( 1,105.1 - 822.8 )

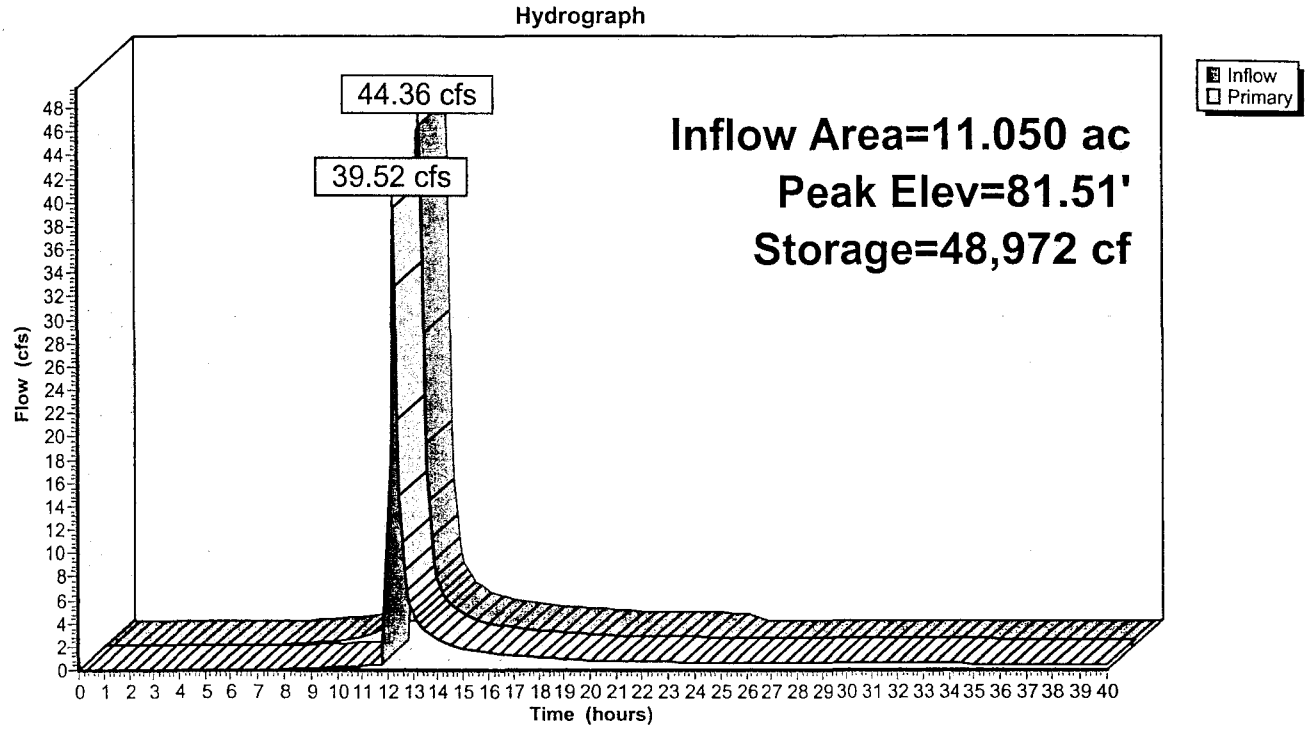
| # | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| 1 | 72.00' | 67,503 cf | **Custom Stage Data (Prismatic)** Listed below |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 72.00 | 978 | 0 | 0 |
| 74.00 | 2,170 | 3,148 | 3,148 |
| 76.00 | 3,836 | 6,006 | 9,154 |
| 78.00 | 5,977 | 9,813 | 18,967 |
| 80.00 | 8,661 | 14,638 | 33,605 |
| 82.00 | 11,732 | 20,393 | 53,998 |
| 83.00 | 15,277 | 13,505 | 67,503 |

| # | Routing | Invert | Outlet Devices |
|---|---|---|---|
| 1 | Primary | 67.84' | **30.0" x 84.0' long Culvert** RCP, end-section conforming to fill, Ke= 0.500<br>Outlet Invert= 67.00' S= 0.0100 '/' n= 0.013 Cc= 0.900 |
| 2 | Device 1 | 72.00' | **3.0" x 16.0' long Culvert** RCP, square edge headwall, Ke= 0.500<br>Outlet Invert= 70.00' S= 0.1250 '/' n= 0.012 Cc= 0.900 |
| 3 | Device 1 | 80.64' | **60.0" Horiz. Orifice** Limited to weir flow C= 0.600 |

**Primary OutFlow** Max=34.73 cfs @ 12.24 hrs HW=81.40' (Free Discharge)
└**1=Culvert** (Passes 34.73 cfs of 82.93 cfs potential flow)
  ├**2=Culvert** (Barrel Controls 0.64 cfs @ 13.1 fps)
  └**3=Orifice** (Weir Controls 34.09 cfs @ 2.9 fps)

## Pond BMP - 1: BMP #1



## Subcatchment 1/3 ac lots BMP: Post Development to SB 1

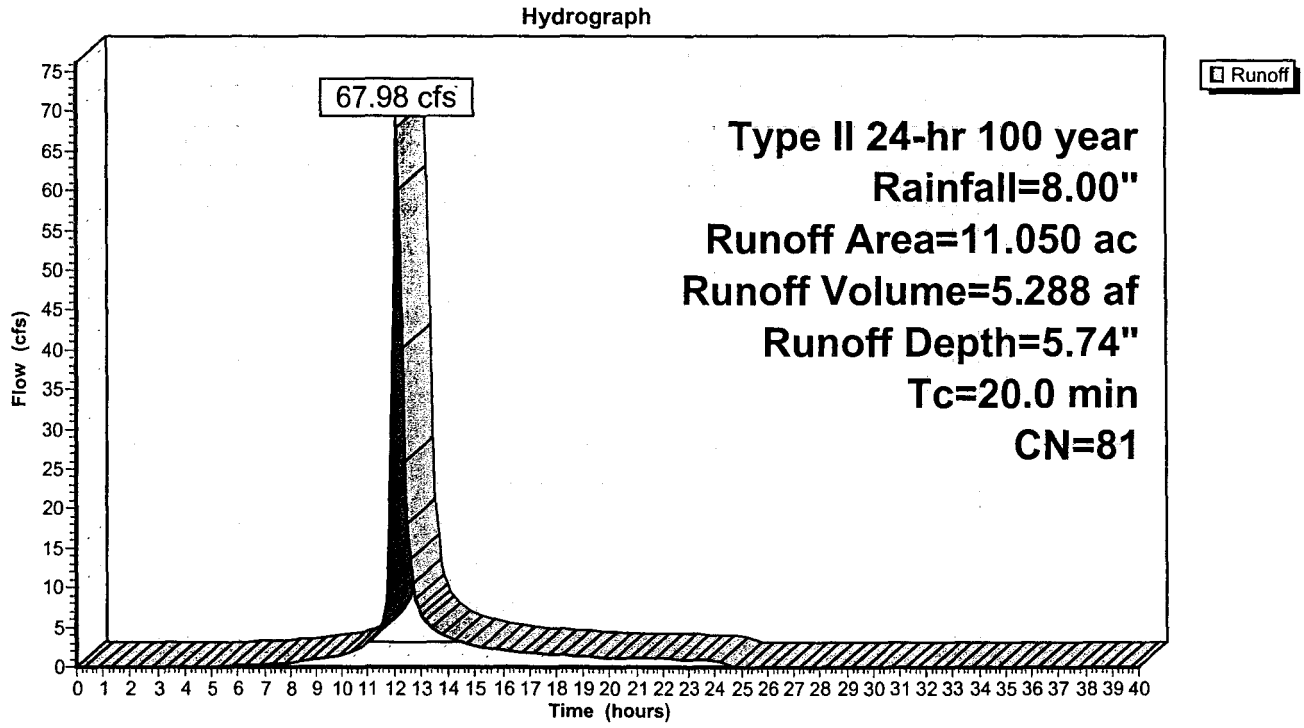
Runoff = 67.98 cfs @ 12.12 hrs, Volume= 5.288 af, Depth= 5.74"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-40.00 hrs, dt= 0.10 hrs
Type II 24-hr 100 year Rainfall=8.00"

| Area (ac) | CN | Description |
|---|---|---|
| 11.050 | 81 | 1/3 acre lots, 30% imp, HSG C |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 20.0 | | | | | **Direct Entry,** |

## Subcatchment 1/3 ac lots BMP: Post Development to SB 1



## Pond BMP - 1: BMP #1

| | | | | | |
|---|---|---|---|---|---|
| Inflow Area = | 11.050 ac, | Inflow Depth = | 5.74" | for | 100 year event |
| Inflow = | 67.98 cfs @ | 12.12 hrs, | Volume= | | 5.288 af |
| Outflow = | 65.51 cfs @ | 12.16 hrs, | Volume= | | 5.076 af, Atten= 4%, Lag= 2.3 min |
| Primary = | 65.51 cfs @ | 12.16 hrs, | Volume= | | 5.076 af |

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.10 hrs
Peak Elev= 81.81' @ 12.16 hrs Surf.Area= 11,439 sf Storage= 52,054 cf
Plug-Flow detention time= 208.9 min calculated for 5.076 af (96% of inflow)
Center-of-Mass det. time= 185.2 min ( 995.6 - 810.4 )

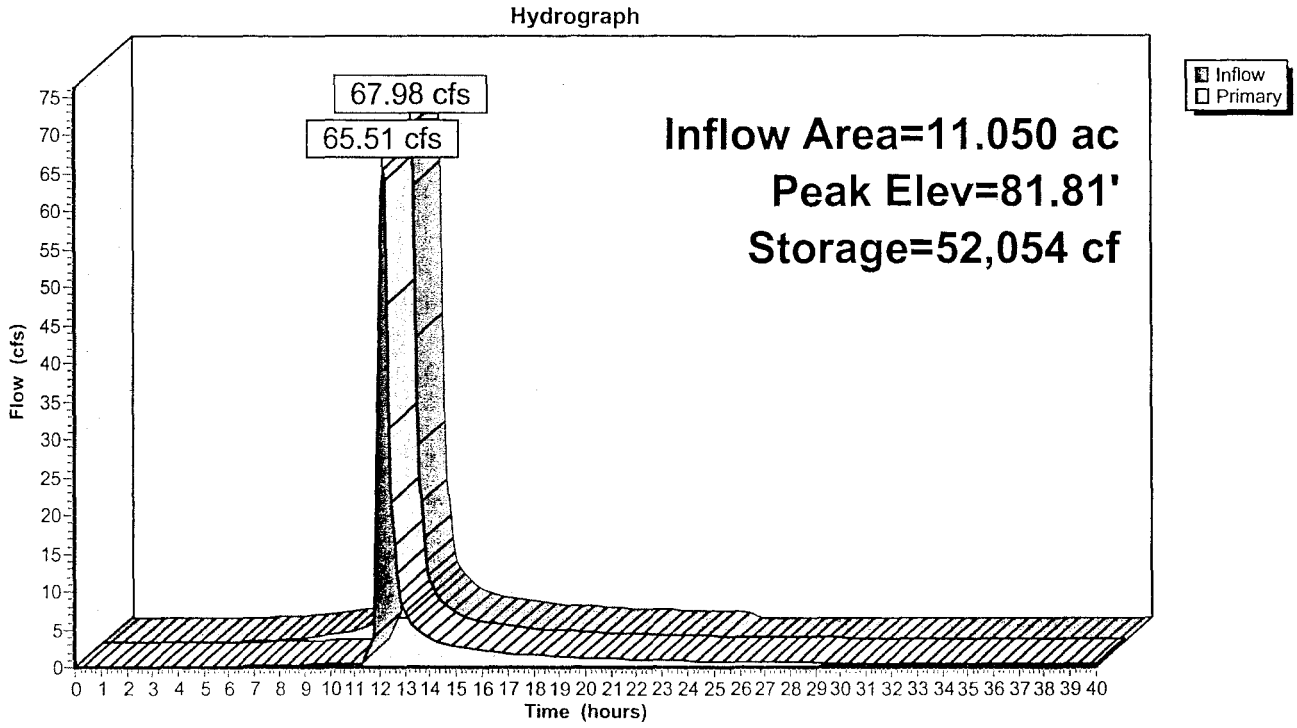
| # | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| 1 | 72.00' | 67,503 cf | **Custom Stage Data (Prismatic)** Listed below |

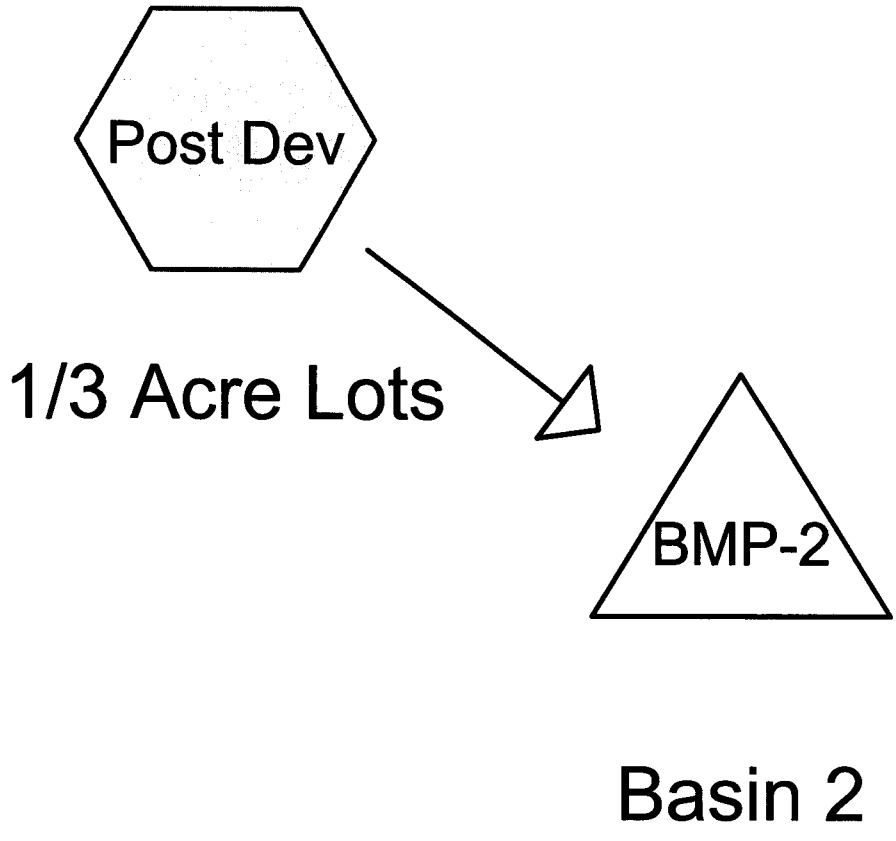
| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 72.00 | 978 | 0 | 0 |
| 74.00 | 2,170 | 3,148 | 3,148 |
| 76.00 | 3,836 | 6,006 | 9,154 |
| 78.00 | 5,977 | 9,813 | 18,967 |
| 80.00 | 8,661 | 14,638 | 33,605 |
| 82.00 | 11,732 | 20,393 | 53,998 |
| 83.00 | 15,277 | 13,505 | 67,503 |

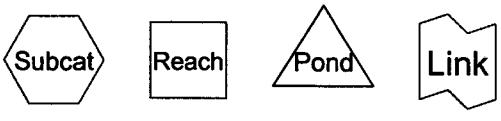
| # | Routing | Invert | Outlet Devices |
|---|---|---|---|
| 1 | Primary | 67.84' | **30.0" x 84.0' long Culvert** RCP, end-section conforming to fill, Ke= 0.500<br>Outlet Invert= 67.00' S= 0.0100 '/' n= 0.013 Cc= 0.900 |
| 2 | Device 1 | 72.00' | **3.0" x 16.0' long Culvert** RCP, square edge headwall, Ke= 0.500<br>Outlet Invert= 70.00' S= 0.1250 '/' n= 0.012 Cc= 0.900 |
| 3 | Device 1 | 80.64' | **60.0" Horiz. Orifice** Limited to weir flow C= 0.600 |

**Primary OutFlow** Max=63.34 cfs @ 12.16 hrs HW=81.78' (Free Discharge)
└**1=Culvert** (Passes 63.34 cfs of 84.20 cfs potential flow)
  ├**2=Culvert** (Barrel Controls 0.65 cfs @ 13.3 fps)
  └**3=Orifice** (Weir Controls 62.69 cfs @ 3.5 fps)

## Pond BMP - 1: BMP #1






**Drainage Diagram for bmp2**
Prepared by Landmark Design Group 05/10/2005
HydroCAD® 7.00 s/n 001765 © 1986-2003 Applied Microcomputer Systems

## Subcatchment Post Dev: 1/3 Acre Lots

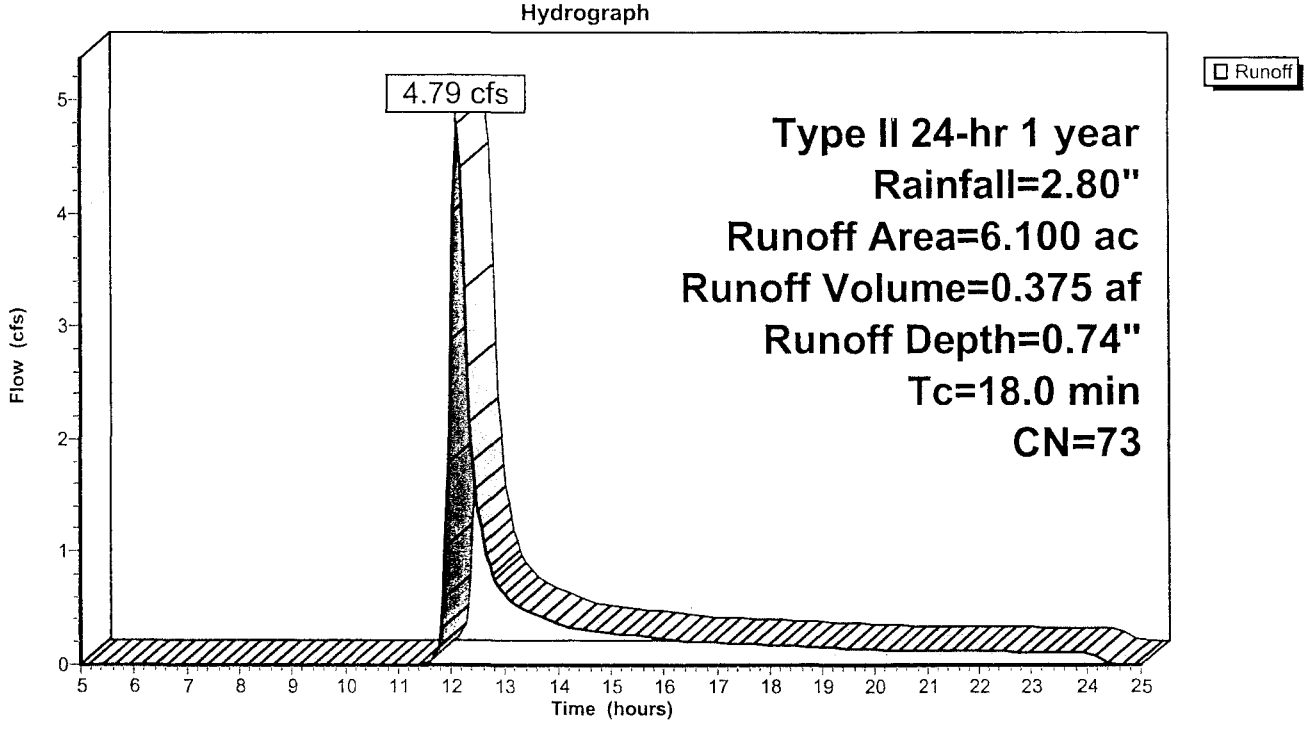
Runoff = 4.79 cfs @ 12.12 hrs, Volume= 0.375 af, Depth= 0.74"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-25.00 hrs, dt= 0.05 hrs
Type II 24-hr 1 year Rainfall=2.80"

| Area (ac) | CN | Description |
|---|---|---|
| 1.900 | 55 | Woods, Good, HSG B |
| 4.200 | 81 | 1/3 acre lots, 30% imp, HSG C |
| 6.100 | 73 | Weighted Average |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 18.0 | | | | | **Direct Entry,** |

## Subcatchment Post Dev: 1/3 Acre Lots



## Pond BMP-2: Basin 2

| | | | | | |
|---|---|---|---|---|---|
| Inflow Area = | 6.100 ac, | Inflow Depth = | 0.74" | for | 1 year event |
| Inflow = | 4.79 cfs @ | 12.12 hrs, | Volume= | 0.375 af | |
| Outflow = | 0.59 cfs @ | 13.06 hrs, | Volume= | 0.375 af, | Atten= 88%, Lag= 56.1 min |
| Primary = | 0.59 cfs @ | 13.06 hrs, | Volume= | 0.375 af | |

Routing by Stor-Ind method, Time Span= 5.00-25.00 hrs, dt= 0.05 hrs
Peak Elev= 75.98' @ 13.06 hrs Surf.Area= 1,947 sf Storage= 5,861 cf
Plug-Flow detention time= 91.4 min calculated for 0.375 af (100% of inflow)
Center-of-Mass det. time= 91.4 min ( 974.1 - 882.7 )

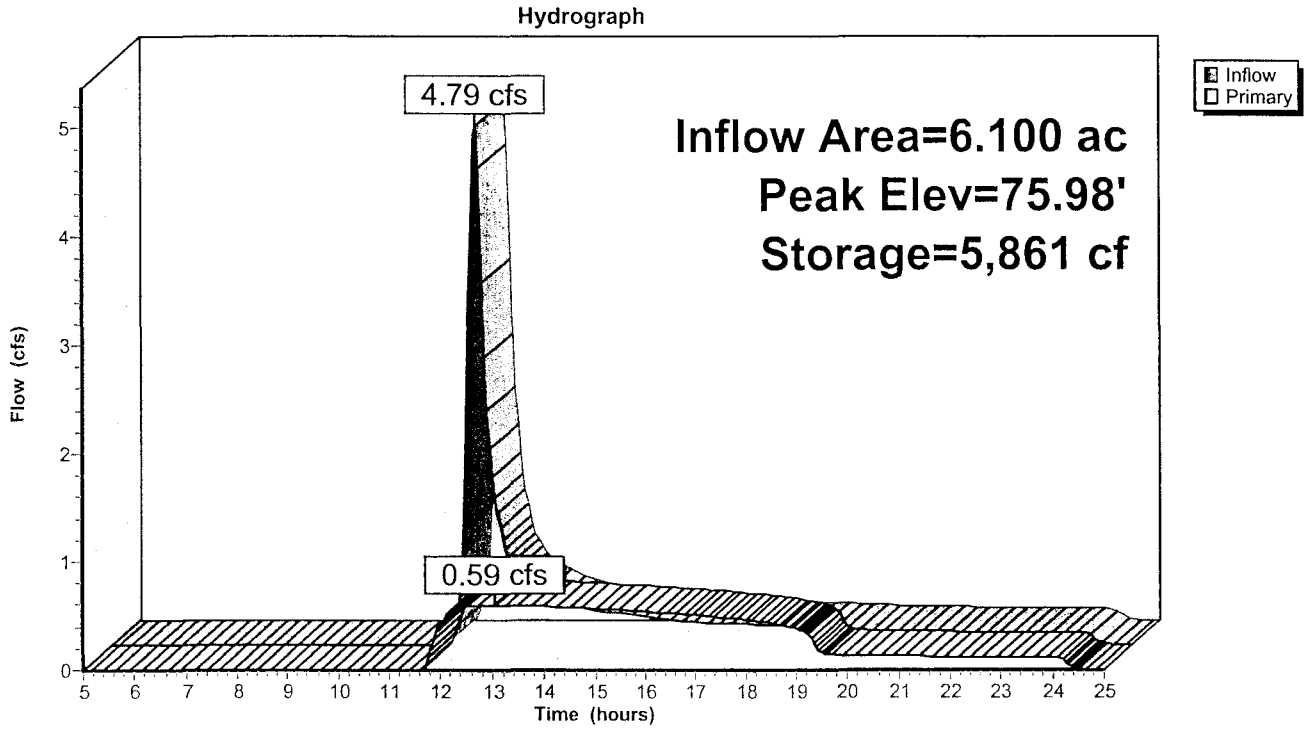
| # | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| 1 | 68.00' | 33,029 cf | **Custom Stage Data (Prismatic)** Listed below |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 68.00 | 0 | 0 | 0 |
| 70.00 | 95 | 95 | 95 |
| 71.00 | 305 | 200 | 295 |
| 72.00 | 667 | 486 | 781 |
| 73.00 | 944 | 806 | 1,587 |
| 74.00 | 1,267 | 1,106 | 2,692 |
| 75.00 | 1,590 | 1,429 | 4,121 |
| 76.00 | 1,954 | 1,772 | 5,893 |
| 77.00 | 2,570 | 2,262 | 8,155 |
| 78.00 | 3,275 | 2,923 | 11,077 |
| 79.00 | 4,236 | 3,756 | 14,833 |
| 80.00 | 5,320 | 4,778 | 19,611 |
| 81.00 | 6,700 | 6,010 | 25,621 |
| 82.00 | 8,117 | 7,409 | 33,029 |

| # | Routing | Invert | Outlet Devices |
|---|---|---|---|
| 1 | Primary | 66.80' | **24.0" x 79.0' long Culvert** CMP, square edge headwall, Ke= 0.500<br>Outlet Invert= 66.01' S= 0.0100 '/' n= 0.013 Cc= 0.900 |
| 2 | Device 1 | 68.00' | **3.0" x 14.0' long Culvert** RCP, square edge headwall, Ke= 0.500<br>Outlet Invert= 67.00' S= 0.0714 '/' n= 0.012 Cc= 0.900 |
| 3 | Device 1 | 80.55' | **48.0" Horiz. Orifice/Grate** Limited to weir flow C= 0.600 |

**Primary OutFlow** Max=0.59 cfs @ 13.06 hrs HW=75.98' (Free Discharge)
└─**1=Culvert** (Passes 0.59 cfs of 43.27 cfs potential flow)
  ├─**2=Culvert** (Barrel Controls 0.59 cfs @ 12.0 fps)
  └─**3=Orifice/Grate** ( Controls 0.00 cfs)

## Pond BMP-2: Basin 2



## Subcatchment Post Dev: 1/3 Acre Lots

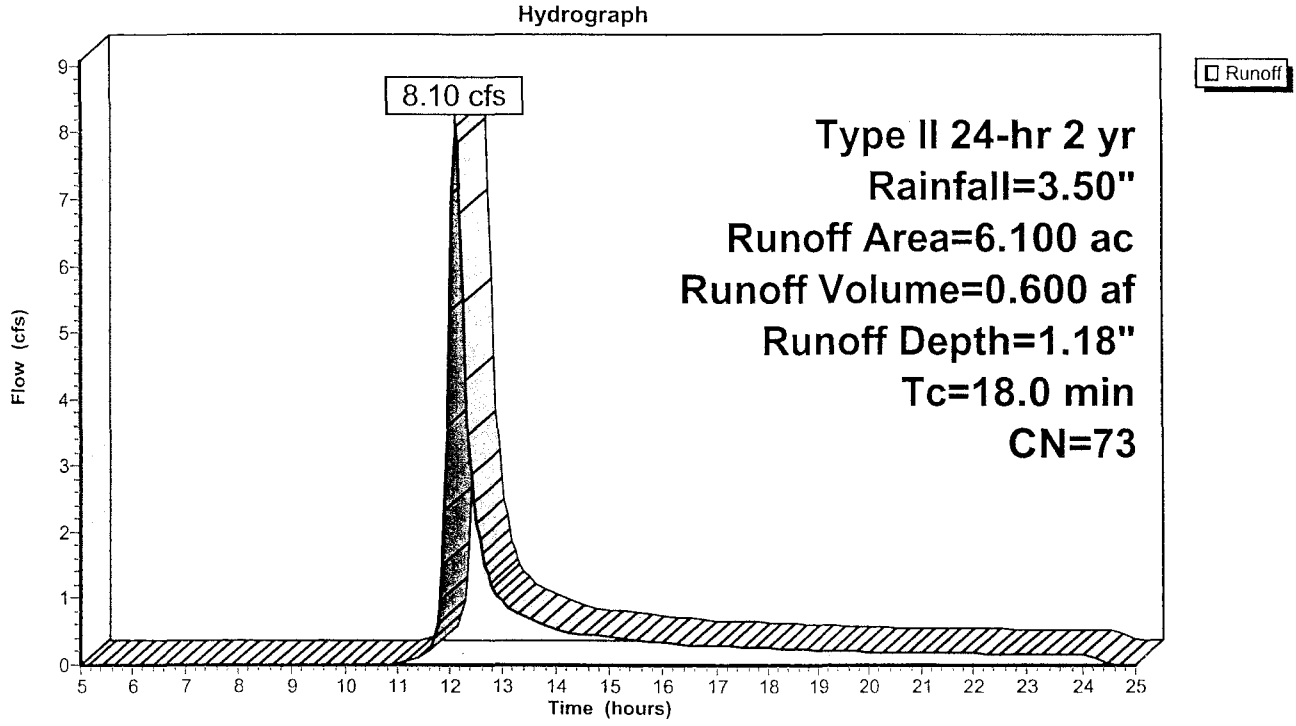
Runoff = 8.10 cfs @ 12.12 hrs, Volume= 0.600 af, Depth= 1.18"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-25.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 yr Rainfall=3.50"

| Area (ac) | CN | Description |
|---|---|---|
| 1.900 | 55 | Woods, Good, HSG B |
| 4.200 | 81 | 1/3 acre lots, 30% imp, HSG C |
| 6.100 | 73 | Weighted Average |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 18.0 | | | | | **Direct Entry,** |

## Subcatchment Post Dev: 1/3 Acre Lots



## Pond BMP-2: Basin 2

Inflow Area = 6.100 ac, Inflow Depth = 1.18" for 2 yr event
Inflow = 8.10 cfs @ 12.12 hrs, Volume= 0.600 af
Outflow = 0.66 cfs @ 13.58 hrs, Volume= 0.600 af, Atten= 92%, Lag= 87.7 min
Primary = 0.66 cfs @ 13.58 hrs, Volume= 0.600 af

Routing by Stor-Ind method, Time Span= 5.00-25.00 hrs, dt= 0.05 hrs
Peak Elev= 78.12' @ 13.58 hrs Surf.Area= 3,389 sf Storage= 11,523 cf
Plug-Flow detention time= 183.6 min calculated for 0.600 af (100% of inflow)
Center-of-Mass det. time= 183.6 min ( 1,051.1 - 867.5 )

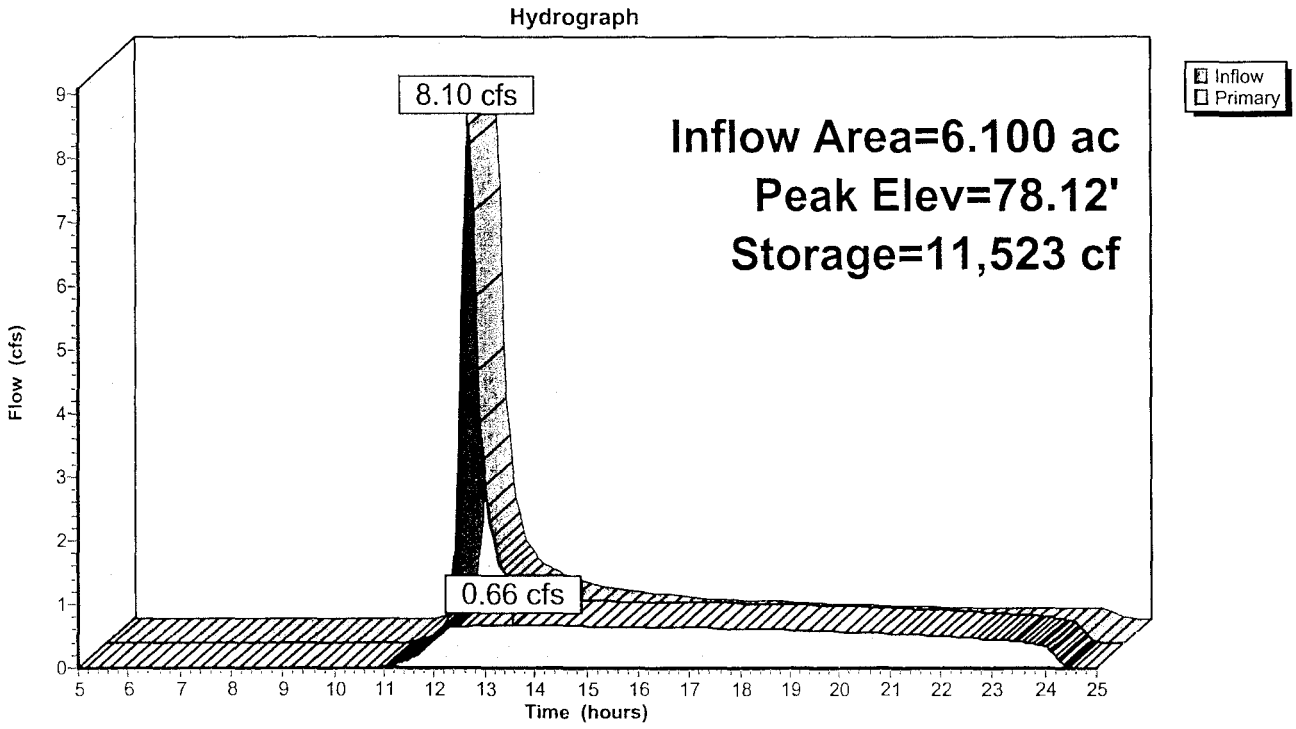
| # | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| 1 | 68.00' | 33,029 cf | **Custom Stage Data (Prismatic)** Listed below |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 68.00 | 0 | 0 | 0 |
| 70.00 | 95 | 95 | 95 |
| 71.00 | 305 | 200 | 295 |
| 72.00 | 667 | 486 | 781 |
| 73.00 | 944 | 806 | 1,587 |
| 74.00 | 1,267 | 1,106 | 2,692 |
| 75.00 | 1,590 | 1,429 | 4,121 |
| 76.00 | 1,954 | 1,772 | 5,893 |
| 77.00 | 2,570 | 2,262 | 8,155 |
| 78.00 | 3,275 | 2,923 | 11,077 |
| 79.00 | 4,236 | 3,756 | 14,833 |
| 80.00 | 5,320 | 4,778 | 19,611 |
| 81.00 | 6,700 | 6,010 | 25,621 |
| 82.00 | 8,117 | 7,409 | 33,029 |

| # | Routing | Invert | Outlet Devices |
|---|---|---|---|
| 1 | Primary | 66.80' | **24.0" x 79.0' long Culvert** CMP, square edge headwall, Ke= 0.500<br>Outlet Invert= 66.01' S= 0.0100 '/' n= 0.013 Cc= 0.900 |
| 2 | Device 1 | 68.00' | **3.0" x 14.0' long Culvert** RCP, square edge headwall, Ke= 0.500<br>Outlet Invert= 67.00' S= 0.0714 '/' n= 0.012 Cc= 0.900 |
| 3 | Device 1 | 80.55' | **48.0" Horiz. Orifice/Grate** Limited to weir flow C= 0.600 |

**Primary OutFlow** Max=0.66 cfs @ 13.58 hrs HW=78.12' (Free Discharge)
└─**1=Culvert** (Passes 0.66 cfs of 48.59 cfs potential flow)
  ├─**2=Culvert** (Barrel Controls 0.66 cfs @ 13.4 fps)
  └─**3=Orifice/Grate** ( Controls 0.00 cfs)

## Pond BMP-2: Basin 2



## Subcatchment Post Dev: 1/3 Acre Lots

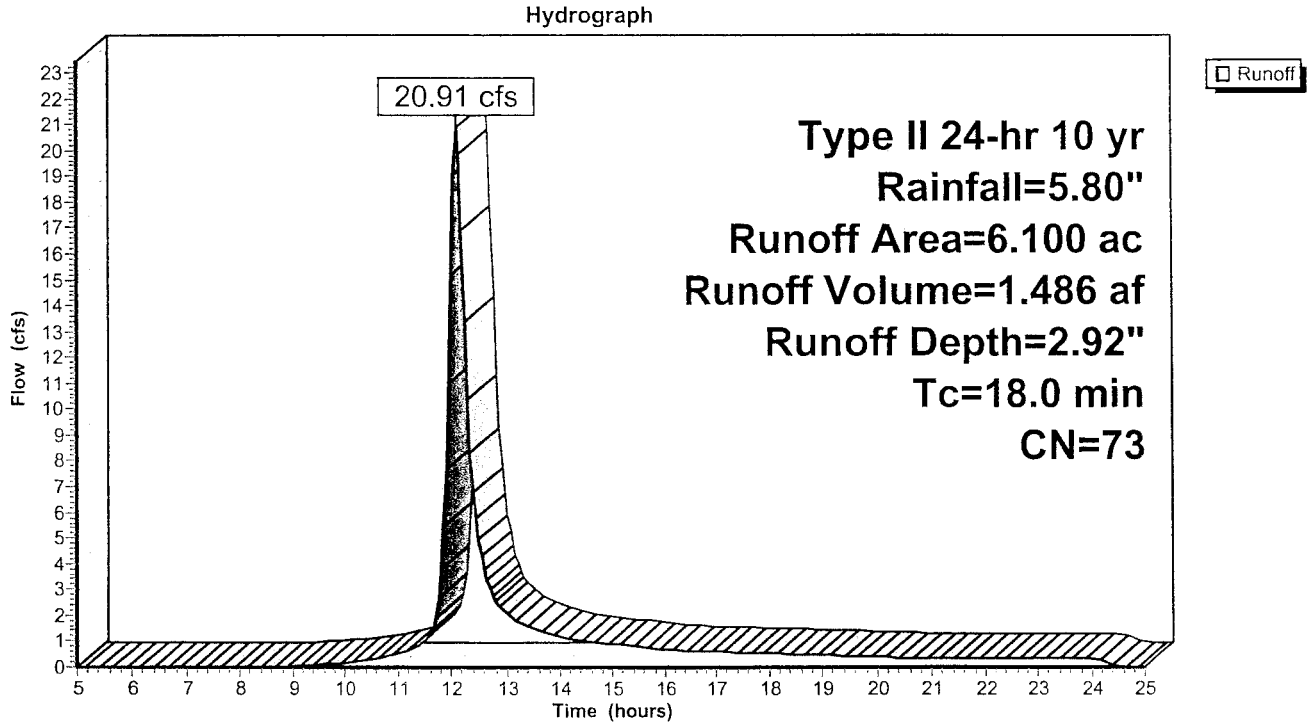
Runoff = 20.91 cfs @ 12.11 hrs, Volume= 1.486 af, Depth= 2.92"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-25.00 hrs, dt= 0.05 hrs
Type II 24-hr 10 yr Rainfall=5.80"

| Area (ac) | CN | Description |
|---|---|---|
| 1.900 | 55 | Woods, Good, HSG B |
| 4.200 | 81 | 1/3 acre lots, 30% imp, HSG C |
| 6.100 | 73 | Weighted Average |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 18.0 | | | | | **Direct Entry,** |

## Subcatchment Post Dev: 1/3 Acre Lots



## Pond BMP-2: Basin 2

Inflow Area = 6.100 ac, Inflow Depth = 2.92" for 10 yr event
Inflow = 20.91 cfs @ 12.11 hrs, Volume= 1.486 af
Outflow = 8.76 cfs @ 12.35 hrs, Volume= 1.189 af, Atten= 58%, Lag= 14.8 min
Primary = 8.76 cfs @ 12.35 hrs, Volume= 1.189 af

Routing by Stor-Ind method, Time Span= 5.00-25.00 hrs, dt= 0.05 hrs
Peak Elev= 80.89' @ 12.35 hrs Surf.Area= 6,543 sf Storage= 24,936 cf
Plug-Flow detention time= 226.9 min calculated for 1.189 af (80% of inflow)
Center-of-Mass det. time= 142.6 min ( 983.3 - 840.7 )

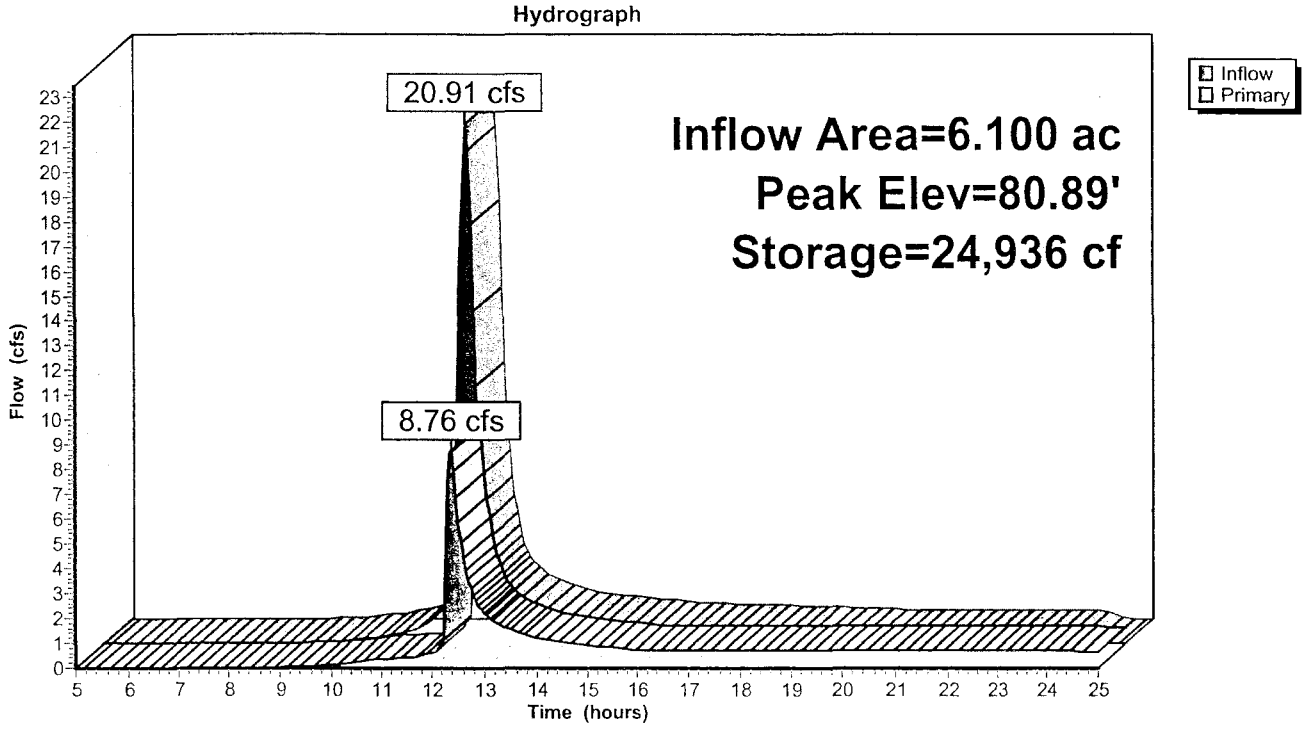
| # | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| 1 | 68.00' | 33,029 cf | **Custom Stage Data (Prismatic)** Listed below |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 68.00 | 0 | 0 | 0 |
| 70.00 | 95 | 95 | 95 |
| 71.00 | 305 | 200 | 295 |
| 72.00 | 667 | 486 | 781 |
| 73.00 | 944 | 806 | 1,587 |
| 74.00 | 1,267 | 1,106 | 2,692 |
| 75.00 | 1,590 | 1,429 | 4,121 |
| 76.00 | 1,954 | 1,772 | 5,893 |
| 77.00 | 2,570 | 2,262 | 8,155 |
| 78.00 | 3,275 | 2,923 | 11,077 |
| 79.00 | 4,236 | 3,756 | 14,833 |
| 80.00 | 5,320 | 4,778 | 19,611 |
| 81.00 | 6,700 | 6,010 | 25,621 |
| 82.00 | 8,117 | 7,409 | 33,029 |

| # | Routing | Invert | Outlet Devices |
|---|---|---|---|
| 1 | Primary | 66.80' | **24.0" x 79.0' long Culvert** CMP, square edge headwall, Ke= 0.500<br>Outlet Invert= 66.01' S= 0.0100 '/' n= 0.013 Cc= 0.900 |
| 2 | Device 1 | 68.00' | **3.0" x 14.0' long Culvert** RCP, square edge headwall, Ke= 0.500<br>Outlet Invert= 67.00' S= 0.0714 '/' n= 0.012 Cc= 0.900 |
| 3 | Device 1 | 80.55' | **48.0" Horiz. Orifice/Grate** Limited to weir flow C= 0.600 |

**Primary OutFlow** Max=8.67 cfs @ 12.35 hrs HW=80.88' (Free Discharge)
└**1=Culvert** (Passes 8.67 cfs of 54.72 cfs potential flow)
  ├**2=Culvert** (Barrel Controls 0.74 cfs @ 15.0 fps)
  └**3=Orifice/Grate** (Weir Controls 7.93 cfs @ 1.9 fps)

## Pond BMP-2: Basin 2



## Subcatchment Post Dev: 1/3 Acre Lots

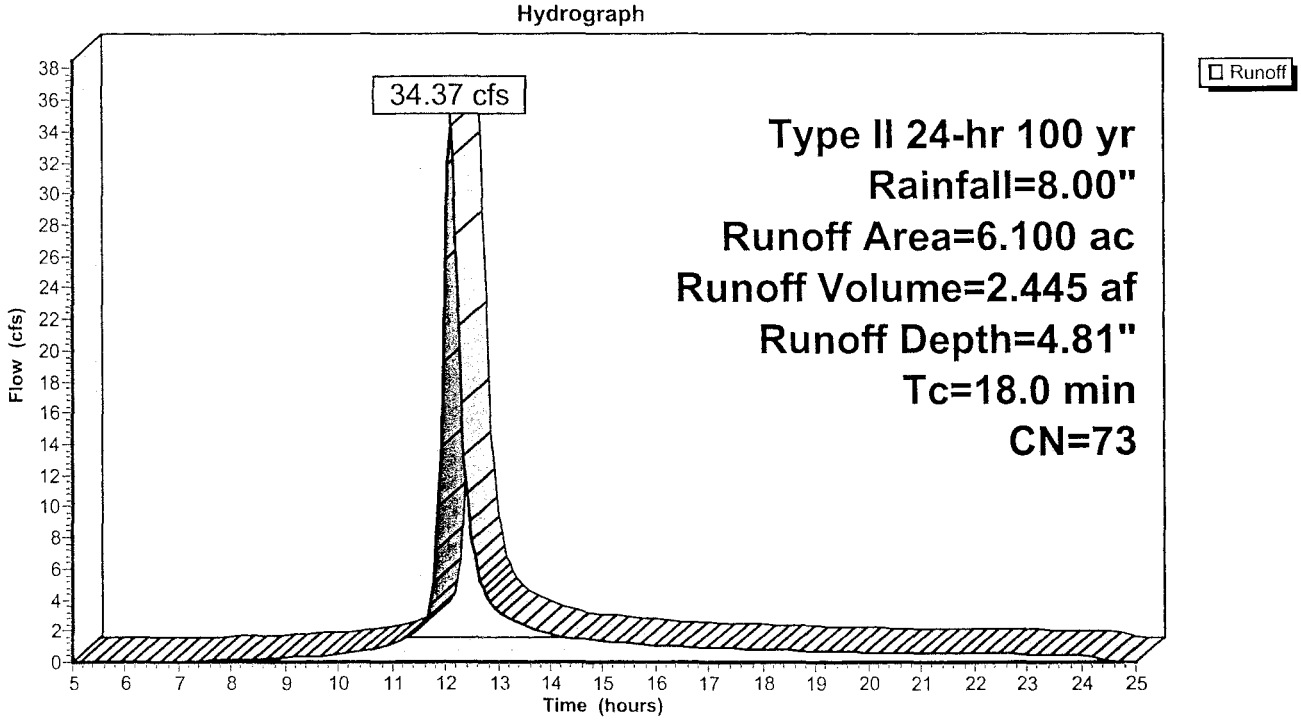
Runoff = 34.37 cfs @ 12.10 hrs, Volume= 2.445 af, Depth= 4.81"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-25.00 hrs, dt= 0.05 hrs
Type II 24-hr 100 yr Rainfall=8.00"

| Area (ac) | CN | Description |
|---|---|---|
| 1.900 | 55 | Woods, Good, HSG B |
| 4.200 | 81 | 1/3 acre lots, 30% imp, HSG C |
| 6.100 | 73 | Weighted Average |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 18.0 | | | | | **Direct Entry,** |

## Subcatchment Post Dev: 1/3 Acre Lots



## Pond BMP-2: Basin 2

| | | | | | |
|---|---|---|---|---|---|
| Inflow Area = | 6.100 ac, | Inflow Depth = | 4.81" | for | 100 yr event |
| Inflow = | 34.37 cfs @ | 12.10 hrs, | Volume= | 2.445 af | |
| Outflow = | 30.00 cfs @ | 12.18 hrs, | Volume= | 2.040 af, | Atten= 13%, Lag= 4.7 min |
| Primary = | 30.00 cfs @ | 12.18 hrs, | Volume= | 2.040 af | |

Routing by Stor-Ind method, Time Span= 5.00-25.00 hrs, dt= 0.05 hrs
Peak Elev= 81.35' @ 12.18 hrs Surf.Area= 7,191 sf Storage= 28,186 cf
Plug-Flow detention time= 138.8 min calculated for 2.035 af (83% of inflow)
Center-of-Mass det. time= 66.2 min ( 892.7 - 826.5 )

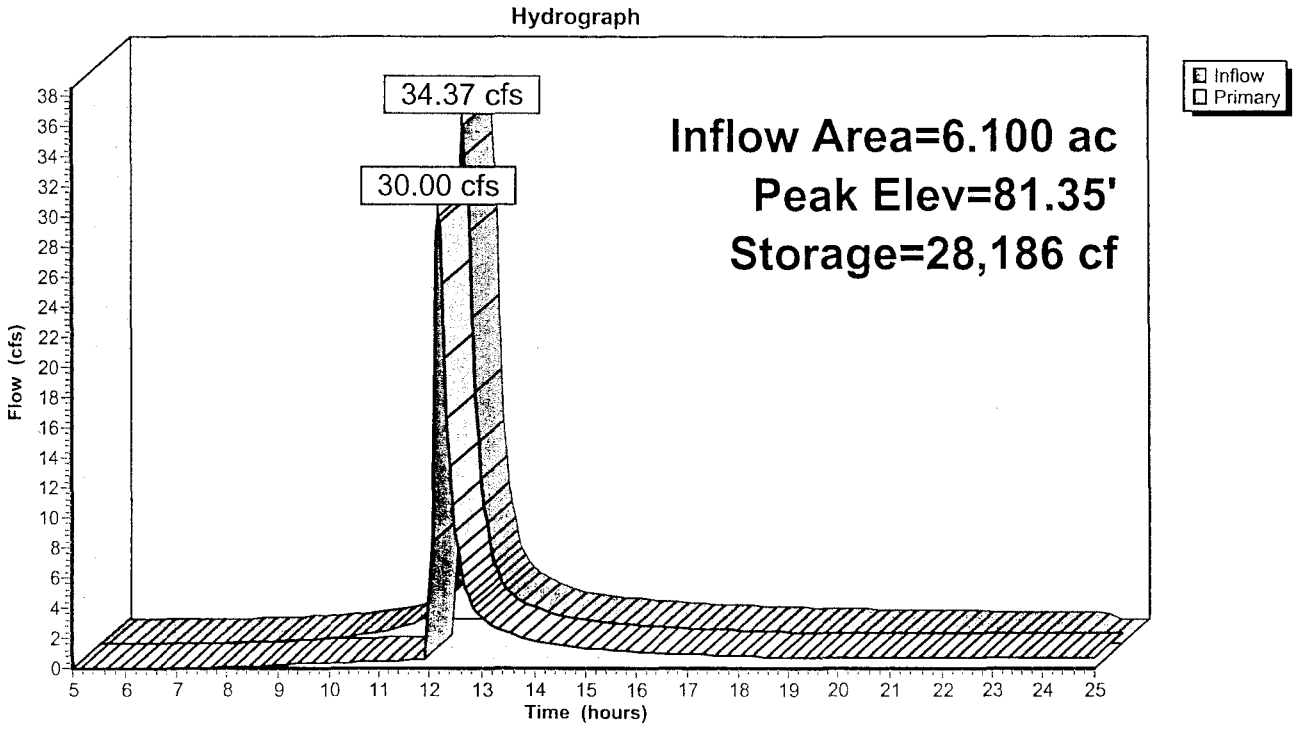
| # | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| 1 | 68.00' | 33,029 cf | **Custom Stage Data (Prismatic)** Listed below |

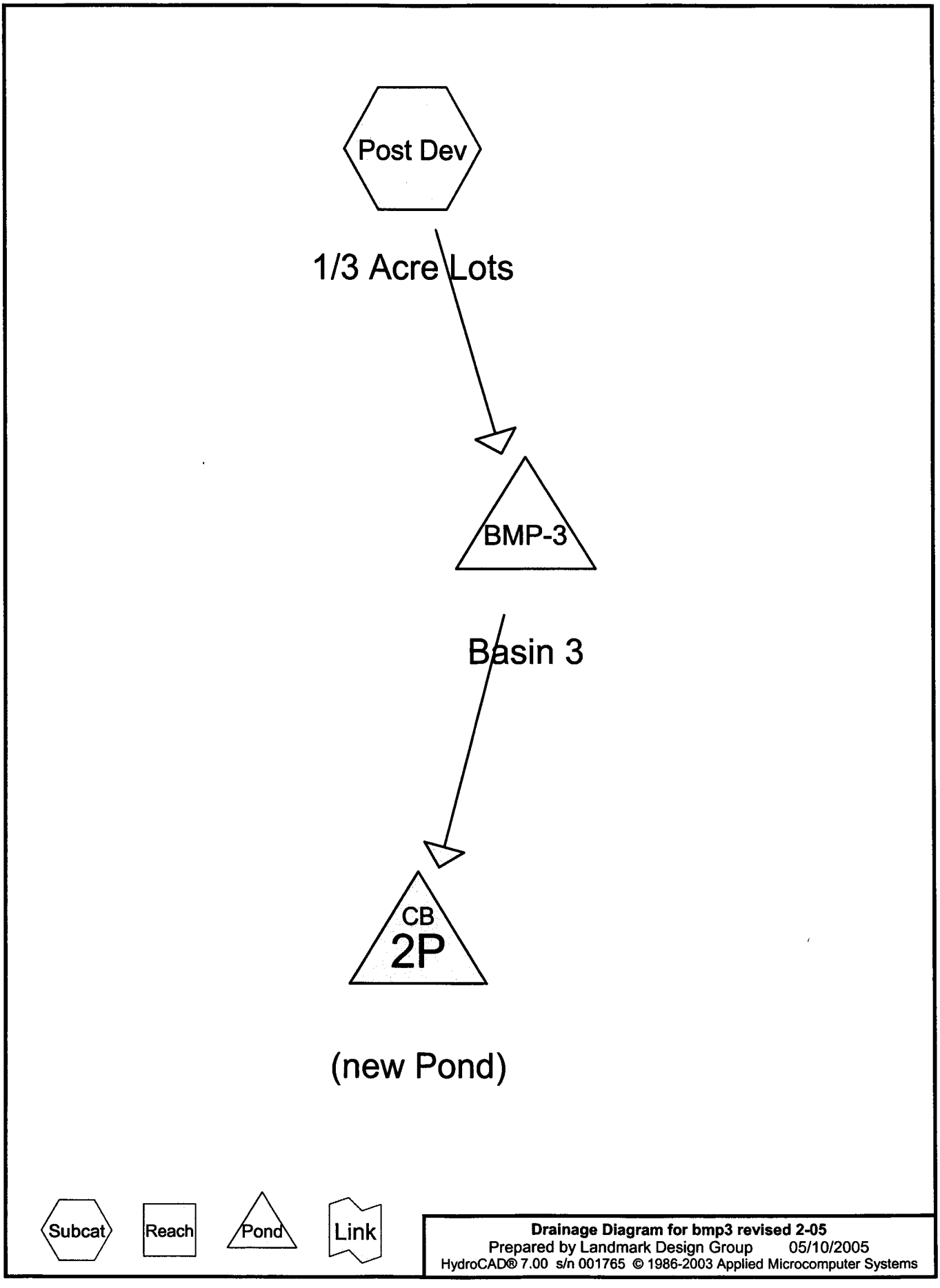
| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 68.00 | 0 | 0 | 0 |
| 70.00 | 95 | 95 | 95 |
| 71.00 | 305 | 200 | 295 |
| 72.00 | 667 | 486 | 781 |
| 73.00 | 944 | 806 | 1,587 |
| 74.00 | 1,267 | 1,106 | 2,692 |
| 75.00 | 1,590 | 1,429 | 4,121 |
| 76.00 | 1,954 | 1,772 | 5,893 |
| 77.00 | 2,570 | 2,262 | 8,155 |
| 78.00 | 3,275 | 2,923 | 11,077 |
| 79.00 | 4,236 | 3,756 | 14,833 |
| 80.00 | 5,320 | 4,778 | 19,611 |
| 81.00 | 6,700 | 6,010 | 25,621 |
| 82.00 | 8,117 | 7,409 | 33,029 |

| # | Routing | Invert | Outlet Devices |
|---|---|---|---|
| 1 | Primary | 66.80' | **24.0" x 79.0' long Culvert** CMP, square edge headwall, Ke= 0.500<br>Outlet Invert= 66.01' S= 0.0100 '/' n= 0.013 Cc= 0.900 |
| 2 | Device 1 | 68.00' | **3.0" x 14.0' long Culvert** RCP, square edge headwall, Ke= 0.500<br>Outlet Invert= 67.00' S= 0.0714 '/' n= 0.012 Cc= 0.900 |
| 3 | Device 1 | 80.55' | **48.0" Horiz. Orifice/Grate** Limited to weir flow C= 0.600 |

**Primary OutFlow** Max=29.38 cfs @ 12.18 hrs HW=81.34' (Free Discharge)
└─**1=Culvert** (Passes 29.38 cfs of 55.65 cfs potential flow)
  ├─**2=Culvert** (Barrel Controls 0.75 cfs @ 15.3 fps)
  └─**3=Orifice/Grate** (Weir Controls 28.63 cfs @ 2.9 fps)

## Pond BMP-2: Basin 2




Post Dev
1/3 Acre Lots
BMP-3
Basin 3
CB
2P
(new Pond)
Subcat
Reach
Pond
Link
Drainage Diagram for bmp3 revised 2-05
Prepared by Landmark Design Group 05/10/2005
HydroCAD® 7.00 s/n 001765 © 1986-2003 Applied Microcomputer Systems

## Subcatchment Post Dev: 1/3 Acre Lots

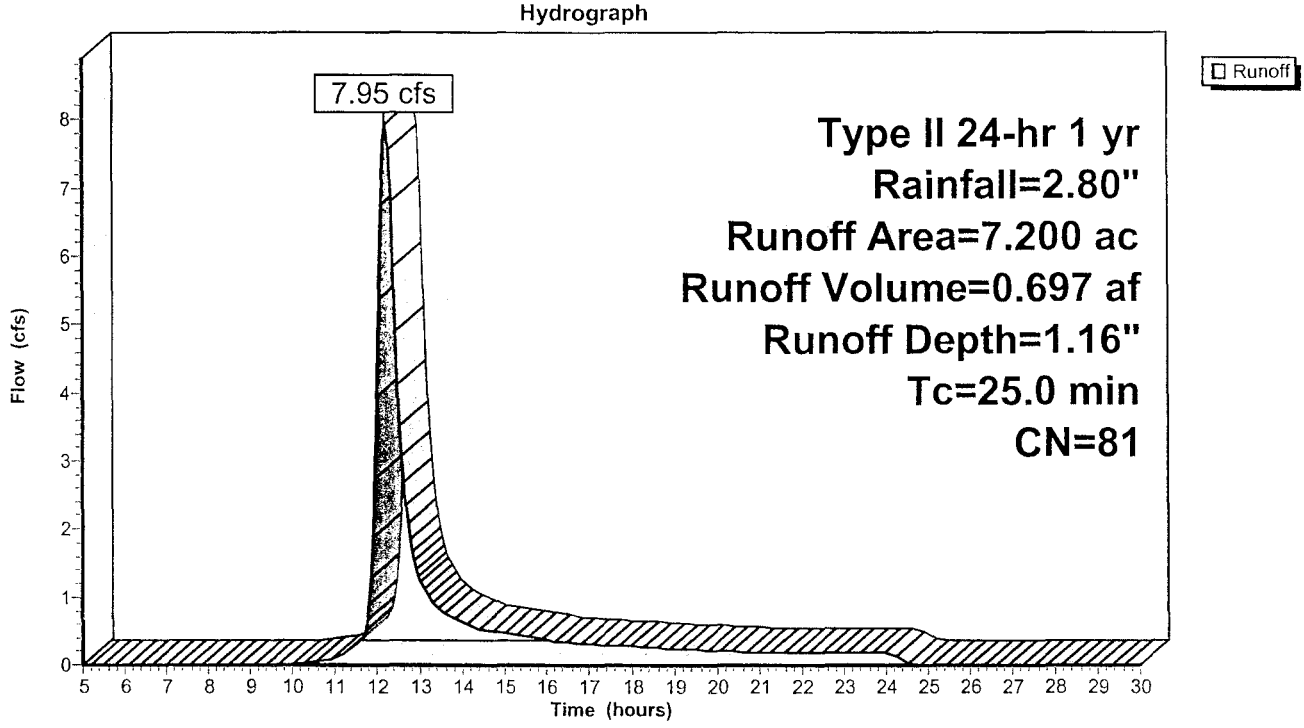
Runoff = 7.95 cfs @ 12.20 hrs, Volume= 0.697 af, Depth= 1.16"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Type II 24-hr 1 yr Rainfall=2.80"

| Area (ac) | CN | Description |
|---|---|---|
| 7.200 | 81 | 1/3 acre lots, 30% imp, HSG C |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 25.0 | | | | | **Direct Entry,** |

## Subcatchment Post Dev: 1/3 Acre Lots



## Pond 2P: (new Pond)

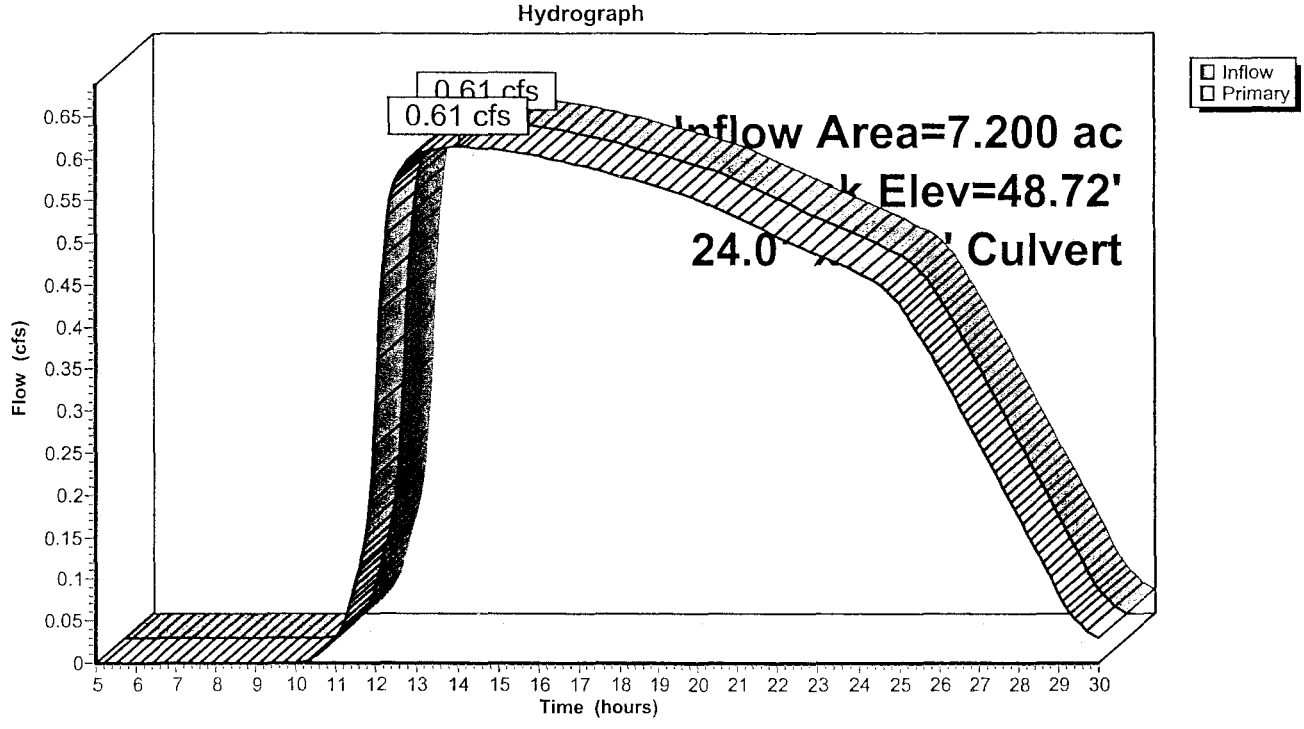
| | | | | | |
|---|---|---|---|---|---|
| Inflow Area = | 7.200 ac, | Inflow Depth = | 1.16" | for | 1 yr event |
| Inflow = | 0.61 cfs @ | 14.02 hrs, | Volume= | 0.694 af | |
| Outflow = | 0.61 cfs @ | 14.02 hrs, | Volume= | 0.694 af, | Atten= 0%, Lag= 0.0 min |
| Primary = | 0.61 cfs @ | 14.02 hrs, | Volume= | 0.694 af | |

Routing by Stor-Ind method, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 48.72' @ 14.02 hrs
Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= (not calculated)

| # | Routing | Invert | Outlet Devices |
|---|---|---|---|
| 1 | Primary | 48.40' | **24.0" x 20.0' long Culvert** RCP, square edge headwall, Ke= 0.500<br>Outlet Invert= 48.00' S= 0.0200 '/' n= 0.012 Cc= 0.900 |

**Primary OutFlow** Max=0.61 cfs @ 14.02 hrs HW=48.72' (Free Discharge)
└**1=Culvert** (Inlet Controls 0.61 cfs @ 1.9 fps)

## Pond 2P: (new Pond)



## Pond BMP-3: Basin 3

| | | | | | |
|---|---|---|---|---|---|
| Inflow Area = | 7.200 ac, | Inflow Depth = 1.16" | for 1 yr event | | |
| Inflow = | 7.95 cfs @ | 12.20 hrs, Volume= | 0.697 af | | |
| Outflow = | 0.61 cfs @ | 14.02 hrs, Volume= | 0.694 af, | Atten= 92%, | Lag= 109.5 min |
| Primary = | 0.61 cfs @ | 14.02 hrs, Volume= | 0.694 af | | |

Routing by Stor-Ind method, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 63.51' @ 14.02 hrs Surf.Area= 3,975 sf Storage= 15,509 cf
Plug-Flow detention time= 295.4 min calculated for 0.694 af (100% of inflow)
Center-of-Mass det. time= 293.0 min ( 1,153.7 - 860.7 )

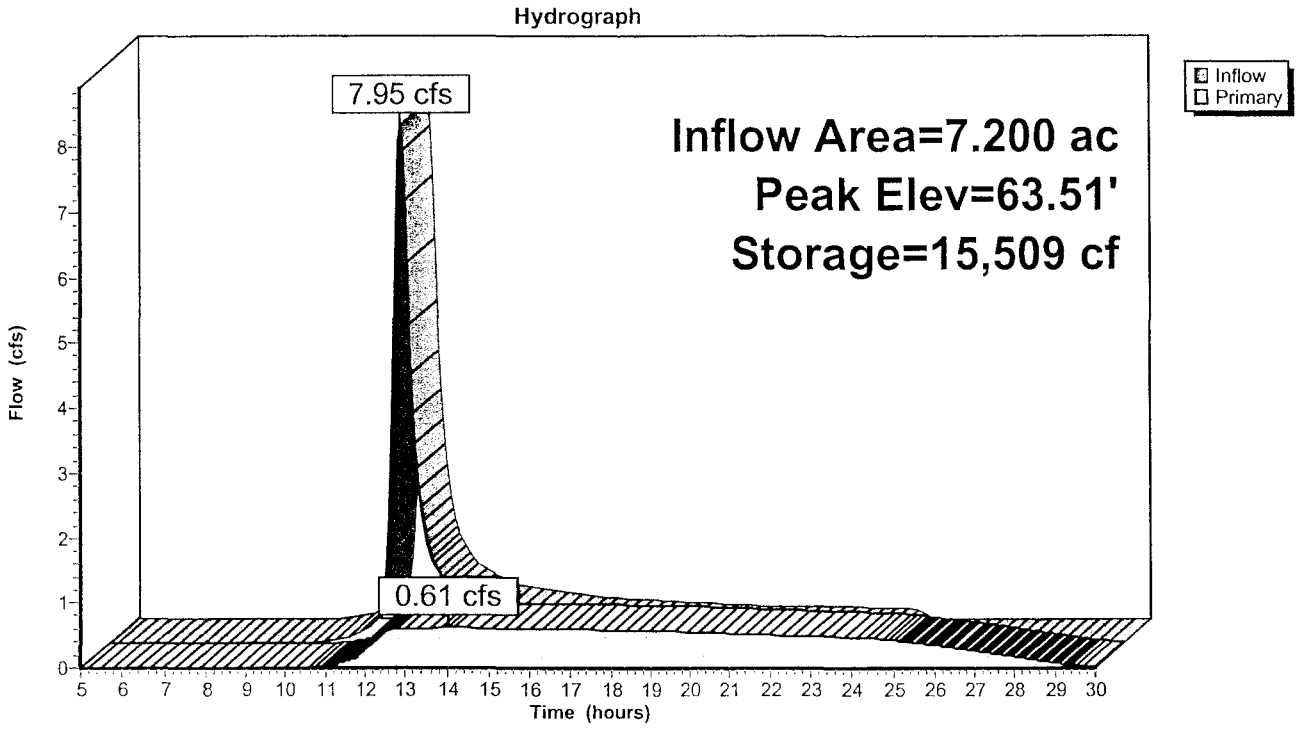
| # | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| 1 | 56.00' | 77,692 cf | **Custom Stage Data (Pyramidal)** Listed below |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) | Wet.Area (sq-ft) |
|---|---|---|---|---|
| 56.00 | 600 | 0 | 0 | 600 |
| 59.50 | 1,800 | 4,012 | 4,012 | 1,888 |
| 60.00 | 2,020 | 954 | 4,967 | 2,125 |
| 62.00 | 3,050 | 5,035 | 10,002 | 3,230 |
| 64.00 | 4,275 | 7,291 | 17,292 | 4,547 |
| 66.00 | 5,720 | 9,960 | 27,252 | 6,098 |
| 68.00 | 7,375 | 13,060 | 40,312 | 7,874 |
| 70.00 | 9,300 | 16,638 | 56,950 | 9,933 |
| 72.00 | 11,480 | 20,742 | 77,692 | 12,260 |

| # | Routing | Invert | Outlet Devices |
|---|---|---|---|
| 1 | Primary | 55.00' | **24.0" x 60.0' long Culvert** RCP, square edge headwall, Ke= 0.500<br>Outlet Invert= 50.40' S= 0.0767 '/' n= 0.012 Cc= 0.900 |
| 2 | Device 1 | 56.00' | **3.0" x 10.0' long Culvert** RCP, square edge headwall, Ke= 0.500<br>Outlet Invert= 55.50' S= 0.0500 '/' n= 0.012 Cc= 0.900 |
| 3 | Device 1 | 66.50' | **48.0" Horiz. Orifice/Grate** Limited to weir flow C= 0.600 |

**Primary OutFlow** Max=0.61 cfs @ 14.02 hrs HW=63.51' (Free Discharge)
└**1=Culvert** (Passes 0.61 cfs of 41.46 cfs potential flow)
  ├**2=Culvert** (Barrel Controls 0.61 cfs @ 12.5 fps)
  └**3=Orifice/Grate** ( Controls 0.00 cfs)

## Pond BMP-3: Basin 3



## Subcatchment Post Dev: 1/3 Acre Lots

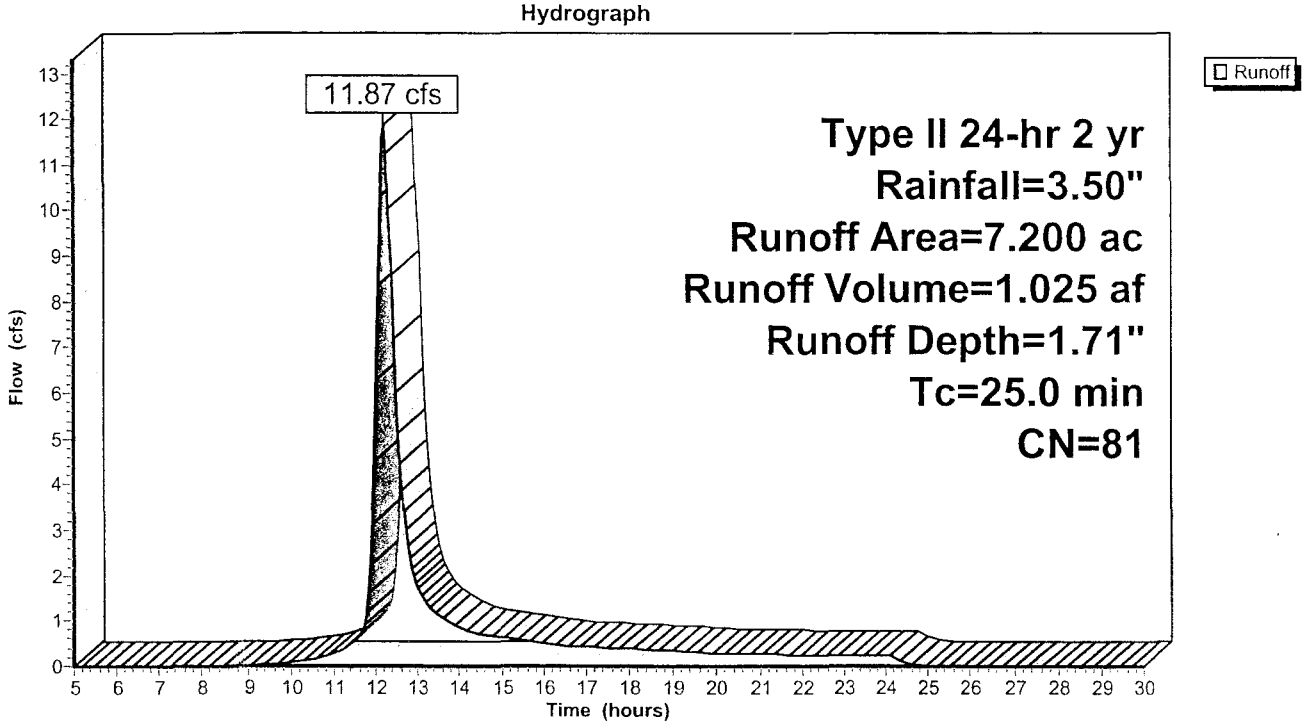
Runoff = 11.87 cfs @ 12.19 hrs, Volume= 1.025 af, Depth= 1.71"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 yr Rainfall=3.50"

| Area (ac) | CN | Description |
|---|---|---|
| 7.200 | 81 | 1/3 acre lots, 30% imp, HSG C |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 25.0 | | | | | **Direct Entry,** |

## Subcatchment Post Dev: 1/3 Acre Lots



## Pond 2P: (new Pond)

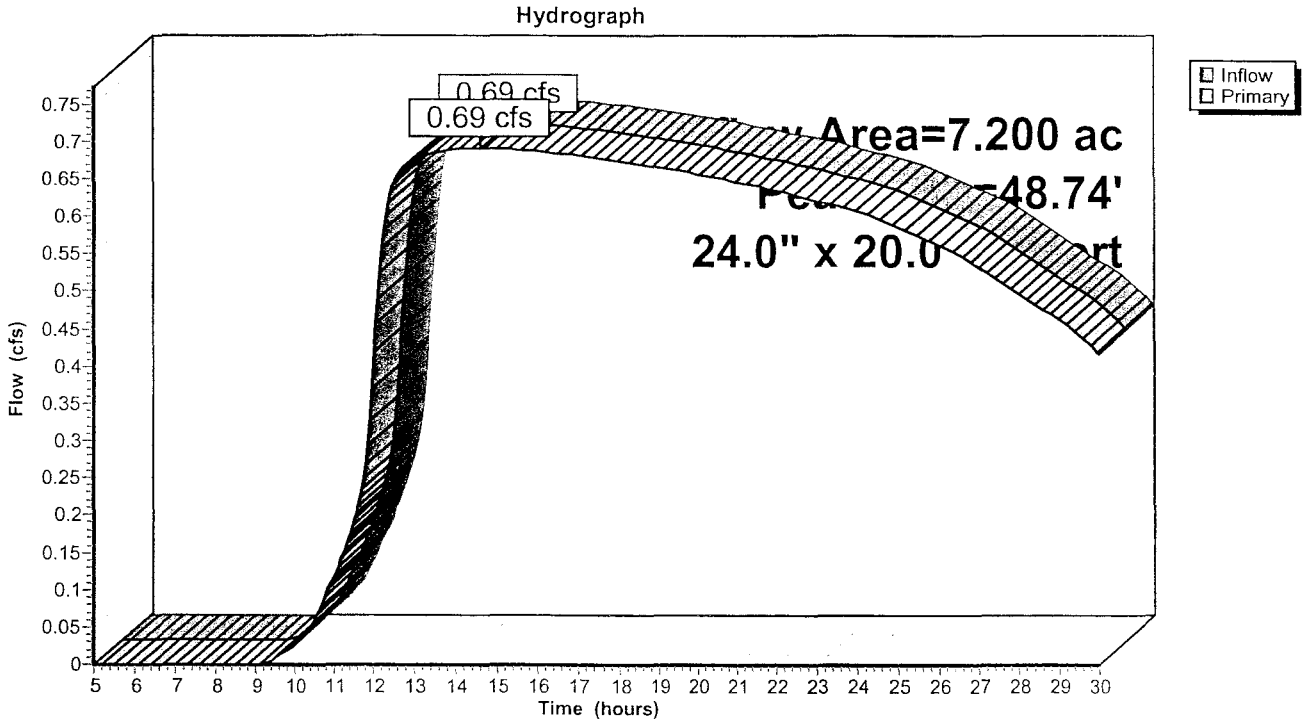
| | | | | | |
|---|---|---|---|---|---|
| Inflow Area = | 7.200 ac, | Inflow Depth = | 1.56" | for | 2 yr event |
| Inflow = | 0.69 cfs @ | 14.59 hrs, | Volume= | 0.939 af | |
| Outflow = | 0.69 cfs @ | 14.59 hrs, | Volume= | 0.939 af, | Atten= 0%, Lag= 0.0 min |
| Primary = | 0.69 cfs @ | 14.59 hrs, | Volume= | 0.939 af | |

Routing by Stor-Ind method, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 48.74' @ 14.59 hrs
Plug-Flow detention time= 0.0 min calculated for 0.937 af (100% of inflow)
Center-of-Mass det. time= (not calculated: outflow precedes inflow)

| # | Routing | Invert | Outlet Devices |
|---|---|---|---|
| 1 | Primary | 48.40' | **24.0" x 20.0' long Culvert** RCP, square edge headwall, Ke= 0.500<br>Outlet Invert= 48.00' S= 0.0200 '/' n= 0.012 Cc= 0.900 |

**Primary OutFlow** Max=0.69 cfs @ 14.59 hrs HW=48.74' (Free Discharge)
└**1=Culvert** (Inlet Controls 0.69 cfs @ 2.0 fps)

## Pond 2P: (new Pond)



## Pond BMP-3: Basin 3

| | | | | | |
|---|---|---|---|---|---|
| Inflow Area = | 7.200 ac, | Inflow Depth = 1.71" | for 2 yr event | | |
| Inflow = | 11.87 cfs @ | 12.19 hrs, Volume= | 1.025 af | | |
| Outflow = | 0.69 cfs @ | 14.59 hrs, Volume= | 0.939 af, | Atten= 94%, | Lag= 144.3 min |
| Primary = | 0.69 cfs @ | 14.59 hrs, Volume= | 0.939 af | | |

Routing by Stor-Ind method, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 65.56' @ 14.59 hrs Surf.Area= 5,402 sf Storage= 25,061 cf
Plug-Flow detention time= 409.2 min calculated for 0.937 af (91% of inflow)
Center-of-Mass det. time= 365.2 min ( 1,214.7 - 849.5 )

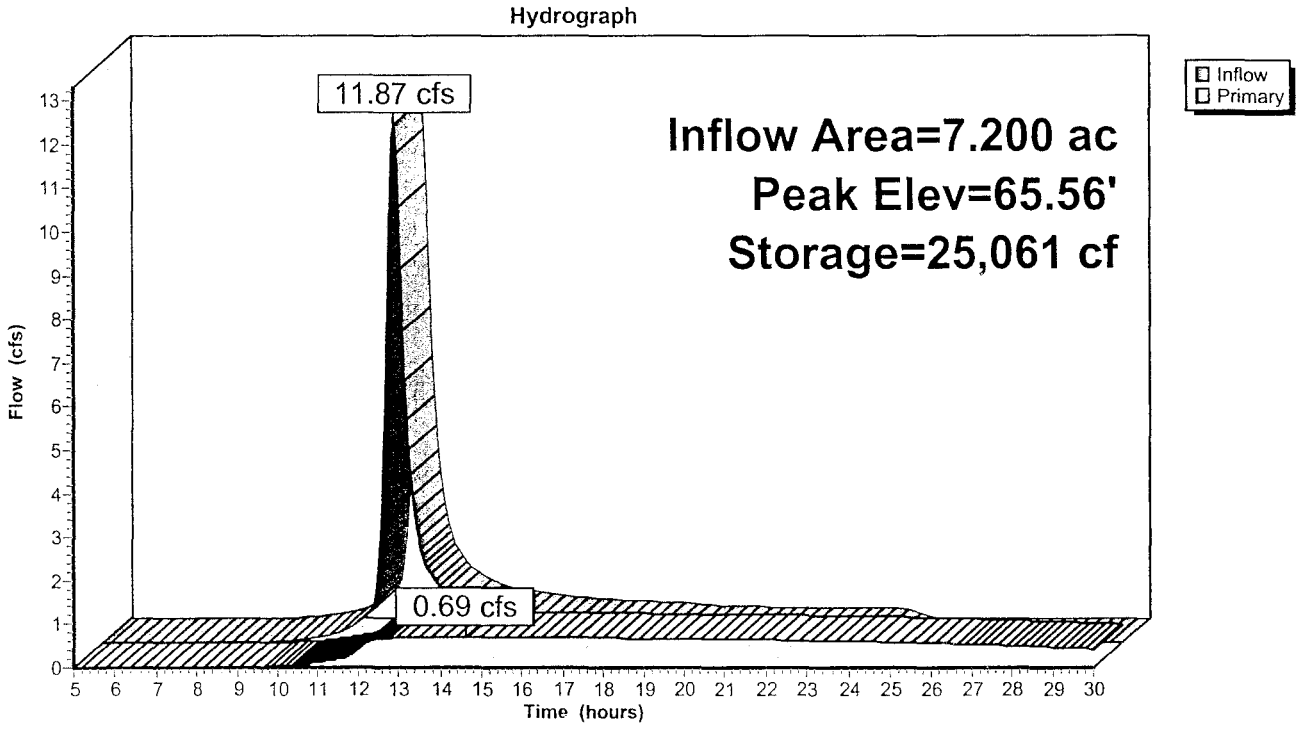
| # | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| 1 | 56.00' | 77,692 cf | **Custom Stage Data (Pyramidal)** Listed below |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) | Wet.Area (sq-ft) |
|---|---|---|---|---|
| 56.00 | 600 | 0 | 0 | 600 |
| 59.50 | 1,800 | 4,012 | 4,012 | 1,888 |
| 60.00 | 2,020 | 954 | 4,967 | 2,125 |
| 62.00 | 3,050 | 5,035 | 10,002 | 3,230 |
| 64.00 | 4,275 | 7,291 | 17,292 | 4,547 |
| 66.00 | 5,720 | 9,960 | 27,252 | 6,098 |
| 68.00 | 7,375 | 13,060 | 40,312 | 7,874 |
| 70.00 | 9,300 | 16,638 | 56,950 | 9,933 |
| 72.00 | 11,480 | 20,742 | 77,692 | 12,260 |

| # | Routing | Invert | Outlet Devices |
|---|---|---|---|
| 1 | Primary | 55.00' | **24.0" x 60.0' long Culvert** RCP, square edge headwall, Ke= 0.500<br>Outlet Invert= 50.40' S= 0.0767 '/' n= 0.012 Cc= 0.900 |
| 2 | Device 1 | 56.00' | **3.0" x 10.0' long Culvert** RCP, square edge headwall, Ke= 0.500<br>Outlet Invert= 55.50' S= 0.0500 '/' n= 0.012 Cc= 0.900 |
| 3 | Device 1 | 66.50' | **48.0" Horiz. Orifice/Grate** Limited to weir flow C= 0.600 |

**Primary OutFlow** Max=0.69 cfs @ 14.59 hrs HW=65.56' (Free Discharge)
└**1=Culvert** (Passes 0.69 cfs of 46.77 cfs potential flow)
  ├**2=Culvert** (Barrel Controls 0.69 cfs @ 14.1 fps)
  └**3=Orifice/Grate** ( Controls 0.00 cfs)

## Pond BMP-3: Basin 3



## Subcatchment Post Dev: 1/3 Acre Lots

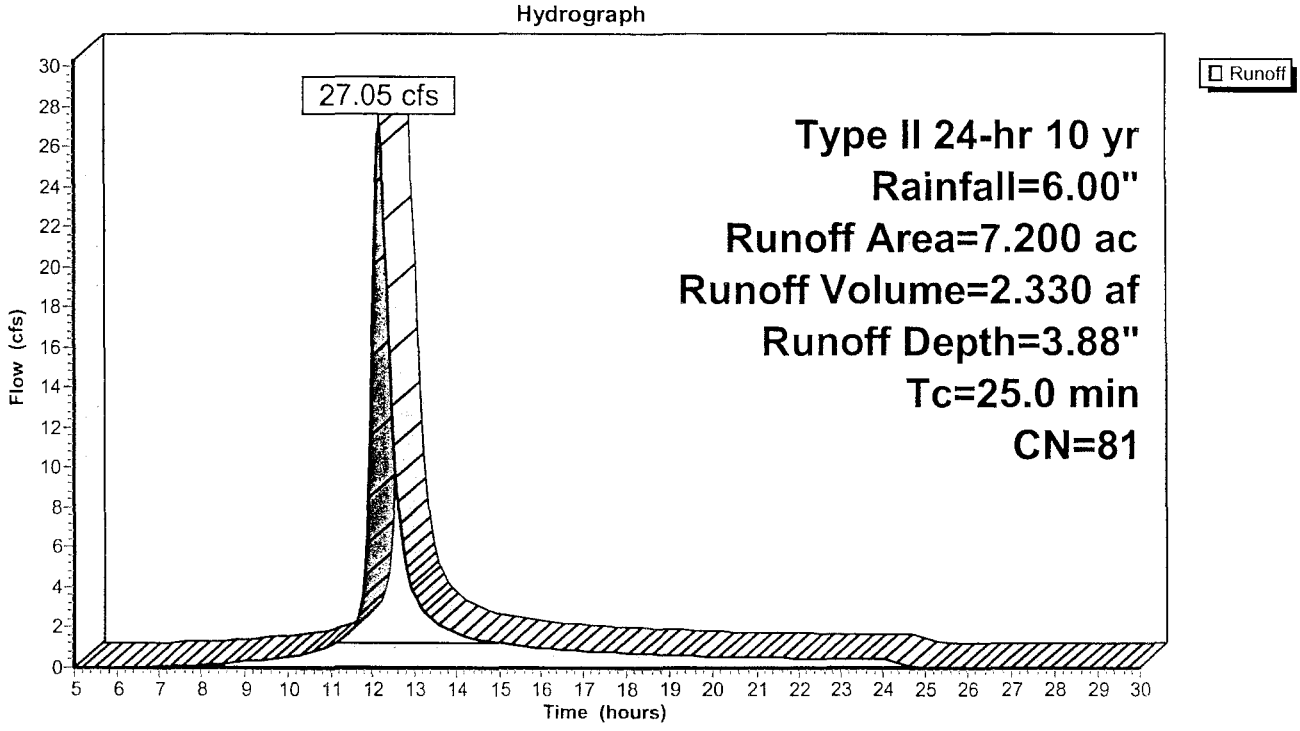
Runoff = 27.05 cfs @ 12.18 hrs, Volume= 2.330 af, Depth= 3.88"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Type II 24-hr 10 yr Rainfall=6.00"

| Area (ac) | CN | Description |
|---|---|---|
| 7.200 | 81 | 1/3 acre lots, 30% imp, HSG C |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 25.0 | | | | | **Direct Entry,** |

## Subcatchment Post Dev: 1/3 Acre Lots



## Pond 2P: (new Pond)

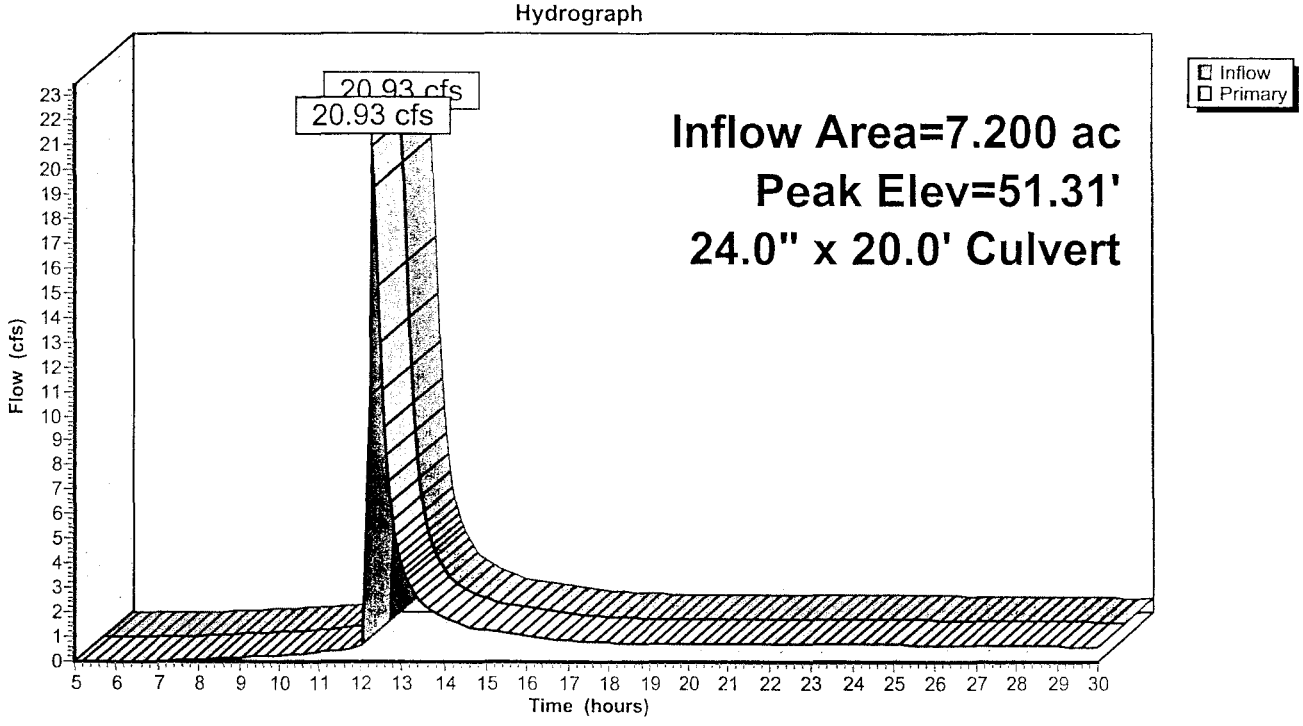
| | | | | | |
|---|---|---|---|---|---|
| Inflow Area = | 7.200 ac, | Inflow Depth = | 3.38" | for | 10 yr event |
| Inflow = | 20.93 cfs @ | 12.33 hrs, | Volume= | 2.027 af | |
| Outflow = | 20.93 cfs @ | 12.33 hrs, | Volume= | 2.027 af, | Atten= 0%, Lag= 0.0 min |
| Primary = | 20.93 cfs @ | 12.33 hrs, | Volume= | 2.027 af | |

Routing by Stor-Ind method, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 51.31' @ 12.33 hrs
Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= (not calculated)

| # | Routing | Invert | Outlet Devices |
|---|---|---|---|
| 1 | Primary | 48.40' | **24.0" x 20.0' long Culvert** RCP, square edge headwall, Ke= 0.500<br>Outlet Invert= 48.00' S= 0.0200 '/' n= 0.012 Cc= 0.900 |

**Primary OutFlow** Max=20.60 cfs @ 12.33 hrs HW=51.25' (Free Discharge)
└**1=Culvert** (Inlet Controls 20.60 cfs @ 6.6 fps)

## Pond 2P: (new Pond)



## Pond BMP-3: Basin 3

| | | | | | | |
|---|---|---|---|---|---|---|
| Inflow Area = | 7.200 ac, | Inflow Depth = | 3.88" | for | 10 yr event | |
| Inflow = | 27.05 cfs @ | 12.18 hrs, | Volume= | | 2.330 af | |
| Outflow = | 20.93 cfs @ | 12.33 hrs, | Volume= | | 2.027 af, | Atten= 23%, Lag= 8.6 min |
| Primary = | 20.93 cfs @ | 12.33 hrs, | Volume= | | 2.027 af | |

Routing by Stor-Ind method, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 67.12' @ 12.33 hrs Surf.Area= 6,647 sf Storage= 34,566 cf
Plug-Flow detention time= 248.4 min calculated for 2.027 af (87% of inflow)
Center-of-Mass det. time= 186.3 min ( 1,012.4 - 826.1 )

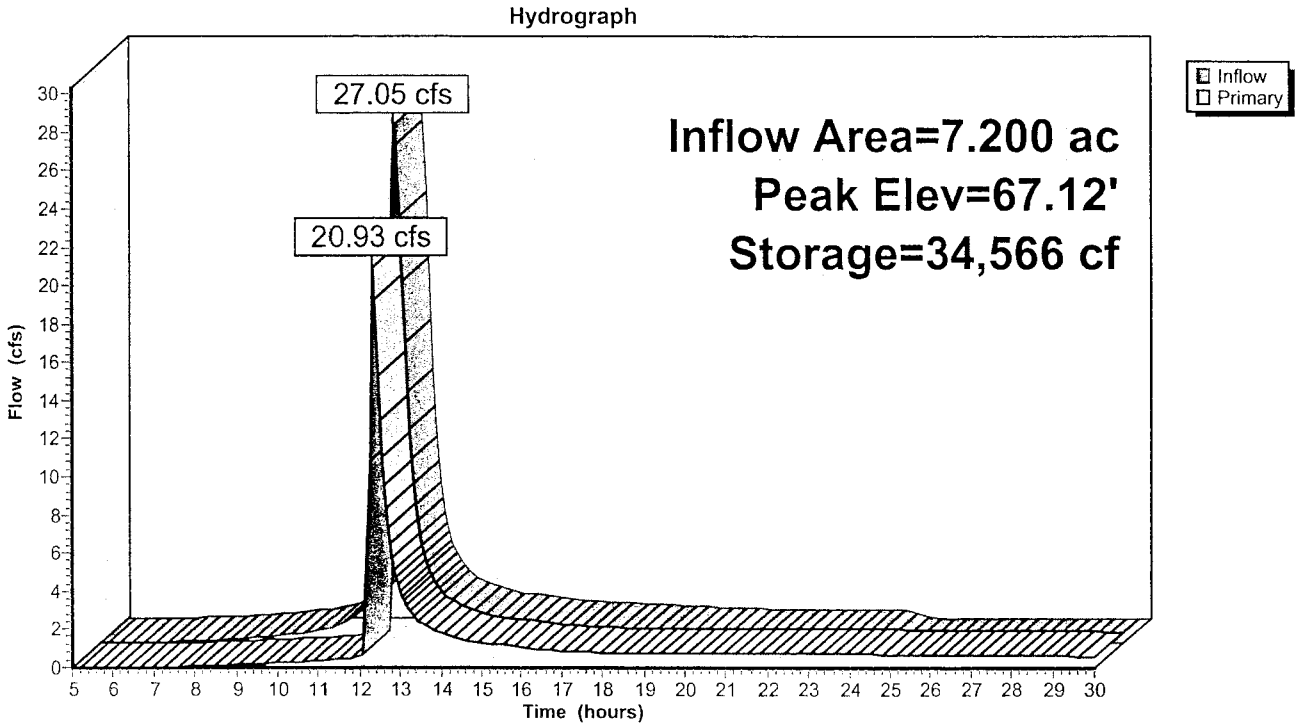
| # | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| 1 | 56.00' | 77,692 cf | **Custom Stage Data (Pyramidal)** Listed below |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) | Wet.Area (sq-ft) |
|---|---|---|---|---|
| 56.00 | 600 | 0 | 0 | 600 |
| 59.50 | 1,800 | 4,012 | 4,012 | 1,888 |
| 60.00 | 2,020 | 954 | 4,967 | 2,125 |
| 62.00 | 3,050 | 5,035 | 10,002 | 3,230 |
| 64.00 | 4,275 | 7,291 | 17,292 | 4,547 |
| 66.00 | 5,720 | 9,960 | 27,252 | 6,098 |
| 68.00 | 7,375 | 13,060 | 40,312 | 7,874 |
| 70.00 | 9,300 | 16,638 | 56,950 | 9,933 |
| 72.00 | 11,480 | 20,742 | 77,692 | 12,260 |

| # | Routing | Invert | Outlet Devices |
|---|---|---|---|
| 1 | Primary | 55.00' | **24.0" x 60.0' long Culvert** RCP, square edge headwall, Ke= 0.500<br>Outlet Invert= 50.40' S= 0.0767 '/' n= 0.012 Cc= 0.900 |
| 2 | Device 1 | 56.00' | **3.0" x 10.0' long Culvert** RCP, square edge headwall, Ke= 0.500<br>Outlet Invert= 55.50' S= 0.0500 '/' n= 0.012 Cc= 0.900 |
| 3 | Device 1 | 66.50' | **48.0" Horiz. Orifice/Grate** Limited to weir flow C= 0.600 |

**Primary OutFlow** Max=20.48 cfs @ 12.33 hrs HW=67.11' (Free Discharge)
└─**1=Culvert** (Passes 20.48 cfs of 50.43 cfs potential flow)
  ├─**2=Culvert** (Barrel Controls 0.74 cfs @ 15.1 fps)
  └─**3=Orifice/Grate** (Weir Controls 19.73 cfs @ 2.6 fps)

## Pond BMP-3: Basin 3



## Subcatchment Post Dev: 1/3 Acre Lots

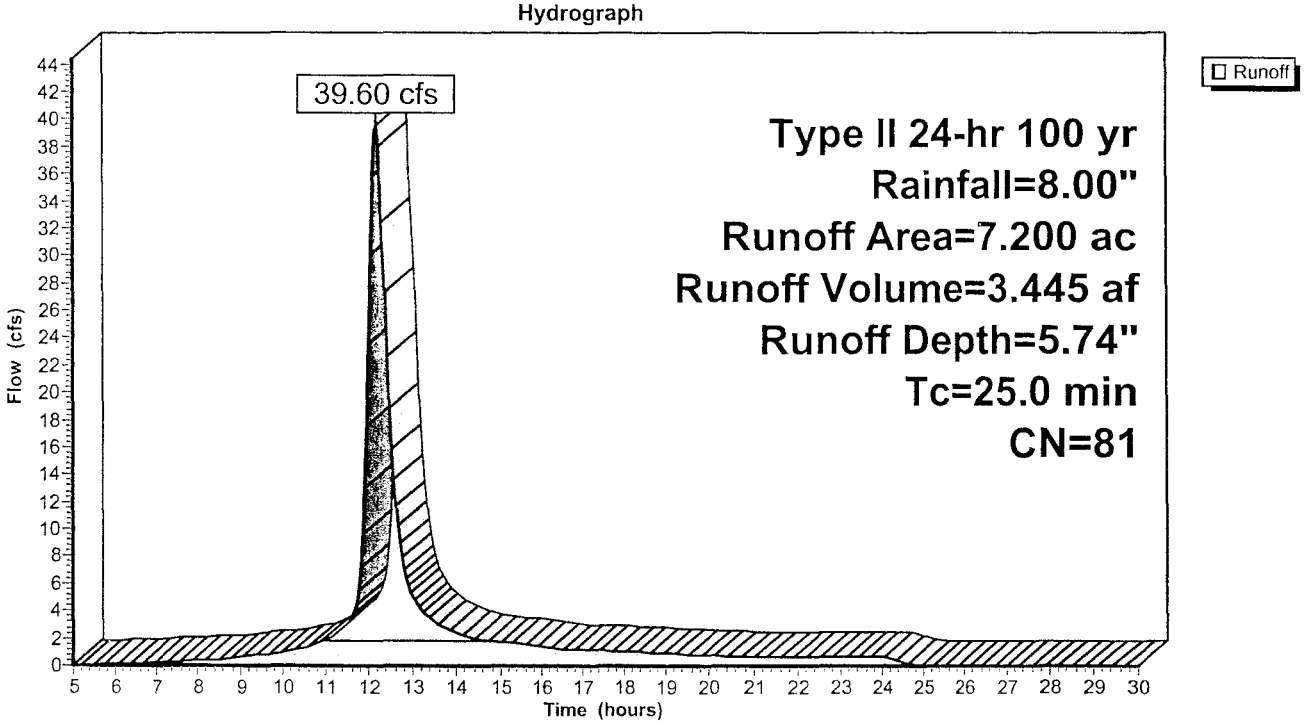
Runoff = 39.60 cfs @ 12.18 hrs, Volume= 3.445 af, Depth= 5.74"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Type II 24-hr 100 yr Rainfall=8.00"

| Area (ac) | CN | Description |
|---|---|---|
| 7.200 | 81 | 1/3 acre lots, 30% imp, HSG C |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 25.0 | | | | | **Direct Entry,** |

## Subcatchment Post Dev: 1/3 Acre Lots



## Pond 2P: (new Pond)

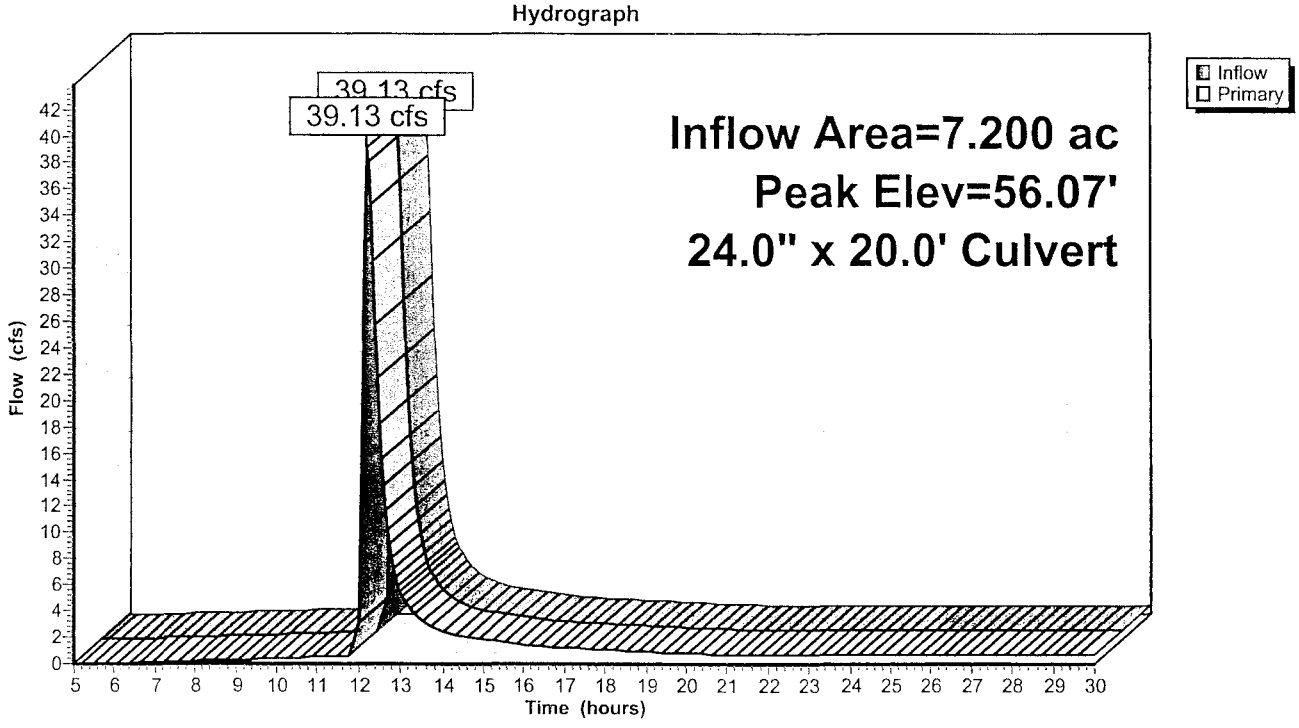
| | | | | | |
|---|---|---|---|---|---|
| Inflow Area = | 7.200 ac, | Inflow Depth = | 5.13" | for | 100 yr event |
| Inflow = | 39.13 cfs @ | 12.22 hrs, | Volume= | 3.079 af | |
| Outflow = | 39.13 cfs @ | 12.22 hrs, | Volume= | 3.079 af, | Atten= 0%, Lag= 0.0 min |
| Primary = | 39.13 cfs @ | 12.22 hrs, | Volume= | 3.079 af | |

Routing by Stor-Ind method, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 56.07' @ 12.22 hrs
Plug-Flow detention time= 0.0 min calculated for 3.079 af (100% of inflow)
Center-of-Mass det. time= 0.0 min ( 934.8 - 934.8 )

| # | Routing | Invert | Outlet Devices |
|---|---|---|---|
| 1 | Primary | 48.40' | **24.0" x 20.0' long Culvert** RCP, square edge headwall, Ke= 0.500<br>Outlet Invert= 48.00' S= 0.0200 '/' n= 0.012 Cc= 0.900 |

**Primary OutFlow** Max=38.28 cfs @ 12.22 hrs HW=55.80' (Free Discharge)
└**1=Culvert** (Inlet Controls 38.28 cfs @ 12.2 fps)

## Pond 2P: (new Pond)



## Pond BMP-3: Basin 3

| | | | | | |
|---|---|---|---|---|---|
| Inflow Area = | 7.200 ac, | Inflow Depth = | 5.74" | for | 100 yr event |
| Inflow = | 39.60 cfs @ | 12.18 hrs, | Volume= | 3.445 af | |
| Outflow = | 39.13 cfs @ | 12.22 hrs, | Volume= | 3.079 af, | Atten= 1%, Lag= 2.7 min |
| Primary = | 39.13 cfs @ | 12.22 hrs, | Volume= | 3.079 af | |

Routing by Stor-Ind method, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 67.45' @ 12.22 hrs Surf.Area= 6,923 sf Storage= 36,748 cf
Plug-Flow detention time= 172.3 min calculated for 3.073 af (89% of inflow)
Center-of-Mass det. time= 119.8 min ( 934.8 - 815.0 )

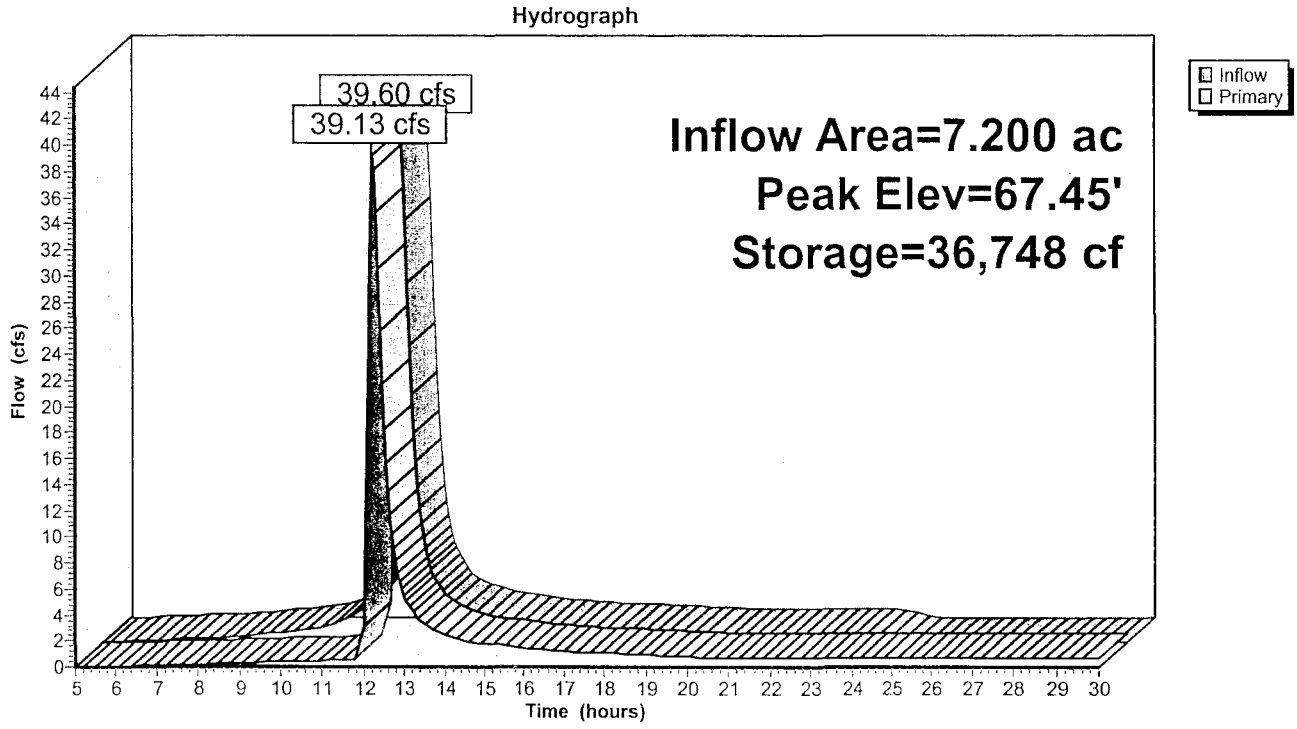
| # | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| 1 | 56.00' | 77,692 cf | **Custom Stage Data (Pyramidal)** Listed below |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) | Wet.Area (sq-ft) |
|---|---|---|---|---|
| 56.00 | 600 | 0 | 0 | 600 |
| 59.50 | 1,800 | 4,012 | 4,012 | 1,888 |
| 60.00 | 2,020 | 954 | 4,967 | 2,125 |
| 62.00 | 3,050 | 5,035 | 10,002 | 3,230 |
| 64.00 | 4,275 | 7,291 | 17,292 | 4,547 |
| 66.00 | 5,720 | 9,960 | 27,252 | 6,098 |
| 68.00 | 7,375 | 13,060 | 40,312 | 7,874 |
| 70.00 | 9,300 | 16,638 | 56,950 | 9,933 |
| 72.00 | 11,480 | 20,742 | 77,692 | 12,260 |

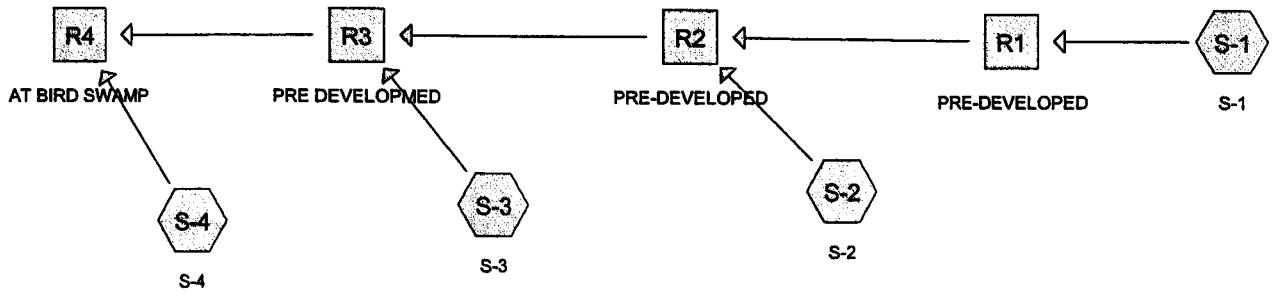
| # | Routing | Invert | Outlet Devices |
|---|---|---|---|
| 1 | Primary | 55.00' | **24.0" x 60.0' long Culvert** RCP, square edge headwall, Ke= 0.500<br>Outlet Invert= 50.40' S= 0.0767 '/' n= 0.012 Cc= 0.900 |
| 2 | Device 1 | 56.00' | **3.0" x 10.0' long Culvert** RCP, square edge headwall, Ke= 0.500<br>Outlet Invert= 55.50' S= 0.0500 '/' n= 0.012 Cc= 0.900 |
| 3 | Device 1 | 66.50' | **48.0" Horiz. Orifice/Grate** Limited to weir flow C= 0.600 |

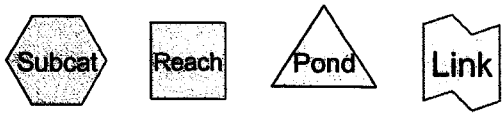
**Primary OutFlow** Max=38.17 cfs @ 12.22 hrs HW=67.44' (Free Discharge)
└**1=Culvert** (Passes 38.17 cfs of 51.16 cfs potential flow)
  ├**2=Culvert** (Barrel Controls 0.75 cfs @ 15.3 fps)
  └**3=Orifice/Grate** (Weir Controls 37.42 cfs @ 3.2 fps)

## Pond BMP-3: Basin 3



# CHANNEL 1
# PRE-DEVELOPMENT




**Drainage Diagram for channel 1 pre development**
Prepared by LANDMARK DESIGN GROUP 11/4/2004
HydroCAD® 7.00 s/n 001765 © 1986-2003 Applied Microcomputer Systems

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment S-1: S-1** Runoff Area=19.200 ac Runoff Depth=0.53"
Flow Length=950' Tc=32.6 min CN=70 Runoff=7.72 cfs 0.844 af

**Subcatchment S-2: S-2** Runoff Area=42.800 ac Runoff Depth=0.52"
Flow Length=1,460' Tc=58.5 min CN=70 Runoff=11.26 cfs 1.851 af

**Subcatchment S-3: S-3** Runoff Area=7.800 ac Runoff Depth=0.52"
Flow Length=2,200' Tc=47.3 min CN=70 Runoff=2.40 cfs 0.340 af

**Subcatchment S-4: S-4** Runoff Area=9.900 ac Runoff Depth=0.53"
Flow Length=680' Tc=18.9 min CN=70 Runoff=5.79 cfs 0.439 af

**Reach R1: PRE-DEVELOPED** Peak Depth=0.23' Max Vel=1.2 fps Inflow=7.72 cfs 0.844 af
n=0.040 L=830.0' S=0.0133 '/' Capacity=152.25 cfs Outflow=6.54 cfs 0.823 af

**Reach R2: PRE-DEVELOPED** Peak Depth=0.37' Max Vel=1.6 fps Inflow=17.78 cfs 2.674 af
n=0.040 L=515.0' S=0.0126 '/' Capacity=148.58 cfs Outflow=17.40 cfs 2.642 af

**Reach R3: PRE DEVELOPMED** Peak Depth=0.45' Max Vel=1.1 fps Inflow=19.22 cfs 2.982 af
n=0.040 L=660.0' S=0.0041 '/' Capacity=22.84 cfs Outflow=17.88 cfs 2.911 af

**Reach R4: AT BIRD SWAMP** Peak Depth=0.46' Max Vel=1.1 fps Inflow=18.67 cfs 3.350 af
n=0.040 L=10.0' S=0.0040 '/' Capacity=22.59 cfs Outflow=18.67 cfs 3.349 af

**Total Runoff Area = 79.700 ac Runoff Volume = 3.473 af Average Runoff Depth = 0.52"**

## Subcatchment S-1: S-1

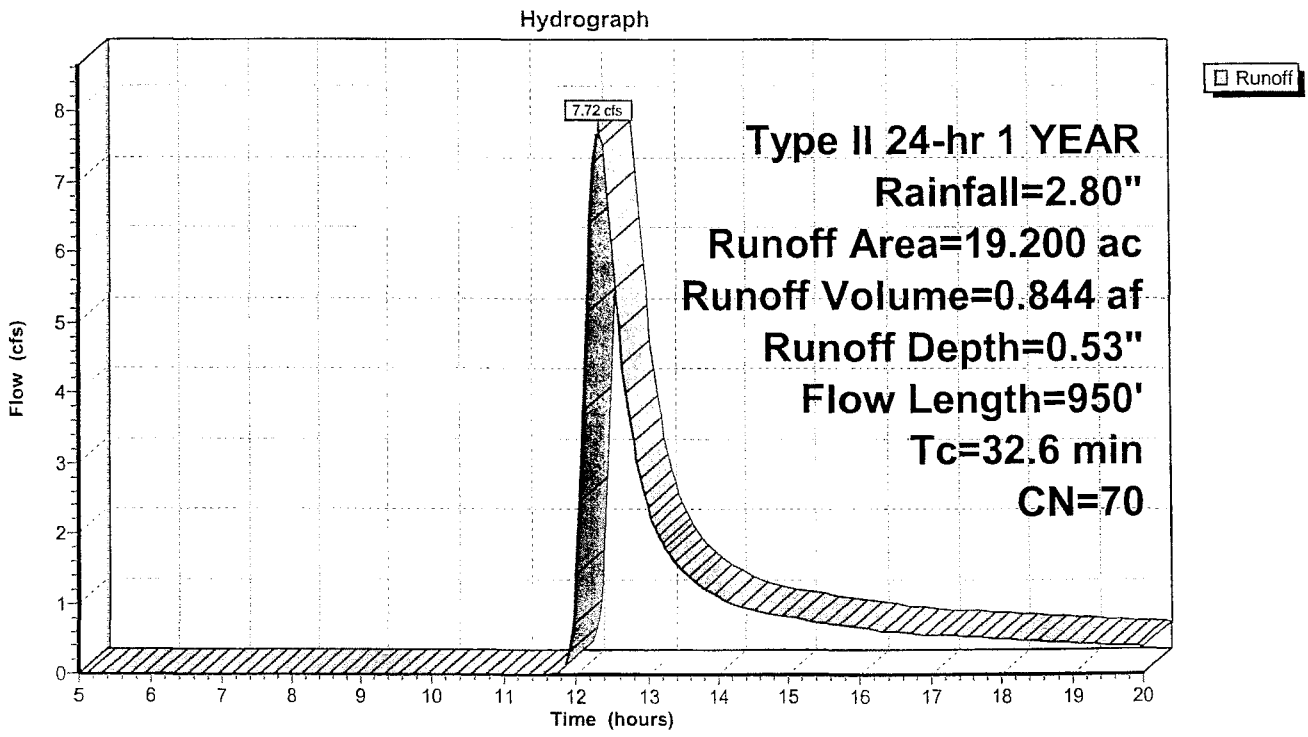
Runoff = 7.72 cfs @ 12.33 hrs, Volume= 0.844 af, Depth= 0.53"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 1 YEAR Rainfall=2.80"

| Area (ac) | CN | Description |
|---|---|---|
| 19.200 | 70 | Woods, Good, HSG C |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 23.0 | 100 | 0.0200 | 0.1 | | **Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.80" |
| 8.7 | 600 | 0.0530 | 1.2 | | **Shallow Concentrated Flow,** Woodland Kv= 5.0 fps |
| 0.9 | 250 | 0.0700 | 4.7 | 31.47 | **Parabolic Channel,** W=20.00' D=0.50' Area=6.7 sf Perim=20.0' n= 0.040 |
| 32.6 | 950 | Total | | | |

## Subcatchment S-1: S-1



## Subcatchment S-2: S-2

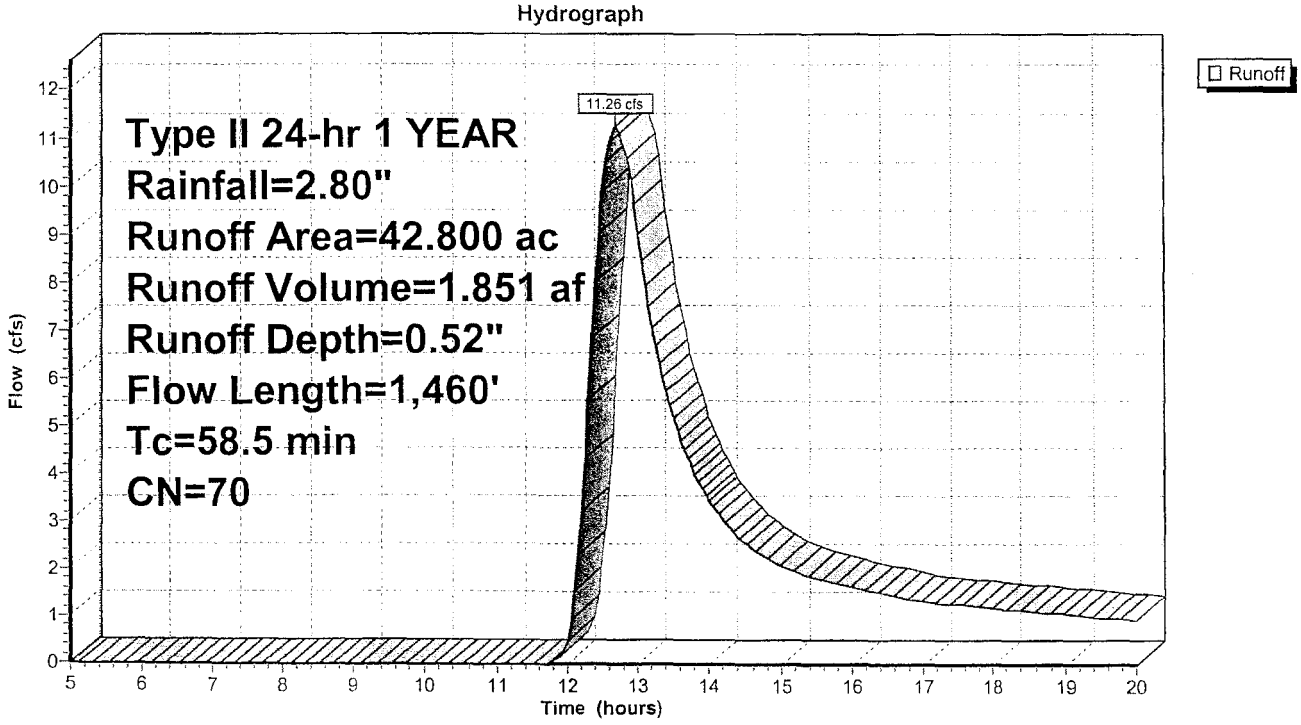
Runoff = 11.26 cfs @ 12.69 hrs, Volume= 1.851 af, Depth= 0.52"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 1 YEAR Rainfall=2.80"

| Area (ac) | CN | Description |
|---|---|---|
| 42.800 | 70 | Woods, Good, HSG C |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 46.4 | 300 | 0.0310 | 0.1 | | **Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.80" |
| 10.5 | 830 | 0.0700 | 1.3 | | **Shallow Concentrated Flow,** Woodland Kv= 5.0 fps |
| 1.6 | 330 | 0.0150 | 3.5 | 138.82 | **Parabolic Channel,** W=60.00' D=1.00' Area=40.0 sf Perim=60.0' n= 0.040 |
| 58.5 | 1,460 | Total | | | |

## Subcatchment S-2: S-2



## Subcatchment S-3: S-3

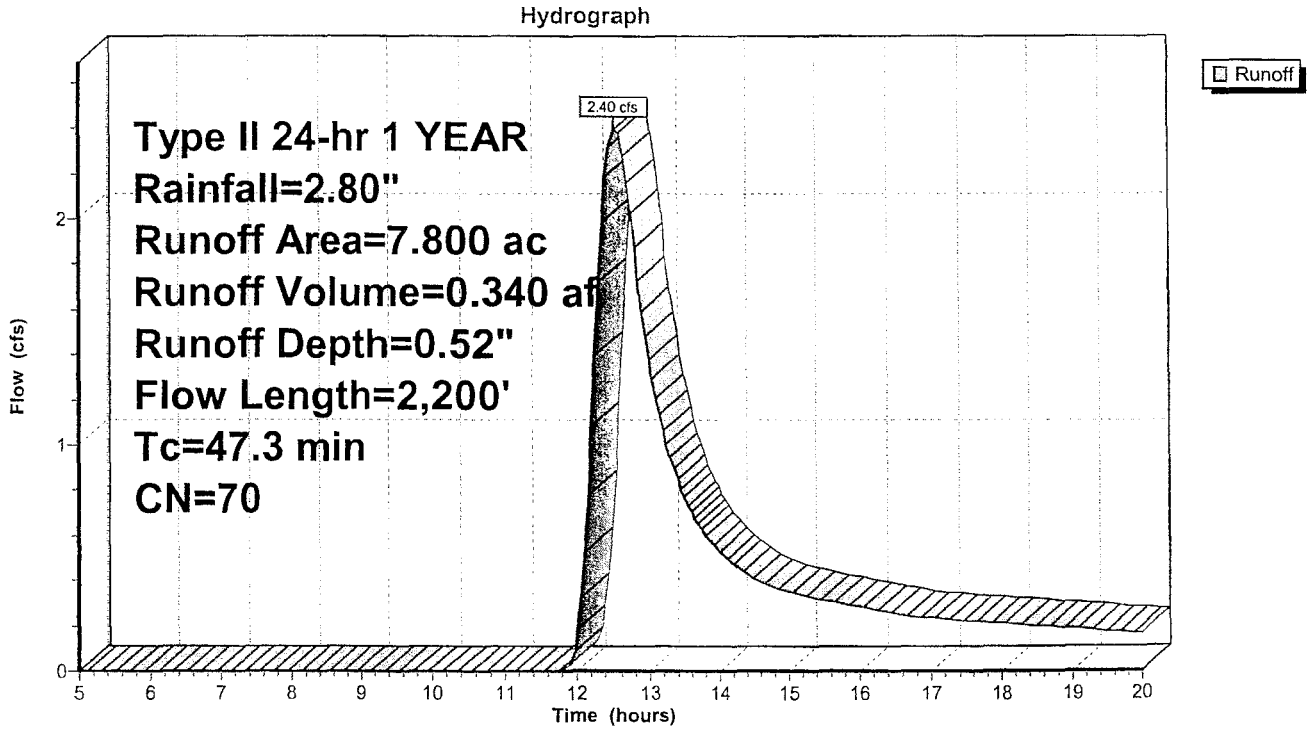
Runoff = 2.40 cfs @ 12.54 hrs, Volume= 0.340 af, Depth= 0.52"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 1 YEAR Rainfall=2.80"

| Area (ac) | CN | Description |
|---|---|---|
| 7.800 | 70 | Woods, Good, HSG C |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 33.1 | 300 | 0.0720 | 0.2 | | **Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.80" |
| 3.9 | 300 | 0.0670 | 1.3 | | **Shallow Concentrated Flow,** Woodland Kv= 5.0 fps |
| 10.3 | 1,600 | 0.0210 | 2.6 | 60.38 | **Parabolic Channel,** W=70.00' D=0.50' Area=23.3 sf Perim=70.0' n= 0.040 |
| 47.3 | 2,200 | Total | | | |

## Subcatchment S-3: S-3



## Subcatchment S-4: S-4

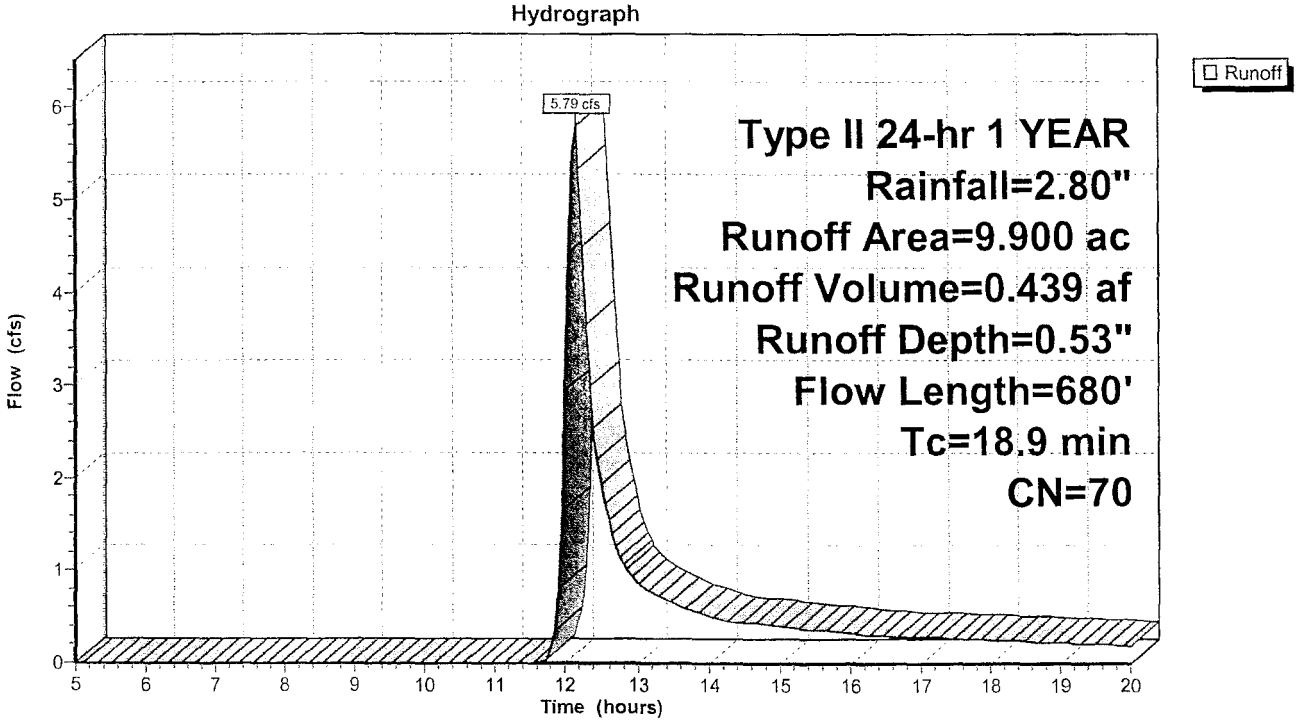
Runoff = 5.79 cfs @ 12.14 hrs, Volume= 0.439 af, Depth= 0.53"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 1 YEAR Rainfall=2.80"

| Area (ac) | CN | Description |
|---|---|---|
| 9.900 | 70 | Woods, Good, HSG C |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 14.4 | 130 | 0.1080 | 0.2 | | **Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.80" |
| 1.4 | 200 | 0.2250 | 2.4 | | **Shallow Concentrated Flow,** Woodland Kv= 5.0 fps |
| 3.1 | 350 | 0.0110 | 1.9 | 37.46 | **Parabolic Channel,** W=60.00' D=0.50' Area=20.0 sf Perim=60.0' n= 0.040 |
| 18.9 | 680 | Total | | | |

## Subcatchment S-4: S-4



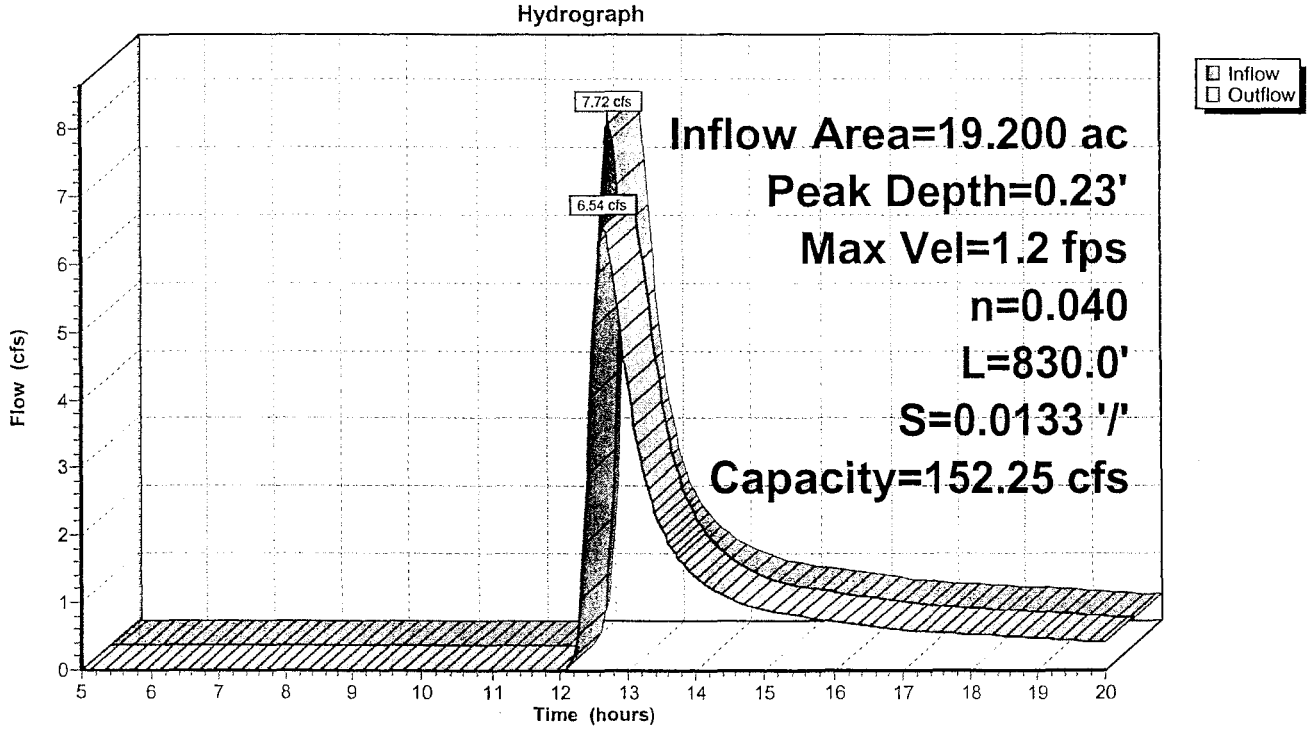
## Reach R1: PRE-DEVELOPED

Inflow Area = 19.200 ac, Inflow Depth = 0.53" for 1 YEAR event
Inflow = 7.72 cfs @ 12.33 hrs, Volume= 0.844 af
Outflow = 6.54 cfs @ 12.66 hrs, Volume= 0.823 af, Atten= 15%, Lag= 20.1 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.2 fps, Min. Travel Time= 11.2 min
Avg. Velocity = 0.7 fps, Avg. Travel Time= 20.7 min

Peak Depth= 0.23' @ 12.47 hrs
Capacity at bank full= 152.25 cfs
Inlet Invert= 54.00', Outlet Invert= 43.00'
70.00' x 1.00' deep Parabolic Channel, n= 0.040 Length= 830.0' Slope= 0.0133 '/'

## Reach R1: PRE-DEVELOPED



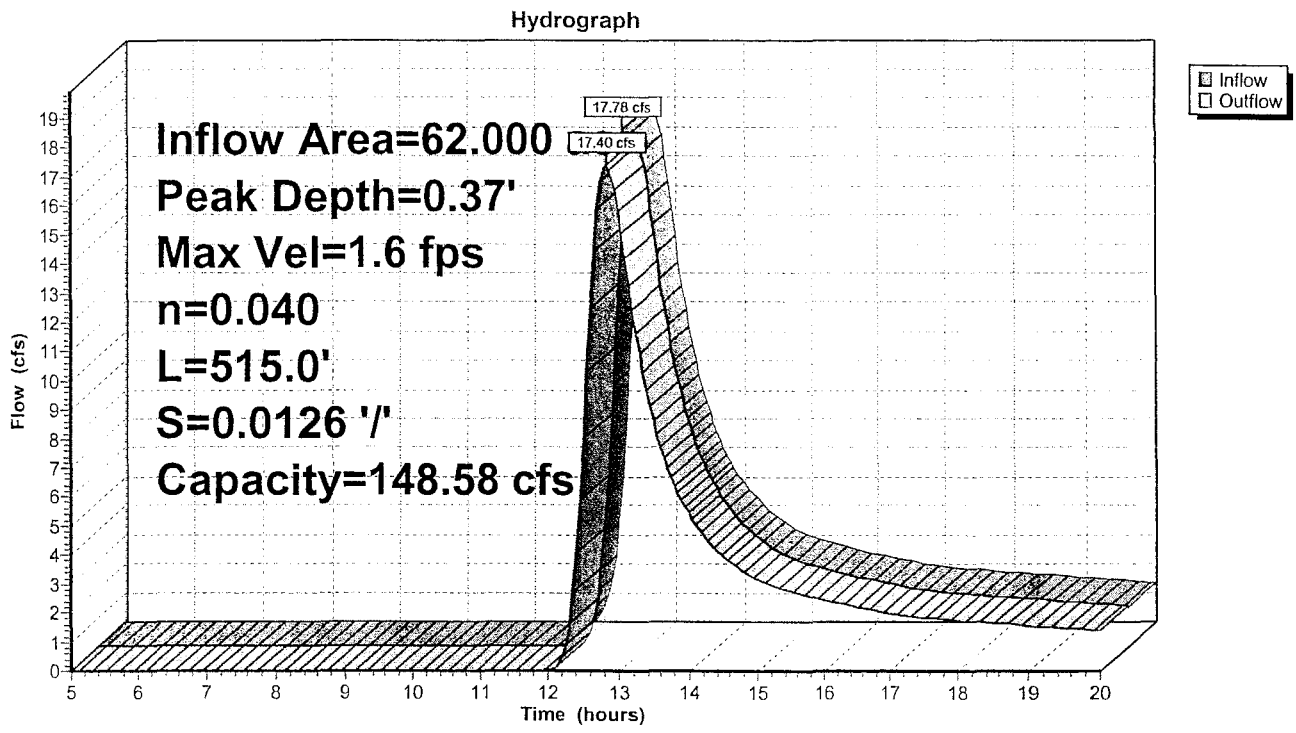
## Reach R2: PRE-DEVELOPED

Inflow Area = 62.000 ac, Inflow Depth = 0.52" for 1 YEAR event
Inflow = 17.78 cfs @ 12.67 hrs, Volume= 2.674 af
Outflow = 17.40 cfs @ 12.83 hrs, Volume= 2.642 af, Atten= 2%, Lag= 9.4 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.6 fps, Min. Travel Time= 5.2 min
Avg. Velocity = 0.9 fps, Avg. Travel Time= 9.1 min

Peak Depth= 0.37' @ 12.74 hrs
Capacity at bank full= 148.58 cfs
Inlet Invert= 43.00', Outlet Invert= 36.50'
70.00' x 1.00' deep Parabolic Channel, n= 0.040 Length= 515.0' Slope= 0.0126 '/'

## Reach R2: PRE-DEVELOPED



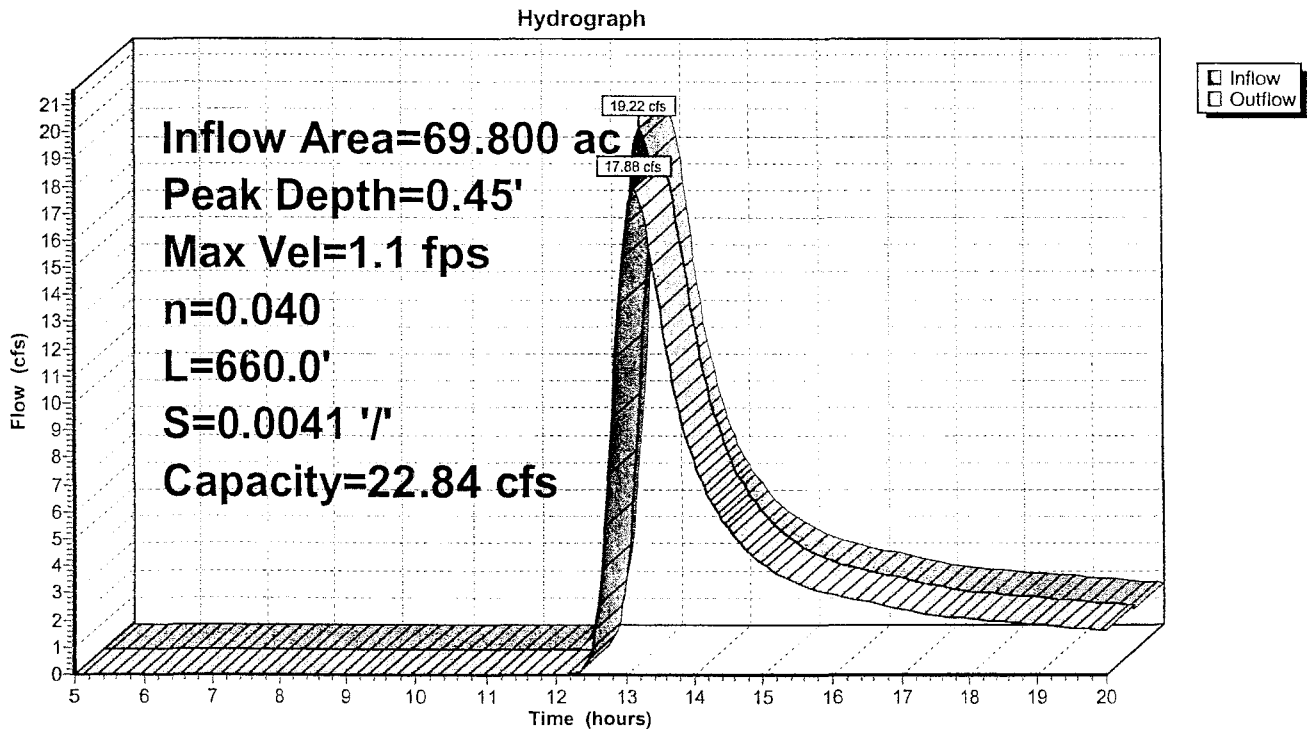
## Reach R3: PRE DEVELOPMED

Inflow Area = 69.800 ac, Inflow Depth = 0.51" for 1 YEAR event
Inflow = 19.22 cfs @ 12.81 hrs, Volume= 2.982 af
Outflow = 17.88 cfs @ 13.13 hrs, Volume= 2.911 af, Atten= 7%, Lag= 19.3 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.1 fps, Min. Travel Time= 10.4 min
Avg. Velocity = 0.6 fps, Avg. Travel Time= 17.8 min

Peak Depth= 0.45' @ 12.96 hrs
Capacity at bank full= 22.84 cfs
Inlet Invert= 34.50', Outlet Invert= 31.80'
60.00' x 0.50' deep Parabolic Channel, n= 0.040 Length= 660.0' Slope= 0.0041 '/'

## Reach R3: PRE DEVELOPMED



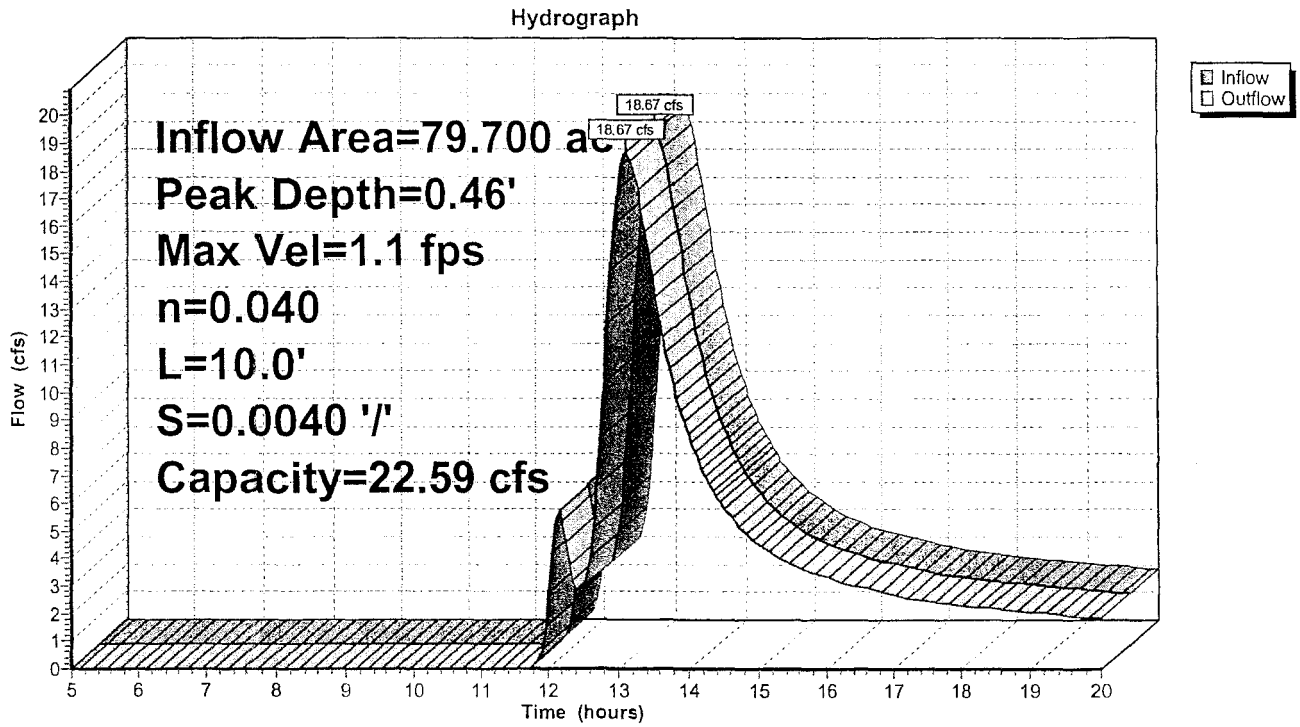
## Reach R4: AT BIRD SWAMP

Inflow Area = 79.700 ac, Inflow Depth = 0.50" for 1 YEAR event
Inflow = 18.67 cfs @ 13.13 hrs, Volume= 3.350 af
Outflow = 18.67 cfs @ 13.13 hrs, Volume= 3.349 af, Atten= 0%, Lag= 0.3 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.1 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 0.7 fps, Avg. Travel Time= 0.3 min

Peak Depth= 0.46' @ 13.13 hrs
Capacity at bank full= 22.59 cfs
Inlet Invert= 31.80', Outlet Invert= 31.76'
60.00' x 0.50' deep Parabolic Channel, n= 0.040 Length= 10.0' Slope= 0.0040 '/'

## Reach R4: AT BIRD SWAMP



Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment S-1: S-1** Runoff Area=19.200 ac Runoff Depth=0.89"
Flow Length=950' Tc=32.6 min CN=70 Runoff=14.26 cfs 1.428 af

**Subcatchment S-2: S-2** Runoff Area=42.800 ac Runoff Depth=0.88"
Flow Length=1,460' Tc=58.5 min CN=70 Runoff=20.80 cfs 3.138 af

**Subcatchment S-3: S-3** Runoff Area=7.800 ac Runoff Depth=0.89"
Flow Length=2,200' Tc=47.3 min CN=70 Runoff=4.43 cfs 0.575 af

**Subcatchment S-4: S-4** Runoff Area=9.900 ac Runoff Depth=0.90"
Flow Length=680' Tc=18.9 min CN=70 Runoff=10.53 cfs 0.741 af

**Reach R1: PRE-DEVELOPED** Peak Depth=0.32' Max Vel=1.5 fps Inflow=14.26 cfs 1.428 af
n=0.040 L=830.0' S=0.0133 '/' Capacity=152.25 cfs Outflow=12.72 cfs 1.401 af

**Reach R2: PRE-DEVELOPED** Peak Depth=0.50' Max Vel=2.0 fps Inflow=33.21 cfs 4.538 af
n=0.040 L=515.0' S=0.0126 '/' Capacity=148.58 cfs Outflow=32.71 cfs 4.498 af

**Reach R3: PRE DEVELOPMED** Peak Depth=0.62' Max Vel=1.3 fps Inflow=36.40 cfs 5.074 af
n=0.040 L=660.0' S=0.0041 '/' Capacity=22.84 cfs Outflow=34.27 cfs 4.983 af

**Reach R4: AT BIRD SWAMP** Peak Depth=0.63' Max Vel=1.3 fps Inflow=35.64 cfs 5.724 af
n=0.040 L=10.0' S=0.0040 '/' Capacity=22.59 cfs Outflow=35.63 cfs 5.723 af

**Total Runoff Area = 79.700 ac Runoff Volume = 5.882 af Average Runoff Depth = 0.89"**

## Subcatchment S-1: S-1

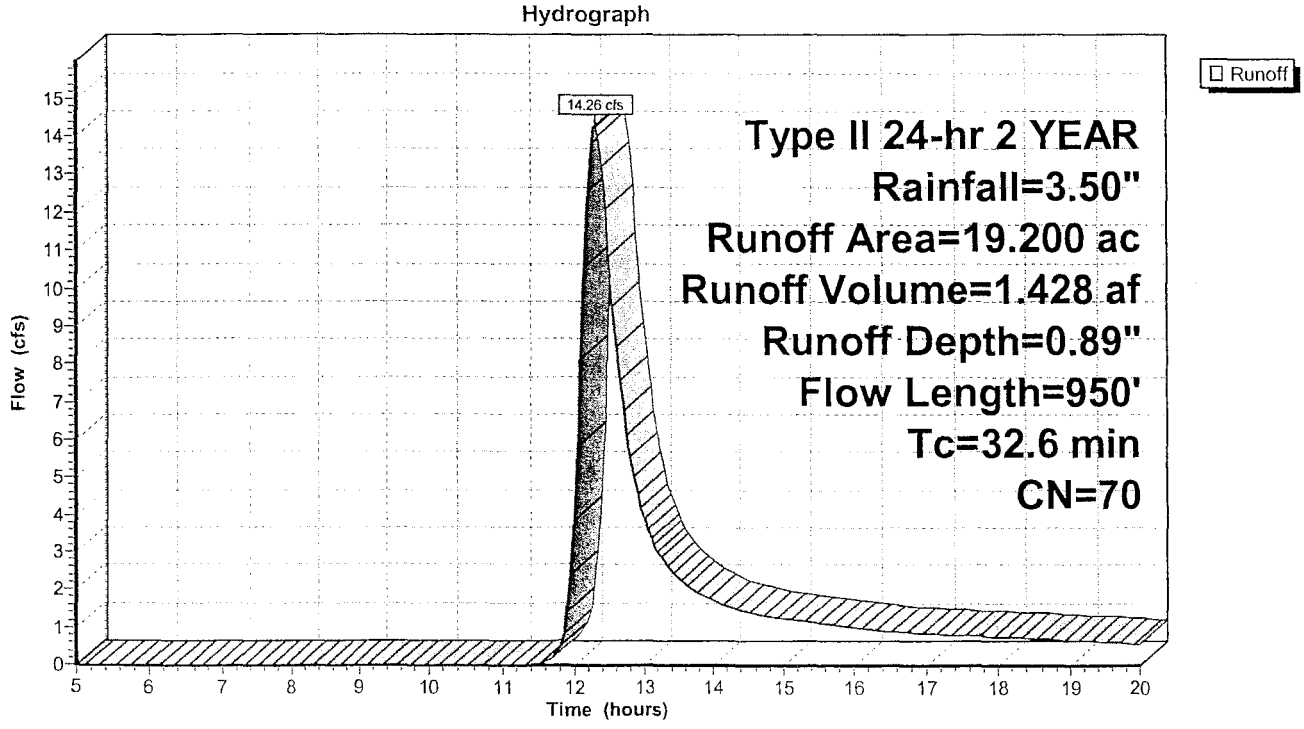
Runoff = 14.26 cfs @ 12.31 hrs, Volume= 1.428 af, Depth= 0.89"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 YEAR Rainfall=3.50"

| Area (ac) | CN | Description |
|---|---|---|
| 19.200 | 70 | Woods, Good, HSG C |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 23.0 | 100 | 0.0200 | 0.1 | | **Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.80" |
| 8.7 | 600 | 0.0530 | 1.2 | | **Shallow Concentrated Flow,** Woodland Kv= 5.0 fps |
| 0.9 | 250 | 0.0700 | 4.7 | 31.47 | **Parabolic Channel,** W=20.00' D=0.50' Area=6.7 sf Perim=20.0' n= 0.040 |
| 32.6 | 950 | Total | | | |

## Subcatchment S-1: S-1



## Subcatchment S-2: S-2

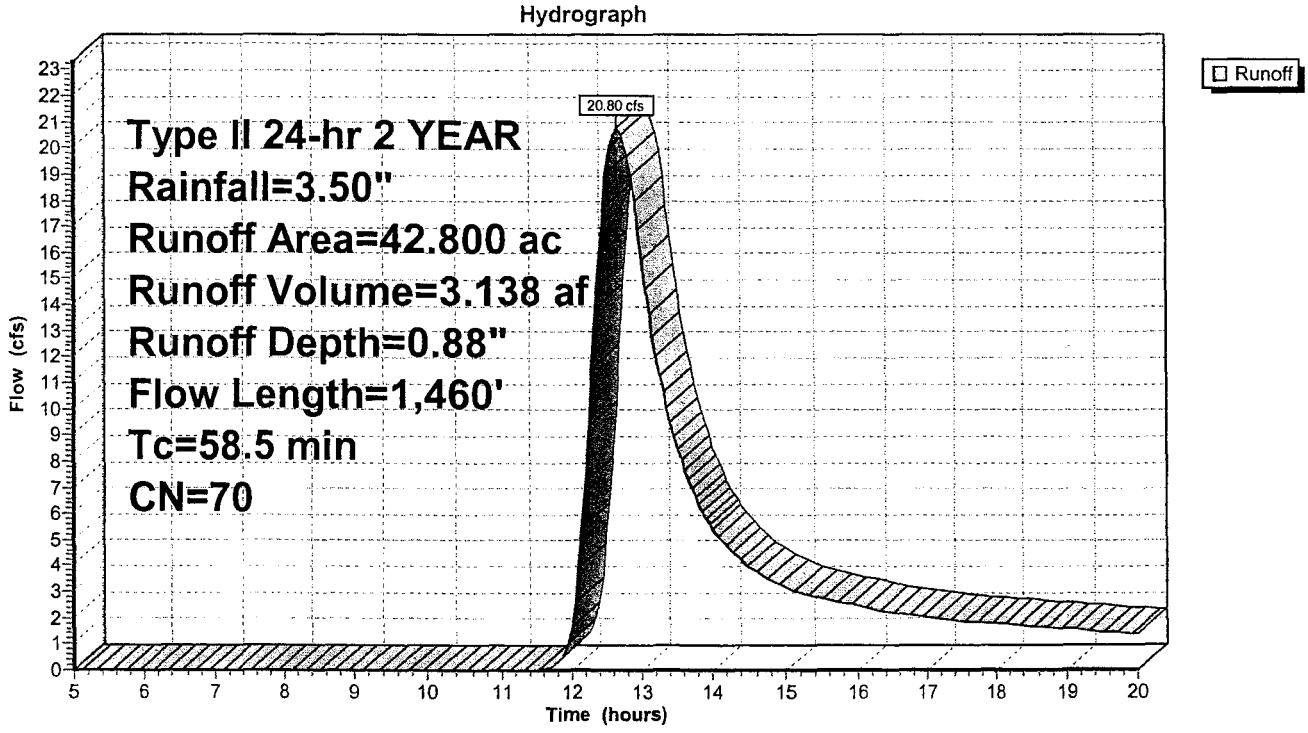
Runoff = 20.80 cfs @ 12.66 hrs, Volume= 3.138 af, Depth= 0.88"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 YEAR Rainfall=3.50"

| Area (ac) | CN | Description |
|---|---|---|
| 42.800 | 70 | Woods, Good, HSG C |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 46.4 | 300 | 0.0310 | 0.1 | | **Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.80" |
| 10.5 | 830 | 0.0700 | 1.3 | | **Shallow Concentrated Flow,** Woodland Kv= 5.0 fps |
| 1.6 | 330 | 0.0150 | 3.5 | 138.82 | **Parabolic Channel,** W=60.00' D=1.00' Area=40.0 sf Perim=60.0' n= 0.040 |
| 58.5 | 1,460 | Total | | | |

## Subcatchment S-2: S-2



## Subcatchment S-3: S-3

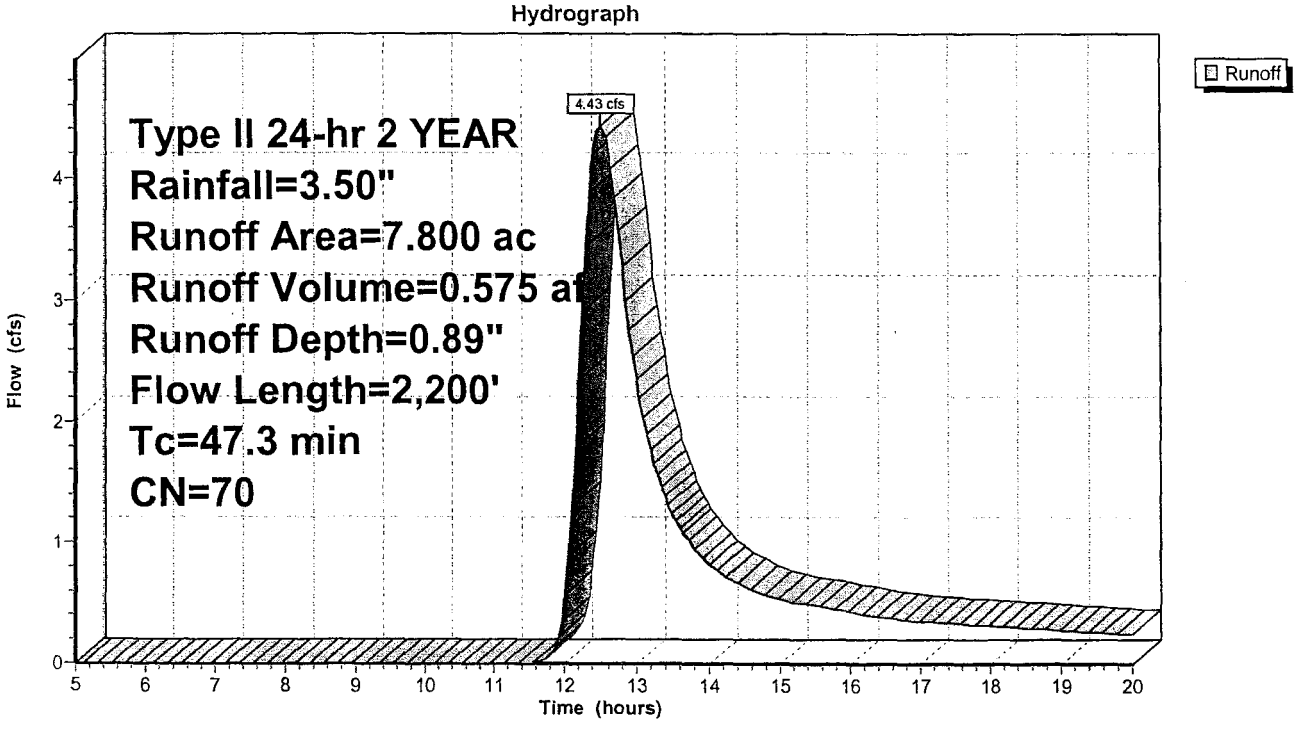
Runoff = 4.43 cfs @ 12.51 hrs, Volume= 0.575 af, Depth= 0.89"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 YEAR Rainfall=3.50"

| Area (ac) | CN | Description |
|---|---|---|
| 7.800 | 70 | Woods, Good, HSG C |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 33.1 | 300 | 0.0720 | 0.2 | | **Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.80" |
| 3.9 | 300 | 0.0670 | 1.3 | | **Shallow Concentrated Flow,** Woodland Kv= 5.0 fps |
| 10.3 | 1,600 | 0.0210 | 2.6 | 60.38 | **Parabolic Channel,** W=70.00' D=0.50' Area=23.3 sf Perim=70.0' n= 0.040 |
| 47.3 | 2,200 | Total | | | |

## Subcatchment S-3: S-3



## Subcatchment S-4: S-4

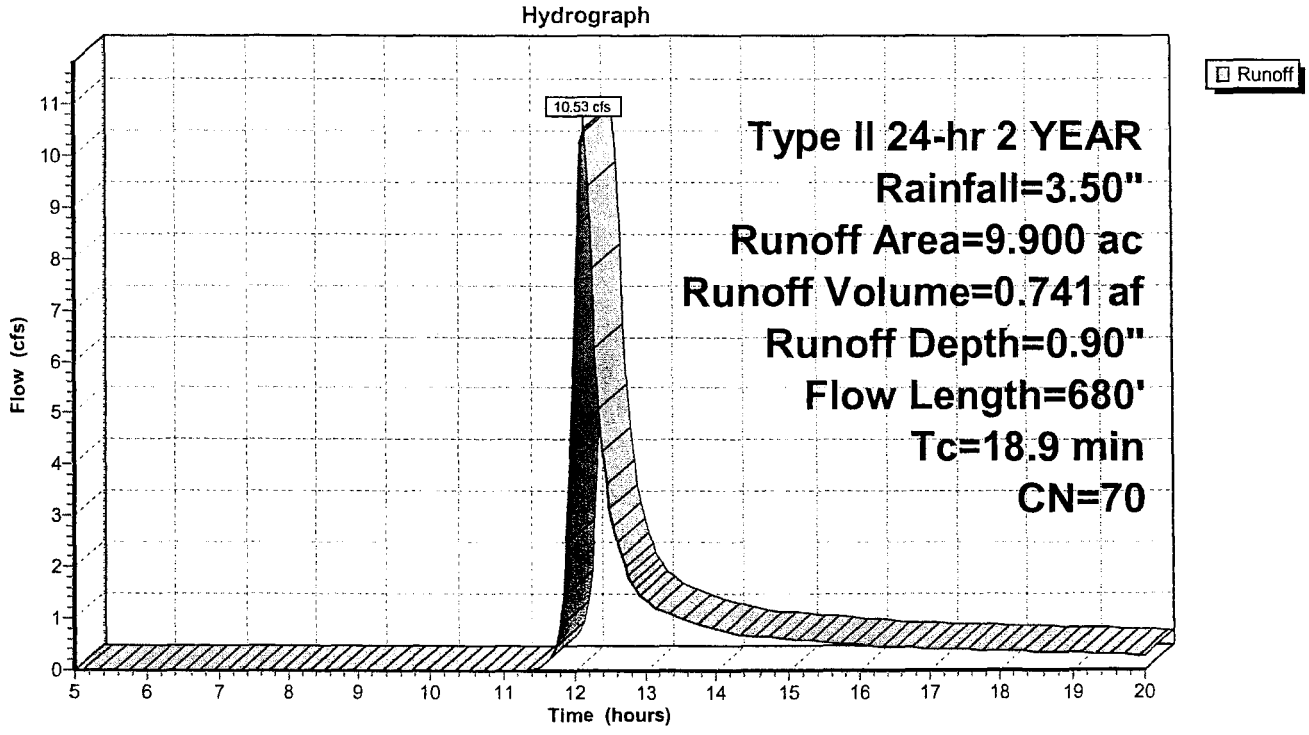
Runoff = 10.53 cfs @ 12.13 hrs, Volume= 0.741 af, Depth= 0.90"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 YEAR Rainfall=3.50"

| Area (ac) | CN | Description |
|---|---|---|
| 9.900 | 70 | Woods, Good, HSG C |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 14.4 | 130 | 0.1080 | 0.2 | | **Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.80" |
| 1.4 | 200 | 0.2250 | 2.4 | | **Shallow Concentrated Flow,** Woodland Kv= 5.0 fps |
| 3.1 | 350 | 0.0110 | 1.9 | 37.46 | **Parabolic Channel,** W=60.00' D=0.50' Area=20.0 sf Perim=60.0' n= 0.040 |
| 18.9 | 680 | Total | | | |

## Subcatchment S-4: S-4



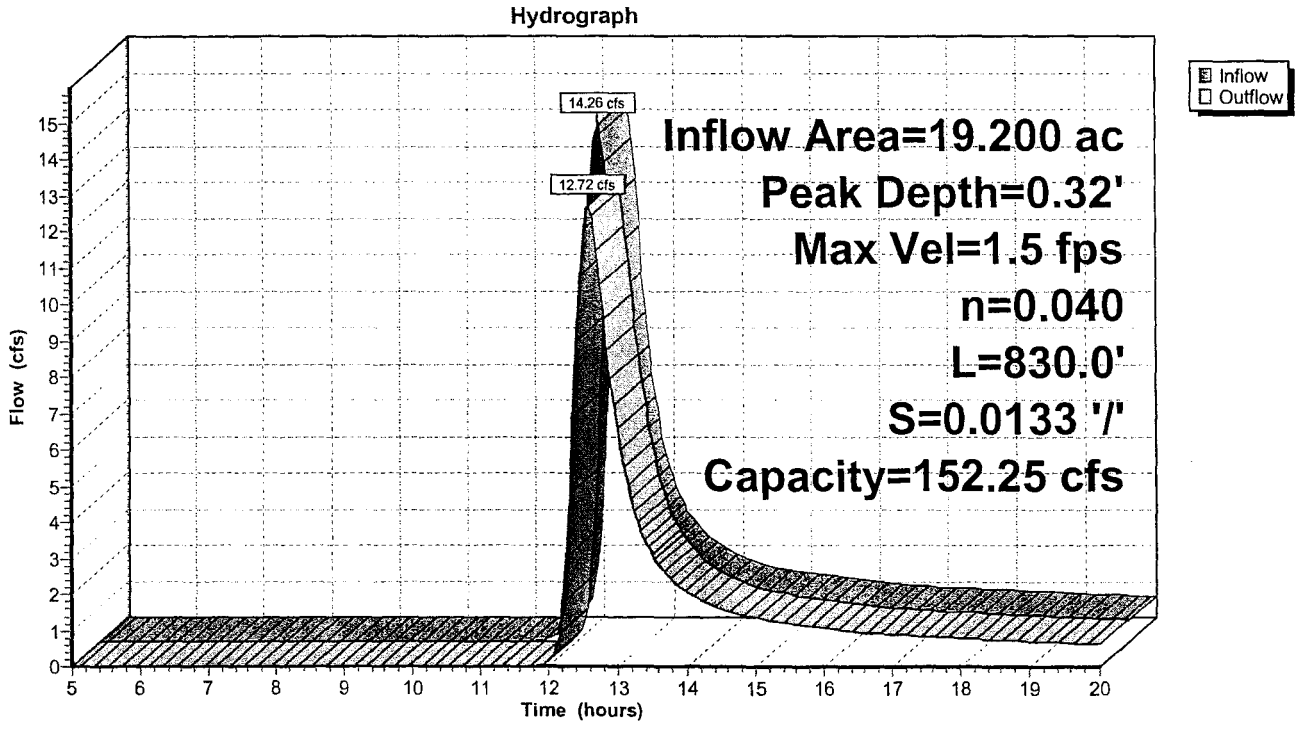
## Reach R1: PRE-DEVELOPED

Inflow Area = 19.200 ac, Inflow Depth = 0.89" for 2 YEAR event
Inflow = 14.26 cfs @ 12.31 hrs, Volume= 1.428 af
Outflow = 12.72 cfs @ 12.58 hrs, Volume= 1.401 af, Atten= 11%, Lag= 16.2 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.5 fps, Min. Travel Time= 9.1 min
Avg. Velocity = 0.7 fps, Avg. Travel Time= 18.5 min

Peak Depth= 0.32' @ 12.42 hrs
Capacity at bank full= 152.25 cfs
Inlet Invert= 54.00', Outlet Invert= 43.00'
70.00' x 1.00' deep Parabolic Channel, n= 0.040 Length= 830.0' Slope= 0.0133 '/'

## Reach R1: PRE-DEVELOPED



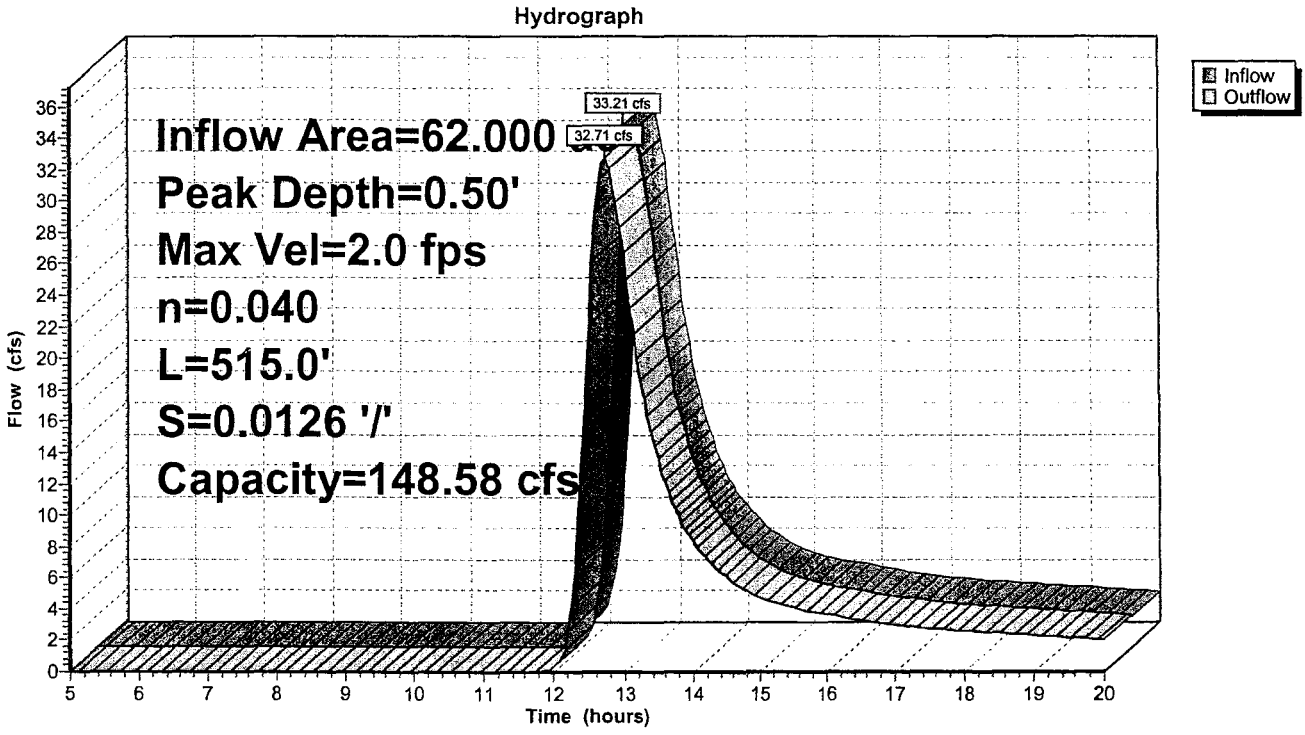
## Reach R2: PRE-DEVELOPED

Inflow Area = 62.000 ac, Inflow Depth = 0.88" for 2 YEAR event
Inflow = 33.21 cfs @ 12.61 hrs, Volume= 4.538 af
Outflow = 32.71 cfs @ 12.74 hrs, Volume= 4.498 af, Atten= 2%, Lag= 7.7 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.0 fps, Min. Travel Time= 4.3 min
Avg. Velocity = 1.1 fps, Avg. Travel Time= 8.1 min

Peak Depth= 0.50' @ 12.67 hrs
Capacity at bank full= 148.58 cfs
Inlet Invert= 43.00', Outlet Invert= 36.50'
70.00' x 1.00' deep Parabolic Channel, n= 0.040 Length= 515.0' Slope= 0.0126 '/'

## Reach R2: PRE-DEVELOPED



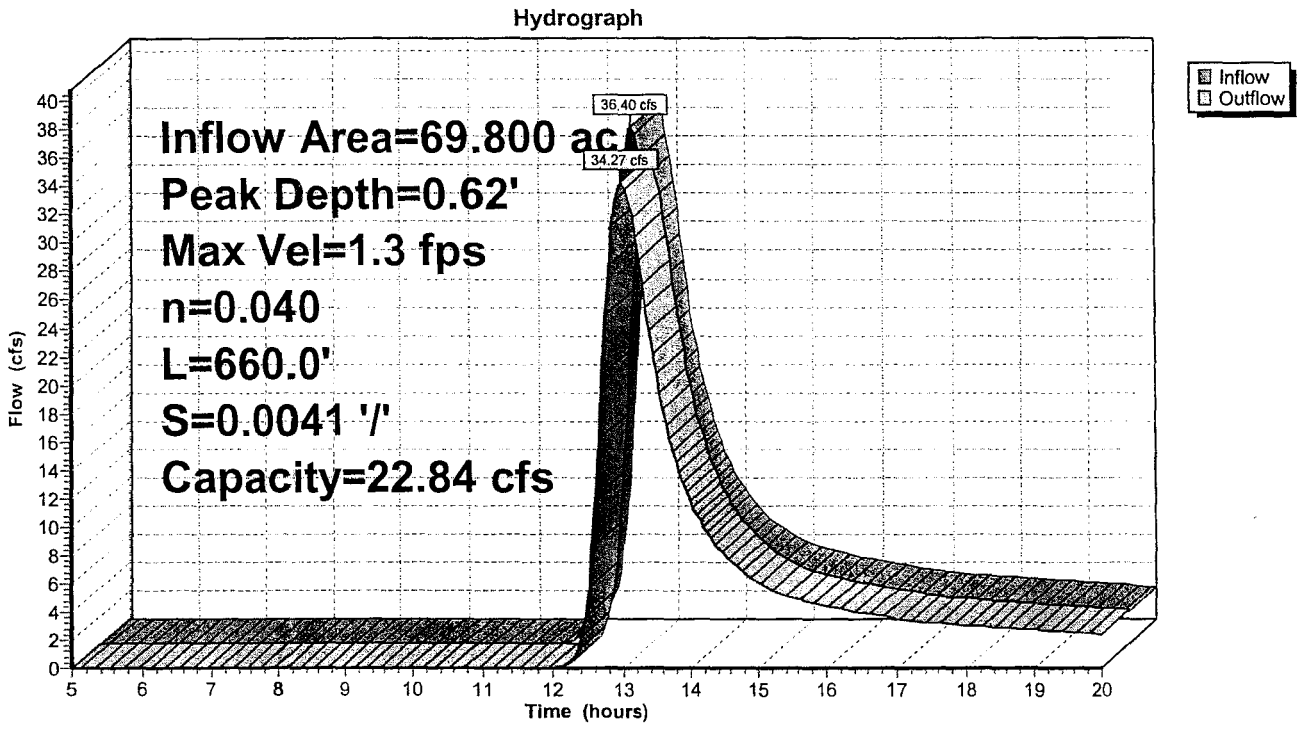
## Reach R3: PRE DEVELOPMED

Inflow Area = 69.800 ac, Inflow Depth = 0.87" for 2 YEAR event
Inflow = 36.40 cfs @ 12.72 hrs, Volume= 5.074 af
Outflow = 34.27 cfs @ 12.99 hrs, Volume= 4.983 af, Atten= 6%, Lag= 16.3 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.3 fps, Min. Travel Time= 8.6 min
Avg. Velocity = 0.7 fps, Avg. Travel Time= 15.9 min

Peak Depth= 0.62' @ 12.85 hrs
Capacity at bank full= 22.84 cfs
Inlet Invert= 34.50', Outlet Invert= 31.80'
60.00' x 0.50' deep Parabolic Channel, n= 0.040 Length= 660.0' Slope= 0.0041 '/'

## Reach R3: PRE DEVELOPMED



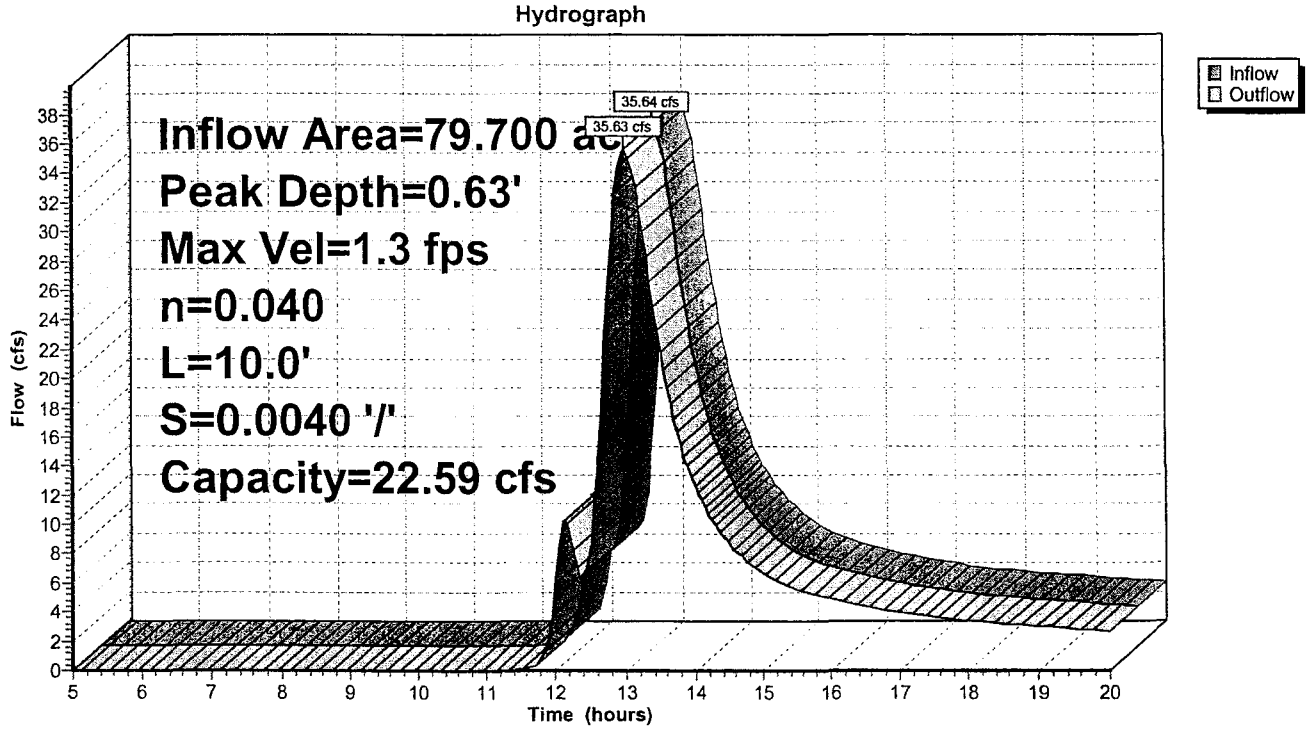
## Reach R4: AT BIRD SWAMP

Inflow Area = 79.700 ac, Inflow Depth = 0.86" for 2 YEAR event
Inflow = 35.64 cfs @ 12.99 hrs, Volume= 5.724 af
Outflow = 35.63 cfs @ 12.99 hrs, Volume= 5.723 af, Atten= 0%, Lag= 0.3 min

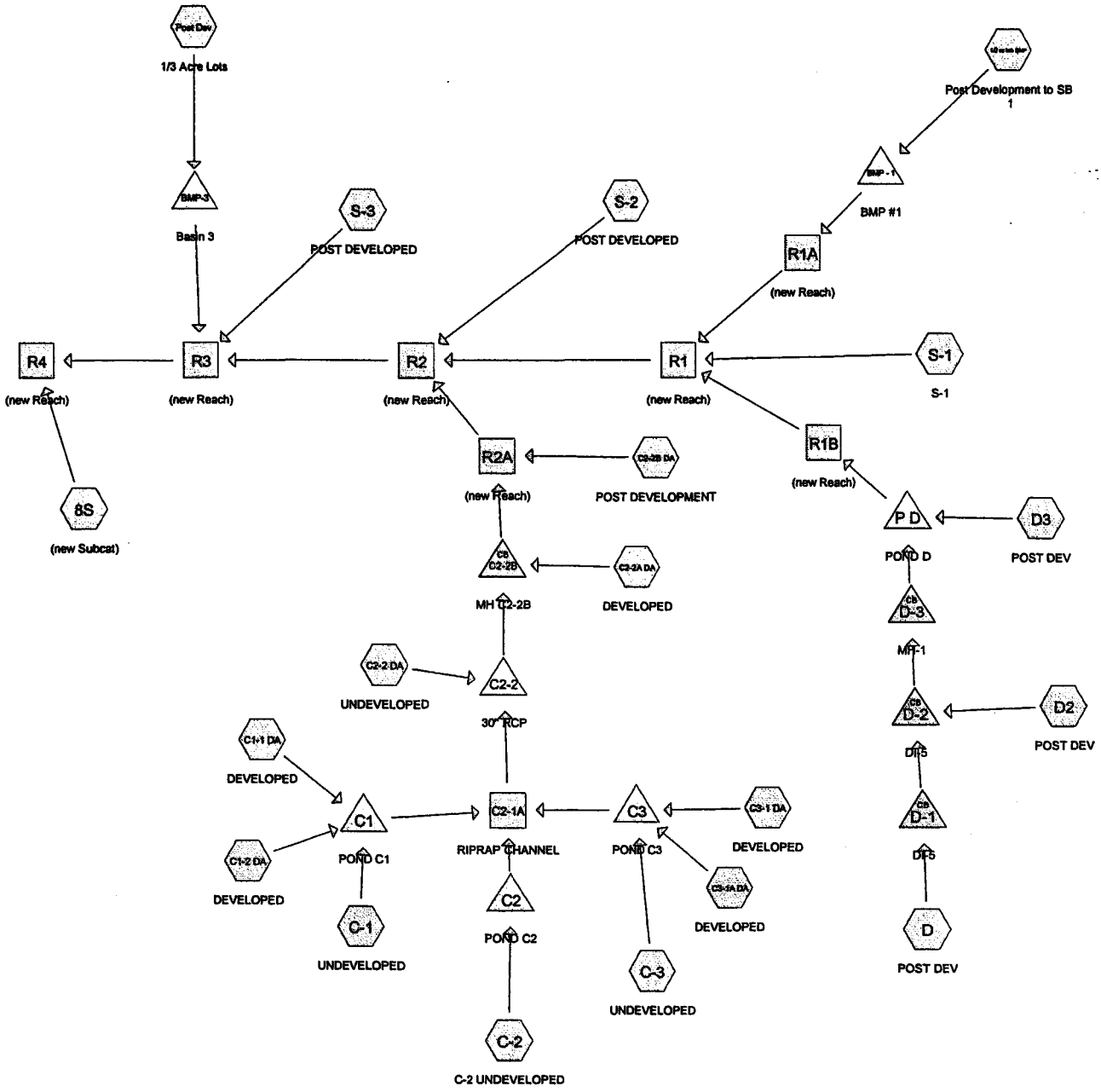
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.3 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 0.7 fps, Avg. Travel Time= 0.2 min

Peak Depth= 0.63' @ 12.99 hrs
Capacity at bank full= 22.59 cfs
Inlet Invert= 31.80', Outlet Invert= 31.76'
60.00' x 0.50' deep Parabolic Channel, n= 0.040 Length= 10.0' Slope= 0.0040 '/'

## Reach R4: AT BIRD SWAMP



# CHANNEL 1
# POST DEVELOPMENT




**Drainage Diagram for channel 1 POST development**
Prepared by LANDMARK DESIGN GROUP 11/4/2004
HydroCAD® 7.00 s/n 001765 © 1986-2003 Applied Microcomputer Systems

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment 1/3 ac lots BMP: Post Development to SB 1** Runoff Area=11.050 ac Runoff Depth=1.05"
Tc=20.0 min CN=81 Runoff=13.96 cfs 0.971 af

**Subcatchment 8S: (new Subcat)** Runoff Area=7.700 ac Runoff Depth=0.65"
Flow Length=680' Tc=18.9 min CN=73 Runoff=5.85 cfs 0.419 af

**Subcatchment C-1: UNDEVELOPED** Runoff Area=1.560 ac Runoff Depth=0.53"
Tc=15.0 min CN=70 Runoff=1.05 cfs 0.069 af

**Subcatchment C-2: C-2 UNDEVELOPED** Runoff Area=2.000 ac Runoff Depth=0.53"
Tc=25.0 min CN=70 Runoff=0.97 cfs 0.088 af

**Subcatchment C-3: UNDEVELOPED** Runoff Area=4.200 ac Runoff Depth=0.53"
Flow Length=560' Tc=25.6 min CN=70 Runoff=2.00 cfs 0.185 af

**Subcatchment C1-1 DA: DEVELOPED** Runoff Area=0.330 ac Runoff Depth=1.85"
Tc=5.0 min CN=92 Runoff=1.12 cfs 0.051 af

**Subcatchment C1-2 DA: DEVELOPED** Runoff Area=0.640 ac Runoff Depth=1.84"
Tc=10.0 min CN=92 Runoff=1.86 cfs 0.098 af

**Subcatchment C2-2 DA: UNDEVELOPED** Runoff Area=1.000 ac Runoff Depth=1.06"
Tc=10.0 min CN=81 Runoff=1.75 cfs 0.088 af

**Subcatchment C2-2A DA: DEVELOPED** Runoff Area=0.480 ac Runoff Depth=1.84"
Tc=10.0 min CN=92 Runoff=1.39 cfs 0.074 af

**Subcatchment C2-2B DA: POST DEVELOPMENT** Runoff Area=0.350 ac Runoff Depth=0.95"
Flow Length=100' Tc=3.4 min CN=79 Runoff=0.70 cfs 0.028 af

**Subcatchment C3-1 DA: DEVELOPED** Runoff Area=0.760 ac Runoff Depth=1.85"
Tc=5.0 min CN=92 Runoff=2.59 cfs 0.117 af

**Subcatchment C3-1A DA: DEVELOPED** Runoff Area=0.510 ac Runoff Depth=1.85"
Tc=5.0 min CN=92 Runoff=1.74 cfs 0.078 af

**Subcatchment D: POST DEV** Runoff Area=3.670 ac Runoff Depth=0.79"
Flow Length=250' Tc=25.1 min CN=76 Runoff=2.93 cfs 0.241 af

**Subcatchment D2: POST DEV** Runoff Area=1.570 ac Runoff Depth=1.85"
Flow Length=620' Tc=5.0 min CN=92 Runoff=5.35 cfs 0.241 af

**Subcatchment D3: POST DEV** Runoff Area=2.200 ac Runoff Depth=0.53"
Tc=15.0 min CN=70 Runoff=1.48 cfs 0.098 af

**Subcatchment Post Dev: 1/3 Acre Lots** Runoff Area=7.600 ac Runoff Depth=1.05"
Tc=25.0 min CN=81 Runoff=8.39 cfs 0.666 af

**Subcatchment S-1: S-1** Runoff Area=5.250 ac Runoff Depth=0.53"
Flow Length=785' Tc=19.2 min CN=70 Runoff=3.04 cfs 0.233 af

**Subcatchment S-2: POST DEVELOPED** Runoff Area=24.200 ac Runoff Depth=0.60"
Flow Length=2,200' Tc=47.3 min CN=72 Runoff=8.96 cfs 1.214 af

**Subcatchment S-3: POST DEVELOPED** Runoff Area=5.800 ac Runoff Depth=0.61"
Tc=20.0 min CN=72 Runoff=3.93 cfs 0.295 af

**Reach C2-1A: RIPRAP CHANNEL** Peak Depth=0.11' Max Vel=1.8 fps Inflow=1.03 cfs 0.517 af
n=0.040 L=40.0' S=0.0500 '/' Capacity=177.27 cfs Outflow=1.03 cfs 0.517 af

**Reach R1: (new Reach)** Peak Depth=0.17' Max Vel=1.0 fps Inflow=4.14 cfs 1.272 af
n=0.040 L=830.0' S=0.0133 '/' Capacity=152.25 cfs Outflow=3.12 cfs 1.206 af

**Reach R1A: (new Reach)** Peak Depth=0.16' Max Vel=2.7 fps Inflow=1.06 cfs 0.684 af
n=0.040 L=180.0' S=0.0778 '/' Capacity=1,634.29 cfs Outflow=1.06 cfs 0.681 af

**Reach R1B: (new Reach)** Peak Depth=0.36' Max Vel=1.4 fps Inflow=0.55 cfs 0.372 af
n=0.040 L=831.0' S=0.0142 '/' Capacity=325.67 cfs Outflow=0.55 cfs 0.358 af

**Reach R2: (new Reach)** Peak Depth=0.33' Max Vel=1.5 fps Inflow=13.57 cfs 3.115 af
n=0.040 L=515.0' S=0.0126 '/' Capacity=148.58 cfs Outflow=13.28 cfs 3.061 af

**Reach R2A: (new Reach)** Peak Depth=0.31' Max Vel=2.0 fps Inflow=4.04 cfs 0.705 af
n=0.040 L=510.0' S=0.0176 '/' Capacity=125.75 cfs Outflow=3.65 cfs 0.695 af

**Reach R3: (new Reach)** Peak Depth=0.41' Max Vel=1.0 fps Inflow=15.34 cfs 4.021 af
n=0.040 L=660.0' S=0.0041 '/' Capacity=22.84 cfs Outflow=14.54 cfs 3.897 af

**Reach R4: (new Reach)** Peak Depth=0.42' Max Vel=1.0 fps Inflow=15.33 cfs 4.317 af
n=0.040 L=10.0' S=0.0040 '/' Capacity=22.59 cfs Outflow=15.33 cfs 4.315 af

**Pond BMP - 1: BMP #1** Peak Elev=78.55' Storage=23,005 cf Inflow=13.96 cfs 0.971 af
Outflow=1.06 cfs 0.684 af

**Pond BMP-3: Basin 3** Peak Elev=58.25' Storage=12,831 cf Inflow=8.39 cfs 0.666 af
Outflow=1.19 cfs 0.665 af

**Pond C1: POND C1** Peak Elev=74.05' Storage=4,449 cf Inflow=3.52 cfs 0.218 af
Outflow=0.40 cfs 0.205 af

**Pond C2: POND C2** Peak Elev=72.62' Storage=1,136 cf Inflow=0.97 cfs 0.088 af
Outflow=0.28 cfs 0.086 af

## Subcatchment 8S: (new Subcat)

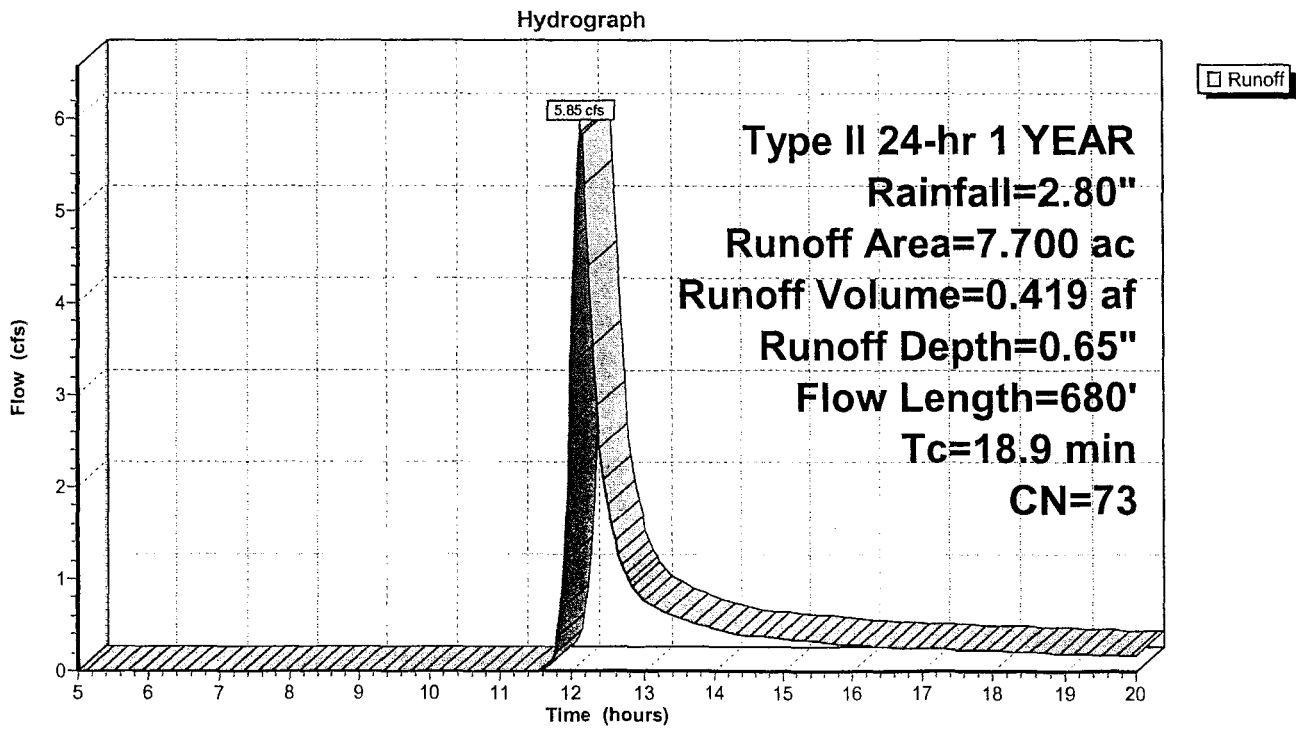
Runoff = 5.85 cfs @ 12.14 hrs, Volume= 0.419 af, Depth= 0.65"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 1 YEAR Rainfall=2.80"

| Area (ac) | CN | Description |
|---|---|---|
| 5.400 | 70 | Woods, Good, HSG C |
| 2.300 | 81 | 1/3 acre lots, 30% imp, HSG C |
| 7.700 | 73 | Weighted Average |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 14.4 | 130 | 0.1080 | 0.2 | | **Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.80" |
| 1.4 | 200 | 0.2250 | 2.4 | | **Shallow Concentrated Flow,** Woodland Kv= 5.0 fps |
| 3.1 | 350 | 0.0110 | 1.9 | 37.46 | **Parabolic Channel,** W=60.00' D=0.50' Area=20.0 sf Perim=60.0' n= 0.040 |
| 18.9 | 680 | Total | | | |

## Subcatchment 8S: (new Subcat)



## Subcatchment C-1: UNDEVELOPED

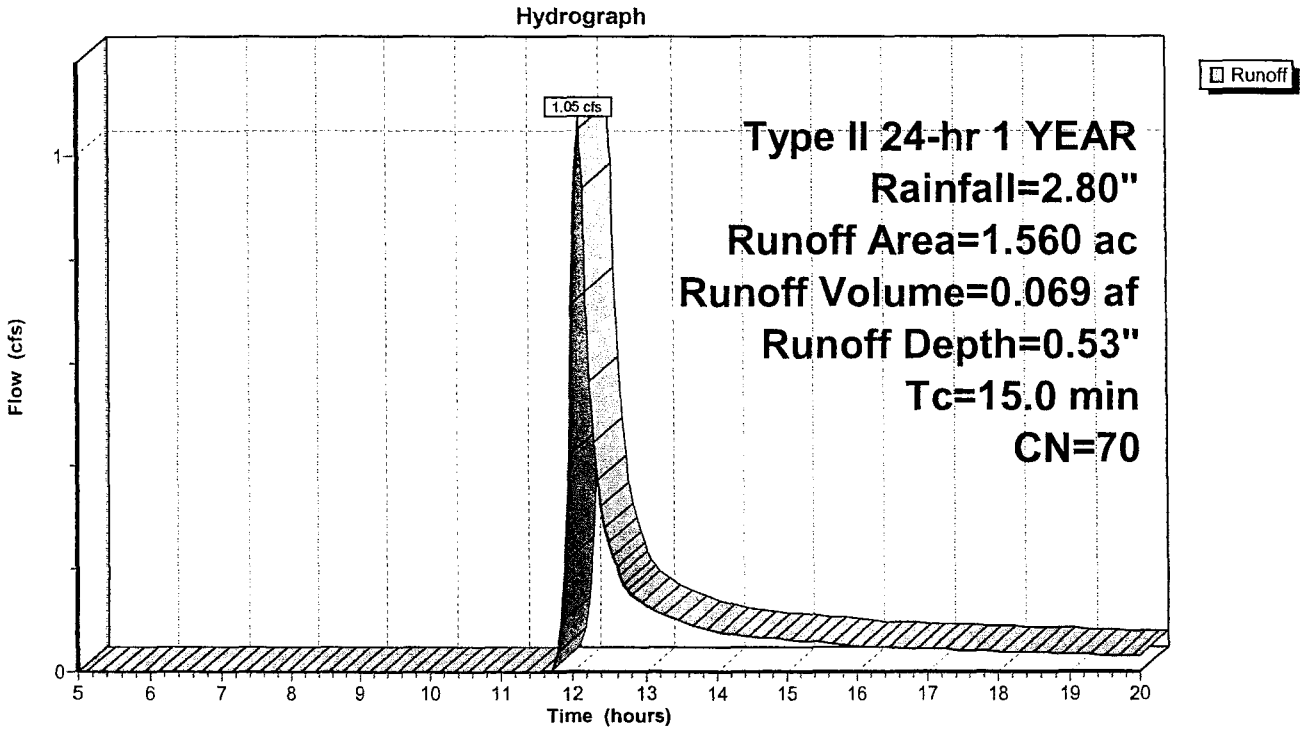
Runoff = 1.05 cfs @ 12.10 hrs, Volume= 0.069 af, Depth= 0.53"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 1 YEAR Rainfall=2.80"

| Area (ac) | CN | Description |
|---|---|---|
| 1.560 | 70 | Woods, Good, HSG C |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 15.0 | | | | | **Direct Entry,** |

## Subcatchment C-1: UNDEVELOPED



## Subcatchment C-2: C-2 UNDEVELOPED

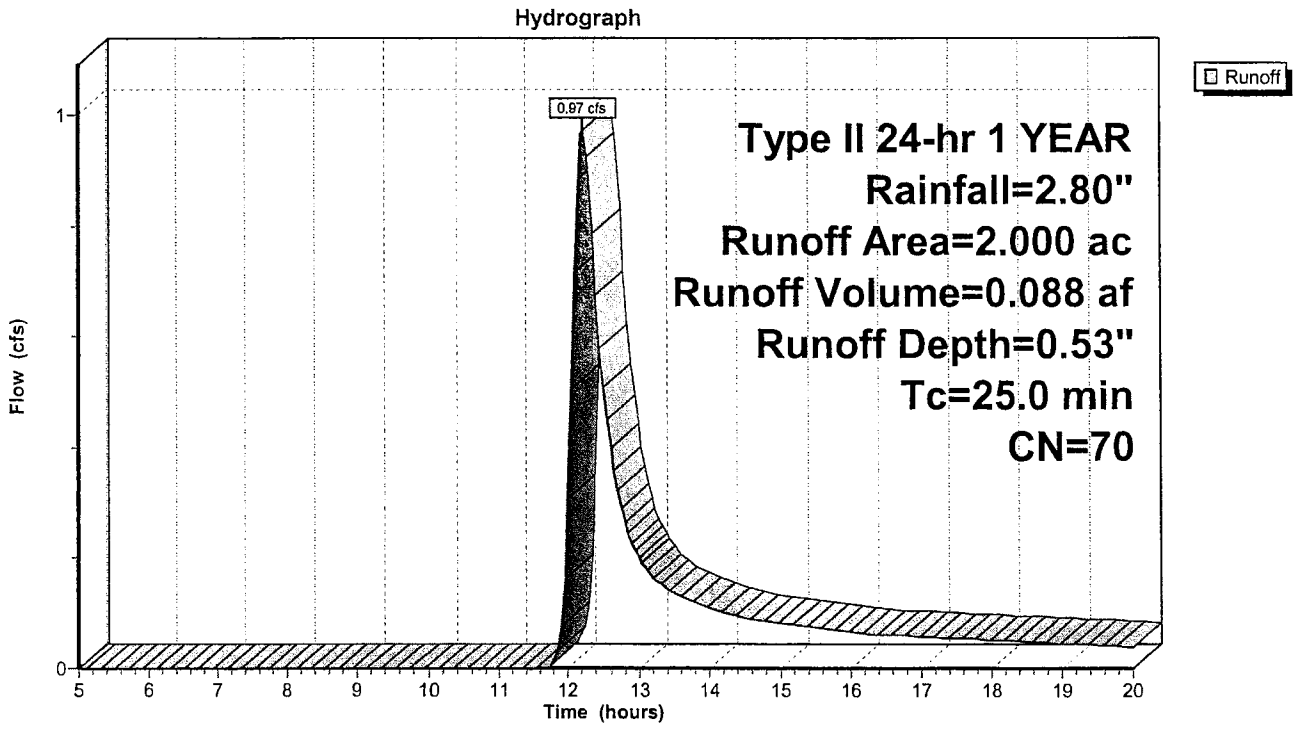
Runoff = 0.97 cfs @ 12.22 hrs, Volume= 0.088 af, Depth= 0.53"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 1 YEAR Rainfall=2.80"

| Area (ac) | CN | Description |
|---|---|---|
| 2.000 | 70 | Woods, Good, HSG C |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 25.0 | | | | | **Direct Entry,** |

## Subcatchment C-2: C-2 UNDEVELOPED



## Subcatchment C-3: UNDEVELOPED

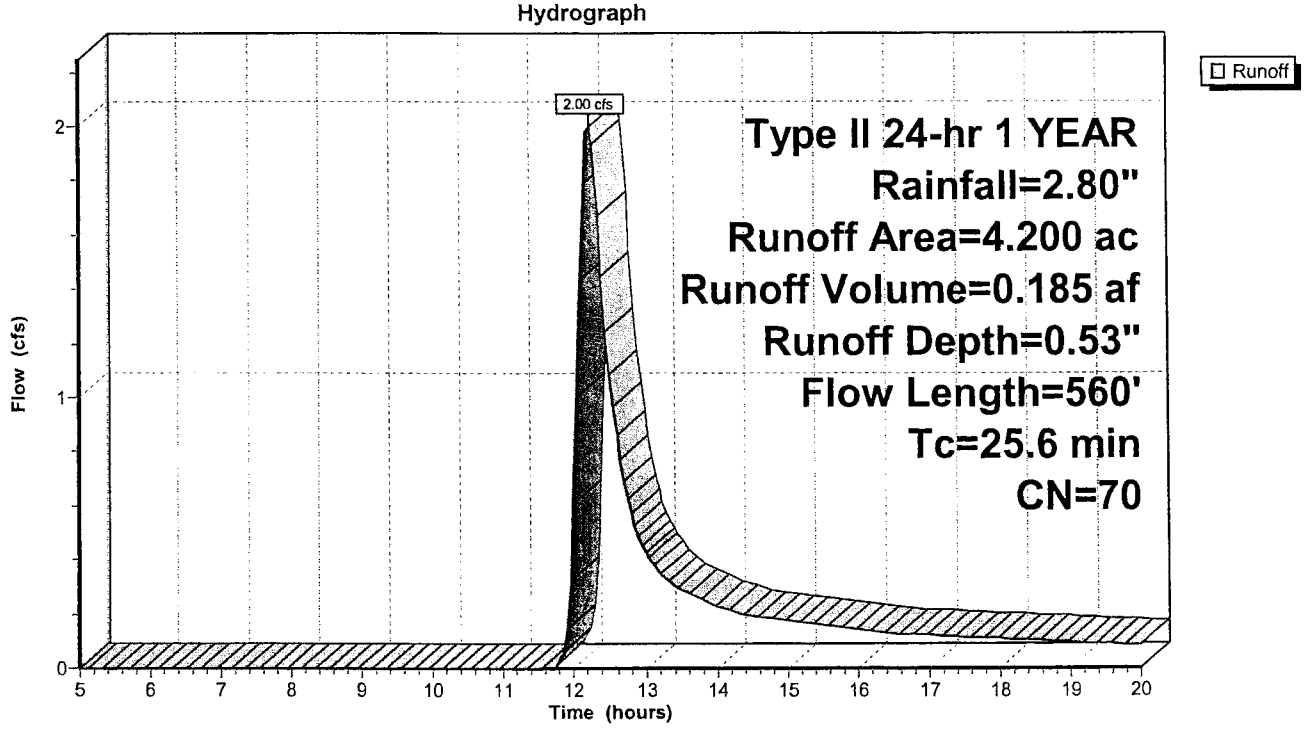
Runoff = 2.00 cfs @ 12.23 hrs, Volume= 0.185 af, Depth= 0.53"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 1 YEAR Rainfall=2.80"

| Area (ac) | CN | Description |
|---|---|---|
| 4.200 | 70 | Woods, Good, HSG C |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 19.5 | 100 | 0.0300 | 0.1 | | **Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.80" |
| 6.1 | 460 | 0.0630 | 1.3 | | **Shallow Concentrated Flow,** Woodland Kv= 5.0 fps |
| 25.6 | 560 | Total | | | |

## Subcatchment C-3: UNDEVELOPED



## Subcatchment C1-1 DA: DEVELOPED

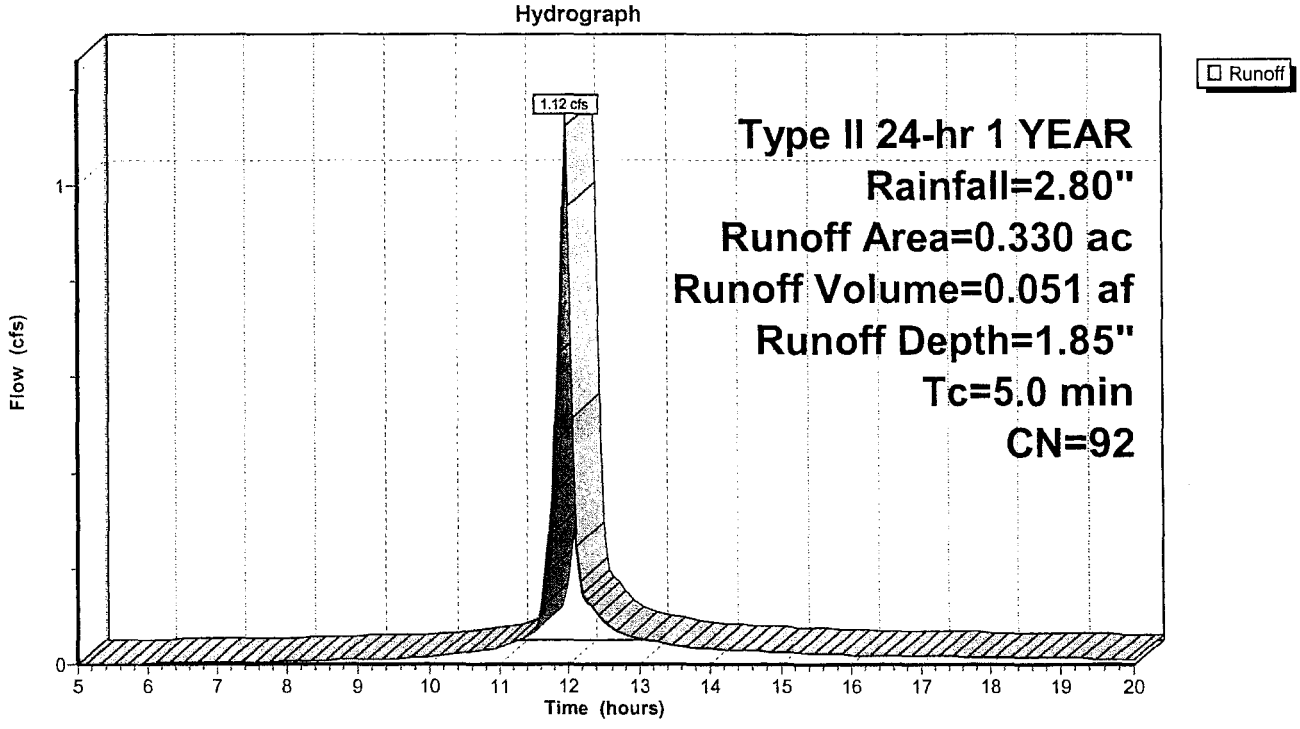
Runoff = 1.12 cfs @ 11.95 hrs, Volume= 0.051 af, Depth= 1.85"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 1 YEAR Rainfall=2.80"

| Area (ac) | CN | Description |
|---|---|---|
| 0.330 | 92 | Paved roads w/open ditches, HSG C |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.0 | | | | | **Direct Entry,** |

## Subcatchment C1-1 DA: DEVELOPED



## Subcatchment C1-2 DA: DEVELOPED

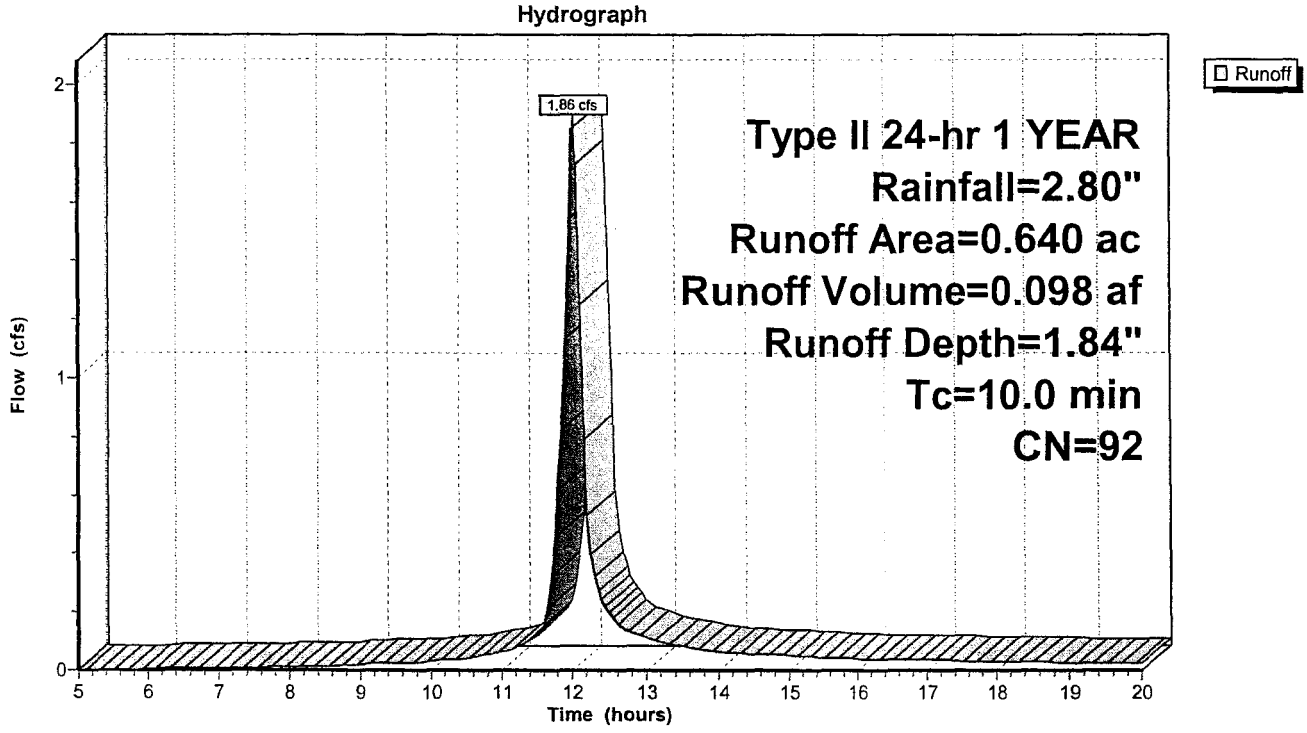
Runoff = 1.86 cfs @ 12.01 hrs, Volume= 0.098 af, Depth= 1.84"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 1 YEAR Rainfall=2.80"

| Area (ac) | CN | Description |
|---|---|---|
| 0.640 | 92 | Paved roads w/open ditches, HSG C |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 10.0 | | | | | **Direct Entry,** |

## Subcatchment C1-2 DA: DEVELOPED



## Subcatchment C2-2 DA: UNDEVELOPED

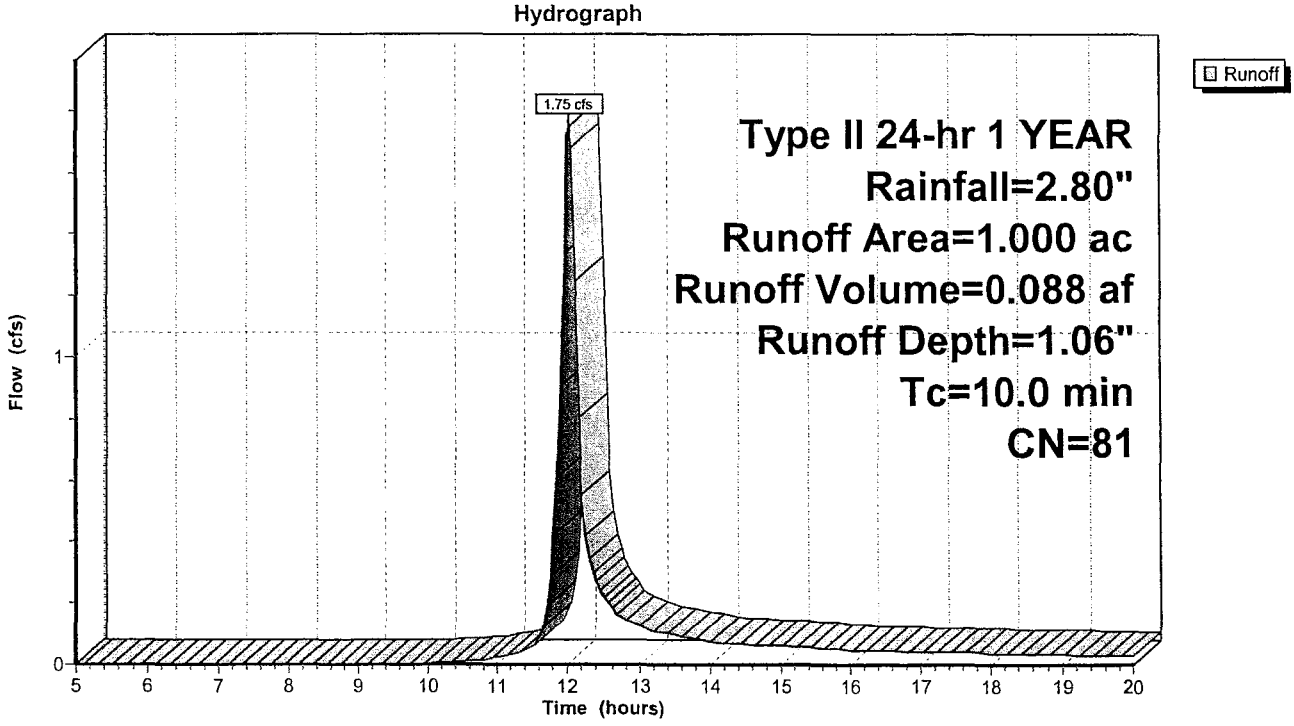
Runoff = 1.75 cfs @ 12.02 hrs, Volume= 0.088 af, Depth= 1.06"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 1 YEAR Rainfall=2.80"

| Area (ac) | CN | Description |
|---|---|---|
| 0.500 | 70 | Woods, Good, HSG C |
| 0.500 | 92 | Paved roads w/open ditches, HSG C |
| 1.000 | 81 | Weighted Average |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 10.0 | | | | | **Direct Entry,** |

## Subcatchment C2-2 DA: UNDEVELOPED



## Subcatchment C2-2A DA: DEVELOPED

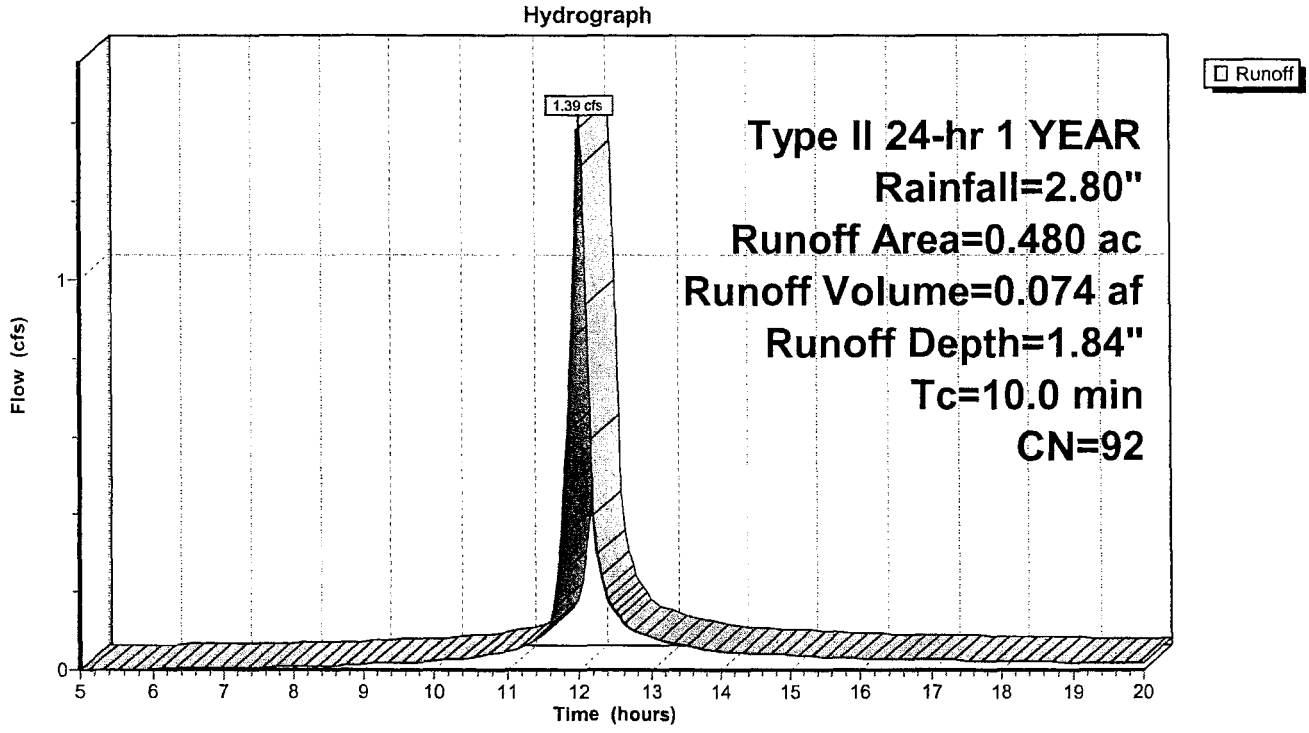
Runoff = 1.39 cfs @ 12.01 hrs, Volume= 0.074 af, Depth= 1.84"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 1 YEAR Rainfall=2.80"

| Area (ac) | CN | Description |
|---|---|---|
| 0.480 | 92 | Paved roads w/open ditches, HSG C |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 10.0 | | | | | **Direct Entry,** |

## Subcatchment C2-2A DA: DEVELOPED



## Subcatchment C2-2B DA: POST DEVELOPMENT

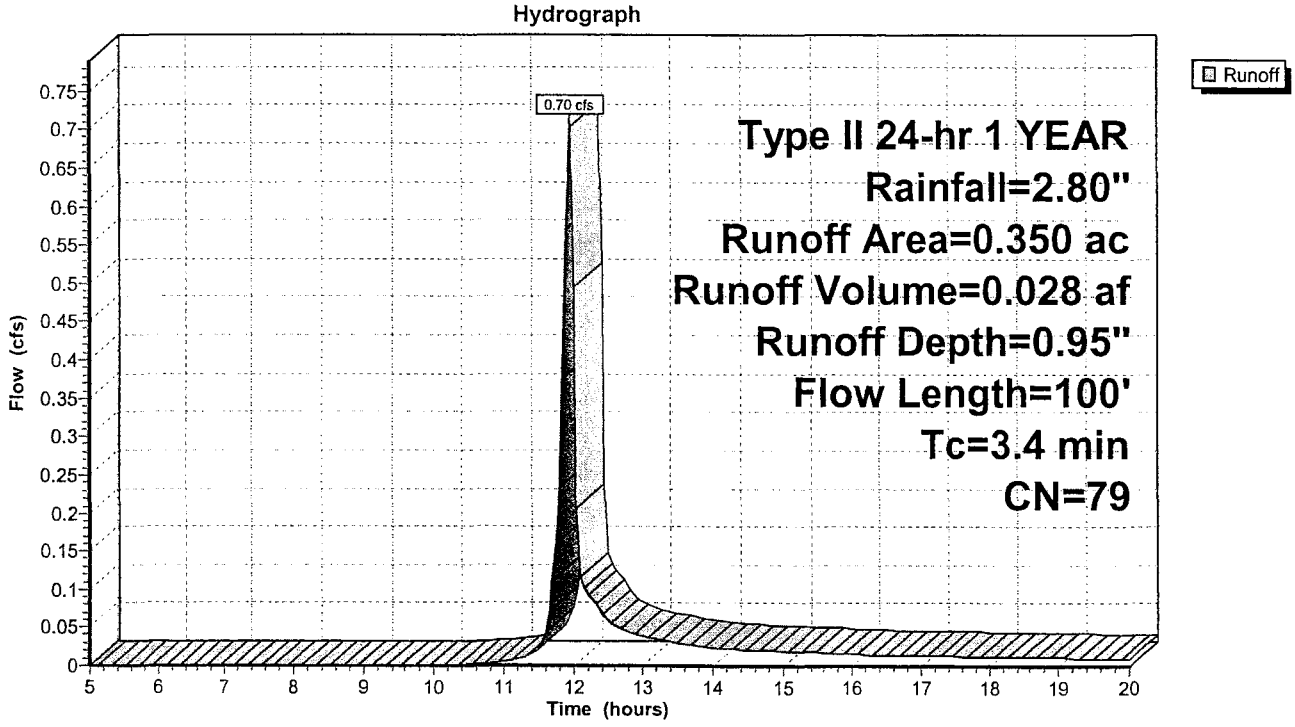
Runoff = 0.70 cfs @ 11.94 hrs, Volume= 0.028 af, Depth= 0.95"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 1 YEAR Rainfall=2.80"

| Area (ac) | CN | Description |
|---|---|---|
| 0.350 | 79 | 50-75% Grass cover, Fair, HSG C |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 3.4 | 100 | 0.3300 | 0.5 | | **Sheet Flow,** Grass: Short n= 0.150 P2= 2.80" |

## Subcatchment C2-2B DA: POST DEVELOPMENT



## Subcatchment C3-1 DA: DEVELOPED

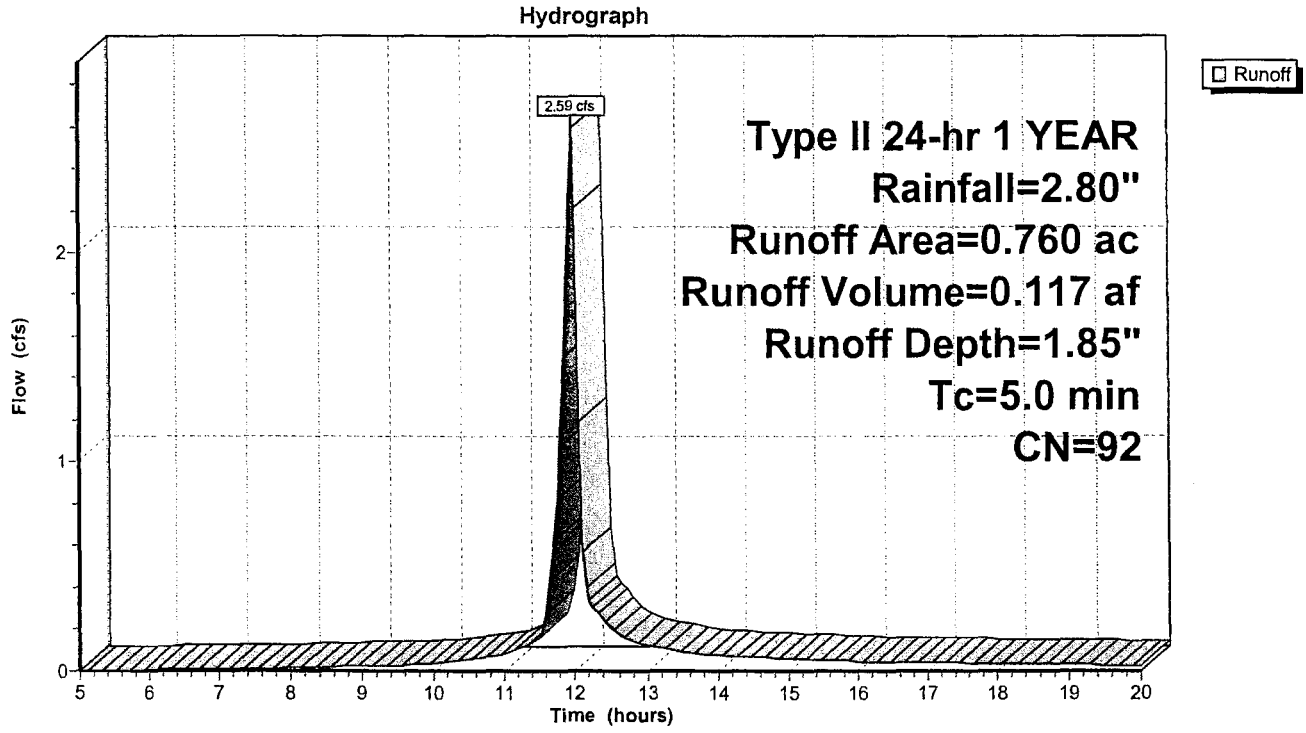
Runoff = 2.59 cfs @ 11.95 hrs, Volume= 0.117 af, Depth= 1.85"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 1 YEAR Rainfall=2.80"

| Area (ac) | CN | Description |
|---|---|---|
| 0.760 | 92 | Paved roads w/open ditches, HSG C |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.0 | | | | | **Direct Entry,** |

## Subcatchment C3-1 DA: DEVELOPED



## Subcatchment C3-1A DA: DEVELOPED

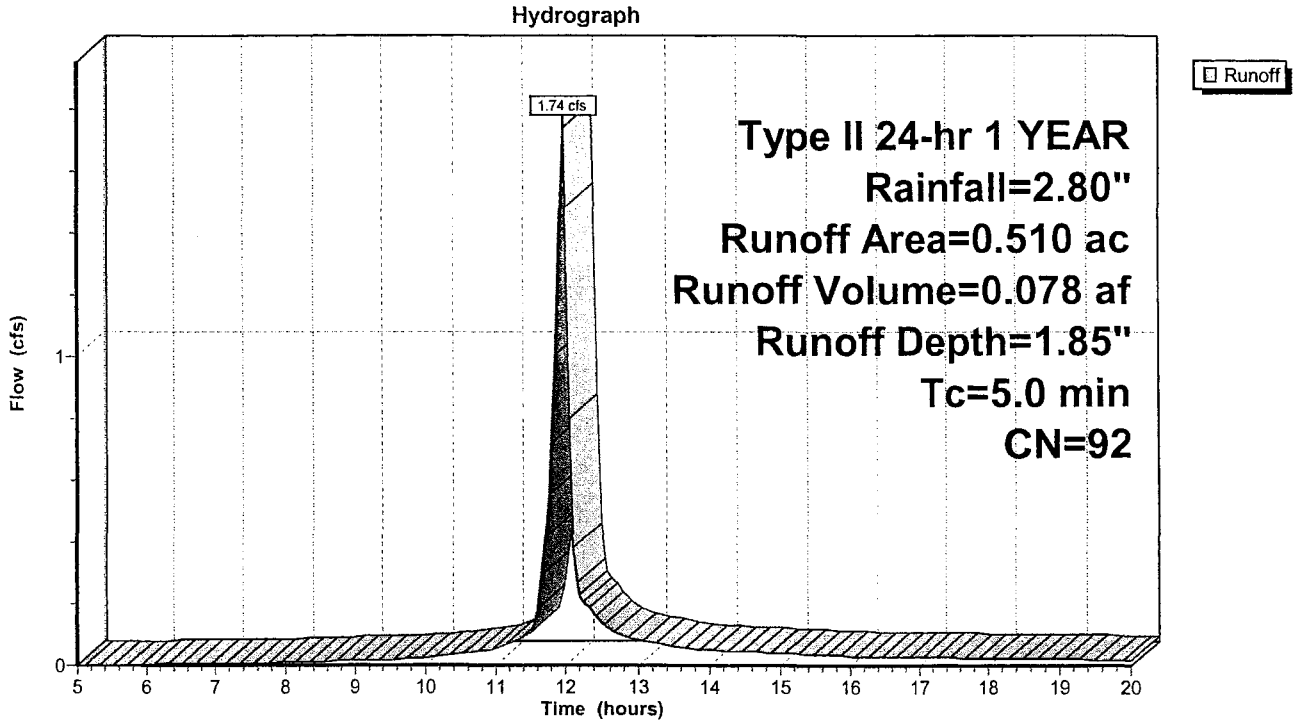
Runoff = 1.74 cfs @ 11.95 hrs, Volume= 0.078 af, Depth= 1.85"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 1 YEAR Rainfall=2.80"

| Area (ac) | CN | Description |
|---|---|---|
| 0.510 | 92 | Paved roads w/open ditches, HSG C |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.0 | | | | | **Direct Entry,** |

## Subcatchment C3-1A DA: DEVELOPED



## Subcatchment D: POST DEV

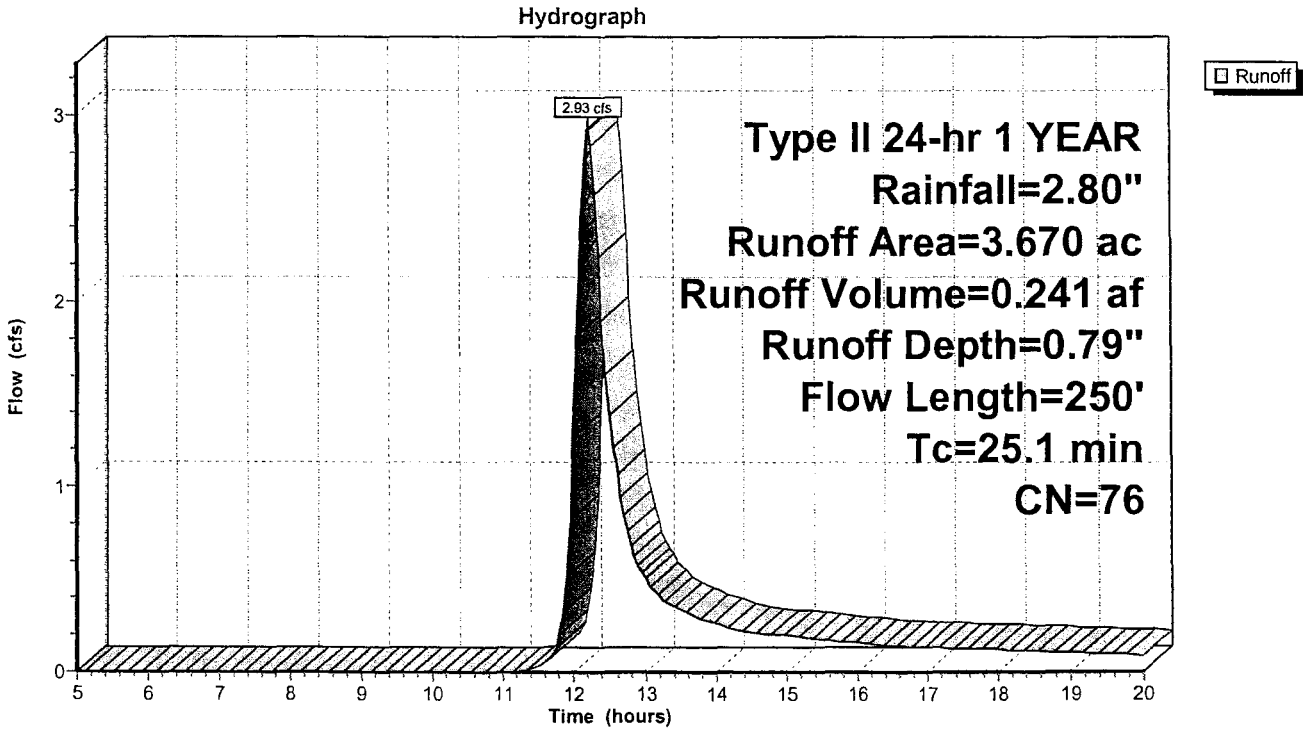
Runoff = 2.93 cfs @ 12.21 hrs, Volume= 0.241 af, Depth= 0.79"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 1 YEAR Rainfall=2.80"

| Area (ac) | CN | Description |
|---|---|---|
| 2.600 | 70 | Woods, Good, HSG C |
| 1.070 | 92 | Paved roads w/open ditches, HSG C |
| 3.670 | 76 | Weighted Average |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 2.1 | 150 | 0.0560 | 1.2 | | **Shallow Concentrated Flow,** Woodland Kv= 5.0 fps |
| 23.0 | 100 | 0.0200 | 0.1 | | **Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.80" |
| 25.1 | 250 | Total | | | |

## Subcatchment D: POST DEV



## Subcatchment D2: POST DEV

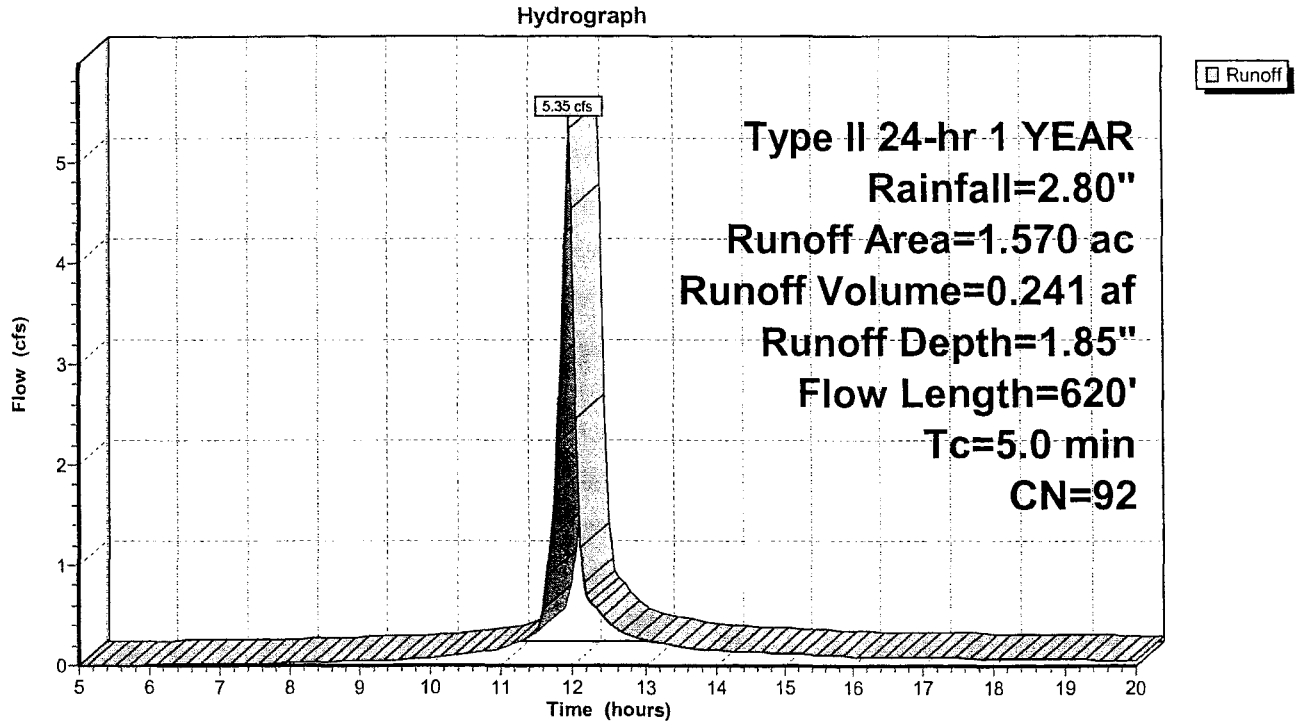
Runoff = 5.35 cfs @ 11.95 hrs, Volume= 0.241 af, Depth= 1.85"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 1 YEAR Rainfall=2.80"

| Area (ac) | CN | Description |
|---|---|---|
| 1.570 | 92 | Paved roads w/open ditches, HSG C |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 1.6 | 40 | 0.3300 | 0.4 | | **Sheet Flow,** Grass: Short n= 0.150 P2= 2.80" |
| 3.4 | 580 | 0.0232 | 2.8 | 14.07 | **Trap/Vee/Rect Channel Flow,** Bot.W=0.00' D=1.00' Z= 6.0 & 4.0 '/' n= 0.050 |
| 5.0 | 620 | Total | | | |

## Subcatchment D2: POST DEV



## Subcatchment D3: POST DEV

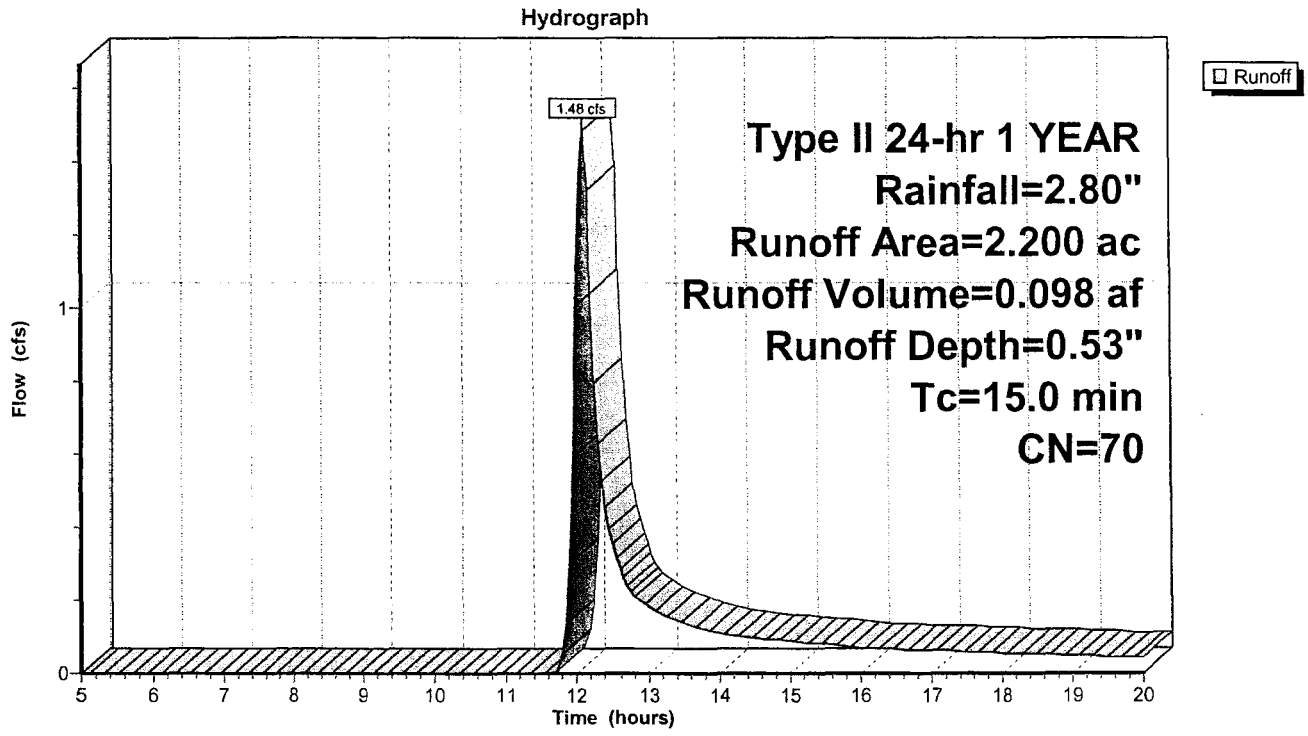
Runoff = 1.48 cfs @ 12.10 hrs, Volume= 0.098 af, Depth= 0.53"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 1 YEAR Rainfall=2.80"

| Area (ac) | CN | Description |
|---|---|---|
| 2.000 | 70 | Woods, Good, HSG C |
| 0.200 | 74 | >75% Grass cover, Good, HSG C |
| 2.200 | 70 | Weighted Average |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 15.0 | | | | | **Direct Entry,** |

## Subcatchment D3: POST DEV



## Subcatchment Post Dev: 1/3 Acre Lots

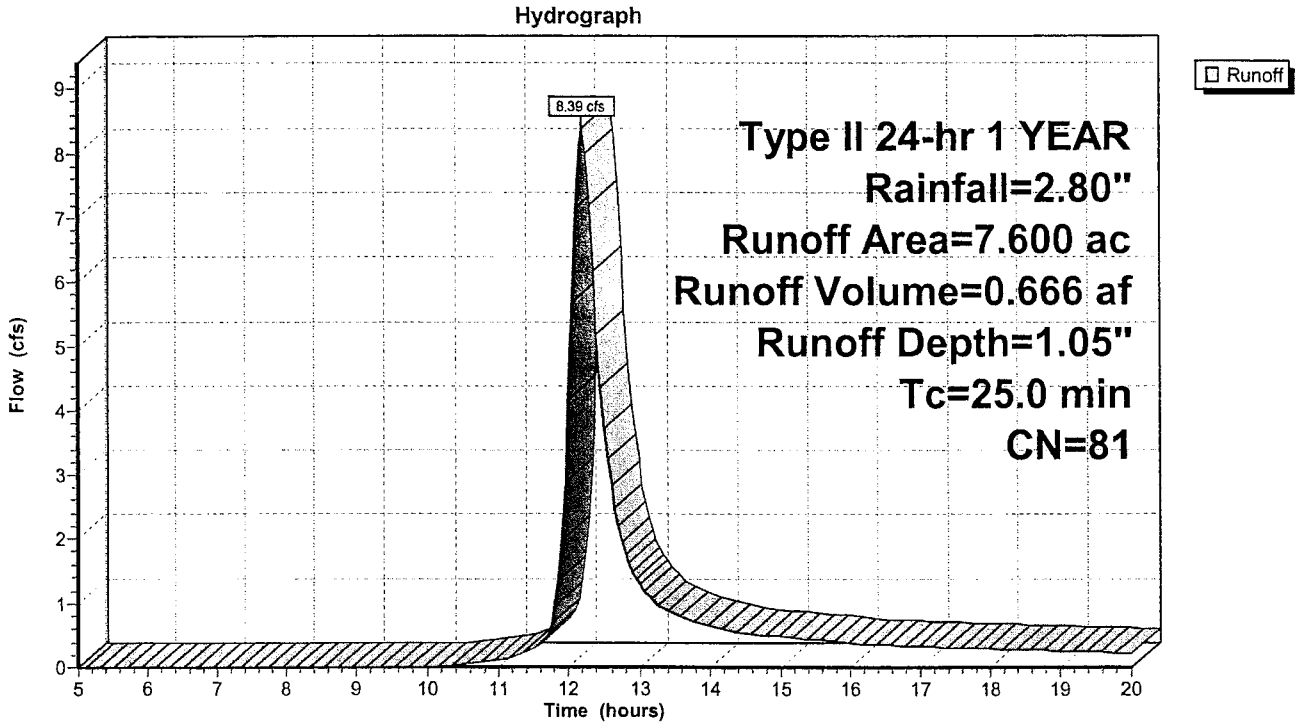
Runoff = 8.39 cfs @ 12.20 hrs, Volume= 0.666 af, Depth= 1.05"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 1 YEAR Rainfall=2.80"

| Area (ac) | CN | Description |
|---|---|---|
| 7.600 | 81 | 1/3 acre lots, 30% imp, HSG C |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 25.0 | | | | | **Direct Entry,** |

## Subcatchment Post Dev: 1/3 Acre Lots



## Subcatchment S-1: S-1

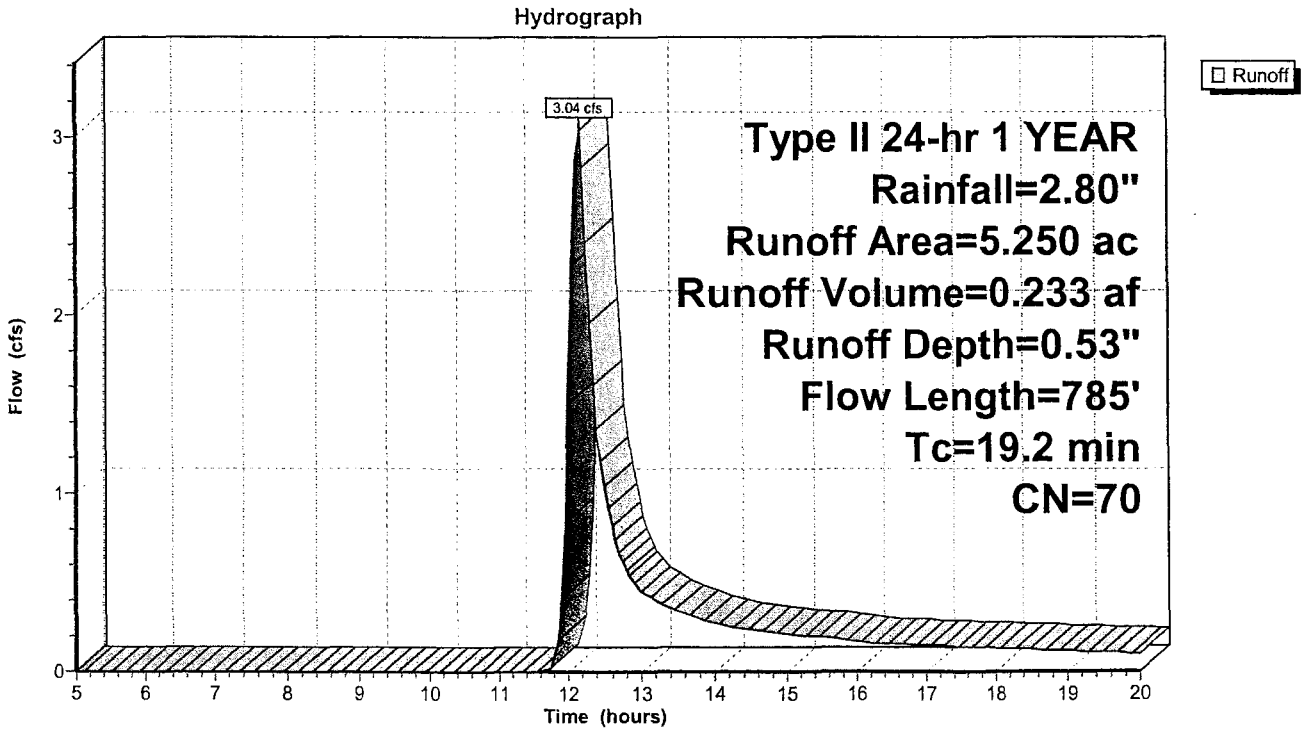
Runoff = 3.04 cfs @ 12.15 hrs, Volume= 0.233 af, Depth= 0.53"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 1 YEAR Rainfall=2.80"

| Area (ac) | CN | Description |
|---|---|---|
| 5.100 | 70 | Woods, Good, HSG C |
| 0.150 | 81 | 1/3 acre lots, 30% imp, HSG C |
| 5.250 | 70 | Weighted Average |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 13.9 | 100 | 0.0700 | 0.1 | | **Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.80" |
| 4.2 | 360 | 0.0800 | 1.4 | | **Shallow Concentrated Flow,** Woodland Kv= 5.0 fps |
| 1.1 | 325 | 0.0800 | 5.0 | 33.64 | **Parabolic Channel,** W=20.00' D=0.50' Area=6.7 sf Perim=20.0' n= 0.040 |
| 19.2 | 785 | Total | | | |

## Subcatchment S-1: S-1



## Subcatchment S-2: POST DEVELOPED

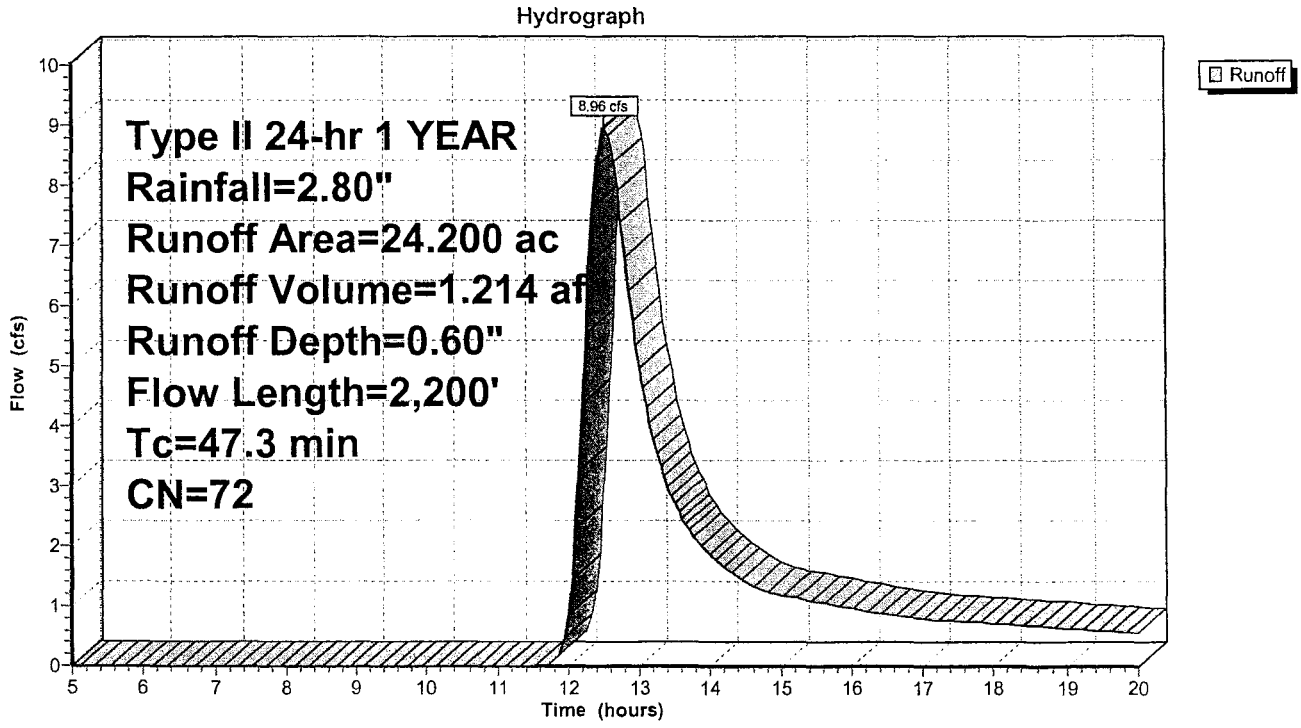
Runoff = 8.96 cfs @ 12.53 hrs, Volume= 1.214 af, Depth= 0.60"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 1 YEAR Rainfall=2.80"

| Area (ac) | CN | Description |
|---|---|---|
| 20.100 | 70 | Woods, Good, HSG C |
| 4.100 | 81 | 1/3 acre lots, 30% imp, HSG C |
| 24.200 | 72 | Weighted Average |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 33.1 | 300 | 0.0720 | 0.2 | | **Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.80" |
| 3.9 | 300 | 0.0670 | 1.3 | | **Shallow Concentrated Flow,** Woodland Kv= 5.0 fps |
| 10.3 | 1,600 | 0.0210 | 2.6 | 60.38 | **Parabolic Channel,** W=70.00' D=0.50' Area=23.3 sf Perim=70.0' n= 0.040 |
| 47.3 | 2,200 | Total | | | |

## Subcatchment S-2: POST DEVELOPED



## Subcatchment S-3: POST DEVELOPED

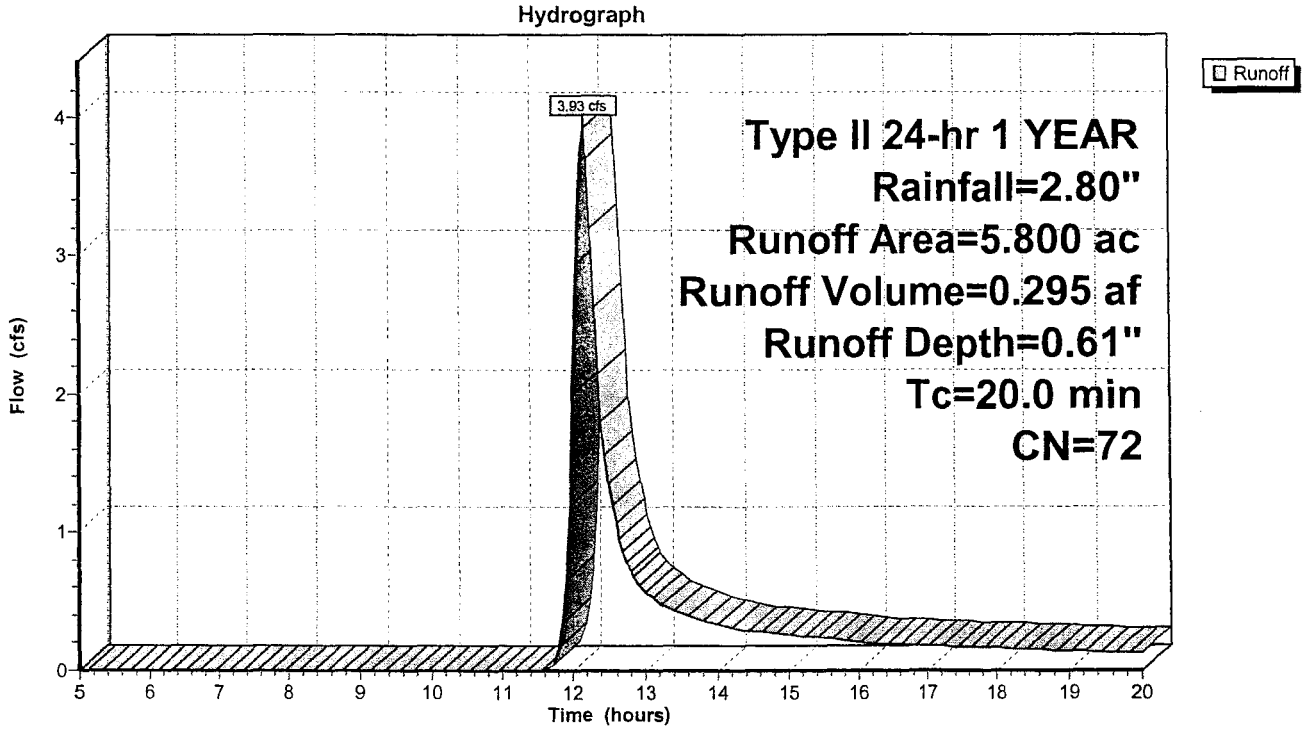
Runoff = 3.93 cfs @ 12.15 hrs, Volume= 0.295 af, Depth= 0.61"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 1 YEAR Rainfall=2.80"

| Area (ac) | CN | Description |
|---|---|---|
| 4.600 | 70 | Woods, Good, HSG C |
| 1.200 | 81 | 1/3 acre lots, 30% imp, HSG C |
| 5.800 | 72 | Weighted Average |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 20.0 | | | | | **Direct Entry,** |

## Subcatchment S-3: POST DEVELOPED



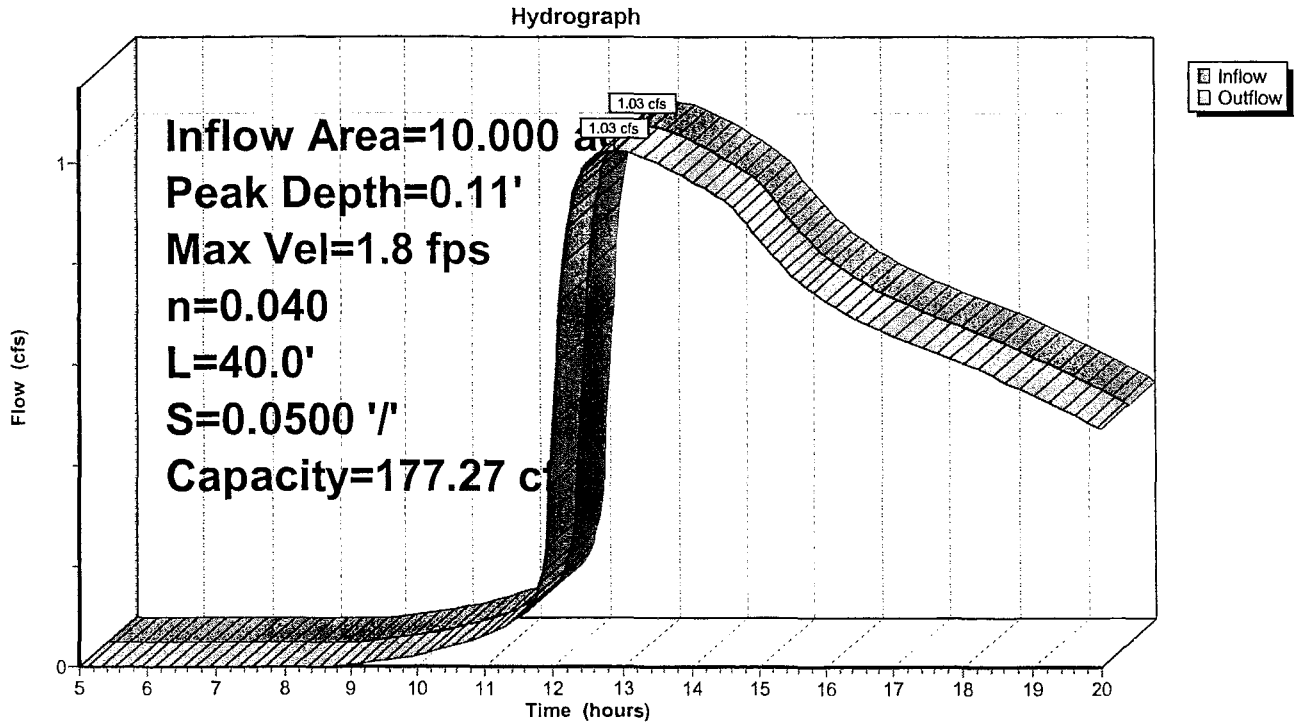
## Reach C2-1A: RIPRAP CHANNEL

Inflow Area = 10.000 ac, Inflow Depth = 0.62" for 1 YEAR event
Inflow = 1.03 cfs @ 12.88 hrs, Volume= 0.517 af
Outflow = 1.03 cfs @ 12.90 hrs, Volume= 0.517 af, Atten= 0%, Lag= 0.8 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.8 fps, Min. Travel Time= 0.4 min
Avg. Velocity = 1.3 fps, Avg. Travel Time= 0.5 min

Peak Depth= 0.11' @ 12.89 hrs
Capacity at bank full= 177.27 cfs
Inlet Invert= 67.06', Outlet Invert= 65.06'
5.00' x 2.00' deep channel, n= 0.040 Length= 40.0' Slope= 0.0500 '/'
Side Slope Z-value= 2.0 '/'

## Reach C2-1A: RIPRAP CHANNEL



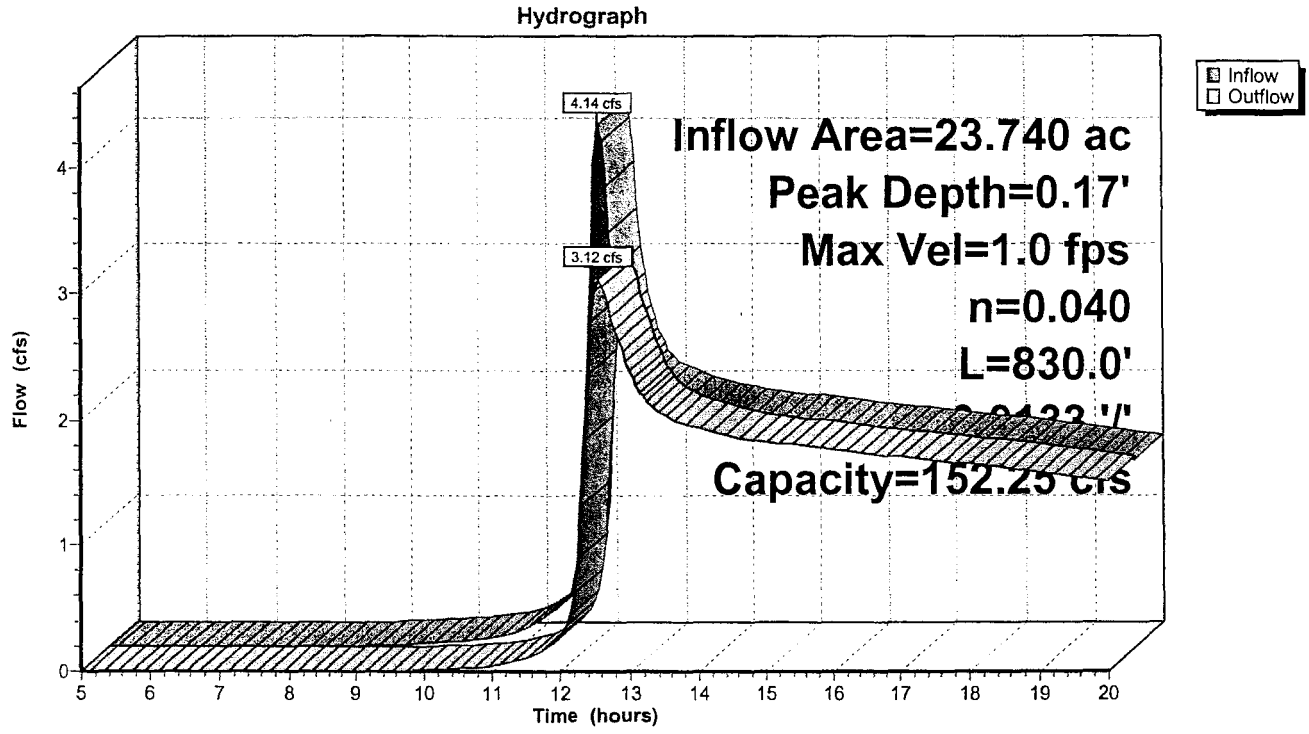
## Reach R1: (new Reach)

Inflow Area = 23.740 ac, Inflow Depth = 0.64" for 1 YEAR event
Inflow = 4.14 cfs @ 12.16 hrs, Volume= 1.272 af
Outflow = 3.12 cfs @ 12.57 hrs, Volume= 1.206 af, Atten= 25%, Lag= 24.4 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.0 fps, Min. Travel Time= 14.0 min
Avg. Velocity = 0.6 fps, Avg. Travel Time= 21.4 min

Peak Depth= 0.17' @ 12.33 hrs
Capacity at bank full= 152.25 cfs
Inlet Invert= 54.00', Outlet Invert= 43.00'
70.00' x 1.00' deep Parabolic Channel, n= 0.040 Length= 830.0' Slope= 0.0133 '/'

## Reach R1: (new Reach)



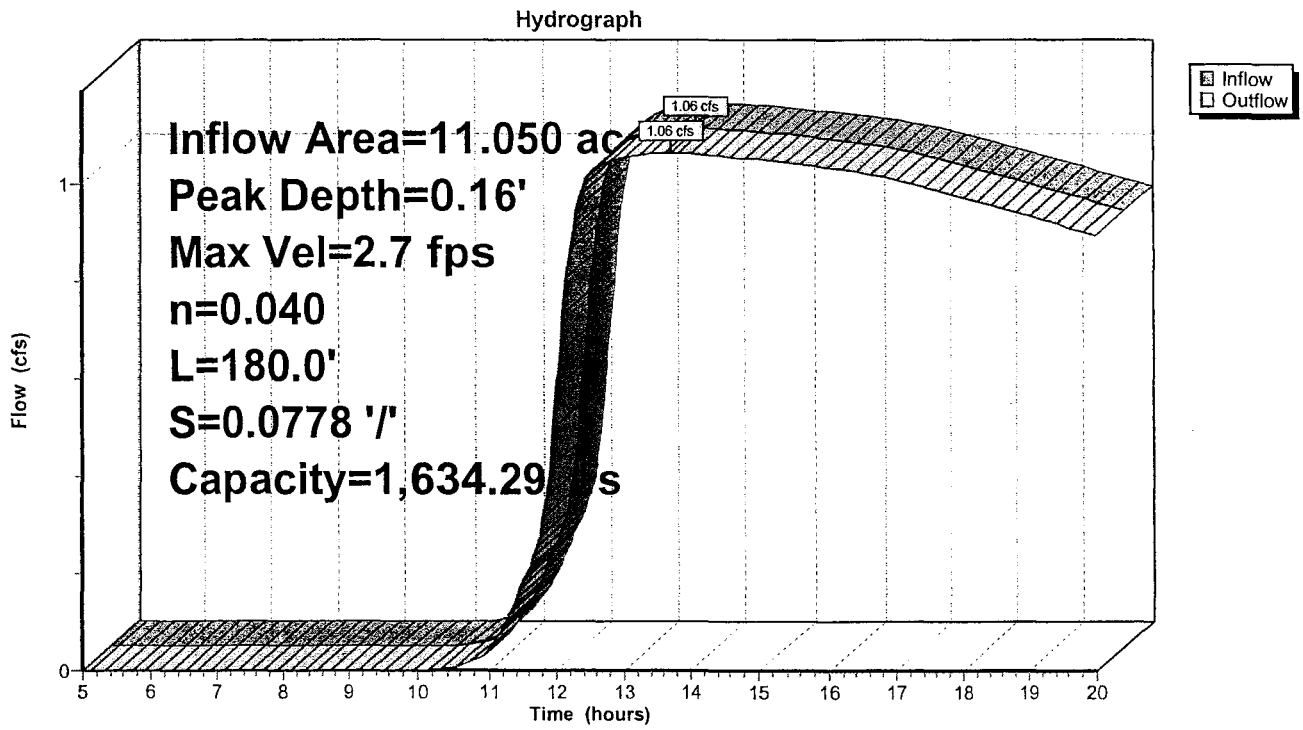
## Reach R1A: (new Reach)

Inflow Area = 11.050 ac, Inflow Depth = 0.74" for 1 YEAR event
Inflow = 1.06 cfs @ 13.68 hrs, Volume= 0.684 af
Outflow = 1.06 cfs @ 13.71 hrs, Volume= 0.681 af, Atten= 0%, Lag= 1.9 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.7 fps, Min. Travel Time= 1.1 min
Avg. Velocity = 2.4 fps, Avg. Travel Time= 1.3 min

Peak Depth= 0.16' @ 13.70 hrs
Capacity at bank full= 1,634.29 cfs
Inlet Invert= 68.00', Outlet Invert= 54.00'
2.00' x 5.00' deep channel, n= 0.040 Length= 180.0' Slope= 0.0778 '/'
Side Slope Z-value= 3.0 '/'

## Reach R1A: (new Reach)



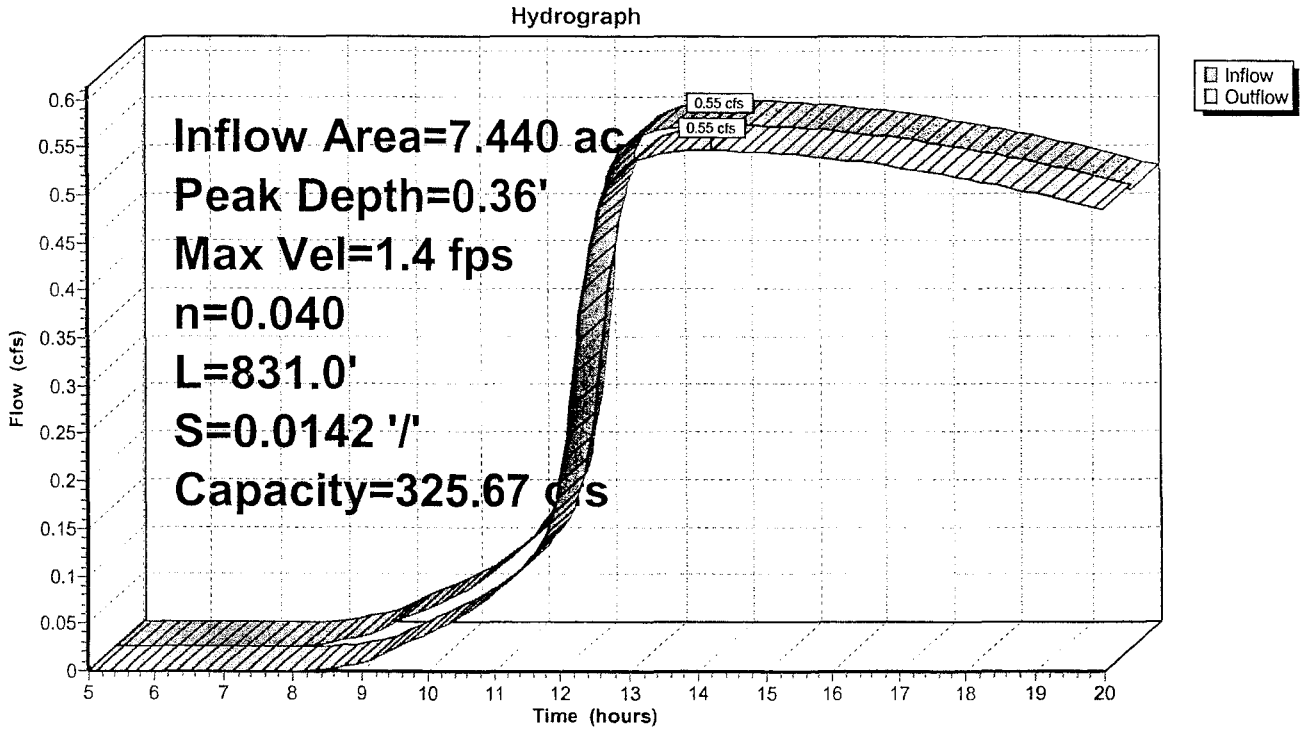
## Reach R1B: (new Reach)

Inflow Area = 7.440 ac, Inflow Depth = 0.60" for 1 YEAR event
Inflow = 0.55 cfs @ 13.94 hrs, Volume= 0.372 af
Outflow = 0.55 cfs @ 14.23 hrs, Volume= 0.358 af, Atten= 0%, Lag= 17.8 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.4 fps, Min. Travel Time= 10.1 min
Avg. Velocity = 1.1 fps, Avg. Travel Time= 12.2 min

Peak Depth= 0.36' @ 14.07 hrs
Capacity at bank full= 325.67 cfs
Inlet Invert= 67.80', Outlet Invert= 56.00'
0.00' x 4.00' deep channel, n= 0.040 Length= 831.0' Slope= 0.0142 '/'
Side Slope Z-value= 3.0 '/'

## Reach R1B: (new Reach)



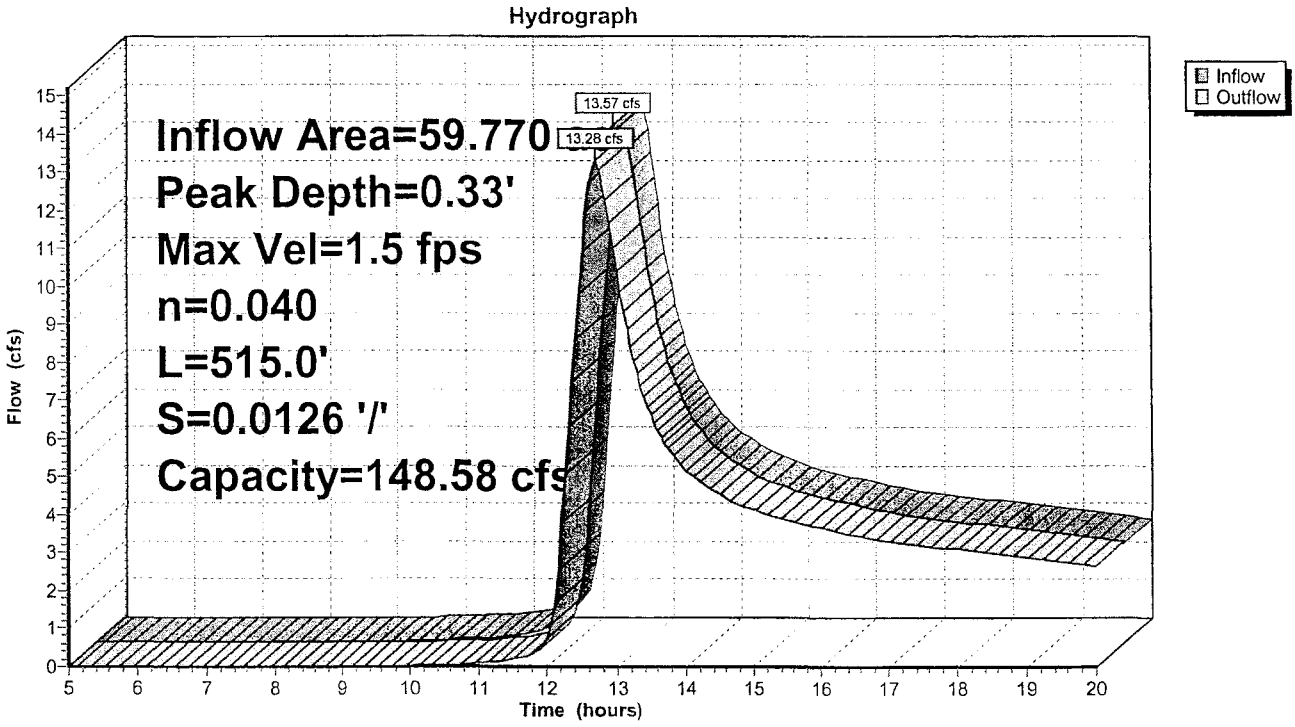
## Reach R2: (new Reach)

Inflow Area = 59.770 ac, Inflow Depth = 0.63" for 1 YEAR event
Inflow = 13.57 cfs @ 12.53 hrs, Volume= 3.115 af
Outflow = 13.28 cfs @ 12.70 hrs, Volume= 3.061 af, Atten= 2%, Lag= 9.9 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.5 fps, Min. Travel Time= 5.7 min
Avg. Velocity = 0.7 fps, Avg. Travel Time= 12.5 min

Peak Depth= 0.33' @ 12.60 hrs
Capacity at bank full= 148.58 cfs
Inlet Invert= 43.00', Outlet Invert= 36.50'
70.00' x 1.00' deep Parabolic Channel, n= 0.040 Length= 515.0' Slope= 0.0126 '/'

## Reach R2: (new Reach)



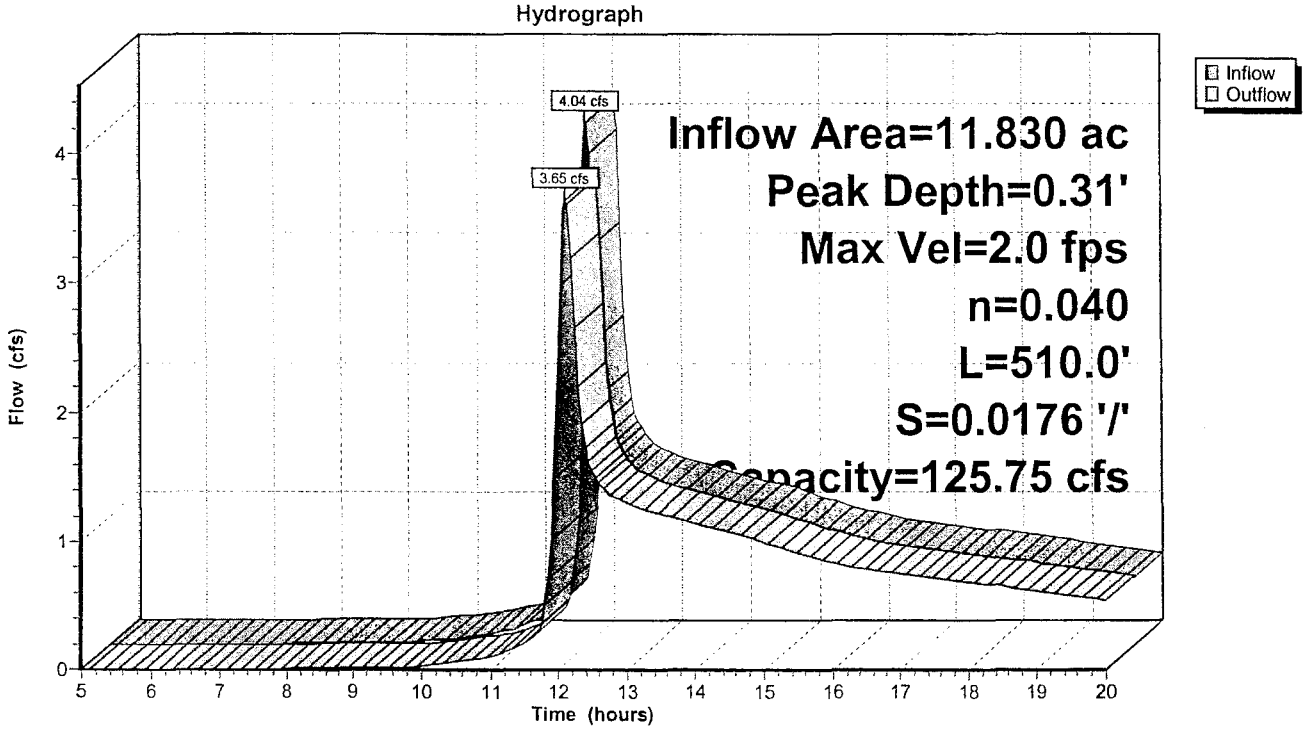
## Reach R2A: (new Reach)

Inflow Area = 11.830 ac, Inflow Depth = 0.71" for 1 YEAR event
Inflow = 4.04 cfs @ 12.01 hrs, Volume= 0.705 af
Outflow = 3.65 cfs @ 12.13 hrs, Volume= 0.695 af, Atten= 10%, Lag= 7.1 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.0 fps, Min. Travel Time= 4.2 min
Avg. Velocity = 0.9 fps, Avg. Travel Time= 9.7 min

Peak Depth= 0.31' @ 12.06 hrs
Capacity at bank full= 125.75 cfs
Inlet Invert= 52.00', Outlet Invert= 43.00'
5.00' x 2.00' deep channel, n= 0.040 Length= 510.0' Slope= 0.0176 '/'
Side Slope Z-value= 3.0 '/'

## Reach R2A: (new Reach)



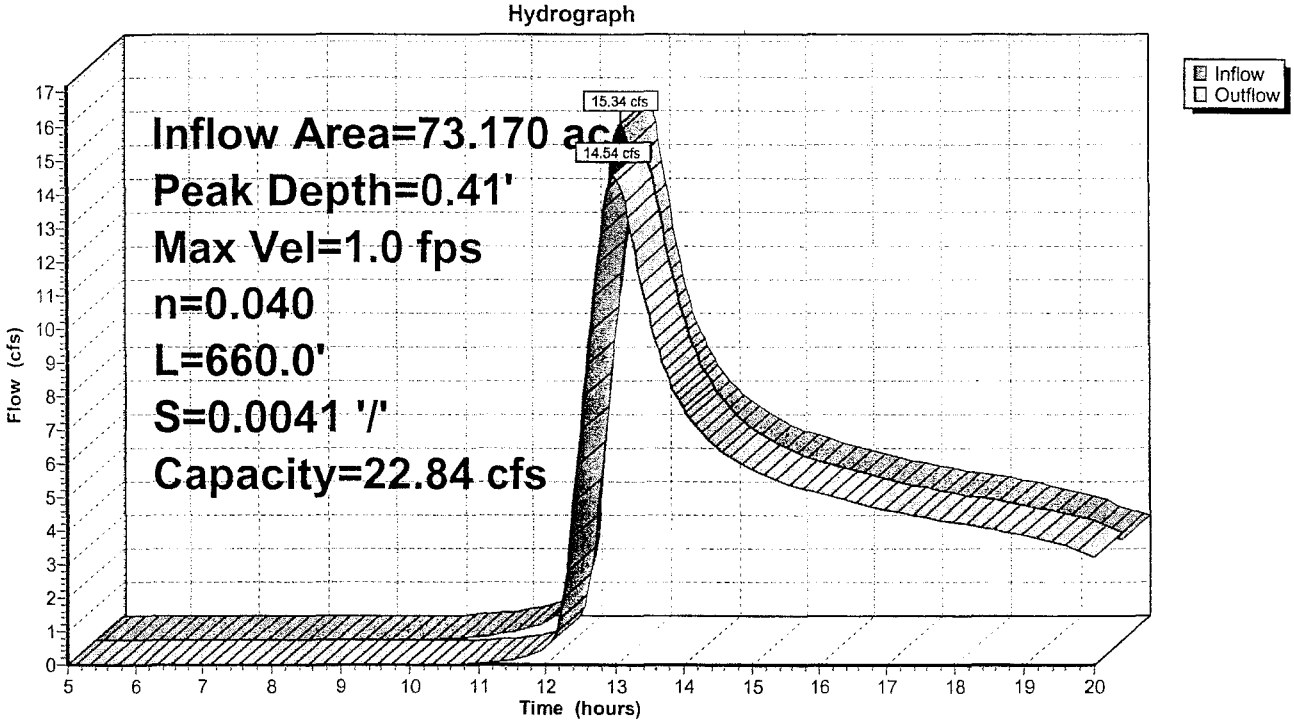
## Reach R3: (new Reach)

Inflow Area = 73.170 ac, Inflow Depth = 0.66" for 1 YEAR event
Inflow = 15.34 cfs @ 12.68 hrs, Volume= 4.021 af
Outflow = 14.54 cfs @ 13.00 hrs, Volume= 3.897 af, Atten= 5%, Lag= 19.1 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.0 fps, Min. Travel Time= 11.1 min
Avg. Velocity = 0.5 fps, Avg. Travel Time= 23.6 min

Peak Depth= 0.41' @ 12.81 hrs
Capacity at bank full= 22.84 cfs
Inlet Invert= 34.50', Outlet Invert= 31.80'
60.00' x 0.50' deep Parabolic Channel, n= 0.040 Length= 660.0' Slope= 0.0041 '/'

## Reach R3: (new Reach)



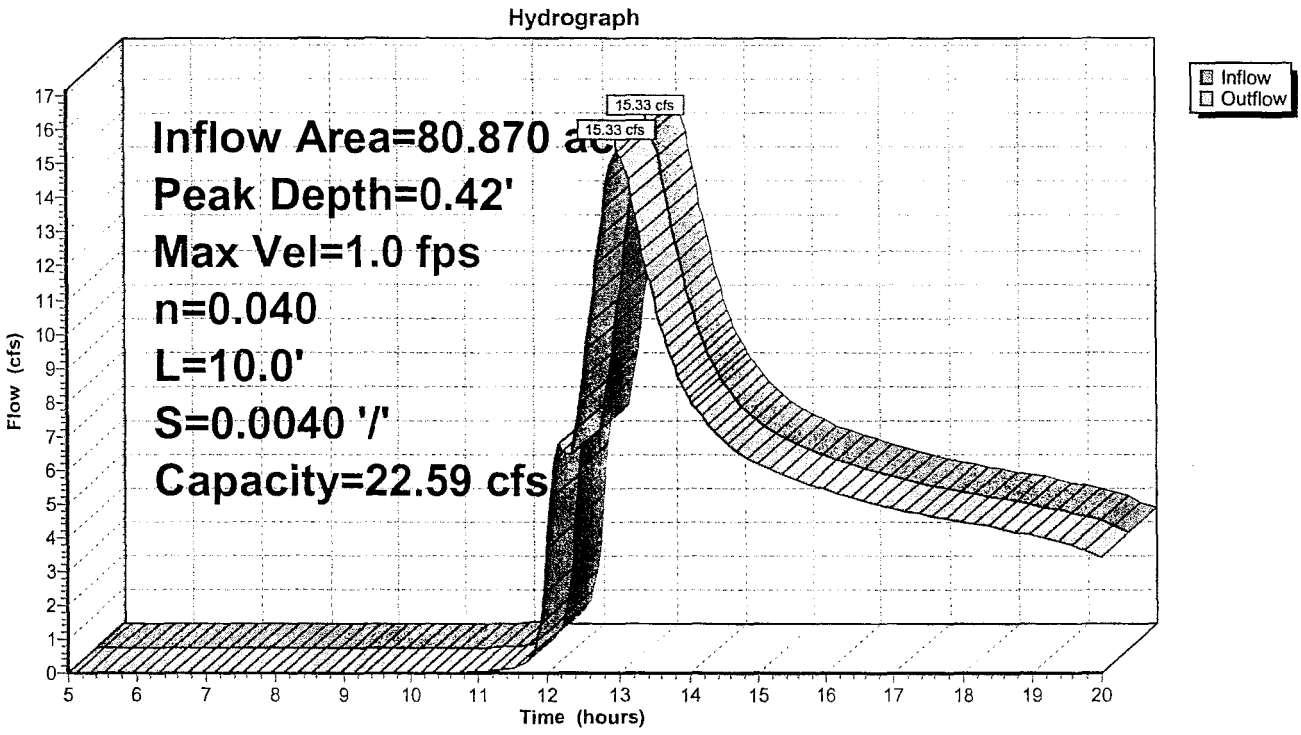
## Reach R4: (new Reach)

Inflow Area = 80.870 ac, Inflow Depth = 0.64" for 1 YEAR event
Inflow = 15.33 cfs @ 12.99 hrs, Volume= 4.317 af
Outflow = 15.33 cfs @ 13.00 hrs, Volume= 4.315 af, Atten= 0%, Lag= 0.3 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.0 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 0.5 fps, Avg. Travel Time= 0.3 min

Peak Depth= 0.42' @ 12.99 hrs
Capacity at bank full= 22.59 cfs
Inlet Invert= 31.80', Outlet Invert= 31.76'
60.00' x 0.50' deep Parabolic Channel, n= 0.040 Length= 10.0' Slope= 0.0040 '/'

## Reach R4: (new Reach)



## Pond BMP - 1: BMP #1

Inflow Area = 11.050 ac, Inflow Depth = 1.05" for 1 YEAR event
Inflow = 13.96 cfs @ 12.14 hrs, Volume= 0.971 af
Outflow = 1.06 cfs @ 13.68 hrs, Volume= 0.684 af, Atten= 92%, Lag= 92.9 min
Primary = 1.06 cfs @ 13.68 hrs, Volume= 0.684 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 78.55' @ 13.68 hrs Surf.Area= 6,717 sf Storage= 23,005 cf
Plug-Flow detention time= 210.1 min calculated for 0.684 af (70% of inflow)
Center-of-Mass det. time= 140.6 min ( 948.8 - 808.1 )

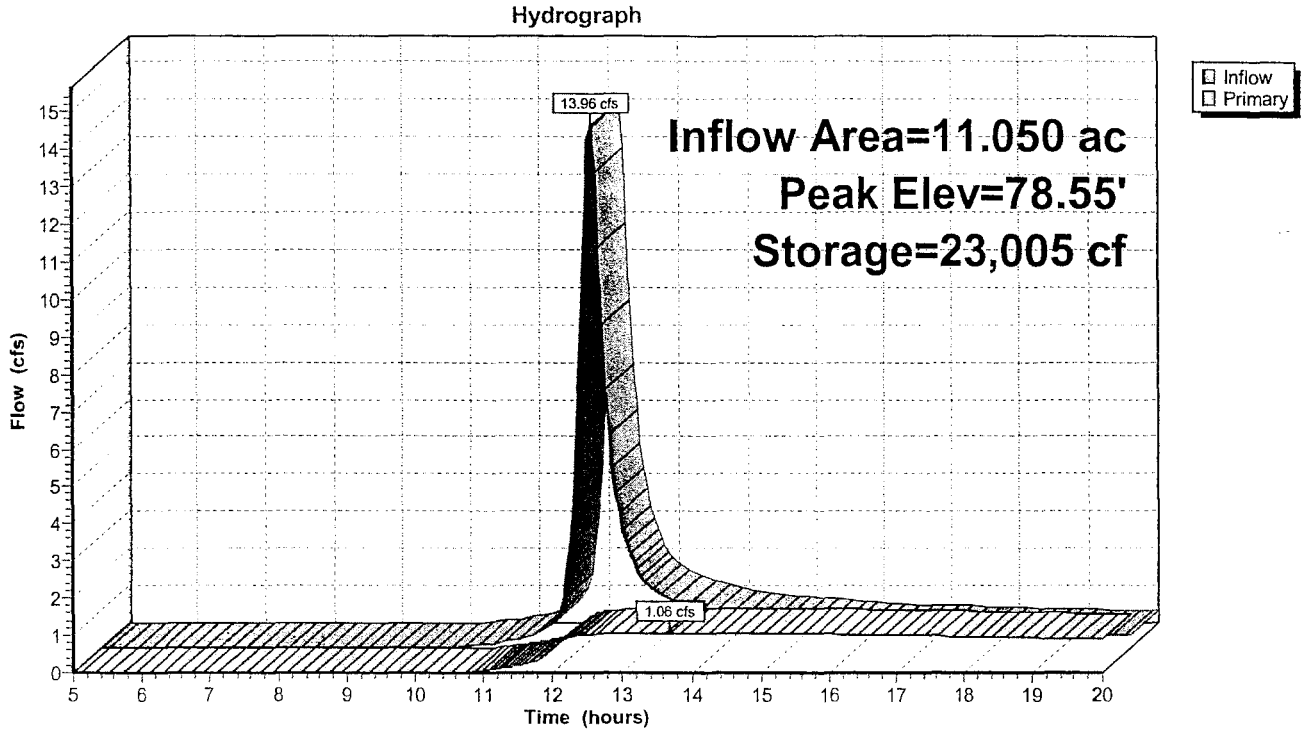
| # | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| 1 | 72.00' | 67,503 cf | **Custom Stage Data (Prismatic)** Listed below |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 72.00 | 978 | 0 | 0 |
| 74.00 | 2,170 | 3,148 | 3,148 |
| 76.00 | 3,836 | 6,006 | 9,154 |
| 78.00 | 5,977 | 9,813 | 18,967 |
| 80.00 | 8,661 | 14,638 | 33,605 |
| 82.00 | 11,732 | 20,393 | 53,998 |
| 83.00 | 15,277 | 13,505 | 67,503 |

| # | Routing | Invert | Outlet Devices |
|---|---|---|---|
| 1 | Primary | 67.84' | **30.0" x 84.0' long Culvert** RCP, end-section conforming to fill, Ke= 0.500<br>Outlet Invert= 67.00' S= 0.0100 '/' n= 0.013 Cc= 0.900 |
| 2 | Device 1 | 72.00' | **4.0" Vert. 4" Orifice** C= 0.600 |
| 3 | Device 1 | 80.64' | **60.0" Horiz. Orifice** Limited to weir flow C= 0.600 |

**Primary OutFlow** Max=1.06 cfs @ 13.68 hrs HW=78.55' (Free Discharge)
└─**1=Culvert** (Passes 1.06 cfs of 72.70 cfs potential flow)
  ├─**2=4" Orifice** (Orifice Controls 1.06 cfs @ 12.2 fps)
  └─**3=Orifice** ( Controls 0.00 cfs)

## Pond BMP - 1: BMP #1



## Pond BMP-3: Basin 3

| | | | | | |
|---|---|---|---|---|---|
| Inflow Area = | 7.600 ac, | Inflow Depth = | 1.05" | for | 1 YEAR event |
| Inflow = | 8.39 cfs @ | 12.20 hrs, | Volume= | 0.666 af | |
| Outflow = | 1.19 cfs @ | 13.07 hrs, | Volume= | 0.665 af, | Atten= 86%, Lag= 52.3 min |
| Primary = | 1.19 cfs @ | 13.07 hrs, | Volume= | 0.665 af | |

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 58.25' @ 13.07 hrs Surf.Area= 4,091 sf Storage= 12,831 cf
Plug-Flow detention time= 108.9 min calculated for 0.665 af (100% of inflow)
Center-of-Mass det. time= 108.0 min ( 920.0 - 811.9 )

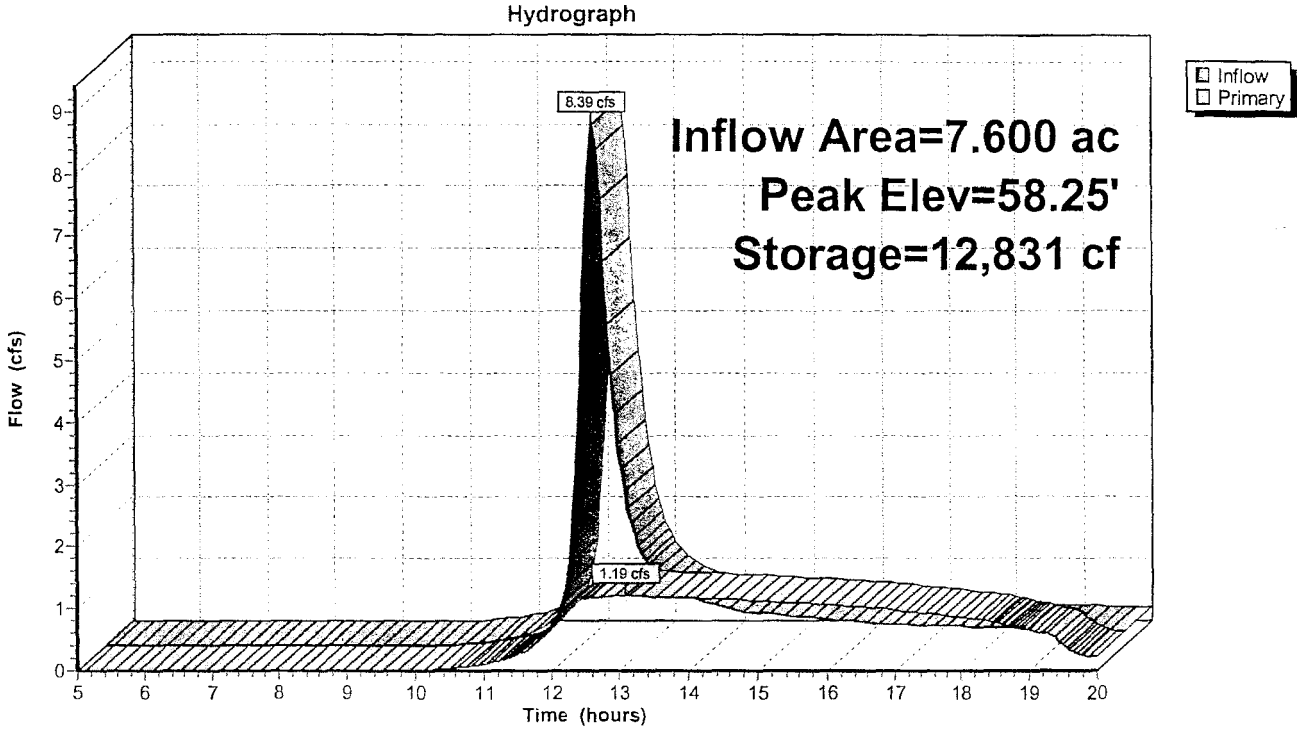
| # | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| 1 | 50.00' | 34,833 cf | **Custom Stage Data (Pyramidal)** Listed below |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) | Wet.Area (sq-ft) |
|---|---|---|---|---|
| 50.00 | 0 | 0 | 0 | 0 |
| 52.00 | 450 | 300 | 300 | 458 |
| 54.00 | 1,230 | 1,616 | 1,916 | 1,270 |
| 56.00 | 2,375 | 3,543 | 5,459 | 2,463 |
| 58.00 | 3,858 | 6,173 | 11,632 | 4,011 |
| 60.00 | 5,710 | 9,508 | 21,140 | 5,943 |
| 62.00 | 8,050 | 13,693 | 34,833 | 8,374 |

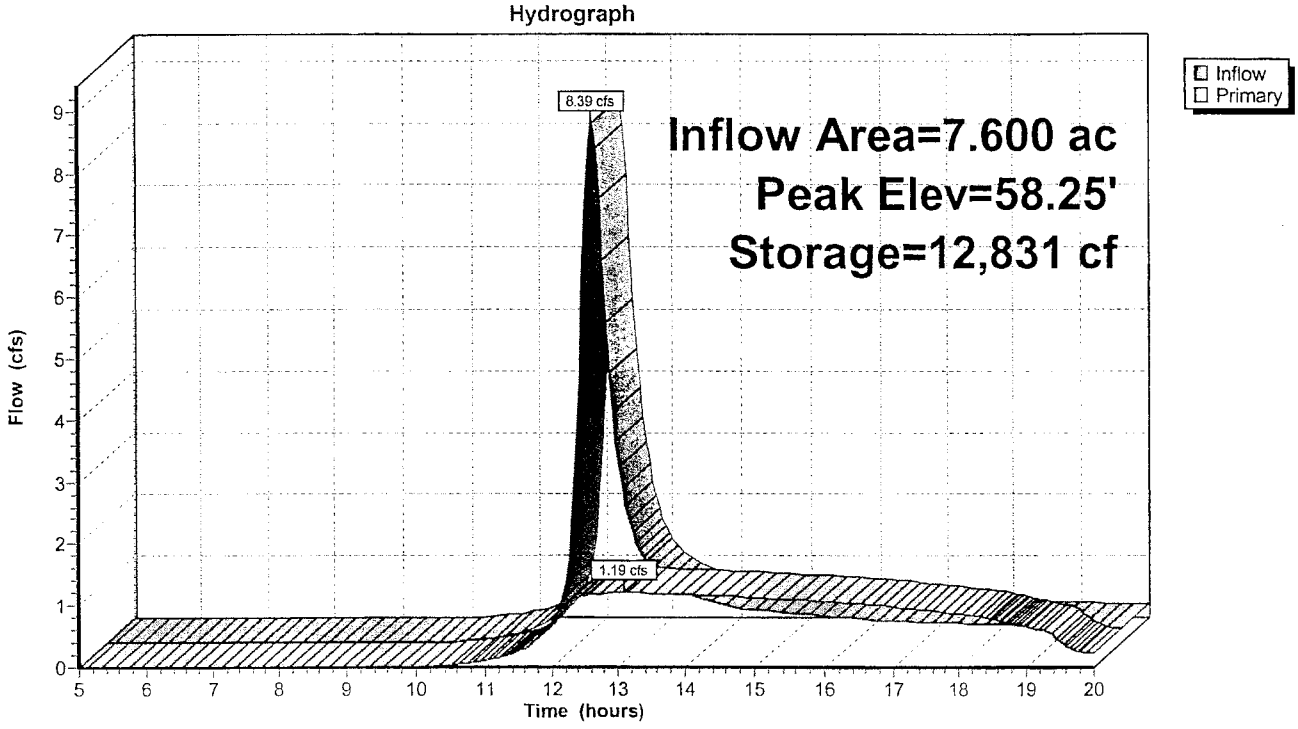
| # | Routing | Invert | Outlet Devices |
|---|---|---|---|
| 1 | Primary | 42.40' | **24.0" x 85.0' long Culvert** RCP, square edge headwall, Ke= 0.500<br>Outlet Invert= 39.85' S= 0.0300 '/' n= 0.012 Cc= 0.900 |
| 2 | Device 1 | 50.00' | **4.0" Vert. Orifice/Grate** C= 0.600 |
| 3 | Device 1 | 59.60' | **48.0" Horiz. Orifice/Grate** Limited to weir flow C= 0.600 |

**Primary OutFlow** Max=1.19 cfs @ 13.07 hrs HW=58.25' (Free Discharge)
└─**1=Culvert** (Passes 1.19 cfs of 58.30 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 1.19 cfs @ 13.7 fps)
  └─**3=Orifice/Grate** ( Controls 0.00 cfs)

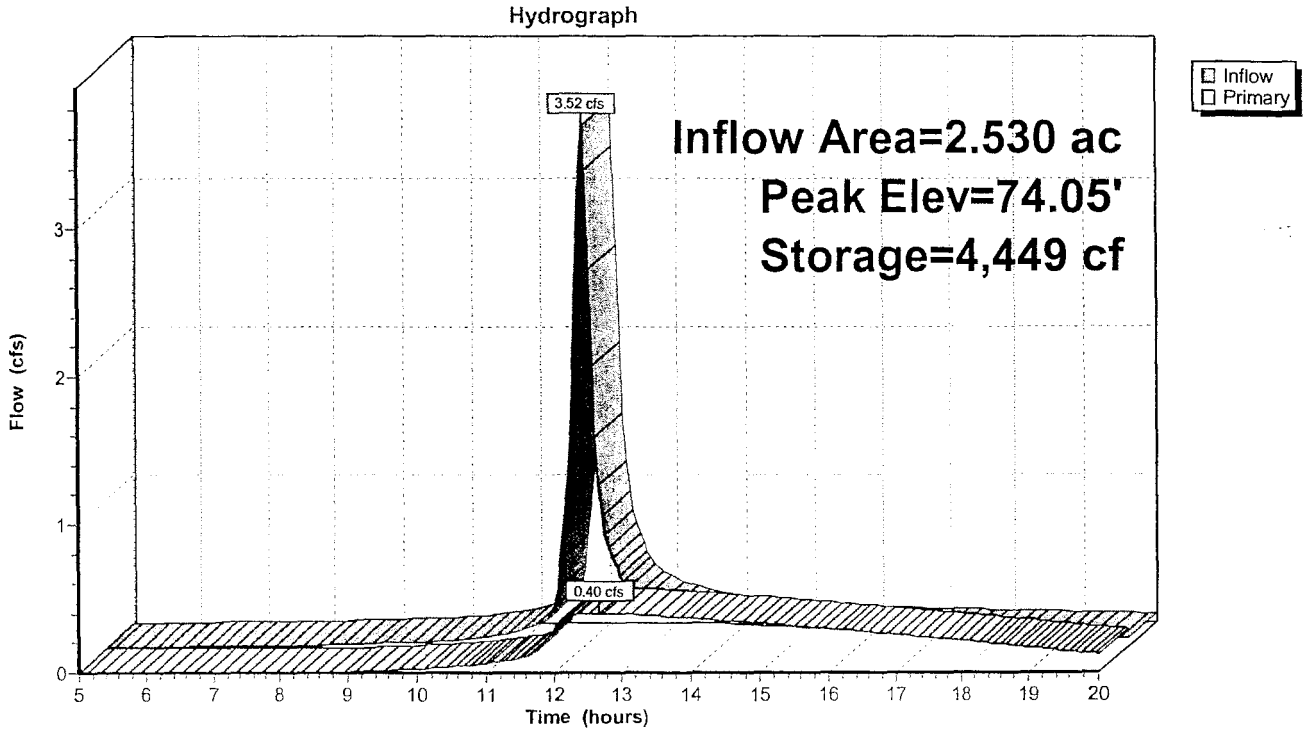
## Pond BMP-3: Basin 3



## Pond BMP-3: Basin 3



## Pond C1: POND C1



## Pond C2: POND C2

| | | | | | |
|---|---|---|---|---|---|
| Inflow Area = | 2.000 ac, | Inflow Depth = | 0.53" | for | 1 YEAR event |
| Inflow = | 0.97 cfs @ | 12.22 hrs, | Volume= | 0.088 af | |
| Outflow = | 0.28 cfs @ | 12.77 hrs, | Volume= | 0.086 af, | Atten= 71%, Lag= 33.2 min |
| Primary = | 0.28 cfs @ | 12.77 hrs, | Volume= | 0.086 af | |

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 72.62' @ 12.77 hrs Surf.Area= 993 sf Storage= 1,136 cf
Plug-Flow detention time= 45.3 min calculated for 0.086 af (97% of inflow)
Center-of-Mass det. time= 36.2 min ( 876.0 - 839.8 )

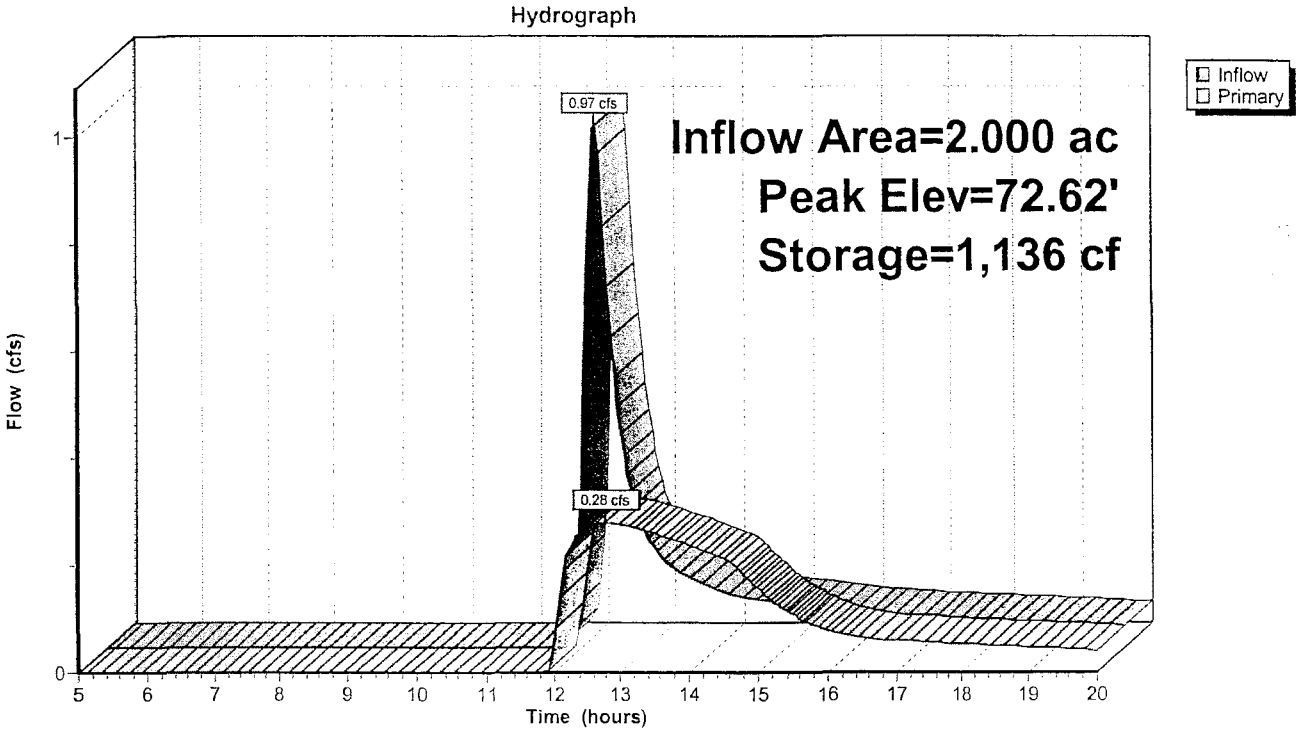
| # | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| 1 | 71.00' | 26,524 cf | **Custom Stage Data (Prismatic)** Listed below |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 71.00 | 117 | 0 | 0 |
| 72.00 | 685 | 401 | 401 |
| 74.00 | 1,670 | 2,355 | 2,756 |
| 76.00 | 3,000 | 4,670 | 7,426 |
| 78.00 | 4,667 | 7,667 | 15,093 |
| 80.00 | 6,764 | 11,431 | 26,524 |

| # | Routing | Invert | Outlet Devices |
|---|---|---|---|
| 1 | Primary | 68.06' | **24.0" x 45.0' long Culvert** RCP, square edge headwall, Ke= 0.500<br>Outlet Invert= 67.31' S= 0.0167 '/' n= 0.013 Cc= 0.900 |
| 2 | Device 1 | 71.10' | **3.0" Vert. Orifice/Grate** C= 0.600 |
| 3 | Device 1 | 77.00' | **2.50' x 2.50' Horiz. Orifice/Grate** Limited to weir flow C= 0.600 |

**Primary OutFlow** Max=0.28 cfs @ 12.77 hrs HW=72.62' (Free Discharge)
└─**1=Culvert** (Passes 0.28 cfs of 28.56 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 0.28 cfs @ 5.7 fps)
  └─**3=Orifice/Grate** ( Controls 0.00 cfs)

## Pond C2: POND C2



## Pond C2-2: 30" RCP

| | | | | | |
|---|---|---|---|---|---|
| Inflow Area = | 11.000 ac, | Inflow Depth = | 0.66" | for | 1 YEAR event |
| Inflow = | 2.30 cfs @ | 12.03 hrs, | Volume= | 0.605 af | |
| Outflow = | 2.30 cfs @ | 12.04 hrs, | Volume= | 0.603 af, | Atten= 0%, Lag= 0.5 min |
| Primary = | 2.30 cfs @ | 12.04 hrs, | Volume= | 0.603 af | |

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 65.65' @ 12.04 hrs Surf.Area= 260 sf Storage= 130 cf
Plug-Flow detention time= 1.7 min calculated for 0.601 af (99% of inflow)
Center-of-Mass det. time= 1.0 min ( 905.7 - 904.7 )

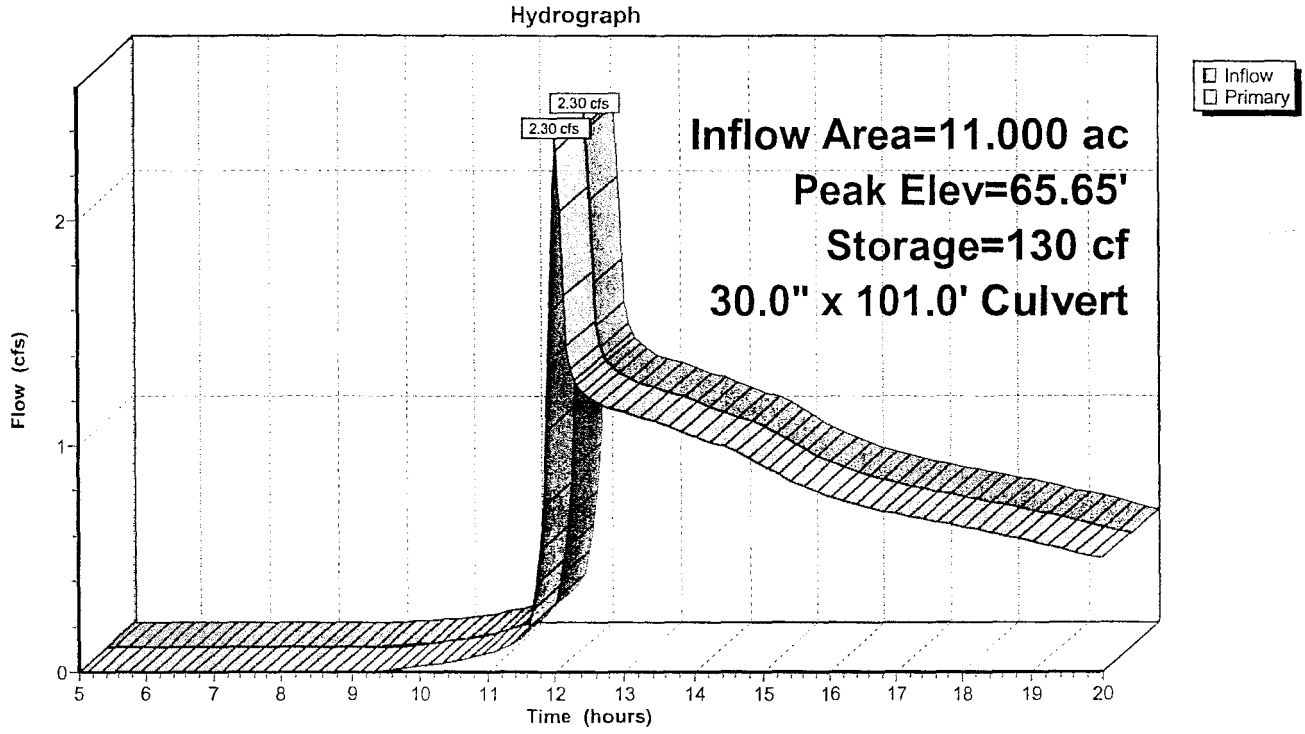
| # | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| 1 | 65.00' | 13,000 cf | **Custom Stage Data (Prismatic)** Listed below |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 65.00 | 0 | 0 | 0 |
| 66.00 | 400 | 200 | 200 |
| 68.00 | 2,400 | 2,800 | 3,000 |
| 70.00 | 7,600 | 10,000 | 13,000 |

| # | Routing | Invert | Outlet Devices |
|---|---|---|---|
| 1 | Primary | 65.06' | **30.0" x 101.0' long Culvert** RCP, end-section conforming to fill, Ke= 0.500<br>Outlet Invert= 64.00' S= 0.0105 '/' n= 0.013 Cc= 0.900 |

**Primary OutFlow** Max=2.28 cfs @ 12.04 hrs HW=65.65' (Free Discharge)
└─**1=Culvert** (Inlet Controls 2.28 cfs @ 2.6 fps)

## Pond C2-2: 30" RCP



## Pond C2-2B: MH C2-2B

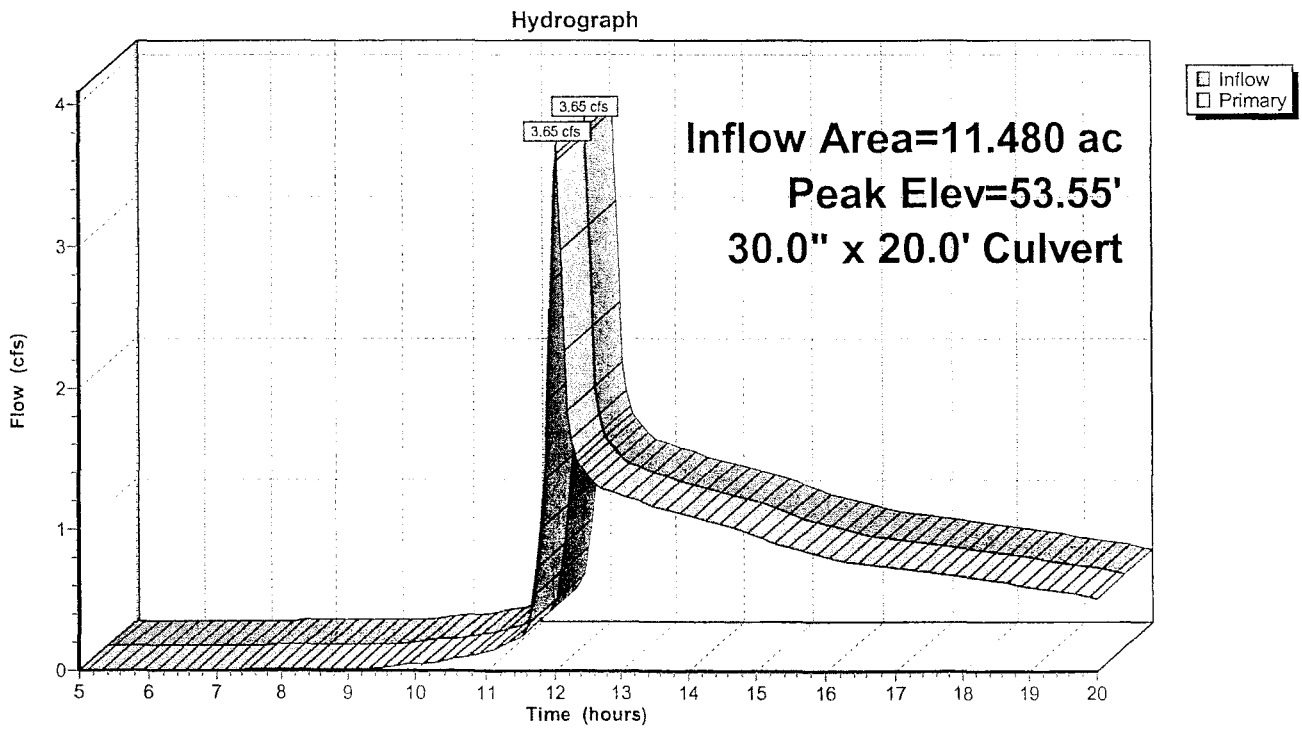
| | | | | | |
|---|---|---|---|---|---|
| Inflow Area = | 11.480 ac, | Inflow Depth = | 0.71" | for 1 YEAR event | |
| Inflow = | 3.65 cfs @ | 12.03 hrs, | Volume= | 0.677 af | |
| Outflow = | 3.65 cfs @ | 12.03 hrs, | Volume= | 0.677 af, | Atten= 0%, Lag= 0.0 min |
| Primary = | 3.65 cfs @ | 12.03 hrs, | Volume= | 0.677 af | |

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 53.55' @ 12.03 hrs
Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= (not calculated)

| # | Routing | Invert | Outlet Devices |
|---|---|---|---|
| 1 | Primary | 52.80' | **30.0" x 20.0' long Culvert** RCP, square edge headwall, Ke= 0.500<br>Outlet Invert= 52.00' S= 0.0400 '/' n= 0.013 Cc= 0.900 |

**Primary OutFlow** Max=3.57 cfs @ 12.03 hrs HW=53.54' (Free Discharge)
└─**1=Culvert** (Inlet Controls 3.57 cfs @ 2.9 fps)

## Pond C2-2B: MH C2-2B



## Pond C3: POND C3

Inflow Area = 5.470 ac, Inflow Depth = 0.84" for 1 YEAR event
Inflow = 4.68 cfs @ 11.96 hrs, Volume= 0.381 af
Outflow = 0.36 cfs @ 13.99 hrs, Volume= 0.226 af, Atten= 92%, Lag= 121.4 min
Primary = 0.36 cfs @ 13.99 hrs, Volume= 0.226 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 72.54' @ 13.99 hrs Surf.Area= 3,918 sf Storage= 9,628 cf
Plug-Flow detention time= 242.5 min calculated for 0.225 af (59% of inflow)
Center-of-Mass det. time= 156.5 min ( 956.9 - 800.4 )

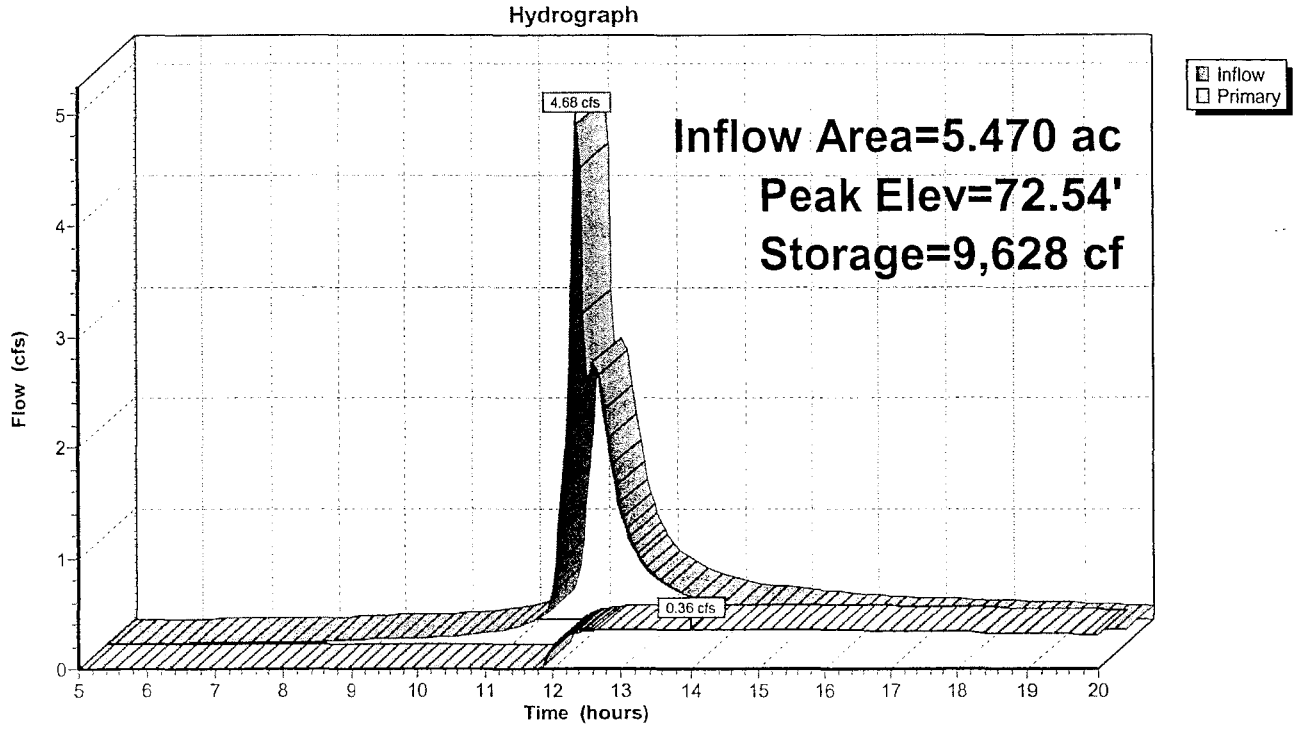
| # | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| 1 | 68.00' | 33,575 cf | **Custom Stage Data (Prismatic)** Listed below |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 68.00 | 850 | 0 | 0 |
| 70.00 | 1,700 | 2,550 | 2,550 |
| 70.50 | 1,925 | 906 | 3,456 |
| 72.00 | 2,800 | 3,544 | 7,000 |
| 74.00 | 6,950 | 9,750 | 16,750 |
| 76.00 | 9,875 | 16,825 | 33,575 |

| # | Routing | Invert | Outlet Devices |
|---|---|---|---|
| 1 | Primary | 68.00' | **24.0" x 50.0' long Culvert** RCP, square edge headwall, Ke= 0.500<br>Outlet Invert= 67.00' S= 0.0200 '/' n= 0.013 Cc= 0.900 |
| 2 | Device 1 | 70.10' | **3.0" Vert. Orifice/Grate** C= 0.600 |
| 3 | Device 1 | 73.25' | **2.50' x 2.50' Horiz. Orifice/Grate** Limited to weir flow C= 0.600 |

**Primary OutFlow** Max=0.36 cfs @ 13.99 hrs HW=72.54' (Free Discharge)
└─**1=Culvert** (Passes 0.36 cfs of 28.46 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 0.36 cfs @ 7.3 fps)
  └─**3=Orifice/Grate** ( Controls 0.00 cfs)

## Pond C3: POND C3



## Pond D-1: DI-5

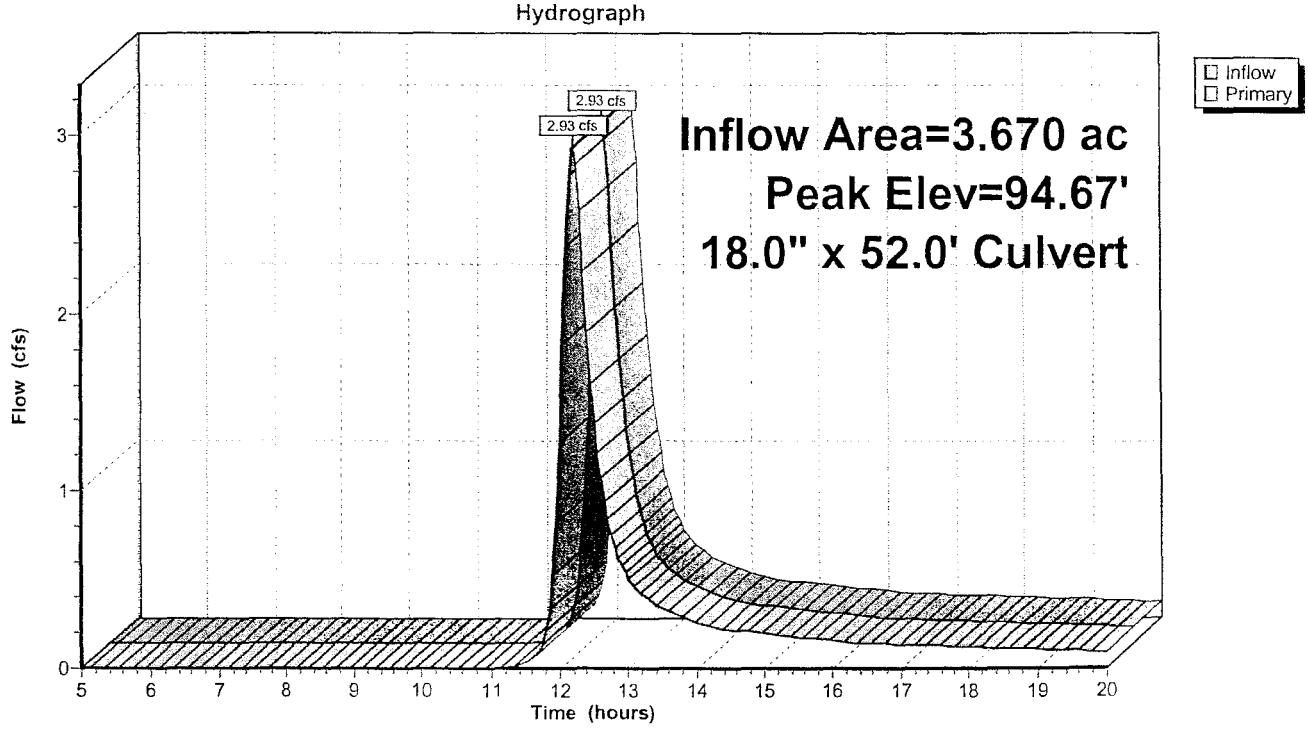
| | | | | | |
|---|---|---|---|---|---|
| Inflow Area = | 3.670 ac, | Inflow Depth = | 0.79" | for | 1 YEAR event |
| Inflow = | 2.93 cfs @ | 12.21 hrs, | Volume= | 0.241 af | |
| Outflow = | 2.93 cfs @ | 12.21 hrs, | Volume= | 0.241 af, | Atten= 0%, Lag= 0.0 min |
| Primary = | 2.93 cfs @ | 12.21 hrs, | Volume= | 0.241 af | |

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 94.67' @ 12.21 hrs
Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= (not calculated)

| # | Routing | Invert | Outlet Devices |
|---|---|---|---|
| 1 | Primary | 93.87' | **18.0" x 52.0' long Culvert** RCP, square edge headwall, Ke= 0.500<br>Outlet Invert= 90.94' S= 0.0563 '/' n= 0.013 Cc= 0.900 |

**Primary OutFlow** Max=2.92 cfs @ 12.21 hrs HW=94.67' (Free Discharge)
└**1=Culvert** (Inlet Controls 2.92 cfs @ 3.0 fps)

## Pond D-1: DI-5



## Pond D-2: DI-5

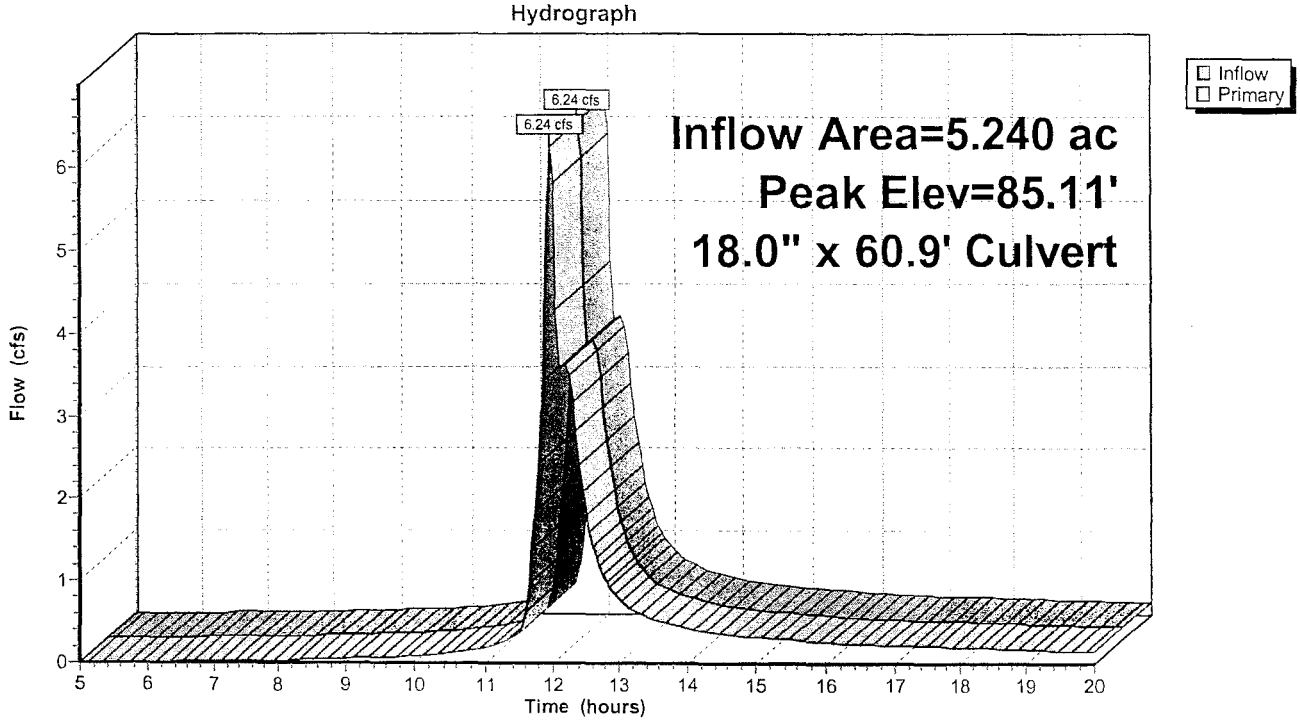
| | | | | | |
|---|---|---|---|---|---|
| Inflow Area = | 5.240 ac, | Inflow Depth = | 1.10" | for | 1 YEAR event |
| Inflow = | 6.24 cfs @ | 11.96 hrs, | Volume= | 0.482 af | |
| Outflow = | 6.24 cfs @ | 11.96 hrs, | Volume= | 0.482 af, | Atten= 0%, Lag= 0.0 min |
| Primary = | 6.24 cfs @ | 11.96 hrs, | Volume= | 0.482 af | |

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 85.11' @ 11.96 hrs
Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= (not calculated)

| # | Routing | Invert | Outlet Devices |
|---|---|---|---|
| 1 | Primary | 83.82' | **18.0" x 60.9' long Culvert** RCP, square edge headwall, Ke= 0.500<br>Outlet Invert= 82.60' S= 0.0200 '/' n= 0.013 Cc= 0.900 |

**Primary OutFlow** Max=6.07 cfs @ 11.96 hrs HW=85.08' (Free Discharge)
└**1=Culvert** (Inlet Controls 6.07 cfs @ 3.8 fps)

## Pond D-2: DI-5



## Pond D-3: MH-1

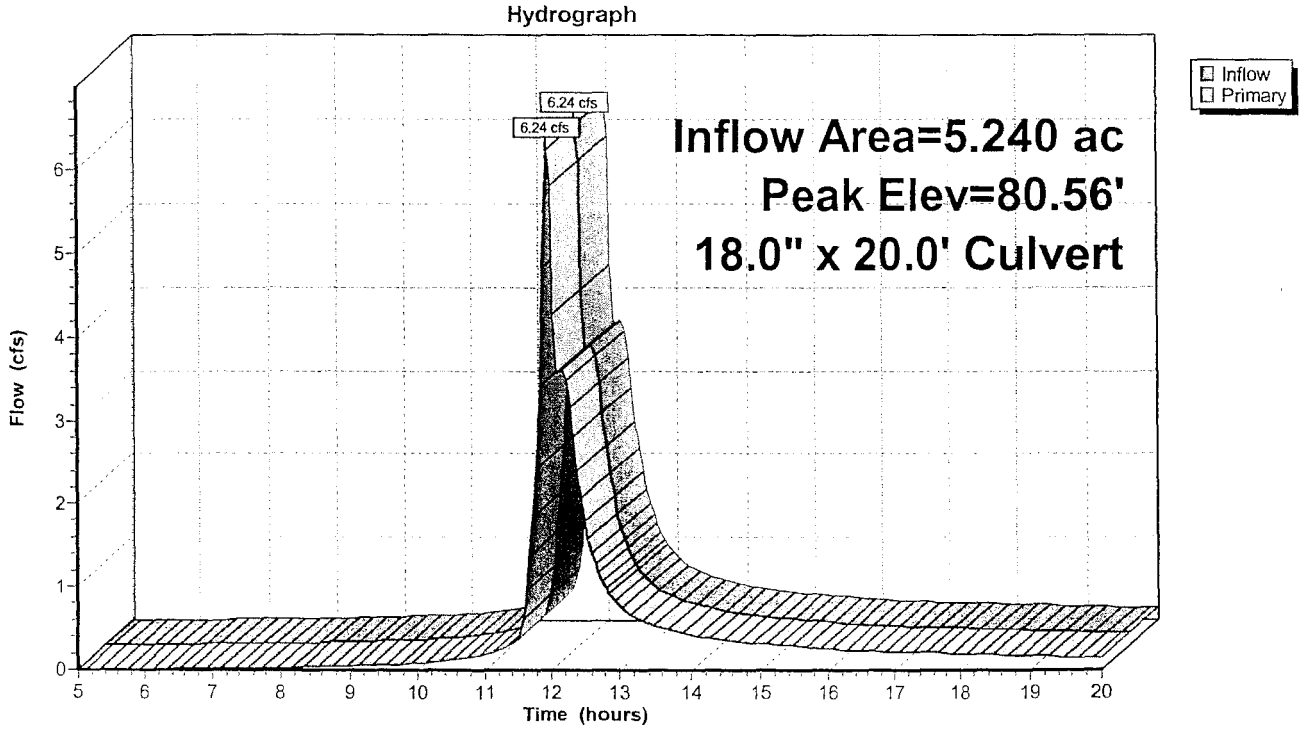
| | | | | | |
|---|---|---|---|---|---|
| Inflow Area = | 5.240 ac, | Inflow Depth = | 1.10" | for | 1 YEAR event |
| Inflow = | 6.24 cfs @ | 11.96 hrs, | Volume= | 0.482 af | |
| Outflow = | 6.24 cfs @ | 11.96 hrs, | Volume= | 0.482 af, | Atten= 0%, Lag= 0.0 min |
| Primary = | 6.24 cfs @ | 11.96 hrs, | Volume= | 0.482 af | |

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 80.56' @ 11.96 hrs
Plug-Flow detention time= (not calculated)
Center-of-Mass det. time= (not calculated)

| # | Routing | Invert | Outlet Devices |
|---|---|---|---|
| 1 | Primary | 79.25' | **18.0" x 20.0' long Culvert** RCP, square edge headwall, Ke= 0.500<br>Outlet Invert= 78.85' S= 0.0200 '/' n= 0.013 Cc= 0.900 |

**Primary OutFlow** Max=6.06 cfs @ 11.96 hrs HW=80.53' (Free Discharge)
└─**1=Culvert** (Barrel Controls 6.06 cfs @ 5.1 fps)

## Pond D-3: MH-1



## Pond P D: POND D

| | | | | | |
|---|---|---|---|---|---|
| Inflow Area = | 7.440 ac, | Inflow Depth = | 0.94" | for | 1 YEAR event |
| Inflow = | 6.95 cfs @ | 11.98 hrs, | Volume= | 0.580 af | |
| Outflow = | 0.55 cfs @ | 13.94 hrs, | Volume= | 0.372 af, | Atten= 92%, Lag= 117.6 min |
| Primary = | 0.55 cfs @ | 13.94 hrs, | Volume= | 0.372 af | |

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 78.57' @ 13.94 hrs Surf.Area= 4,677 sf Storage= 13,772 cf
Plug-Flow detention time= 216.9 min calculated for 0.370 af (64% of inflow)
Center-of-Mass det. time= 137.8 min ( 937.7 - 799.9 )

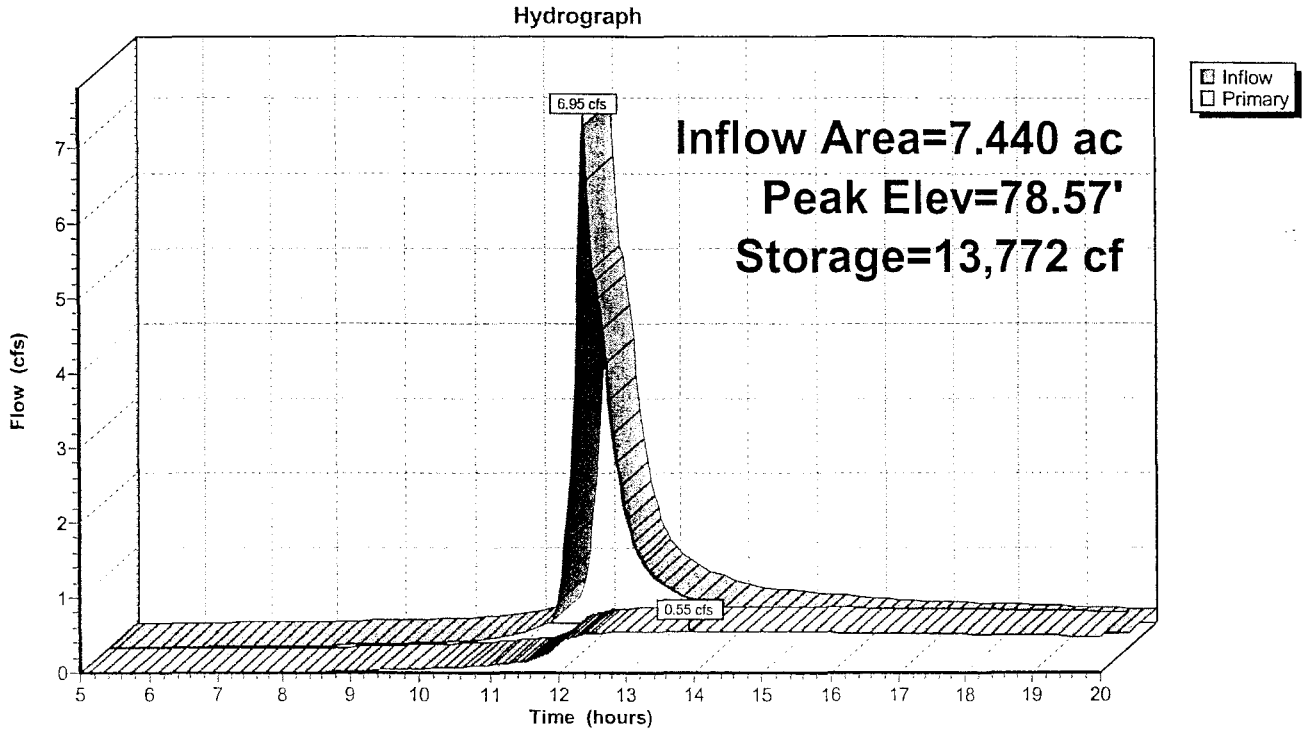
| # | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| 1 | 73.00' | 36,249 cf | **Custom Stage Data (Prismatic)** Listed below |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 73.00 | 963 | 0 | 0 |
| 74.00 | 1,391 | 1,177 | 1,177 |
| 76.00 | 2,465 | 3,856 | 5,033 |
| 76.50 | 2,775 | 1,310 | 6,343 |
| 78.00 | 3,821 | 4,947 | 11,290 |
| 78.25 | 4,010 | 979 | 12,269 |
| 78.85 | 5,241 | 2,775 | 15,044 |
| 80.00 | 6,284 | 6,627 | 21,671 |
| 82.00 | 8,294 | 14,578 | 36,249 |

| # | Routing | Invert | Outlet Devices |
|---|---|---|---|
| 1 | Primary | 71.00' | **24.0" x 60.0' long Culvert** RCP, square edge headwall, Ke= 0.500<br>Outlet Invert= 70.00' S= 0.0167 '/' n= 0.013 Cc= 0.900 |
| 2 | Device 1 | 79.00' | **3.00' x 3.00' Horiz. Orifice/Grate** Limited to weir flow C= 0.600 |
| 3 | Device 1 | 73.10' | **3.0" Vert. Orifice/Grate** C= 0.600 |

**Primary OutFlow** Max=0.55 cfs @ 13.94 hrs HW=78.57' (Free Discharge)
└─**1=Culvert** (Passes 0.55 cfs of 38.79 cfs potential flow)
  ├─**2=Orifice/Grate** ( Controls 0.00 cfs)
  └─**3=Orifice/Grate** (Orifice Controls 0.55 cfs @ 11.1 fps)

## Pond P D: POND D



Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment 1/3 ac lots BMP: Post Development to SB 1** Runoff Area=11.050 ac Runoff Depth=1.56"
Tc=20.0 min CN=81 Runoff=20.80 cfs 1.439 af

**Subcatchment 8S: (new Subcat)** Runoff Area=7.700 ac Runoff Depth=1.06"
Flow Length=680' Tc=18.9 min CN=73 Runoff=9.90 cfs 0.680 af

**Subcatchment C-1: UNDEVELOPED** Runoff Area=1.560 ac Runoff Depth=0.90"
Tc=15.0 min CN=70 Runoff=1.90 cfs 0.117 af

**Subcatchment C-2: C-2 UNDEVELOPED** Runoff Area=2.000 ac Runoff Depth=0.90"
Tc=25.0 min CN=70 Runoff=1.79 cfs 0.149 af

**Subcatchment C-3: UNDEVELOPED** Runoff Area=4.200 ac Runoff Depth=0.90"
Flow Length=560' Tc=25.6 min CN=70 Runoff=3.69 cfs 0.313 af

**Subcatchment C1-1 DA: DEVELOPED** Runoff Area=0.330 ac Runoff Depth=2.47"
Tc=5.0 min CN=92 Runoff=1.48 cfs 0.068 af

**Subcatchment C1-2 DA: DEVELOPED** Runoff Area=0.640 ac Runoff Depth=2.47"
Tc=10.0 min CN=92 Runoff=2.45 cfs 0.132 af

**Subcatchment C2-2 DA: UNDEVELOPED** Runoff Area=1.000 ac Runoff Depth=1.57"
Tc=10.0 min CN=81 Runoff=2.59 cfs 0.131 af

**Subcatchment C2-2A DA: DEVELOPED** Runoff Area=0.480 ac Runoff Depth=2.47"
Tc=10.0 min CN=92 Runoff=1.83 cfs 0.099 af

**Subcatchment C2-2B DA: POST DEVELOPMENT** Runoff Area=0.350 ac Runoff Depth=1.44"
Flow Length=100' Tc=3.4 min CN=79 Runoff=1.05 cfs 0.042 af

**Subcatchment C3-1 DA: DEVELOPED** Runoff Area=0.760 ac Runoff Depth=2.47"
Tc=5.0 min CN=92 Runoff=3.40 cfs 0.157 af

**Subcatchment C3-1A DA: DEVELOPED** Runoff Area=0.510 ac Runoff Depth=2.47"
Tc=5.0 min CN=92 Runoff=2.28 cfs 0.105 af

**Subcatchment D: POST DEV** Runoff Area=3.670 ac Runoff Depth=1.23"
Flow Length=250' Tc=25.1 min CN=76 Runoff=4.71 cfs 0.377 af

**Subcatchment D2: POST DEV** Runoff Area=1.570 ac Runoff Depth=2.47"
Flow Length=620' Tc=5.0 min CN=92 Runoff=7.02 cfs 0.323 af

**Subcatchment D3: POST DEV** Runoff Area=2.200 ac Runoff Depth=0.90"
Tc=15.0 min CN=70 Runoff=2.67 cfs 0.165 af

**Subcatchment Post Dev: 1/3 Acre Lots** Runoff Area=7.600 ac Runoff Depth=1.56"
Tc=25.0 min CN=81 Runoff=12.53 cfs 0.988 af

**Subcatchment S-1: S-1** Runoff Area=5.250 ac Runoff Depth=0.90"
Flow Length=785' Tc=19.2 min CN=70 Runoff=5.54 cfs 0.393 af

**Subcatchment S-2: POST DEVELOPED** Runoff Area=24.200 ac Runoff Depth=0.99"
Flow Length=2,200' Tc=47.3 min CN=72 Runoff=15.75 cfs 1.998 af

**Subcatchment S-3: POST DEVELOPED** Runoff Area=5.800 ac Runoff Depth=1.00"
Tc=20.0 min CN=72 Runoff=6.80 cfs 0.485 af

**Reach C2-1A: RIPRAP CHANNEL** Peak Depth=0.17' Max Vel=2.4 fps Inflow=2.22 cfs 0.755 af
n=0.040 L=40.0' S=0.0500 '/' Capacity=177.27 cfs Outflow=2.22 cfs 0.755 af

**Reach R1: (new Reach)** Peak Depth=0.21' Max Vel=1.2 fps Inflow=6.85 cfs 1.766 af
n=0.040 L=830.0' S=0.0133 '/' Capacity=152.25 cfs Outflow=5.41 cfs 1.695 af

**Reach R1A: (new Reach)** Peak Depth=0.17' Max Vel=2.8 fps Inflow=1.20 cfs 0.817 af
n=0.040 L=180.0' S=0.0778 '/' Capacity=1,634.29 cfs Outflow=1.20 cfs 0.814 af

**Reach R1B: (new Reach)** Peak Depth=0.71' Max Vel=2.1 fps Inflow=3.77 cfs 0.572 af
n=0.040 L=831.0' S=0.0142 '/' Capacity=325.67 cfs Outflow=3.20 cfs 0.559 af

**Reach R2: (new Reach)** Peak Depth=0.42' Max Vel=1.8 fps Inflow=23.16 cfs 4.705 af
n=0.040 L=515.0' S=0.0126 '/' Capacity=148.58 cfs Outflow=22.69 cfs 4.642 af

**Reach R2A: (new Reach)** Peak Depth=0.38' Max Vel=2.3 fps Inflow=5.81 cfs 1.024 af
n=0.040 L=510.0' S=0.0176 '/' Capacity=125.75 cfs Outflow=5.37 cfs 1.013 af

**Reach R3: (new Reach)** Peak Depth=0.52' Max Vel=1.2 fps Inflow=26.24 cfs 6.017 af
n=0.040 L=660.0' S=0.0041 '/' Capacity=22.84 cfs Outflow=25.23 cfs 5.856 af

**Reach R4: (new Reach)** Peak Depth=0.54' Max Vel=1.2 fps Inflow=26.53 cfs 6.536 af
n=0.040 L=10.0' S=0.0040 '/' Capacity=22.59 cfs Outflow=26.52 cfs 6.534 af

**Pond BMP - 1: BMP #1** Peak Elev=80.35' Storage=37,151 cf Inflow=20.80 cfs 1.439 af
Outflow=1.20 cfs 0.817 af

**Pond BMP-3: Basin 3** Peak Elev=59.70' Storage=19,736 cf Inflow=12.53 cfs 0.988 af
Outflow=2.79 cfs 0.889 af

**Pond C1: POND C1** Peak Elev=75.14' Storage=6,865 cf Inflow=5.11 cfs 0.317 af
Outflow=0.47 cfs 0.279 af

**Pond C2: POND C2** Peak Elev=73.74' Storage=2,449 cf Inflow=1.79 cfs 0.149 af
Outflow=0.37 cfs 0.147 af

**Pond C2-2: 30" RCP** Peak Elev=65.78' Storage=157 cf Inflow=3.41 cfs 0.885 af
30.0" x 101.0' Culvert Outflow=3.41 cfs 0.884 af

**Pond C2-2B: MH C2-2B** Peak Elev=53.71' Inflow=5.20 cfs 0.982 af
30.0" x 20.0' Culvert Outflow=5.20 cfs 0.982 af

**Pond C3: POND C3** Peak Elev=73.34' Storage=13,541 cf Inflow=6.69 cfs 0.575 af
Outflow=1.38 cfs 0.330 af

**Pond D-1: DI-5** Peak Elev=94.93' Inflow=4.71 cfs 0.377 af
18.0" x 52.0' Culvert Outflow=4.71 cfs 0.377 af

**Pond D-2: DI-5** Peak Elev=85.61' Inflow=8.70 cfs 0.700 af
18.0" x 60.9' Culvert Outflow=8.70 cfs 0.700 af

**Pond D-3: MH-1** Peak Elev=81.04' Inflow=8.70 cfs 0.700 af
18.0" x 20.0' Culvert Outflow=8.70 cfs 0.700 af

**Pond P D: POND D** Peak Elev=79.19' Storage=16,977 cf Inflow=10.29 cfs 0.865 af
Outflow=3.77 cfs 0.572 af

**Total Runoff Area = 80.870 ac Runoff Volume = 8.161 af Average Runoff Depth = 1.21"**

## Subcatchment 1/3 ac lots BMP: Post Development to SB 1

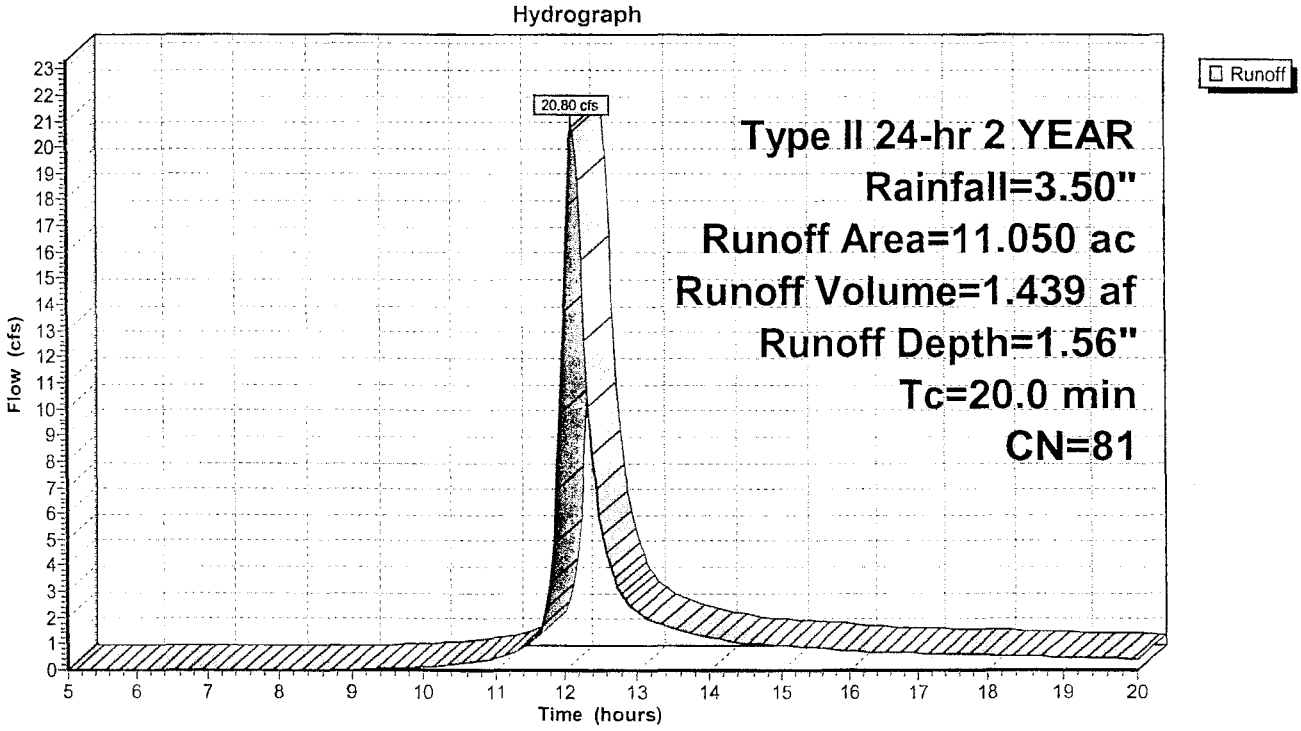
Runoff = 20.80 cfs @ 12.13 hrs, Volume= 1.439 af, Depth= 1.56"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 YEAR Rainfall=3.50"

| Area (ac) | CN | Description |
|---|---|---|
| 11.050 | 81 | 1/3 acre lots, 30% imp, HSG C |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 20.0 | | | | | **Direct Entry,** |

## Subcatchment 1/3 ac lots BMP: Post Development to SB 1



## Subcatchment 8S: (new Subcat)

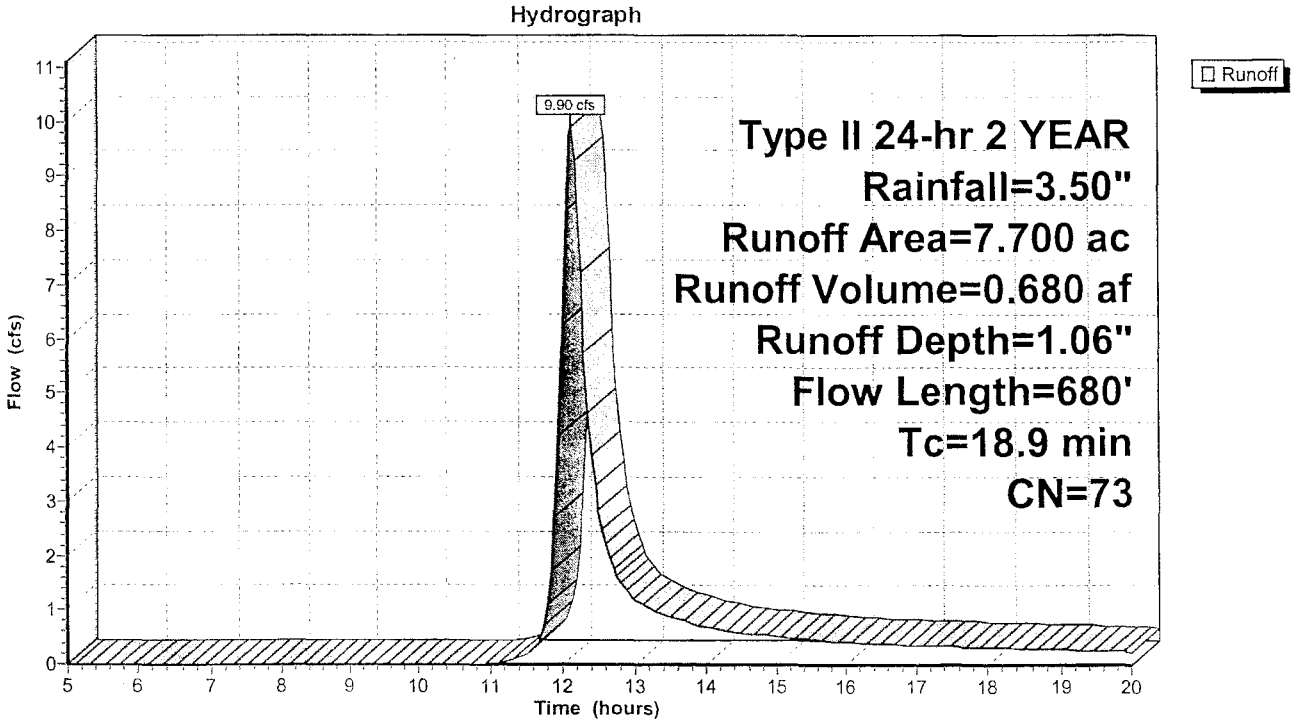
Runoff = 9.90 cfs @ 12.13 hrs, Volume= 0.680 af, Depth= 1.06"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 YEAR Rainfall=3.50"

| Area (ac) | CN | Description |
|---|---|---|
| 5.400 | 70 | Woods, Good, HSG C |
| 2.300 | 81 | 1/3 acre lots, 30% imp, HSG C |
| 7.700 | 73 | Weighted Average |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 14.4 | 130 | 0.1080 | 0.2 | | **Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.80" |
| 1.4 | 200 | 0.2250 | 2.4 | | **Shallow Concentrated Flow,** Woodland Kv= 5.0 fps |
| 3.1 | 350 | 0.0110 | 1.9 | 37.46 | **Parabolic Channel,** W=60.00' D=0.50' Area=20.0 sf Perim=60.0' n= 0.040 |
| 18.9 | 680 | Total | | | |

## Subcatchment 8S: (new Subcat)



## Subcatchment C-1: UNDEVELOPED

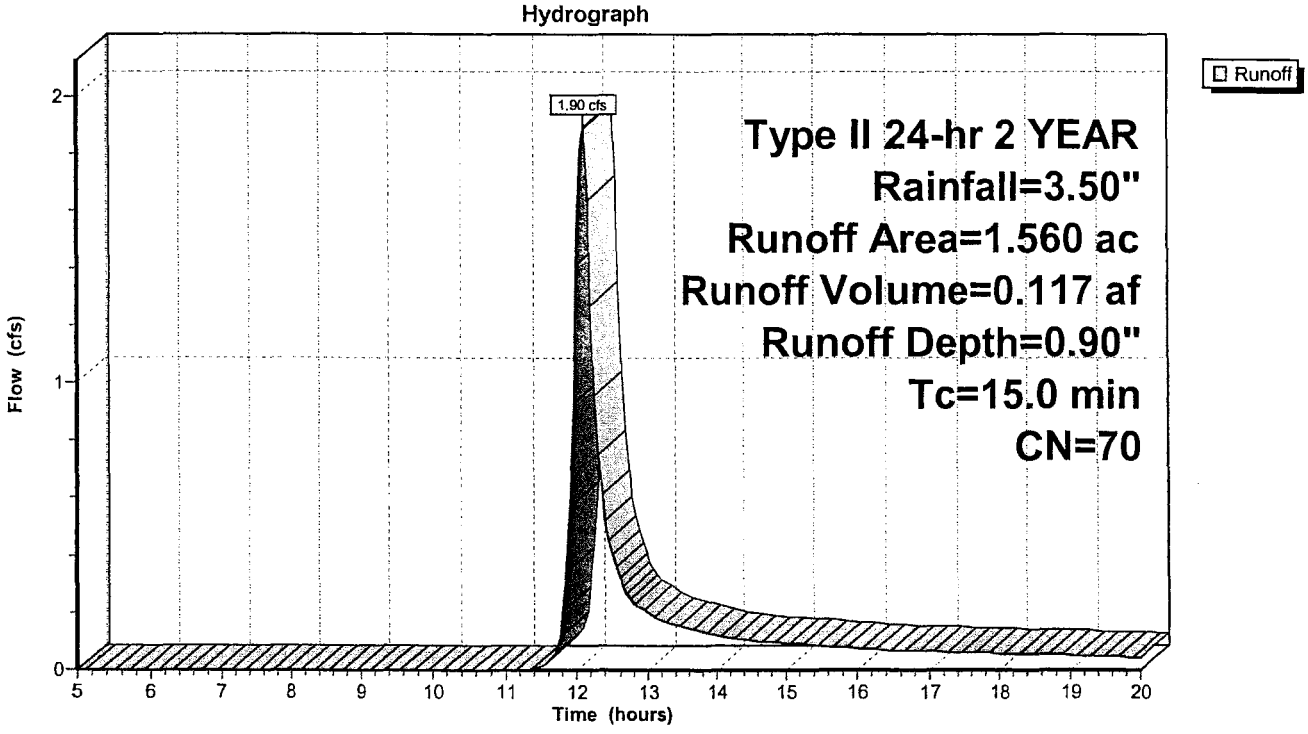
Runoff = 1.90 cfs @ 12.09 hrs, Volume= 0.117 af, Depth= 0.90"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 YEAR Rainfall=3.50"

| Area (ac) | CN | Description |
|---|---|---|
| 1.560 | 70 | Woods, Good, HSG C |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 15.0 | | | | | **Direct Entry,** |

## Subcatchment C-1: UNDEVELOPED



## Subcatchment C-2: C-2 UNDEVELOPED

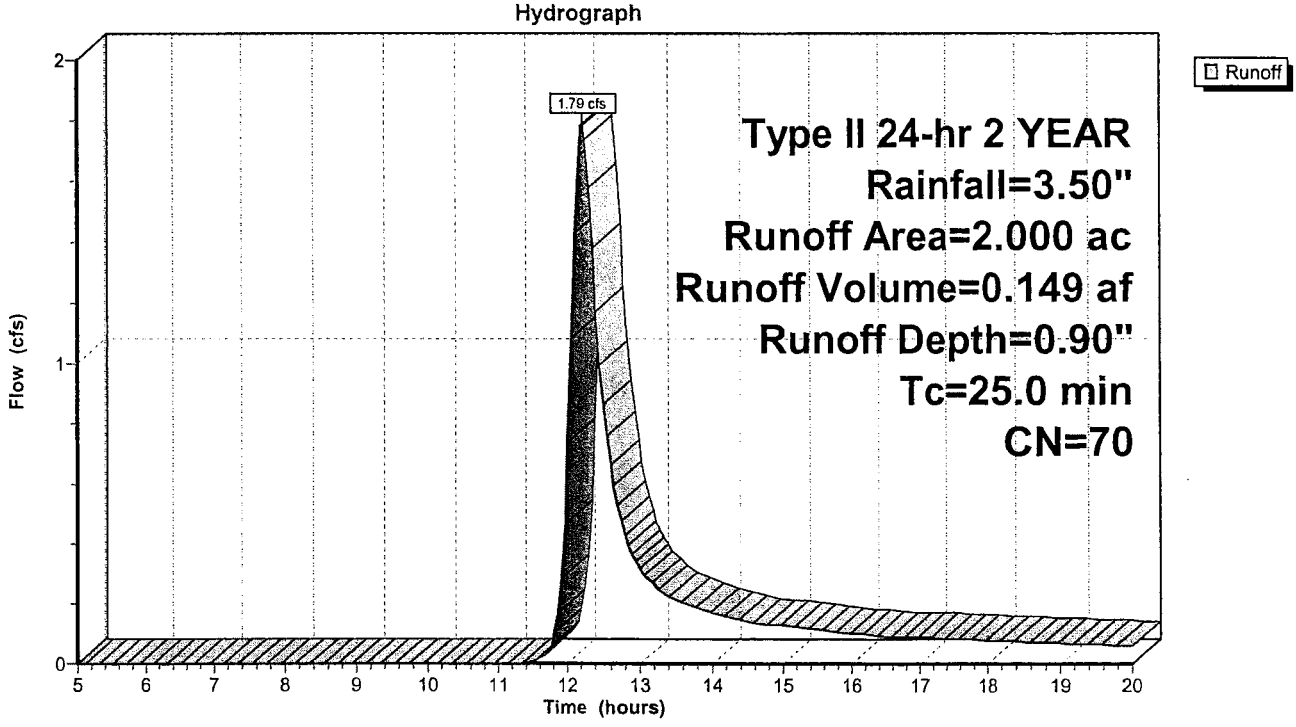
Runoff = 1.79 cfs @ 12.21 hrs, Volume= 0.149 af, Depth= 0.90"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 YEAR Rainfall=3.50"

| Area (ac) | CN | Description |
|---|---|---|
| 2.000 | 70 | Woods, Good, HSG C |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 25.0 | | | | | **Direct Entry,** |

## Subcatchment C-2: C-2 UNDEVELOPED



## Subcatchment C-3: UNDEVELOPED

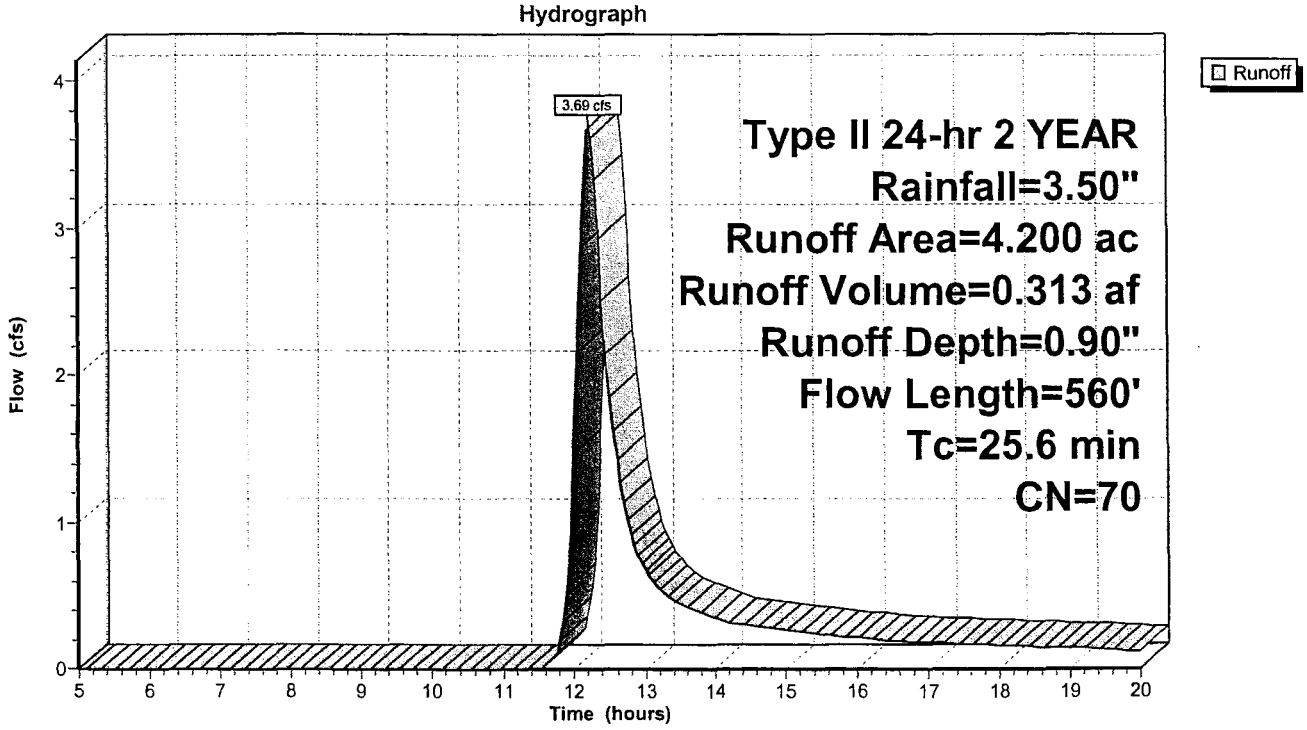
Runoff = 3.69 cfs @ 12.22 hrs, Volume= 0.313 af, Depth= 0.90"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 YEAR Rainfall=3.50"

| Area (ac) | CN | Description |
|---|---|---|
| 4.200 | 70 | Woods, Good, HSG C |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 19.5 | 100 | 0.0300 | 0.1 | | **Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.80" |
| 6.1 | 460 | 0.0630 | 1.3 | | **Shallow Concentrated Flow,** Woodland Kv= 5.0 fps |
| 25.6 | 560 | Total | | | |

## Subcatchment C-3: UNDEVELOPED



## Subcatchment C1-1 DA: DEVELOPED

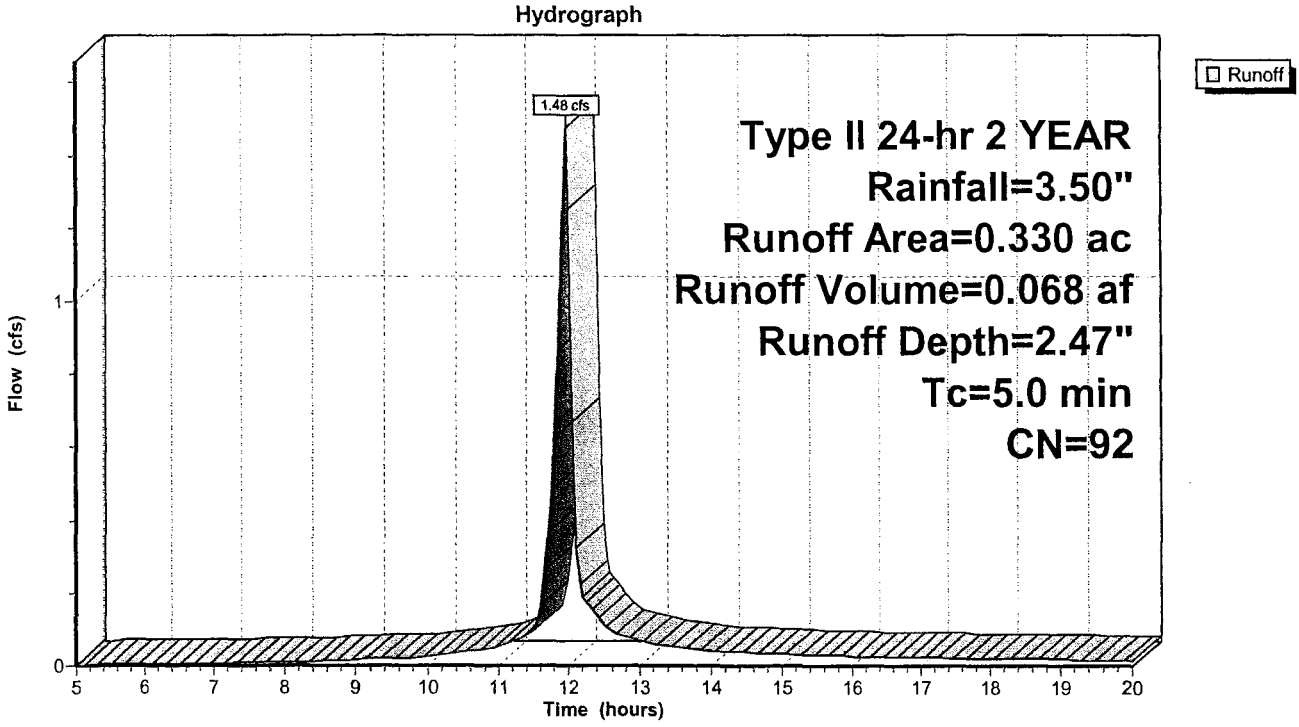
Runoff = 1.48 cfs @ 11.95 hrs, Volume= 0.068 af, Depth= 2.47"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 YEAR Rainfall=3.50"

| Area (ac) | CN | Description |
|---|---|---|
| 0.330 | 92 | Paved roads w/open ditches, HSG C |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.0 | | | | | **Direct Entry,** |

## Subcatchment C1-1 DA: DEVELOPED



## Subcatchment C1-2 DA: DEVELOPED

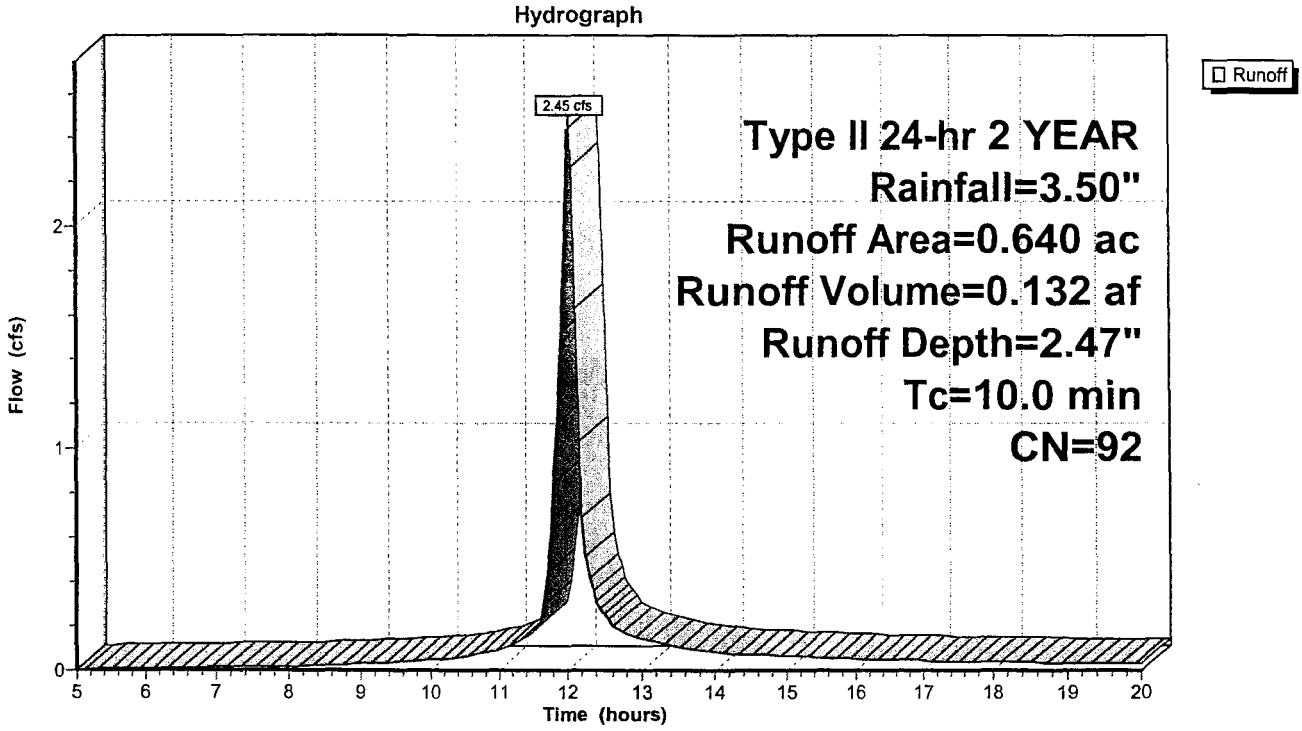
Runoff = 2.45 cfs @ 12.01 hrs, Volume= 0.132 af, Depth= 2.47"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 YEAR Rainfall=3.50"

| Area (ac) | CN | Description |
|---|---|---|
| 0.640 | 92 | Paved roads w/open ditches, HSG C |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 10.0 | | | | | **Direct Entry,** |

## Subcatchment C1-2 DA: DEVELOPED



## Subcatchment C2-2 DA: UNDEVELOPED

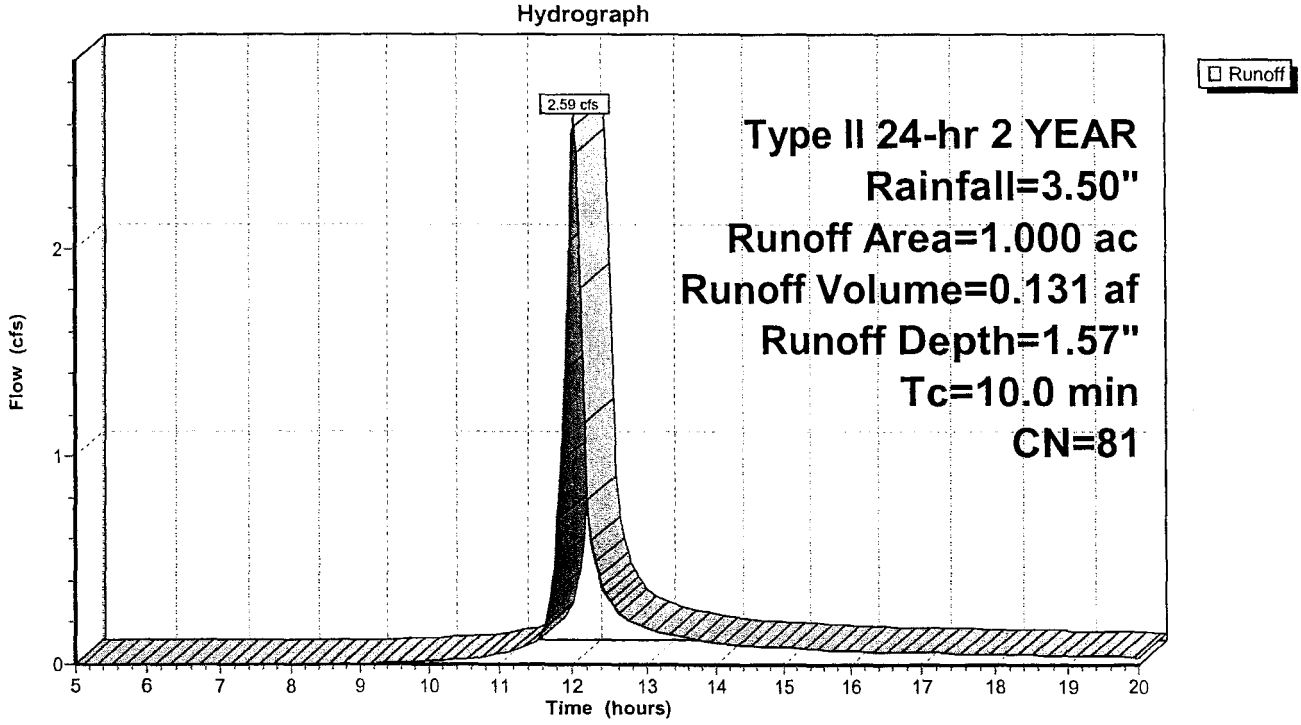
Runoff = 2.59 cfs @ 12.02 hrs, Volume= 0.131 af, Depth= 1.57"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 YEAR Rainfall=3.50"

| Area (ac) | CN | Description |
|---|---|---|
| 0.500 | 70 | Woods, Good, HSG C |
| 0.500 | 92 | Paved roads w/open ditches, HSG C |
| 1.000 | 81 | Weighted Average |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 10.0 | | | | | **Direct Entry,** |

## Subcatchment C2-2 DA: UNDEVELOPED



## Subcatchment C2-2A DA: DEVELOPED

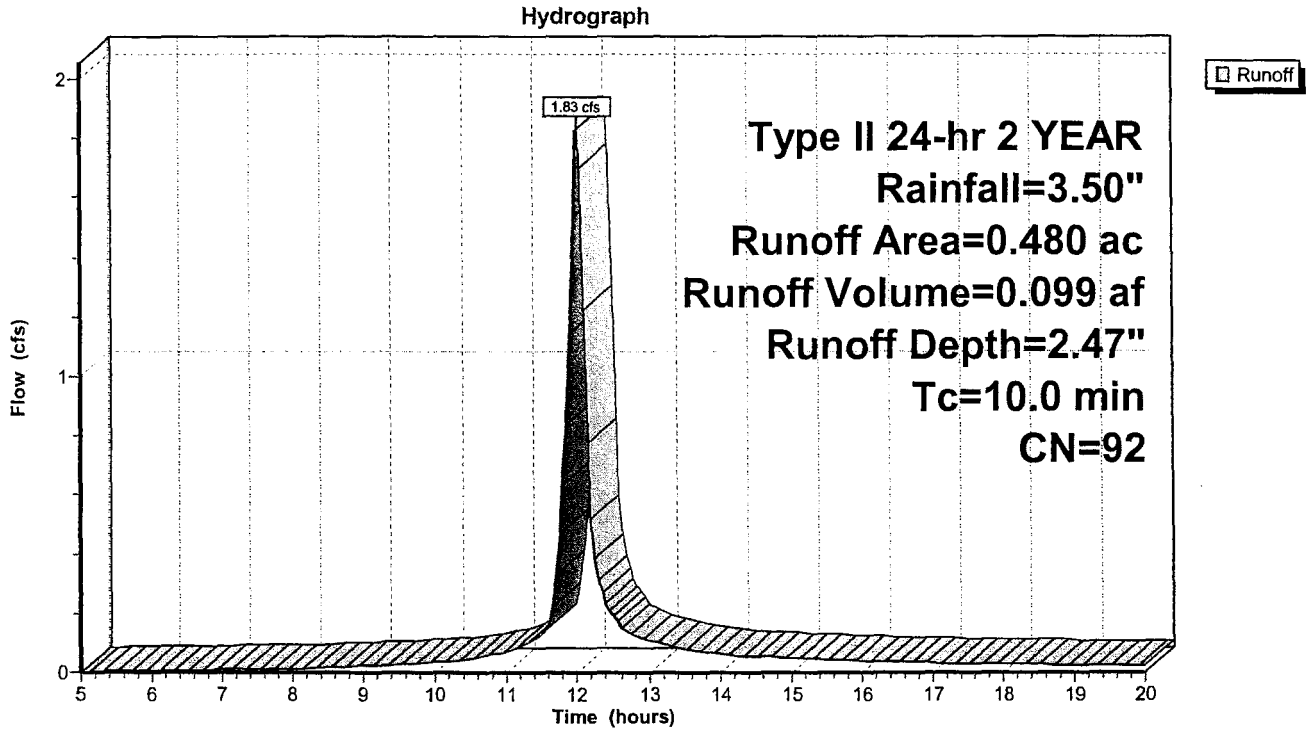
Runoff = 1.83 cfs @ 12.01 hrs, Volume= 0.099 af, Depth= 2.47"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 YEAR Rainfall=3.50"

| Area (ac) | CN | Description |
|---|---|---|
| 0.480 | 92 | Paved roads w/open ditches, HSG C |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 10.0 | | | | | **Direct Entry,** |

## Subcatchment C2-2A DA: DEVELOPED



## Subcatchment C2-2B DA: POST DEVELOPMENT

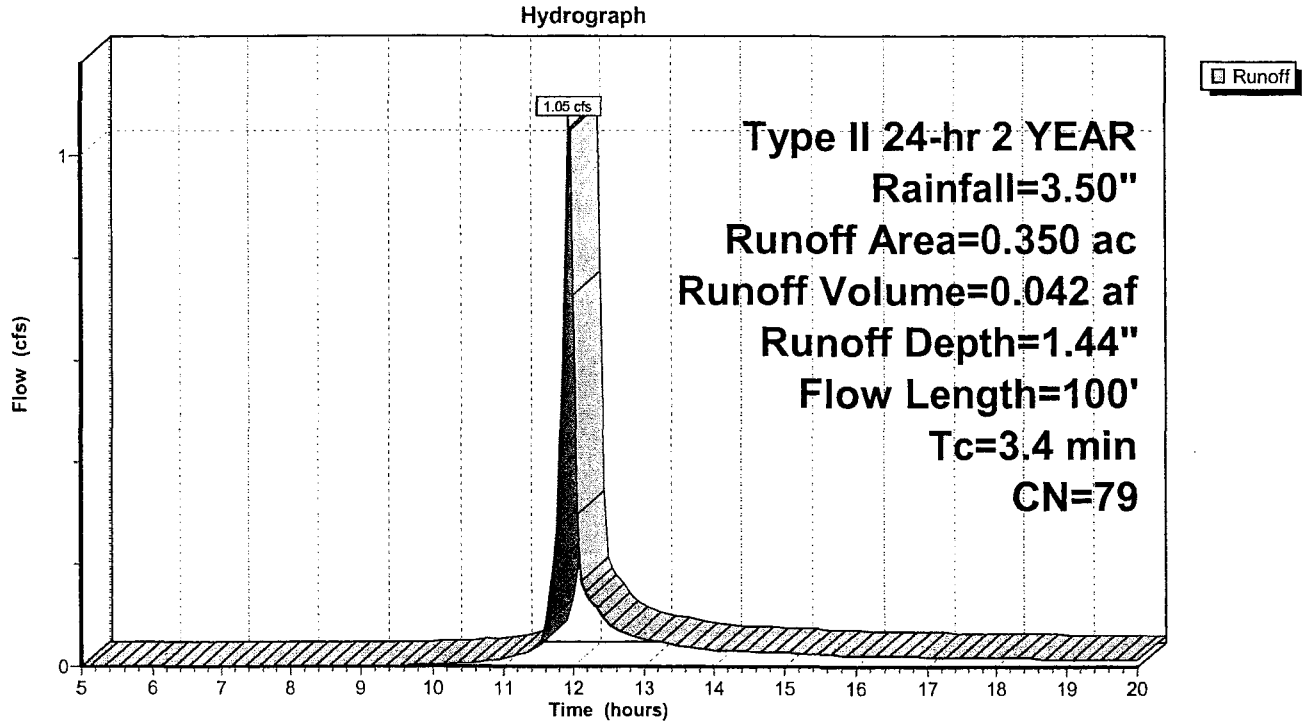
Runoff = 1.05 cfs @ 11.94 hrs, Volume= 0.042 af, Depth= 1.44"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 YEAR Rainfall=3.50"

| Area (ac) | CN | Description |
|---|---|---|
| 0.350 | 79 | 50-75% Grass cover, Fair, HSG C |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 3.4 | 100 | 0.3300 | 0.5 | | **Sheet Flow,** Grass: Short n= 0.150 P2= 2.80" |

## Subcatchment C2-2B DA: POST DEVELOPMENT



## Subcatchment C3-1 DA: DEVELOPED

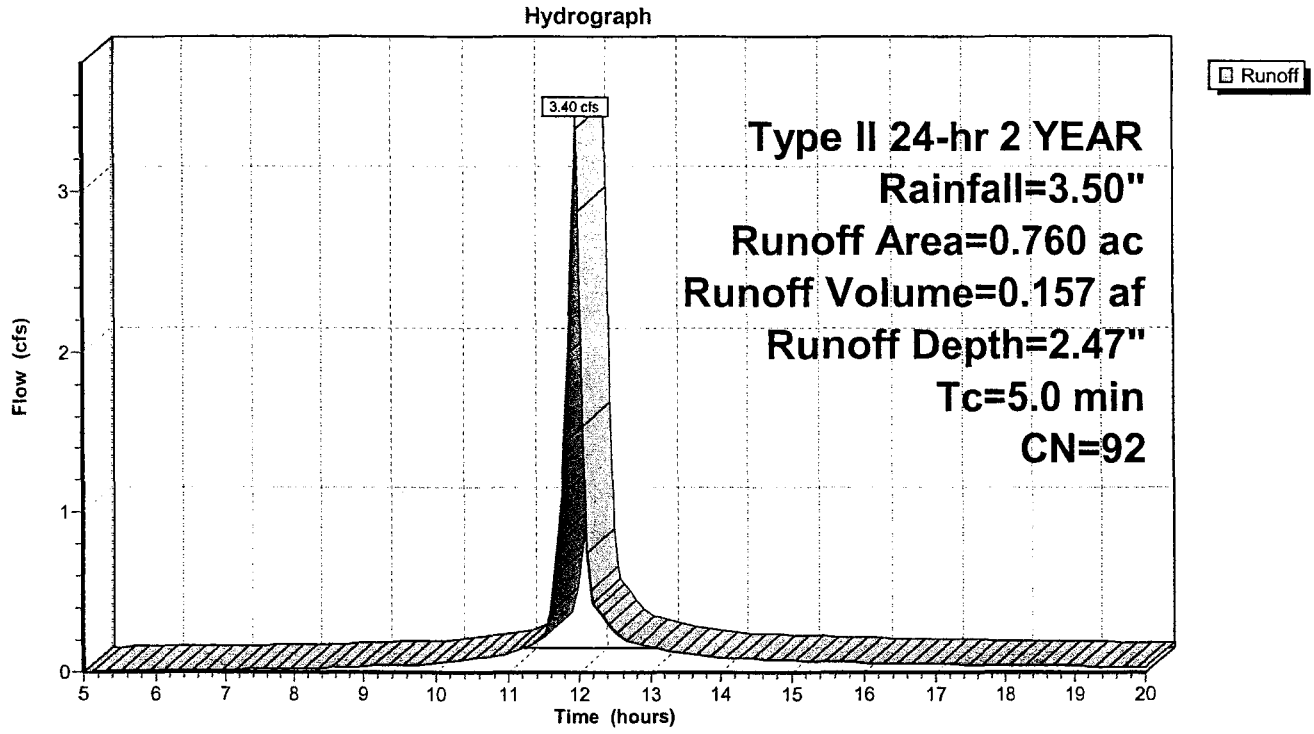
Runoff = 3.40 cfs @ 11.95 hrs, Volume= 0.157 af, Depth= 2.47"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 YEAR Rainfall=3.50"

| Area (ac) | CN | Description |
|---|---|---|
| 0.760 | 92 | Paved roads w/open ditches, HSG C |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.0 | | | | | **Direct Entry,** |

## Subcatchment C3-1 DA: DEVELOPED



## Subcatchment C3-1A DA: DEVELOPED

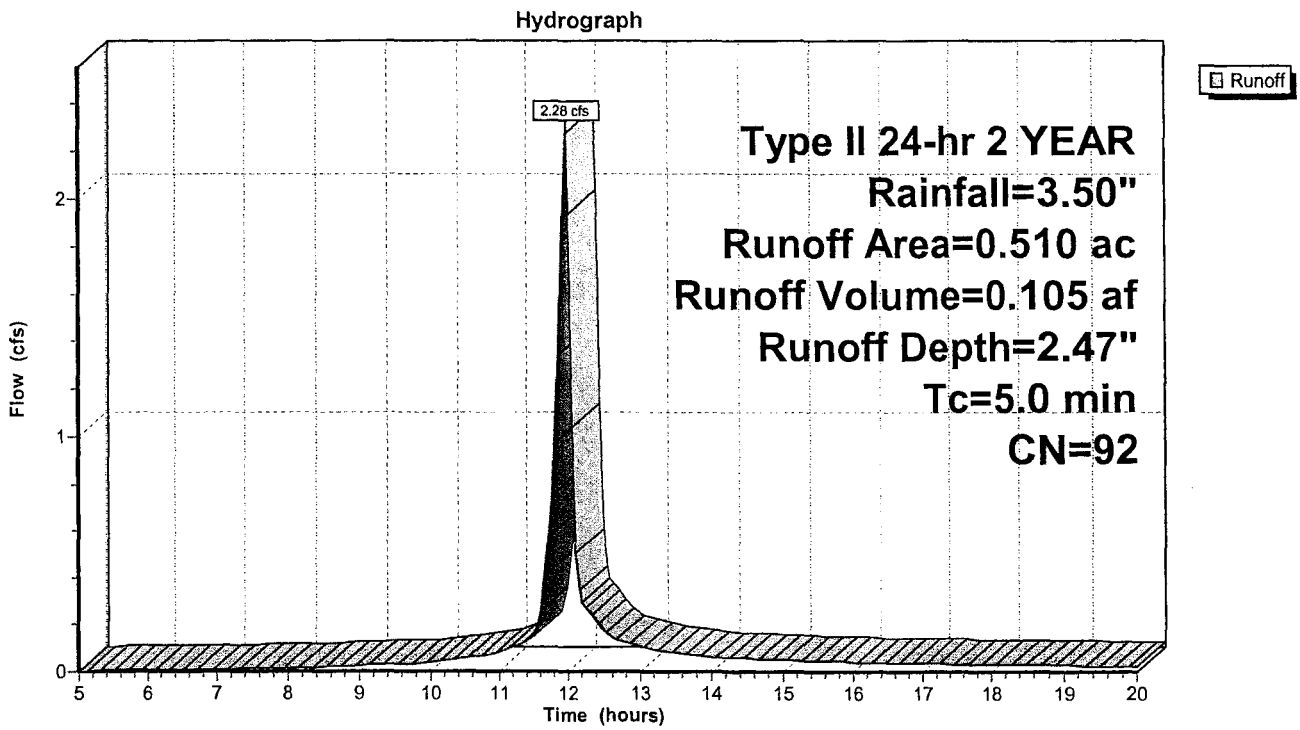
Runoff = 2.28 cfs @ 11.95 hrs, Volume= 0.105 af, Depth= 2.47"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 YEAR Rainfall=3.50"

| Area (ac) | CN | Description |
|---|---|---|
| 0.510 | 92 | Paved roads w/open ditches, HSG C |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.0 | | | | | **Direct Entry,** |

## Subcatchment C3-1A DA: DEVELOPED



## Subcatchment D: POST DEV

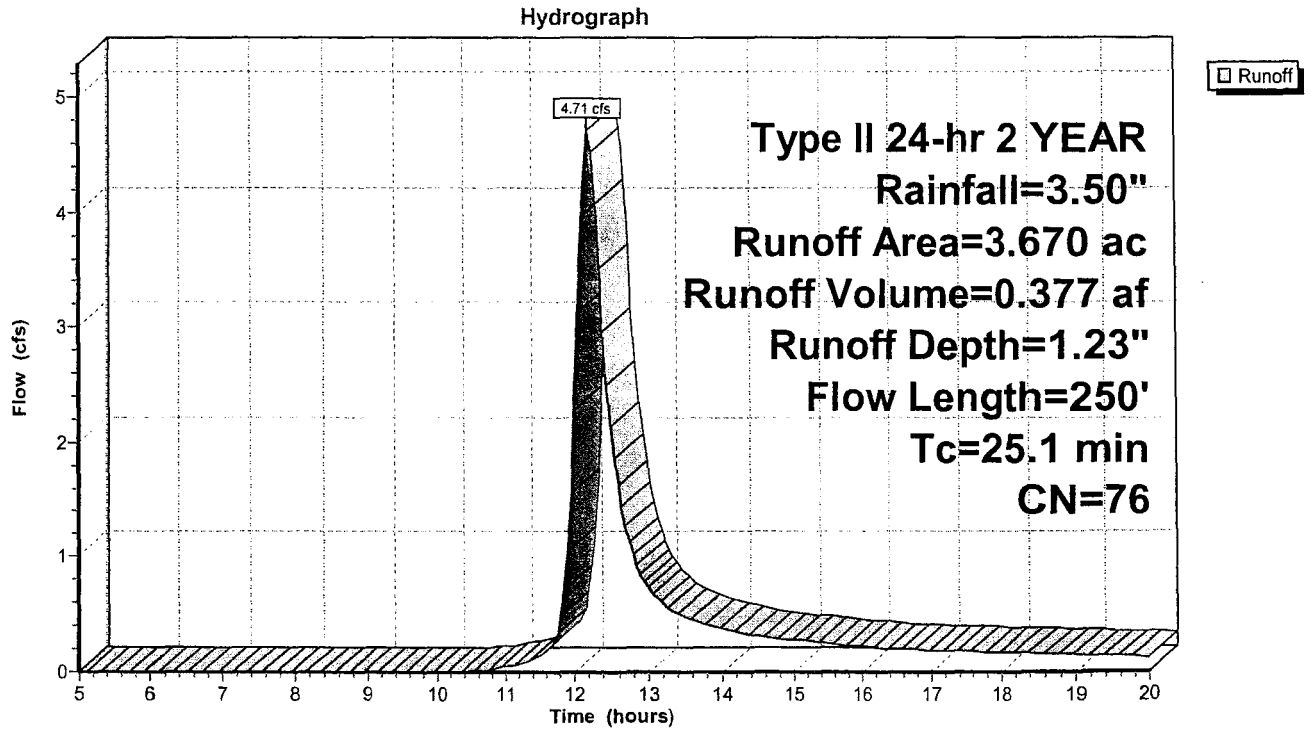
Runoff = 4.71 cfs @ 12.20 hrs, Volume= 0.377 af, Depth= 1.23"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 YEAR Rainfall=3.50"

| Area (ac) | CN | Description |
|---|---|---|
| 2.600 | 70 | Woods, Good, HSG C |
| 1.070 | 92 | Paved roads w/open ditches, HSG C |
| 3.670 | 76 | Weighted Average |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 2.1 | 150 | 0.0560 | 1.2 | | **Shallow Concentrated Flow,** Woodland Kv= 5.0 fps |
| 23.0 | 100 | 0.0200 | 0.1 | | **Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.80" |
| 25.1 | 250 | Total | | | |

## Subcatchment D: POST DEV



## Subcatchment D2: POST DEV

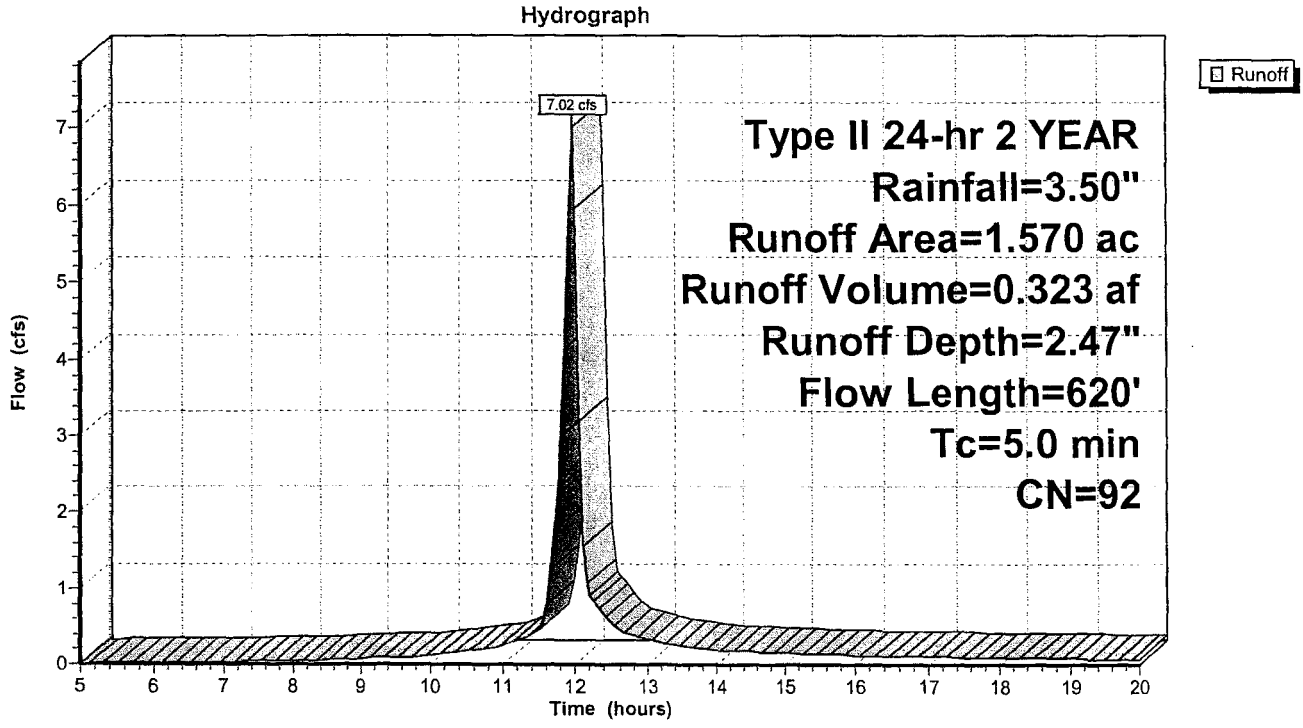
Runoff = 7.02 cfs @ 11.95 hrs, Volume= 0.323 af, Depth= 2.47"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 YEAR Rainfall=3.50"

| Area (ac) | CN | Description |
|---|---|---|
| 1.570 | 92 | Paved roads w/open ditches, HSG C |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 1.6 | 40 | 0.3300 | 0.4 | | **Sheet Flow,** Grass: Short n= 0.150 P2= 2.80" |
| 3.4 | 580 | 0.0232 | 2.8 | 14.07 | **Trap/Vee/Rect Channel Flow,** Bot.W=0.00' D=1.00' Z= 6.0 & 4.0 '/' n= 0.050 |
| 5.0 | 620 | Total | | | |

## Subcatchment D2: POST DEV



## Subcatchment D3: POST DEV

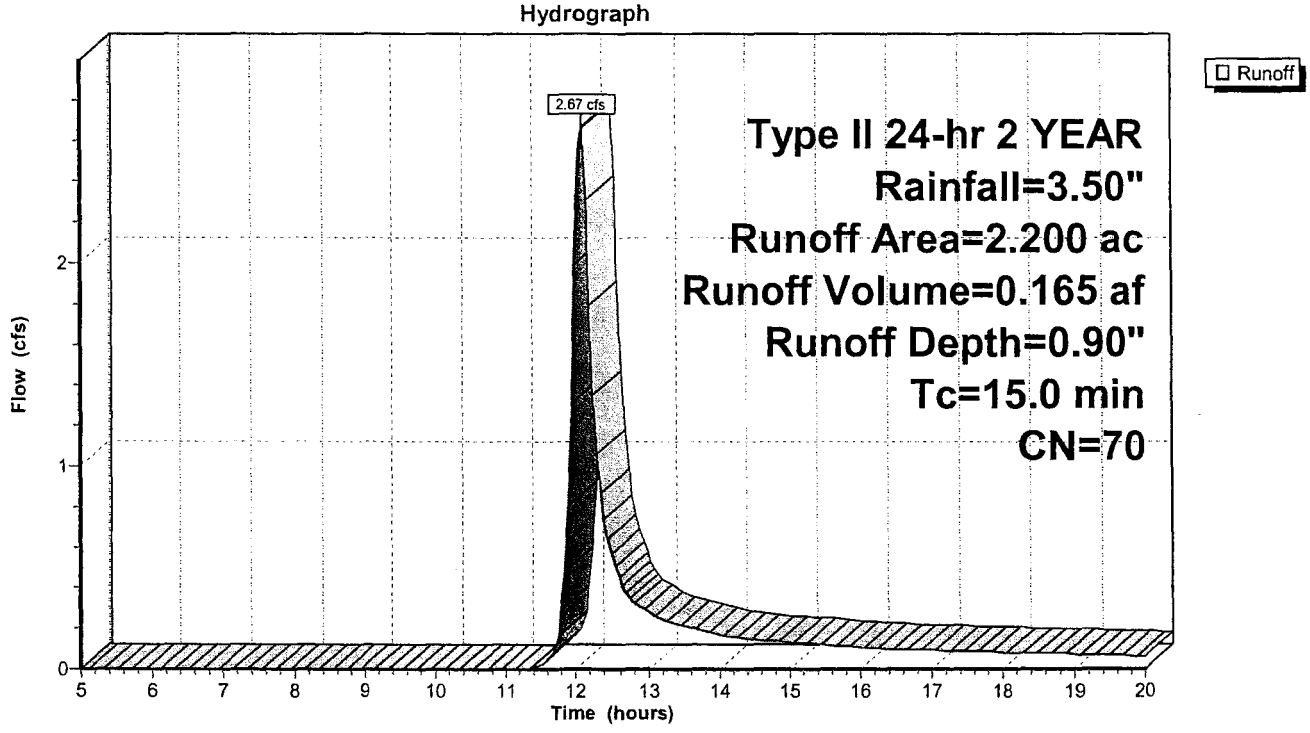
Runoff = 2.67 cfs @ 12.09 hrs, Volume= 0.165 af, Depth= 0.90"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 YEAR Rainfall=3.50"

| Area (ac) | CN | Description |
|---|---|---|
| 2.000 | 70 | Woods, Good, HSG C |
| 0.200 | 74 | >75% Grass cover, Good, HSG C |
| 2.200 | 70 | Weighted Average |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 15.0 | | | | | **Direct Entry,** |

## Subcatchment D3: POST DEV



## Subcatchment Post Dev: 1/3 Acre Lots

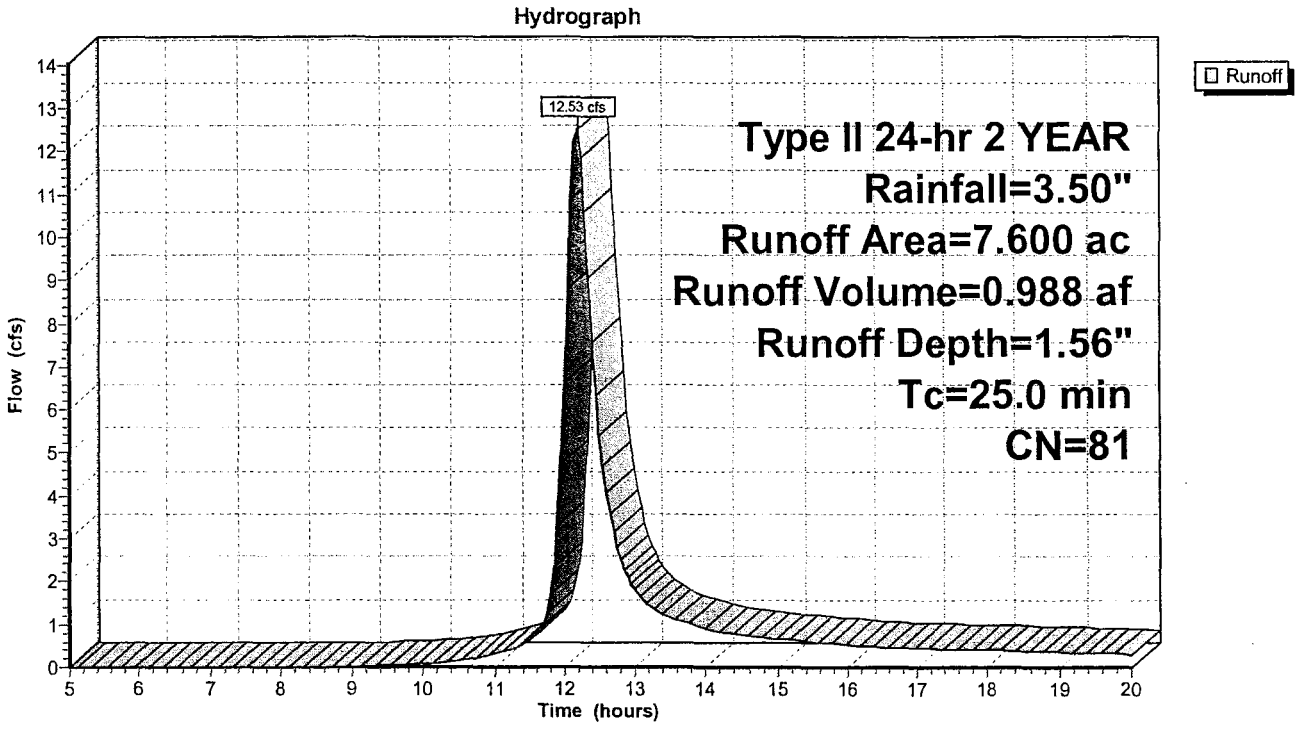
Runoff = 12.53 cfs @ 12.19 hrs, Volume= 0.988 af, Depth= 1.56"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 YEAR Rainfall=3.50"

| Area (ac) | CN | Description |
|---|---|---|
| 7.600 | 81 | 1/3 acre lots, 30% imp, HSG C |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 25.0 | | | | | **Direct Entry,** |

## Subcatchment Post Dev: 1/3 Acre Lots



## Subcatchment S-1: S-1

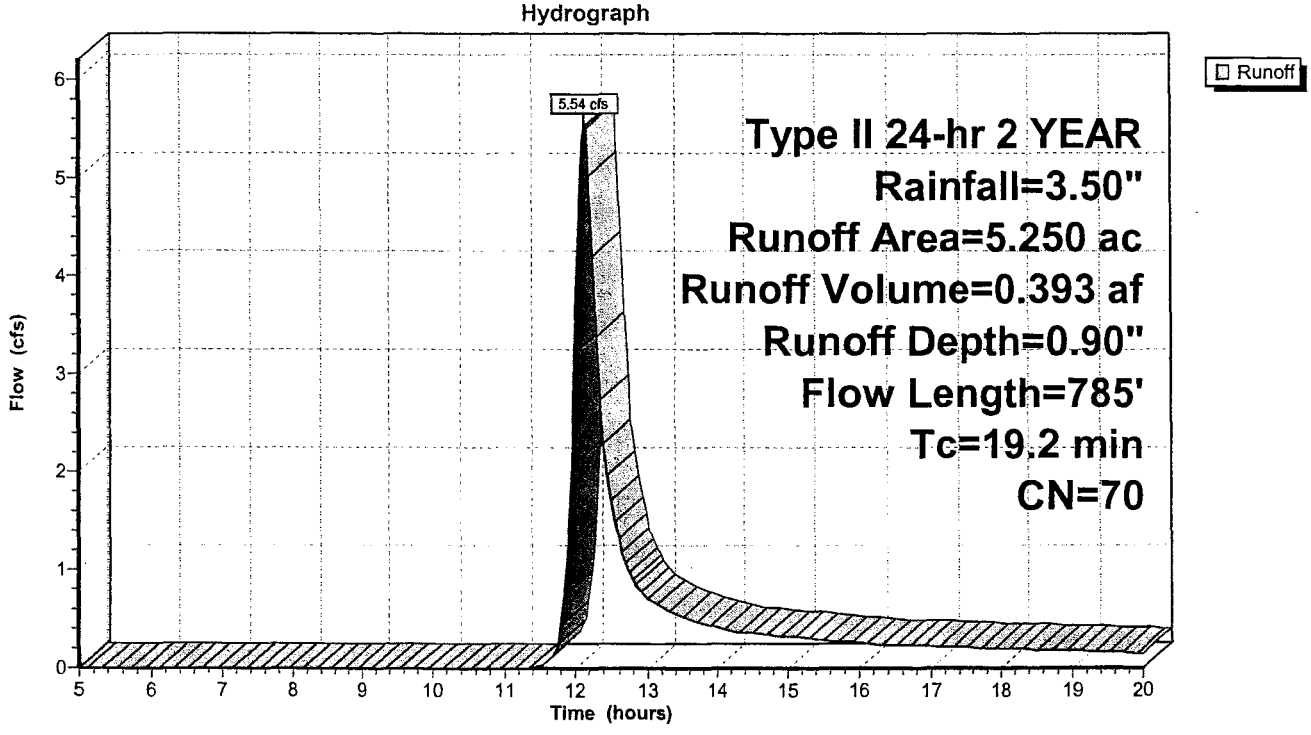
Runoff = 5.54 cfs @ 12.14 hrs, Volume= 0.393 af, Depth= 0.90"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 YEAR Rainfall=3.50"

| Area (ac) | CN | Description |
|---|---|---|
| 5.100 | 70 | Woods, Good, HSG C |
| 0.150 | 81 | 1/3 acre lots, 30% imp, HSG C |
| 5.250 | 70 | Weighted Average |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 13.9 | 100 | 0.0700 | 0.1 | | **Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.80" |
| 4.2 | 360 | 0.0800 | 1.4 | | **Shallow Concentrated Flow,** Woodland Kv= 5.0 fps |
| 1.1 | 325 | 0.0800 | 5.0 | 33.64 | **Parabolic Channel,** W=20.00' D=0.50' Area=6.7 sf Perim=20.0' n= 0.040 |
| 19.2 | 785 | Total | | | |

## Subcatchment S-1: S-1



## Subcatchment S-2: POST DEVELOPED

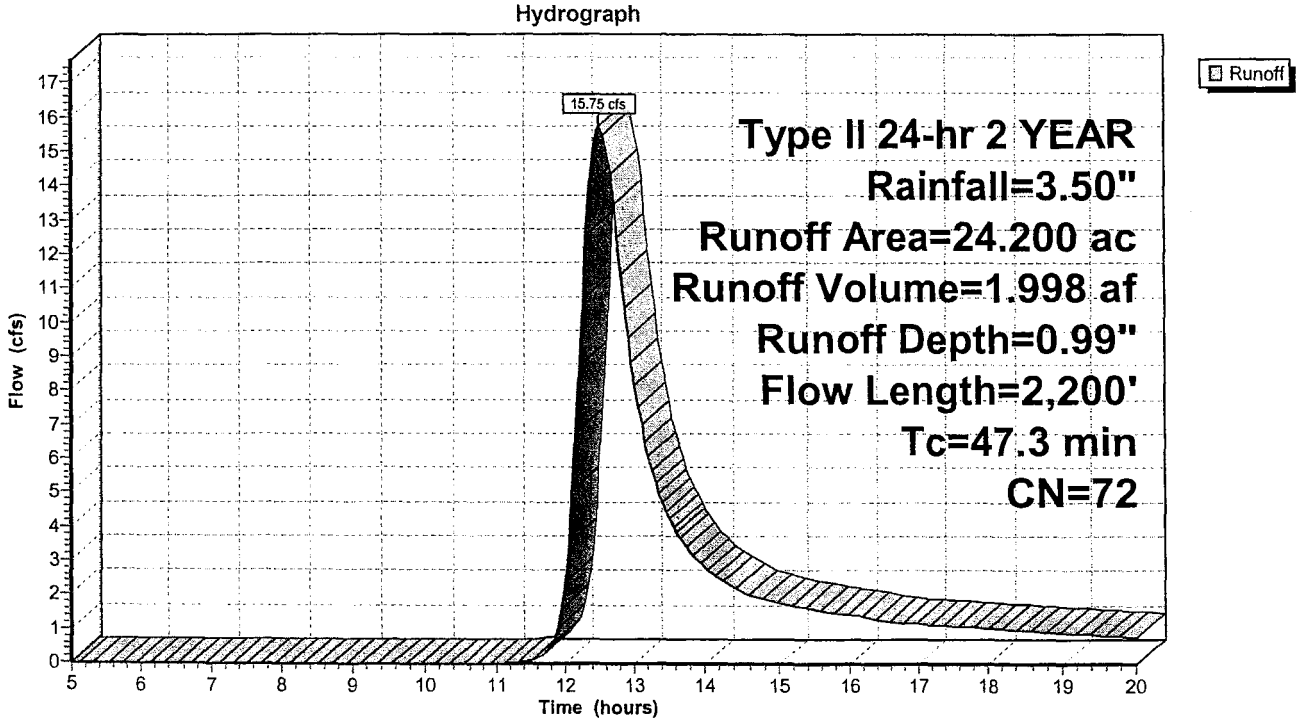
Runoff = 15.75 cfs @ 12.50 hrs, Volume= 1.998 af, Depth= 0.99"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 YEAR Rainfall=3.50"

| Area (ac) | CN | Description |
|---|---|---|
| 20.100 | 70 | Woods, Good, HSG C |
| 4.100 | 81 | 1/3 acre lots, 30% imp, HSG C |
| 24.200 | 72 | Weighted Average |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 33.1 | 300 | 0.0720 | 0.2 | | **Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.80" |
| 3.9 | 300 | 0.0670 | 1.3 | | **Shallow Concentrated Flow,** Woodland Kv= 5.0 fps |
| 10.3 | 1,600 | 0.0210 | 2.6 | 60.38 | **Parabolic Channel,** W=70.00' D=0.50' Area=23.3 sf Perim=70.0' n= 0.040 |
| 47.3 | 2,200 | Total | | | |

## Subcatchment S-2: POST DEVELOPED



## Subcatchment S-3: POST DEVELOPED

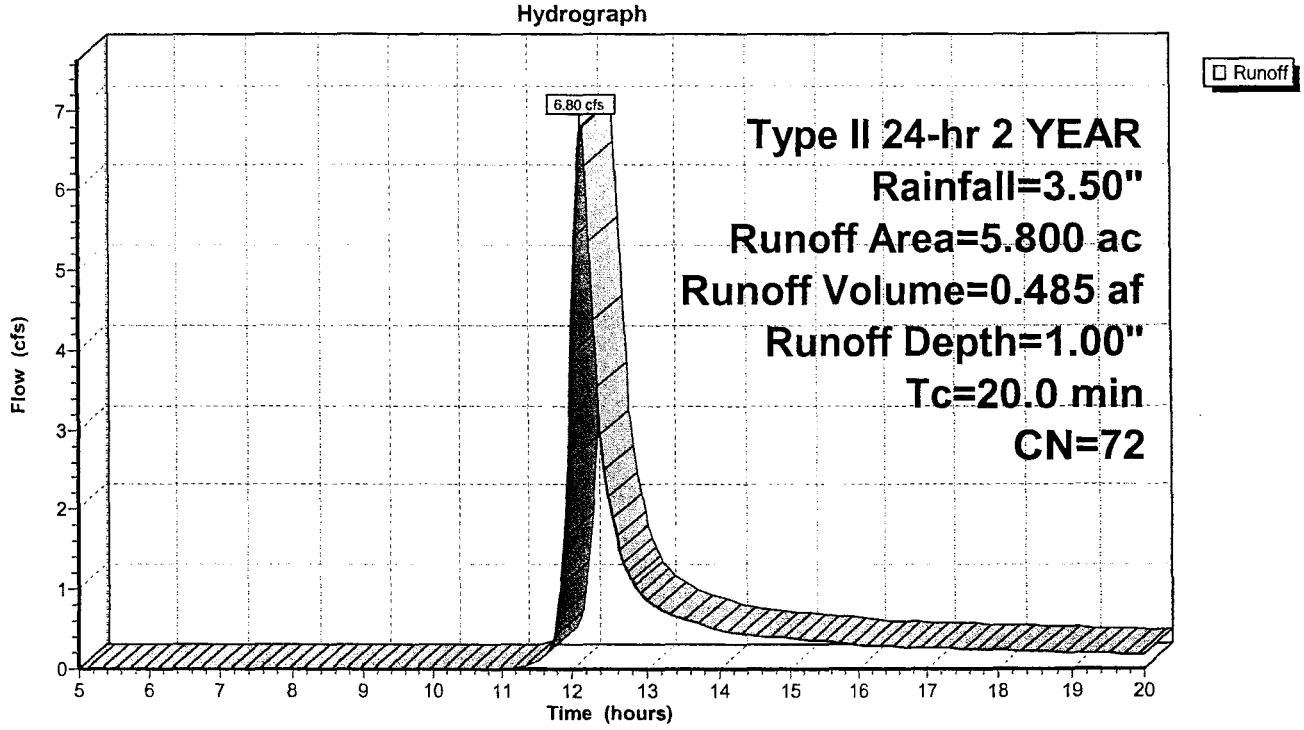
Runoff = 6.80 cfs @ 12.14 hrs, Volume= 0.485 af, Depth= 1.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 YEAR Rainfall=3.50"

| Area (ac) | CN | Description |
|---|---|---|
| 4.600 | 70 | Woods, Good, HSG C |
| 1.200 | 81 | 1/3 acre lots, 30% imp, HSG C |
| 5.800 | 72 | Weighted Average |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 20.0 | | | | | **Direct Entry,** |

## Subcatchment S-3: POST DEVELOPED



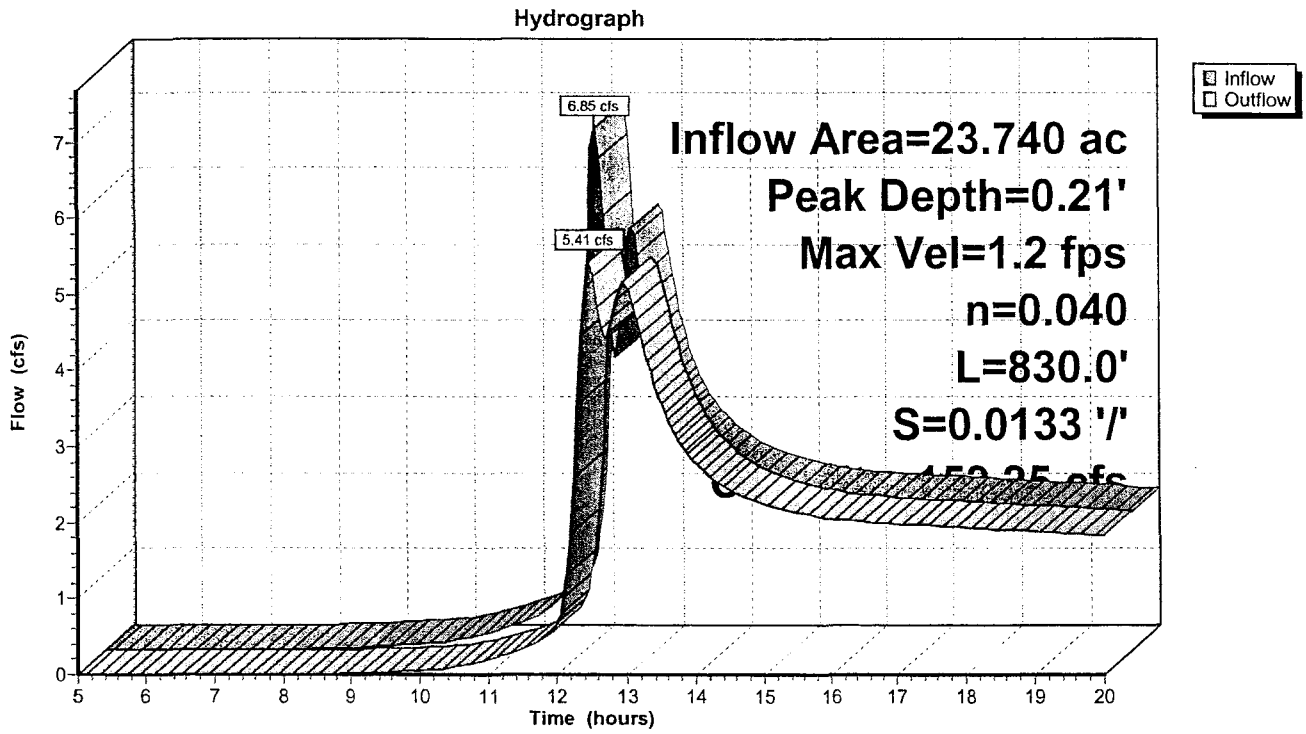
## Reach R1: (new Reach)

Inflow Area = 23.740 ac, Inflow Depth = 0.89" for 2 YEAR event
Inflow = 6.85 cfs @ 12.14 hrs, Volume= 1.766 af
Outflow = 5.41 cfs @ 12.47 hrs, Volume= 1.695 af, Atten= 21%, Lag= 19.5 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.2 fps, Min. Travel Time= 11.8 min
Avg. Velocity = 0.7 fps, Avg. Travel Time= 20.3 min

Peak Depth= 0.21' @ 12.27 hrs
Capacity at bank full= 152.25 cfs
Inlet Invert= 54.00', Outlet Invert= 43.00'
70.00' x 1.00' deep Parabolic Channel, n= 0.040 Length= 830.0' Slope= 0.0133 '/'

## Reach R1: (new Reach)



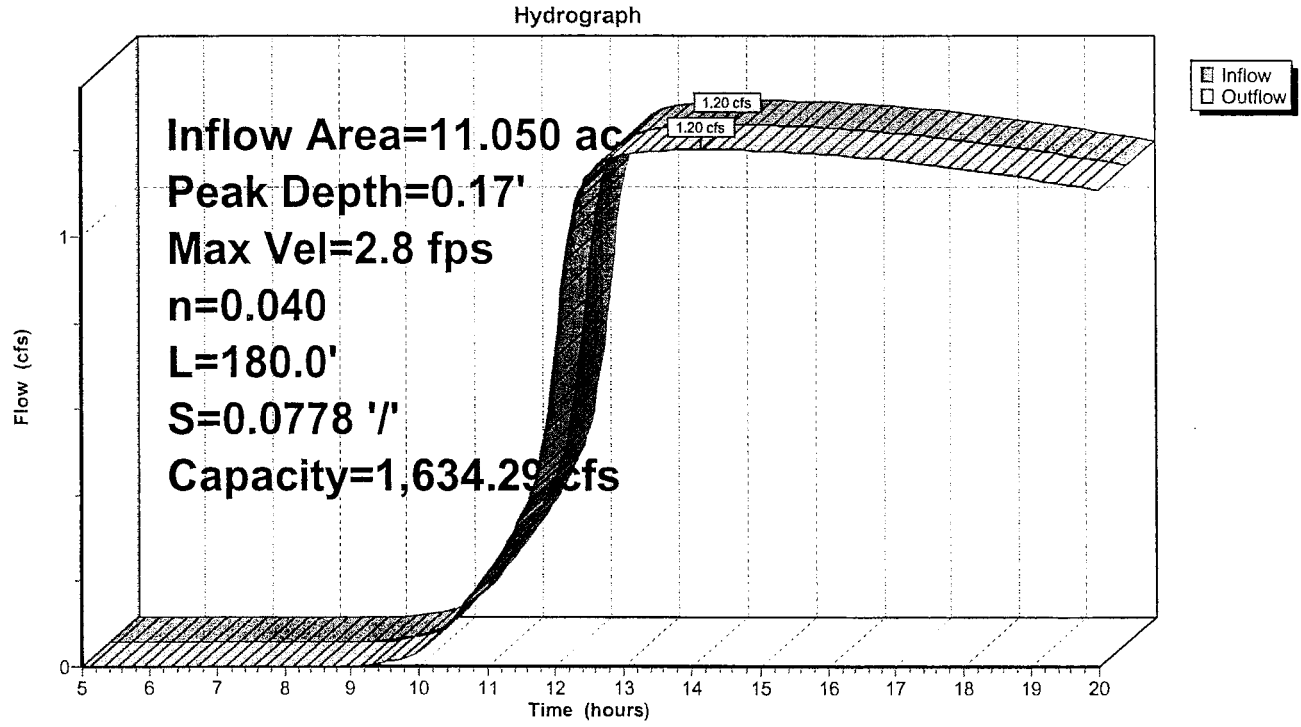
## Reach R1A: (new Reach)

Inflow Area = 11.050 ac, Inflow Depth = 0.89" for 2 YEAR event
Inflow = 1.20 cfs @ 14.12 hrs, Volume= 0.817 af
Outflow = 1.20 cfs @ 14.15 hrs, Volume= 0.814 af, Atten= 0%, Lag= 1.8 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.8 fps, Min. Travel Time= 1.1 min
Avg. Velocity = 2.4 fps, Avg. Travel Time= 1.2 min

Peak Depth= 0.17' @ 14.13 hrs
Capacity at bank full= 1,634.29 cfs
Inlet Invert= 68.00', Outlet Invert= 54.00'
2.00' x 5.00' deep channel, n= 0.040 Length= 180.0' Slope= 0.0778 '/'
Side Slope Z-value= 3.0 '/'

## Reach R1A: (new Reach)



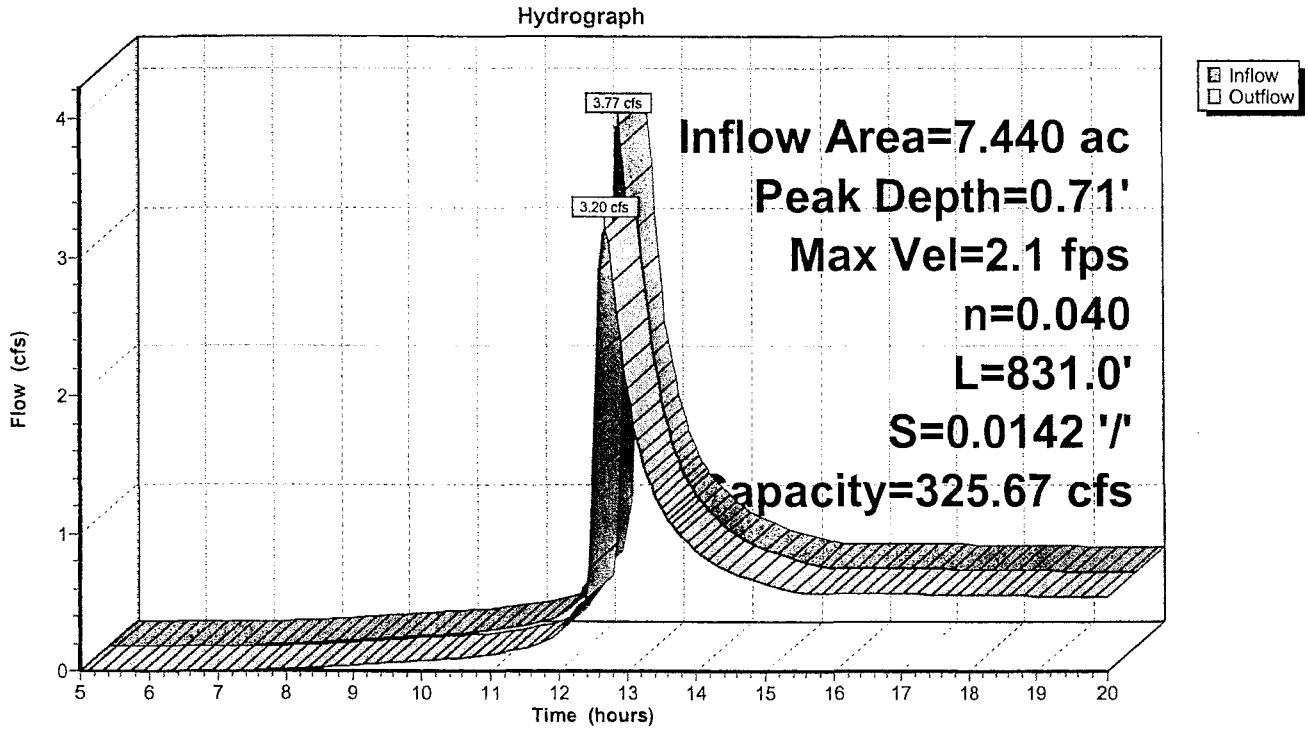
## Reach R1B: (new Reach)

Inflow Area = 7.440 ac, Inflow Depth = 0.92" for 2 YEAR event
Inflow = 3.77 cfs @ 12.46 hrs, Volume= 0.572 af
Outflow = 3.20 cfs @ 12.68 hrs, Volume= 0.559 af, Atten= 15%, Lag= 13.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.1 fps, Min. Travel Time= 6.5 min
Avg. Velocity = 1.2 fps, Avg. Travel Time= 11.6 min

Peak Depth= 0.71' @ 12.57 hrs
Capacity at bank full= 325.67 cfs
Inlet Invert= 67.80', Outlet Invert= 56.00'
0.00' x 4.00' deep channel, n= 0.040 Length= 831.0' Slope= 0.0142 '/'
Side Slope Z-value= 3.0 '/'

## Reach R1B: (new Reach)



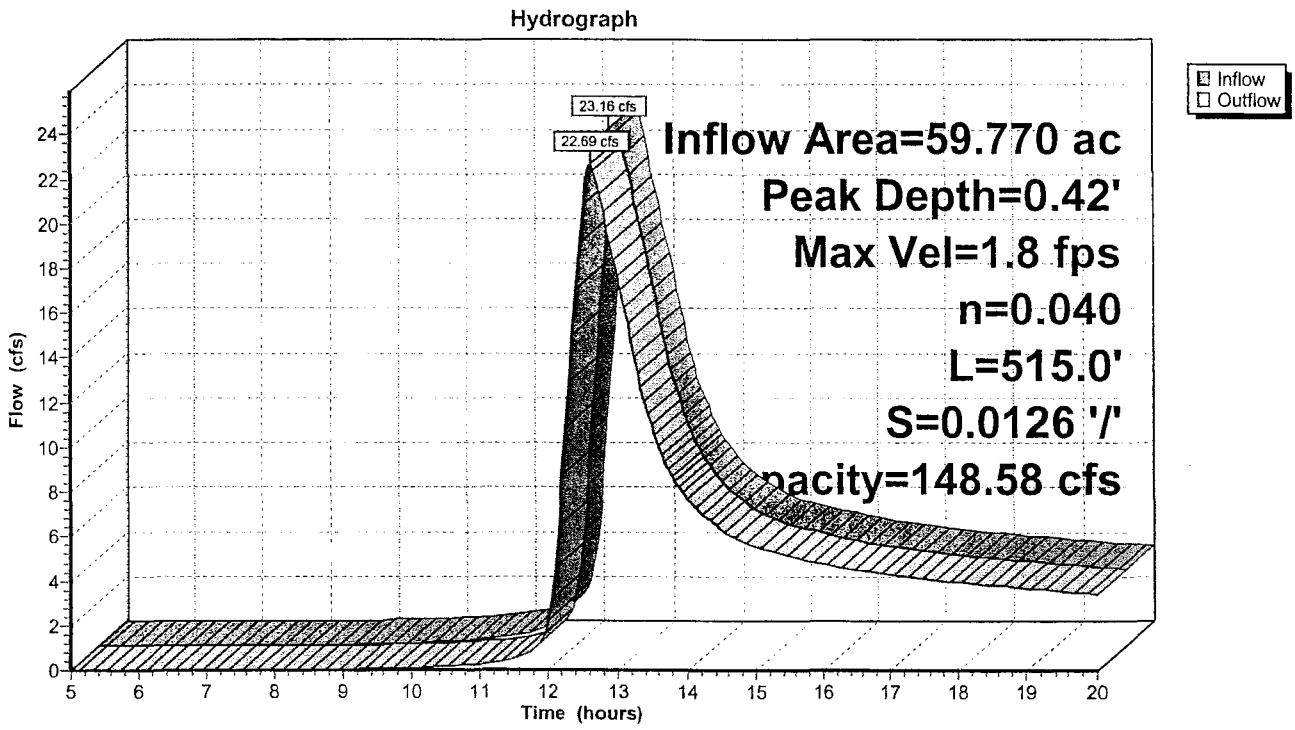
## Reach R2: (new Reach)

Inflow Area = 59.770 ac, Inflow Depth = 0.94" for 2 YEAR event
Inflow = 23.16 cfs @ 12.47 hrs, Volume= 4.705 af
Outflow = 22.69 cfs @ 12.62 hrs, Volume= 4.642 af, Atten= 2%, Lag= 8.8 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.8 fps, Min. Travel Time= 4.8 min
Avg. Velocity = 0.8 fps, Avg. Travel Time= 11.1 min

Peak Depth= 0.42' @ 12.54 hrs
Capacity at bank full= 148.58 cfs
Inlet Invert= 43.00', Outlet Invert= 36.50'
70.00' x 1.00' deep Parabolic Channel, n= 0.040 Length= 515.0' Slope= 0.0126 '/'

## Reach R2: (new Reach)



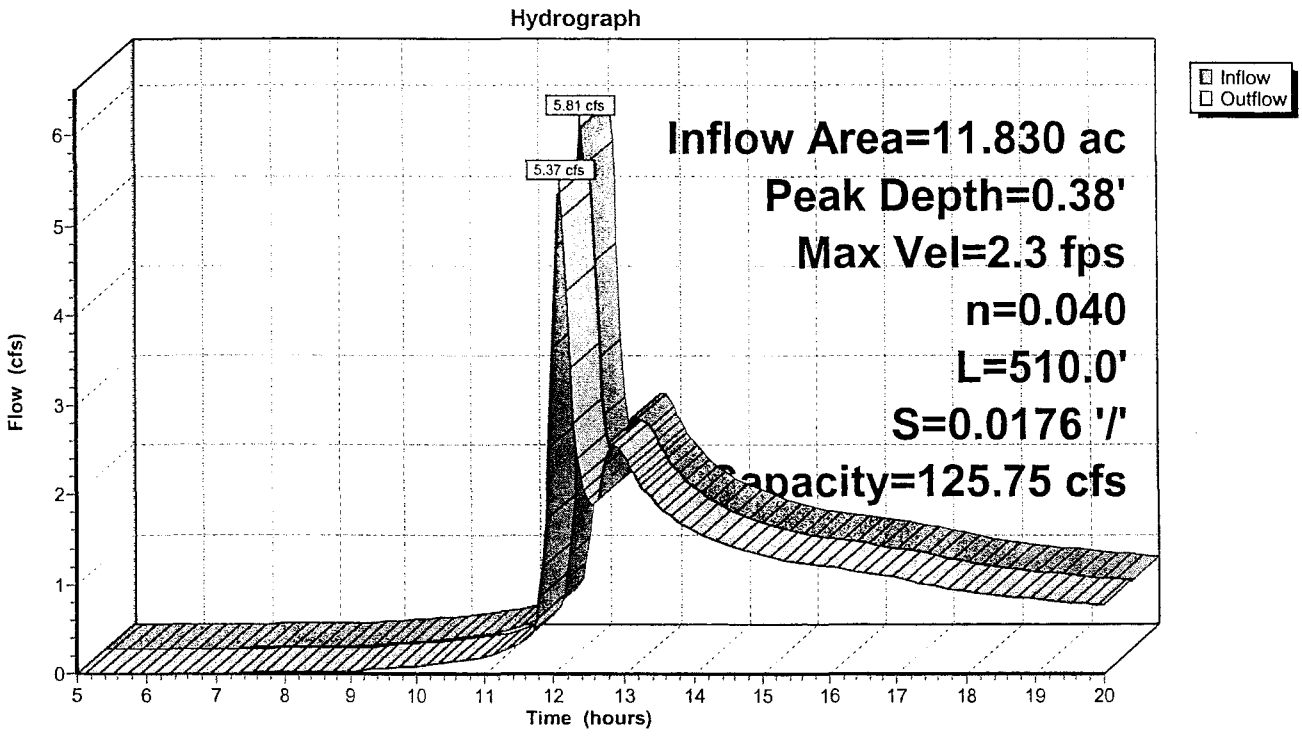
## Reach R2A: (new Reach)

Inflow Area = 11.830 ac, Inflow Depth = 1.04" for 2 YEAR event
Inflow = 5.81 cfs @ 12.01 hrs, Volume= 1.024 af
Outflow = 5.37 cfs @ 12.11 hrs, Volume= 1.013 af, Atten= 8%, Lag= 6.2 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.3 fps, Min. Travel Time= 3.7 min
Avg. Velocity = 1.0 fps, Avg. Travel Time= 8.6 min

Peak Depth= 0.38' @ 12.05 hrs
Capacity at bank full= 125.75 cfs
Inlet Invert= 52.00', Outlet Invert= 43.00'
5.00' x 2.00' deep channel, n= 0.040 Length= 510.0' Slope= 0.0176 '/'
Side Slope Z-value= 3.0 '/'

## Reach R2A: (new Reach)



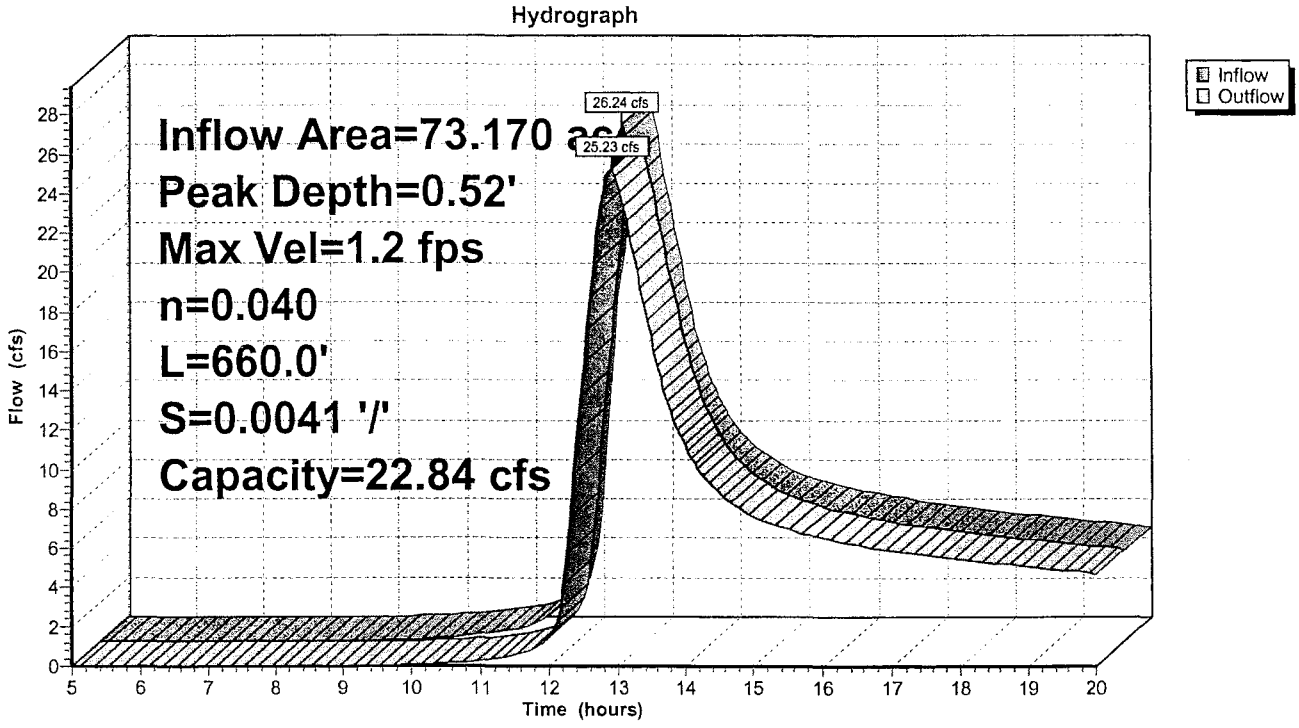
## Reach R3: (new Reach)

Inflow Area = 73.170 ac, Inflow Depth = 0.99" for 2 YEAR event
Inflow = 26.24 cfs @ 12.67 hrs, Volume= 6.017 af
Outflow = 25.23 cfs @ 12.92 hrs, Volume= 5.856 af, Atten= 4%, Lag= 14.9 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.2 fps, Min. Travel Time= 9.4 min
Avg. Velocity = 0.5 fps, Avg. Travel Time= 20.9 min

Peak Depth= 0.52' @ 12.76 hrs
Capacity at bank full= 22.84 cfs
Inlet Invert= 34.50', Outlet Invert= 31.80'
60.00' x 0.50' deep Parabolic Channel, n= 0.040 Length= 660.0' Slope= 0.0041 '/'

## Reach R3: (new Reach)



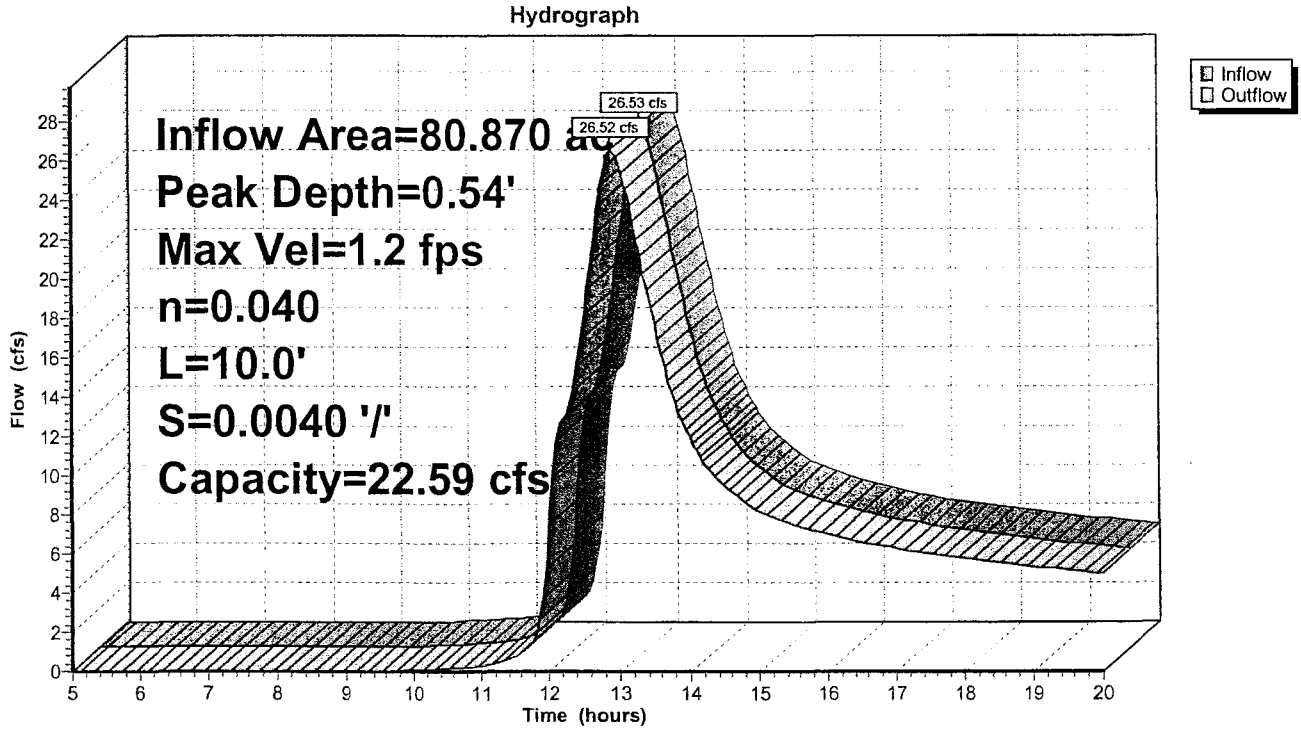
## Reach R4: (new Reach)

Inflow Area = 80.870 ac, Inflow Depth = 0.97" for 2 YEAR event
Inflow = 26.53 cfs @ 12.91 hrs, Volume= 6.536 af
Outflow = 26.52 cfs @ 12.91 hrs, Volume= 6.534 af, Atten= 0%, Lag= 0.2 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.2 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 0.5 fps, Avg. Travel Time= 0.3 min

Peak Depth= 0.54' @ 12.91 hrs
Capacity at bank full= 22.59 cfs
Inlet Invert= 31.80', Outlet Invert= 31.76'
60.00' x 0.50' deep Parabolic Channel, n= 0.040 Length= 10.0' Slope= 0.0040 '/'

## Reach R4: (new Reach)



## Pond BMP - 1: BMP #1

Inflow Area = 11.050 ac, Inflow Depth = 1.56" for 2 YEAR event
Inflow = 20.80 cfs @ 12.13 hrs, Volume= 1.439 af
Outflow = 1.20 cfs @ 14.12 hrs, Volume= 0.817 af, Atten= 94%, Lag= 119.1 min
Primary = 1.20 cfs @ 14.12 hrs, Volume= 0.817 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 80.35' @ 14.12 hrs Surf.Area= 9,195 sf Storage= 37,151 cf
Plug-Flow detention time= 221.8 min calculated for 0.817 af (57% of inflow)
Center-of-Mass det. time= 144.6 min ( 944.6 - 800.0 )

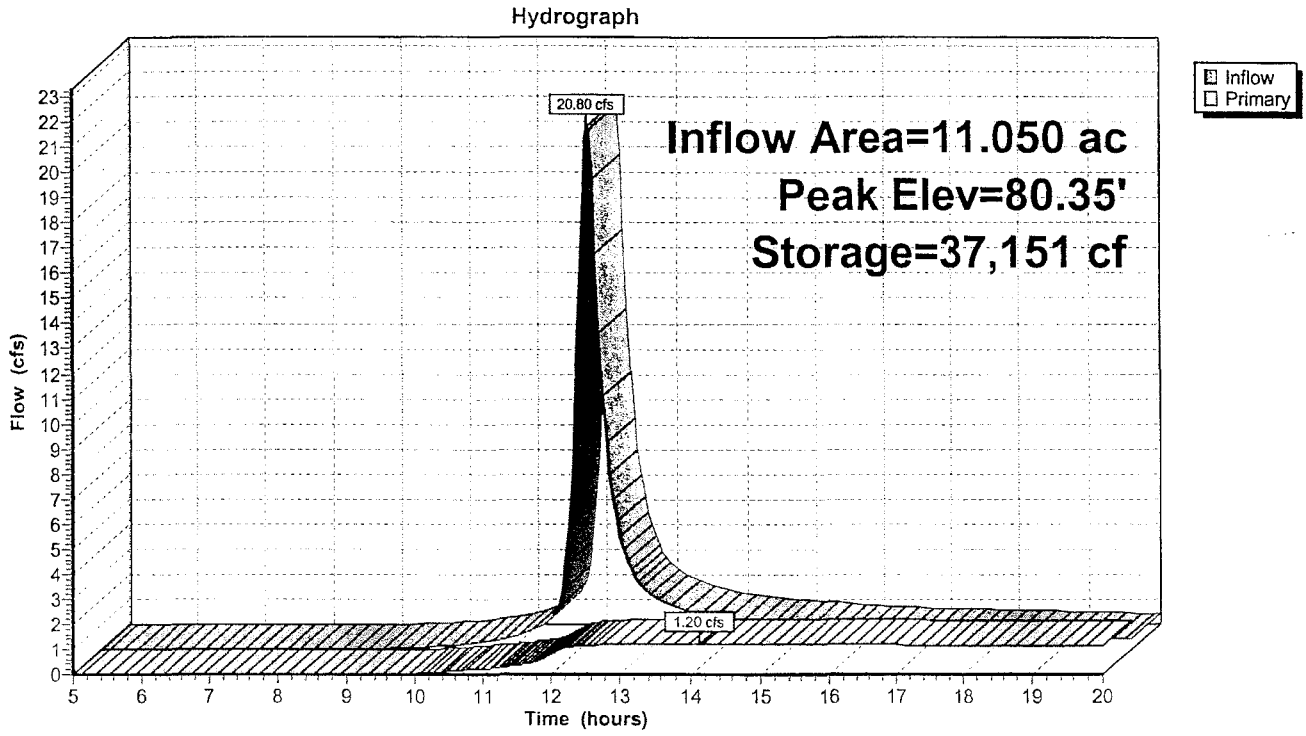
| # | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| 1 | 72.00' | 67,503 cf | **Custom Stage Data (Prismatic)** Listed below |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 72.00 | 978 | 0 | 0 |
| 74.00 | 2,170 | 3,148 | 3,148 |
| 76.00 | 3,836 | 6,006 | 9,154 |
| 78.00 | 5,977 | 9,813 | 18,967 |
| 80.00 | 8,661 | 14,638 | 33,605 |
| 82.00 | 11,732 | 20,393 | 53,998 |
| 83.00 | 15,277 | 13,505 | 67,503 |

| # | Routing | Invert | Outlet Devices |
|---|---|---|---|
| 1 | Primary | 67.84' | **30.0" x 84.0' long Culvert** RCP, end-section conforming to fill, Ke= 0.500<br>Outlet Invert= 67.00' S= 0.0100 '/' n= 0.013 Cc= 0.900 |
| 2 | Device 1 | 72.00' | **4.0" Vert. 4" Orifice** C= 0.600 |
| 3 | Device 1 | 80.64' | **60.0" Horiz. Orifice** Limited to weir flow C= 0.600 |

**Primary OutFlow** Max=1.20 cfs @ 14.12 hrs HW=80.35' (Free Discharge)
└─**1=Culvert** (Passes 1.20 cfs of 79.30 cfs potential flow)
  ├─**2=4" Orifice** (Orifice Controls 1.20 cfs @ 13.8 fps)
  └─**3=Orifice** ( Controls 0.00 cfs)

## Pond BMP - 1: BMP #1



## Pond BMP-3: Basin 3

Inflow Area = 7.600 ac, Inflow Depth = 1.56" for 2 YEAR event
Inflow = 12.53 cfs @ 12.19 hrs, Volume= 0.988 af
Outflow = 2.79 cfs @ 12.76 hrs, Volume= 0.889 af, Atten= 78%, Lag= 34.3 min
Primary = 2.79 cfs @ 12.76 hrs, Volume= 0.889 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 59.70' @ 12.76 hrs Surf.Area= 5,437 sf Storage= 19,736 cf
Plug-Flow detention time= 153.4 min calculated for 0.889 af (90% of inflow)
Center-of-Mass det. time= 120.6 min ( 924.5 - 803.9 )

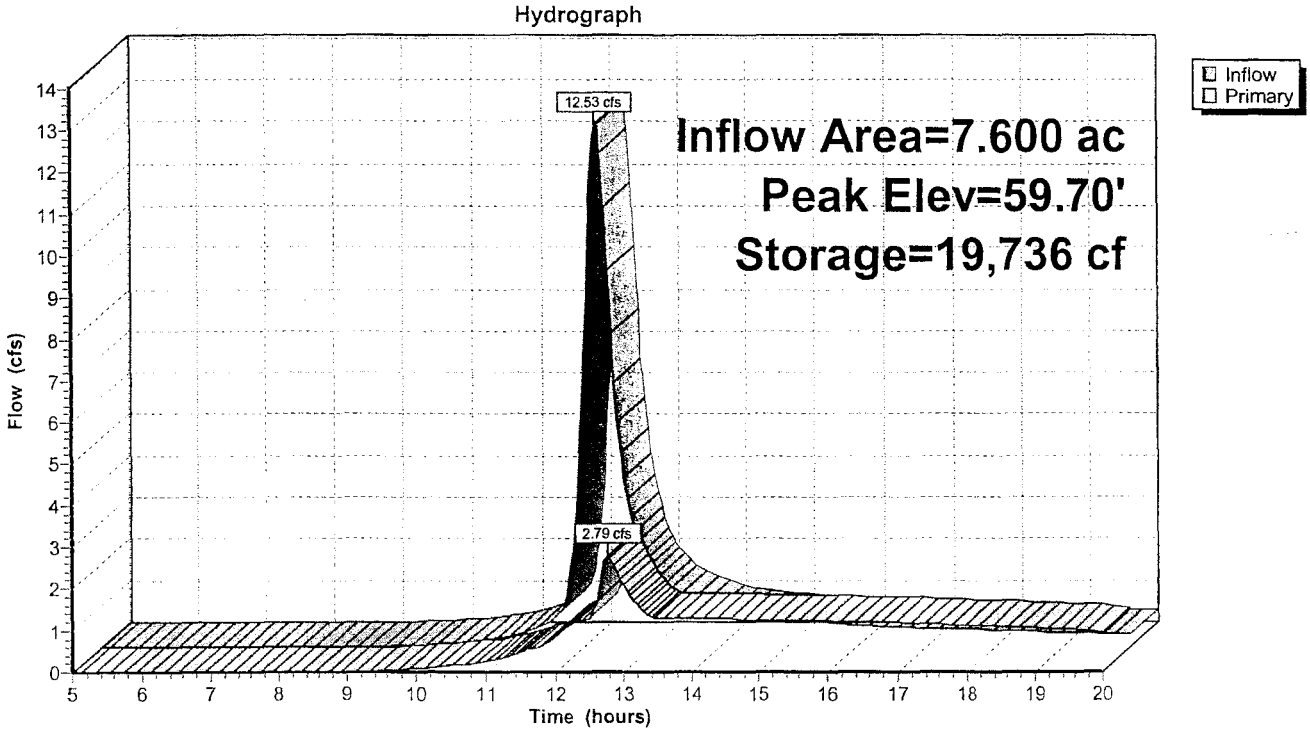
| # | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| 1 | 50.00' | 34,833 cf | **Custom Stage Data (Pyramidal)** Listed below |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) | Wet.Area (sq-ft) |
|---|---|---|---|---|
| 50.00 | 0 | 0 | 0 | 0 |
| 52.00 | 450 | 300 | 300 | 458 |
| 54.00 | 1,230 | 1,616 | 1,916 | 1,270 |
| 56.00 | 2,375 | 3,543 | 5,459 | 2,463 |
| 58.00 | 3,858 | 6,173 | 11,632 | 4,011 |
| 60.00 | 5,710 | 9,508 | 21,140 | 5,943 |
| 62.00 | 8,050 | 13,693 | 34,833 | 8,374 |

| # | Routing | Invert | Outlet Devices |
|---|---|---|---|
| 1 | Primary | 42.40' | **24.0" x 85.0' long Culvert** RCP, square edge headwall, Ke= 0.500<br>Outlet Invert= 39.85' S= 0.0300 '/' n= 0.012 Cc= 0.900 |
| 2 | Device 1 | 50.00' | **4.0" Vert. Orifice/Grate** C= 0.600 |
| 3 | Device 1 | 59.60' | **48.0" Horiz. Orifice/Grate** Limited to weir flow C= 0.600 |

**Primary OutFlow** Max=2.67 cfs @ 12.76 hrs HW=59.70' (Free Discharge)
└─**1=Culvert** (Passes 2.67 cfs of 61.08 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 1.30 cfs @ 14.9 fps)
  └─**3=Orifice/Grate** (Weir Controls 1.37 cfs @ 1.1 fps)

## Pond BMP-3: Basin 3



## Pond C1: POND C1

| | | | | | |
|---|---|---|---|---|---|
| Inflow Area = | 2.530 ac, | Inflow Depth = | 1.50" | for | 2 YEAR event |
| Inflow = | 5.11 cfs @ | 12.01 hrs, | Volume= | 0.317 af | |
| Outflow = | 0.47 cfs @ | 12.85 hrs, | Volume= | 0.279 af, | Atten= 91%, Lag= 50.6 min |
| Primary = | 0.47 cfs @ | 12.85 hrs, | Volume= | 0.279 af | |

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 75.14' @ 12.85 hrs Surf.Area= 2,363 sf Storage= 6,865 cf
Plug-Flow detention time= 171.5 min calculated for 0.279 af (88% of inflow)
Center-of-Mass det. time= 131.7 min ( 913.2 - 781.4 )

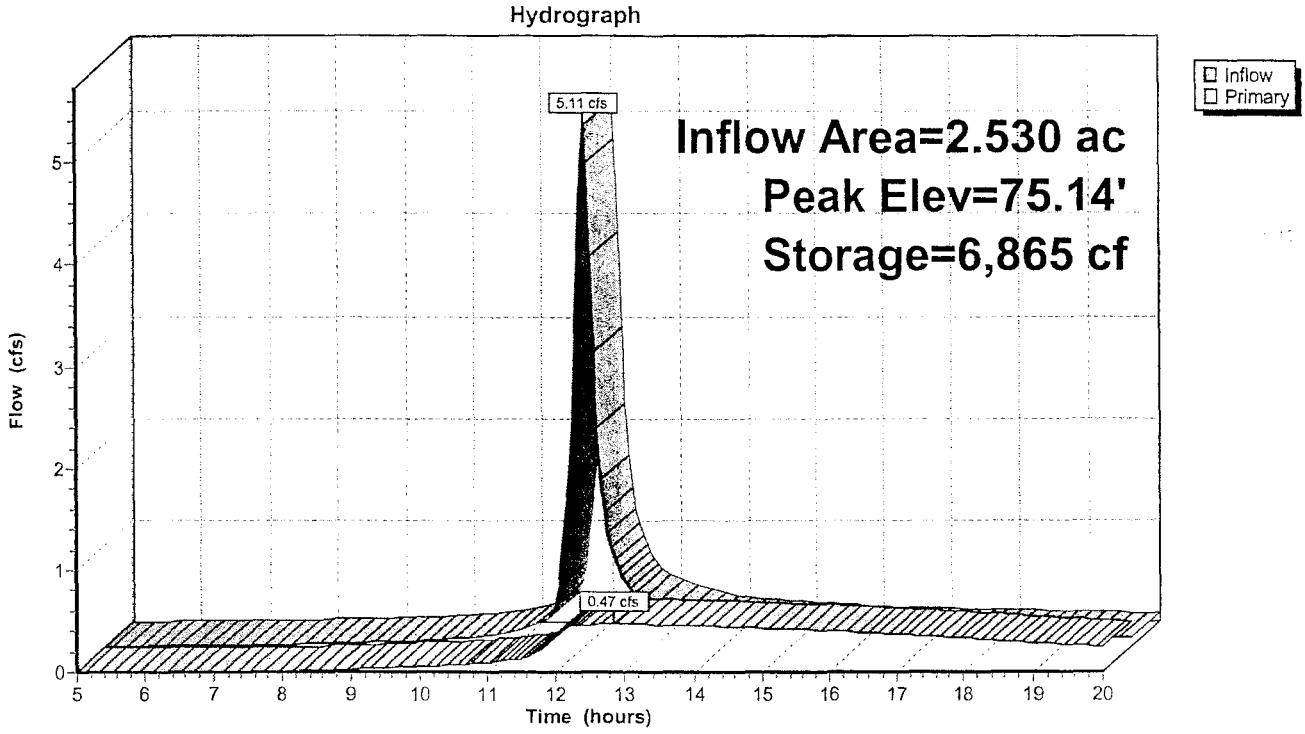
| # | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| 1 | 71.00' | 15,442 cf | **Custom Stage Data (Prismatic)** Listed below |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 71.00 | 1,007 | 0 | 0 |
| 72.00 | 1,285 | 1,146 | 1,146 |
| 74.00 | 1,915 | 3,200 | 4,346 |
| 75.50 | 2,505 | 3,315 | 7,661 |
| 76.00 | 2,780 | 1,321 | 8,982 |
| 78.00 | 3,680 | 6,460 | 15,442 |

| # | Routing | Invert | Outlet Devices |
|---|---|---|---|
| 1 | Primary | 71.00' | **24.0" x 47.0' long Culvert** RCP, mitered to conform to fill, Ke= 0.700<br>Outlet Invert= 70.50' S= 0.0106 '/' n= 0.013 Cc= 0.900 |
| 2 | Device 1 | 75.25' | **2.50' x 2.50' Horiz. Orifice/Grate** Limited to weir flow C= 0.600 |
| 3 | Device 1 | 71.10' | **3.0" Vert. Orifice/Grate** C= 0.600 |

**Primary OutFlow** Max=0.47 cfs @ 12.85 hrs HW=75.14' (Free Discharge)
└─**1=Culvert** (Passes 0.47 cfs of 23.65 cfs potential flow)
  ├─**2=Orifice/Grate** ( Controls 0.00 cfs)
  └─**3=Orifice/Grate** (Orifice Controls 0.47 cfs @ 9.5 fps)

## Pond C1: POND C1



## Pond C2: POND C2

| | | | | | |
|---|---|---|---|---|---|
| Inflow Area = | 2.000 ac, | Inflow Depth = | 0.90" | for | 2 YEAR event |
| Inflow = | 1.79 cfs @ | 12.21 hrs, | Volume= | 0.149 af | |
| Outflow = | 0.37 cfs @ | 12.88 hrs, | Volume= | 0.147 af, | Atten= 79%, Lag= 40.5 min |
| Primary = | 0.37 cfs @ | 12.88 hrs, | Volume= | 0.147 af | |

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 73.74' @ 12.88 hrs Surf.Area= 1,542 sf Storage= 2,449 cf
Plug-Flow detention time= 72.2 min calculated for 0.146 af (98% of inflow)
Center-of-Mass det. time= 65.4 min ( 893.2 - 827.8 )

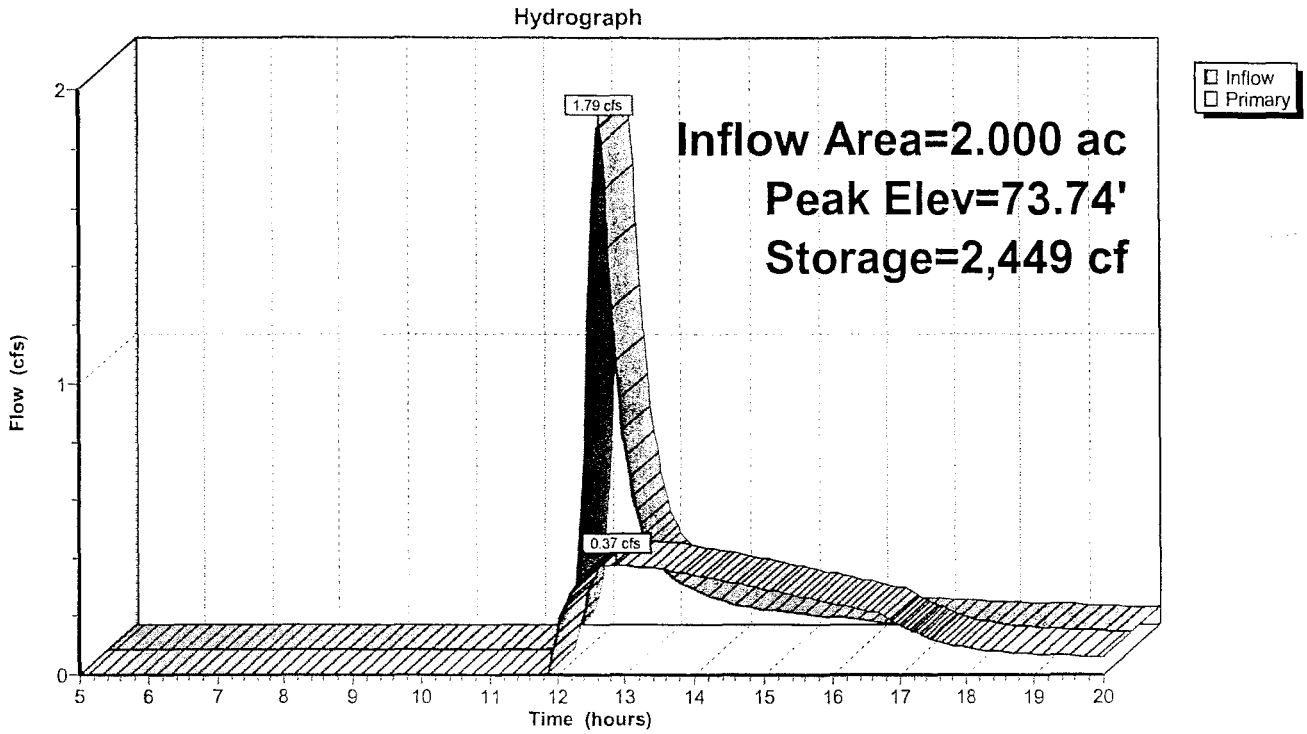
| # | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| 1 | 71.00' | 26,524 cf | **Custom Stage Data (Prismatic)** Listed below |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 71.00 | 117 | 0 | 0 |
| 72.00 | 685 | 401 | 401 |
| 74.00 | 1,670 | 2,355 | 2,756 |
| 76.00 | 3,000 | 4,670 | 7,426 |
| 78.00 | 4,667 | 7,667 | 15,093 |
| 80.00 | 6,764 | 11,431 | 26,524 |

| # | Routing | Invert | Outlet Devices |
|---|---|---|---|
| 1 | Primary | 68.06' | **24.0" x 45.0' long Culvert** RCP, square edge headwall, Ke= 0.500<br>Outlet Invert= 67.31' S= 0.0167 '/' n= 0.013 Cc= 0.900 |
| 2 | Device 1 | 71.10' | **3.0" Vert. Orifice/Grate** C= 0.600 |
| 3 | Device 1 | 77.00' | **2.50' x 2.50' Horiz. Orifice/Grate** Limited to weir flow C= 0.600 |

**Primary OutFlow** Max=0.37 cfs @ 12.88 hrs HW=73.74' (Free Discharge)
└─**1=Culvert** (Passes 0.37 cfs of 32.72 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 0.37 cfs @ 7.6 fps)
  └─**3=Orifice/Grate** ( Controls 0.00 cfs)

## Pond C2: POND C2



## Pond C2-2: 30" RCP

| | | | | | |
|---|---|---|---|---|---|
| Inflow Area = | 11.000 ac, | Inflow Depth = | 0.97" | for | 2 YEAR event |
| Inflow = | 3.41 cfs @ | 12.03 hrs, | Volume= | 0.885 af | |
| Outflow = | 3.41 cfs @ | 12.04 hrs, | Volume= | 0.884 af, | Atten= 0%, Lag= 0.5 min |
| Primary = | 3.41 cfs @ | 12.04 hrs, | Volume= | 0.884 af | |

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 65.78' @ 12.04 hrs Surf.Area= 313 sf Storage= 157 cf
Plug-Flow detention time= 1.4 min calculated for 0.884 af (100% of inflow)
Center-of-Mass det. time= 0.8 min ( 897.7 - 896.9 )

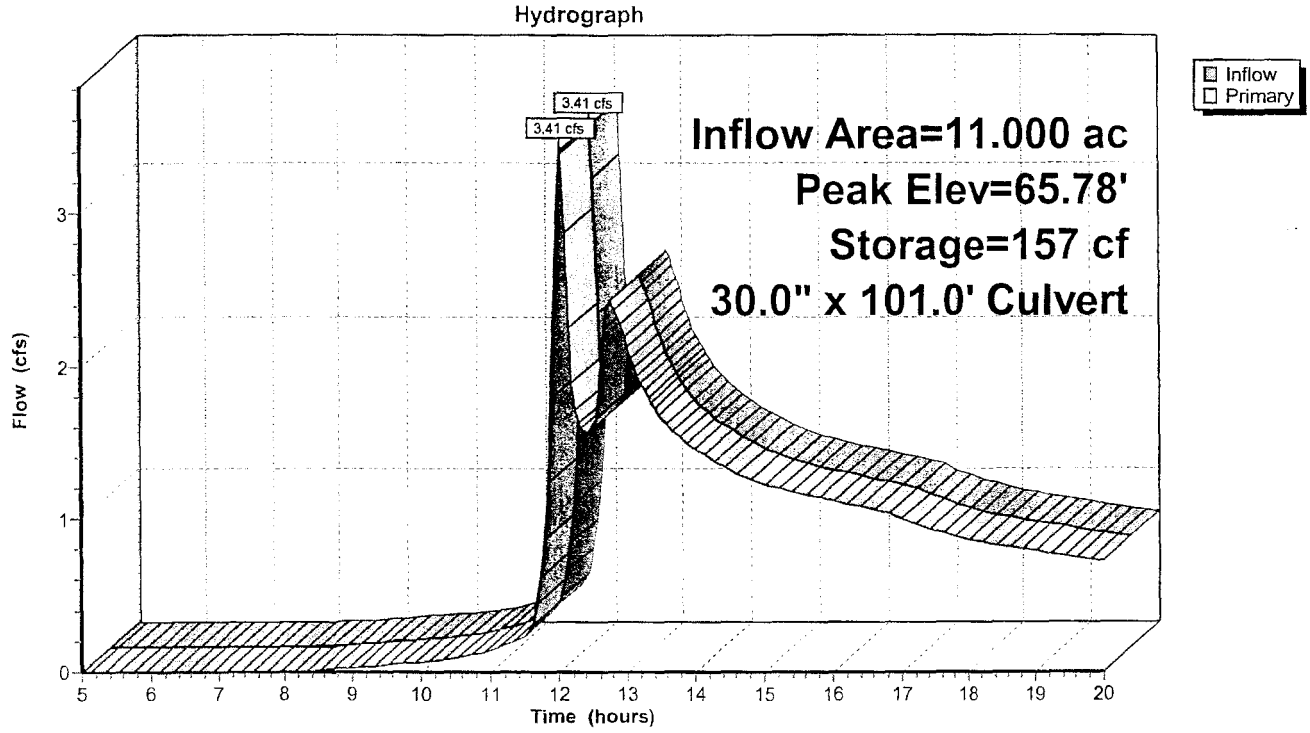
| # | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| 1 | 65.00' | 13,000 cf | **Custom Stage Data (Prismatic)** Listed below |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 65.00 | 0 | 0 | 0 |
| 66.00 | 400 | 200 | 200 |
| 68.00 | 2,400 | 2,800 | 3,000 |
| 70.00 | 7,600 | 10,000 | 13,000 |

| # | Routing | Invert | Outlet Devices |
|---|---|---|---|
| 1 | Primary | 65.06' | **30.0" x 101.0' long Culvert** RCP, end-section conforming to fill, Ke= 0.500<br>Outlet Invert= 64.00' S= 0.0105 '/' n= 0.013 Cc= 0.900 |

**Primary OutFlow** Max=3.34 cfs @ 12.04 hrs HW=65.78' (Free Discharge)
└─**1=Culvert** (Inlet Controls 3.34 cfs @ 2.9 fps)

## Pond C2-2: 30" RCP



## Pond C2-2B: MH C2-2B

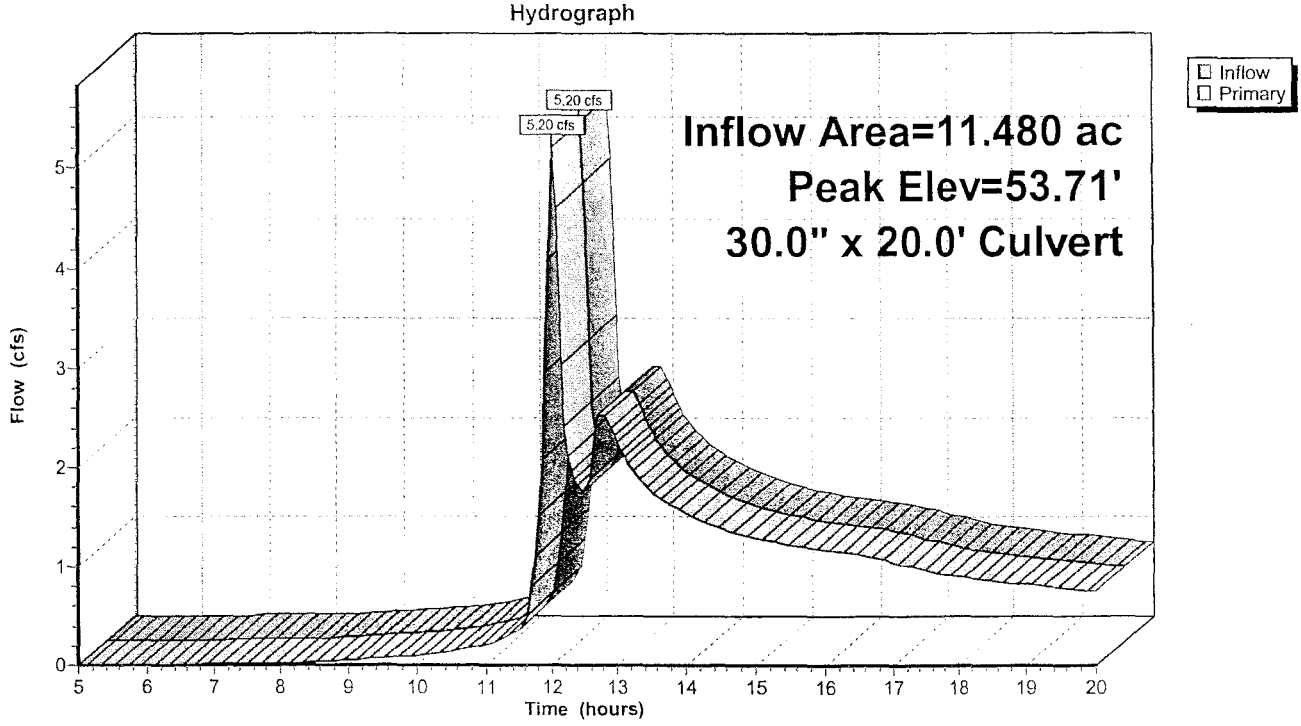
| | | | | | |
|---|---|---|---|---|---|
| Inflow Area = | 11.480 ac, | Inflow Depth = | 1.03" | for | 2 YEAR event |
| Inflow = | 5.20 cfs @ | 12.03 hrs, | Volume= | 0.982 af | |
| Outflow = | 5.20 cfs @ | 12.03 hrs, | Volume= | 0.982 af, | Atten= 0%, Lag= 0.0 min |
| Primary = | 5.20 cfs @ | 12.03 hrs, | Volume= | 0.982 af | |

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 53.71' @ 12.03 hrs
Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= (not calculated)

| # | Routing | Invert | Outlet Devices |
|---|---|---|---|
| 1 | Primary | 52.80' | **30.0" x 20.0' long Culvert** RCP, square edge headwall, Ke= 0.500<br>Outlet Invert= 52.00' S= 0.0400 '/' n= 0.013 Cc= 0.900 |

**Primary OutFlow** Max=5.08 cfs @ 12.03 hrs HW=53.69' (Free Discharge)
└**1=Culvert** (Inlet Controls 5.08 cfs @ 3.2 fps)

## Pond C2-2B: MH C2-2B



## Pond C3: POND C3

Inflow Area = 5.470 ac, Inflow Depth = 1.26" for 2 YEAR event
Inflow = 6.69 cfs @ 11.97 hrs, Volume= 0.575 af
Outflow = 1.38 cfs @ 12.75 hrs, Volume= 0.330 af, Atten= 79%, Lag= 46.8 min
Primary = 1.38 cfs @ 12.75 hrs, Volume= 0.330 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 73.34' @ 12.75 hrs Surf.Area= 5,584 sf Storage= 13,541 cf
Plug-Flow detention time= 215.2 min calculated for 0.330 af (57% of inflow)
Center-of-Mass det. time= 129.9 min ( 925.3 - 795.4 )

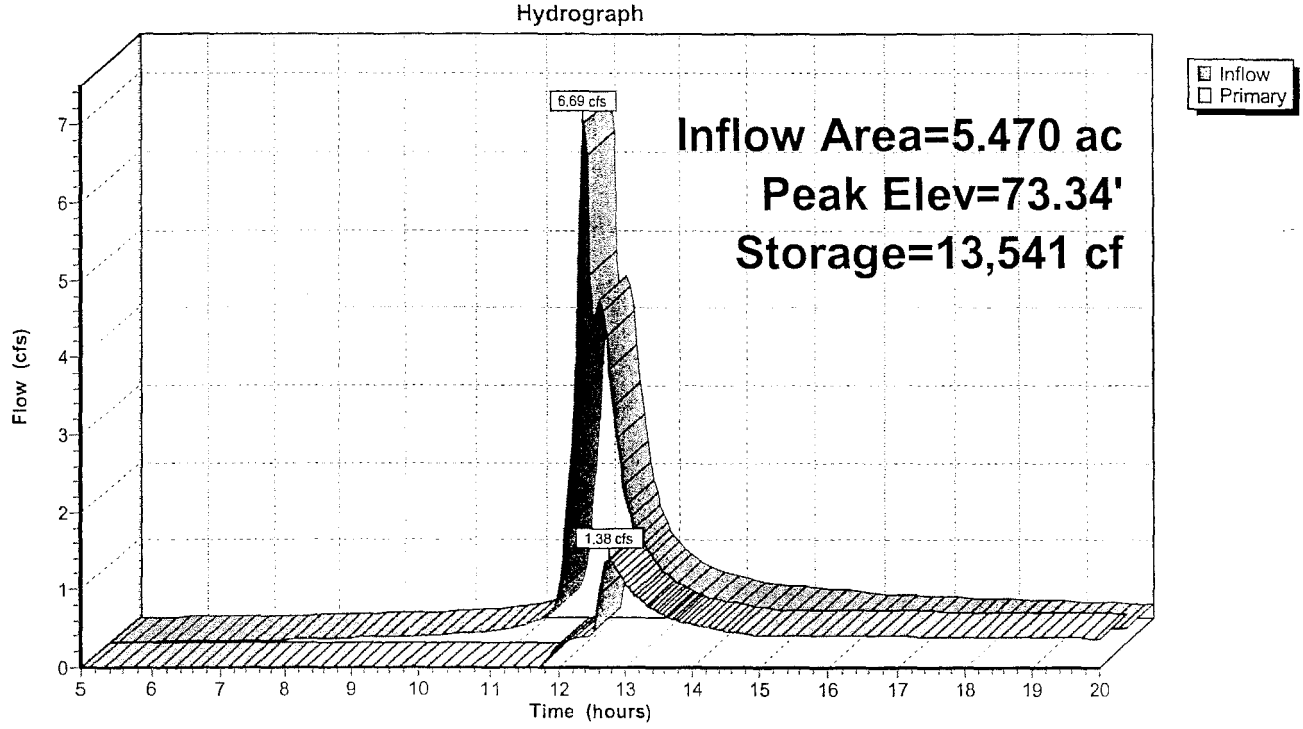
| # | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| 1 | 68.00' | 33,575 cf | **Custom Stage Data (Prismatic)** Listed below |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 68.00 | 850 | 0 | 0 |
| 70.00 | 1,700 | 2,550 | 2,550 |
| 70.50 | 1,925 | 906 | 3,456 |
| 72.00 | 2,800 | 3,544 | 7,000 |
| 74.00 | 6,950 | 9,750 | 16,750 |
| 76.00 | 9,875 | 16,825 | 33,575 |

| # | Routing | Invert | Outlet Devices |
|---|---|---|---|
| 1 | Primary | 68.00' | **24.0" x 50.0' long Culvert** RCP, square edge headwall, Ke= 0.500<br>Outlet Invert= 67.00' S= 0.0200 '/' n= 0.013 Cc= 0.900 |
| 2 | Device 1 | 70.10' | **3.0" Vert. Orifice/Grate** C= 0.600 |
| 3 | Device 1 | 73.25' | **2.50' x 2.50' Horiz. Orifice/Grate** Limited to weir flow C= 0.600 |

**Primary OutFlow** Max=1.32 cfs @ 12.75 hrs HW=73.34' (Free Discharge)
└─**1=Culvert** (Passes 1.32 cfs of 31.52 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 0.42 cfs @ 8.5 fps)
  └─**3=Orifice/Grate** (Weir Controls 0.90 cfs @ 1.0 fps)

## Pond C3: POND C3



## Pond D-1: DI-5

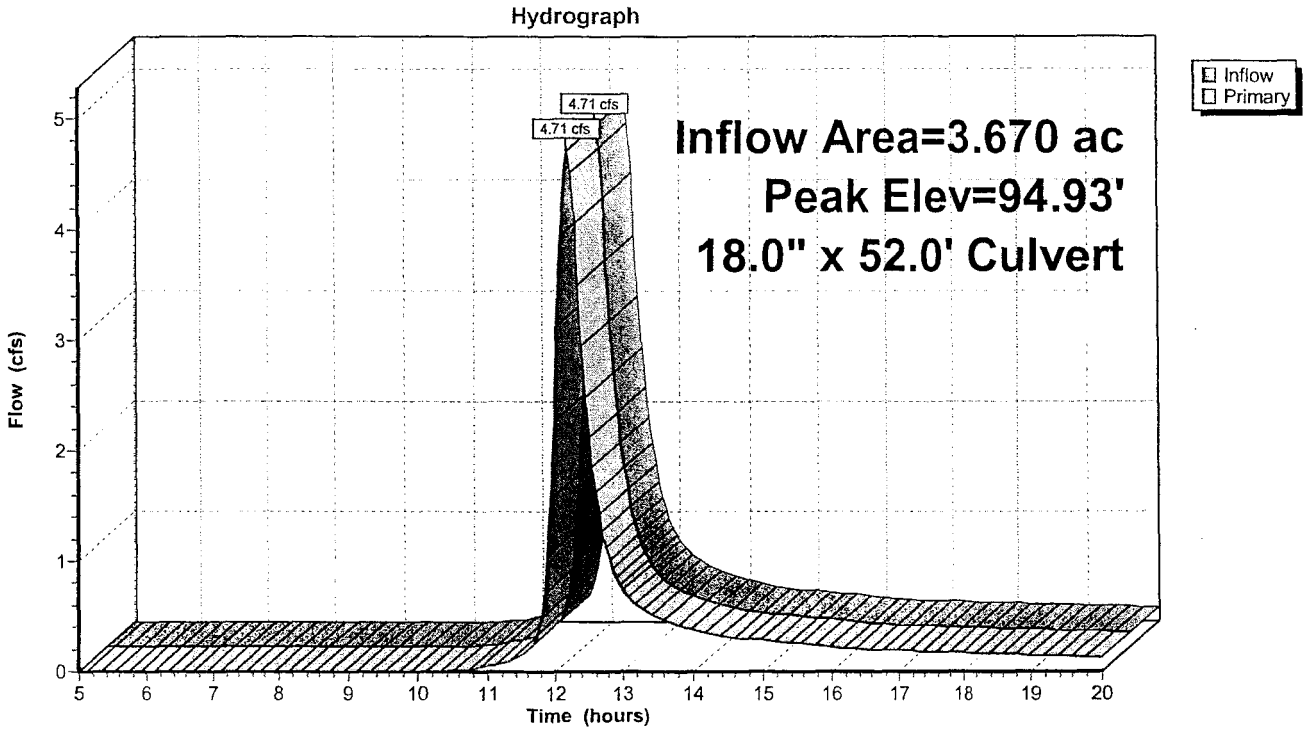
| | | | | | |
|---|---|---|---|---|---|
| Inflow Area = | 3.670 ac, | Inflow Depth = | 1.23" | for | 2 YEAR event |
| Inflow = | 4.71 cfs @ | 12.20 hrs, | Volume= | 0.377 af | |
| Outflow = | 4.71 cfs @ | 12.20 hrs, | Volume= | 0.377 af, | Atten= 0%, Lag= 0.0 min |
| Primary = | 4.71 cfs @ | 12.20 hrs, | Volume= | 0.377 af | |

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 94.93' @ 12.20 hrs
Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= (not calculated)

| # | Routing | Invert | Outlet Devices |
|---|---|---|---|
| 1 | Primary | 93.87' | **18.0" x 52.0' long Culvert** RCP, square edge headwall, Ke= 0.500<br>Outlet Invert= 90.94' S= 0.0563 '/' n= 0.013 Cc= 0.900 |

**Primary OutFlow** Max=4.71 cfs @ 12.20 hrs HW=94.93' (Free Discharge)
└─**1=Culvert** (Inlet Controls 4.71 cfs @ 3.5 fps)

## Pond D-1: DI-5



## Pond D-2: DI-5

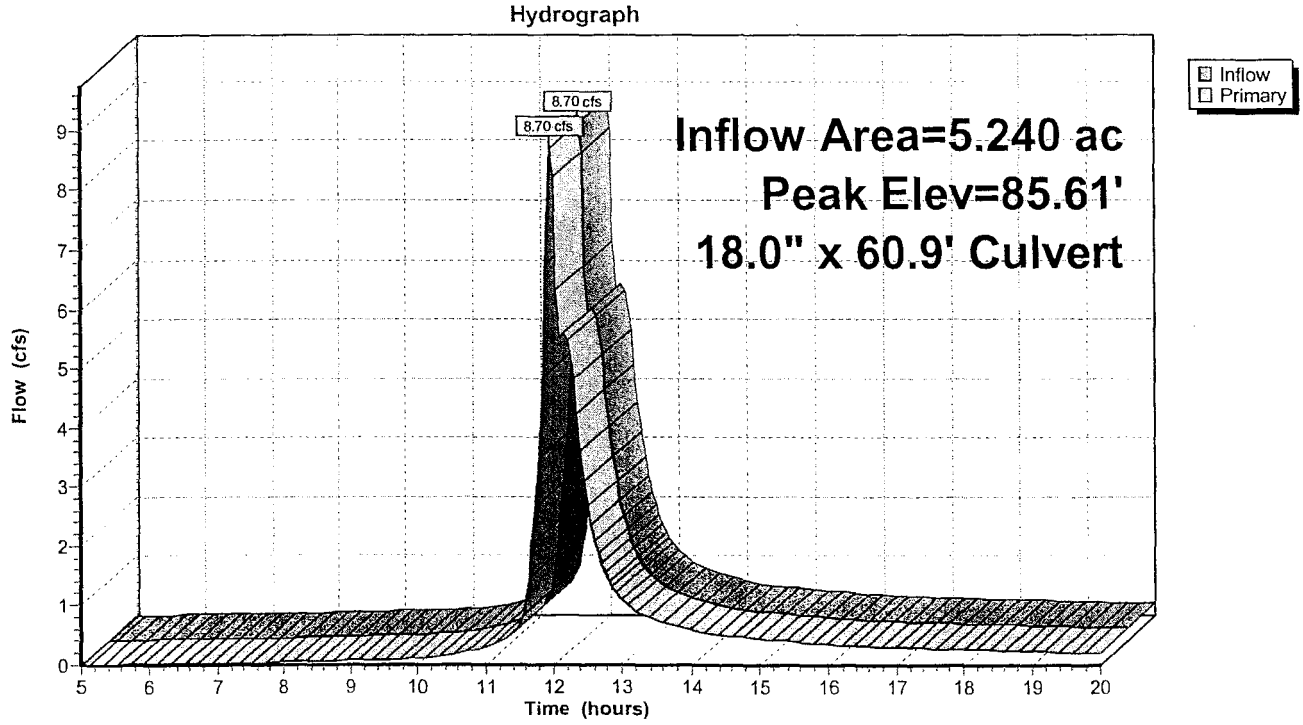
| | | | | | |
|---|---|---|---|---|---|
| Inflow Area = | 5.240 ac, | Inflow Depth = | 1.60" | for | 2 YEAR event |
| Inflow = | 8.70 cfs @ | 11.97 hrs, | Volume= | 0.700 af | |
| Outflow = | 8.70 cfs @ | 11.97 hrs, | Volume= | 0.700 af, | Atten= 0%, Lag= 0.0 min |
| Primary = | 8.70 cfs @ | 11.97 hrs, | Volume= | 0.700 af | |

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 85.61' @ 11.97 hrs
Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= (not calculated)

| # | Routing | Invert | Outlet Devices |
|---|---|---|---|
| 1 | Primary | 83.82' | **18.0" x 60.9' long Culvert** RCP, square edge headwall, Ke= 0.500<br>Outlet Invert= 82.60' S= 0.0200 '/' n= 0.013 Cc= 0.900 |

**Primary OutFlow** Max=8.46 cfs @ 11.97 hrs HW=85.56' (Free Discharge)
└**1=Culvert** (Inlet Controls 8.46 cfs @ 4.8 fps)

## Pond D-2: DI-5



## Pond D-3: MH-1

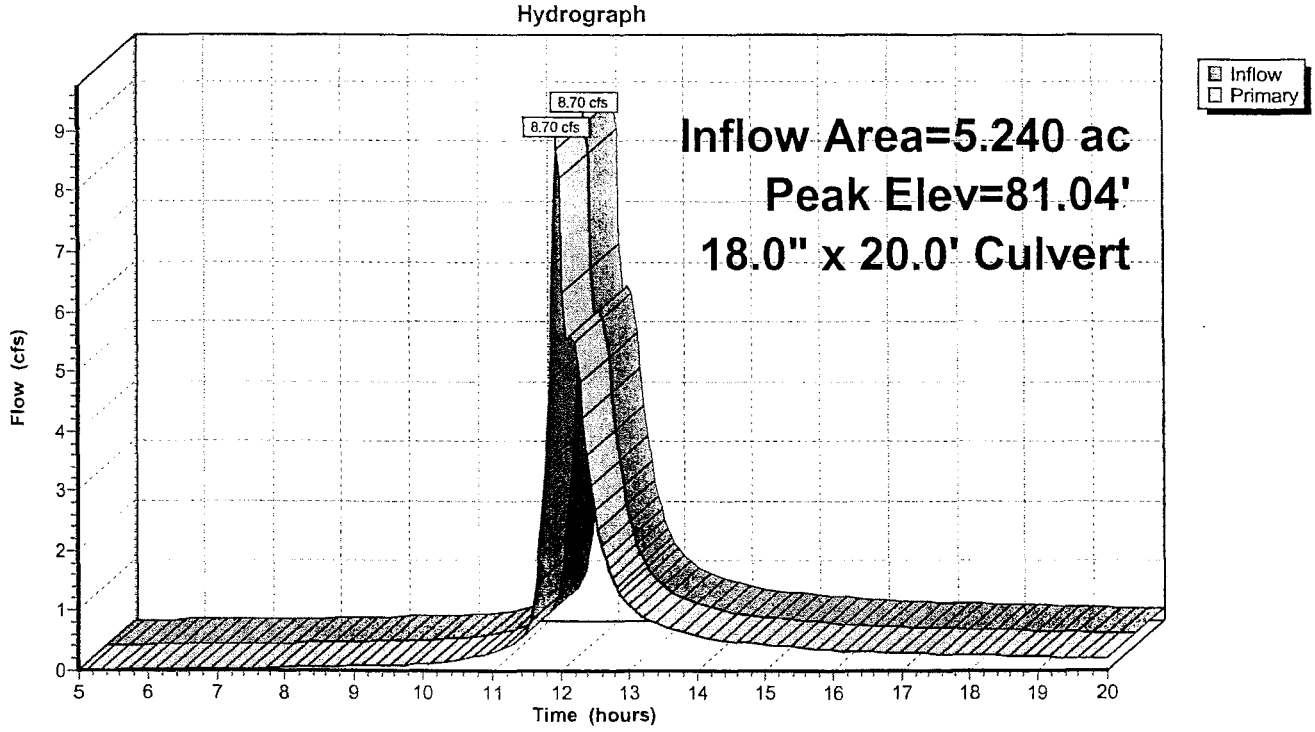
| | | | | | |
|---|---|---|---|---|---|
| Inflow Area = | 5.240 ac, | Inflow Depth = | 1.60" | for | 2 YEAR event |
| Inflow = | 8.70 cfs @ | 11.97 hrs, | Volume= | 0.700 af | |
| Outflow = | 8.70 cfs @ | 11.97 hrs, | Volume= | 0.700 af, | Atten= 0%, Lag= 0.0 min |
| Primary = | 8.70 cfs @ | 11.97 hrs, | Volume= | 0.700 af | |

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 81.04' @ 11.97 hrs
Plug-Flow detention time= (not calculated)
Center-of-Mass det. time= (not calculated)

| # | Routing | Invert | Outlet Devices |
|---|---|---|---|
| 1 | Primary | 79.25' | **18.0" x 20.0' long Culvert** RCP, square edge headwall, Ke= 0.500<br>Outlet Invert= 78.85' S= 0.0200 '/' n= 0.013 Cc= 0.900 |

**Primary OutFlow** Max=8.46 cfs @ 11.97 hrs HW=80.99' (Free Discharge)
└─**1=Culvert** (Inlet Controls 8.46 cfs @ 4.8 fps)

## Pond D-3: MH-1



## Pond P D: POND D

Inflow Area = 7.440 ac, Inflow Depth = 1.40" for 2 YEAR event
Inflow = 10.29 cfs @ 11.98 hrs, Volume= 0.865 af
Outflow = 3.77 cfs @ 12.46 hrs, Volume= 0.572 af, Atten= 63%, Lag= 28.5 min
Primary = 3.77 cfs @ 12.46 hrs, Volume= 0.572 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 79.19' @ 12.46 hrs Surf.Area= 5,545 sf Storage= 16,977 cf
Plug-Flow detention time= 166.2 min calculated for 0.570 af (66% of inflow)
Center-of-Mass det. time= 91.7 min ( 885.6 - 793.9 )

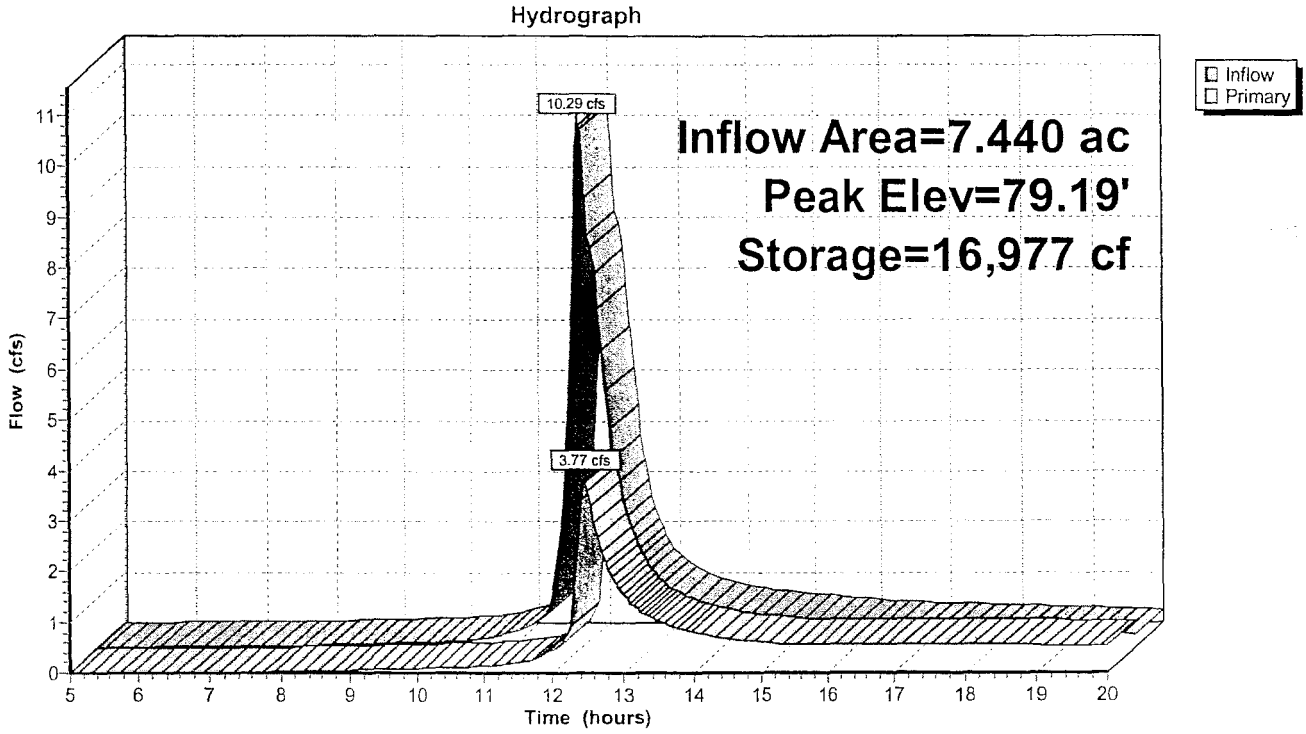
| # | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| 1 | 73.00' | 36,249 cf | **Custom Stage Data (Prismatic)** Listed below |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 73.00 | 963 | 0 | 0 |
| 74.00 | 1,391 | 1,177 | 1,177 |
| 76.00 | 2,465 | 3,856 | 5,033 |
| 76.50 | 2,775 | 1,310 | 6,343 |
| 78.00 | 3,821 | 4,947 | 11,290 |
| 78.25 | 4,010 | 979 | 12,269 |
| 78.85 | 5,241 | 2,775 | 15,044 |
| 80.00 | 6,284 | 6,627 | 21,671 |
| 82.00 | 8,294 | 14,578 | 36,249 |

| # | Routing | Invert | Outlet Devices |
|---|---|---|---|
| 1 | Primary | 71.00' | **24.0" x 60.0' long Culvert** RCP, square edge headwall, Ke= 0.500<br>Outlet Invert= 70.00' S= 0.0167 '/' n= 0.013 Cc= 0.900 |
| 2 | Device 1 | 79.00' | **3.00' x 3.00' Horiz. Orifice/Grate** Limited to weir flow C= 0.600 |
| 3 | Device 1 | 73.10' | **3.0" Vert. Orifice/Grate** C= 0.600 |

**Primary OutFlow** Max=3.67 cfs @ 12.46 hrs HW=79.18' (Free Discharge)
└─**1=Culvert** (Passes 3.67 cfs of 40.54 cfs potential flow)
  ├─**2=Orifice/Grate** (Weir Controls 3.09 cfs @ 1.4 fps)
  └─**3=Orifice/Grate** (Orifice Controls 0.58 cfs @ 11.8 fps)

## Pond P D: POND D



# CHANNELS A, B & C
# PRE & POST DEVELOPMENT

# N value Determination

**Project:** Stonehouse Glen Phase 1 **Project No.** 2002261-500.04

**Date:** 7/29/2004 **Prepared By:** AJR

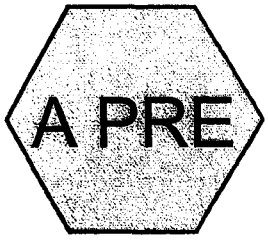
**Date Of Field Survey** 5/17/2004
**Crew:** wp/sw

**Conditions Noted:** All three natural channels have defined slopes, minor debris from fallen trees

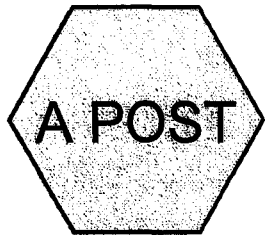
**Channels A,B, and C**

| | Reference | n | Description |
|---|---|---|---|
| Basic n Value | Table 5-16 | 0.02 | Channel cut into earth |
| Surface irregularity | Table 5-17 | 0.01 | Moderate |
| Shape variations | Table 5-18 | 0 | Occasional |
| Obstructions | Table 5-19 | 0.01 | minor |
| Vegetation | Table 5-20 | 0.015 | Dense Growth of Grasses and tree seedlings along outside edge of flow pattern. |
| Sinuosity | Table 5-21 | 0 | Ratio 156/150 = 1.04 Minor |
| | Total | 0.055 | |

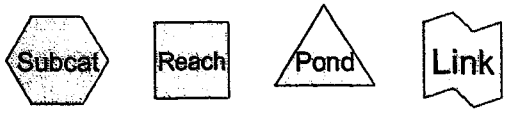
Permissible Velociy Based upon Field Observation 2.5'/sec sandy loam




CHANNEL A PRE DEVELOPMENT




CHANNEL A POST DEVELOPMENT




**Drainage Diagram for channel ADEQUACY**
Prepared by LANDMARK DESIGN GROUP 11/2/2004
HydroCAD® 7.00 s/n 001765 © 1986-2003 Applied Microcomputer Systems

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment A POST: CHANNEL A POST DEVELOPMENT** Runoff Area=6.650 ac Runoff Depth=1.12"
Flow Length=784' Tc=17.3 min CN=74 Runoff=9.57 cfs 0.619 af

**Subcatchment A PRE: CHANNEL A PRE DEVELOPMENT** Runoff Area=7.860 ac Runoff Depth=0.89"
Flow Length=1,004' Tc=30.6 min CN=70 Runoff=6.10 cfs 0.585 af

**Total Runoff Area = 14.510 ac Runoff Volume = 1.204 af Average Runoff Depth = 1.00"**

## Subcatchment A POST: CHANNEL A POST DEVELOPMENT

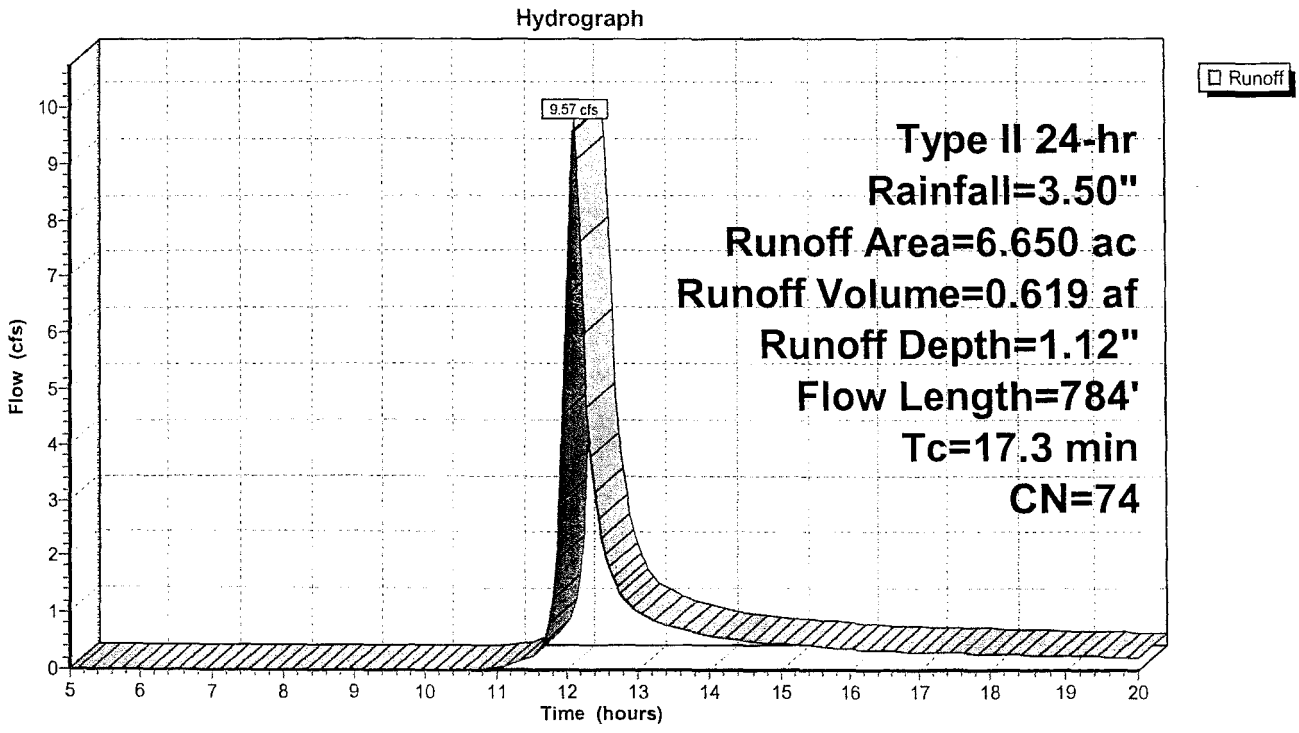
Runoff = 9.57 cfs @ 12.11 hrs, Volume= 0.619 af, Depth= 1.12"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=3.50"

| Area (ac) | CN | Description |
|---|---|---|
| 0.780 | 98 | Paved parking & roofs |
| 4.870 | 70 | Woods, Good, HSG C |
| 1.000 | 74 | >75% Grass cover, Good, HSG C |
| 6.650 | 74 | Weighted Average |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 10.5 | 100 | 0.1400 | 0.2 | | **Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.80" |
| 5.9 | 216 | 0.0150 | 0.6 | | **Shallow Concentrated Flow,** Woodland Kv= 5.0 fps |
| 0.9 | 468 | 0.0430 | 8.6 | 412.14 | **Channel Flow,** Area= 48.0 sf Perim= 25.3' r= 1.90' n= 0.055 |
| 17.3 | 784 | Total | | | |

## Subcatchment A POST: CHANNEL A POST DEVELOPMENT



## Subcatchment A PRE: CHANNEL A PRE DEVELOPMENT

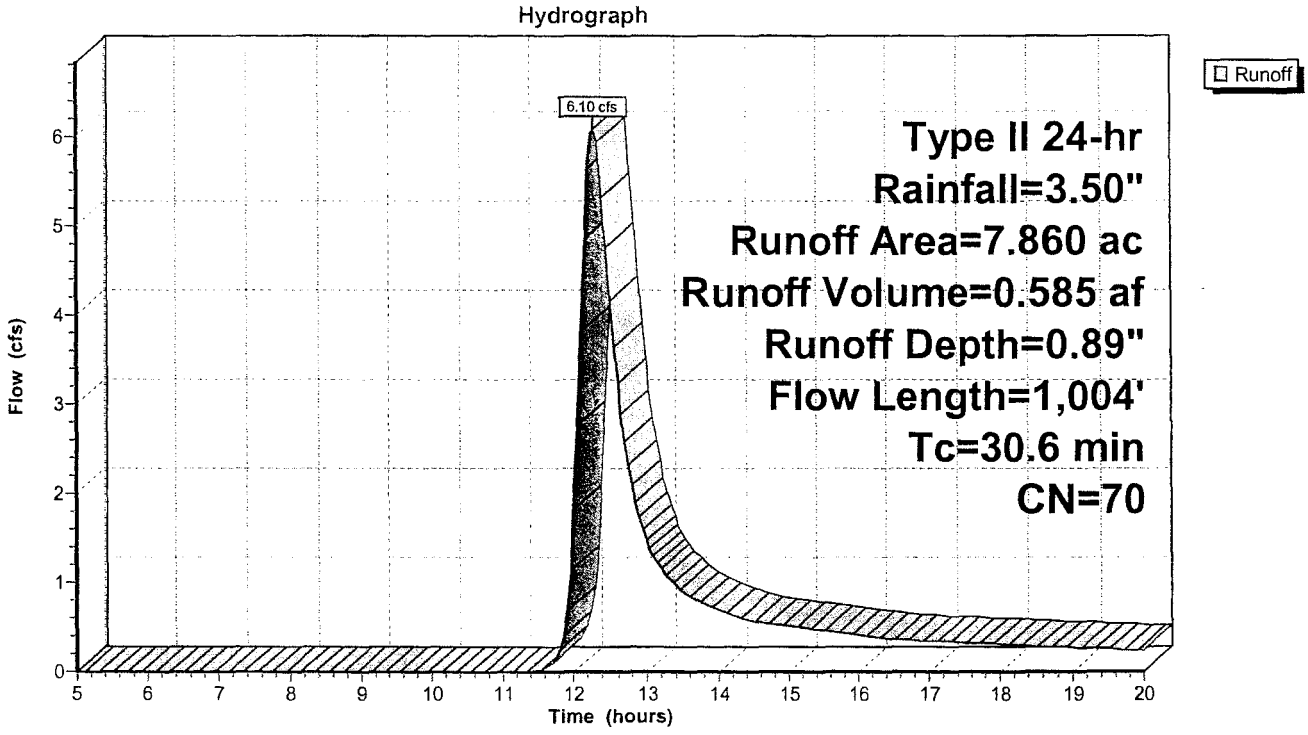
Runoff = 6.10 cfs @ 12.28 hrs, Volume= 0.585 af, Depth= 0.89"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=3.50"

| Area (ac) | CN | Description |
|---|---|---|
| 7.860 | 70 | Woods, Good, HSG C |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 25.8 | 100 | 0.0150 | 0.1 | | **Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.80" |
| 3.9 | 436 | 0.1420 | 1.9 | | **Shallow Concentrated Flow,** Woodland Kv= 5.0 fps |
| 0.9 | 468 | 0.0430 | 8.6 | 412.14 | **Channel Flow,** Area= 48.0 sf Perim= 25.3' r= 1.90' n= 0.055 |
| 30.6 | 1,004 | Total | | | |

## Subcatchment A PRE: CHANNEL A PRE DEVELOPMENT



# CHANNEL A POST DEVELOPMENT
## Worksheet for Irregular Channel

| Project Description | |
|---|---|
| Project File | c:\haestad\fmw\channel .fm2 |
| Worksheet | channel A |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Water Elevation |

| Input Data | | |
|---|---|---|
| Channel Slope | 0.041000 | ft/ft |

Elevation range: 33.90 ft to 41.60 ft.

| Station (ft) | Elevation (ft) | Start Station | End Station | Roughness |
|---|---|---|---|---|
| 0.00 | 38.70 | 0.00 | 69.10 | 0.055 |
| 8.70 | 34.40 | | | |
| 9.50 | 33.90 | | | |
| 13.20 | 34.30 | | | |
| 16.00 | 35.00 | | | |
| 23.50 | 34.90 | | | |
| 34.90 | 35.40 | | | |
| 37.90 | 34.70 | | | |
| 40.20 | 34.10 | | | |
| 42.10 | 34.10 | | | |
| 44.40 | 34.30 | | | |
| 52.70 | 36.10 | | | |
| 61.80 | 38.90 | | | |
| 69.10 | 41.60 | | | |

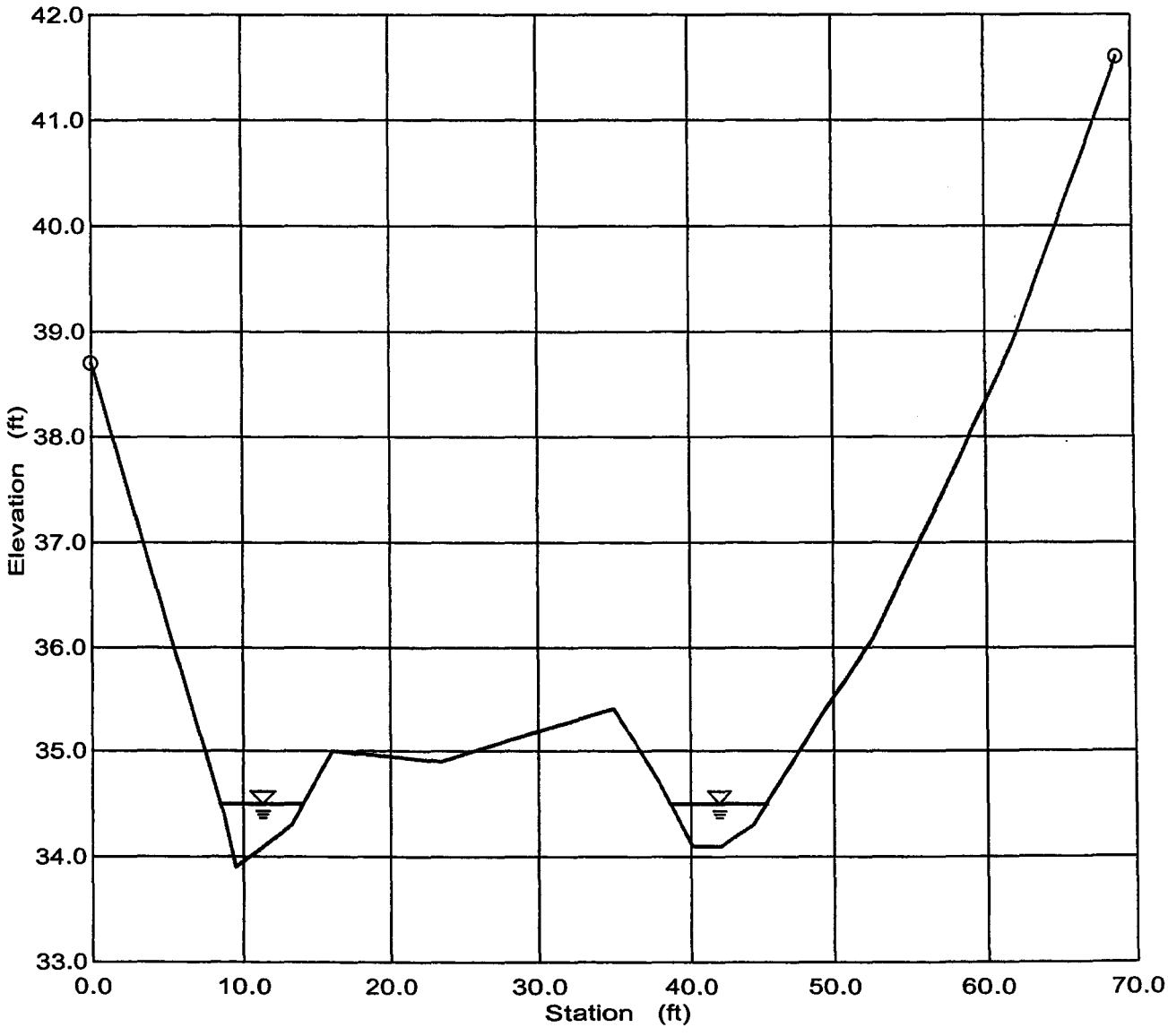
| | | |
|---|---|---|
| Discharge | 9.57 | cfs |

| Results | | |
|---|---|---|
| Wtd. Mannings Coefficient | 0.055 | |
| Water Surface Elevation | 34.51 | ft |
| Flow Area | 3.86 | ft² |
| Wetted Perimeter | 12.65 | ft |
| Top Width | 12.35 | ft |
| Height | 0.61 | ft |
| Critical Depth | 34.46 | ft |
| Critical Slope | 0.069704 | ft/ft |
| Velocity | 2.48 | ft/s |
| Velocity Head | 0.10 | ft |
| Specific Energy | 34.61 | ft |
| Froude Number | 0.78 | |
| Flow is subcritical. | | |
| Flow is divided. | | |

# Cross Section
## Cross Section for Irregular Channel

| Project Description | |
|---|---|
| Project File | c:\haestad\fmw\channel .fm2 |
| Worksheet | channel A |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Water Elevation |

| Section Data | | |
|---|---|---|
| Wtd. Mannings Coefficient | 0.055 | |
| Channel Slope | 0.041000 | ft/ft |
| Water Surface Elevation | 34.51 | ft |
| Discharge | 9.57 | cfs |



# CHANNEL A PRE DEVELOPMENT
## Worksheet for Irregular Channel

| Project Description | |
|---|---|
| Project File | c:\haestad\fmw\channel .fm2 |
| Worksheet | channel A |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Water Elevation |

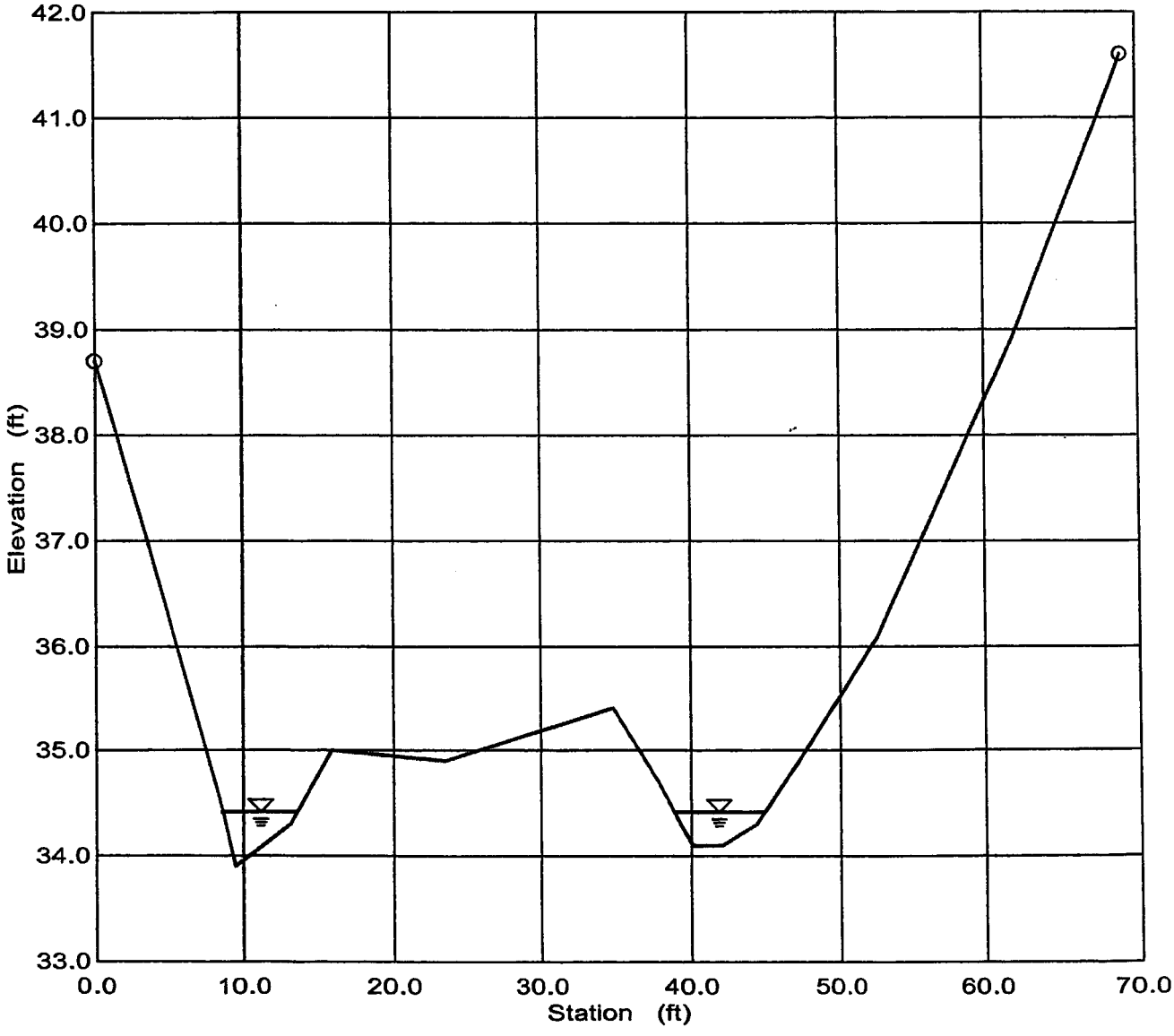
| Input Data | | | | |
|---|---|---|---|---|
| Channel Slope | 0.041000 ft/ft | | | |
| Elevation range: 33.90 ft to 41.60 ft. | | | | |
| Station (ft) | Elevation (ft) | Start Station | End Station | Roughness |
| 0.00 | 38.70 | 0.00 | 69.10 | 0.055 |
| 8.70 | 34.40 | | | |
| 9.50 | 33.90 | | | |
| 13.20 | 34.30 | | | |
| 16.00 | 35.00 | | | |
| 23.50 | 34.90 | | | |
| 34.90 | 35.40 | | | |
| 37.90 | 34.70 | | | |
| 40.20 | 34.10 | | | |
| 42.10 | 34.10 | | | |
| 44.40 | 34.30 | | | |
| 52.70 | 36.10 | | | |
| 61.80 | 38.90 | | | |
| 69.10 | 41.60 | | | |
| Discharge | 6.10 | cfs | | |

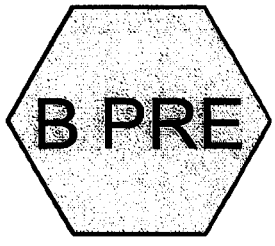
| Results | | |
|---|---|---|
| Wtd. Mannings Coefficient | 0.055 | |
| Water Surface Elevation | 34.42 | ft |
| Flow Area | 2.82 | $ft^2$ |
| Wetted Perimeter | 11.31 | ft |
| Top Width | 11.06 | ft |
| Height | 0.52 | ft |
| Critical Depth | 34.37 | ft |
| Critical Slope | 0.074967 | ft/ft |
| Velocity | 2.17 | ft/s |
| Velocity Head | 0.07 | ft |
| Specific Energy | 34.50 | ft |
| Froude Number | 0.76 | |
| Flow is subcritical. | | |
| Flow is divided. | | |

# CHANNEL A PRE DEVELOPMENT
## Cross Section for Irregular Channel

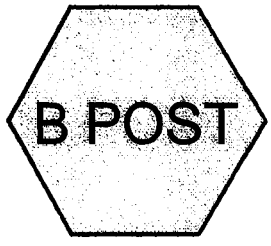
| Project Description | |
|---|---|
| Project File | c:\haestad\fmw\channel .fm2 |
| Worksheet | channel A |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Water Elevation |

| Section Data | | |
|---|---|---|
| Wtd. Mannings Coefficient | 0.055 | |
| Channel Slope | 0.041000 | ft/ft |
| Water Surface Elevation | 34.42 | ft |
| Discharge | 6.10 | cfs |

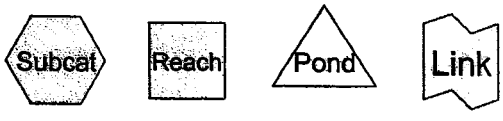





channel B pre development




channel B post development




**Drainage Diagram for channel ADEQUACY**
Prepared by LANDMARK DESIGN GROUP 11/2/2004
HydroCAD® 7.00 s/n 001765 © 1986-2003 Applied Microcomputer Systems

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment B POST: channel B post development** Runoff Area=7.700 ac Runoff Depth=1.12"
Flow Length=762' Tc=17.8 min CN=74 Runoff=10.91 cfs 0.717 af

**Subcatchment B PRE: channel B pre development** Runoff Area=7.540 ac Runoff Depth=0.90"
Flow Length=890' Tc=25.4 min CN=70 Runoff=6.66 cfs 0.563 af

**Total Runoff Area = 15.240 ac Runoff Volume = 1.280 af Average Runoff Depth = 1.01"**

## Subcatchment B POST: channel B post development

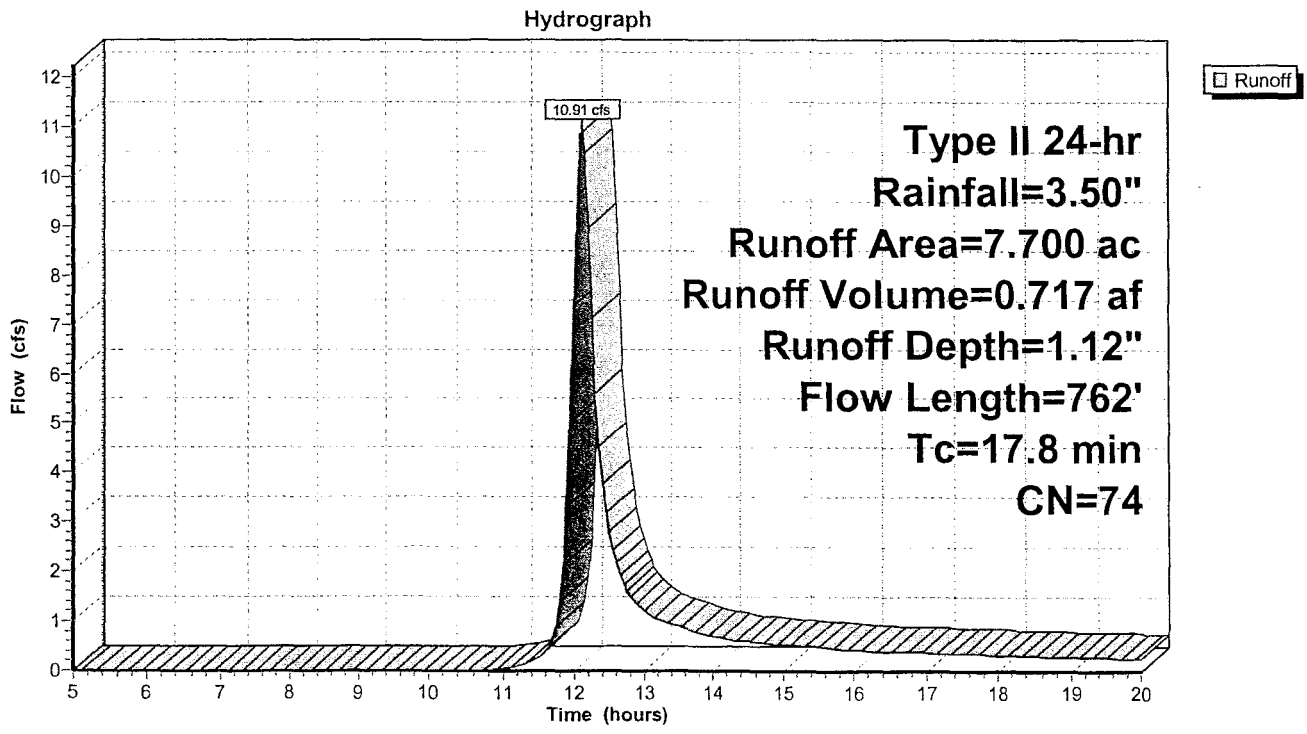
Runoff = 10.91 cfs @ 12.11 hrs, Volume= 0.717 af, Depth= 1.12"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=3.50"

| Area (ac) | CN | Description |
|---|---|---|
| 0.900 | 98 | Paved parking & roofs |
| 5.900 | 70 | Woods, Good, HSG C |
| 0.900 | 74 | >75% Grass cover, Good, HSG C |
| 7.700 | 74 | Weighted Average |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 14.8 | 100 | 0.0600 | 0.1 | | **Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.80" |
| 2.4 | 217 | 0.0920 | 1.5 | | **Shallow Concentrated Flow,** Woodland Kv= 5.0 fps |
| 0.6 | 445 | 0.0850 | 12.1 | 579.46 | **Channel Flow, natural channel** Area= 48.0 sf Perim= 25.3' r= 1.90' n= 0.055 |
| 17.8 | 762 | Total | | | |

## Subcatchment B POST: channel B post development



## Subcatchment B PRE: channel B pre development

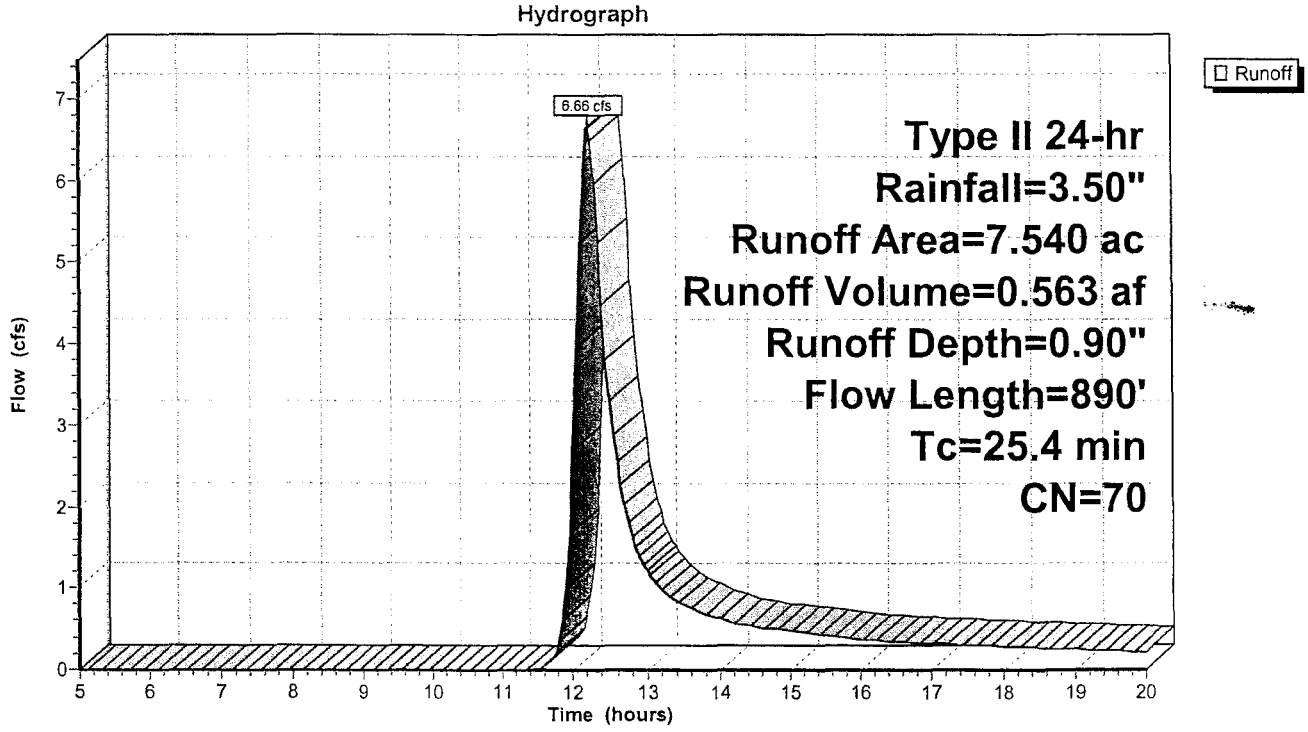
Runoff = 6.66 cfs @ 12.21 hrs, Volume= 0.563 af, Depth= 0.90"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=3.50"

| Area (ac) | CN | Description |
|---|---|---|
| 7.540 | 70 | Woods, Good, HSG C |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 21.0 | 100 | 0.0250 | 0.1 | | **Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.80" |
| 3.8 | 345 | 0.0930 | 1.5 | | **Shallow Concentrated Flow,** Woodland Kv= 5.0 fps |
| 0.6 | 445 | 0.0850 | 11.6 | 520.36 | **Channel Flow,** Area= 45.0 sf Perim= 25.3' r= 1.78' n= 0.055 |
| 25.4 | 890 | Total | | | |

## Subcatchment B PRE: channel B pre development



# CHANNEL B POST DEVELOPMENT
## Worksheet for Irregular Channel

| Project Description | |
|---|---|
| Project File | c:\haestad\fmw\channel .fm2 |
| Worksheet | CHANNEL B |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Water Elevation |

| Input Data | | |
|---|---|---|
| Channel Slope | 0.033000 | ft/ft |

Elevation range: 35.10 ft to 43.60 ft.

| Station (ft) | Elevation (ft) | Start Station | End Station | Roughness |
|---|---|---|---|---|
| 0.00 | 43.60 | 0.00 | 68.40 | 0.055 |
| 10.10 | 41.00 | | | |
| 18.40 | 38.10 | | | |
| 32.40 | 36.80 | | | |
| 36.40 | 35.80 | | | |
| 40.90 | 35.70 | | | |
| 41.70 | 35.90 | | | |
| 43.80 | 35.70 | | | |
| 44.60 | 35.20 | | | |
| 45.00 | 35.10 | | | |
| 45.75 | 35.10 | | | |
| 48.50 | 36.40 | | | |
| 58.00 | 37.00 | | | |
| 60.80 | 39.10 | | | |
| 68.40 | 42.30 | | | |

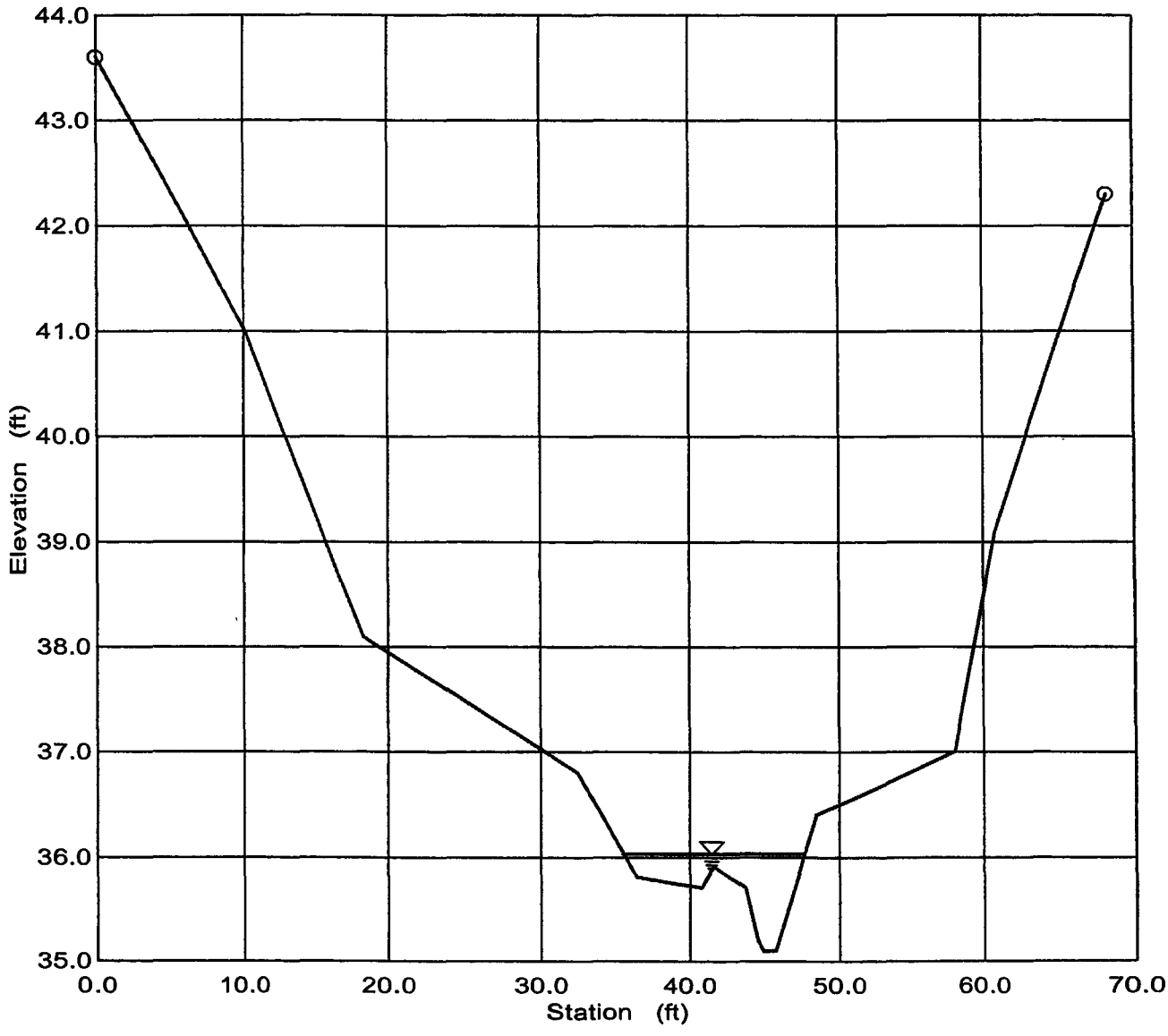
| | | |
|---|---|---|
| Discharge | 10.91 | cfs |

| Results | | |
|---|---|---|
| Wtd. Mannings Coefficient | 0.055 | |
| Water Surface Elevation | 36.03 | ft |
| Flow Area | 4.46 | ft² |
| Wetted Perimeter | 12.66 | ft |
| Top Width | 12.24 | ft |
| Height | 0.93 | ft |
| Critical Depth | 35.95 | ft |
| Critical Slope | 0.068918 | ft/ft |
| Velocity | 2.45 | ft/s |
| Velocity Head | 0.09 | ft |
| Specific Energy | 36.12 | ft |
| Froude Number | 0.71 | |
| Flow is subcritical. | | |

# CHANNEL B POST DEVELOPMENT
## Cross Section for Irregular Channel

| Project Description | |
|---|---|
| Project File | c:\haestad\fmw\channel .fm2 |
| Worksheet | CHANNEL B |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Water Elevation |

| Section Data | | |
|---|---|---|
| Wtd. Mannings Coefficient | 0.055 | |
| Channel Slope | 0.033000 | ft/ft |
| Water Surface Elevation | 36.03 | ft |
| Discharge | 10.91 | cfs |



# CHANNEL B PRE DEVELOPMENT
## Worksheet for Irregular Channel

| Project Description | |
|---|---|
| Project File | c:\haestad\fmw\channel .fm2 |
| Worksheet | CHANNEL B |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Water Elevation |

| Input Data | | |
|---|---|---|
| Channel Slope | 0.033000 | ft/ft |

Elevation range: 35.10 ft to 43.60 ft.

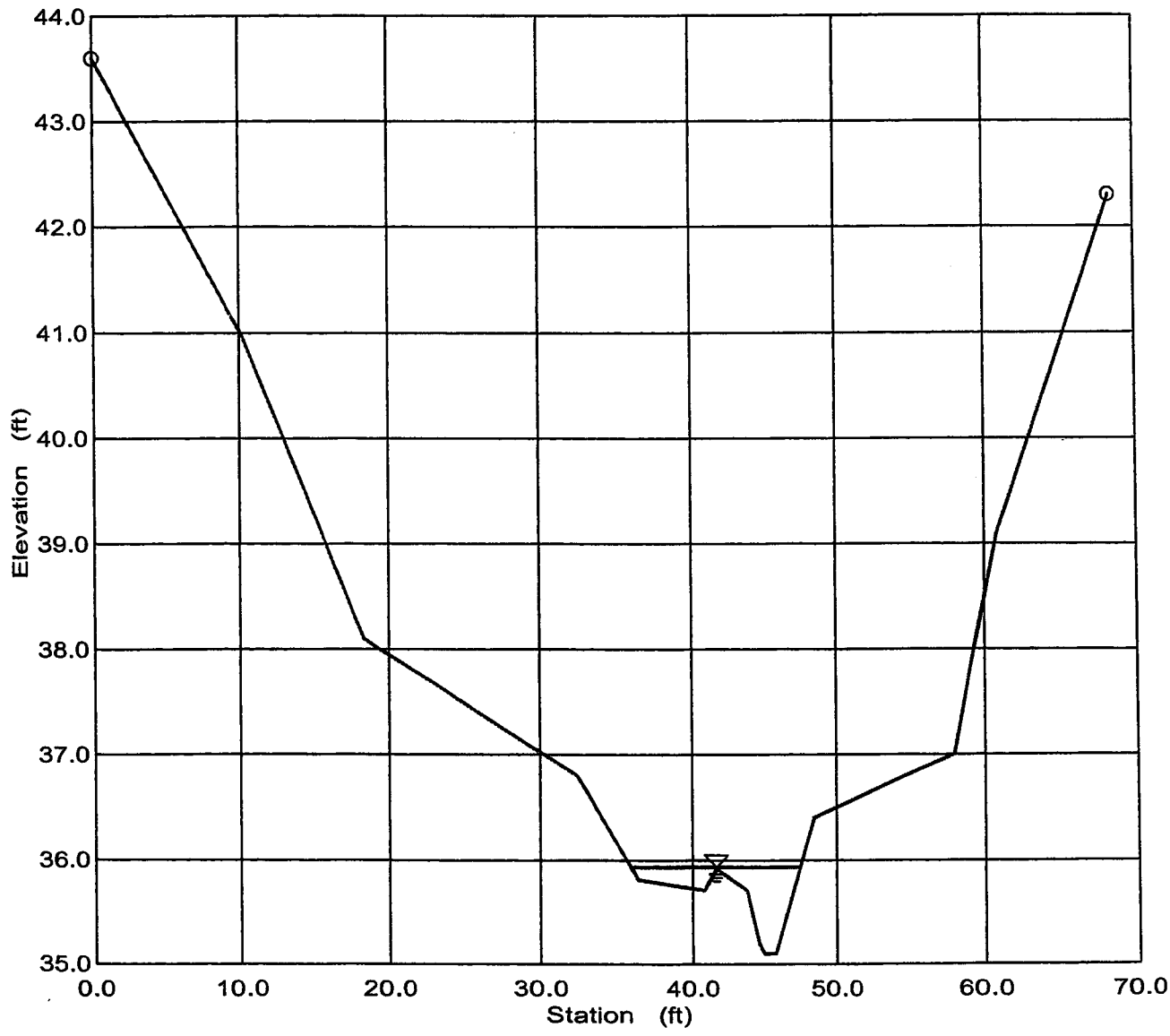
| Station (ft) | Elevation (ft) | Start Station | End Station | Roughness |
|---|---|---|---|---|
| 0.00 | 43.60 | 0.00 | 68.40 | 0.055 |
| 10.10 | 41.00 | | | |
| 18.40 | 38.10 | | | |
| 32.40 | 36.80 | | | |
| 36.40 | 35.80 | | | |
| 40.90 | 35.70 | | | |
| 41.70 | 35.90 | | | |
| 43.80 | 35.70 | | | |
| 44.60 | 35.20 | | | |
| 45.00 | 35.10 | | | |
| 45.75 | 35.10 | | | |
| 48.50 | 36.40 | | | |
| 58.00 | 37.00 | | | |
| 60.80 | 39.10 | | | |
| 68.40 | 42.30 | | | |
| Discharge | 6.66 | cfs | | |

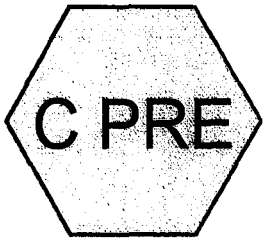
| Results | | |
|---|---|---|
| Wtd. Mannings Coefficient | 0.055 | |
| Water Surface Elevation | 35.93 | ft |
| Flow Area | 3.25 | ft² |
| Wetted Perimeter | 12.01 | ft |
| Top Width | 11.61 | ft |
| Height | 0.83 | ft |
| Critical Depth | 35.86 | ft |
| Critical Slope | 0.075069 | ft/ft |
| Velocity | 2.05 | ft/s |
| Velocity Head | 0.07 | ft |
| Specific Energy | 35.99 | ft |
| Froude Number | 0.68 | |
| Flow is subcritical. | | |

# CHANNEL B PRE DEVELOPMENT
## Cross Section for Irregular Channel

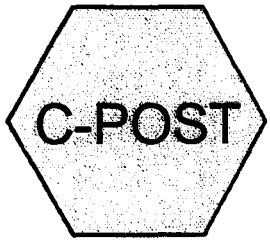
| Project Description | |
|---|---|
| Project File | c:\haestad\fmw\channel .fm2 |
| Worksheet | CHANNEL B |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Water Elevation |

| Section Data | | |
|---|---|---|
| Wtd. Mannings Coefficient | 0.055 | |
| Channel Slope | 0.033000 | ft/ft |
| Water Surface Elevation | 35.93 | ft |
| Discharge | 6.66 | cfs |

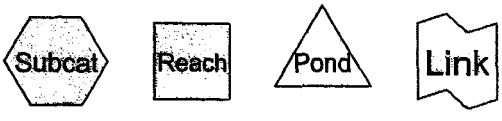





CHANNEL C PRE DEVELOPMENT




CHANNEL C POST DEVELOPMENT




**Drainage Diagram for channel ADEQUACY**
Prepared by LANDMARK DESIGN GROUP 11/2/2004
HydroCAD® 7.00 s/n 001765 © 1986-2003 Applied Microcomputer Systems

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment C PRE: CHANNEL C PRE DEVELOPMENT** Runoff Area=3.950 ac Runoff Depth=0.90"
Flow Length=582' Tc=23.4 min CN=70 Runoff=3.68 cfs 0.295 af

**Subcatchment C-POST: CHANNEL C POST DEVELOPMENT** Runoff Area=3.780 ac Runoff Depth=1.17"
Flow Length=553' Tc=20.8 min CN=75 Runoff=5.16 cfs 0.370 af

**Total Runoff Area = 7.730 ac Runoff Volume = 0.665 af Average Runoff Depth = 1.03"**

## Subcatchment C PRE: CHANNEL C PRE DEVELOPMENT

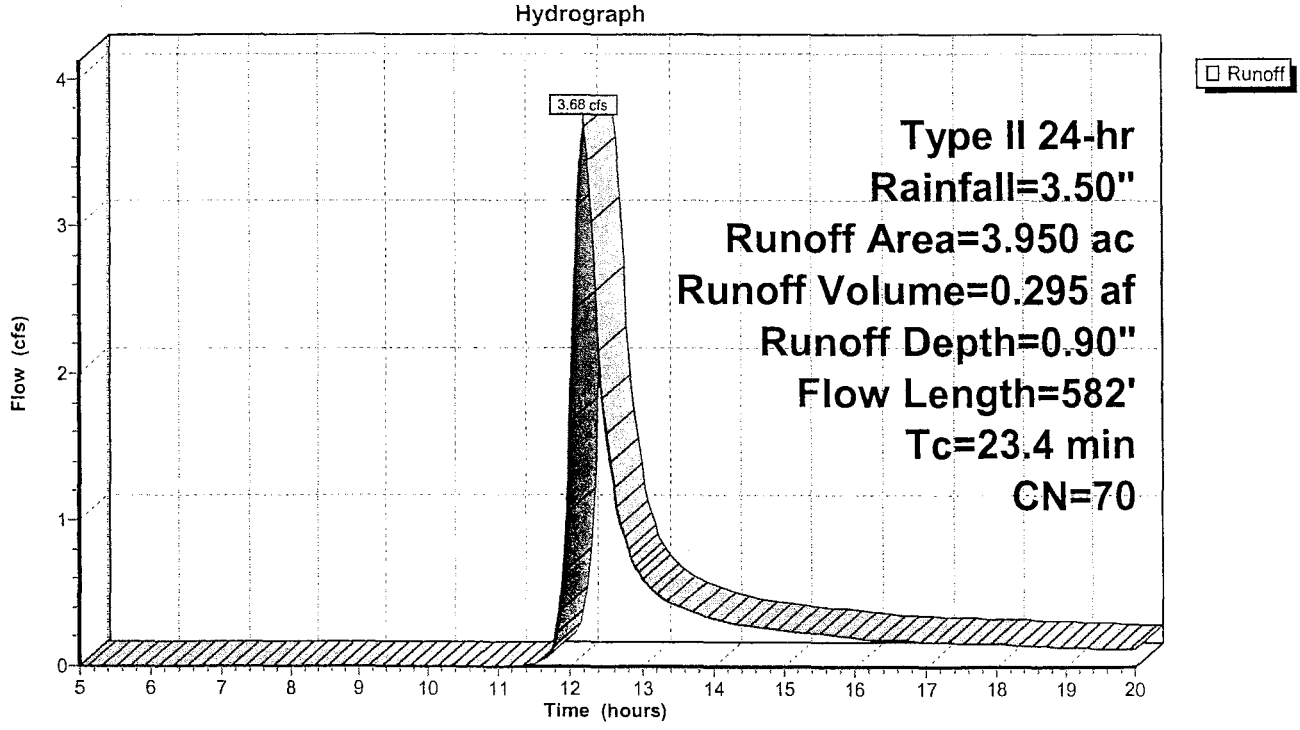
Runoff = 3.68 cfs @ 12.19 hrs, Volume= 0.295 af, Depth= 0.90"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=3.50"

| Area (ac) | CN | Description |
|---|---|---|
| 3.950 | 70 | Woods, Good, HSG C |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 21.0 | 100 | 0.0250 | 0.1 | | **Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.80" |
| 2.1 | 259 | 0.1620 | 2.0 | | **Shallow Concentrated Flow,** Woodland Kv= 5.0 fps |
| 0.3 | 223 | 0.0825 | 11.9 | 570.87 | **Channel Flow,** Area= 48.0 sf Perim= 25.3' r= 1.90' n= 0.055 |
| 23.4 | 582 | Total | | | |

## Subcatchment C PRE: CHANNEL C PRE DEVELOPMENT



## Subcatchment C-POST: CHANNEL C POST DEVELOPMENT

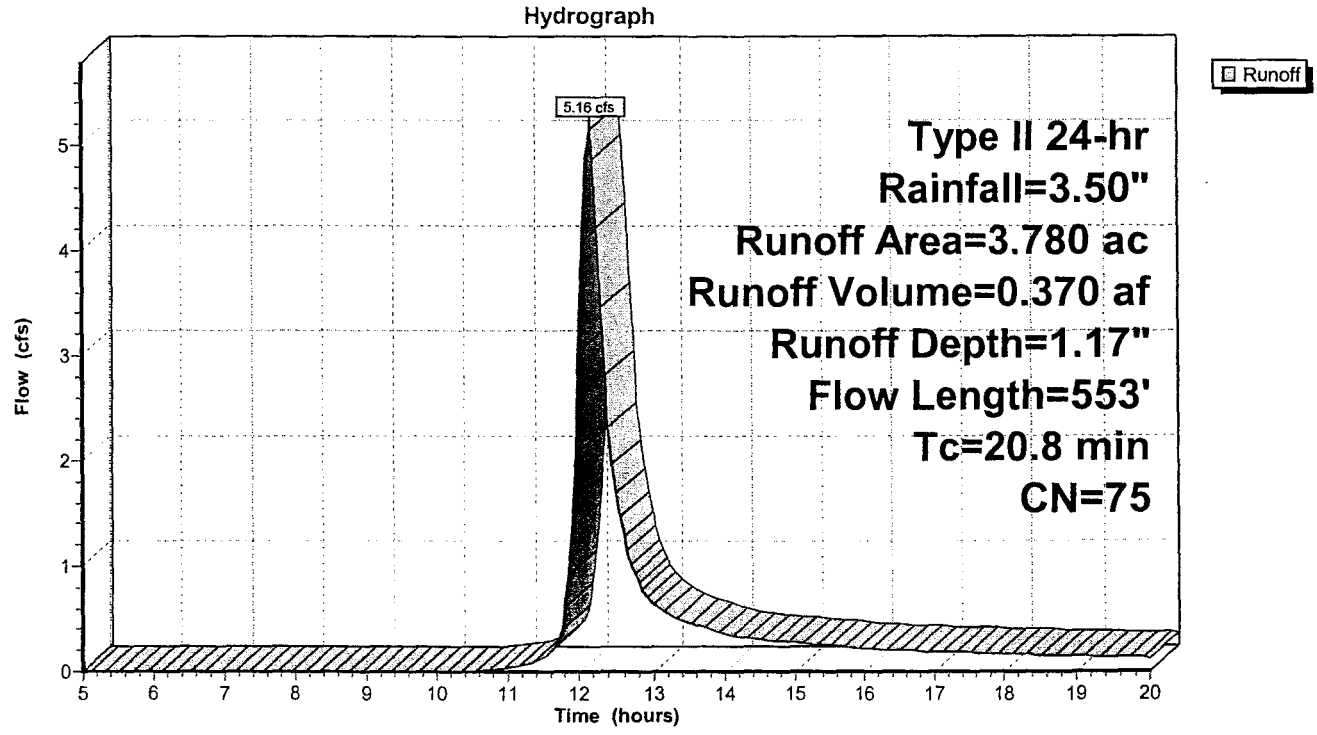
Runoff = 5.16 cfs @ 12.15 hrs, Volume= 0.370 af, Depth= 1.17"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=3.50"

| Area (ac) | CN | Description |
|---|---|---|
| 2.680 | 70 | Woods, Good, HSG C |
| 0.550 | 98 | Paved parking & roofs |
| 0.550 | 74 | >75% Grass cover, Good, HSG C |
| 3.780 | 75 | Weighted Average |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 13.8 | 75 | 0.0400 | 0.1 | | **Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.80" |
| 6.7 | 256 | 0.0162 | 0.6 | | **Shallow Concentrated Flow,** Woodland Kv= 5.0 fps |
| 0.3 | 222 | 0.0825 | 11.9 | 570.87 | **Channel Flow,** Area= 48.0 sf Perim= 25.3' r= 1.90' n= 0.055 |
| 20.8 | 553 | Total | | | |

## Subcatchment C-POST: CHANNEL C POST DEVELOPMENT



# CHANNEL C PRE DEVELOPMENT
## Worksheet for Irregular Channel

| Project Description | |
|---|---|
| Project File | c:\haestad\fmw\channel .fm2 |
| Worksheet | CHANNEL C |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Water Elevation |

| Input Data | | |
|---|---|---|
| Channel Slope | 0.030000 | ft/ft |

Elevation range: 53.50 ft to 62.10 ft.

| Station (ft) | Elevation (ft) | Start Station | End Station | Roughness |
|---|---|---|---|---|
| 0.00 | 60.20 | 0.00 | 42.00 | 0.055 |
| 18.00 | 56.20 | | | |
| 21.00 | 54.20 | | | |
| 24.00 | 53.60 | | | |
| 25.00 | 53.50 | | | |
| 32.00 | 57.30 | | | |
| 42.00 | 62.10 | | | |

| Discharge | 3.68 | cfs |
|---|---|---|

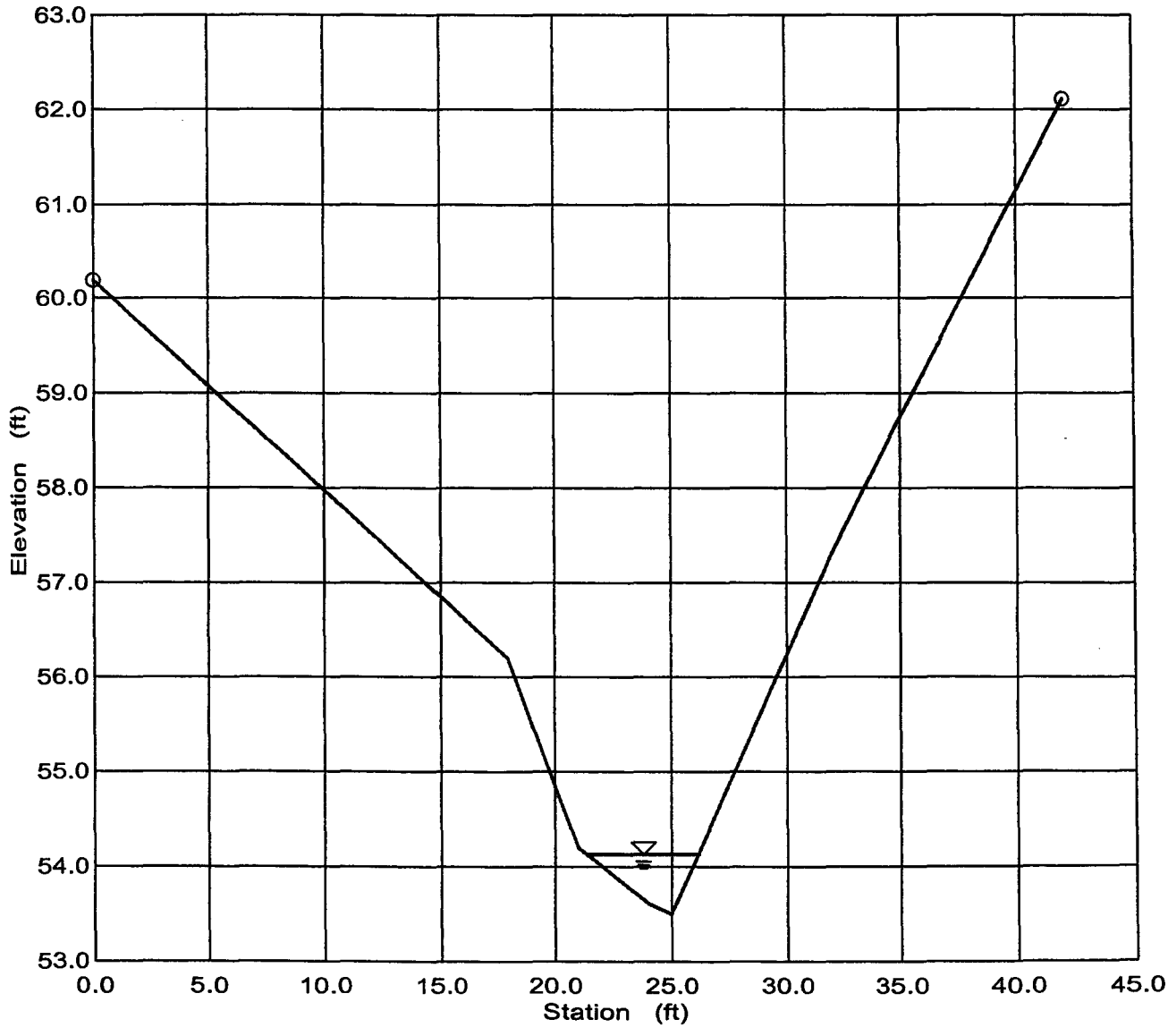
| Results | | |
|---|---|---|
| Wtd. Mannings Coefficient | 0.055 | |
| Water Surface Elevation | 54.13 | ft |
| Flow Area | 1.65 | $ft^2$ |
| Wetted Perimeter | 5.04 | ft |
| Top Width | 4.82 | ft |
| Height | 0.63 | ft |
| Critical Depth | 54.03 | ft |
| Critical Slope | 0.070445 | ft/ft |
| Velocity | 2.23 | ft/s |
| Velocity Head | 0.08 | ft |
| Specific Energy | 54.21 | ft |
| Froude Number | 0.67 | |

Flow is subcritical.

# CHANNEL C PRE DEVELOPMENT
## Cross Section for Irregular Channel

| Project Description | |
|---|---|
| Project File | c:\haestad\fmw\channel .fm2 |
| Worksheet | CHANNEL C |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Water Elevation |

| Section Data | | |
|---|---|---|
| Wtd. Mannings Coefficient | 0.055 | |
| Channel Slope | 0.030000 | ft/ft |
| Water Surface Elevation | 54.13 | ft |
| Discharge | 3.68 | cfs |



# CHANNEL C POST DEVELOPMENT
## Worksheet for Irregular Channel

| Project Description | |
|---|---|
| Project File | c:\haestad\fmw\channel .fm2 |
| Worksheet | CHANNEL C |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Water Elevation |

| Input Data | | |
|---|---|---|
| Channel Slope | 0.030000 | ft/ft |

Elevation range: 53.50 ft to 62.10 ft.

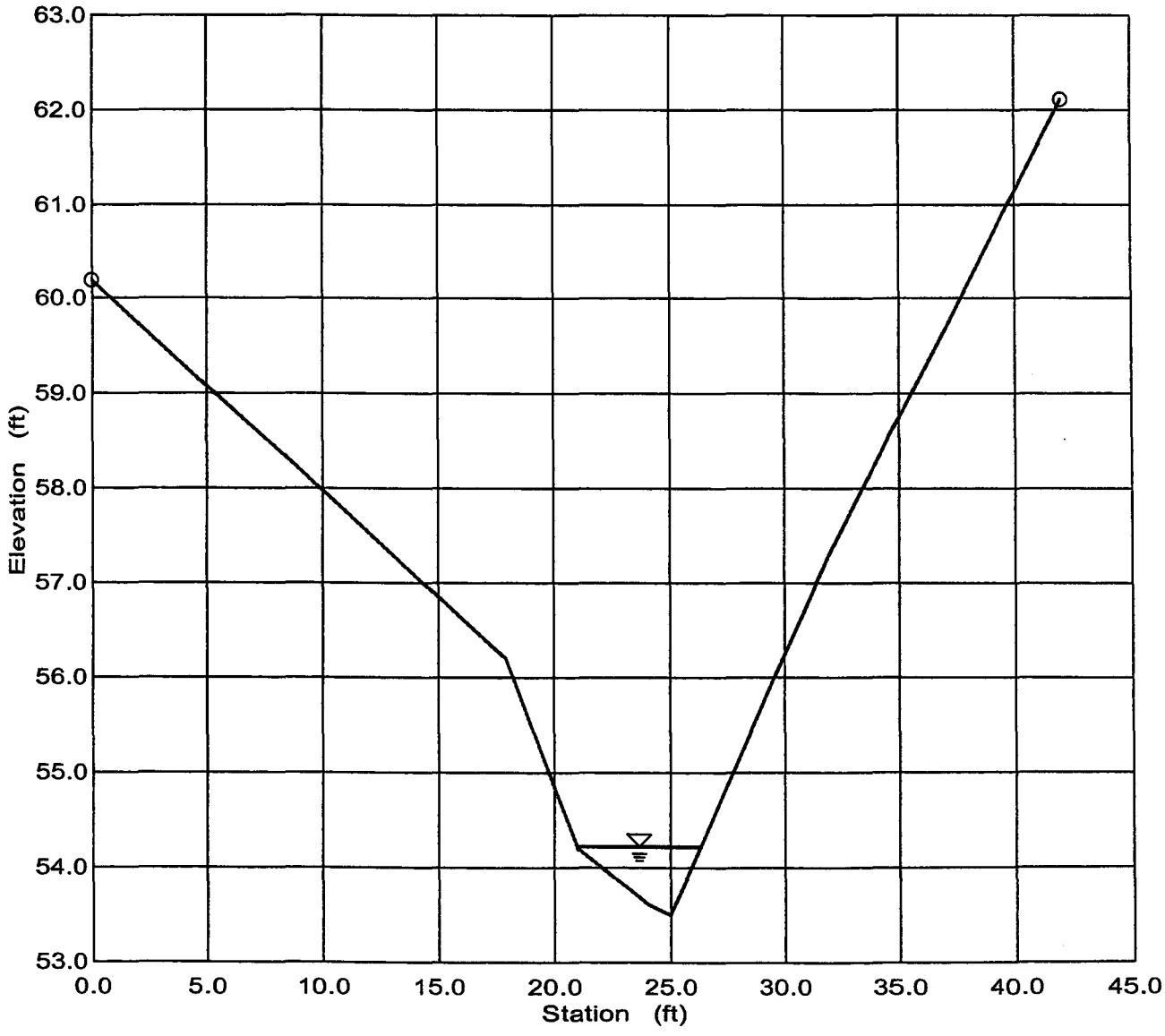
| Station (ft) | Elevation (ft) | Start Station | End Station | Roughness |
|---|---|---|---|---|
| 0.00 | 60.20 | 0.00 | 42.00 | 0.055 |
| 18.00 | 56.20 | | | |
| 21.00 | 54.20 | | | |
| 24.00 | 53.60 | | | |
| 25.00 | 53.50 | | | |
| 32.00 | 57.30 | | | |
| 42.00 | 62.10 | | | |
| Discharge | 5.16 | cfs | | |

| Results | | |
|---|---|---|
| Wtd. Mannings Coefficient | 0.055 | |
| Water Surface Elevation | 54.22 | ft |
| Flow Area | 2.11 | ft² |
| Wetted Perimeter | 5.61 | ft |
| Top Width | 5.36 | ft |
| Height | 0.72 | ft |
| Critical Depth | 54.11 | ft |
| Critical Slope | 0.067347 | ft/ft |
| Velocity | 2.44 | ft/s |
| Velocity Head | 0.09 | ft |
| Specific Energy | 54.31 | ft |
| Froude Number | 0.69 | |
| Flow is subcritical. | | |

# CHANNEL C POST DEVELOPMENT
## Cross Section for Irregular Channel

| Project Description | |
|---|---|
| Project File | c:\haestad\fmw\channel .fm2 |
| Worksheet | CHANNEL C |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Water Elevation |

| Section Data | | |
|---|---|---|
| Wtd. Mannings Coefficient | 0.055 | |
| Channel Slope | 0.030000 | ft/ft |
| Water Surface Elevation | 54.22 | ft |
| Discharge | 5.16 | cfs |



# BMP 1, 2, AND 3
# CHANNEL PROTECTION
# VOLUME CALCULATIONS

# CHANNEL PROTECTION STORAGE VOLUME COMPUTATION SHEET

**PROJECT** Stonehouse glen 1 BMP1
**JOB NO:** 2002261-504.02
**DATE:** 2/23/2005

## Pre Developed Condition

| Cover Description | Soil Name/type | CN | Area |
|---|---|---|---|
| woods(good) | C | 70 | 4.10 |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

| WEIGHTED CN | TOTAL AREA |
|---|---|
| 70 | 4.10 |

### Time of Concentration

| | |
|---|---|
| sheet | |
| shallow | |
| channel | |
| total | 0.35 |

## Post Developed Condition

| Cover Description | Soil Name/type | CN | Area |
|---|---|---|---|
| | | | |
| 1/3 ACRE LOTS | C | 81 | 11.05 |
| | | | |
| | | | |
| | | | |
| | | | |

| WEIGHTED CN | TOTAL AREA |
|---|---|
| 81 | 11.05 |

### Time of Concentration

| | |
|---|---|
| sheet | |
| shallow | |
| channel | |
| total | 0.33 |

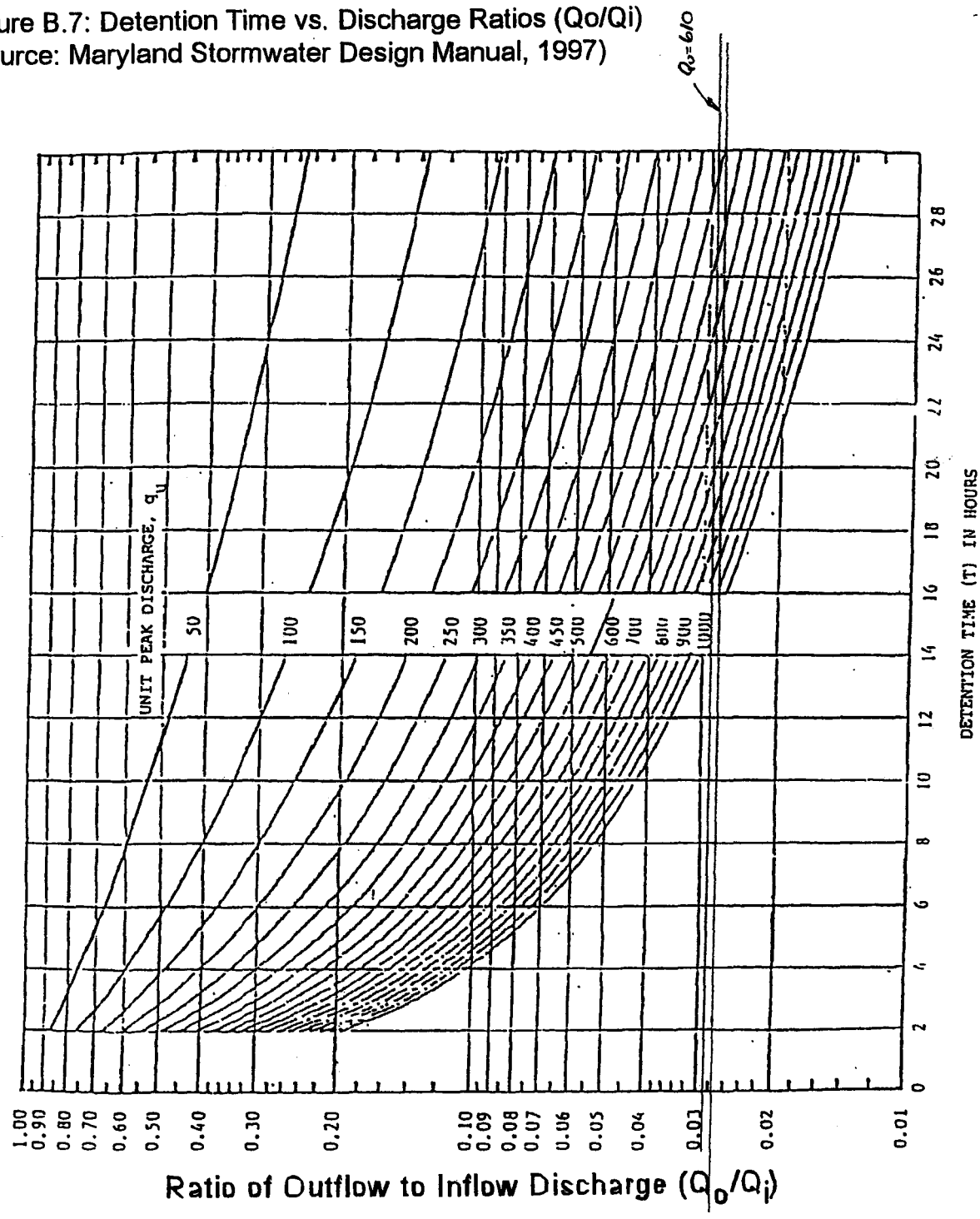
| condition | CN | Tc | Qa 1 yr storm | Q 1 year | Q 2 year | Q 10 year | Q 100 year |
|---|---|---|---|---|---|---|---|
| | | hrs | inches | cfs | cfs | cfs | cfs |
| pre-developed | 70 | 0.35 | 0.60 | 0.00 | 0.00 | 0.00 | 0.00 |
| post developed | 81 | 0.33 | 1.20 | 12.64 | 0.00 | 0.00 | 0.00 |

| Storm | P |
|---|---|
| 1 Year | 2.8 |
| 2 Year | 3.6 |
| 10 Year | 5.8 |
| 100 Year | 8 |

| Pre-dev. | | Post Dev | |
|---|---|---|---|
| Ia | 0.9 | Ia | 0.47 |
| Ia/P | qu | Ia/P | qu |
| | | 0.17 | 610 |
| | 0 | 0.00 | |
| | 0 | 0.00 | |
| | 0 | 0.00 | |

**Qo/Qi** 0.029
**Qo 1yr** 0.37 cfs
**Vs/Vr** 0.64
**Vs 1yr** 0.71 ac-ft 30945 cu ft

Figure B.7: Detention Time vs. Discharge Ratios (Qo/Qi)
(Source: Maryland Stormwater Design Manual, 1997)

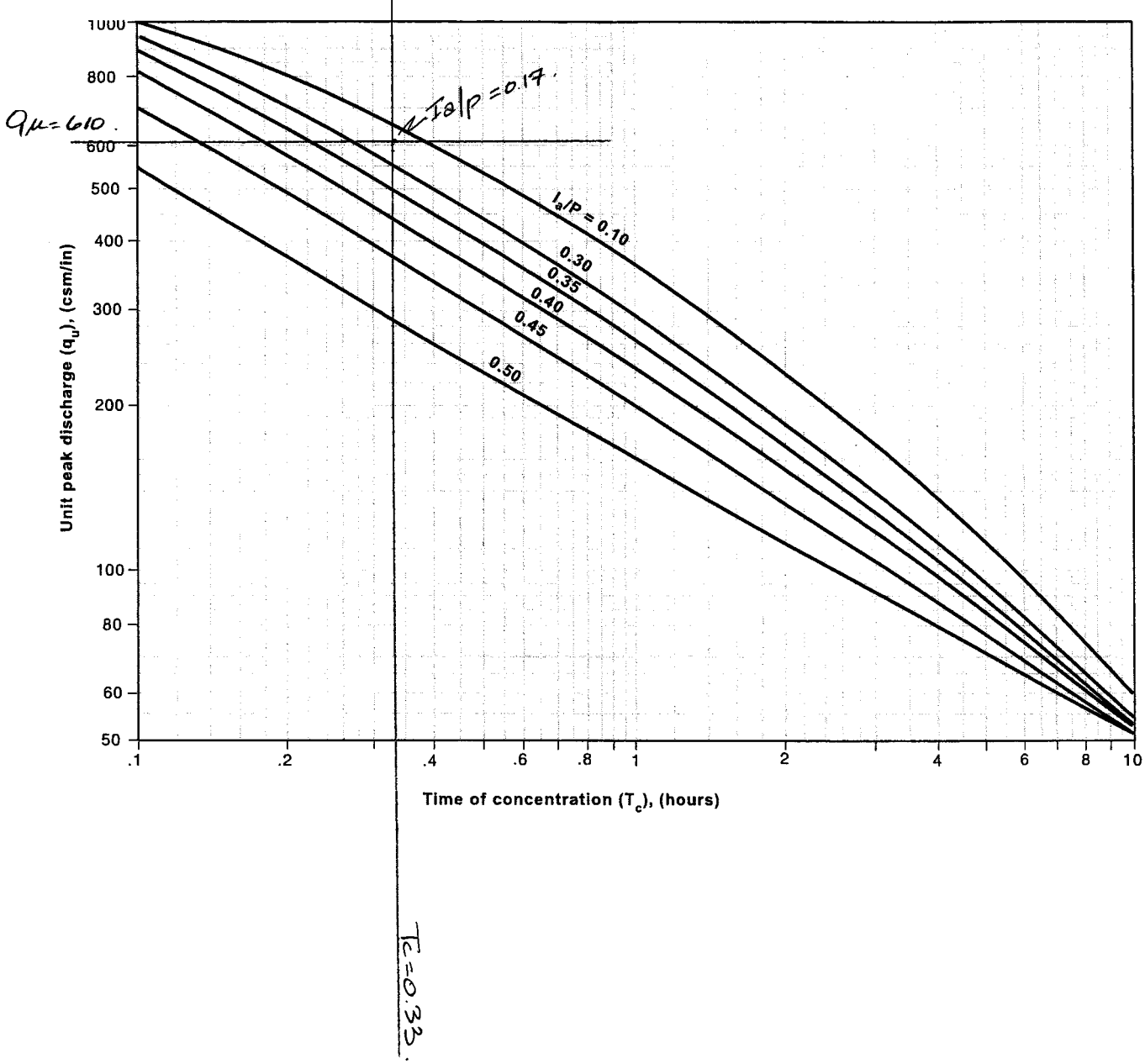



$Q_o/Q_i = 0.20$



BMP #1

**Exhibit 4-II** Unit peal discharge ($q_u$) for NRCS (SCS) type II rainfall distribution






BMP #1.

## Hydrograph for Pond BMP - 1: BMP #1

| Time (hours) | Inflow (cfs) | Storage (cubic-feet) | Elevation (feet) | Primary (cfs) |
|---|---|---|---|---|
| 0.00 | 0.00 | 0 | 72.00 | 0.00 |
| 1.00 | 0.00 | 0 | 72.00 | 0.00 |
| 2.00 | 0.00 | 0 | 72.00 | 0.00 |
| 3.00 | 0.00 | 0 | 72.00 | 0.00 |
| 4.00 | 0.00 | 0 | 72.00 | 0.00 |
| 5.00 | 0.00 | 0 | 72.00 | 0.00 |
| 6.00 | 0.00 | 0 | 72.00 | 0.00 |
| 7.00 | 0.00 | 0 | 72.00 | 0.00 |
| 8.00 | 0.00 | 0 | 72.00 | 0.00 |
| 9.00 | 0.00 | 0 | 72.00 | 0.00 |
| 10.00 | 0.00 | 0 | 72.00 | 0.00 |
| 11.00 | 0.03 | 13 | 72.01 | 0.00 |
| 12.00 | **5.56** | 2,413 | 73.53 | 0.49 |
| 13.00 | **1.16** | **13,852** | **76.96** | **0.92** |
| 14.00 | 0.66 | **13,632** | **76.91** | **0.92** |
| 15.00 | 0.51 | 12,413 | 76.66 | 0.89 |
| 16.00 | 0.40 | 10,899 | 76.36 | 0.86 |
| 17.00 | 0.35 | 9,195 | 76.01 | 0.82 |
| 18.00 | 0.31 | 7,521 | 75.46 | 0.76 |
| 19.00 | 0.27 | 5,939 | 74.93 | 0.70 |
| 20.00 | 0.23 | 4,449 | 74.43 | 0.63 |
| 21.00 | 0.21 | 3,085 | 73.96 | 0.56 |
| 22.00 | 0.21 | 2,035 | 73.29 | 0.45 |
| 23.00 | 0.20 | 1,346 | 72.85 | 0.35 |
| 24.00 | 0.19 | 939 | 72.60 | 0.27 |
| 25.00 | 0.00 | 394 | 72.25 | 0.12 |
| 26.00 | 0.00 | 171 | 72.11 | 0.03 |
| 27.00 | 0.00 | 95 | 72.06 | 0.02 |
| 28.00 | 0.00 | 53 | 72.03 | 0.01 |
| 29.00 | 0.00 | 29 | 72.02 | 0.00 |
| 30.00 | 0.00 | 16 | 72.01 | 0.00 |
| 31.00 | 0.00 | 9 | 72.01 | 0.00 |
| 32.00 | 0.00 | 5 | 72.00 | 0.00 |
| 33.00 | 0.00 | 3 | 72.00 | 0.00 |
| 34.00 | 0.00 | 2 | 72.00 | 0.00 |
| 35.00 | 0.00 | 1 | 72.00 | 0.00 |
| 36.00 | 0.00 | 0 | 72.00 | 0.00 |
| 37.00 | 0.00 | 0 | 72.00 | 0.00 |
| 38.00 | 0.00 | 0 | 72.00 | 0.00 |
| 39.00 | 0.00 | 0 | 72.00 | 0.00 |
| 40.00 | 0.00 | 0 | 72.00 | 0.00 |

24 Hrs.

17 Hrs.

## Stage-Discharge for Pond BMP - 1: BMP #1

| Elevation (feet) | Primary (cfs) | Elevation (feet) | Primary (cfs) | Elevation (feet) | Primary (cfs) | Elevation (feet) | Primary (cfs) |
|---|---|---|---|---|---|---|---|
| 72.00 | 0.00 | 75.12 | 0.72 | 78.24 | 1.04 | 81.36 | 32.65 |
| 72.06 | 0.01 | 75.18 | 0.73 | 78.30 | 1.04 | 81.42 | 36.66 |
| 72.12 | 0.03 | 75.24 | 0.74 | 78.36 | 1.05 | 81.48 | 40.82 |
| 72.18 | 0.07 | 75.30 | 0.74 | 78.42 | 1.05 | 81.54 | 45.14 |
| 72.24 | 0.11 | 75.36 | 0.75 | 78.48 | 1.06 | 81.60 | 49.60 |
| 72.30 | 0.15 | 75.42 | 0.76 | 78.54 | 1.06 | 81.66 | 54.20 |
| 72.36 | 0.18 | 75.48 | 0.76 | 78.60 | 1.07 | 81.72 | 58.94 |
| 72.42 | 0.21 | 75.54 | 0.77 | 78.66 | 1.07 | 81.78 | 63.82 |
| 72.48 | 0.24 | 75.60 | 0.78 | 78.72 | 1.08 | 81.84 | 68.82 |
| 72.54 | 0.26 | 75.66 | 0.79 | 78.78 | 1.08 | 81.90 | 73.95 |
| 72.60 | 0.28 | 75.72 | 0.79 | 78.84 | 1.09 | 81.96 | 79.20 |
| 72.66 | 0.30 | 75.78 | 0.80 | 78.90 | 1.09 | 82.02 | 84.58 |
| 72.72 | 0.31 | 75.84 | 0.81 | 78.96 | 1.10 | 82.08 | 85.19 |
| 72.78 | 0.33 | 75.90 | 0.81 | 79.02 | 1.10 | 82.14 | 85.38 |
| 72.84 | 0.34 | 75.96 | 0.82 | 79.08 | 1.10 | 82.20 | 85.58 |
| 72.90 | 0.36 | 76.02 | 0.82 | 79.14 | 1.11 | 82.26 | 85.77 |
| 72.96 | 0.37 | 76.08 | 0.83 | 79.20 | 1.11 | 82.32 | 85.97 |
| 73.02 | 0.39 | 76.14 | 0.84 | 79.26 | 1.12 | 82.38 | 86.16 |
| 73.08 | 0.40 | 76.20 | 0.84 | 79.32 | 1.12 | 82.44 | 86.36 |
| 73.14 | 0.41 | 76.26 | 0.85 | 79.38 | 1.13 | 82.50 | 86.55 |
| 73.20 | 0.43 | 76.32 | 0.86 | 79.44 | 1.13 | 82.56 | 86.75 |
| 73.26 | 0.44 | 76.38 | 0.86 | 79.50 | 1.14 | 82.62 | 86.94 |
| 73.32 | 0.45 | 76.44 | 0.87 | 79.56 | 1.14 | 82.68 | 87.13 |
| 73.38 | 0.46 | 76.50 | 0.87 | 79.62 | 1.15 | 82.74 | 87.32 |
| 73.44 | 0.47 | 76.56 | 0.88 | 79.68 | 1.15 | 82.80 | 87.52 |
| 73.50 | 0.49 | 76.62 | 0.89 | 79.74 | 1.16 | 82.86 | 87.71 |
| 73.56 | 0.50 | 76.68 | 0.89 | 79.80 | 1.16 | 82.92 | 87.90 |
| 73.62 | 0.51 | 76.74 | 0.90 | 79.86 | 1.17 | 82.98 | **88.09** |
| 73.68 | 0.52 | 76.80 | 0.90 | 79.92 | 1.17 | | |
| 73.74 | 0.53 | 76.86 | 0.91 | 79.98 | 1.17 | | |
| 73.80 | 0.54 | 76.92 | 0.92 | 80.04 | 1.18 | | |
| 73.86 | 0.55 | 76.98 | 0.92 | 80.10 | 1.18 | | |
| 73.92 | 0.56 | 77.04 | 0.93 | 80.16 | 1.19 | | |
| 73.98 | 0.57 | 77.10 | 0.93 | 80.22 | 1.19 | | |
| 74.04 | 0.58 | 77.16 | 0.94 | 80.28 | 1.20 | | |
| 74.10 | 0.58 | 77.22 | 0.94 | 80.34 | 1.20 | | |
| 74.16 | 0.59 | 77.28 | 0.95 | 80.40 | 1.21 | | |
| 74.22 | 0.60 | 77.34 | 0.96 | 80.46 | 1.21 | | |
| 74.28 | 0.61 | 77.40 | 0.96 | 80.52 | 1.21 | | |
| 74.34 | 0.62 | 77.46 | 0.97 | 80.58 | 1.22 | | |
| 74.40 | 0.63 | 77.52 | 0.97 | 80.64 | 1.22 | | |
| 74.46 | 0.64 | 77.58 | 0.98 | 80.70 | 1.98 | | |
| 74.52 | 0.64 | 77.64 | 0.98 | 80.76 | 3.37 | | |
| 74.58 | 0.65 | 77.70 | 0.99 | 80.82 | 5.16 | | |
| 74.64 | 0.66 | 77.76 | 0.99 | 80.88 | 7.28 | | |
| 74.70 | 0.67 | 77.82 | 1.00 | 80.94 | 9.68 | | |
| 74.76 | 0.68 | 77.88 | 1.00 | 81.00 | 12.34 | | |
| 74.82 | 0.68 | 77.94 | 1.01 | 81.06 | 15.23 | | |
| 74.88 | 0.69 | 78.00 | 1.01 | 81.12 | 18.34 | | |
| 74.94 | 0.70 | 78.06 | 1.02 | 81.18 | 21.64 | | |
| 75.00 | 0.71 | 78.12 | 1.03 | 81.24 | 25.14 | | |
| 75.06 | 0.71 | 78.18 | 1.03 | 81.30 | 28.81 | | |

## Stage-Discharge for Pond BMP-3: Basin 3

| Elevation (feet) | Primary (cfs) | Elevation (feet) | Primary (cfs) | Elevation (feet) | Primary (cfs) | Elevation (feet) | Primary (cfs) |
|---|---|---|---|---|---|---|---|
| 56.00 | 0.00 | 60.16 | 0.75 | 64.32 | 1.04 | 68.48 | 53.44 |
| 56.08 | 0.02 | 60.24 | 0.75 | 64.40 | 1.05 | 68.56 | 53.61 |
| 56.16 | 0.06 | 60.32 | 0.76 | 64.48 | 1.05 | 68.64 | 53.78 |
| 56.24 | 0.11 | 60.40 | 0.77 | 64.56 | 1.06 | 68.72 | 53.95 |
| 56.32 | 0.17 | 60.48 | 0.77 | 64.64 | 1.06 | 68.80 | 54.12 |
| 56.40 | 0.20 | 60.56 | 0.78 | 64.72 | 1.07 | 68.88 | 54.29 |
| 56.48 | 0.24 | 60.64 | 0.79 | 64.80 | 1.07 | 68.96 | 54.46 |
| 56.56 | 0.26 | 60.72 | 0.79 | 64.88 | 1.08 | 69.04 | 54.62 |
| 56.64 | 0.29 | 60.80 | 0.80 | 64.96 | 1.08 | 69.12 | 54.79 |
| 56.72 | 0.31 | 60.88 | 0.81 | 65.04 | 1.09 | 69.20 | 54.96 |
| 56.80 | 0.33 | 60.96 | 0.81 | 65.12 | 1.09 | 69.28 | 55.12 |
| 56.88 | 0.35 | 61.04 | 0.82 | 65.20 | 1.10 | 69.36 | 55.29 |
| 56.96 | 0.37 | 61.12 | 0.82 | 65.28 | 1.10 | 69.44 | 55.46 |
| 57.04 | 0.39 | 61.20 | 0.83 | 65.36 | 1.11 | 69.52 | 55.62 |
| 57.12 | 0.41 | 61.28 | 0.84 | 65.44 | 1.11 | 69.60 | 55.78 |
| 57.20 | 0.42 | 61.36 | 0.84 | 65.52 | 1.12 | 69.68 | 55.95 |
| 57.28 | 0.43 | 61.44 | 0.85 | 65.60 | 1.12 | 69.76 | 56.11 |
| 57.36 | 0.44 | 61.52 | 0.86 | 65.68 | 1.13 | 69.84 | 56.27 |
| 57.44 | 0.45 | 61.60 | 0.86 | 65.76 | 1.13 | 69.92 | 56.44 |
| 57.52 | 0.47 | 61.68 | 0.87 | 65.84 | 1.13 | 70.00 | 56.60 |
| 57.60 | 0.48 | 61.76 | 0.87 | 65.92 | 1.14 | 70.08 | 56.76 |
| 57.68 | 0.49 | 61.84 | 0.88 | 66.00 | 1.14 | 70.16 | 56.92 |
| 57.76 | 0.50 | 61.92 | 0.88 | 66.08 | 1.15 | 70.24 | 57.08 |
| 57.84 | 0.51 | 62.00 | 0.89 | 66.16 | 1.15 | 70.32 | 57.24 |
| 57.92 | 0.52 | 62.08 | 0.90 | 66.24 | 1.16 | 70.40 | 57.40 |
| 58.00 | 0.53 | 62.16 | 0.90 | 66.32 | 1.16 | 70.48 | 57.56 |
| 58.08 | 0.54 | 62.24 | 0.91 | 66.40 | 1.17 | 70.56 | 57.72 |
| 58.16 | 0.55 | 62.32 | 0.91 | 66.48 | 1.17 | 70.64 | 57.88 |
| 58.24 | 0.56 | 62.40 | 0.92 | 66.56 | 1.78 | 70.72 | 58.04 |
| 58.32 | 0.57 | 62.48 | 0.92 | 66.64 | 3.33 | 70.80 | 58.19 |
| 58.40 | 0.57 | 62.56 | 0.93 | 66.72 | 5.42 | 70.88 | 58.35 |
| 58.48 | 0.58 | 62.64 | 0.94 | 66.80 | 7.94 | 70.96 | 58.51 |
| 58.56 | 0.59 | 62.72 | 0.94 | 66.88 | 10.82 | 71.04 | 58.66 |
| 58.64 | 0.60 | 62.80 | 0.95 | 66.96 | 14.02 | 71.12 | 58.82 |
| 58.72 | 0.61 | 62.88 | 0.95 | 67.04 | 17.51 | 71.20 | 58.97 |
| 58.80 | 0.62 | 62.96 | 0.96 | 67.12 | 21.27 | 71.28 | 59.13 |
| 58.88 | 0.63 | 63.04 | 0.96 | 67.20 | 25.27 | 71.36 | 59.28 |
| 58.96 | 0.63 | 63.12 | 0.97 | 67.28 | 29.52 | 71.44 | 59.44 |
| 59.04 | 0.64 | 63.20 | 0.97 | 67.36 | 33.99 | 71.52 | 59.59 |
| 59.12 | 0.65 | 63.28 | 0.98 | 67.44 | 38.67 | 71.60 | 59.75 |
| 59.20 | 0.66 | 63.36 | 0.98 | 67.52 | 43.56 | 71.68 | 59.90 |
| 59.28 | 0.67 | 63.44 | 0.99 | 67.60 | 48.64 | 71.76 | 60.05 |
| 59.36 | 0.67 | 63.52 | 0.99 | 67.68 | 51.70 | 71.84 | 60.20 |
| 59.44 | 0.68 | 63.60 | 1.00 | 67.76 | 51.87 | 71.92 | 60.36 |
| 59.52 | 0.69 | 63.68 | 1.00 | 67.84 | 52.05 | 72.00 | **60.51** |
| 59.60 | 0.70 | 63.76 | 1.01 | 67.92 | 52.23 | | |
| 59.68 | 0.70 | 63.84 | 1.01 | 68.00 | 52.40 | | |
| 59.76 | 0.71 | 63.92 | 1.02 | 68.08 | 52.57 | | |
| 59.84 | 0.72 | 64.00 | 1.02 | 68.16 | 52.75 | | |
| 59.92 | 0.72 | 64.08 | 1.03 | 68.24 | 52.92 | | |
| 60.00 | 0.73 | 64.16 | 1.03 | 68.32 | 53.09 | | |
| 60.08 | 0.74 | 64.24 | 1.04 | 68.40 | 53.27 | | |

# CHANNEL PROTECTION STORAGE VOLUME COMPUTATION SHEET

**PROJECT** Stonehouse glen 1 BMP 2
**JOB NO:** 2002261-504.02
**DATE:** 9/30/2004

## Pre Developed Condition

| Cover Description | Soil Name/type | CN | Area |
|---|---|---|---|
| woods(good) | C | 70 | 2.00 |
| woods (good | B | 55 | 2.70 |
| | | | |
| | | | |
| | | | |
| | | | |
| | | WEIGHTED CN | TOTAL AREA |
| | | 61 | 4.70 |

### Time of Concentration

| | |
|---|---|
| sheet | 0.32 |
| shallow | 0.01 |
| channel | 0.01 |
| total | 0.33 |

## Post Developed Condition

| Cover Description | Soil Name/type | CN | Area |
|---|---|---|---|
| woods good | B | 55 | 1.90 |
| 1/3 ACRE LOTS | C | 81 | 4.20 |
| | | | |
| | | | |
| | | | |
| | | | |
| | | WEIGHTED CN | TOTAL AREA |
| | | 73 | 6.10 |

### Time of Concentration

| | |
|---|---|
| sheet | 0.23 |
| shallow | 0.01 |
| channel | 0.01 |
| total | 0.25 |

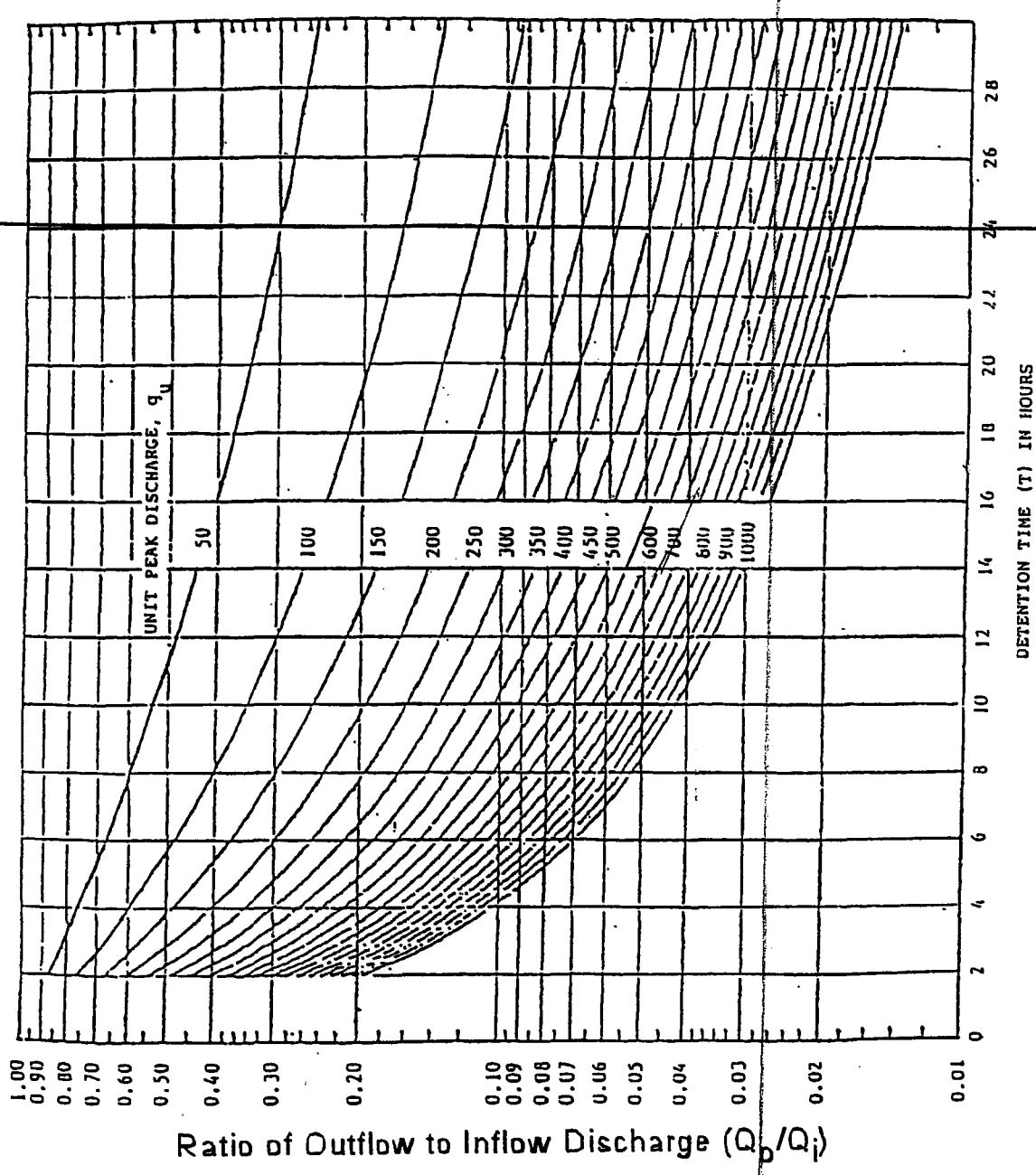
| condition | CN | Tc | Qa 1 yr storm | Q 1 year | Q 2 year | Q 10 year | Q 100 year |
|---|---|---|---|---|---|---|---|
| | | hrs | inches | cfs | cfs | cfs | cfs |
| pre-developed | 61 | 0.33 | 0.30 | 1.42 | 0.00 | 0.00 | 0.00 |
| post developed | 73 | 0.25 | 0.70 | 3.30 | 0.00 | 0.00 | 0.00 |

| Storm | P |
|---|---|
| 1 Year | 2.8 |
| 2 Year | 3.6 |
| 10 Year | 5.8 |
| 100 Year | 8 |

| Pre-dev. | | Post Dev | |
|---|---|---|---|
| Ia | 1.3 | Ia | 0.74 |
| Ia/P | qu | Ia/P | qu |
| 0.45 | 495 | 0.27 | 495 |
| 0.35 | 0 | 0.00 | |
| 0.22 | 0 | 0.00 | |
| 0.16 | 0 | 0.00 | |

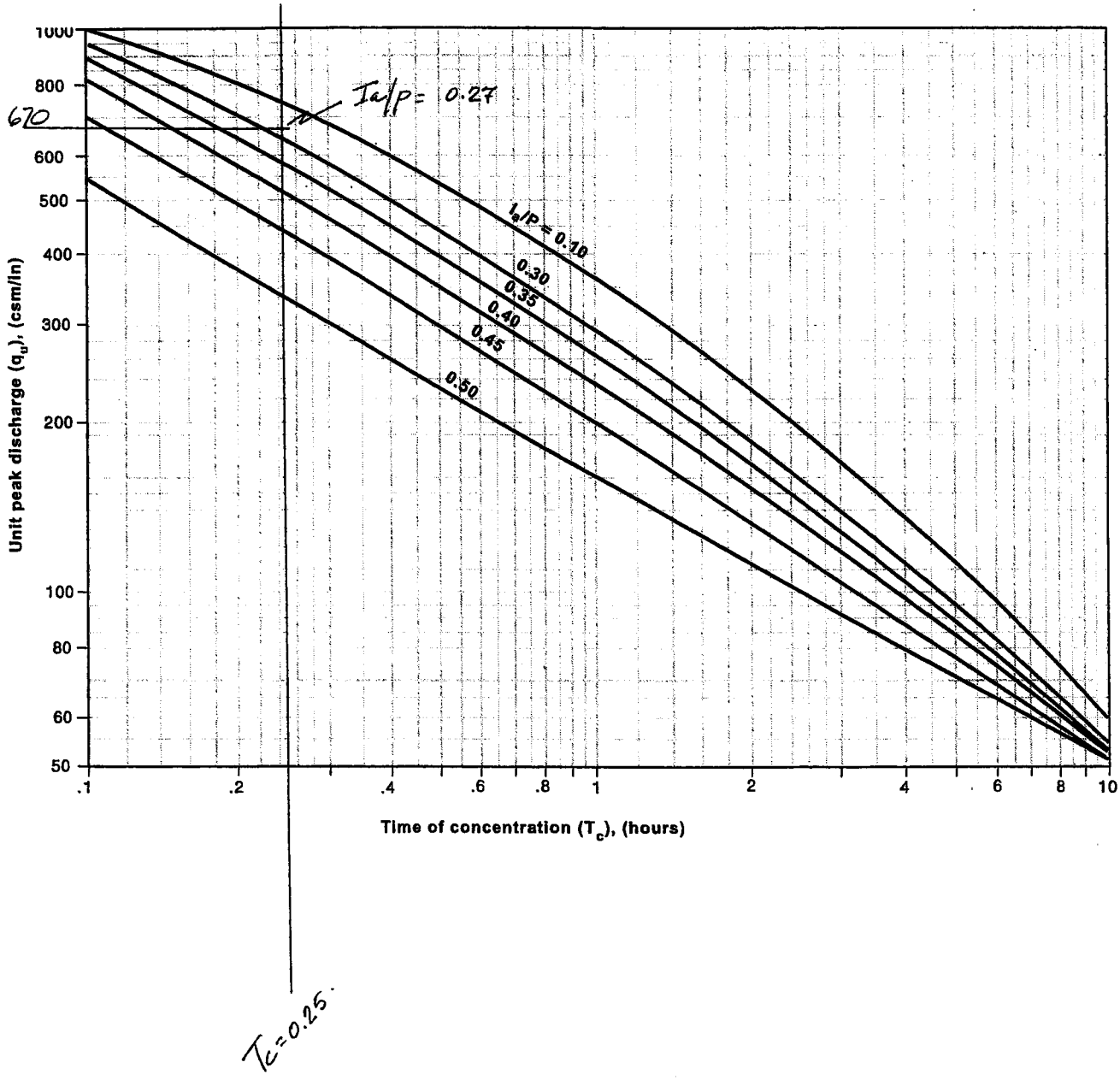
**Qo/Qi** 0.027
**Qo 1yr** 0.09 cfs
**Vs/Vr** 0.65
**Vs 1yr** 0.23 ac-ft

*Figure B.7: Detention Time vs. Discharge Ratios (Qo/Qi)*
*(Source: Maryland Stormwater Design Manual, 1997)*




0.027

**Exhibit 4-II** Unit peal discharge ($q_u$) for NRCS (SCS) type II rainfall distribution



## Hydrograph for Subcatchment Post Dev: 1/3 Acre Lots

| Time (hours) | Precip. (inches) | Excess (inches) | Runoff (cfs) |
|---|---|---|---|
| 5.00 | 0.18 | 0.00 | 0.00 |
| 5.25 | 0.19 | 0.00 | 0.00 |
| 5.50 | 0.20 | 0.00 | 0.00 |
| 5.75 | 0.21 | 0.00 | 0.00 |
| 6.00 | 0.22 | 0.00 | 0.00 |
| 6.25 | 0.24 | 0.00 | 0.00 |
| 6.50 | 0.25 | 0.00 | 0.00 |
| 6.75 | 0.26 | 0.00 | 0.00 |
| 7.00 | 0.28 | 0.00 | 0.00 |
| 7.25 | 0.29 | 0.00 | 0.00 |
| 7.50 | 0.31 | 0.00 | 0.00 |
| 7.75 | 0.32 | 0.00 | 0.00 |
| 8.00 | 0.34 | 0.00 | 0.00 |
| 8.25 | 0.35 | 0.00 | 0.00 |
| 8.50 | 0.37 | 0.00 | 0.00 |
| 8.75 | 0.39 | 0.00 | 0.00 |
| 9.00 | 0.41 | 0.00 | 0.00 |
| 9.25 | 0.43 | 0.00 | 0.00 |
| 9.50 | 0.46 | 0.00 | 0.00 |
| 9.75 | 0.48 | 0.00 | 0.00 |
| 10.00 | 0.51 | 0.00 | 0.00 |
| 10.25 | 0.54 | 0.00 | 0.00 |
| 10.50 | 0.57 | 0.00 | 0.00 |
| 10.75 | 0.61 | 0.00 | 0.00 |
| 11.00 | 0.66 | 0.00 | 0.00 |
| 11.25 | 0.72 | 0.00 | 0.00 |
| 11.50 | 0.79 | 0.00 | 0.00 |
| 11.75 | 1.08 | 0.03 | 0.16 |
| 12.00 | 1.86 | 0.26 | **2.88** |
| 12.25 | 1.98 | 0.31 | **3.34** |
| 12.50 | 2.06 | 0.35 | 1.37 |
| 12.75 | 2.11 | 0.37 | 0.81 |
| 13.00 | 2.16 | 0.39 | 0.62 |
| 13.25 | 2.20 | 0.41 | 0.52 |
| 13.50 | 2.24 | 0.43 | 0.46 |
| 13.75 | 2.27 | 0.45 | 0.41 |
| 14.00 | 2.30 | 0.46 | 0.37 |
| 14.25 | 2.32 | 0.47 | 0.33 |
| 14.50 | 2.35 | 0.49 | 0.31 |
| 14.75 | 2.37 | 0.50 | 0.30 |
| 15.00 | 2.39 | 0.51 | 0.28 |
| 15.25 | 2.41 | 0.52 | 0.27 |
| 15.50 | 2.43 | 0.53 | 0.26 |
| 15.75 | 2.45 | 0.54 | 0.24 |
| 16.00 | 2.46 | 0.55 | 0.23 |
| 16.25 | 2.48 | 0.56 | 0.21 |
| 16.50 | 2.50 | 0.57 | 0.21 |
| 16.75 | 2.51 | 0.57 | 0.20 |
| 17.00 | 2.52 | 0.58 | 0.20 |
| 17.25 | 2.54 | 0.59 | 0.19 |
| 17.50 | 2.55 | 0.60 | 0.19 |
| 17.75 | 2.57 | 0.60 | 0.18 |
| 18.00 | 2.58 | 0.61 | 0.18 |
| 18.25 | 2.59 | 0.62 | 0.17 |
| 18.50 | 2.60 | 0.62 | 0.17 |
| 18.75 | 2.61 | 0.63 | 0.16 |
| 19.00 | 2.63 | 0.64 | 0.16 |
| 19.25 | 2.64 | 0.64 | 0.15 |
| 19.50 | 2.65 | 0.65 | 0.14 |
| 19.75 | 2.66 | 0.65 | 0.14 |
| 20.00 | 2.67 | 0.66 | 0.13 |
| 20.25 | 2.67 | 0.66 | 0.13 |
| 20.50 | 2.68 | 0.67 | 0.13 |
| 20.75 | 2.69 | 0.67 | 0.13 |
| 21.00 | 2.70 | 0.68 | 0.12 |
| 21.25 | 2.71 | 0.68 | 0.12 |
| 21.50 | 2.72 | 0.69 | 0.12 |
| 21.75 | 2.73 | 0.69 | 0.12 |
| 22.00 | 2.74 | 0.70 | 0.12 |
| 22.25 | 2.74 | 0.70 | 0.12 |
| 22.50 | 2.75 | 0.71 | 0.12 |
| 22.75 | 2.76 | 0.71 | 0.12 |
| 23.00 | 2.77 | 0.72 | 0.12 |
| 23.25 | 2.78 | 0.72 | 0.12 |
| 23.50 | 2.78 | 0.73 | 0.11 |
| 23.75 | 2.79 | 0.73 | 0.11 |
| 24.00 | **2.80** | **0.74** | 0.11 |
| 24.25 | 2.80 | 0.74 | 0.06 |
| 24.50 | 2.80 | 0.74 | 0.01 |
| 24.75 | 2.80 | 0.74 | 0.00 |
| 25.00 | 2.80 | 0.74 | 0.00 |

# CHANNEL PROTECTION STORAGE VOLUME COMPUTATION SHEET

**PROJECT** Stonehouse glen 1 BMP3
**JOB NO:** 2002261-504.02
**DATE:** 2/23/2005

## Pre Developed Condition

| Cover Description | Soil Name/type | CN | Area |
|---|---|---|---|
| woods(good) | C | 70 | 2.10 |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

| WEIGHTED CN | TOTAL AREA |
|---|---|
| 70 | 2.10 |

### Time of Concentration

| | |
|---|---|
| sheet | |
| shallow | |
| channel | |
| total | 0.47 |

## Post Developed Condition

| Cover Description | Soil Name/type | CN | Area |
|---|---|---|---|
| | | | |
| 1/3 ACRE LOTS | C | 81 | 7.20 |
| | | | |
| | | | |
| | | | |
| | | | |

| WEIGHTED CN | TOTAL AREA |
|---|---|
| 81 | 7.20 |

### Time of Concentration

| | |
|---|---|
| sheet | |
| shallow | |
| channel | |
| total | 0.42 |

| condition | CN | Tc | Qa 1 yr storm | Q 1 year | Q 2 year | Q 10 year | Q 100 year |
|---|---|---|---|---|---|---|---|
| | | hrs | inches | cfs | cfs | cfs | cfs |
| pre-developed | 70 | 0.47 | 0.60 | 3.24 | 0.00 | 0.00 | 0.00 |
| post developed | 81 | 0.42 | 1.20 | 7.43 | 0.00 | 0.00 | 0.00 |

| Storm | P |
|---|---|
| 1 Year | 2.8 |
| 2 Year | 3.6 |
| 10 Year | 5.8 |
| 100 Year | 8 |

| Pre-dev. | | Post Dev | |
|---|---|---|---|
| Ia | 0.9 | Ia | 0.47 |
| Ia/P | qu | Ia/P | qu |
| 0.31 | 480 | 0.17 | 550 |
| 0.24 | 0 | 0.00 | |
| 0.15 | 0 | 0.00 | |
| 0.11 | 0 | 0.00 | |

**Qo/Qi** 0.031
**Qo 1yr** 0.23 cfs
**Vs/Vr** 0.64
**Vs 1yr** 0.46 ac-ft 20079 cu ft

Qi = 6.11
Qo = 0.47

Figure B.7: Detention Time vs. Discharge Ratios (Qo/Qi)
(Source: Maryland Stormwater Design Manual, 1997)

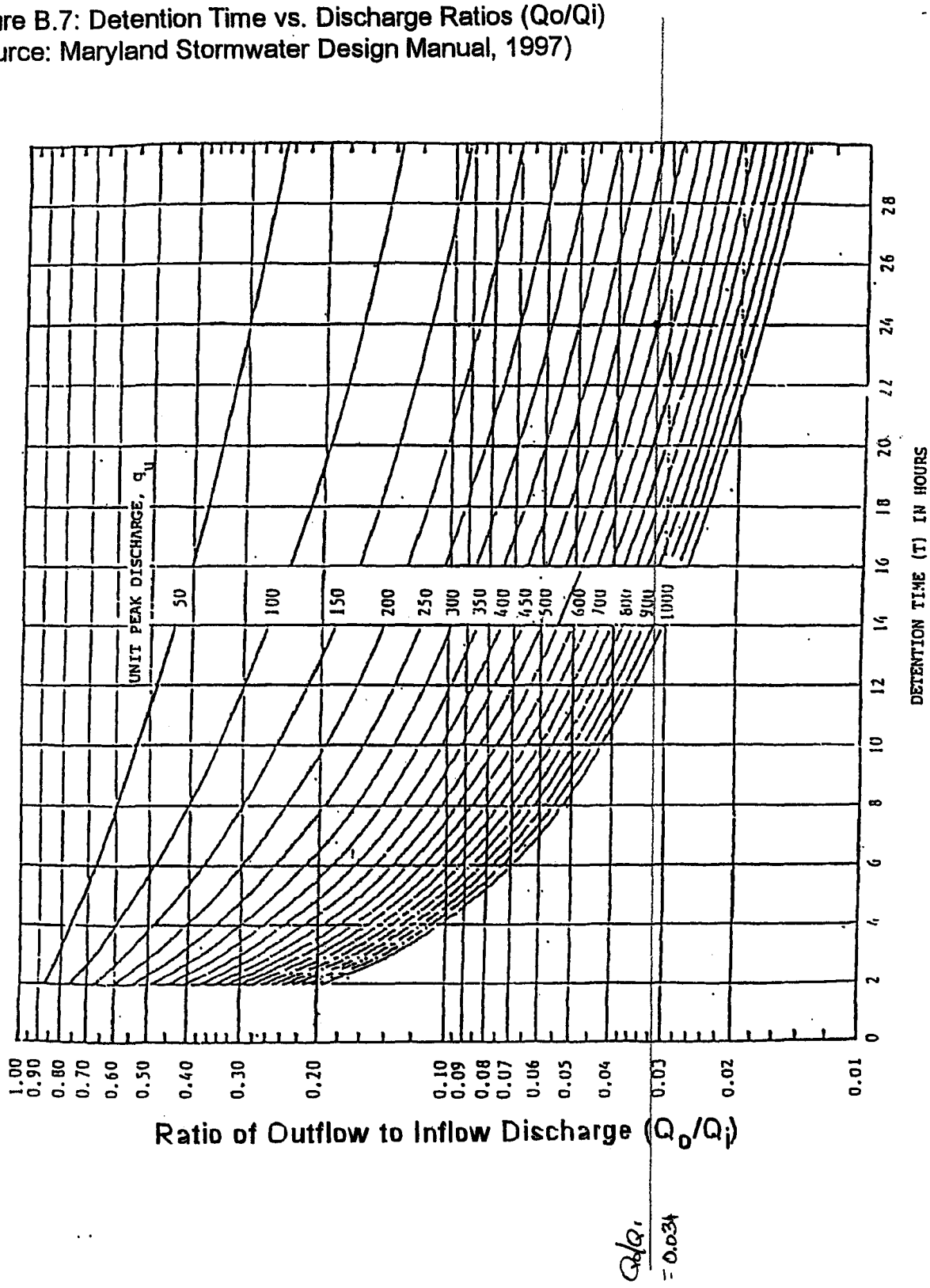
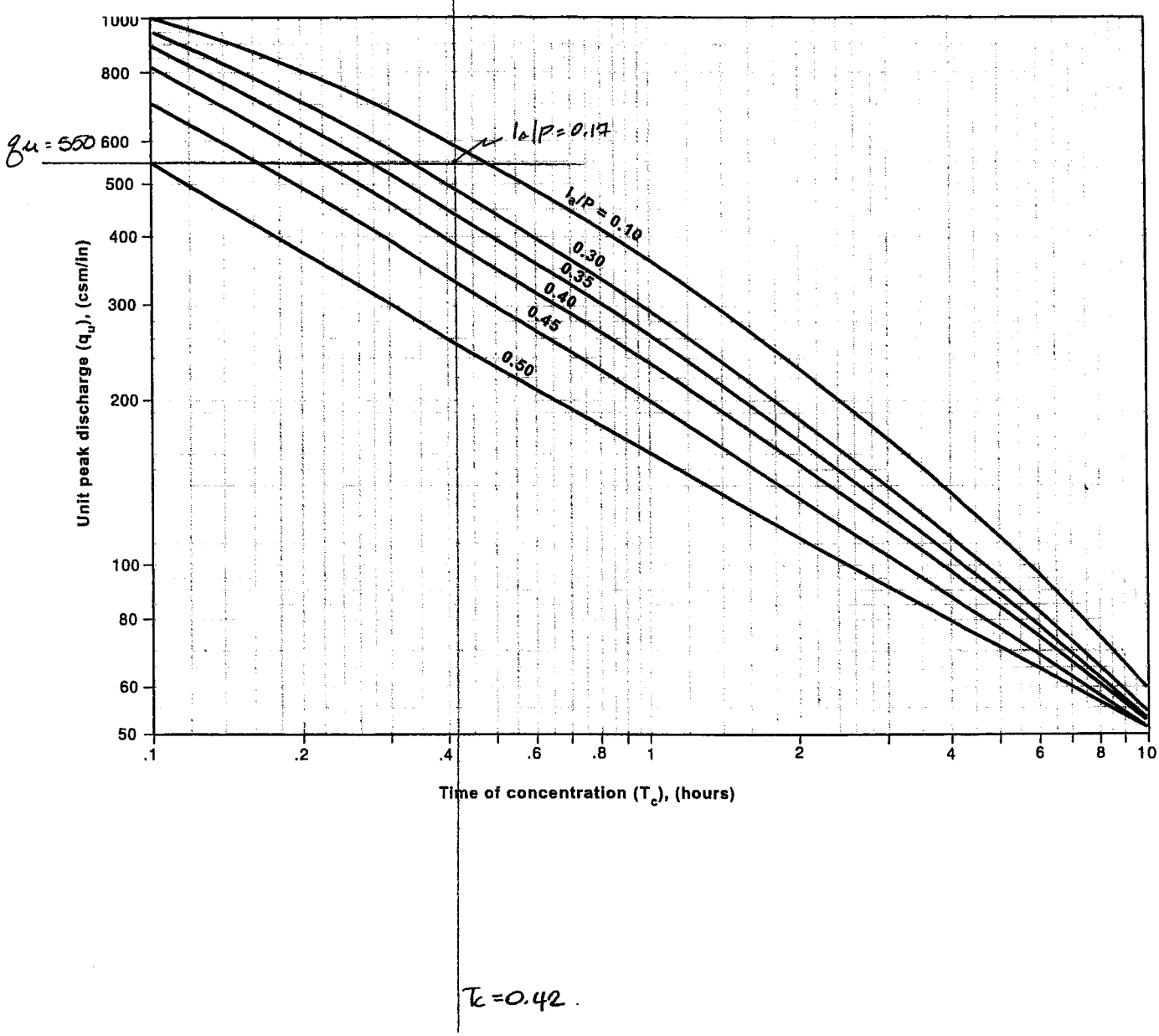


**Exhibit 4-II** Unit peal discharge ($q_u$) for NRCS (SCS) type II rainfall distribution






BMP #3

## Hydrograph for Pond BMP-3: Basin 3

| Time (hours) | Inflow (cfs) | Storage (cubic-feet) | Elevation (feet) | Primary (cfs) |
|---|---|---|---|---|
| 5.00 | 0.00 | 0 | 56.00 | 0.00 |
| 5.50 | 0.00 | 0 | 56.00 | 0.00 |
| 6.00 | 0.00 | 0 | 56.00 | 0.00 |
| 6.50 | 0.00 | 0 | 56.00 | 0.00 |
| 7.00 | 0.00 | 0 | 56.00 | 0.00 |
| 7.50 | 0.00 | 0 | 56.00 | 0.00 |
| 8.00 | 0.00 | 0 | 56.00 | 0.00 |
| 8.50 | 0.00 | 0 | 56.00 | 0.00 |
| 9.00 | 0.00 | 0 | 56.00 | 0.00 |
| 9.50 | 0.00 | 0 | 56.00 | 0.00 |
| 10.00 | 0.00 | 1 | 56.00 | 0.00 |
| 10.50 | 0.04 | 28 | 56.02 | 0.01 |
| 11.00 | 0.11 | 120 | 56.10 | 0.04 |
| 11.50 | 0.29 | 317 | 56.28 | 0.14 |
| 12.00 | **3.95** | 1,858 | 57.62 | 0.48 |
| 12.50 | **3.54** | 11,408 | 62.39 | 0.92 |
| 13.00 | 1.22 | **13,376** | **62.93** | **0.95** |
| 13.50 | 0.80 | **13,391** | **62.93** | **0.96** |
| 14.00 | 0.62 | 12,940 | 62.81 | 0.95 |
| 14.50 | 0.51 | 12,251 | 62.62 | 0.93 |
| 15.00 | 0.46 | 11,456 | 62.40 | 0.92 |
| 15.50 | 0.41 | 10,605 | 62.17 | 0.90 |
| 16.00 | 0.37 | 9,702 | 61.88 | 0.88 |
| 16.50 | 0.33 | 8,763 | 61.51 | 0.85 |
| 17.00 | 0.31 | 7,827 | 61.14 | 0.83 |
| 17.50 | 0.29 | 6,912 | 60.77 | 0.80 |
| 18.00 | 0.28 | 6,018 | 60.42 | 0.77 |
| 18.50 | 0.26 | 5,147 | 60.07 | 0.74 |
| 19.00 | 0.24 | 4,304 | 59.65 | 0.70 |
| 19.50 | 0.23 | 3,510 | 59.06 | 0.64 |
| 20.00 | 0.21 | 2,799 | 58.44 | 0.58 |
| 20.50 | 0.19 | 2,174 | 57.90 | 0.52 |
| 21.00 | 0.19 | 1,648 | 57.44 | 0.45 |
| 21.50 | 0.19 | 1,221 | 57.07 | 0.40 |
| 22.00 | 0.18 | 901 | 56.79 | 0.33 |
| 22.50 | 0.18 | 685 | 56.60 | 0.27 |
| 23.00 | 0.18 | 550 | 56.48 | 0.24 |
| 23.50 | 0.17 | 472 | 56.41 | 0.21 |
| 24.00 | 0.17 | 427 | 56.37 | 0.19 |
| 24.50 | 0.04 | 326 | 56.28 | 0.14 |
| 25.00 | 0.00 | 180 | 56.16 | 0.06 |
| 25.50 | 0.00 | 104 | 56.09 | 0.03 |
| 26.00 | 0.00 | 60 | 56.05 | 0.02 |
| 26.50 | 0.00 | 34 | 56.03 | 0.01 |
| 27.00 | 0.00 | 20 | 56.02 | 0.01 |
| 27.50 | 0.00 | 11 | 56.01 | 0.00 |
| 28.00 | 0.00 | 7 | 56.01 | 0.00 |
| 28.50 | 0.00 | 4 | 56.00 | 0.00 |
| 29.00 | 0.00 | 2 | 56.00 | 0.00 |
| 29.50 | 0.00 | 1 | 56.00 | 0.00 |
| 30.00 | 0.00 | 1 | 56.00 | 0.00 |

20 hrs.
note.
MIN. 4" ϕ ORIFICE
USED.

5

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LD-229
July 2000

STORM SEWER DESIGN
COMPUTATIONS

ROUTE: Sept 17, 2004 PROJ: STONEHOUSE GLEN SECT. I
COUNTY: DISTRICT: CURB & GUTTER
DESCRIPTION:

SHEET ____ OF ____

| FROM POINT (1) | TO POINT (2) | AREA DRAIN "A" ACRES (3) | RUN-OFF COEF. C (4) | CA INCREMENT (5) | CA ACCUMULATED (6) | INLET TIME MINUTES (7) | RAIN FALL IN./HR. (8) | RUN-OFF Q C.F.S. (9) | INVERT ELEVATIONS UPPER END (10) | INVERT ELEVATIONS LOWER END (11) | LENGTH FT. (12) | SLOPE FT./FT. (13) | DIA. IN. (14) | CAPA-CITY C.F.S. (15) | VEL. F.P.S. (16) | FLOW TIME MINUTES INCREMENT / ACCUMULATED (17) | REMARKS (18) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 0.74 | 0.65 | – | 0.48 | 14 | 5.3 | 2.54 | 101.88 | 101.58 | 40' | 0.0076 | 15" | 5.63 | 4.47 | 0.15 / – | |
| 2 | 3 | 0.31 | 0.85 | 0.26 | 0.74 | 14.1 | 5.3 | 3.92 | 101.48 | 101.07 | 70' | 0.0059 | 15" | 4.96 | 4.48 | 0.25 / 0.40 | |
| FUTURE SECT. II to 3A | | | | | 0.96 | 15.18 | 5.99 | | | | | | | | | | |
| 3A | 3 | 0.62 | 0.65 | 0.40 | 1.36 | 15.51 | 5.20 | 7.14 | 100.94 | 100.75 | 40' | 0.0048 | 18" | 7.28 | 4.09 | 0.14 / 1.65 | |
| 3 | 4 | 0.13 | 0.9 | 0.12 | 2.22 | 15.65 | 5.18 | 11.49 | 100.45 | 99.88 | 151' | 0.0038 | 24" | 13.94 | 4.96 | 0.51 / 2.16 | |
| 4 | 5 | 0.09 | 0.9 | 0.08 | 2.3 | 16.16 | 5.12 | 11.78 | 99.78 | 98.77 | 268' | 0.0038 | 24" | 13.94 | 4.98 | 0.89 / 3.05 | |
| 5 | 6 | 0.13 | 0.9 | 0.12 | 2.42 | 17.05 | 5.02 | 12.15 | 98.67 | 97.96 | 168' | 0.0042 | 24" | 14.66 | 5.22 | 0.54 / 3.58 | |
| | | | | | | | | | | | | | | | | | |
| 6A | 6 | 0.92 | 0.45 | – | 0.41 | 12 | 5.5 | 2.26 | 100.68 | 100.33 | 38' | 0.0092 | 15" | 6.20 | 4.66 | 0.13 / – | |
| 6 | 7 | 0.66 | 0.45 | 0.30 | 3.13 | 17.58 | 4.97 | 15.56 | 93.34 | 92.53 | 44' | 0.0184 | 24" | 30.68 | 9.80 | 0.07 / 3.65 | |
| 7 | 8 | 0.38 | 0.85 | 0.32 | 3.45 | 17.10 | 4.96 | 17.11 | 87.87 | 86.21 | 93' | 0.0178 | 24" | 30.18 | 9.90 | 0.14 / 3.79 | |
| | | | | | | | | | | | | | | | | | |
| 3B | 3A | From | Future | Sec | 0.96 | 15.18 | 5.2 | 4.99 | 101.20 | 104.87 | 128' | 0.0287 | 15" | 10.94 | 8.71 | | |

# Worksheet
## Worksheet for Curb Inlet In Sag

| Project Description | |
|---|---|
| Worksheet | Curb Inlet - 1 |
| Type | Curb Inlet In Sag |
| Solve For | Spread |

| Input Data | | |
|---|---|---|
| Discharge | 1.92 | cfs |
| Gutter Width | 1.67 | ft |
| Gutter Cross Slope | 0.083333 | ft/ft |
| Road Cross Slope | 0.020800 | ft/ft |
| Curb Opening Length | 8.00 | ft |
| Opening Height | 0.39 | ft |
| Curb Throat Type | Horizontal | |
| Local Depression | 2.0 | in |
| Local Depression Width | 2.00 | ft |

| Results | | |
|---|---|---|
| Spread | 8.32 | ft |
| Throat Incline Angle | 90.00 | degrees |
| Depth | 0.44 | ft |
| Gutter Depression | 1.3 | in |
| Total Depression | 3.3 | in |

# Worksheet
## Worksheet for Gutter Section

| Project Description | |
|---|---|
| Worksheet | Gutter Section - 1 - R |
| Type | Gutter Section |
| Solve For | Spread |

| Input Data | | |
|---|---|---|
| Slope | 0.004000 | ft/ft |
| Discharge | 0.65 | cfs |
| Gutter Width | 1.67 | ft |
| Gutter Cross Slope | 0.083333 | ft/ft |
| Road Cross Slope | 0.020800 | ft/ft |
| Mannings Coefficient | 0.015 | |

| Results | | |
|---|---|---|
| Spread | 5.80 | ft |
| Flow Area | 0.4 | $ft^2$ |
| Depth | 0.23 | ft |
| Gutter Depression | 1.3 | in |
| Velocity | 1.49 | ft/s |

# Worksheet
## Worksheet for Gutter Section

| Project Description | |
|---|---|
| Worksheet | Gutter Section - 1 - L |
| Type | Gutter Section |
| Solve For | Spread |

| Input Data | | |
|---|---|---|
| Slope | 0.004000 | ft/ft |
| Discharge | 1.27 | cfs |
| Gutter Width | 1.67 | ft |
| Gutter Cross Slope | 0.083333 | ft/ft |
| Road Cross Slope | 0.020800 | ft/ft |
| Mannings Coefficient | 0.015 | |

| Results | | |
|---|---|---|
| Spread | 8.07 | ft |
| Flow Area | 0.8 | $ft^2$ |
| Depth | 0.27 | ft |
| Gutter Depression | 1.3 | in |
| Velocity | 1.66 | ft/s |

# Worksheet
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | 1 to 2 |
| Flow Element | Circular Channel |
| Method | Manning's Formul |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Slope | 0.007600 | ft/ft |
| Diameter | 15 | in |
| Discharge | 2.54 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.59 | ft |
| Flow Area | 0.6 | ft² |
| Wetted Perimeter | 1.89 | ft |
| Top Width | 1.25 | ft |
| Critical Depth | 0.64 | ft |
| Percent Full | 47.1 | % |
| Critical Slope | 0.005750 | ft/ft |
| Velocity | 4.47 | ft/s |
| Velocity Head | 0.31 | ft |
| Specific Energy | 0.90 | ft |
| Froude Number | 1.17 | |
| Maximum Discharg | 6.06 | cfs |
| Discharge Full | 5.63 | cfs |
| Slope Full | 0.001546 | ft/ft |
| Flow Type | Supercritical | |

# Worksheet
## Worksheet for Curb Inlet In Sag

| Project Description | |
|---|---|
| Worksheet | Curb Inlet - 2 |
| Type | Curb Inlet In Sag |
| Solve For | Spread |

| Input Data | | |
|---|---|---|
| Discharge | 1.05 | cfs |
| Gutter Width | 2.00 | ft |
| Gutter Cross Slope | 0.083330 | ft/ft |
| Road Cross Slope | 0.020800 | ft/ft |
| Curb Opening Length | 6.00 | ft |
| Opening Height | 0.39 | ft |
| Curb Throat Type | Horizontal | |
| Local Depression | 2.0 | in |
| Local Depression Width | 2.00 | ft |

| Results | | |
|---|---|---|
| Spread | 6.31 | ft |
| Throat Incline Angle | 90.00 | degrees |
| Depth | 0.42 | ft |
| Gutter Depression | 1.5 | in |
| Total Depression | 3.5 | in |

# Worksheet
## Worksheet for Gutter Section

| Project Description | |
|---|---|
| Worksheet | Gutter Section - 2 - R |
| Type | Gutter Section |
| Solve For | Spread |

| Input Data | | |
|---|---|---|
| Slope | 0.004000 | ft/ft |
| Discharge | 0.10 | cfs |
| Gutter Width | 1.67 | ft |
| Gutter Cross Slope | 0.083330 | ft/ft |
| Road Cross Slope | 0.020800 | ft/ft |
| Mannings Coefficient | 0.015 | |

| Results | | |
|---|---|---|
| Spread | 1.46 | ft |
| Flow Area | 0.1 | $ft^2$ |
| Depth | 0.12 | ft |
| Gutter Depression | 1.3 | in |
| Velocity | 1.15 | ft/s |

Notes: Sta 14+00 Rt. Ottoway Court

# Worksheet
## Worksheet for Gutter Section

| Project Description | |
|---|---|
| Worksheet | Gutter Section - 2 - L |
| Type | Gutter Section |
| Solve For | Spread |

| Input Data | | |
|---|---|---|
| Slope | 0.004000 | ft/ft |
| Discharge | 0.95 | cfs |
| Gutter Width | 1.67 | ft |
| Gutter Cross Slope | 0.083330 | ft/ft |
| Road Cross Slope | 0.020800 | ft/ft |
| Mannings Coefficient | 0.015 | |

| Results | | |
|---|---|---|
| Spread | 7.04 | ft |
| Flow Area | 0.6 | $ft^2$ |
| Depth | 0.25 | ft |
| Gutter Depression | 1.3 | in |
| Velocity | 1.58 | ft/s |

Notes: Sta 14+00 Rt. Ottoway Court

# Worksheet
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | 2 to 3 |
| Flow Element | Circular Channel |
| Method | Manning's Formul |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Slope | 0.005900 | ft/ft |
| Diameter | 15 | in |
| Discharge | 3.92 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.84 | ft |
| Flow Area | 0.9 | ft² |
| Wetted Perimeter | 2.40 | ft |
| Top Width | 1.18 | ft |
| Critical Depth | 0.80 | ft |
| Percent Full | 67.0 | % |
| Critical Slope | 0.006705 | ft/ft |
| Velocity | 4.48 | ft/s |
| Velocity Head | 0.31 | ft |
| Specific Energy | 1.15 | ft |
| Froude Number | 0.92 | |
| Maximum Discharg | 5.34 | cfs |
| Discharge Full | 4.96 | cfs |
| Slope Full | 0.003683 | ft/ft |
| Flow Type | Subcritical | |

# Worksheet
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | 3 - B to 3 - A |
| Flow Element | Circular Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Slope | 0.028700 | ft/ft |
| Diameter | 15 | in |
| Discharge | 4.99 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.59 | ft |
| Flow Area | 0.6 | ft² |
| Wetted Perimeter | 1.90 | ft |
| Top Width | 1.25 | ft |
| Critical Depth | 0.91 | ft |
| Percent Full | 47.4 | % |
| Critical Slope | 0.007797 | ft/ft |
| Velocity | 8.71 | ft/s |
| Velocity Head | 1.18 | ft |
| Specific Energy | 1.77 | ft |
| Froude Number | 2.27 | |
| Maximum Discharg | 11.77 | cfs |
| Discharge Full | 10.94 | cfs |
| Slope Full | 0.005968 | ft/ft |
| Flow Type | Supercritical | |

# Worksheet
## Worksheet for Curb Inlet In Sag

| Project Description | |
|---|---|
| Worksheet | Curb Inlet - 3A |
| Type | Curb Inlet In Sag |
| Solve For | Spread |

| Input Data | | |
|---|---|---|
| Discharge | 1.61 | cfs |
| Gutter Width | 1.67 | ft |
| Gutter Cross Slope | 0.083333 | ft/ft |
| Road Cross Slope | 0.020800 | ft/ft |
| Curb Opening Length | 8.00 | ft |
| Opening Height | 0.39 | ft |
| Curb Throat Type | Horizontal | |
| Local Depression | 2.0 | in |
| Local Depression Width | 2.00 | ft |

| Results | | |
|---|---|---|
| Spread | 7.40 | ft |
| Throat Incline Angle | 90.00 | degrees |
| Depth | 0.42 | ft |
| Gutter Depression | 1.3 | in |
| Total Depression | 3.3 | in |

# Worksheet
## Worksheet for Gutter Section

| Project Description | |
|---|---|
| Worksheet | Gutter Section - 3A - R |
| Type | Gutter Section |
| Solve For | Spread |

| Input Data | | |
|---|---|---|
| Slope | 0.004000 | ft/ft |
| Discharge | 0.23 | cfs |
| Gutter Width | 1.67 | ft |
| Gutter Cross Slope | 0.083333 | ft/ft |
| Road Cross Slope | 0.020800 | ft/ft |
| Mannings Coefficient | 0.015 | |

| Results | | |
|---|---|---|
| Spread | 2.89 | ft |
| Flow Area | 0.2 | $ft^2$ |
| Depth | 0.16 | ft |
| Gutter Depression | 1.3 | in |
| Velocity | 1.34 | ft/s |

# Worksheet
## Worksheet for Gutter Section

| Project Description | |
|---|---|
| Worksheet | Gutter Section - 3A - L |
| Type | Gutter Section |
| Solve For | Spread |

| Input Data | | |
|---|---|---|
| Slope | 0.004000 | ft/ft |
| Discharge | 1.38 | cfs |
| Gutter Width | 1.67 | ft |
| Gutter Cross Slope | 0.083333 | ft/ft |
| Road Cross Slope | 0.020800 | ft/ft |
| Mannings Coefficient | 0.015 | |

| Results | | |
|---|---|---|
| Spread | 8.38 | ft |
| Flow Area | 0.8 | $ft^2$ |
| Depth | 0.28 | ft |
| Gutter Depression | 1.3 | in |
| Velocity | 1.69 | ft/s |

# Worksheet
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | 3A to 3 |
| Flow Element | Circular Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Slope | 0.004800 | ft/ft |
| Diameter | 18 | in |
| Discharge | 7.14 | cfs |

| Results | | |
|---|---|---|
| Depth | 1.20 | ft |
| Flow Area | 1.5 | ft² |
| Wetted Perimeter | 3.33 | ft |
| Top Width | 1.19 | ft |
| Critical Depth | 1.03 | ft |
| Percent Full | 80.3 | % |
| Critical Slope | 0.006848 | ft/ft |
| Velocity | 4.69 | ft/s |
| Velocity Head | 0.34 | ft |
| Specific Energy | 1.55 | ft |
| Froude Number | 0.73 | |
| Maximum Discharg | 7.83 | cfs |
| Discharge Full | 7.28 | cfs |
| Slope Full | 0.004621 | ft/ft |
| Flow Type | Subcritical | |

# Worksheet
## Worksheet for Curb Inlet In Sag

| Project Description | |
|---|---|
| Worksheet | Curb Inlet - 3 |
| Type | Curb Inlet In Sag |
| Solve For | Spread |

| Input Data | | |
|---|---|---|
| Discharge | 0.57 | cfs |
| Gutter Width | 1.67 | ft |
| Gutter Cross Slope | 0.083333 | ft/ft |
| Road Cross Slope | 0.020800 | ft/ft |
| Curb Opening Length | 2.50 | ft |
| Opening Height | 0.39 | ft |
| Curb Throat Type | Horizontal | |
| Local Depression | 2.0 | in |
| Local Depression Width | 2.00 | ft |

| Results | | |
|---|---|---|
| Spread | 5.68 | ft |
| Throat Incline Angle | 90.00 | degrees |
| Depth | 0.39 | ft |
| Gutter Depression | 1.3 | in |
| Total Depression | 3.3 | in |

# Worksheet
## Worksheet for Gutter Section

| Project Description | |
|---|---|
| Worksheet | Gutter Section - 3 - R |
| Type | Gutter Section |
| Solve For | Spread |

| Input Data | | |
|---|---|---|
| Slope | 0.004000 | ft/ft |
| Discharge | 0.42 | cfs |
| Gutter Width | 1.67 | ft |
| Gutter Cross Slope | 0.083333 | ft/ft |
| Road Cross Slope | 0.020800 | ft/ft |
| Mannings Coefficient | 0.015 | |

| Results | | |
|---|---|---|
| Spread | 4.50 | ft |
| Flow Area | 0.3 | $ft^2$ |
| Depth | 0.20 | ft |
| Gutter Depression | 1.3 | in |
| Velocity | 1.41 | ft/s |

# Worksheet
## Worksheet for Gutter Section

| Project Description | |
|---|---|
| Worksheet | Gutter Section - 3 - L |
| Type | Gutter Section |
| Solve For | Spread |

| Input Data | | |
|---|---|---|
| Slope | 0.004000 | ft/ft |
| Discharge | 0.14 | cfs |
| Gutter Width | 1.67 | ft |
| Gutter Cross Slope | 0.083333 | ft/ft |
| Road Cross Slope | 0.020800 | ft/ft |
| Mannings Coefficient | 0.015 | |

| Results | | |
|---|---|---|
| Spread | 1.64 | ft |
| Flow Area | 0.1 | $ft^2$ |
| Depth | 0.14 | ft |
| Gutter Depression | 1.3 | in |
| Velocity | 1.25 | ft/s |

# Worksheet
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | 3 to 4 |
| Flow Element | Circular Channel |
| Method | Manning's Formul: |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Slope | 0.003800 | ft/ft |
| Diameter | 24 | in |
| Discharge | 11.49 | cfs |

| Results | | |
|---|---|---|
| Depth | 1.38 | ft |
| Flow Area | 2.3 | ft² |
| Wetted Perimeter | 3.93 | ft |
| Top Width | 1.85 | ft |
| Critical Depth | 1.22 | ft |
| Percent Full | 69.2 | % |
| Critical Slope | 0.005480 | ft/ft |
| Velocity | 4.96 | ft/s |
| Velocity Head | 0.38 | ft |
| Specific Energy | 1.77 | ft |
| Froude Number | 0.78 | |
| Maximum Discharg | 15.00 | cfs |
| Discharge Full | 13.94 | cfs |
| Slope Full | 0.002580 | ft/ft |
| Flow Type | Subcritical | |

# Worksheet
## Worksheet for Curb Inlet On Grade

| Project Description | |
|---|---|
| Worksheet | Curb Inlet - 4 |
| Type | Curb Inlet On Grade |
| Solve For | Efficiency |

| Input Data | | |
|---|---|---|
| Discharge | 0.32 | cfs |
| Slope | 0.036600 | ft/ft |
| Gutter Width | 1.67 | ft |
| Gutter Cross Slope | 0.083333 | ft/ft |
| Road Cross Slope | 0.020800 | ft/ft |
| Mannings Coefficient | 0.015 | |
| Curb Opening Length | 2.50 | ft |
| Local Depression | 2.0 | in |
| Local Depression Width | 2.00 | ft |

| Results | | |
|---|---|---|
| Efficiency | 0.69 | |
| Intercepted Flow | 0.22 | cfs |
| Bypass Flow | 0.10 | cfs |
| Spread | 1.49 | ft |
| Depth | 0.12 | ft |
| Flow Area | 0.1 | $ft^2$ |
| Gutter Depression | 1.3 | in |
| Total Depression | 3.3 | in |
| Velocity | 3.52 | ft/s |
| Equivalent Cross Slope | 0.156348 | ft/ft |
| Length Factor | 0.48 | |
| Total Interception Length | 5.24 | ft |

# Worksheet
## Worksheet for Gutter Section

| Project Description | |
|---|---|
| Worksheet | Gutter Section - 4 |
| Type | Gutter Section |
| Solve For | Spread |

| Input Data | | |
|---|---|---|
| Slope | 0.036600 | ft/ft |
| Discharge | 0.32 | cfs |
| Gutter Width | 1.67 | ft |
| Gutter Cross Slope | 0.083333 | ft/ft |
| Road Cross Slope | 0.020800 | ft/ft |
| Mannings Coefficient | 0.015 | |

| Results | | |
|---|---|---|
| Spread | 1.48 | ft |
| Flow Area | 0.1 | $ft^2$ |
| Depth | 0.12 | ft |
| Gutter Depression | 1.3 | in |
| Velocity | 3.51 | ft/s |

# Worksheet
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | 4 to 5 |
| Flow Element | Circular Channel |
| Method | Manning's Formul |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Slope | 0.003800 | ft/ft |
| Diameter | 24 | in |
| Discharge | 11.78 | cfs |

| Results | | |
|---|---|---|
| Depth | 1.41 | ft |
| Flow Area | 2.4 | ft² |
| Wetted Perimeter | 3.99 | ft |
| Top Width | 1.82 | ft |
| Critical Depth | 1.23 | ft |
| Percent Full | 70.5 | % |
| Critical Slope | 0.005539 | ft/ft |
| Velocity | 4.98 | ft/s |
| Velocity Head | 0.39 | ft |
| Specific Energy | 1.79 | ft |
| Froude Number | 0.77 | |
| Maximum Discharg | 15.00 | cfs |
| Discharge Full | 13.94 | cfs |
| Slope Full | 0.002712 | ft/ft |
| Flow Type | Subcritical | |

# Worksheet
## Worksheet for Curb Inlet On Grade

| Project Description | |
|---|---|
| Worksheet | Curb Inlet - 5 |
| Type | Curb Inlet On Grade |
| Solve For | Efficiency |

| Input Data | | |
|---|---|---|
| Discharge | 0.48 | cfs |
| Slope | 0.036000 | ft/ft |
| Gutter Width | 1.67 | ft |
| Gutter Cross Slope | 0.083333 | ft/ft |
| Road Cross Slope | 0.020800 | ft/ft |
| Mannings Coefficient | 0.015 | |
| Curb Opening Length | 4.00 | ft |
| Local Depression | 2.0 | in |
| Local Depression Width | 2.00 | ft |

| Results | | |
|---|---|---|
| Efficiency | 0.85 | |
| Intercepted Flow | 0.41 | cfs |
| Bypass Flow | 0.07 | cfs |
| Spread | 1.90 | ft |
| Depth | 0.14 | ft |
| Flow Area | 0.1 | $ft^2$ |
| Gutter Depression | 1.3 | in |
| Total Depression | 3.3 | in |
| Velocity | 3.85 | ft/s |
| Equivalent Cross Slope | 0.156289 | ft/ft |
| Length Factor | 0.65 | |
| Total Interception Length | 6.15 | ft |

# Worksheet
## Worksheet for Gutter Section

| Project Description | |
|---|---|
| Worksheet | Gutter Section - 5 |
| Type | Gutter Section |
| Solve For | Spread |

| Input Data | | |
|---|---|---|
| Slope | 0.036000 | ft/ft |
| Discharge | 0.48 | cfs |
| Gutter Width | 1.67 | ft |
| Gutter Cross Slope | 0.083333 | ft/ft |
| Road Cross Slope | 0.020800 | ft/ft |
| Mannings Coefficient | 0.015 | |

| Results | | |
|---|---|---|
| Spread | 1.90 | ft |
| Flow Area | 0.1 | $ft^2$ |
| Depth | 0.14 | ft |
| Gutter Depression | 1.3 | in |
| Velocity | 3.85 | ft/s |

# Worksheet
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | 5 to 6 |
| Flow Element | Circular Channel |
| Method | Manning's Formul |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Slope | 0.004200 | ft/ft |
| Diameter | 24 | in |
| Discharge | 12.15 | cfs |

| Results | | |
|---|---|---|
| Depth | 1.39 | ft |
| Flow Area | 2.3 | $ft^2$ |
| Wetted Perimeter | 3.94 | ft |
| Top Width | 1.84 | ft |
| Critical Depth | 1.25 | ft |
| Percent Full | 69.5 | % |
| Critical Slope | 0.005617 | ft/ft |
| Velocity | 5.22 | ft/s |
| Velocity Head | 0.42 | ft |
| Specific Energy | 1.81 | ft |
| Froude Number | 0.82 | |
| Maximum Discharg | 15.77 | cfs |
| Discharge Full | 14.66 | cfs |
| Slope Full | 0.002885 | ft/ft |
| Flow Type | Subcritical | |

# Worksheet
## Worksheet for Curb Inlet On Grade

| Project Description | |
|---|---|
| Worksheet | Curb Inlet - 6A |
| Type | Curb Inlet On Grade |
| Solve For | Efficiency |

| Input Data | | |
|---|---|---|
| Discharge | 1.66 | cfs |
| Slope | 0.017700 | ft/ft |
| Gutter Width | 1.67 | ft |
| Gutter Cross Slope | 0.083333 | ft/ft |
| Road Cross Slope | 0.020800 | ft/ft |
| Mannings Coefficient | 0.015 | |
| Curb Opening Length | 6.00 | ft |
| Local Depression | 2.0 | in |
| Local Depression Width | 2.00 | ft |

| Results | | |
|---|---|---|
| Efficiency | 0.81 | |
| Intercepted Flow | 1.34 | cfs |
| Bypass Flow | 0.32 | cfs |
| Spread | 6.42 | ft |
| Depth | 0.24 | ft |
| Flow Area | 0.5 | $ft^2$ |
| Gutter Depression | 1.3 | in |
| Total Depression | 3.3 | in |
| Velocity | 3.22 | ft/s |
| Equivalent Cross Slope | 0.115898 | ft/ft |
| Length Factor | 0.60 | |
| Total Interception Length | 10.02 | ft |

# Worksheet
## Worksheet for Gutter Section

| Project Description | |
|---|---|
| Worksheet | Gutter Section - 6A |
| Type | Gutter Section |
| Solve For | Spread |

| Input Data | | |
|---|---|---|
| Slope | 0.017700 | ft/ft |
| Discharge | 1.66 | cfs |
| Gutter Width | 1.67 | ft |
| Gutter Cross Slope | 0.083333 | ft/ft |
| Road Cross Slope | 0.020800 | ft/ft |
| Mannings Coefficient | 0.015 | |

| Results | | |
|---|---|---|
| Spread | 6.42 | ft |
| Flow Area | 0.5 | $ft^2$ |
| Depth | 0.24 | ft |
| Gutter Depression | 1.3 | in |
| Velocity | 3.22 | ft/s |

# Worksheet
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | 6A to 6 |
| Flow Element | Circular Channel |
| Method | Manning's Formul: |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Slope | 0.009200 | ft/ft |
| Diameter | 15 | in |
| Discharge | 2.26 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.52 | ft |
| Flow Area | 0.5 | ft² |
| Wetted Perimeter | 1.76 | ft |
| Top Width | 1.23 | ft |
| Critical Depth | 0.60 | ft |
| Percent Full | 41.8 | % |
| Critical Slope | 0.005616 | ft/ft |
| Velocity | 4.65 | ft/s |
| Velocity Head | 0.34 | ft |
| Specific Energy | 0.86 | ft |
| Froude Number | 1.31 | |
| Maximum Discharg | 6.66 | cfs |
| Discharge Full | 6.20 | cfs |
| Slope Full | 0.001224 | ft/ft |
| Flow Type | Supercritical | |

# Worksheet
## Worksheet for Curb Inlet In Sag

| Project Description | |
|---|---|
| Worksheet | Curb Inlet - 6 |
| Type | Curb Inlet In Sag |
| Solve For | Spread |

| Input Data | | |
|---|---|---|
| Discharge | 1.58 | cfs |
| Gutter Width | 1.67 | ft |
| Gutter Cross Slope | 0.083333 | ft/ft |
| Road Cross Slope | 0.020800 | ft/ft |
| Curb Opening Length | 6.00 | ft |
| Opening Height | 0.39 | ft |
| Curb Throat Type | Horizontal | |
| Local Depression | 2.0 | in |
| Local Depression Width | 2.00 | ft |

| Results | | |
|---|---|---|
| Spread | 8.29 | ft |
| Throat Incline Angle | 90.00 | degrees |
| Depth | 0.44 | ft |
| Gutter Depression | 1.3 | in |
| Total Depression | 3.3 | in |

# Worksheet
## Worksheet for Gutter Section

| Project Description | |
|---|---|
| Worksheet | Gutter Section - 6 - R |
| Type | Gutter Section |
| Solve For | Spread |

| Input Data | | |
|---|---|---|
| Slope | 0.004000 | ft/ft |
| Discharge | 0.43 | cfs |
| Gutter Width | 1.67 | ft |
| Gutter Cross Slope | 0.083333 | ft/ft |
| Road Cross Slope | 0.020800 | ft/ft |
| Mannings Coefficient | 0.015 | |

| Results | | |
|---|---|---|
| Spread | 4.57 | ft |
| Flow Area | 0.3 | $ft^2$ |
| Depth | 0.20 | ft |
| Gutter Depression | 1.3 | in |
| Velocity | 1.41 | ft/s |

# Worksheet
## Worksheet for Gutter Section

| Project Description | |
|---|---|
| Worksheet | Gutter Section - 6 - L |
| Type | Gutter Section |
| Solve For | Spread |

| Input Data | | |
|---|---|---|
| Slope | 0.004000 | ft/ft |
| Discharge | 1.15 | cfs |
| Gutter Width | 1.67 | ft |
| Gutter Cross Slope | 0.083333 | ft/ft |
| Road Cross Slope | 0.020800 | ft/ft |
| Mannings Coefficient | 0.015 | |

| Results | | |
|---|---|---|
| Spread | 7.71 | ft |
| Flow Area | 0.7 | $ft^2$ |
| Depth | 0.26 | ft |
| Gutter Depression | 1.3 | in |
| Velocity | 1.63 | ft/s |

# Worksheet
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | 6 to 7 |
| Flow Element | Circular Channel |
| Method | Manning's Formul: |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Slope | 0.018400 | ft/ft |
| Diameter | 24 | in |
| Discharge | 15.56 | cfs |

| Results | | |
|---|---|---|
| Depth | 1.01 | ft |
| Flow Area | 1.6 | ft² |
| Wetted Perimeter | 3.16 | ft |
| Top Width | 2.00 | ft |
| Critical Depth | 1.42 | ft |
| Percent Full | 50.4 | % |
| Critical Slope | 0.006480 | ft/ft |
| Velocity | 9.80 | ft/s |
| Velocity Head | 1.49 | ft |
| Specific Energy | 2.50 | ft |
| Froude Number | 1.94 | |
| Maximum Discharg | 33.01 | cfs |
| Discharge Full | 30.68 | cfs |
| Slope Full | 0.004731 | ft/ft |
| Flow Type | Supercritical | |

# Worksheet
## Worksheet for Curb Inlet In Sag

| Project Description | |
|---|---|
| Worksheet | Curb Inlet - 7 |
| Type | Curb Inlet In Sag |
| Solve For | Spread |

| Input Data | | |
|---|---|---|
| Discharge | 1.29 | cfs |
| Gutter Width | 1.67 | ft |
| Gutter Cross Slope | 0.083333 | ft/ft |
| Road Cross Slope | 0.020800 | ft/ft |
| Curb Opening Length | 8.00 | ft |
| Opening Height | 0.39 | ft |
| Curb Throat Type | Horizontal | |
| Local Depression | 2.0 | in |
| Local Depression Width | 2.00 | ft |

| Results | | |
|---|---|---|
| Spread | 6.38 | ft |
| Throat Incline Angle | 90.00 | degrees |
| Depth | 0.40 | ft |
| Gutter Depression | 1.3 | in |
| Total Depression | 3.3 | in |

# Worksheet
## Worksheet for Gutter Section

| Project Description | |
|---|---|
| Worksheet | Gutter Section - 7 - R |
| Type | Gutter Section |
| Solve For | Spread |

| Input Data | | |
|---|---|---|
| Slope | 0.004000 | ft/ft |
| Discharge | 0.65 | cfs |
| Gutter Width | 1.67 | ft |
| Gutter Cross Slope | 0.083333 | ft/ft |
| Road Cross Slope | 0.020800 | ft/ft |
| Mannings Coefficient | 0.015 | |

| Results | | |
|---|---|---|
| Spread | 5.80 | ft |
| Flow Area | 0.4 | $ft^2$ |
| Depth | 0.23 | ft |
| Gutter Depression | 1.3 | in |
| Velocity | 1.49 | ft/s |

# Worksheet
## Worksheet for Gutter Section

| Project Description | |
|---|---|
| Worksheet | Gutter Section - 7 - L |
| Type | Gutter Section |
| Solve For | Spread |

| Input Data | | |
|---|---|---|
| Slope | 0.004000 | ft/ft |
| Discharge | 0.65 | cfs |
| Gutter Width | 1.67 | ft |
| Gutter Cross Slope | 0.083333 | ft/ft |
| Road Cross Slope | 0.020800 | ft/ft |
| Mannings Coefficient | 0.015 | |

| Results | | |
|---|---|---|
| Spread | 5.80 | ft |
| Flow Area | 0.4 | $ft^2$ |
| Depth | 0.23 | ft |
| Gutter Depression | 1.3 | in |
| Velocity | 1.49 | ft/s |

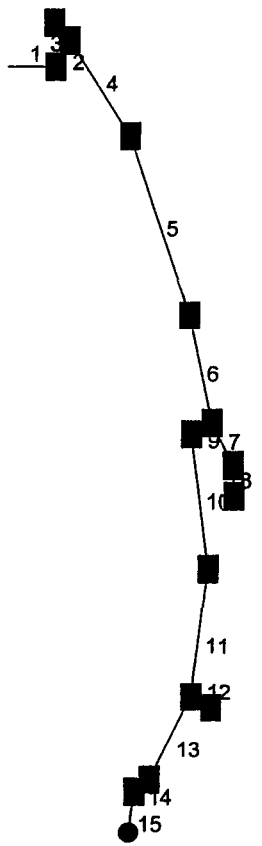
# Worksheet
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | 7 to 8 |
| Flow Element | Circular Channel |
| Method | Manning's Formul |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Slope | 0.017800 | ft/ft |
| Diameter | 24 | in |
| Discharge | 17.08 | cfs |

| Results | | |
|---|---|---|
| Depth | 1.08 | ft |
| Flow Area | 1.7 | ft² |
| Wetted Perimeter | 3.30 | ft |
| Top Width | 1.99 | ft |
| Critical Depth | 1.49 | ft |
| Percent Full | 53.9 | % |
| Critical Slope | 0.006964 | ft/ft |
| Velocity | 9.90 | ft/s |
| Velocity Head | 1.52 | ft |
| Specific Energy | 2.60 | ft |
| Froude Number | 1.88 | |
| Maximum Discharg | 32.47 | cfs |
| Discharge Full | 30.18 | cfs |
| Slope Full | 0.005701 | ft/ft |
| Flow Type | Supercritical | |

# Hydraflow Plan View




| | | | |
|---|---|---|---|
| Project file: Stonehouse Glen System 1.stm | IDF file: Norfolk.IDF | No. Lines: 15 | 10-18-2004 |

# Hydraflow Storm Sewer Inventory Report



| Line No. | Alignment | | | | Flow Data | | | | Physical Data | | | | | | | | Line ID |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Dnstr line No. | Line length (ft) | Defl angle (deg) | Junc type | Known Q (cfs) | Drng area (ac) | Runoff coeff (C) | Inlet time (min) | Invert El Dn (ft) | Line slope (%) | Invert El Up (ft) | Line size (in) | Line type | N value (n) | J-loss coeff (K) | Inlet/ Rim El (ft) | |
| 1 | End | 86.0 | 0.0 | Curb | 17.11 | 0.00 | 0.00 | 0.0 | 86.59 | 1.78 | 88.12 | 24 | Cir | 0.013 | 1.10 | 104.15 | 7 to 8 |
| 2 | 1 | 43.0 | -53.0 | Curb | 15.56 | 0.00 | 0.00 | 0.0 | 92.53 | 1.88 | 93.34 | 24 | Cir | 0.013 | 1.50 | 104.15 | 6 to 7 |
| 3 | 2 | 37.0 | -87.0 | Curb | 2.26 | 0.00 | 0.00 | 0.0 | 100.33 | 0.95 | 100.68 | 15 | Cir | 0.013 | 1.00 | 104.60 | 6A to 6 |
| 4 | 2 | 169.0 | 101.0 | Curb | 12.15 | 0.00 | 0.00 | 0.0 | 97.96 | 0.42 | 98.67 | 24 | Cir | 0.013 | 0.70 | 109.55 | 5 to 6 |
| 5 | 4 | 267.0 | 17.0 | Curb | 11.78 | 0.00 | 0.00 | 0.0 | 98.77 | 0.38 | 99.78 | 24 | Cir | 0.013 | 0.50 | 109.46 | 4 to 5 |
| 6 | 5 | 151.0 | 9.0 | Curb | 5.18 | 0.00 | 0.00 | 0.0 | 99.88 | 0.38 | 100.45 | 24 | Cir | 0.013 | 1.50 | 105.12 | 4 to 3 |
| 7 | 6 | 68.0 | -20.0 | Curb | 3.92 | 0.00 | 0.00 | 0.0 | 101.07 | 0.60 | 101.48 | 15 | Cir | 0.013 | 0.70 | 105.80 | 2 to 3 |
| 8 | 7 | 40.0 | 33.0 | Curb | 2.54 | 0.00 | 0.00 | 0.0 | 101.58 | 0.75 | 101.88 | 15 | Cir | 0.013 | 1.00 | 105.80 | 1 to 2 |
| 9 | 6 | 40.0 | 84.0 | Curb | 7.14 | 0.00 | 0.00 | 0.0 | 100.75 | 0.48 | 100.94 | 18 | Cir | 0.013 | 1.50 | 105.12 | 3 to 3A |
| 10 | 9 | 179.0 | -78.0 | Curb | 4.99 | 0.00 | 0.00 | 0.0 | 101.20 | 2.88 | 106.35 | 15 | Cir | 0.013 | 0.70 | 110.45 | 3A to 6(2) |
| 11 | 10 | 173.0 | 20.0 | Curb | 4.52 | 0.00 | 0.00 | 0.0 | 106.45 | 1.46 | 108.98 | 15 | Cir | 0.013 | 1.50 | 113.30 | 5 to6 (2) |
| 12 | 11 | 40.0 | -78.0 | Curb | 1.21 | 0.00 | 0.00 | 0.0 | 109.08 | 0.60 | 109.32 | 15 | Cir | 0.013 | 1.00 | 113.30 | 4 to 5 (2) |
| 13 | 11 | 136.0 | 24.0 | Curb | 2.97 | 0.00 | 0.00 | 0.0 | 109.25 | 0.82 | 110.36 | 15 | Cir | 0.013 | 0.70 | 114.65 | 3 to 5 (2) |
| 14 | 13 | 32.0 | 27.0 | Curb | 2.49 | 0.00 | 0.00 | 0.0 | 110.46 | 0.66 | 110.67 | 15 | Cir | 0.013 | 1.10 | 114.65 | 2 to 3 (2) |
| 15 | 14 | 56.0 | -50.0 | MH | 1.27 | 0.00 | 0.00 | 0.0 | 110.77 | 3.61 | 112.79 | 15 | Cir | 0.013 | 1.00 | 116.75 | 1 to 2 (2) |

Project File: Stonehouse Glen System 1.stm | I-D-F File: Norfolk.IDF | Total number of lines: 15 | Date: 10-18-2004

# Hydraflow Summary Report



| Line No. | Line ID | Flow rate (cfs) | Line size (in) | Line length (ft) | Invert EL Dn (ft) | Invert EL Up (ft) | Line slope (%) | HGL down (ft) | HGL up (ft) | Minor loss (ft) | Dns line No. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 7 to 8 | 17.11 | 24 c | 86.0 | 86.59 | 88.12 | 1.779 | 88.59 | 89.59 | 0.82 | End |
| 2 | 6 to 7 | 15.56 | 24 c | 43.0 | 92.53 | 93.34 | 1.884 | 93.53 | 95.10 | 0.66 | 1 |
| 3 | 6A to 6 | 2.26 | 15 c | 37.0 | 100.33 | 100.68 | 0.946 | 100.85 | 101.28 | 0.23 | 2 |
| 4 | 5 to 6 | 12.15 | 24 c | 169.0 | 97.96 | 98.67 | 0.420 | 99.35 | 100.06 | 0.30 | 2 |
| 5 | 4 to 5 | 11.78 | 24 c | 267.0 | 98.77 | 99.78 | 0.378 | 100.35 | 101.17 | 0.20 | 4 |
| 6 | 4 to 3 | 5.18 | 24 c | 151.0 | 99.88 | 100.45 | 0.377 | 101.37 | 101.47 | 0.24 | 5 |
| 7 | 2 to 3 | 3.92 | 15 c | 68.0 | 101.07 | 101.48 | 0.603 | 101.91 | 102.31 | 0.23 | 6 |
| 8 | 1 to 2 | 2.54 | 15 c | 40.0 | 101.58 | 101.88 | 0.750 | 102.53 | 102.54 | 0.24 | 7 |
| 9 | 3 to 3A | 7.14 | 18 c | 40.0 | 100.75 | 100.94 | 0.475 | 101.97 | 102.16 | 0.50 | 6 |
| 10 | 3A to 6(2) | 4.99 | 15 c | 179.0 | 101.20 | 106.35 | 2.877 | 102.66 | 107.24 | 0.31 | 9 |
| 11 | 5 to6 (2) | 4.52 | 15 c | 173.0 | 106.45 | 108.98 | 1.462 | 107.55 | 109.83 | 0.60 | 10 |
| 12 | 4 to 5 (2) | 1.21 | 15 c | 40.0 | 109.08 | 109.32 | 0.600 | 110.43 | 110.44 | 0.02 | 11 |
| 13 | 3 to 5 (2) | 2.97 | 15 c | 136.0 | 109.25 | 110.36 | 0.816 | 110.43 | 111.05 | 0.20 | 11 |
| 14 | 2 to 3 (2) | 2.49 | 15 c | 32.0 | 110.46 | 110.67 | 0.656 | 111.25 | 111.30 | 0.27 | 13 |
| 15 | 1 to 2 (2) | 1.27 | 15 c | 56.0 | 110.77 | 112.79 | 3.607 | 111.58 | 113.24 | 0.16 | 14 |

Project File: Stonehouse Glen System 1l-D-F File: Norfolk.IDF | Total No. Lines: 15 | Run Date: 10-18-2004

NOTES: c = circular; e = elliptical; b = box; Return period = 10 Yrs.; * Indicates surcharge condition.

# Hydraflow Storm Sewer Tabulation



| Station | | Len | Drng Area | | Rnoff coeff | Area x C | | Tc | | Rain (I) | Total flow | Cap full | Vel | Pipe | | Invert Elev | | HGL Elev | | Grnd / Rim Elev | | Line ID |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Line | To Line | | Incr | Total | | Incr | Total | Inlet | Syst | | | | | Size | Slope | Up | Dn | Up | Dn | Up | Dn | |
| | | (ft) | (ac) | (ac) | (C) | | | (min) | (min) | (in/hr) | (cfs) | (cfs) | (ft/s) | (in) | (%) | (ft) | (ft) | (ft) | (ft) | (ft) | (ft) | |
| 1 | End | 86.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.0 | 6.9 | 0.0 | 17.11 | 30.17 | 6.19 | 24 | 1.78 | 88.12 | 86.59 | 89.59 | 88.59 | 104.15 | 0.00 | 7 to 8 |
| 2 | 1 | 43.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.0 | 6.7 | 0.0 | 15.56 | 31.04 | 7.59 | 24 | 1.88 | 93.34 | 92.53 | 95.10 | 93.53 | 104.15 | 104.15 | 6 to 7 |
| 3 | 2 | 37.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.0 | 0.0 | 0.0 | 2.26 | 6.28 | 4.27 | 15 | 0.95 | 100.68 | 100.33 | 101.28 | 100.85 | 104.60 | 104.15 | 6A to 6 |
| 4 | 2 | 169.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.0 | 5.7 | 0.0 | 12.15 | 14.66 | 5.21 | 24 | 0.42 | 98.67 | 97.96 | 100.06 | 99.35 | 109.55 | 104.15 | 5 to 6 |
| 5 | 4 | 267.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.0 | 4.3 | 0.0 | 11.78 | 13.91 | 4.73 | 24 | 0.38 | 99.78 | 98.77 | 101.17 | 100.35 | 109.46 | 109.55 | 4 to 5 |
| 6 | 5 | 151.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.0 | 3.4 | 0.0 | 5.18 | 13.90 | 2.64 | 24 | 0.38 | 100.45 | 99.88 | 101.47 | 101.37 | 105.12 | 109.46 | 4 to 3 |
| 7 | 6 | 68.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.0 | 0.2 | 0.0 | 3.92 | 5.01 | 4.51 | 15 | 0.60 | 101.48 | 101.07 | 102.31 | 101.91 | 105.80 | 105.12 | 2 to 3 |
| 8 | 7 | 40.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.0 | 0.0 | 0.0 | 2.54 | 5.59 | 3.21 | 15 | 0.75 | 101.88 | 101.58 | 102.54 | 102.53 | 105.80 | 105.80 | 1 to 2 |
| 9 | 6 | 40.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.0 | 3.2 | 0.0 | 7.14 | 7.24 | 4.64 | 18 | 0.48 | 100.94 | 100.75 | 102.16 | 101.97 | 105.12 | 105.12 | 3 to 3A |
| 10 | 9 | 179.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.0 | 2.2 | 0.0 | 4.99 | 10.95 | 4.69 | 15 | 2.88 | 106.35 | 101.20 | 107.24 | 102.66 | 110.45 | 105.12 | 3A to 6(2) |
| 11 | 10 | 173.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.0 | 1.2 | 0.0 | 4.52 | 7.81 | 4.51 | 15 | 1.46 | 108.98 | 106.45 | 109.83 | 107.55 | 113.30 | 110.45 | 5 to6 (2) |
| 12 | 11 | 40.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.0 | 0.0 | 0.0 | 1.21 | 5.00 | 1.01 | 15 | 0.60 | 109.32 | 109.08 | 110.44 | 110.43 | 113.30 | 113.30 | 4 to 5 (2) |
| 13 | 11 | 136.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.0 | 0.5 | 0.0 | 2.97 | 5.83 | 3.37 | 15 | 0.82 | 110.36 | 109.25 | 111.05 | 110.43 | 114.65 | 113.30 | 3 to 5 (2) |
| 14 | 13 | 32.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.0 | 0.3 | 0.0 | 2.49 | 5.23 | 3.52 | 15 | 0.66 | 110.67 | 110.46 | 111.30 | 111.25 | 114.65 | 114.65 | 2 to 3 (2) |
| 15 | 14 | 56.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.0 | 0.0 | 0.0 | 1.27 | 12.26 | 2.35 | 15 | 3.61 | 112.79 | 110.77 | 113.24 | 111.58 | 116.75 | 114.65 | 1 to 2 (2) |

Project File: Stonehouse Glen System 1.stm | I-D-F File: Norfolk.IDF | Total number of lines: 15 | Run Date: 10-18-2004

NOTES: Intensity = 128.59 / (Tc + 17.70) ^ 0.89; Return period = 10 Yrs. ; Initial tailwater elevation = 88.59 (ft)

# Hydraflow Inlet Report



| Line No | Line ID | A (ac) | Inlet time (min) | I (in/hr) | C | Q = CIA (cfs) | Q carry (cfs) | Q capt (cfs) | Q byp (cfs) | Junc type | Curb Inlet Ht (in) | Curb Inlet L (ft) | Grate Inlet area (sqft) | Grate Inlet L (ft) | Grate Inlet W (ft) | Gutter So (ft/ft) | Gutter W (ft) | Gutter Sw (ft/ft) | Gutter Sx (ft/ft) | Flow depth (ft) | Flow spread (ft) | Byp line No |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 7 to 8 | 0.00 | 0.0 | 0.00 | 0.00 | 17.11* | 26.41 | 43.52 | 0.00 | Curb | 0.4 | 8.00 | 0.00 | 0.00 | 0.00 | Sag | 1.67 | 0.083 | 0.020 | 1.78 | 83.76 | Offsite |
| 2 | 6 to 7 | 0.00 | 0.0 | 0.00 | 0.00 | 15.56* | 0.00 | 15.56 | 0.00 | Curb | 0.4 | 6.00 | 0.00 | 0.00 | 0.00 | Sag | 1.67 | 0.083 | 0.020 | 1.08 | 48.93 | 1 |
| 3 | 6A to 6 | 0.00 | 0.0 | 0.00 | 0.00 | 2.26* | 0.00 | 1.27 | 0.99 | Curb | 0.4 | 6.00 | 0.00 | 0.00 | 0.00 | 0.018 | 1.67 | 0.083 | 0.020 | 0.27 | 8.24 | 1 |
| 4 | 5 to 6 | 0.00 | 0.0 | 0.00 | 0.00 | 12.15* | 0.00 | 1.71 | 10.44 | Curb | 0.4 | 4.00 | 0.00 | 0.00 | 0.00 | 0.035 | 1.67 | 0.083 | 0.020 | 0.39 | 14.24 | 1 |
| 5 | 4 to 5 | 0.00 | 0.0 | 0.00 | 0.00 | 11.78* | 0.00 | 1.07 | 10.71 | Curb | 0.4 | 2.50 | 0.00 | 0.00 | 0.00 | 0.036 | 1.67 | 0.083 | 0.020 | 0.39 | 14.24 | 1 |
| 6 | 4 to 3 | 0.00 | 0.0 | 0.00 | 0.00 | 5.18* | 0.00 | 5.18 | 0.00 | Curb | 0.4 | 2.50 | 0.00 | 0.00 | 0.00 | Sag | 1.67 | 0.083 | 0.020 | 0.93 | 41.36 | 1 |
| 7 | 2 to 3 | 0.00 | 0.0 | 0.00 | 0.00 | 3.92* | 0.00 | 3.92 | 0.00 | Curb | 0.4 | 4.00 | 0.00 | 0.00 | 0.00 | Sag | 1.67 | 0.083 | 0.020 | 0.56 | 22.97 | 1 |
| 8 | 1 to 2 | 0.00 | 0.0 | 0.00 | 0.00 | 2.54* | 0.00 | 2.54 | 0.00 | Curb | 0.4 | 8.00 | 0.00 | 0.00 | 0.00 | Sag | 1.67 | 0.083 | 0.020 | 0.27 | 8.01 | 1 |
| 9 | 3 to 3A | 0.00 | 0.0 | 0.00 | 0.00 | 7.14* | 0.00 | 7.14 | 0.00 | Curb | 0.4 | 8.00 | 0.00 | 0.00 | 0.00 | Sag | 1.67 | 0.083 | 0.020 | 0.53 | 21.26 | 1 |
| 10 | 3A to 6(2) | 0.00 | 0.0 | 0.00 | 0.00 | 4.99* | 0.00 | 0.72 | 4.27 | Curb | 0.4 | 2.50 | 0.00 | 0.00 | 0.00 | 0.035 | 1.67 | 0.083 | 0.020 | 0.30 | 9.74 | 1 |
| 11 | 5 to6 (2) | 0.00 | 0.0 | 0.00 | 0.00 | 4.52* | 0.00 | 4.52 | 0.00 | Curb | 0.4 | 4.00 | 0.00 | 0.00 | 0.00 | Sag | 1.67 | 0.083 | 0.020 | 0.62 | 25.80 | 10 |
| 12 | 4 to 5 (2) | 0.00 | 0.0 | 0.00 | 0.00 | 1.21* | 0.00 | 1.21 | 0.00 | Curb | 0.4 | 4.00 | 0.00 | 0.00 | 0.00 | Sag | 1.67 | 0.083 | 0.020 | 0.26 | 7.58 | 10 |
| 13 | 3 to 5 (2) | 0.00 | 0.0 | 0.00 | 0.00 | 2.97* | 0.00 | 2.97 | 0.00 | Curb | 0.4 | 4.00 | 0.00 | 0.00 | 0.00 | Sag | 1.67 | 0.083 | 0.020 | 0.47 | 18.18 | 10 |
| 14 | 2 to 3 (2) | 0.00 | 0.0 | 0.00 | 0.00 | 2.49* | 1.27 | 3.76 | 0.00 | Curb | 0.4 | 6.00 | 0.00 | 0.00 | 0.00 | Sag | 1.67 | 0.083 | 0.020 | 0.42 | 15.66 | 10 |
| 15 | 1 to 2 (2) | 0.00 | 0.0 | 0.00 | 0.00 | 1.27* | 0.00 | 0.00 | 1.27 | MH | 0.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 | 0.00 | 0.000 | 0.000 | 0.00 | 0.00 | 14 |

Project File: Stonehouse Glen System 1.stm | I-D-F File: Norfolk.IDF | Total number of lines: 15 | Run Date: 10-18-2004

NOTES: Inlet N-Values = 0.016 ; Design depth for grate(s) = 0.3 (ft); Intensity = 128.59 / (Inlet time + 17.70) ^ 0.89; Return period = 10 Yrs. ; * Indicates Known Q added

# Hydraflow 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 | 24 | 17.11 | 86.59 | 88.59 | 2.00 | 3.14 | 5.45 | 0.46 | 89.05 | 0.573 | 86.0 | 88.12 | 89.59 | 1.47** | 2.47 | 6.94 | 0.75 | 90.33 | 0.728 | 0.650 | N/A | 1.10 | 0.82 |
| 2 | 24 | 15.56 | 92.53 | 93.53 | 1.00* | 1.58 | 9.85 | 1.51 | 95.04 | 1.866 | 43.0 | 93.34 | 95.10 | 1.76 | 2.92 | 5.32 | 0.44 | 95.54 | 0.427 | 1.147 | 0.493 | 1.50 | 0.66 |
| 3 | 15 | 2.26 | 100.33 | 100.85 | 0.52* | 0.48 | 4.69 | 0.34 | 101.19 | 0.943 | 37.0 | 100.68 | 101.28 | 0.60 | 0.59 | 3.84 | 0.23 | 101.51 | 0.548 | 0.746 | 0.276 | 1.00 | 0.23 |
| 4 | 24 | 12.15 | 97.96 | 99.35 | 1.39* | 2.34 | 5.20 | 0.42 | 99.77 | 0.417 | 169 | 98.67 | 100.06 | 1.39 | 2.32 | 5.23 | 0.42 | 100.48 | 0.422 | 0.420 | 0.709 | 0.70 | 0.30 |
| 5 | 24 | 11.78 | 98.77 | 100.35 | 1.58 | 2.67 | 4.41 | 0.30 | 100.66 | 0.290 | 267 | 99.78 | 101.17 | 1.39 | 2.33 | 5.05 | 0.40 | 101.57 | 0.393 | 0.341 | 0.912 | 0.50 | 0.20 |
| 6 | 24 | 5.18 | 99.88 | 101.37 | 1.49 | 2.51 | 2.06 | 0.07 | 101.44 | 0.064 | 151 | 100.45 | 101.47 | 1.02 | 1.61 | 3.22 | 0.16 | 101.63 | 0.196 | 0.130 | 0.197 | 1.50 | 0.24 |
| 7 | 15 | 3.92 | 101.07 | 101.91 | 0.84* | 0.88 | 4.46 | 0.31 | 102.22 | 0.583 | 68.0 | 101.48 | 102.31 | 0.83 | 0.86 | 4.56 | 0.32 | 102.63 | 0.616 | 0.600 | 0.408 | 0.70 | 0.23 |
| 8 | 15 | 2.54 | 101.58 | 102.53 | 0.95 | 1.00 | 2.53 | 0.10 | 102.63 | 0.180 | 40.0 | 101.88 | 102.54 | 0.66 | 0.65 | 3.89 | 0.24 | 102.77 | 0.524 | 0.352 | 0.141 | 1.00 | 0.24 |
| 9 | 18 | 7.14 | 100.75 | 101.97 | 1.22* | 1.54 | 4.63 | 0.33 | 102.31 | 0.468 | 40.0 | 100.94 | 102.16 | 1.22 | 1.54 | 4.65 | 0.34 | 102.49 | 0.471 | 0.469 | 0.188 | 1.50 | 0.50 |
| 10 | 15 | 4.99 | 101.20 | 102.66 | 1.25 | 1.23 | 4.07 | 0.26 | 102.92 | 0.597 | 179 | 106.35 | 107.24 | 0.89** | 0.94 | 5.31 | 0.44 | 107.68 | 0.806 | 0.702 | N/A | 0.70 | 0.31 |
| 11 | 15 | 4.52 | 106.45 | 107.55 | 1.10 | 1.14 | 3.95 | 0.24 | 107.79 | 0.440 | 173 | 108.98 | 109.83 | 0.85** | 0.89 | 5.08 | 0.40 | 110.23 | 0.753 | 0.597 | N/A | 1.50 | 0.60 |
| 12 | 15 | 1.21 | 109.08 | 110.43 | 1.25 | 1.23 | 0.99 | 0.02 | 110.45 | 0.035 | 40.0 | 109.32 | 110.44 | 1.12 | 1.16 | 1.04 | 0.02 | 110.46 | 0.031 | 0.033 | 0.013 | 1.00 | 0.02 |
| 13 | 15 | 2.97 | 109.25 | 110.43 | 1.18 | 1.20 | 2.47 | 0.09 | 110.53 | 0.183 | 136 | 110.36 | 111.05 | 0.69** | 0.69 | 4.28 | 0.28 | 111.33 | 0.610 | 0.397 | N/A | 0.70 | 0.20 |
| 14 | 15 | 2.49 | 110.46 | 111.25 | 0.79 | 0.82 | 3.05 | 0.14 | 111.39 | 0.283 | 32.0 | 110.67 | 111.30 | 0.63 | 0.63 | 3.98 | 0.25 | 111.55 | 0.565 | 0.424 | 0.136 | 1.10 | 0.27 |
| 15 | 15 | 1.27 | 110.77 | 111.58 | 0.81 | 0.84 | 1.52 | 0.04 | 111.61 | 0.069 | 56.0 | 112.79 | 113.24 | 0.45** | 0.40 | 3.18 | 0.16 | 113.40 | 0.499 | 0.284 | N/A | 1.00 | 0.16 |

Project File: Stonehouse Glen System 1.stm | I-D-F File: Norfolk.IDF | Total number of lines: 15 | Run Date: 10-18-2004

NOTES: Initial tailwater elevation = 88.59 (ft) , * Normal depth assumed., ** Critical depth assumed.

LD-229
July 2000

STORM SEWER DESIGN
COMPUTATIONS

ROUTE: Oct. 1, 2004 PROJ: STONEHOUSE GLEN SECTION I
COUNTY: DISTRICT: CURB & GUTTER
DESCRIPTION:
SHEET ____ OF ____

| FROM POINT (1) | TO POINT (2) | AREA DRAIN "A" ACRES (3) | RUN-OFF COEF. C (4) | CA INCREMENT (5) | CA ACCUMULATED (6) | INLET TIME MINUTES (7) | RAIN FALL IN./HR. (8) | RUN-OFF Q C.F.S. (9) | INVERT ELEVATIONS UPPER END (10) | INVERT ELEVATIONS LOWER END (11) | LENGTH FT. (12) | SLOPE FT./FT. (13) | DIA. IN. (14) | CAPACITY C.F.S. (15) | VEL. F.P.S. (16) | FLOW TIME MINUTES INCREMENT (17) | FLOW TIME MINUTES ACCUMULATED (17) | REMARKS (18) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 10-C | 10-B | 0.40 | 0.80 | – | 0.32 | 12 | 5.5 | 1.76 | 90.38 | 89.31 | 296' | 0.0036 | 15" | 3.88 | 3.08 | 1.60 | – | |
| 10-B | 10-A-1 | 0.14 | 0.65 | 0.09 | 0.41 | 13.6 | 5.4 | 2.21 | 89.21 | 88.56 | 180' | 0.0036 | 15" | 3.88 | 3.26 | 0.92 | 2.52 | |
| 10-A-1 | 10 | 0.19 | 0.80 | 0.15 | 0.56 | 14.52 | 5.3 | 2.97 | 88.46 | 88.22 | 66' | 0.0036 | 15" | 3.88 | 3.48 | 0.31 | 2.83 | |
| 10-A-2 | 10 | 0.33 | 0.90 | – | 0.30 | 12 | 5.5 | 1.65 | 88.54 | 88.22 | 33' | 0.01 | 15" | 6.46 | 4.40 | 0.09 | – | |
| | | | | | | | | | | | | | | | | | | |
| 10 | 11 | 0.15 | 0.90 | 0.14 | 1.00 | 14.83 | 5.27 | 5.27 | 88.12 | 86.76 | 189' | 0.0072 | 15" | 5.48 | 5.09 | 0.61 | 3.44 | |
| 11 | 12 | 0.08 | 0.90 | 0.07 | 1.07 | 15.59 | 5.19 | 5.55 | 86.66 | 85.35 | 173' | 0.0076 | 15" | 5.63 | 5.23 | 0.68 | 4.27 | |
| | | | | | | | | | | | | | | | | | | |
| 12-C | 12-A | 0.39 | 0.7 | – | 0.27 | 12 | 5.5 | 1.49 | 96.50 | 94.47 | 75' | 0.0271 | 15" | 10.63 | 6.11 | 0.20 | – | |
| 12-B | 12-A | 0.25 | 0.9 | – | 0.23 | 12 | 5.5 | 1.27 | 94.41 | 94.09 | 32' | 0.01 | 15" | 6.46 | 4.09 | 0.13 | – | |
| 12-A | 12 | 0.07 | 0.9 | 0.06 | 0.56 | 12.20 | 5.5 | 3.08 | 93.09 | 91.90 | 30' | 0.0397 | 15" | 12.87 | 8.61 | 0.11 | 0.31 | |
| | | | | | | | | | | | | | | | | | | |
| 12 | 13 | – | – | – | 1.63 | 16.27 | 5.12 | 8.34 | 85.10 | 82.72 | 244' | 0.0097 | 18" | 10.35 | 6.51 | 0.62 | 4.89 | |
| | | | | | | | | | | | | | | | | | | |
| 13-C-1 | 13-C | 0.09 | 0.9 | – | 0.08 | 10 | 5.75 | 0.46 | 84.00 | 83.41 | 74' | 0.0080 | 15" | 5.78 | 2.82 | 0.44 | – | |
| 13-C | 13-B | 0.16 | 0.7 | 0.11 | 0.19 | 10.44 | 5.71 | 1.08 | 83.31 | 83.13 | 51' | 0.0036 | 15" | 3.88 | 2.71 | 0.31 | 0.75 | |
| | | | | | | | | | | | | | | | | | | |
| 13-B-1 | 13-B | 0.22 | 0.9 | – | 0.20 | 10 | 5.75 | 1.15 | 84.91 | 84.59 | 32' | 0.01 | 15" | 3.50 | 2.55 | 0.21 | – | |

# Appendix 9B-2 LD-229 Storm Drain Design Computations

LD-229
July 2000

STORM SEWER DESIGN COMPUTATIONS

ROUTE: _____ PROJ: Stonehouse Glen Section I
COUNTY: _____ DISTRICT: _____
DESCRIPTION: _____
SHEET ____ OF ____

| FROM POINT (1) | TO POINT (2) | AREA DRAIN "A" ACRES (3) | RUN-OFF COEF. C (4) | CA INCREMENT (5) | CA ACCUMULATED (6) | INLET TIME MINUTES (7) | RAIN FALL IN./HR. (8) | RUN-OFF Q C.F.S. (9) | INVERT ELEVATIONS UPPER END (10) | INVERT ELEVATIONS LOWER END (11) | LENGTH FT. (12) | SLOPE FT./FT. (13) | DIA. IN. (14) | CAPACITY C.F.S. (15) | VEL. F.P.S. (16) | FLOW TIME MINUTES INCREMENT / ACCUMULATED (17) | REMARKS (18) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 13-B | 13 | 0.10 | 0.7 | 0.07 | 0.46 | 12 | 5.5 | 2.53 | 83.03 | 82.72 | 87' | 0.0036 | 15" | 3.88 | 3.43 | 0.42 / 0.63 | |
| | | | | | | | | | | | | | | | | | |
| 13 | 14 | 0.27 | 0.6 | 0.16 | 2.25 | 16.81 | 5.07 | 11.41 | 81.00 | 70.00 | 199 | 0.0553 | 18" | 24.70 | 13.70 | 0.24 / 5.05 | |
| 14 | 15 | — | — | — | — | | | 11.41 | 66.50 | 65.78 | 30' | 0.0240 | 18" | 16.27 | 9.97 | 0.06 / 5.11 | |
| 15 | 16 | — | — | — | — | | | 11.41 | 61.58 | 61.00 | 24' | 0.0240 | 18" | 16.27 | 9.97 | | |
| 25 | 26 | 0.72 | 0.45 | — | 0.32 | 14 | 5.3 | 1.70 | 78.75 | 68.5 | 128' | 0.08 | 15" | 5.78 | 4.09 | 0.52 / — | |
| 26-A | 26 | 0.17 | 0.9 | — | 0.15 | 12 | 5.5 | 0.82 | 71.39 | 71.08 | 31' | 0.01 | 15" | 6.46 | 3.61 | 0.14 / — | |
| 26 | 27 | — | — | — | 0.47 | 14.5 | 5.3 | 2.49 | 68.4 | 68.18 | 45 | 0.0048 | 15" | 4.48 | 3.74 | 0.20 / 0.72 | |
| 27 | 28 | 1.33 | 0.45 | 0.60 | 1.07 | 14.7 | 5.29 | 5.66 | 68.08 | 66.16 | 240 | 0.0080 | 15" | 5.48 | 5.09 | 0.63 / 1.33 | |
| 28 | 29 | — | — | — | — | | | 5.66 | 61.87 | 61.00 | 33' | 0.0380 | 15" | 12.59 | 9.99 | 0.11 / 1.44 | |

# Appendix 9B-2 LD-229 Storm Drain Design Computations

LD-229
July 2000

STORM SEWER DESIGN
COMPUTATIONS

ROUTE: _____ PROJ: STONEHOUSE GLEN SECTION I
COUNTY: _____ DISTRICT: CURB & GUTTER
DESCRIPTION: _____
SHEET ____ OF ____

| FROM POINT (1) | TO POINT (2) | AREA DRAIN "A" ACRES (3) | RUN-OFF COEF. C (4) | CA INCREMENT (5) | CA ACCUMULATED (6) | INLET TIME MINUTES (7) | RAIN FALL IN./HR. (8) | RUN-OFF Q C.F.S. (9) | INVERT ELEVATIONS UPPER END (10) | INVERT ELEVATIONS LOWER END (11) | LENGTH FT. (12) | SLOPE FT./FT. (13) | DIA. IN. (14) | CAPACITY C.F.S. (15) | VEL. F.P.S. (16) | FLOW TIME MINUTES INCREMENT / ACCUMULATED (17) | REMARKS (18) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 13 | 14 | 0.27 | 0.6 | 0.16 | 2.25 | 16.81 | 5.07 | 11.41 | 81.00 | 70.62 | 173' | 0.060 | 18" | 25.73 | 14.12 | 0.8d | |
| 14A | 14 | 0.73 | 0.35 | 0.26 | — | 12 | 5.54 | 1.44 | 76.17 | 72.88 | 28' | 0.113 | 15" | 21.71 | 10.03 | | |
| 14 | 15 | – | – | – | 2.51 | 16.81 | 5.07 | 12.73 | 65.38 | 62.66 | 34' | 0.080 | 18" | 29.71 | 16.16 | | |
| 15 | 16 | – | – | – | – | | | 12.73 | 56.39 | 56.25 | 31' | 0.0045 | 24" | 15.17 | 5.41 | | |
| | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| ~~27~~ | ~~28~~ | ~~1.33~~ | ~~0.45~~ | ~~0.60~~ | ~~1.07~~ | ~~14.7~~ | ~~5.29~~ | ~~5.66~~ | ~~66.67~~ | ~~65.08~~ | ~~199'~~ | ~~0.0080~~ | ~~15"~~ | ~~5.78~~ | ~~9.54~~ | | |
| 28 | 29 | – | – | – | – | | | ~~5.66~~ | ~~64.00~~ | 60.40 | 45' | 0.08 | 15" | 18.27 | 13.13 | | |
| ~~29~~ | ~~29A~~ | – | – | – | – | – | – | 5.66 | 56.40 | 56.25 | 30' | 0.005 | 18" | 7.43 | ~~2.09~~ | | |

# Worksheet
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | 10-C to 10-B |
| Flow Element | Circular Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Slope | 0.003600 | ft/ft |
| Diameter | 15 | in |
| Discharge | 1.76 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.59 | ft |
| Flow Area | 0.6 | ft² |
| Wetted Perimeter | 1.90 | ft |
| Top Width | 1.25 | ft |
| Critical Depth | 0.53 | ft |
| Percent Full | 47.3 | % |
| Critical Slope | 0.005397 | ft/ft |
| Velocity | 3.08 | ft/s |
| Velocity Head | 0.15 | ft |
| Specific Energy | 0.74 | ft |
| Froude Number | 0.80 | |
| Maximum Discharg | 4.17 | cfs |
| Discharge Full | 3.88 | cfs |
| Slope Full | 0.000742 | ft/ft |
| Flow Type | Subcritical | |

# Worksheet
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | 10-B to 10-A - 1 |
| Flow Element | Circular Channel |
| Method | Manning's Formul: |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Slope | 0.003600 | ft/ft |
| Diameter | 15 | in |
| Discharge | 2.21 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.68 | ft |
| Flow Area | 0.7 | ft² |
| Wetted Perimeter | 2.07 | ft |
| Top Width | 1.25 | ft |
| Critical Depth | 0.59 | ft |
| Percent Full | 54.1 | % |
| Critical Slope | 0.005579 | ft/ft |
| Velocity | 3.26 | ft/s |
| Velocity Head | 0.17 | ft |
| Specific Energy | 0.84 | ft |
| Froude Number | 0.78 | |
| Maximum Discharg | 4.17 | cfs |
| Discharge Full | 3.88 | cfs |
| Slope Full | 0.001171 | ft/ft |
| Flow Type | Subcritical | |

# Worksheet
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | 10 - A - 1 to 10 |
| Flow Element | Circular Channel |
| Method | Manning's Formul: |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Slope | 0.003600 | ft/ft |
| Diameter | 15 | in |
| Discharge | 2.97 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.82 | ft |
| Flow Area | 0.9 | ft² |
| Wetted Perimeter | 2.36 | ft |
| Top Width | 1.19 | ft |
| Critical Depth | 0.69 | ft |
| Percent Full | 65.6 | % |
| Critical Slope | 0.006006 | ft/ft |
| Velocity | 3.48 | ft/s |
| Velocity Head | 0.19 | ft |
| Specific Energy | 1.01 | ft |
| Froude Number | 0.72 | |
| Maximum Discharg | 4.17 | cfs |
| Discharge Full | 3.88 | cfs |
| Slope Full | 0.002114 | ft/ft |
| Flow Type | Subcritical | |

# Worksheet
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | 10 - A - 2 to 10 |
| Flow Element | Circular Channel |
| Method | Manning's Formul: |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Slope | 0.010000 | ft/ft |
| Diameter | 15 | in |
| Discharge | 1.65 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.43 | ft |
| Flow Area | 0.4 | ft² |
| Wetted Perimeter | 1.57 | ft |
| Top Width | 1.19 | ft |
| Critical Depth | 0.51 | ft |
| Percent Full | 34.5 | % |
| Critical Slope | 0.005356 | ft/ft |
| Velocity | 4.40 | ft/s |
| Velocity Head | 0.30 | ft |
| Specific Energy | 0.73 | ft |
| Froude Number | 1.38 | |
| Maximum Discharg | 6.95 | cfs |
| Discharge Full | 6.46 | cfs |
| Slope Full | 0.000652 | ft/ft |
| Flow Type | Supercritical | |

# Worksheet
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | 10 to 11 |
| Flow Element | Circular Channel |
| Method | Manning's Formul: |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Slope | 0.007200 | ft/ft |
| Diameter | 15 | in |
| Discharge | 5.27 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.98 | ft |
| Flow Area | 1.0 | ft² |
| Wetted Perimeter | 2.73 | ft |
| Top Width | 1.02 | ft |
| Critical Depth | 0.93 | ft |
| Percent Full | 78.7 | % |
| Critical Slope | 0.008141 | ft/ft |
| Velocity | 5.09 | ft/s |
| Velocity Head | 0.40 | ft |
| Specific Energy | 1.39 | ft |
| Froude Number | 0.89 | |
| Maximum Discharg | 5.90 | cfs |
| Discharge Full | 5.48 | cfs |
| Slope Full | 0.006656 | ft/ft |
| Flow Type | Subcritical | |

# Worksheet
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | 11 - 12 |
| Flow Element | Circular Channel |
| Method | Manning's Formul |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Slope | 0.007600 | ft/ft |
| Diameter | 15 | in |
| Discharge | 5.55 | cfs |

| Results | | |
|---|---|---|
| Depth | 1.01 | ft |
| Flow Area | 1.1 | ft² |
| Wetted Perimeter | 2.79 | ft |
| Top Width | 0.99 | ft |
| Critical Depth | 0.95 | ft |
| Percent Full | 80.7 | % |
| Critical Slope | 0.008516 | ft/ft |
| Velocity | 5.23 | ft/s |
| Velocity Head | 0.43 | ft |
| Specific Energy | 1.43 | ft |
| Froude Number | 0.89 | |
| Maximum Discharg | 6.06 | cfs |
| Discharge Full | 5.63 | cfs |
| Slope Full | 0.007382 | ft/ft |
| Flow Type | Subcritical | |

# Worksheet
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | 12 - C to 12 - A |
| Flow Element | Circular Channel |
| Method | Manning's Formul: |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Slope | 0.027100 | ft/ft |
| Diameter | 15 | in |
| Discharge | 1.49 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.32 | ft |
| Flow Area | 0.2 | ft² |
| Wetted Perimeter | 1.32 | ft |
| Top Width | 1.09 | ft |
| Critical Depth | 0.48 | ft |
| Percent Full | 25.3 | % |
| Critical Slope | 0.005302 | ft/ft |
| Velocity | 6.11 | ft/s |
| Velocity Head | 0.58 | ft |
| Specific Energy | 0.90 | ft |
| Froude Number | 2.27 | |
| Maximum Discharg | 11.44 | cfs |
| Discharge Full | 10.63 | cfs |
| Slope Full | 0.000532 | ft/ft |
| Flow Type | Supercritical | |

# Worksheet
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | 12 - B to 12 - A |
| Flow Element | Circular Channel |
| Method | Manning's Formul: |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Slope | 0.010000 | ft/ft |
| Diameter | 15 | in |
| Discharge | 1.27 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.38 | ft |
| Flow Area | 0.3 | ft² |
| Wetted Perimeter | 1.45 | ft |
| Top Width | 1.15 | ft |
| Critical Depth | 0.44 | ft |
| Percent Full | 30.1 | % |
| Critical Slope | 0.005255 | ft/ft |
| Velocity | 4.09 | ft/s |
| Velocity Head | 0.26 | ft |
| Specific Energy | 0.64 | ft |
| Froude Number | 1.39 | |
| Maximum Discharg | 6.95 | cfs |
| Discharge Full | 6.46 | cfs |
| Slope Full | 0.000387 | ft/ft |
| Flow Type | Supercritical | |

# Worksheet
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | 12 - A to 12 |
| Flow Element | Circular Channel |
| Method | Manning's Formul |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Slope | 0.039700 | ft/ft |
| Diameter | 15 | in |
| Discharge | 3.08 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.42 | ft |
| Flow Area | 0.4 | ft² |
| Wetted Perimeter | 1.54 | ft |
| Top Width | 1.18 | ft |
| Critical Depth | 0.71 | ft |
| Percent Full | 33.3 | % |
| Critical Slope | 0.006077 | ft/ft |
| Velocity | 8.61 | ft/s |
| Velocity Head | 1.15 | ft |
| Specific Energy | 1.57 | ft |
| Froude Number | 2.76 | |
| Maximum Discharg | 13.84 | cfs |
| Discharge Full | 12.87 | cfs |
| Slope Full | 0.002274 | ft/ft |
| Flow Type | Supercritical | |

# Worksheet
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | 12 to 13 |
| Flow Element | Circular Channel |
| Method | Manning's Formul |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Slope | 0.009700 | ft/ft |
| Diameter | 18 | in |
| Discharge | 8.34 | cfs |

| Results | | |
|---|---|---|
| Depth | 1.02 | ft |
| Flow Area | 1.3 | ft² |
| Wetted Perimeter | 2.91 | ft |
| Top Width | 1.40 | ft |
| Critical Depth | 1.12 | ft |
| Percent Full | 68.0 | % |
| Critical Slope | 0.007679 | ft/ft |
| Velocity | 6.51 | ft/s |
| Velocity Head | 0.66 | ft |
| Specific Energy | 1.68 | ft |
| Froude Number | 1.20 | |
| Maximum Discharg | 11.13 | cfs |
| Discharge Full | 10.35 | cfs |
| Slope Full | 0.006304 | ft/ft |
| Flow Type | Supercritical | |

# Worksheet
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | 13 - C - 1 to 13 - C |
| Flow Element | Circular Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Slope | 0.008000 | ft/ft |
| Diameter | 15 | in |
| Discharge | 0.46 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.24 | ft |
| Flow Area | 0.2 | ft² |
| Wetted Perimeter | 1.13 | ft |
| Top Width | 0.98 | ft |
| Critical Depth | 0.26 | ft |
| Percent Full | 19.1 | % |
| Critical Slope | 0.005342 | ft/ft |
| Velocity | 2.82 | ft/s |
| Velocity Head | 0.12 | ft |
| Specific Energy | 0.36 | ft |
| Froude Number | 1.22 | |
| Maximum Discharg | 6.21 | cfs |
| Discharge Full | 5.78 | cfs |
| Slope Full | 0.000051 | ft/ft |
| Flow Type | Supercritical | |

# Worksheet
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | 13 - C to 13 - B |
| Flow Element | Circular Channel |
| Method | Manning's Formul: |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Slope | 0.003600 | ft/ft |
| Diameter | 15 | in |
| Discharge | 1.08 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.45 | ft |
| Flow Area | 0.4 | ft² |
| Wetted Perimeter | 1.61 | ft |
| Top Width | 1.20 | ft |
| Critical Depth | 0.41 | ft |
| Percent Full | 36.1 | % |
| Critical Slope | 0.005226 | ft/ft |
| Velocity | 2.71 | ft/s |
| Velocity Head | 0.11 | ft |
| Specific Energy | 0.56 | ft |
| Froude Number | 0.83 | |
| Maximum Discharg | 4.17 | cfs |
| Discharge Full | 3.88 | cfs |
| Slope Full | 0.000280 | ft/ft |
| Flow Type | Subcritical | |

# Worksheet
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | 13 - B - 1 to 13 - B |
| Flow Element | Circular Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.024 | |
| Slope | 0.010000 | ft/ft |
| Diameter | 15 | in |
| Discharge | 1.15 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.49 | ft |
| Flow Area | 0.5 | ft² |
| Wetted Perimeter | 1.70 | ft |
| Top Width | 1.22 | ft |
| Critical Depth | 0.42 | ft |
| Percent Full | 39.5 | % |
| Critical Slope | 0.017835 | ft/ft |
| Velocity | 2.55 | ft/s |
| Velocity Head | 0.10 | ft |
| Specific Energy | 0.59 | ft |
| Froude Number | 0.74 | |
| Maximum Discharg | 3.76 | cfs |
| Discharge Full | 3.50 | cfs |
| Slope Full | 0.001080 | ft/ft |
| Flow Type | Subcritical | |

# Worksheet
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | 13 - B to 13 |
| Flow Element | Circular Channel |
| Method | Manning's Formul: |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Slope | 0.003600 | ft/ft |
| Diameter | 15 | in |
| Discharge | 2.75 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.78 | ft |
| Flow Area | 0.8 | ft² |
| Wetted Perimeter | 2.27 | ft |
| Top Width | 1.21 | ft |
| Critical Depth | 0.67 | ft |
| Percent Full | 62.2 | % |
| Critical Slope | 0.005874 | ft/ft |
| Velocity | 3.43 | ft/s |
| Velocity Head | 0.18 | ft |
| Specific Energy | 0.96 | ft |
| Froude Number | 0.74 | |
| Maximum Discharg | 4.17 | cfs |
| Discharge Full | 3.88 | cfs |
| Slope Full | 0.001812 | ft/ft |
| Flow Type | Subcritical | |

# Worksheet
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | 13 to 14 |
| Flow Element | Circular Channel |
| Method | Manning's Formul: |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Slope | 0.060000 | ft/ft |
| Diameter | 18 | in |
| Discharge | 11.41 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.70 | ft |
| Flow Area | 0.8 | ft² |
| Wetted Perimeter | 2.26 | ft |
| Top Width | 1.50 | ft |
| Critical Depth | 1.29 | ft |
| Percent Full | 46.6 | % |
| Critical Slope | 0.010938 | ft/ft |
| Velocity | 14.12 | ft/s |
| Velocity Head | 3.10 | ft |
| Specific Energy | 3.80 | ft |
| Froude Number | 3.39 | |
| Maximum Discharg | 27.68 | cfs |
| Discharge Full | 25.73 | cfs |
| Slope Full | 0.011800 | ft/ft |
| Flow Type | Supercritical | |

# Worksheet
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | 14 - A to 14 |
| Flow Element | Circular Channel |
| Method | Manning's Formul: |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Slope | 0.113000 | ft/ft |
| Diameter | 15 | in |
| Discharge | 1.44 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.22 | ft |
| Flow Area | 0.1 | ft² |
| Wetted Perimeter | 1.08 | ft |
| Top Width | 0.95 | ft |
| Critical Depth | 0.47 | ft |
| Percent Full | 17.4 | % |
| Critical Slope | 0.005288 | ft/ft |
| Velocity | 10.03 | ft/s |
| Velocity Head | 1.56 | ft |
| Specific Energy | 1.78 | ft |
| Froude Number | 4.54 | |
| Maximum Discharg | 23.36 | cfs |
| Discharge Full | 21.71 | cfs |
| Slope Full | 0.000497 | ft/ft |
| Flow Type | Supercritical | |

# Worksheet
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | 14 to 15 |
| Flow Element | Circular Channel |
| Method | Manning's Formul |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Slope | 0.080000 | ft/ft |
| Diameter | 18 | in |
| Discharge | 12.73 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.69 | ft |
| Flow Area | 0.8 | ft² |
| Wetted Perimeter | 2.23 | ft |
| Top Width | 1.49 | ft |
| Critical Depth | 1.34 | ft |
| Percent Full | 45.7 | % |
| Critical Slope | 0.012997 | ft/ft |
| Velocity | 16.16 | ft/s |
| Velocity Head | 4.06 | ft |
| Specific Energy | 4.75 | ft |
| Froude Number | 3.93 | |
| Maximum Discharg | 31.96 | cfs |
| Discharge Full | 29.71 | cfs |
| Slope Full | 0.014688 | ft/ft |
| Flow Type | Supercritical | |

# Worksheet
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | 15 to 16 |
| Flow Element | Circular Channel |
| Method | Manning's Formul |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Slope | 0.004500 | ft/ft |
| Diameter | 24 | in |
| Discharge | 12.73 | cfs |

| Results | | |
|---|---|---|
| Depth | 1.40 | ft |
| Flow Area | 2.4 | ft² |
| Wetted Perimeter | 3.97 | ft |
| Top Width | 1.83 | ft |
| Critical Depth | 1.28 | ft |
| Percent Full | 70.1 | % |
| Critical Slope | 0.005741 | ft/ft |
| Velocity | 5.41 | ft/s |
| Velocity Head | 0.45 | ft |
| Specific Energy | 1.86 | ft |
| Froude Number | 0.84 | |
| Maximum Discharg | 16.32 | cfs |
| Discharge Full | 15.17 | cfs |
| Slope Full | 0.003167 | ft/ft |
| Flow Type | Subcritical | |

# Worksheet
## Worksheet for Curb Inlet On Grade

| Project Description | |
|---|---|
| Worksheet | Curb Inlet - 13 - B |
| Type | Curb Inlet On Grade |
| Solve For | Efficiency |

| Input Data | | |
|---|---|---|
| Discharge | 0.51 | cfs |
| Slope | 0.015000 | ft/ft |
| Gutter Width | 1.67 | ft |
| Gutter Cross Slope | 0.083330 | ft/ft |
| Road Cross Slope | 0.020800 | ft/ft |
| Mannings Coefficient | 0.015 | |
| Curb Opening Length | 4.00 | ft |
| Local Depression | 2.0 | in |
| Local Depression Width | 2.00 | ft |

| Results | | |
|---|---|---|
| Efficiency | 0.95 | |
| Intercepted Flow | 0.48 | cfs |
| Bypass Flow | 0.03 | cfs |
| Spread | 3.21 | ft |
| Depth | 0.17 | ft |
| Flow Area | 0.2 | $ft^2$ |
| Gutter Depression | 1.3 | in |
| Total Depression | 3.3 | in |
| Velocity | 2.62 | ft/s |
| Equivalent Cross Slope | 0.150313 | ft/ft |
| Length Factor | 0.80 | |
| Total Interception Length | 4.97 | ft |

# Worksheet
## Worksheet for Curb Inlet On Grade

| Project Description | |
|---|---|
| Worksheet | Curb Inlet - 13 |
| Type | Curb Inlet On Grade |
| Solve For | Efficiency |

| Input Data | | |
|---|---|---|
| Discharge | 0.66 | cfs |
| Slope | 0.034300 | ft/ft |
| Gutter Width | 1.67 | ft |
| Gutter Cross Slope | 0.083330 | ft/ft |
| Road Cross Slope | 0.020800 | ft/ft |
| Mannings Coefficient | 0.015 | |
| Curb Opening Length | 6.00 | ft |
| Local Depression | 2.0 | in |
| Local Depression Width | 2.00 | ft |

| Results | | |
|---|---|---|
| Efficiency | 0.97 | |
| Intercepted Flow | 0.64 | cfs |
| Bypass Flow | 0.02 | cfs |
| Spread | 2.79 | ft |
| Depth | 0.16 | ft |
| Flow Area | 0.2 | $ft^2$ |
| Gutter Depression | 1.3 | in |
| Total Depression | 3.3 | in |
| Velocity | 3.92 | ft/s |
| Equivalent Cross Slope | 0.153307 | ft/ft |
| Length Factor | 0.86 | |
| Total Interception Length | 7.01 | ft |

# Worksheet
## Worksheet for Curb Inlet On Grade

| Project Description | |
|---|---|
| Worksheet | Curb Inlet - 12 - C |
| Type | Curb Inlet On Grade |
| Solve For | Efficiency |

| Input Data | | |
|---|---|---|
| Discharge | 1.09 | cfs |
| Slope | 0.040800 | ft/ft |
| Gutter Width | 1.67 | ft |
| Gutter Cross Slope | 0.083333 | ft/ft |
| Road Cross Slope | 0.020800 | ft/ft |
| Mannings Coefficient | 0.015 | |
| Curb Opening Length | 6.00 | ft |
| Local Depression | 2.0 | in |
| Local Depression Width | 2.00 | ft |

| Results | | |
|---|---|---|
| Efficiency | 0.83 | |
| Intercepted Flow | 0.91 | cfs |
| Bypass Flow | 0.18 | cfs |
| Spread | 3.92 | ft |
| Depth | 0.19 | ft |
| Flow Area | 0.2 | $ft^2$ |
| Gutter Depression | 1.3 | in |
| Total Depression | 3.3 | in |
| Velocity | 4.41 | ft/s |
| Equivalent Cross Slope | 0.143601 | ft/ft |
| Length Factor | 0.63 | |
| Total Interception Length | 9.49 | ft |

# Worksheet
## Worksheet for Curb Inlet On Grade

| Project Description | |
|---|---|
| Worksheet | Curb Inlet - 13 |
| Type | Curb Inlet On Grade |
| Solve For | Efficiency |

| Input Data | | |
|---|---|---|
| Discharge | 0.66 | cfs |
| Slope | 0.034300 | ft/ft |
| Gutter Width | 1.67 | ft |
| Gutter Cross Slope | 0.083330 | ft/ft |
| Road Cross Slope | 0.020800 | ft/ft |
| Mannings Coefficient | 0.015 | |
| Curb Opening Length | 6.00 | ft |
| Local Depression | 2.0 | in |
| Local Depression Width | 2.00 | ft |

| Results | | |
|---|---|---|
| Efficiency | 0.97 | |
| Intercepted Flow | 0.64 | cfs |
| Bypass Flow | 0.02 | cfs |
| Spread | 2.79 | ft |
| Depth | 0.16 | ft |
| Flow Area | 0.2 | $ft^2$ |
| Gutter Depression | 1.3 | in |
| Total Depression | 3.3 | in |
| Velocity | 3.92 | ft/s |
| Equivalent Cross Slope | 0.153307 | ft/ft |
| Length Factor | 0.86 | |
| Total Interception Length | 7.01 | ft |

# Worksheet
## Worksheet for Curb Inlet In Sag

| Project Description | |
|---|---|
| Worksheet | Curb Inlet - 13 - C - 1 |
| Type | Curb Inlet in Sag |
| Solve For | Spread |

| Input Data | | |
|---|---|---|
| Discharge | 0.32 | cfs |
| Gutter Width | 1.67 | ft |
| Gutter Cross Slope | 0.083330 | ft/ft |
| Road Cross Slope | 0.020800 | ft/ft |
| Curb Opening Length | 2.50 | ft |
| Opening Height | 0.39 | ft |
| Curb Throat Type | Horizontal | |
| Local Depression | 2.0 | in |
| Local Depression Width | 2.00 | ft |

| Results | | |
|---|---|---|
| Spread | 3.87 | ft |
| Throat Incline Angle | 90.00 | degrees |
| Depth | 0.35 | ft |
| Gutter Depression | 1.3 | in |
| Total Depression | 3.3 | in |

# Worksheet
## Worksheet for Curb Inlet On Grade

| Project Description | |
|---|---|
| Worksheet | Curb Inlet - 13 - B - 1 |
| Type | Curb Inlet On Grade |
| Solve For | Efficiency |

| Input Data | | |
|---|---|---|
| Discharge | 0.79 | cfs |
| Slope | 0.015000 | ft/ft |
| Gutter Width | 1.67 | ft |
| Gutter Cross Slope | 0.083330 | ft/ft |
| Road Cross Slope | 0.020800 | ft/ft |
| Mannings Coefficient | 0.015 | |
| Curb Opening Length | 6.00 | ft |
| Local Depression | 2.0 | in |
| Local Depression Width | 2.00 | ft |

| Results | | |
|---|---|---|
| Efficiency | 1.00 | |
| Intercepted Flow | 0.79 | cfs |
| Bypass Flow | 2.98e-3 | cfs |
| Spread | 4.42 | ft |
| Depth | 0.20 | ft |
| Flow Area | 0.3 | $ft^2$ |
| Gutter Depression | 1.3 | in |
| Total Depression | 3.3 | in |
| Velocity | 2.72 | ft/s |
| Equivalent Cross Slope | 0.138125 | ft/ft |
| Length Factor | 0.95 | |
| Total Interception Length | 6.28 | ft |

# Worksheet
## Worksheet for Curb Inlet In Sag

| Project Description | |
|---|---|
| Worksheet | Curb Inlet - 12 - B |
| Type | Curb Inlet In Sag |
| Solve For | Spread |

| Input Data | | |
|---|---|---|
| Discharge | 0.90 | cfs |
| Gutter Width | 1.67 | ft |
| Gutter Cross Slope | 0.083333 | ft/ft |
| Road Cross Slope | 0.020800 | ft/ft |
| Curb Opening Length | 6.00 | ft |
| Opening Height | 0.39 | ft |
| Curb Throat Type | Horizontal | |
| Local Depression | 2.0 | in |
| Local Depression Width | 2.00 | ft |

| Results | | |
|---|---|---|
| Spread | 5.69 | ft |
| Throat Incline Angle | 90.00 | degrees |
| Depth | 0.39 | ft |
| Gutter Depression | 1.3 | in |
| Total Depression | 3.3 | in |

# Worksheet
## Worksheet for Curb Inlet In Sag

| Project Description | |
|---|---|
| Worksheet | Curb Inlet - 12 - A |
| Type | Curb Inlet In Sag |
| Solve For | Spread |

| Input Data | | |
|---|---|---|
| Discharge | 0.25 | cfs |
| Gutter Width | 1.67 | ft |
| Gutter Cross Slope | 0.083333 | ft/ft |
| Road Cross Slope | 0.020800 | ft/ft |
| Curb Opening Length | 2.50 | ft |
| Opening Height | 0.39 | ft |
| Curb Throat Type | Horizontal | |
| Local Depression | 2.0 | in |
| Local Depression Width | 2.00 | ft |

| Results | | |
|---|---|---|
| Spread | 3.28 | ft |
| Throat Incline Angle | 90.00 | degrees |
| Depth | 0.34 | ft |
| Gutter Depression | 1.3 | in |
| Total Depression | 3.3 | in |

# Worksheet
## Worksheet for Curb Inlet On Grade

| Project Description | |
|---|---|
| Worksheet | Curb Inlet - 11 |
| Type | Curb Inlet On Grade |
| Solve For | Efficiency |

| Input Data | | |
|---|---|---|
| Discharge | 0.29 | cfs |
| Slope | 0.014600 | ft/ft |
| Gutter Width | 1.67 | ft |
| Gutter Cross Slope | 0.083330 | ft/ft |
| Road Cross Slope | 0.020800 | ft/ft |
| Mannings Coefficient | 0.015 | |
| Curb Opening Length | 2.50 | ft |
| Local Depression | 2.0 | in |
| Local Depression Width | 2.00 | ft |

| Results | | |
|---|---|---|
| Efficiency | 0.86 | |
| Intercepted Flow | 0.25 | cfs |
| Bypass Flow | 0.04 | cfs |
| Spread | 1.76 | ft |
| Depth | 0.14 | ft |
| Flow Area | 0.1 | $ft^2$ |
| Gutter Depression | 1.3 | in |
| Total Depression | 3.3 | in |
| Velocity | 2.43 | ft/s |
| Equivalent Cross Slope | 0.156340 | ft/ft |
| Length Factor | 0.66 | |
| Total Interception Length | 3.80 | ft |

# Worksheet
## Worksheet for Curb Inlet In Sag

| Project Description | |
|---|---|
| Worksheet | Curb Inlet - 10 |
| Type | Curb Inlet In Sag |
| Solve For | Spread |

| Input Data | | |
|---|---|---|
| Discharge | 0.54 | cfs |
| Gutter Width | 2.00 | ft |
| Gutter Cross Slope | 0.083330 | ft/ft |
| Road Cross Slope | 0.020800 | ft/ft |
| Curb Opening Length | 6.00 | ft |
| Opening Height | 0.39 | ft |
| Curb Throat Type | Horizontal | |
| Local Depression | 2.0 | in |
| Local Depression Width | 2.00 | ft |

| Results | | |
|---|---|---|
| Spread | 4.05 | ft |
| Throat Incline Angle | 90.00 | degrees |
| Depth | 0.38 | ft |
| Gutter Depression | 1.5 | in |
| Total Depression | 3.5 | in |

# Worksheet
## Worksheet for Curb Inlet On Grade

| Project Description | |
|---|---|
| Worksheet | Curb Inlet - 10 - A - 1 |
| Type | Curb Inlet On Grade |
| Solve For | Efficiency |

| Input Data | | |
|---|---|---|
| Discharge | 0.65 | cfs |
| Slope | 0.010000 | ft/ft |
| Gutter Width | 1.67 | ft |
| Gutter Cross Slope | 0.083333 | ft/ft |
| Road Cross Slope | 0.020800 | ft/ft |
| Mannings Coefficient | 0.015 | |
| Curb Opening Length | 4.00 | ft |
| Local Depression | 2.0 | in |
| Local Depression Width | 2.00 | ft |

| Results | | |
|---|---|---|
| Efficiency | 0.93 | |
| Intercepted Flow | 0.61 | cfs |
| Bypass Flow | 0.04 | cfs |
| Spread | 4.44 | ft |
| Depth | 0.20 | ft |
| Flow Area | 0.3 | $ft^2$ |
| Gutter Depression | 1.3 | in |
| Total Depression | 3.3 | in |
| Velocity | 2.22 | ft/s |
| Equivalent Cross Slope | 0.137882 | ft/ft |
| Length Factor | 0.78 | |
| Total Interception Length | 5.13 | ft |

# Worksheet
## Worksheet for Curb Inlet In Sag

| Project Description | |
|---|---|
| Worksheet | Curb Inlet - 10 - A - 2 |
| Type | Curb Inlet In Sag |
| Solve For | Spread |

| Input Data | | |
|---|---|---|
| Discharge | 1.20 | cfs |
| Gutter Width | 1.67 | ft |
| Gutter Cross Slope | 0.083330 | ft/ft |
| Road Cross Slope | 0.020800 | ft/ft |
| Curb Opening Length | 6.00 | ft |
| Opening Height | 0.39 | ft |
| Curb Throat Type | Horizontal | |
| Local Depression | 2.0 | in |
| Local Depression Width | 2.00 | ft |

| Results | | |
|---|---|---|
| Spread | 6.90 | ft |
| Throat Incline Angle | 90.00 | degrees |
| Depth | 0.41 | ft |
| Gutter Depression | 1.3 | in |
| Total Depression | 3.3 | in |

# Worksheet
## Worksheet for Curb Inlet On Grade

| Project Description | |
|---|---|
| Worksheet | Curb Inlet - 10 - B |
| Type | Curb Inlet On Grade |
| Solve For | Efficiency |

| Input Data | | |
|---|---|---|
| Discharge | 0.36 | cfs |
| Slope | 0.010000 | ft/ft |
| Gutter Width | 1.67 | ft |
| Gutter Cross Slope | 0.083330 | ft/ft |
| Road Cross Slope | 0.020800 | ft/ft |
| Mannings Coefficient | 0.015 | |
| Curb Opening Length | 2.50 | ft |
| Local Depression | 2.0 | in |
| Local Depression Width | 2.00 | ft |

| Results | | |
|---|---|---|
| Efficiency | 0.86 | |
| Intercepted Flow | 0.31 | cfs |
| Bypass Flow | 0.05 | cfs |
| Spread | 2.82 | ft |
| Depth | 0.16 | ft |
| Flow Area | 0.2 | $ft^2$ |
| Gutter Depression | 1.3 | in |
| Total Depression | 3.3 | in |
| Velocity | 2.12 | ft/s |
| Equivalent Cross Slope | 0.153141 | ft/ft |
| Length Factor | 0.67 | |
| Total Interception Length | 3.76 | ft |

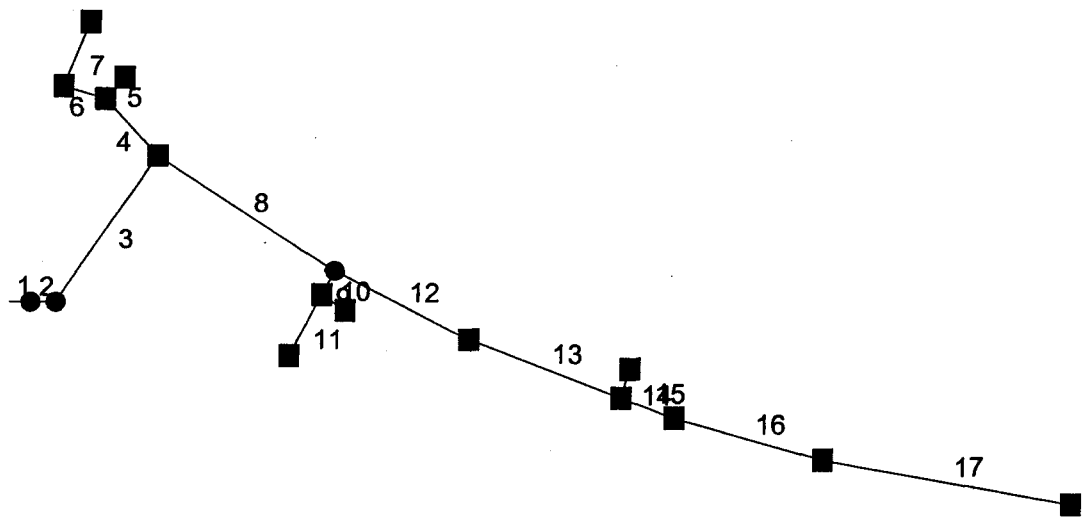
# Worksheet
## Worksheet for Curb Inlet In Sag

| Project Description | |
|---|---|
| Worksheet | Curb Inlet - 10 - C |
| Type | Curb Inlet In Sag |
| Solve For | Spread |

| Input Data | | |
|---|---|---|
| Discharge | 1.28 | cfs |
| Gutter Width | 1.67 | ft |
| Gutter Cross Slope | 0.083330 | ft/ft |
| Road Cross Slope | 0.020800 | ft/ft |
| Curb Opening Length | 8.00 | ft |
| Opening Height | 0.39 | ft |
| Curb Throat Type | Horizontal | |
| Local Depression | 2.0 | in |
| Local Depression Width | 2.00 | ft |

| Results | | |
|---|---|---|
| Spread | 6.35 | ft |
| Throat Incline Angle | 90.00 | degrees |
| Depth | 0.40 | ft |
| Gutter Depression | 1.3 | in |
| Total Depression | 3.3 | in |

# Hydraflow Plan View




| | | | |
|---|---|---|---|
| Project file: Stonehouse Glen System 3.stm | IDF file: Norfolk.IDF | No. Lines: 17 | 10-19-2004 |

# Hydraflow Storm Sewer Inventory Report



| Line No. | Alignment | | | | Flow Data | | | | Physical Data | | | | | | | | Line ID |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Dnstr line No. | Line length (ft) | Defl angle (deg) | Junc type | Known Q (cfs) | Drng area (ac) | Runoff coeff (C) | Inlet time (min) | Invert El Dn (ft) | Line slope (%) | Invert El Up (ft) | Line size (in) | Line type | N value (n) | J-loss coeff (K) | Inlet/ Rim El (ft) | |
| 1 | End | 24.0 | 0.0 | MH | 11.41 | 0.00 | 0.00 | 0.0 | 61.00 | 2.42 | 61.58 | 18 | Cir | 0.013 | 0.15 | 71.00 | 15 to 16 |
| 2 | 1 | 30.0 | 0.0 | MH | 11.41 | 0.00 | 0.00 | 0.0 | 65.78 | 2.40 | 66.50 | 18 | Cir | 0.013 | 0.75 | 78.00 | 14 to 15 |
| 3 | 2 | 199.0 | -53.0 | Curb | 11.41 | 0.00 | 0.00 | 0.0 | 70.00 | 5.53 | 81.00 | 18 | Cir | 0.013 | 1.50 | 91.43 | 13 to 14 |
| 4 | 3 | 87.0 | -82.0 | Curb | 2.53 | 0.00 | 0.00 | 0.0 | 82.72 | 0.36 | 83.03 | 15 | Cir | 0.013 | 1.50 | 88.84 | 13 to 13 B |
| 5 | 4 | 32.0 | 90.0 | Curb | 1.15 | 0.00 | 0.00 | 0.0 | 84.59 | 1.00 | 84.91 | 15 | Cir | 0.013 | 1.00 | 88.83 | 13 B to 13 B 1 |
| 6 | 4 | 51.0 | -30.0 | Curb | 1.08 | 0.00 | 0.00 | 0.0 | 83.13 | 0.35 | 83.31 | 15 | Cir | 0.013 | 1.50 | 87.94 | 13 B to 13 C |
| 7 | 6 | 74.0 | 100.0 | Curb | 0.46 | 0.00 | 0.00 | 0.0 | 83.41 | 0.80 | 84.00 | 15 | Cir | 0.013 | 1.00 | 87.96 | 13 C to 13 C 1 |
| 8 | 3 | 244.0 | 84.0 | MH | 8.34 | 0.00 | 0.00 | 0.0 | 82.72 | 0.98 | 85.10 | 18 | Cir | 0.013 | 1.00 | 98.78 | 12 to 13 |
| 9 | 8 | 30.0 | 90.0 | Curb | 3.08 | 0.00 | 0.00 | 0.0 | 91.90 | 3.97 | 93.09 | 15 | Cir | 0.013 | 1.50 | 98.39 | 12 to 12 A |
| 10 | 9 | 32.0 | -90.0 | Curb | 1.27 | 0.00 | 0.00 | 0.0 | 94.09 | 1.00 | 94.41 | 15 | Cir | 0.013 | 1.00 | 98.33 | 12 A to 12 B |
| 11 | 9 | 75.0 | 0.0 | Curb | 1.49 | 0.00 | 0.00 | 0.0 | 94.47 | 2.71 | 96.50 | 15 | Cir | 0.013 | 1.00 | 100.42 | 12 C to 12 A |
| 12 | 8 | 173.0 | -6.0 | Curb | 5.55 | 0.00 | 0.00 | 0.0 | 85.35 | 0.76 | 86.66 | 15 | Cir | 0.013 | 0.50 | 97.78 | 12 to 11 |
| 13 | 12 | 189.0 | -6.0 | Curb | 5.27 | 0.00 | 0.00 | 0.0 | 86.76 | 0.72 | 88.12 | 15 | Cir | 0.013 | 1.50 | 95.46 | 10 to 11 |
| 14 | 13 | 32.0 | -90.0 | Curb | 1.65 | 0.00 | 0.00 | 0.0 | 91.22 | 1.00 | 91.54 | 15 | Cir | 0.013 | 1.00 | 95.46 | 10 A 2 to 10 |
| 15 | 13 | 66.0 | 0.0 | Curb | 2.97 | 0.00 | 0.00 | 0.0 | 88.22 | 0.36 | 88.46 | 15 | Cir | 0.013 | 0.50 | 96.00 | 10 A 1 to 10 |
| 16 | 15 | 180.0 | -5.0 | Curb | 2.21 | 0.00 | 0.00 | 0.0 | 88.56 | 0.36 | 89.21 | 15 | Cir | 0.013 | 0.50 | 91.72 | 10 B to 10 A 1 |
| 17 | 16 | 296.0 | -5.0 | Curb | 1.76 | 0.00 | 0.00 | 0.0 | 89.31 | 0.36 | 90.38 | 15 | Cir | 0.013 | 1.00 | 94.30 | 10 C 10 B |

Project File: Stonehouse Glen System 3.stm | I-D-F File: Norfolk.IDF | Total number of lines: 17 | Date: 10-19-2004

# Hydraflow Summary Report



| Line No. | Line ID | Flow rate (cfs) | Line size (in) | Line length (ft) | Invert EL Dn (ft) | Invert EL Up (ft) | Line slope (%) | HGL down (ft) | HGL up (ft) | Minor loss (ft) | Dns line No. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 15 to 16 | 11.41 | 18 c | 24.0 | 61.00 | 61.58 | 2.417 | 62.20 | 62.87 | 0.12 | End |
| 2 | 14 to 15 | 11.41 | 18 c | 30.0 | 65.78 | 66.50 | 2.400 | 66.72* | 68.09* | 0.49 | 1 |
| 3 | 13 to 14 | 11.41 | 18 c | 199.0 | 70.00 | 81.00 | 5.528 | 70.73 | 82.29 | 1.16 | 2 |
| 4 | 13 to 13 B | 2.53 | 15 c | 87.0 | 82.72 | 83.03 | 0.356 | 83.47 | 83.77 | 0.26 | 3 |
| 5 | 13 B to 13 B 1 | 1.15 | 15 c | 32.0 | 84.59 | 84.91 | 1.000 | 84.96 | 85.34 | 0.15 | 4 |
| 6 | 13 B to 13 C | 1.08 | 15 c | 51.0 | 83.13 | 83.31 | 0.353 | 84.03 | 84.04 | 0.05 | 4 |
| 7 | 13 C to 13 C 1 | 0.46 | 15 c | 74.0 | 83.41 | 84.00 | 0.797 | 84.09 | 84.27 | 0.09 | 6 |
| 8 | 12 to 13 | 8.34 | 18 c | 244.0 | 82.72 | 85.10 | 0.975 | 83.75 | 86.20 | 0.56 | 3 |
| 9 | 12 to 12 A | 3.08 | 15 c | 30.0 | 91.90 | 93.09 | 3.967 | 92.33 | 93.79 | 0.44 | 8 |
| 10 | 12 A to 12 B | 1.27 | 15 c | 32.0 | 94.09 | 94.41 | 1.000 | 94.47 | 94.86 | 0.16 | 9 |
| 11 | 12 C to 12 A | 1.49 | 15 c | 75.0 | 94.47 | 96.50 | 2.707 | 94.80 | 96.99 | 0.17 | 9 |
| 12 | 12 to 11 | 5.55 | 15 c | 173.0 | 85.35 | 86.66 | 0.757 | 86.76* | 88.04* | 0.16 | 8 |
| 13 | 10 to 11 | 5.27 | 15 c | 189.0 | 86.76 | 88.12 | 0.720 | 88.20 | 89.34 | 0.44 | 12 |
| 14 | 10 A 2 to 10 | 1.65 | 15 c | 32.0 | 91.22 | 91.54 | 1.000 | 91.66 | 92.05 | 0.19 | 13 |
| 15 | 10 A 1 to 10 | 2.97 | 15 c | 66.0 | 88.22 | 88.46 | 0.364 | 89.78* | 89.92* | 0.05 | 13 |
| 16 | 10 B to 10 A 1 | 2.21 | 15 c | 180.0 | 88.56 | 89.21 | 0.361 | 89.96 | 90.16 | 0.04 | 15 |
| 17 | 10 C 10 B | 1.76 | 15 c | 296.0 | 89.31 | 90.38 | 0.361 | 90.20 | 90.93 | 0.18 | 16 |

Project File: Stonehouse Glen System 3I-D-F File: Norfolk.IDF | Total No. Lines: 17 | Run Date: 10-19-2004

NOTES: c = circular; e = elliptical; b = box; Return period = 10 Yrs.; * Indicates surcharge condition.

# Hydraflow Storm Sewer Tabulation



| Station | | Len | Drng Area | | Rnoff coeff | Area x C | | Tc | | Rain (I) | Total flow | Cap full | Vel | Pipe | | Invert Elev | | HGL Elev | | Grnd / Rim Elev | | Line ID |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Line | To Line | (ft) | Incr (ac) | Total (ac) | (C) | Incr | Total | Inlet (min) | Syst (min) | (in/hr) | (cfs) | (cfs) | (ft/s) | Size (in) | Slope (%) | Up (ft) | Dn (ft) | Up (ft) | Dn (ft) | Up (ft) | Dn (ft) | |
| 1 | End | 24.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.0 | 7.7 | 0.0 | 11.41 | 16.32 | 7.29 | 18 | 2.42 | 61.58 | 61.00 | 62.87 | 62.20 | 71.00 | 0.00 | 15 to 16 |
| 2 | 1 | 30.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.0 | 7.5 | 0.0 | 11.41 | 16.27 | 8.13 | 18 | 2.40 | 66.50 | 65.78 | 68.09 | 66.72 | 78.00 | 71.00 | 14 to 15 |
| 3 | 2 | 199.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.0 | 6.4 | 0.0 | 11.41 | 24.69 | 10.15 | 18 | 5.53 | 81.00 | 70.00 | 82.29 | 70.73 | 91.43 | 78.00 | 13 to 14 |
| 4 | 3 | 87.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.0 | 0.7 | 0.0 | 2.53 | 3.85 | 3.32 | 15 | 0.36 | 83.03 | 82.72 | 83.77 | 83.47 | 88.84 | 91.43 | 13 to 13 B |
| 5 | 4 | 32.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.0 | 0.0 | 0.0 | 1.15 | 6.46 | 3.44 | 15 | 1.00 | 84.91 | 84.59 | 85.34 | 84.96 | 88.83 | 88.84 | 13 B to 13 B |
| 6 | 4 | 51.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.0 | 0.4 | 0.0 | 1.08 | 3.84 | 1.29 | 15 | 0.35 | 83.31 | 83.13 | 84.04 | 84.03 | 87.94 | 88.84 | 13 B to 13 C |
| 7 | 6 | 74.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.0 | 0.0 | 0.0 | 0.46 | 5.77 | 1.51 | 15 | 0.80 | 84.00 | 83.41 | 84.27 | 84.09 | 87.96 | 87.94 | 13 C to 13 C |
| 8 | 3 | 244.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.0 | 5.0 | 0.0 | 8.34 | 10.37 | 6.23 | 18 | 0.98 | 85.10 | 82.72 | 86.20 | 83.75 | 98.78 | 91.43 | 12 to 13 |
| 9 | 8 | 30.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.0 | 0.4 | 0.0 | 3.08 | 12.86 | 6.32 | 15 | 3.97 | 93.09 | 91.90 | 93.79 | 92.33 | 98.39 | 98.78 | 12 to 12 A |
| 10 | 9 | 32.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.0 | 0.0 | 0.0 | 1.27 | 6.46 | 3.58 | 15 | 1.00 | 94.41 | 94.09 | 94.86 | 94.47 | 98.33 | 98.39 | 12 A to 12 B |
| 11 | 9 | 75.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.0 | 0.0 | 0.0 | 1.49 | 10.62 | 4.58 | 15 | 2.71 | 96.50 | 94.47 | 96.99 | 94.80 | 100.42 | 98.39 | 12 C to 12 A |
| 12 | 8 | 173.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.0 | 4.1 | 0.0 | 5.55 | 5.62 | 4.52 | 15 | 0.76 | 86.66 | 85.35 | 88.04 | 86.76 | 97.78 | 98.78 | 12 to 11 |
| 13 | 12 | 189.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.0 | 3.0 | 0.0 | 5.27 | 5.48 | 4.31 | 15 | 0.72 | 88.12 | 86.76 | 89.34 | 88.20 | 95.46 | 97.78 | 10 to 11 |
| 14 | 13 | 32.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.0 | 0.0 | 0.0 | 1.65 | 6.46 | 3.85 | 15 | 1.00 | 91.54 | 91.22 | 92.05 | 91.66 | 95.46 | 95.46 | 10 A 2 to 10 |
| 15 | 13 | 66.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.0 | 2.6 | 0.0 | 2.97 | 3.89 | 2.42 | 15 | 0.36 | 88.46 | 88.22 | 89.92 | 89.78 | 96.00 | 95.46 | 10 A 1 to 10 |
| 16 | 15 | 180.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.0 | 1.6 | 0.0 | 2.21 | 3.88 | 2.00 | 15 | 0.36 | 89.21 | 88.56 | 90.16 | 89.96 | 91.72 | 96.00 | 10 B to 10 A |
| 17 | 16 | 296.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.0 | 0.0 | 0.0 | 1.76 | 3.88 | 2.65 | 15 | 0.36 | 90.38 | 89.31 | 90.93 | 90.20 | 94.30 | 91.72 | 10 C 10 B |

Project File: Stonehouse Glen System 3.stm | I-D-F File: Norfolk.IDF | Total number of lines: 17 | Run Date: 10-19-2004

NOTES: Intensity = 128.59 / (Tc + 17.70) ^ 0.89; Return period = 10 Yrs. ; Initial tailwater elevation = 62.20 (ft)

# Hydraflow Inlet Report



| Line No | Line ID | A (ac) | Inlet time (min) | I (in/hr) | C | Q = CIA (cfs) | Q carry (cfs) | Q capt (cfs) | Q byp (cfs) | Junc type | Curb Inlet Ht (in) | Curb Inlet L (ft) | Grate Inlet area (sqft) | Grate Inlet L (ft) | Grate Inlet W (ft) | Gutter So (ft/ft) | Gutter W (ft) | Gutter Sw (ft/ft) | Gutter Sx (ft/ft) | Flow depth (ft) | Flow spread (ft) | Byp line No |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 15 to 16 | 0.00 | 0.0 | 0.00 | 0.00 | 11.41* | 36.85 | 0.00 | 48.26 | MH | 0.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 | 0.00 | 0.000 | 0.000 | 0.00 | 0.00 | Offsite |
| 2 | 14 to 15 | 0.00 | 0.0 | 0.00 | 0.00 | 11.41* | 25.44 | 0.00 | 36.85 | MH | 0.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 | 0.00 | 0.000 | 0.000 | 0.00 | 0.00 | 1 |
| 3 | 13 to 14 | 0.00 | 0.0 | 0.00 | 0.00 | 11.41* | 8.34 | 3.19 | 16.56 | Curb | 4.0 | 6.00 | 0.00 | 0.00 | 0.00 | 0.034 | 1.67 | 0.083 | 0.020 | 0.45 | 17.24 | 2 |
| 4 | 13 to 13 B | 0.00 | 0.0 | 0.00 | 0.00 | 2.53* | 0.00 | 0.97 | 1.56 | Curb | 4.0 | 4.00 | 0.00 | 0.00 | 0.00 | 0.015 | 1.67 | 0.083 | 0.020 | 0.28 | 8.74 | 2 |
| 5 | 13 B to 13 B 1 | 0.00 | 0.0 | 0.00 | 0.00 | 1.15* | 0.00 | 0.90 | 0.25 | Curb | 4.0 | 6.00 | 0.00 | 0.00 | 0.00 | 0.015 | 1.67 | 0.083 | 0.020 | 0.23 | 6.24 | 2 |
| 6 | 13 B to 13 C | 0.00 | 0.0 | 0.00 | 0.00 | 1.08* | 0.00 | 1.08 | 0.00 | Curb | 4.0 | 2.50 | 0.00 | 0.00 | 0.00 | Sag | 1.67 | 0.083 | 0.020 | 0.33 | 11.05 | 2 |
| 7 | 13 C to 13 C 1 | 0.00 | 0.0 | 0.00 | 0.00 | 0.46* | 0.00 | 0.46 | 0.00 | Curb | 4.0 | 2.50 | 0.00 | 0.00 | 0.00 | Sag | 1.67 | 0.083 | 0.020 | 0.18 | 3.94 | 2 |
| 8 | 12 to 13 | 0.00 | 0.0 | 0.00 | 0.00 | 8.34* | 0.00 | 0.00 | 8.34 | MH | 0.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 | 0.00 | 0.000 | 0.000 | 0.00 | 0.00 | 3 |
| 9 | 12 to 12 A | 0.00 | 0.0 | 0.00 | 0.00 | 3.08* | 0.00 | 3.08 | 0.00 | Curb | 4.0 | 2.50 | 0.00 | 0.00 | 0.00 | Sag | 1.67 | 0.083 | 0.020 | 0.66 | 27.65 | 2 |
| 10 | 12 A to 12 B | 0.00 | 0.0 | 0.00 | 0.00 | 1.27* | 0.00 | 1.27 | 0.00 | Curb | 4.0 | 6.00 | 0.00 | 0.00 | 0.00 | Sag | 1.67 | 0.083 | 0.020 | 0.20 | 4.85 | 2 |
| 11 | 12 C to 12 A | 0.00 | 0.0 | 0.00 | 0.00 | 1.49* | 0.00 | 0.87 | 0.62 | Curb | 4.0 | 6.00 | 0.00 | 0.00 | 0.00 | 0.040 | 1.67 | 0.083 | 0.020 | 0.21 | 5.24 | 2 |
| 12 | 12 to 11 | 0.00 | 0.0 | 0.00 | 0.00 | 5.55* | 0.00 | 0.93 | 4.62 | Curb | 4.0 | 2.50 | 0.00 | 0.00 | 0.00 | 0.014 | 1.67 | 0.083 | 0.020 | 0.36 | 12.74 | 2 |
| 13 | 10 to 11 | 0.00 | 0.0 | 0.00 | 0.00 | 5.27* | 0.00 | 5.27 | 0.00 | Curb | 4.0 | 6.00 | 0.00 | 0.00 | 0.00 | Sag | 1.67 | 0.083 | 0.020 | 0.41 | 15.10 | 2 |
| 14 | 10 A 2 to 10 | 0.00 | 0.0 | 0.00 | 0.00 | 1.65* | 0.00 | 1.65 | 0.00 | Curb | 4.0 | 6.00 | 0.00 | 0.00 | 0.00 | Sag | 1.67 | 0.083 | 0.020 | 0.24 | 6.79 | 2 |
| 15 | 10 A 1 to 10 | 0.00 | 0.0 | 0.00 | 0.00 | 2.97* | 0.00 | 1.14 | 1.83 | Curb | 4.0 | 4.00 | 0.00 | 0.00 | 0.00 | 0.010 | 1.67 | 0.083 | 0.020 | 0.31 | 10.24 | 2 |
| 16 | 10 B to 10 A 1 | 0.00 | 0.0 | 0.00 | 0.00 | 2.21* | 0.00 | 2.21 | 0.00 | Curb | 4.0 | 2.50 | 0.00 | 0.00 | 0.00 | Sag | 1.67 | 0.083 | 0.020 | 0.41 | 15.25 | 2 |
| 17 | 10 C 10 B | 0.00 | 0.0 | 0.00 | 0.00 | 1.76* | 0.00 | 1.76 | 0.00 | Curb | 4.0 | 6.00 | 0.00 | 0.00 | 0.00 | Sag | 1.67 | 0.083 | 0.020 | 0.25 | 7.32 | 2 |

Project File: Stonehouse Glen System 3.stm | I-D-F File: Norfolk.IDF | Total number of lines: 17 | Run Date: 10-19-2004

NOTES: Inlet N-Values = 0.016 ; Design depth for grate(s) = 0.3 (ft); Intensity = 128.59 / (Inlet time + 17.70) ^ 0.89; Return period = 10 Yrs. ; * Indicates Known Q added

# Hydraflow 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 | 18 | 11.41 | 61.00 | 62.20 | 1.20 | 1.52 | 7.53 | 0.88 | 63.08 | 1.236 | 24.0 | 61.58 | 62.87 | 1.29** | 1.62 | 7.04 | 0.77 | 63.64 | 1.090 | 1.163 | N/A | 0.15 | 0.12 |
| 2 | 18 | 11.41 | 65.78 | 66.72 | 0.94* | 1.16 | 9.81 | 1.50 | 68.21 | 2.305 | 30.0 | 66.50 | 68.09 | 1.50 | 1.77 | 6.46 | 0.65 | 68.74 | 1.181 | 1.743 | 0.523 | 0.75 | 0.49 |
| 3 | 18 | 11.41 | 70.00 | 70.73 | 0.73* | 0.86 | 13.26 | 2.74 | 73.47 | 5.073 | 199 | 81.00 | 82.29 | 1.29** | 1.62 | 7.04 | 0.77 | 83.06 | 1.090 | 3.082 | N/A | 1.50 | 1.16 |
| 4 | 15 | 2.53 | 82.72 | 83.47 | 0.75* | 0.77 | 3.28 | 0.17 | 83.64 | 0.338 | 87.0 | 83.03 | 83.77 | 0.74 | 0.75 | 3.37 | 0.18 | 83.94 | 0.360 | 0.349 | 0.304 | 1.50 | 0.26 |
| 5 | 15 | 1.15 | 84.59 | 84.96 | 0.37* | 0.30 | 3.79 | 0.22 | 85.18 | 0.874 | 32.0 | 84.91 | 85.34 | 0.43** | 0.37 | 3.08 | 0.15 | 85.49 | 0.493 | 0.684 | N/A | 1.00 | 0.15 |
| 6 | 15 | 1.08 | 83.13 | 84.03 | 0.90 | 0.95 | 1.14 | 0.02 | 84.05 | 0.037 | 51.0 | 83.31 | 84.04 | 0.73 | 0.75 | 1.44 | 0.03 | 84.08 | 0.066 | 0.052 | 0.026 | 1.50 | 0.05 |
| 7 | 15 | 0.46 | 83.41 | 84.09 | 0.68 | 0.68 | 0.67 | 0.01 | 84.10 | 0.015 | 74.0 | 84.00 | 84.27 | 0.27** | 0.20 | 2.34 | 0.09 | 84.36 | 0.475 | 0.245 | N/A | 1.00 | 0.09 |
| 8 | 18 | 8.34 | 82.72 | 83.75 | 1.03* | 1.29 | 6.46 | 0.65 | 84.40 | 0.953 | 244 | 85.10 | 86.20 | 1.10** | 1.39 | 5.99 | 0.56 | 86.76 | 0.796 | 0.874 | N/A | 1.00 | 0.56 |
| 9 | 15 | 3.08 | 91.90 | 92.33 | 0.43* | 0.37 | 8.29 | 1.07 | 93.40 | 3.578 | 30.0 | 93.09 | 93.79 | 0.70** | 0.71 | 4.34 | 0.29 | 94.08 | 0.619 | 2.099 | N/A | 1.50 | 0.44 |
| 10 | 15 | 1.27 | 94.09 | 94.47 | 0.38* | 0.32 | 3.97 | 0.24 | 94.72 | 0.920 | 32.0 | 94.41 | 94.86 | 0.45** | 0.40 | 3.18 | 0.16 | 95.02 | 0.499 | 0.710 | N/A | 1.00 | 0.16 |
| 11 | 15 | 1.49 | 94.47 | 94.80 | 0.33* | 0.26 | 5.81 | 0.52 | 95.32 | 2.353 | 75.0 | 96.50 | 96.99 | 0.49** | 0.44 | 3.35 | 0.17 | 97.16 | 0.511 | 1.432 | N/A | 1.00 | 0.17 |
| 12 | 15 | 5.55 | 85.35 | 86.76 | 1.25 | 1.23 | 4.52 | 0.32 | 87.08 | 0.739 | 173 | 86.66 | 88.04 | 1.25 | 1.23 | 4.52 | 0.32 | 88.36 | 0.739 | 0.739 | 1.278 | 0.50 | 0.16 |
| 13 | 15 | 5.27 | 86.76 | 88.20 | 1.25 | 1.23 | 4.30 | 0.29 | 88.48 | 0.666 | 189 | 88.12 | 89.34 | 1.22 | 1.22 | 4.32 | 0.29 | 89.63 | 0.593 | 0.629 | 1.190 | 1.50 | 0.44 |
| 14 | 15 | 1.65 | 91.22 | 91.66 | 0.44* | 0.39 | 4.24 | 0.28 | 91.94 | 0.903 | 32.0 | 91.54 | 92.05 | 0.51** | 0.48 | 3.47 | 0.19 | 92.24 | 0.520 | 0.711 | N/A | 1.00 | 0.19 |
| 15 | 15 | 2.97 | 88.22 | 89.78 | 1.25 | 1.23 | 2.42 | 0.09 | 89.87 | 0.212 | 66.0 | 88.46 | 89.92 | 1.25 | 1.23 | 2.42 | 0.09 | 90.01 | 0.212 | 0.212 | 0.140 | 0.50 | 0.05 |
| 16 | 15 | 2.21 | 88.56 | 89.96 | 1.25 | 1.23 | 1.80 | 0.05 | 90.01 | 0.117 | 180 | 89.21 | 90.16 | 0.95 | 1.00 | 2.20 | 0.08 | 90.24 | 0.136 | 0.126 | 0.228 | 0.50 | 0.04 |
| 17 | 15 | 1.76 | 89.31 | 90.20 | 0.89 | 0.94 | 1.88 | 0.06 | 90.26 | 0.101 | 296 | 90.38 | 90.93 | 0.55 | 0.52 | 3.41 | 0.18 | 91.11 | 0.475 | 0.288 | 0.852 | 1.00 | 0.18 |

Project File: Stonehouse Glen System 3.stm | I-D-F File: Norfolk.IDF | Total number of lines: 17 | Run Date: 10-19-2004

NOTES: Initial tailwater elevation = 62.2 (ft) , * Normal depth assumed., ** Critical depth assumed.

# Appendix 9B-2 LD-229 Storm Drain Design Computations

LD-229
July 2000

STORM SEWER DESIGN
COMPUTATIONS

~~ROUTE:~~ DATE Sept 1 2004 PROJ: STONEHOUSE GLEN Sect 1
COUNTY: DISTRICT: CURB & GUTTER
DESCRIPTION:
SHEET ____ OF ____

| FROM POINT (1) | TO POINT (2) | AREA DRAIN "A" ACRES (3) | RUN-OFF COEF. C (4) | CA INCREMENT (5) | CA ACCUMULATED (6) | INLET TIME MINUTES (7) | RAIN FALL IN./HR. (8) | RUN-OFF Q C.F.S. (9) | INVERT ELEVATIONS UPPER END (10) | INVERT ELEVATIONS LOWER END (11) | LENGTH FT. (12) | SLOPE FT./FT. (13) | DIA. IN. (14) | CAPACITY C.F.S. (15) | VEL. F.P.S. (16) | FLOW TIME MINUTES INCREMENT (17) | FLOW TIME MINUTES ACCUMULATED (17) | REMARKS (18) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 17-G | 17-F | 0.23 | 0.9 | — | 0.21 | 10' | 5.75 | 1.21 | 104.76 | 103.15 | 210' | 0.006 | 15" | 5.00 | 3.36 | 1.32 | — | |
| 17-F | 17-E | 0.28 | 0.85 | 0.24 | 0.45 | 11.3 | 5.62 | 2.53 | 103.05 | 102.90 | 32' | 0.0048 | 15" | 4.48 | 3.76 | 0.14 | 1.46 | |
| 17-E | 17-D | 0.13 | 0.9 | 0.12 | 0.57 | 11.5 | 5.6 | 3.19 | 102.80 | 102.03 | 148' | 0.0052 | 15" | 4.66 | 4.09 | 0.60 | 2.06 | |
| 17-D | 17-C | — | — | — | — | 12.06 | 5.54 | 3.16 | 101.93 | 101.34 | 114' | 0.0052 | 15" | 4.66 | 4.08 | 0.46 | 2.52 | |
| 17-C | 17-B | 0.07 | 0.9 | 0.06 | 0.63 | 12.52 | 5.50 | 3.47 | 101.00 | 100.85 | 32' | 0.0048 | 15" | 4.48 | 4.03 | 0.13 | 2.65 | |
| 17-B | 17-A | 0.21 | 0.7 | 0.15 | 0.78 | 12.65 | 5.49 | 4.28 | 100.75 | 98.85 | 101' | 0.0188 | 15" | 8.86 | 7.16 | 0.22 | 2.87 | |
| 17-A | 17 | — | — | — | — | 12.87 | 5.46 | 4.28 | 98.75 | 95.65 | 52' | 0.0596 | 15" | 15.26 | 10.26 | .08 | 2.95 | |
| | | | | | | | | | | | | | | | | | | |
| 16 | 17 | 0.99 | 0.35 | — | 0.35 | 14.0 | 5.35 | 1.87 | 92.16 | 90.79 | 286' | 0.0048 | 15" | 4.48 | 3.48 | 1.36 | — | |
| 17 | 18 | 0.07 | 0.35 | 0.02 | 1.15 | 15.36 | 5.21 | 5.99 | 89.70 | 84.87 | 140' | 0.0345 | 15" | 12.00 | 9.77 | 0.24 | 3.19 | |
| 18 | 19 | 0.47 | 0.50 | 0.24 | 1.39 | 15.60 | 5.19 | 7.21 | 84.62 | 84.41 | 34' | 0.0062 | 18" | 8.27 | 5.27 | 0.14 | 3.33 | |
| 19 | 20 | 0.11 | 0.90 | 0.10 | 1.49 | 15.74 | 5.18 | 7.72 | 84.31 | 82.59 | 292' | 0.0059 | 18" | 8.07 | 5.20 | 0.94 | 4.26 | |
| | | | | | | | | | | | | | | | | | | |
| 20 | 21 | 0.04 | 0.90 | 0.04 | 2.36 | 16.67 | 5.08 | 11.99 | 82.09 | 81.02 | 205' | 0.0052 | 24" | 16.31 | 5.68 | 0.60 | 4.86 | |
| 21 | 22 | — | — | — | 3.85 | 17.13 | 5.04 | 19.40 | 80.92 | 80.70 | 28' | 0.0078 | 24" | 19.98 | 7.25 | 0.06 | 4.86 | |
| 22 | 23 | 0.18 | 0.90 | 0.16 | 4.01 | 17.19 | 5.03 | 20.17 | 80.60 | 79.87 | 89' | 0.0082 | 24" | 20.48 | 7.43 | 0.20 | 5.06 | |
| | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | |

# Worksheet
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | 17 - G to 17 - F |
| Flow Element | Circular Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Slope | 0.006000 | ft/ft |
| Diameter | 15 | in |
| Discharge | 1.21 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.42 | ft |
| Flow Area | 0.4 | ft² |
| Wetted Perimeter | 1.54 | ft |
| Top Width | 1.18 | ft |
| Critical Depth | 0.43 | ft |
| Percent Full | 33.5 | % |
| Critical Slope | 0.005240 | ft/ft |
| Velocity | 3.36 | ft/s |
| Velocity Head | 0.18 | ft |
| Specific Energy | 0.59 | ft |
| Froude Number | 1.07 | |
| Maximum Discharg | 5.38 | cfs |
| Discharge Full | 5.00 | cfs |
| Slope Full | 0.000351 | ft/ft |
| Flow Type | Supercritical | |

# Worksheet
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | 17 - F to 17 - E |
| Flow Element | Circular Channel |
| Method | Manning's Formul |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Slope | 0.004800 | ft/ft |
| Diameter | 15 | in |
| Discharge | 2.53 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.67 | ft |
| Flow Area | 0.7 | ft² |
| Wetted Perimeter | 2.06 | ft |
| Top Width | 1.25 | ft |
| Critical Depth | 0.64 | ft |
| Percent Full | 53.8 | % |
| Critical Slope | 0.005749 | ft/ft |
| Velocity | 3.76 | ft/s |
| Velocity Head | 0.22 | ft |
| Specific Energy | 0.89 | ft |
| Froude Number | 0.90 | |
| Maximum Discharg | 4.81 | cfs |
| Discharge Full | 4.48 | cfs |
| Slope Full | 0.001534 | ft/ft |
| Flow Type | Subcritical | |

# Worksheet
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | 17 - E to 17 - D |
| Flow Element | Circular Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Slope | 0.005200 | ft/ft |
| Diameter | 15 | in |
| Discharge | 3.19 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.76 | ft |
| Flow Area | 0.8 | ft² |
| Wetted Perimeter | 2.23 | ft |
| Top Width | 1.22 | ft |
| Critical Depth | 0.72 | ft |
| Percent Full | 60.8 | % |
| Critical Slope | 0.006156 | ft/ft |
| Velocity | 4.09 | ft/s |
| Velocity Head | 0.26 | ft |
| Specific Energy | 1.02 | ft |
| Froude Number | 0.90 | |
| Maximum Discharg | 5.01 | cfs |
| Discharge Full | 4.66 | cfs |
| Slope Full | 0.002439 | ft/ft |
| Flow Type | Subcritical | |

# Worksheet
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | 17 - D to 17 - C |
| Flow Element | Circular Channel |
| Method | Manning's Formul |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Slope | 0.005200 | ft/ft |
| Diameter | 15 | in |
| Discharge | 3.16 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.75 | ft |
| Flow Area | 0.8 | ft² |
| Wetted Perimeter | 2.22 | ft |
| Top Width | 1.22 | ft |
| Critical Depth | 0.72 | ft |
| Percent Full | 60.4 | % |
| Critical Slope | 0.006126 | ft/ft |
| Velocity | 4.08 | ft/s |
| Velocity Head | 0.26 | ft |
| Specific Energy | 1.01 | ft |
| Froude Number | 0.90 | |
| Maximum Discharg | 5.01 | cfs |
| Discharge Full | 4.66 | cfs |
| Slope Full | 0.002393 | ft/ft |
| Flow Type | Subcritical | |

# Worksheet
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | 17 - C to 17 - B |
| Flow Element | Circular Channel |
| Method | Manning's Formul |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Slope | 0.004800 | ft/ft |
| Diameter | 15 | in |
| Discharge | 3.47 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.83 | ft |
| Flow Area | 0.9 | ft² |
| Wetted Perimeter | 2.37 | ft |
| Top Width | 1.18 | ft |
| Critical Depth | 0.75 | ft |
| Percent Full | 66.1 | % |
| Critical Slope | 0.006350 | ft/ft |
| Velocity | 4.03 | ft/s |
| Velocity Head | 0.25 | ft |
| Specific Energy | 1.08 | ft |
| Froude Number | 0.83 | |
| Maximum Discharg | 4.81 | cfs |
| Discharge Full | 4.48 | cfs |
| Slope Full | 0.002886 | ft/ft |
| Flow Type | Subcritical | |

# Worksheet
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | 17 - B to 17 - A |
| Flow Element | Circular Channel |
| Method | Manning's Formul: |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Slope | 0.018800 | ft/ft |
| Diameter | 15 | in |
| Discharge | 4.28 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.61 | ft |
| Flow Area | 0.6 | ft² |
| Wetted Perimeter | 1.94 | ft |
| Top Width | 1.25 | ft |
| Critical Depth | 0.84 | ft |
| Percent Full | 49.0 | % |
| Critical Slope | 0.007032 | ft/ft |
| Velocity | 7.16 | ft/s |
| Velocity Head | 0.80 | ft |
| Specific Energy | 1.41 | ft |
| Froude Number | 1.82 | |
| Maximum Discharg | 9.53 | cfs |
| Discharge Full | 8.86 | cfs |
| Slope Full | 0.004390 | ft/ft |
| Flow Type | Supercritical | |

# Worksheet
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | 17 - A to 17 |
| Flow Element | Circular Channel |
| Method | Manning's Formul |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Slope | 0.055800 | ft/ft |
| Diameter | 15 | in |
| Discharge | 4.28 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.45 | ft |
| Flow Area | 0.4 | ft² |
| Wetted Perimeter | 1.61 | ft |
| Top Width | 1.20 | ft |
| Critical Depth | 0.84 | ft |
| Percent Full | 36.2 | % |
| Critical Slope | 0.007032 | ft/ft |
| Velocity | 10.67 | ft/s |
| Velocity Head | 1.77 | ft |
| Specific Energy | 2.22 | ft |
| Froude Number | 3.26 | |
| Maximum Discharg | 16.41 | cfs |
| Discharge Full | 15.26 | cfs |
| Slope Full | 0.004390 | ft/ft |
| Flow Type | Supercritical | |

# Worksheet
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | 16 to 17 |
| Flow Element | Circular Channel |
| Method | Manning's Formul |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Slope | 0.004800 | ft/ft |
| Diameter | 15 | in |
| Discharge | 1.87 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.56 | ft |
| Flow Area | 0.5 | ft² |
| Wetted Perimeter | 1.84 | ft |
| Top Width | 1.24 | ft |
| Critical Depth | 0.54 | ft |
| Percent Full | 45.1 | % |
| Critical Slope | 0.005448 | ft/ft |
| Velocity | 3.48 | ft/s |
| Velocity Head | 0.19 | ft |
| Specific Energy | 0.75 | ft |
| Froude Number | 0.93 | |
| Maximum Discharg | 4.81 | cfs |
| Discharge Full | 4.48 | cfs |
| Slope Full | 0.000838 | ft/ft |
| Flow Type | Subcritical | |

# Worksheet
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | 17 to 18 |
| Flow Element | Circular Channel |
| Method | Manning's Formul: |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Slope | 0.034500 | ft/ft |
| Diameter | 15 | in |
| Discharge | 5.99 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.62 | ft |
| Flow Area | 0.6 | ft² |
| Wetted Perimeter | 1.96 | ft |
| Top Width | 1.25 | ft |
| Critical Depth | 0.99 | ft |
| Percent Full | 50.0 | % |
| Critical Slope | 0.009187 | ft/ft |
| Velocity | 9.77 | ft/s |
| Velocity Head | 1.48 | ft |
| Specific Energy | 2.11 | ft |
| Froude Number | 2.46 | |
| Maximum Discharg | 12.91 | cfs |
| Discharge Full | 12.00 | cfs |
| Slope Full | 0.008599 | ft/ft |
| Flow Type | Supercritical | |

# Worksheet
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | 18 to 19 |
| Flow Element | Circular Channel |
| Method | Manning's Formul |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Slope | 0.006200 | ft/ft |
| Diameter | 18 | in |
| Discharge | 7.21 | cfs |

| Results | | |
|---|---|---|
| Depth | 1.08 | ft |
| Flow Area | 1.4 | ft² |
| Wetted Perimeter | 3.05 | ft |
| Top Width | 1.34 | ft |
| Critical Depth | 1.04 | ft |
| Percent Full | 72.3 | % |
| Critical Slope | 0.006896 | ft/ft |
| Velocity | 5.27 | ft/s |
| Velocity Head | 0.43 | ft |
| Specific Energy | 1.52 | ft |
| Froude Number | 0.92 | |
| Maximum Discharg | 8.90 | cfs |
| Discharge Full | 8.27 | cfs |
| Slope Full | 0.004712 | ft/ft |
| Flow Type | Subcritical | |

# Worksheet
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | 19 to 20 |
| Flow Element | Circular Channel |
| Method | Manning's Formul |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Slope | 0.005900 | ft/ft |
| Diameter | 18 | in |
| Discharge | 7.72 | cfs |

| Results | | |
|---|---|---|
| Depth | 1.18 | ft |
| Flow Area | 1.5 | ft² |
| Wetted Perimeter | 3.26 | ft |
| Top Width | 1.24 | ft |
| Critical Depth | 1.08 | ft |
| Percent Full | 78.3 | % |
| Critical Slope | 0.007229 | ft/ft |
| Velocity | 5.20 | ft/s |
| Velocity Head | 0.42 | ft |
| Specific Energy | 1.59 | ft |
| Froude Number | 0.84 | |
| Maximum Discharg | 8.68 | cfs |
| Discharge Full | 8.07 | cfs |
| Slope Full | 0.005402 | ft/ft |
| Flow Type | Subcritical | |

# Worksheet
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | 20 to 21 |
| Flow Element | Circular Channel |
| Method | Manning's Formul |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Slope | 0.005200 | ft/ft |
| Diameter | 24 | in |
| Discharge | 11.99 | cfs |

| Results | | |
|---|---|---|
| Depth | 1.27 | ft |
| Flow Area | 2.1 | ft² |
| Wetted Perimeter | 3.70 | ft |
| Top Width | 1.92 | ft |
| Critical Depth | 1.24 | ft |
| Percent Full | 63.7 | % |
| Critical Slope | 0.005583 | ft/ft |
| Velocity | 5.68 | ft/s |
| Velocity Head | 0.50 | ft |
| Specific Energy | 1.77 | ft |
| Froude Number | 0.95 | |
| Maximum Discharg | 17.55 | cfs |
| Discharge Full | 16.31 | cfs |
| Slope Full | 0.002809 | ft/ft |
| Flow Type | Subcritical | |

# Worksheet
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | 21 to 22 |
| Flow Element | Circular Channel |
| Method | Manning's Formul |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Slope | 0.007800 | ft/ft |
| Diameter | 24 | in |
| Discharge | 19.40 | cfs |

| Results | | |
|---|---|---|
| Depth | 1.59 | ft |
| Flow Area | 2.7 | ft² |
| Wetted Perimeter | 4.40 | ft |
| Top Width | 1.62 | ft |
| Critical Depth | 1.58 | ft |
| Percent Full | 79.5 | % |
| Critical Slope | 0.007856 | ft/ft |
| Velocity | 7.25 | ft/s |
| Velocity Head | 0.82 | ft |
| Specific Energy | 2.41 | ft |
| Froude Number | 0.99 | |
| Maximum Discharg | 21.49 | cfs |
| Discharge Full | 19.98 | cfs |
| Slope Full | 0.007355 | ft/ft |
| Flow Type | Subcritical | |

# Worksheet
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | 22 to 23 |
| Flow Element | Circular Channel |
| Method | Manning's Formul |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Slope | 0.008200 | ft/ft |
| Diameter | 24 | in |
| Discharge | 20.17 | cfs |

| Results | | |
|---|---|---|
| Depth | 1.61 | ft |
| Flow Area | 2.7 | ft² |
| Wetted Perimeter | 4.46 | ft |
| Top Width | 1.58 | ft |
| Critical Depth | 1.61 | ft |
| Percent Full | 80.6 | % |
| Critical Slope | 0.008197 | ft/ft |
| Velocity | 7.43 | ft/s |
| Velocity Head | 0.86 | ft |
| Specific Energy | 2.47 | ft |
| Froude Number | 1.00 | |
| Maximum Discharg | 22.04 | cfs |
| Discharge Full | 20.48 | cfs |
| Slope Full | 0.007950 | ft/ft |
| Flow Type | Supercritical | |

# Worksheet
## Worksheet for Curb Inlet In Sag

| Project Description | |
|---|---|
| Worksheet | Curb Inlet - 17G |
| Type | Curb Inlet In Sag |
| Solve For | Spread |

| Input Data | | |
|---|---|---|
| Discharge | 0.83 | cfs |
| Gutter Width | 1.67 | ft |
| Gutter Cross Slope | 0.083333 | ft/ft |
| Road Cross Slope | 0.020800 | ft/ft |
| Curb Opening Length | 2.50 | ft |
| Opening Height | 0.39 | ft |
| Curb Throat Type | Horizontal | |
| Local Depression | 2.0 | in |
| Local Depression Width | 2.00 | ft |

| Results | | |
|---|---|---|
| Spread | 7.30 | ft |
| Throat Incline Angle | 90.00 | degrees |
| Depth | 0.42 | ft |
| Gutter Depression | 1.3 | in |
| Total Depression | 3.3 | in |

# Worksheet
## Worksheet for Curb Inlet In Sag

| Project Description | |
|---|---|
| Worksheet | Curb Inlet - 17F |
| Type | Curb Inlet In Sag |
| Solve For | Spread |

| Input Data | | |
|---|---|---|
| Discharge | 0.95 | cfs |
| Gutter Width | 1.67 | ft |
| Gutter Cross Slope | 0.083333 | ft/ft |
| Road Cross Slope | 0.020800 | ft/ft |
| Curb Opening Length | 2.50 | ft |
| Opening Height | 0.39 | ft |
| Curb Throat Type | Horizontal | |
| Local Depression | 2.0 | in |
| Local Depression Width | 2.00 | ft |

| Results | | |
|---|---|---|
| Spread | 7.99 | ft |
| Throat Incline Angle | 90.00 | degrees |
| Depth | 0.44 | ft |
| Gutter Depression | 1.3 | in |
| Total Depression | 3.3 | in |

# Worksheet
## Worksheet for Curb Inlet In Sag

| Project Description | |
|---|---|
| Worksheet | Curb Inlet - 17E |
| Type | Curb Inlet In Sag |
| Solve For | Spread |

| Input Data | | |
|---|---|---|
| Discharge | 0.47 | cfs |
| Gutter Width | 1.67 | ft |
| Gutter Cross Slope | 0.083333 | ft/ft |
| Road Cross Slope | 0.020800 | ft/ft |
| Curb Opening Length | 2.50 | ft |
| Opening Height | 0.39 | ft |
| Curb Throat Type | Horizontal | |
| Local Depression | 2.0 | in |
| Local Depression Width | 2.00 | ft |

| Results | | |
|---|---|---|
| Spread | 5.00 | ft |
| Throat Incline Angle | 90.00 | degrees |
| Depth | 0.38 | ft |
| Gutter Depression | 1.3 | in |
| Total Depression | 3.3 | in |

# Worksheet
## Worksheet for Curb Inlet On Grade

| Project Description | |
|---|---|
| Worksheet | Curb Inlet - 17C |
| Type | Curb Inlet On Grade |
| Solve For | Efficiency |

| Input Data | | |
|---|---|---|
| Discharge | 0.25 | cfs |
| Slope | 0.048000 | ft/ft |
| Gutter Width | 1.67 | ft |
| Gutter Cross Slope | 0.083333 | ft/ft |
| Road Cross Slope | 0.020800 | ft/ft |
| Mannings Coefficient | 0.015 | |
| Curb Opening Length | 4.00 | ft |
| Local Depression | 2.0 | in |
| Local Depression Width | 2.00 | ft |

| Results | | |
|---|---|---|
| Efficiency | 0.94 | |
| Intercepted Flow | 0.23 | cfs |
| Bypass Flow | 0.02 | cfs |
| Spread | 1.28 | ft |
| Depth | 0.11 | ft |
| Flow Area | 0.1 | $ft^2$ |
| Gutter Depression | 1.3 | in |
| Total Depression | 3.3 | in |
| Velocity | 3.65 | ft/s |
| Equivalent Cross Slope | 0.156349 | ft/ft |
| Length Factor | 0.78 | |
| Total Interception Length | 5.10 | ft |

# Worksheet
## Worksheet for Curb Inlet On Grade

| Project Description | |
|---|---|
| Worksheet | Curb Inlet - 17B |
| Type | Curb Inlet On Grade |
| Solve For | Efficiency |

| Input Data | | |
|---|---|---|
| Discharge | 0.21 | cfs |
| Slope | 0.048000 | ft/ft |
| Gutter Width | 1.67 | ft |
| Gutter Cross Slope | 0.083333 | ft/ft |
| Road Cross Slope | 0.020800 | ft/ft |
| Mannings Coefficient | 0.015 | |
| Curb Opening Length | 6.00 | ft |
| Local Depression | 2.0 | in |
| Local Depression Width | 2.00 | ft |

| Results | | |
|---|---|---|
| Efficiency | 1.00 | |
| Intercepted Flow | 0.21 | cfs |
| Bypass Flow | 0.00 | cfs |
| Spread | 1.20 | ft |
| Depth | 0.10 | ft |
| Flow Area | 0.1 | $ft^2$ |
| Gutter Depression | 1.3 | in |
| Total Depression | 3.3 | in |
| Velocity | 3.50 | ft/s |
| Equivalent Cross Slope | 0.156349 | ft/ft |
| Length Factor | 1.27 | |
| Total Interception Length | 4.74 | ft |

# Worksheet
## Worksheet for Curb Inlet On Grade

| Project Description | |
|---|---|
| Worksheet | Curb Inlet - 18 |
| Type | Curb Inlet On Grade |
| Solve For | Efficiency |

| Input Data | | |
|---|---|---|
| Discharge | 1.37 | cfs |
| Slope | 0.022500 | ft/ft |
| Gutter Width | 1.67 | ft |
| Gutter Cross Slope | 0.083330 | ft/ft |
| Road Cross Slope | 0.020800 | ft/ft |
| Mannings Coefficient | 0.015 | |
| Curb Opening Length | 8.00 | ft |
| Local Depression | 2.0 | in |
| Local Depression Width | 2.00 | ft |

| Results | | |
|---|---|---|
| Efficiency | 0.97 | |
| Intercepted Flow | 1.32 | cfs |
| Bypass Flow | 0.05 | cfs |
| Spread | 5.44 | ft |
| Depth | 0.22 | ft |
| Flow Area | 0.4 | $ft^2$ |
| Gutter Depression | 1.3 | in |
| Total Depression | 3.3 | in |
| Velocity | 3.47 | ft/s |
| Equivalent Cross Slope | 0.126510 | ft/ft |
| Length Factor | 0.85 | |
| Total Interception Length | 9.43 | ft |

# Worksheet
## Worksheet for Curb Inlet On Grade

| Project Description | |
|---|---|
| Worksheet | Curb Inlet - 19 |
| Type | Curb Inlet On Grade |
| Solve For | Efficiency |

| Input Data | | |
|---|---|---|
| Discharge | 0.39 | cfs |
| Slope | 0.022500 | ft/ft |
| Gutter Width | 1.67 | ft |
| Gutter Cross Slope | 0.083333 | ft/ft |
| Road Cross Slope | 0.020800 | ft/ft |
| Mannings Coefficient | 0.015 | |
| Curb Opening Length | 4.00 | ft |
| Local Depression | 2.0 | in |
| Local Depression Width | 2.00 | ft |

| Results | | |
|---|---|---|
| Efficiency | 0.95 | |
| Intercepted Flow | 0.37 | cfs |
| Bypass Flow | 0.02 | cfs |
| Spread | 1.97 | ft |
| Depth | 0.15 | ft |
| Flow Area | 0.1 | $ft^2$ |
| Gutter Depression | 1.3 | in |
| Total Depression | 3.3 | in |
| Velocity | 3.06 | ft/s |
| Equivalent Cross Slope | 0.156230 | ft/ft |
| Length Factor | 0.82 | |
| Total Interception Length | 4.90 | ft |

# Worksheet
## Worksheet for Curb Inlet On Grade

| Project Description | |
|---|---|
| Worksheet | Curb Inlet - 20 |
| Type | Curb Inlet On Grade |
| Solve For | Efficiency |

| Input Data | | |
|---|---|---|
| Discharge | 0.14 | cfs |
| Slope | 0.024000 | ft/ft |
| Gutter Width | 1.67 | ft |
| Gutter Cross Slope | 0.083333 | ft/ft |
| Road Cross Slope | 0.020800 | ft/ft |
| Mannings Coefficient | 0.015 | |
| Curb Opening Length | 2.50 | ft |
| Local Depression | 2.0 | in |
| Local Depression Width | 2.00 | ft |

| Results | | |
|---|---|---|
| Efficiency | 0.93 | |
| Intercepted Flow | 0.13 | cfs |
| Bypass Flow | 0.01 | cfs |
| Spread | 1.17 | ft |
| Depth | 0.10 | ft |
| Flow Area | 0.1 | $ft^2$ |
| Gutter Depression | 1.3 | in |
| Total Depression | 3.3 | in |
| Velocity | 2.44 | ft/s |
| Equivalent Cross Slope | 0.156348 | ft/ft |
| Length Factor | 0.77 | |
| Total Interception Length | 3.25 | ft |

# Worksheet
## Worksheet for Curb Inlet In Sag

| Project Description | |
|---|---|
| Worksheet | Curb Inlet - 22 |
| Type | Curb Inlet In Sag |
| Solve For | Spread |

| Input Data | | |
|---|---|---|
| Discharge | 0.65 | cfs |
| Gutter Width | 1.67 | ft |
| Gutter Cross Slope | 0.083330 | ft/ft |
| Road Cross Slope | 0.020800 | ft/ft |
| Curb Opening Length | 6.00 | ft |
| Opening Height | 0.39 | ft |
| Curb Throat Type | Horizontal | |
| Local Depression | 2.0 | in |
| Local Depression Width | 2.00 | ft |

| Results | | |
|---|---|---|
| Spread | 4.58 | ft |
| Throat Incline Angle | 90.00 | degrees |
| Depth | 0.37 | ft |
| Gutter Depression | 1.3 | in |
| Total Depression | 3.3 | in |

LD-229
July 2000

STORM SEWER DESIGN
COMPUTATIONS

ROUTE: Oct 4 2004 PROJ: STONEHOUSE GLEN SECT I
COUNTY: DISTRICT: CURB & GUTTER
DESCRIPTION:
SHEET ____ OF ____

| FROM POINT (1) | TO POINT (2) | AREA DRAIN "A" ACRES (3) | RUN-OFF COEF. C (4) | CA INCREMENT (5) | CA ACCUMULATED (6) | INLET TIME MINUTES (7) | RAIN FALL IN./HR. (8) | RUN-OFF Q C.F.S. (9) | INVERT ELEVATIONS UPPER END (10) | INVERT ELEVATIONS LOWER END (11) | LENGTH FT. (12) | SLOPE FT./FT. (13) | DIA. IN. (14) | CAPACITY C.F.S. (15) | VEL. F.P.S. (16) | FLOW TIME MINUTES INCREMENT / ACCUMULATED (17) | REMARKS (18) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 21-G | 21-F | 0.47 | 0.65 | – | 0.31 | 13 | 5.45 | 1.69 | 104.97 | 104.73 | 40' | 0.0060 | 15" | 5.00 | 3.68 | 0.18 / – | |
| 21-F | 21-E | 0.20 | 0.9 | 0.18 | 0.49 | 13.18 | 5.45 | 2.67 | 100.62 | 94.25 | 105' | 0.0607 | 15" | 15.91 | 9.63 | 0.18 / 0.36 | |
| 21-E | 21-D | – | – | – | – | 13.36 | 5.45 | 2.67 | 90.00 | 87.70 | 35' | 0.0657 | 15" | 16.56 | 9.91 | 0.06 / 0.42 | |
| 21-D | 21-C | 0.93 | 0.35 | 0.32 | 0.82 | 14.5 | 5.3 | 4.34 | 84.70 | 82.20 | 123' | 0.0203 | 15" | 9.20 | 7.39 | 0.28 / 0.70 | |
| 21-C | 21-B | 0.84 | 0.35 | 0.29 | 1.11 | 14.73 | 5.28 | 5.86 | 82.10 | 81.92 | 20' | 0.0088 | 15" | 6.06 | 5.63 | 0.06 / 0.76 | |
| 21-A | 21-B | 0.15 | 0.9 | – | 0.13 | 10 | 5.75 | 0.74 | 82.50 | 81.92 | 70' | 0.0082 | 15" | 5.85 | 3.26 | 0.36 / – | |
| | | | | | | | | | | | | | | | | | |
| 21-B | 21 | 0.10 | 0.9 | 0.09 | 1.33 | 15 | 5.25 | 6.98 | 81.67 | 81.51 | 33' | 0.0048 | 18 | 7.28 | 4.69 | 0.12 / 0.88 | |
| | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| FROM DITCH | | 0.79 | 0.35 | – | 0.28 | | | | | | | | | | | | |
| 20-C | 20-B | 0.17 | 0.9 | 0.15 | 0.43 | 13 | 5.45 | 2.34 | 98.12 | 87.19 | 113' | 0.0967 | 15" | 20.09 | 10.94 | 0.17 / – | |
| 20-D | 20-B | 0.13 | 0.9 | – | 0.12 | 10 | 5.75 | 0.69 | 87.60 | 87.41 | 32' | 0.006 | 15" | 5.00 | 2.86 | 0.18 / – | |
| | | | | | | | | | | | | | | | | | |
| 20-B | 20-A | 0.26 | 0.6 | 0.16 | 0.71 | 13.17 | 5.45 | 3.87 | 87.09 | 86.80 | 44' | 0.0066 | 15" | 5.25 | 4.68 | 0.16 / 0.33 | |
| 20-A | 20 | 0.23 | 0.5 | 0.12 | 0.83 | 13.29 | 5.45 | 4.52 | 85.40 | 85.23 | 33' | 0.0052 | 15" | 4.66 | 4.32 | 0.12 / 0.45 | |
| | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |

# Worksheet
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | 21 - G to 21 - F |
| Flow Element | Circular Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Slope | 0.006000 | ft/ft |
| Diameter | 15 | in |
| Discharge | 1.69 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.50 | ft |
| Flow Area | 0.5 | ft² |
| Wetted Perimeter | 1.71 | ft |
| Top Width | 1.23 | ft |
| Critical Depth | 0.52 | ft |
| Percent Full | 40.1 | % |
| Critical Slope | 0.005374 | ft/ft |
| Velocity | 3.68 | ft/s |
| Velocity Head | 0.21 | ft |
| Specific Energy | 0.71 | ft |
| Froude Number | 1.06 | |
| Maximum Discharg | 5.38 | cfs |
| Discharge Full | 5.00 | cfs |
| Slope Full | 0.000685 | ft/ft |
| Flow Type | Supercritical | |

# Worksheet
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | 21 - F to 21 - E |
| Flow Element | Circular Channel |
| Method | Manning's Formul: |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Slope | 0.060700 | ft/ft |
| Diameter | 15 | in |
| Discharge | 2.67 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.35 | ft |
| Flow Area | 0.3 | ft² |
| Wetted Perimeter | 1.39 | ft |
| Top Width | 1.12 | ft |
| Critical Depth | 0.66 | ft |
| Percent Full | 27.7 | % |
| Critical Slope | 0.005825 | ft/ft |
| Velocity | 9.63 | ft/s |
| Velocity Head | 1.44 | ft |
| Specific Energy | 1.79 | ft |
| Froude Number | 3.41 | |
| Maximum Discharg | 17.12 | cfs |
| Discharge Full | 15.91 | cfs |
| Slope Full | 0.001709 | ft/ft |
| Flow Type | Supercritical | |

# Worksheet
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | 21 - E to 21 - D |
| Flow Element | Circular Channel |
| Method | Manning's Formul |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Slope | 0.065700 | ft/ft |
| Diameter | 15 | in |
| Discharge | 2.67 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.34 | ft |
| Flow Area | 0.3 | ft² |
| Wetted Perimeter | 1.37 | ft |
| Top Width | 1.11 | ft |
| Critical Depth | 0.66 | ft |
| Percent Full | 27.2 | % |
| Critical Slope | 0.005825 | ft/ft |
| Velocity | 9.91 | ft/s |
| Velocity Head | 1.53 | ft |
| Specific Energy | 1.86 | ft |
| Froude Number | 3.55 | |
| Maximum Discharg | 17.81 | cfs |
| Discharge Full | 16.56 | cfs |
| Slope Full | 0.001709 | ft/ft |
| Flow Type | Supercritical | |

# Worksheet
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | 21 - D to 21 - C |
| Flow Element | Circular Channel |
| Method | Manning's Formul |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Slope | 0.020300 | ft/ft |
| Diameter | 15 | in |
| Discharge | 4.34 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.60 | ft |
| Flow Area | 0.6 | ft² |
| Wetted Perimeter | 1.92 | ft |
| Top Width | 1.25 | ft |
| Critical Depth | 0.84 | ft |
| Percent Full | 48.3 | % |
| Critical Slope | 0.007090 | ft/ft |
| Velocity | 7.39 | ft/s |
| Velocity Head | 0.85 | ft |
| Specific Energy | 1.45 | ft |
| Froude Number | 1.90 | |
| Maximum Discharg | 9.90 | cfs |
| Discharge Full | 9.20 | cfs |
| Slope Full | 0.004514 | ft/ft |
| Flow Type | Supercritical | |

# Worksheet
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | 21 - C to 21 - B |
| Flow Element | Circular Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Slope | 0.008800 | ft/ft |
| Diameter | 15 | in |
| Discharge | 5.86 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.99 | ft |
| Flow Area | 1.0 | ft² |
| Wetted Perimeter | 2.74 | ft |
| Top Width | 1.02 | ft |
| Critical Depth | 0.98 | ft |
| Percent Full | 79.1 | % |
| Critical Slope | 0.008981 | ft/ft |
| Velocity | 5.63 | ft/s |
| Velocity Head | 0.49 | ft |
| Specific Energy | 1.48 | ft |
| Froude Number | 0.98 | |
| Maximum Discharg | 6.52 | cfs |
| Discharge Full | 6.06 | cfs |
| Slope Full | 0.008230 | ft/ft |
| Flow Type | Subcritical | |

# Worksheet
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | 21 - A to 21 - B |
| Flow Element | Circular Channel |
| Method | Manning's Formul |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Slope | 0.008200 | ft/ft |
| Diameter | 15 | in |
| Discharge | 0.74 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.30 | ft |
| Flow Area | 0.2 | ft² |
| Wetted Perimeter | 1.28 | ft |
| Top Width | 1.07 | ft |
| Critical Depth | 0.34 | ft |
| Percent Full | 24.0 | % |
| Critical Slope | 0.005228 | ft/ft |
| Velocity | 3.26 | ft/s |
| Velocity Head | 0.17 | ft |
| Specific Energy | 0.47 | ft |
| Froude Number | 1.25 | |
| Maximum Discharg | 6.29 | cfs |
| Discharge Full | 5.85 | cfs |
| Slope Full | 0.000131 | ft/ft |
| Flow Type | Supercritical | |

# Worksheet
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | 21 - B to 21 |
| Flow Element | Circular Channel |
| Method | Manning's Formul |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Slope | 0.004800 | ft/ft |
| Diameter | 18 | in |
| Discharge | 6.98 | cfs |

| Results | | |
|---|---|---|
| Depth | 1.18 | ft |
| Flow Area | 1.5 | ft² |
| Wetted Perimeter | 3.27 | ft |
| Top Width | 1.23 | ft |
| Critical Depth | 1.02 | ft |
| Percent Full | 78.5 | % |
| Critical Slope | 0.006754 | ft/ft |
| Velocity | 4.69 | ft/s |
| Velocity Head | 0.34 | ft |
| Specific Energy | 1.52 | ft |
| Froude Number | 0.75 | |
| Maximum Discharg | 7.83 | cfs |
| Discharge Full | 7.28 | cfs |
| Slope Full | 0.004416 | ft/ft |
| Flow Type | Subcritical | |

# Worksheet
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | 20 - C to 20 - B |
| Flow Element | Circular Channel |
| Method | Manning's Formul |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Slope | 0.096700 | ft/ft |
| Diameter | 15 | in |
| Discharge | 2.34 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.29 | ft |
| Flow Area | 0.2 | ft² |
| Wetted Perimeter | 1.25 | ft |
| Top Width | 1.05 | ft |
| Critical Depth | 0.61 | ft |
| Percent Full | 23.0 | % |
| Critical Slope | 0.005653 | ft/ft |
| Velocity | 10.94 | ft/s |
| Velocity Head | 1.86 | ft |
| Specific Energy | 2.15 | ft |
| Froude Number | 4.28 | |
| Maximum Discharg | 21.61 | cfs |
| Discharge Full | 20.09 | cfs |
| Slope Full | 0.001312 | ft/ft |
| Flow Type | Supercritical | |

# Worksheet
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | 20 - D to 20 - B |
| Flow Element | Circular Channel |
| Method | Manning's Formul |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Slope | 0.006000 | ft/ft |
| Diameter | 15 | in |
| Discharge | 0.69 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.31 | ft |
| Flow Area | 0.2 | ft² |
| Wetted Perimeter | 1.31 | ft |
| Top Width | 1.08 | ft |
| Critical Depth | 0.32 | ft |
| Percent Full | 25.1 | % |
| Critical Slope | 0.005231 | ft/ft |
| Velocity | 2.86 | ft/s |
| Velocity Head | 0.13 | ft |
| Specific Energy | 0.44 | ft |
| Froude Number | 1.07 | |
| Maximum Discharg | 5.38 | cfs |
| Discharge Full | 5.00 | cfs |
| Slope Full | 0.000114 | ft/ft |
| Flow Type | Supercritical | |

# Worksheet
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | 20 - B to 20 - A |
| Flow Element | Circular Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Slope | 0.006600 | ft/ft |
| Diameter | 15 | in |
| Discharge | 3.87 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.80 | ft |
| Flow Area | 0.8 | ft² |
| Wetted Perimeter | 2.31 | ft |
| Top Width | 1.20 | ft |
| Critical Depth | 0.80 | ft |
| Percent Full | 63.9 | % |
| Critical Slope | 0.006662 | ft/ft |
| Velocity | 4.68 | ft/s |
| Velocity Head | 0.34 | ft |
| Specific Energy | 1.14 | ft |
| Froude Number | 0.99 | |
| Maximum Discharg | 5.64 | cfs |
| Discharge Full | 5.25 | cfs |
| Slope Full | 0.003589 | ft/ft |
| Flow Type | Subcritical | |

# Worksheet
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | 20 - A to 20 |
| Flow Element | Circular Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Slope | 0.005200 | ft/ft |
| Diameter | 15 | in |
| Discharge | 4.52 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.99 | ft |
| Flow Area | 1.0 | ft² |
| Wetted Perimeter | 2.75 | ft |
| Top Width | 1.01 | ft |
| Critical Depth | 0.86 | ft |
| Percent Full | 79.4 | % |
| Critical Slope | 0.007271 | ft/ft |
| Velocity | 4.32 | ft/s |
| Velocity Head | 0.29 | ft |
| Specific Energy | 1.28 | ft |
| Froude Number | 0.75 | |
| Maximum Discharg | 5.01 | cfs |
| Discharge Full | 4.66 | cfs |
| Slope Full | 0.004897 | ft/ft |
| Flow Type | Subcritical | |

# Worksheet
## Worksheet for Curb Inlet On Grade

| Project Description | |
|---|---|
| Worksheet | Curb Inlet - 20 |
| Type | Curb Inlet On Grade |
| Solve For | Efficiency |

| Input Data | | |
|---|---|---|
| Discharge | 0.14 | cfs |
| Slope | 0.024000 | ft/ft |
| Gutter Width | 1.67 | ft |
| Gutter Cross Slope | 0.083333 | ft/ft |
| Road Cross Slope | 0.020800 | ft/ft |
| Mannings Coefficient | 0.015 | |
| Curb Opening Length | 2.50 | ft |
| Local Depression | 2.0 | in |
| Local Depression Width | 2.00 | ft |

| Results | | |
|---|---|---|
| Efficiency | 0.93 | |
| Intercepted Flow | 0.13 | cfs |
| Bypass Flow | 0.01 | cfs |
| Spread | 1.17 | ft |
| Depth | 0.10 | ft |
| Flow Area | 0.1 | $ft^2$ |
| Gutter Depression | 1.3 | in |
| Total Depression | 3.3 | in |
| Velocity | 2.44 | ft/s |
| Equivalent Cross Slope | 0.156348 | ft/ft |
| Length Factor | 0.77 | |
| Total Interception Length | 3.25 | ft |

# Worksheet
## Worksheet for Curb Inlet On Grade

| Project Description | |
|---|---|
| Worksheet | Curb Inlet - 20 - A |
| Type | Curb Inlet On Grade |
| Solve For | Efficiency |

| Input Data | | |
|---|---|---|
| Discharge | 0.46 | cfs |
| Slope | 0.000000 | ft/ft |
| Gutter Width | 0.00 | ft |
| Gutter Cross Slope | 0.000000 | ft/ft |
| Road Cross Slope | 0.000000 | ft/ft |
| Mannings Coefficient | 0.013 | |
| Curb Opening Length | 0.00 | ft |
| Local Depression | 0.0 | in |
| Local Depression Width | 0.00 | ft |

| Results | | |
|---|---|---|
| Efficiency | 0.00 | |
| Intercepted Flow | 0.00 | cfs |
| Bypass Flow | N/A | cfs |
| Spread | 0.00 | ft |
| Depth | 0.00 | ft |
| Flow Area | 0.0 | $ft^2$ |
| Gutter Depression | 0.0 | in |
| Total Depression | 0.0 | in |
| Velocity | N/A | ft/s |
| Equivalent Cross Slope | N/A | ft/ft |
| Length Factor | N/A | |
| Total Interception Length | N/A | ft |

Error Messages:
Slope must be greater than zero

# Worksheet
## Worksheet for Curb Inlet In Sag

| Project Description | |
|---|---|
| Worksheet | Curb Inlet - 20 - B |
| Type | Curb Inlet In Sag |
| Solve For | Spread |

| Input Data | | |
|---|---|---|
| Discharge | 0.72 | cfs |
| Gutter Width | 1.67 | ft |
| Gutter Cross Slope | 0.083330 | ft/ft |
| Road Cross Slope | 0.020800 | ft/ft |
| Curb Opening Length | 6.00 | ft |
| Opening Height | 0.39 | ft |
| Curb Throat Type | Horizontal | |
| Local Depression | 2.0 | in |
| Local Depression Width | 2.00 | ft |

| Results | | |
|---|---|---|
| Spread | 4.91 | ft |
| Throat Incline Angle | 90.00 | degrees |
| Depth | 0.37 | ft |
| Gutter Depression | 1.3 | in |
| Total Depression | 3.3 | in |

# Worksheet
## Worksheet for Curb Inlet On Grade

| Project Description | |
|---|---|
| Worksheet | Curb Inlet - 20 - C |
| Type | Curb Inlet On Grade |
| Solve For | Efficiency |

| Input Data | | |
|---|---|---|
| Discharge | 0.61 | cfs |
| Slope | 0.109500 | ft/ft |
| Gutter Width | 1.67 | ft |
| Gutter Cross Slope | 0.083330 | ft/ft |
| Road Cross Slope | 0.020800 | ft/ft |
| Mannings Coefficient | 0.015 | |
| Curb Opening Length | 6.00 | ft |
| Local Depression | 2.0 | in |
| Local Depression Width | 2.00 | ft |

| Results | | |
|---|---|---|
| Efficiency | 0.83 | |
| Intercepted Flow | 0.51 | cfs |
| Bypass Flow | 0.10 | cfs |
| Spread | 1.53 | ft |
| Depth | 0.13 | ft |
| Flow Area | 0.1 | $ft^2$ |
| Gutter Depression | 1.3 | in |
| Total Depression | 3.3 | in |
| Velocity | 6.23 | ft/s |
| Equivalent Cross Slope | 0.156346 | ft/ft |
| Length Factor | 0.63 | |
| Total Interception Length | 9.50 | ft |

# Worksheet
## Worksheet for Curb Inlet On Grade

| Project Description | |
|---|---|
| Worksheet | Curb Inlet - 20 - D |
| Type | Curb Inlet On Grade |
| Solve For | Efficiency |

| Input Data | | |
|---|---|---|
| Discharge | 0.47 | cfs |
| Slope | 0.045000 | ft/ft |
| Gutter Width | 1.67 | ft |
| Gutter Cross Slope | 0.083330 | ft/ft |
| Road Cross Slope | 0.020800 | ft/ft |
| Mannings Coefficient | 0.015 | |
| Curb Opening Length | 4.00 | ft |
| Local Depression | 2.0 | in |
| Local Depression Width | 2.00 | ft |

| Results | | |
|---|---|---|
| Efficiency | 0.82 | |
| Intercepted Flow | 0.39 | cfs |
| Bypass Flow | 0.08 | cfs |
| Spread | 1.64 | ft |
| Depth | 0.14 | ft |
| Flow Area | 0.1 | $ft^2$ |
| Gutter Depression | 1.3 | in |
| Total Depression | 3.3 | in |
| Velocity | 4.18 | ft/s |
| Equivalent Cross Slope | 0.156346 | ft/ft |
| Length Factor | 0.61 | |
| Total Interception Length | 6.52 | ft |

# Worksheet
## Worksheet for Curb Inlet In Sag

| Project Description | |
|---|---|
| Worksheet | Curb Inlet - 21 - A |
| Type | Curb Inlet In Sag |
| Solve For | Spread |

| Input Data | | |
|---|---|---|
| Discharge | 0.42 | cfs |
| Gutter Width | 1.67 | ft |
| Gutter Cross Slope | 0.083333 | ft/ft |
| Road Cross Slope | 0.020800 | ft/ft |
| Curb Opening Length | 2.50 | ft |
| Opening Height | 0.39 | ft |
| Curb Throat Type | Horizontal | |
| Local Depression | 2.0 | in |
| Local Depression Width | 2.00 | ft |

| Results | | |
|---|---|---|
| Spread | 4.64 | ft |
| Throat Incline Angle | 90.00 | degrees |
| Depth | 0.37 | ft |
| Gutter Depression | 1.3 | in |
| Total Depression | 3.3 | in |

# Worksheet
## Worksheet for Curb Inlet On Grade

| Project Description | |
|---|---|
| Worksheet | Curb Inlet - 21 - B |
| Type | Curb Inlet On Grade |
| Solve For | Efficiency |

| Input Data | | |
|---|---|---|
| Discharge | 0.36 | cfs |
| Slope | 0.012000 | ft/ft |
| Gutter Width | 1.67 | ft |
| Gutter Cross Slope | 0.083333 | ft/ft |
| Road Cross Slope | 0.020800 | ft/ft |
| Mannings Coefficient | 0.015 | |
| Curb Opening Length | 2.50 | ft |
| Local Depression | 2.0 | in |
| Local Depression Width | 2.00 | ft |

| Results | | |
|---|---|---|
| Efficiency | 0.84 | |
| Intercepted Flow | 0.30 | cfs |
| Bypass Flow | 0.06 | cfs |
| Spread | 2.58 | ft |
| Depth | 0.16 | ft |
| Flow Area | 0.2 | $ft^2$ |
| Gutter Depression | 1.3 | in |
| Total Depression | 3.3 | in |
| Velocity | 2.30 | ft/s |
| Equivalent Cross Slope | 0.154478 | ft/ft |
| Length Factor | 0.63 | |
| Total Interception Length | 3.95 | ft |

# Worksheet
## Worksheet for Curb Inlet In Sag

| Project Description | |
|---|---|
| Worksheet | Curb Inlet - 21-G |
| Type | Curb Inlet In Sag |
| Solve For | Spread |

| Input Data | | |
|---|---|---|
| Discharge | 1.41 | cfs |
| Gutter Width | 1.67 | ft |
| Gutter Cross Slope | 0.083333 | ft/ft |
| Road Cross Slope | 0.020800 | ft/ft |
| Curb Opening Length | 10.00 | ft |
| Opening Height | 0.39 | ft |
| Curb Throat Type | Horizontal | |
| Local Depression | 2.0 | in |
| Local Depression Width | 2.00 | ft |

| Results | | |
|---|---|---|
| Spread | 6.09 | ft |
| Throat Incline Angle | 90.00 | degrees |
| Depth | 0.40 | ft |
| Gutter Depression | 1.3 | in |
| Total Depression | 3.3 | in |

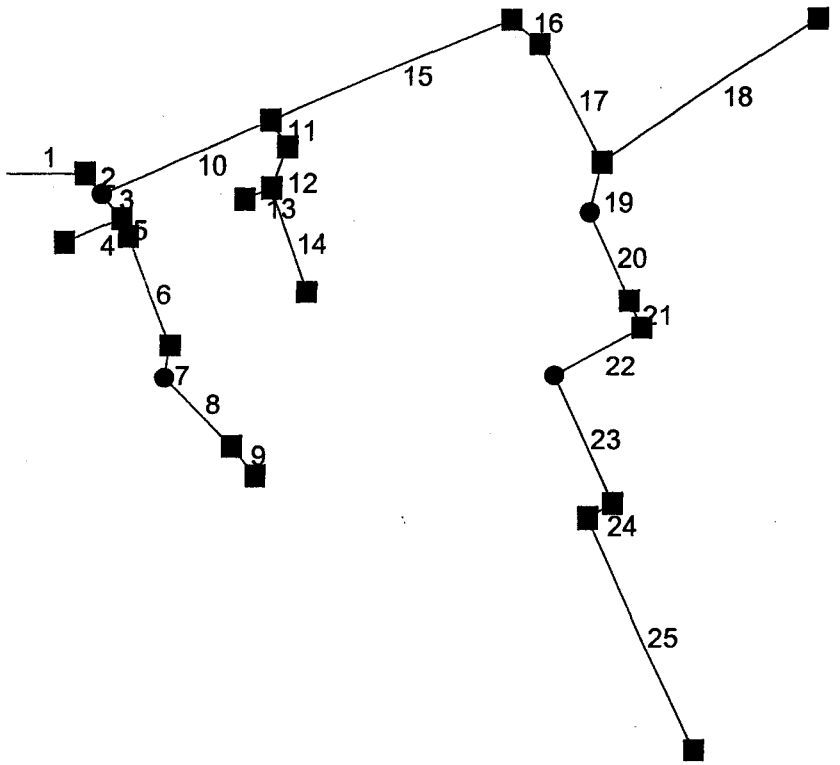
# Worksheet
## Worksheet for Curb Inlet In Sag

| Project Description | |
|---|---|
| Worksheet | Curb Inlet - 21 - F |
| Type | Curb Inlet In Sag |
| Solve For | Spread |

| Input Data | | |
|---|---|---|
| Discharge | 0.72 | cfs |
| Gutter Width | 1.67 | ft |
| Gutter Cross Slope | 0.083333 | ft/ft |
| Road Cross Slope | 0.020800 | ft/ft |
| Curb Opening Length | 2.50 | ft |
| Opening Height | 0.39 | ft |
| Curb Throat Type | Horizontal | |
| Local Depression | 2.0 | in |
| Local Depression Width | 2.00 | ft |

| Results | | |
|---|---|---|
| Spread | 6.64 | ft |
| Throat Incline Angle | 90.00 | degrees |
| Depth | 0.41 | ft |
| Gutter Depression | 1.3 | in |
| Total Depression | 3.3 | in |

# Hydraflow Plan View




| | | | |
|---|---|---|---|
| Project file: Stonehouse Glen System 2.stm | IDF file: Norfolk.IDF | No. Lines: 25 | 10-18-2004 |

# Hydraflow Storm Sewer Inventory Report



| Line No. | Alignment | | | | Flow Data | | | | Physical Data | | | | | | | | Line ID |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Dnstr line No. | Line length (ft) | Defl angle (deg) | Junc type | Known Q (cfs) | Drng area (ac) | Runoff coeff (C) | Inlet time (min) | Invert El Dn (ft) | Line slope (%) | Invert El Up (ft) | Line size (in) | Line type | N value (n) | J-loss coeff (K) | Inlet/ Rim El (ft) | |
| 1 | End | 89.0 | 0.0 | Curb | 17.11 | 0.00 | 0.00 | 0.0 | 79.87 | 0.82 | 80.60 | 24 | Cir | 0.013 | 1.10 | 85.71 | 23 to 22 |
| 2 | 1 | 28.0 | 46.0 | MH | 19.40 | 0.00 | 0.00 | 0.0 | 80.70 | 0.79 | 80.92 | 24 | Cir | 0.013 | 0.85 | 85.81 | 21 to 22 |
| 3 | 2 | 33.0 | 0.0 | Curb | 6.98 | 0.00 | 0.00 | 0.0 | 81.51 | 0.48 | 81.67 | 18 | Cir | 0.013 | 1.50 | 86.18 | 21 to 21B |
| 4 | 3 | 70.0 | 113.0 | Curb | 0.74 | 0.00 | 0.00 | 0.0 | 81.92 | 0.83 | 82.50 | 15 | Cir | 0.013 | 1.00 | 85.75 | 21A to 21B |
| 5 | 3 | 20.0 | 21.0 | Gneric | 5.28 | 0.00 | 0.00 | 0.0 | 81.92 | 0.90 | 82.10 | 15 | Cir | 0.013 | 0.50 | 85.95 | 21B to 21C |
| 6 | 5 | 123.0 | 0.0 | Gneric | 4.34 | 0.00 | 0.00 | 0.0 | 82.20 | 2.03 | 84.70 | 15 | Cir | 0.013 | 0.70 | 92.70 | 21D to 21C |
| 7 | 6 | 35.0 | 33.0 | MH | 2.67 | 0.00 | 0.00 | 0.0 | 87.70 | 6.57 | 90.00 | 15 | Cir | 0.013 | 0.85 | 98.25 | 21D to 21E |
| 8 | 7 | 105.0 | -57.0 | Curb | 2.67 | 0.00 | 0.00 | 0.0 | 94.25 | 6.07 | 100.62 | 15 | Cir | 0.013 | 0.50 | 108.95 | 21F to 21E |
| 9 | 8 | 40.0 | 5.0 | Curb | 1.69 | 0.00 | 0.00 | 0.0 | 104.73 | 0.60 | 104.97 | 15 | Cir | 0.013 | 1.00 | 108.89 | 21G to 21F |
| 10 | 2 | 205.0 | -67.0 | Curb | 11.99 | 0.00 | 0.00 | 0.0 | 81.02 | 0.52 | 82.09 | 24 | Cir | 0.013 | 1.25 | 92.20 | 21 to 20 |
| 11 | 10 | 33.0 | 75.0 | Curb | 4.52 | 0.00 | 0.00 | 0.0 | 86.53 | 0.52 | 86.70 | 15 | Cir | 0.013 | 1.25 | 92.27 | 20 to 20 - A |
| 12 | 11 | 44.0 | 60.0 | Curb | 3.87 | 0.00 | 0.00 | 0.0 | 86.80 | 0.66 | 87.09 | 15 | Cir | 0.013 | 1.10 | 91.33 | 20 - A to 20 - B |
| 13 | 12 | 32.0 | 45.0 | Curb | 0.69 | 0.00 | 0.00 | 0.0 | 87.41 | 0.59 | 87.60 | 15 | Cir | 0.013 | 1.00 | 91.20 | 20 - D to 20 - B |
| 14 | 12 | 113.0 | -45.0 | Curb | 2.34 | 0.00 | 0.00 | 0.0 | 87.19 | 9.67 | 98.12 | 15 | Cir | 0.013 | 1.00 | 100.13 | 20 - C to 20 - B |
| 15 | 10 | 292.0 | 0.0 | Curb | 7.72 | 0.00 | 0.00 | 0.0 | 82.59 | 0.59 | 84.31 | 18 | Cir | 0.013 | 1.25 | 89.14 | 19 to 20 |
| 16 | 15 | 41.0 | 60.0 | Curb | 7.21 | 0.00 | 0.00 | 0.0 | 84.41 | 0.51 | 84.62 | 18 | Cir | 0.013 | 0.70 | 88.86 | 18 to19 |
| 17 | 16 | 140.0 | 20.0 | Gneric | 5.99 | 0.00 | 0.00 | 0.0 | 84.87 | 3.45 | 89.70 | 15 | Cir | 0.013 | 1.50 | 103.40 | 17 to 18 |
| 18 | 17 | 286.0 | -90.0 | Gneric | 5.35 | 0.00 | 0.00 | 0.0 | 90.79 | 0.48 | 92.16 | 15 | Cir | 0.013 | 1.00 | 96.83 | 16 to 17 |
| 19 | 17 | 52.0 | 46.0 | MH | 4.28 | 0.00 | 0.00 | 0.0 | 95.65 | 5.96 | 98.75 | 15 | Cir | 0.013 | 0.75 | 111.67 | 17 - A to 17 |
| 20 | 19 | 101.0 | -42.0 | Curb | 4.28 | 0.00 | 0.00 | 0.0 | 98.85 | 2.13 | 101.00 | 15 | Cir | 0.013 | 0.50 | 107.49 | 17 - B to 17 - A |
| 21 | 20 | 32.0 | 0.0 | Curb | 3.47 | 0.00 | 0.00 | 0.0 | 101.10 | 0.47 | 101.25 | 15 | Cir | 0.013 | 1.50 | 107.49 | 17 - C to 17 - B |

| | | | |
|---|---|---|---|
| Project File: Stonehouse Glen System 2.stm | I-D-F File: Norfolk.IDF | Total number of lines: 25 | Date: 10-18-2004 |

# Hydraflow Storm Sewer Inventory Report



| Line No. | Alignment | | | | Flow Data | | | | Physical Data | | | | | | | | Line ID |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Dnstr line No. | Line length (ft) | Defl angle (deg) | Junc type | Known Q (cfs) | Drng area (ac) | Runoff coeff (C) | Inlet time (min) | Invert El Dn (ft) | Line slope (%) | Invert El Up (ft) | Line size (in) | Line type | N value (n) | J-loss coeff (K) | Inlet/ Rim El (ft) | |
| 22 | 21 | 112.0 | 90.0 | MH | 3.16 | 0.00 | 0.00 | 0.0 | 101.35 | 0.52 | 101.93 | 15 | Cir | 0.013 | 1.00 | 112.26 | 17 - D to 17 - C |
| 23 | 22 | 148.0 | -90.0 | Curb | 3.19 | 0.00 | 0.00 | 0.0 | 102.03 | 0.52 | 102.80 | 15 | Cir | 0.013 | 1.50 | 110.95 | 17 - E to 17 - D |
| 24 | 23 | 32.0 | 90.0 | Curb | 2.53 | 0.00 | 0.00 | 0.0 | 102.90 | 0.47 | 103.05 | 15 | Cir | 0.013 | 1.50 | 110.95 | 17 - F to 17 - E |
| 25 | 24 | 268.0 | -90.0 | Curb | 1.21 | 0.00 | 0.00 | 0.0 | 103.15 | 0.60 | 104.76 | 15 | Cir | 0.013 | 1.00 | 108.68 | 17 - G to 17 - F |

| | | | |
|---|---|---|---|
| Project File: Stonehouse Glen System 2.stm | I-D-F File: Norfolk.IDF | Total number of lines: 25 | Date: 10-18-2004 |

# Hydraflow Summary Report



| Line No. | Line ID | Flow rate (cfs) | Line size (in) | Line length (ft) | Invert EL Dn (ft) | Invert EL Up (ft) | Line slope (%) | HGL down (ft) | HGL up (ft) | Minor loss (ft) | Dns line No. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 23 to 22 | 17.11 | 24 c | 89.0 | 79.87 | 80.60 | 0.820 | 81.62 | 82.07 | 0.82 | End |
| 2 | 21 to 22 | 19.40 | 24 c | 28.0 | 80.70 | 80.92 | 0.786 | 82.89* | 83.09* | 0.50 | 1 |
| 3 | 21 to 21B | 6.98 | 18 c | 33.0 | 81.51 | 81.67 | 0.485 | 83.60* | 83.74* | 0.36 | 2 |
| 4 | 21A to 21B | 0.74 | 15 c | 70.0 | 81.92 | 82.50 | 0.829 | 84.11* | 84.12* | 0.01 | 3 |
| 5 | 21B to 21C | 5.28 | 15 c | 20.0 | 81.92 | 82.10 | 0.900 | 84.11* | 84.24* | 0.14 | 3 |
| 6 | 21D to 21C | 4.34 | 15 c | 123.0 | 82.20 | 84.70 | 2.033 | 84.39 | 85.53 | 0.27 | 5 |
| 7 | 21D to 21E | 2.67 | 15 c | 35.0 | 87.70 | 90.00 | 6.571 | 88.04 | 90.65 | 0.22 | 6 |
| 8 | 21F to 21E | 2.67 | 15 c | 105.0 | 94.25 | 100.62 | 6.067 | 94.61 | 101.27 | 0.13 | 7 |
| 9 | 21G to 21F | 1.69 | 15 c | 40.0 | 104.73 | 104.97 | 0.600 | 105.23 | 105.49 | 0.19 | 8 |
| 10 | 21 to 20 | 11.99 | 24 c | 205.0 | 81.02 | 82.09 | 0.522 | 83.60* | 84.17* | 0.28 | 2 |
| 11 | 20 to 20 - A | 4.52 | 15 c | 33.0 | 86.53 | 86.70 | 0.515 | 87.54 | 87.70 | 0.36 | 10 |
| 12 | 20 - A to 20 - B | 3.87 | 15 c | 44.0 | 86.80 | 87.09 | 0.659 | 88.06 | 88.18 | 0.20 | 11 |
| 13 | 20 - D to 20 - B | 0.69 | 15 c | 32.0 | 87.41 | 87.60 | 0.594 | 88.38 | 88.38 | 0.01 | 12 |
| 14 | 20 - C to 20 - B | 2.34 | 15 c | 113.0 | 87.19 | 98.12 | 9.673 | 88.38 | 98.73 | 0.24 | 12 |
| 15 | 19 to 20 | 7.72 | 18 c | 292.0 | 82.59 | 84.31 | 0.589 | 84.46* | 86.04* | 0.37 | 10 |
| 16 | 18 to19 | 7.21 | 18 c | 41.0 | 84.41 | 84.62 | 0.512 | 86.41* | 86.60* | 0.18 | 15 |
| 17 | 17 to 18 | 5.99 | 15 c | 140.0 | 84.87 | 89.70 | 3.450 | 86.78 | 90.68 | 0.79 | 16 |
| 18 | 16 to 17 | 5.35 | 15 c | 286.0 | 90.79 | 92.16 | 0.479 | 92.04* | 94.00* | 0.30 | 17 |
| 19 | 17 - A to 17 | 4.28 | 15 c | 52.0 | 95.65 | 98.75 | 5.962 | 96.11 | 99.58 | 0.29 | 17 |
| 20 | 17 - B to 17 - A | 4.28 | 15 c | 101.0 | 98.85 | 101.00 | 2.129 | 99.86 | 101.83 | 0.19 | 19 |
| 21 | 17 - C to 17 - B | 3.47 | 15 c | 32.0 | 101.10 | 101.25 | 0.469 | 102.02 | 102.12 | 0.34 | 20 |
| 22 | 17 - D to 17 - C | 3.16 | 15 c | 112.0 | 101.35 | 101.93 | 0.518 | 102.46 | 102.72 | 0.23 | 21 |
| 23 | 17 - E to 17 - D | 3.19 | 15 c | 148.0 | 102.03 | 102.80 | 0.520 | 102.95 | 103.52 | 0.45 | 22 |
| 24 | 17 - F to 17 - E | 2.53 | 15 c | 32.0 | 102.90 | 103.05 | 0.469 | 103.96 | 104.00 | 0.15 | 23 |
| 25 | 17 - G to 17 - F | 1.21 | 15 c | 268.0 | 103.15 | 104.76 | 0.601 | 104.15 | 105.20 | 0.15 | 24 |

Project File: Stonehouse Glen System 2I-D-F File: Norfolk.IDF | Total No. Lines: 25 | Run Date: 10-18-2004

NOTES: c = circular; e = elliptical; b = box; Return period = 10 Yrs.; * Indicates surcharge condition.

# Hydraflow Storm Sewer Tabulation



| Station | | Len | Drng Area | | Rnoff coeff | Area x C | | Tc | | Rain (I) | Total flow | Cap full | Vel | Pipe | | Invert Elev | | HGL Elev | | Grnd / Rim Elev | | Line ID |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Line | To Line | (ft) | Incr (ac) | Total (ac) | (C) | Incr | Total | Inlet (min) | Syst (min) | (in/hr) | (cfs) | (cfs) | (ft/s) | Size (in) | Slope (%) | Up (ft) | Dn (ft) | Up (ft) | Dn (ft) | Up (ft) | Dn (ft) | |
| 1 | End | 89.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.0 | 8.1 | 0.0 | 17.11 | 20.48 | 6.40 | 24 | 0.82 | 80.60 | 79.87 | 82.07 | 81.62 | 85.71 | 0.00 | 23 to 22 |
| 2 | 1 | 28.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.0 | 7.9 | 0.0 | 19.40 | 20.05 | 6.18 | 24 | 0.79 | 80.92 | 80.70 | 83.09 | 82.89 | 85.81 | 85.71 | 21 to 22 |
| 3 | 2 | 33.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.0 | 1.8 | 0.0 | 6.98 | 7.31 | 3.95 | 18 | 0.48 | 81.67 | 81.51 | 83.74 | 83.60 | 86.18 | 85.81 | 21 to 21B |
| 4 | 3 | 70.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.0 | 0.0 | 0.0 | 0.74 | 5.88 | 0.60 | 15 | 0.83 | 82.50 | 81.92 | 84.12 | 84.11 | 85.75 | 86.18 | 21A to 21B |
| 5 | 3 | 20.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.0 | 1.7 | 0.0 | 5.28 | 6.13 | 4.30 | 15 | 0.90 | 82.10 | 81.92 | 84.24 | 84.11 | 85.95 | 86.18 | 21B to 21C |
| 6 | 5 | 123.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.0 | 1.0 | 0.0 | 4.34 | 9.21 | 4.26 | 15 | 2.03 | 84.70 | 82.20 | 85.53 | 84.39 | 92.70 | 85.95 | 21D to 21C |
| 7 | 6 | 35.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.0 | 0.8 | 0.0 | 2.67 | 16.55 | 6.97 | 15 | 6.57 | 90.00 | 87.70 | 90.65 | 88.04 | 98.25 | 92.70 | 21D to 21E |
| 8 | 7 | 105.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.0 | 0.2 | 0.0 | 2.67 | 15.91 | 6.70 | 15 | 6.07 | 100.62 | 94.25 | 101.27 | 94.61 | 108.95 | 98.25 | 21F to 21E |
| 9 | 8 | 40.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.0 | 0.0 | 0.0 | 1.69 | 5.00 | 3.56 | 15 | 0.60 | 104.97 | 104.73 | 105.49 | 105.23 | 108.89 | 108.95 | 21G to 21F |
| 10 | 2 | 205.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.0 | 6.8 | 0.0 | 11.99 | 16.34 | 3.82 | 24 | 0.52 | 82.09 | 81.02 | 84.17 | 83.60 | 92.20 | 85.81 | 21 to 20 |
| 11 | 10 | 33.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.0 | 0.9 | 0.0 | 4.52 | 4.63 | 4.28 | 15 | 0.52 | 86.70 | 86.53 | 87.70 | 87.54 | 92.27 | 92.20 | 20 to 20 - A |
| 12 | 11 | 44.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.0 | 0.6 | 0.0 | 3.87 | 5.24 | 3.28 | 15 | 0.66 | 87.09 | 86.80 | 88.18 | 88.06 | 91.33 | 92.27 | 20 - A to 20 |
| 13 | 12 | 32.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.0 | 0.0 | 0.0 | 0.69 | 4.98 | 0.76 | 15 | 0.59 | 87.60 | 87.41 | 88.38 | 88.38 | 91.20 | 91.33 | 20 - D to 20 |
| 14 | 12 | 113.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.0 | 0.0 | 0.0 | 2.34 | 20.08 | 2.93 | 15 | 9.67 | 98.12 | 87.19 | 98.73 | 88.38 | 100.13 | 91.33 | 20 - C to 20 |
| 15 | 10 | 292.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.0 | 5.1 | 0.0 | 7.72 | 8.06 | 4.37 | 18 | 0.59 | 84.31 | 82.59 | 86.04 | 84.46 | 89.14 | 92.20 | 19 to 20 |
| 16 | 15 | 41.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.0 | 4.9 | 0.0 | 7.21 | 7.52 | 4.08 | 18 | 0.51 | 84.62 | 84.41 | 86.60 | 86.41 | 88.86 | 89.14 | 18 to19 |
| 17 | 16 | 140.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.0 | 4.1 | 0.0 | 5.99 | 11.99 | 5.34 | 15 | 3.45 | 89.70 | 84.87 | 90.68 | 86.78 | 103.40 | 88.86 | 17 to 18 |
| 18 | 17 | 286.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.0 | 0.0 | 0.0 | 5.35 | 4.47 | 4.36 | 15 | 0.48 | 92.16 | 90.79 | 94.00 | 92.04 | 96.83 | 103.40 | 16 to 17 |
| 19 | 17 | 52.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.0 | 3.8 | 0.0 | 4.28 | 15.77 | 7.74 | 15 | 5.96 | 98.75 | 95.65 | 99.58 | 96.11 | 111.67 | 103.40 | 17 - A to 17 |
| 20 | 19 | 101.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.0 | 3.3 | 0.0 | 4.28 | 9.42 | 4.49 | 15 | 2.13 | 101.00 | 98.85 | 101.83 | 99.86 | 107.49 | 111.67 | 17 - B to 17 |
| 21 | 20 | 32.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.0 | 3.1 | 0.0 | 3.47 | 4.42 | 3.70 | 15 | 0.47 | 101.25 | 101.10 | 102.12 | 102.02 | 107.49 | 107.49 | 17 - C to 17 |

Project File: Stonehouse Glen System 2.stm | I-D-F File: Norfolk.IDF | Total number of lines: 25 | Run Date: 10-18-2004

NOTES: Intensity = 128.59 / (Tc + 17.70) ^ 0.89; Return period = 10 Yrs. ; Initial tailwater elevation = 81.62 (ft)

# Hydraflow Storm Sewer Tabulation



| Station | | Len | Drng Area | | Rnoff coeff | Area x C | | Tc | | Rain (I) | Total flow | Cap full | Vel | Pipe | | Invert Elev | | HGL Elev | | Grnd / Rim Elev | | Line ID |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Line | To Line | (ft) | Incr (ac) | Total (ac) | (C) | Incr | Total | Inlet (min) | Syst (min) | (in/hr) | (cfs) | (cfs) | (ft/s) | Size (in) | Slope (%) | Up (ft) | Dn (ft) | Up (ft) | Dn (ft) | Up (ft) | Dn (ft) | |
| 22 | 21 | 112.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.0 | 2.5 | 0.0 | 3.16 | 4.65 | 3.31 | 15 | 0.52 | 101.93 | 101.35 | 102.72 | 102.46 | 112.26 | 107.49 | 17 - D to 17 |
| 23 | 22 | 148.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.0 | 1.7 | 0.0 | 3.19 | 4.66 | 3.83 | 15 | 0.52 | 102.80 | 102.03 | 103.52 | 102.95 | 110.95 | 112.26 | 17 - E to 17 |
| 24 | 23 | 32.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.0 | 1.5 | 0.0 | 2.53 | 4.42 | 2.41 | 15 | 0.47 | 103.05 | 102.90 | 104.00 | 103.96 | 110.95 | 110.95 | 17 - F to 17 |
| 25 | 24 | 268.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.0 | 0.0 | 0.0 | 1.21 | 5.01 | 2.14 | 15 | 0.60 | 104.76 | 103.15 | 105.20 | 104.15 | 108.68 | 110.95 | 17 - G to 17 |

Project File: Stonehouse Glen System 2.stm | I-D-F File: Norfolk.IDF | Total number of lines: 25 | Run Date: 10-18-2004

NOTES: Intensity = 128.59 / (Tc + 17.70) ^ 0.89; Return period = 10 Yrs. ; Initial tailwater elevation = 81.62 (ft)

# Hydraflow Inlet Report



| Line No | Line ID | A (ac) | Inlet time (min) | I (in/hr) | C | Q = CIA (cfs) | Q carry (cfs) | Q capt (cfs) | Q byp (cfs) | Junc type | Curb Inlet Ht (in) | Curb Inlet L (ft) | Grate Inlet area (sqft) | Grate Inlet L (ft) | Grate Inlet W (ft) | Gutter So (ft/ft) | Gutter W (ft) | Gutter Sw (ft/ft) | Gutter Sx (ft/ft) | Flow depth (ft) | Flow spread (ft) | Byp line No |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 23 to 22 | 0.00 | 0.0 | 0.00 | 0.00 | 17.11* | 69.58 | 86.69 | 0.00 | Curb | 0.4 | 6.00 | 0.00 | 0.00 | 0.00 | Sag | 1.67 | 0.083 | 0.020 | 3.43 | 166.01 | Offsite |
| 2 | 21 to 22 | 0.00 | 0.0 | 0.00 | 0.00 | 19.40* | 50.18 | 0.00 | 69.58 | MH | 0.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 | 0.00 | 0.000 | 0.000 | 0.00 | 0.00 | 1 |
| 3 | 21 to 21B | 0.00 | 0.0 | 0.00 | 0.00 | 6.98* | 9.41 | 1.60 | 14.79 | Curb | 0.4 | 2.50 | 0.00 | 0.00 | 0.00 | 0.012 | 1.67 | 0.083 | 0.020 | 0.50 | 19.74 | 2 |
| 4 | 21A to 21B | 0.00 | 0.0 | 0.00 | 0.00 | 0.74* | 0.00 | 0.74 | 0.00 | Curb | 0.4 | 2.50 | 0.00 | 0.00 | 0.00 | Sag | 1.67 | 0.083 | 0.020 | 0.25 | 7.40 | 2 |
| 5 | 21B to 21C | 0.00 | 0.0 | 0.00 | 0.00 | 5.28* | 0.00 | 4.50 | 0.78 | Genr | 0.0 | 0.00 | 0.00 | 0.00 | 0.00 | Sag | 3.00 | 0.001 | 0.001 | 0.30 | 300.00 | 3 |
| 6 | 21D to 21C | 0.00 | 0.0 | 0.00 | 0.00 | 4.34* | 2.67 | 4.00 | 3.01 | Genr | 0.0 | 0.00 | 0.00 | 0.00 | 0.00 | Sag | 3.00 | 0.001 | 0.001 | 0.30 | 300.00 | 3 |
| 7 | 21D to 21E | 0.00 | 0.0 | 0.00 | 0.00 | 2.67* | 0.00 | 0.00 | 2.67 | MH | 0.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 | 0.00 | 0.000 | 0.000 | 0.00 | 0.00 | 6 |
| 8 | 21F to 21E | 0.00 | 0.0 | 0.00 | 0.00 | 2.67* | 0.00 | 2.67 | 0.00 | Curb | 0.4 | 2.50 | 0.00 | 0.00 | 0.00 | Sag | 1.67 | 0.083 | 0.020 | 0.60 | 24.65 | 2 |
| 9 | 21G to 21F | 0.00 | 0.0 | 0.00 | 0.00 | 1.69* | 0.00 | 1.69 | 0.00 | Curb | 0.4 | 10.00 | 0.00 | 0.00 | 0.00 | Sag | 1.67 | 0.083 | 0.020 | 0.17 | 3.44 | 2 |
| 10 | 21 to 20 | 0.00 | 0.0 | 0.00 | 0.00 | 11.99* | 0.00 | 1.38 | 10.61 | Curb | 0.4 | 2.50 | 0.00 | 0.00 | 0.00 | 0.012 | 1.67 | 0.083 | 0.020 | 0.46 | 17.74 | 2 |
| 11 | 20 to 20 - A | 0.00 | 0.0 | 0.00 | 0.00 | 4.52* | 0.00 | 0.78 | 3.74 | Curb | 0.4 | 2.50 | 0.00 | 0.00 | 0.00 | 0.020 | 1.67 | 0.083 | 0.020 | 0.32 | 10.74 | 2 |
| 12 | 20 - A to 20 - B | 0.00 | 0.0 | 0.00 | 0.00 | 3.87* | 0.00 | 3.87 | 0.00 | Curb | 0.4 | 6.00 | 0.00 | 0.00 | 0.00 | Sag | 1.67 | 0.083 | 0.020 | 0.43 | 16.07 | 2 |
| 13 | 20 - D to 20 - B | 0.00 | 0.0 | 0.00 | 0.00 | 0.69* | 0.00 | 0.19 | 0.50 | Curb | 0.4 | 4.00 | 0.00 | 0.00 | 0.00 | 1.000 | 1.67 | 0.083 | 0.020 | 0.10 | 1.20 | 2 |
| 14 | 20 - C to 20 - B | 0.00 | 0.0 | 0.00 | 0.00 | 2.34* | 0.00 | 0.63 | 1.71 | Curb | 0.4 | 4.00 | 0.00 | 0.00 | 0.00 | 0.109 | 1.67 | 0.083 | 0.020 | 0.21 | 5.24 | 2 |
| 15 | 19 to 20 | 0.00 | 0.0 | 0.00 | 0.00 | 7.72* | 0.00 | 1.54 | 6.18 | Curb | 0.4 | 4.00 | 0.00 | 0.00 | 0.00 | 0.022 | 1.67 | 0.083 | 0.020 | 0.37 | 13.24 | 2 |
| 16 | 18 to19 | 0.00 | 0.0 | 0.00 | 0.00 | 7.21* | 0.00 | 2.82 | 4.39 | Curb | 0.4 | 8.00 | 0.00 | 0.00 | 0.00 | 0.022 | 1.67 | 0.083 | 0.020 | 0.36 | 12.74 | 2 |
| 17 | 17 to 18 | 0.00 | 0.0 | 0.00 | 0.00 | 5.99* | 4.28 | 5.00 | 5.27 | Genr | 0.0 | 0.00 | 0.00 | 0.00 | 0.00 | Sag | 3.00 | 0.001 | 0.001 | 0.30 | 300.00 | 3 |
| 18 | 16 to 17 | 0.00 | 0.0 | 0.00 | 0.00 | 5.35* | 0.00 | 5.00 | 0.35 | Genr | 0.0 | 0.00 | 0.00 | 0.00 | 0.00 | Sag | 3.00 | 0.001 | 0.001 | 0.30 | 300.00 | 3 |
| 19 | 17 - A to 17 | 0.00 | 0.0 | 0.00 | 0.00 | 4.28* | 0.00 | 0.00 | 4.28 | MH | 0.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 | 0.00 | 0.000 | 0.000 | 0.00 | 0.00 | 17 |
| 20 | 17 - B to 17 - A | 0.00 | 0.0 | 0.00 | 0.00 | 4.28* | 0.00 | 1.45 | 2.83 | Curb | 0.4 | 6.00 | 0.00 | 0.00 | 0.00 | 0.048 | 1.67 | 0.083 | 0.020 | 0.28 | 8.74 | 2 |
| 21 | 17 - C to 17 - B | 0.00 | 0.0 | 0.00 | 0.00 | 3.47* | 3.16 | 1.20 | 5.43 | Curb | 0.4 | 4.00 | 0.00 | 0.00 | 0.00 | 0.048 | 1.67 | 0.083 | 0.020 | 0.31 | 10.24 | 2 |
| 22 | 17 - D to 17 - C | 0.00 | 0.0 | 0.00 | 0.00 | 3.16* | 0.00 | 0.00 | 3.16 | MH | 0.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 | 0.00 | 0.000 | 0.000 | 0.00 | 0.00 | 21 |

Project File: Stonehouse Glen System 2.stm | I-D-F File: Norfolk.IDF | Total number of lines: 25 | Run Date: 10-18-2004

NOTES: Inlet N-Values = 0.016 ; Design depth for grate(s) = 0.3 (ft); Intensity = 128.59 / (Inlet time + 17.70) ^ 0.89; Return period = 10 Yrs. ; * Indicates Known Q added

# Hydraflow Inlet Report



| Line No | Line ID | A (ac) | Inlet time (min) | I (in/hr) | C | Q = CIA (cfs) | Q carry (cfs) | Q capt (cfs) | Q byp (cfs) | Junc type | Curb Inlet Ht (in) | Curb Inlet L (ft) | Grate Inlet area (sqft) | Grate Inlet L (ft) | Grate Inlet W (ft) | Gutter So (ft/ft) | Gutter W (ft) | Gutter Sw (ft/ft) | Gutter Sx (ft/ft) | Flow depth (ft) | Flow spread (ft) | Byp line No |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23 | 17 - E to 17 - D | 0.00 | 0.0 | 0.00 | 0.00 | 3.19* | 0.00 | 3.19 | 0.00 | Curb | 0.4 | 2.50 | 0.00 | 0.00 | 0.00 | Sag | 1.67 | 0.083 | 0.020 | 0.67 | 28.43 | 2 |
| 24 | 17 - F to 17 - E | 0.00 | 0.0 | 0.00 | 0.00 | 2.53* | 0.00 | 2.53 | 0.00 | Curb | 0.4 | 2.50 | 0.00 | 0.00 | 0.00 | Sag | 1.67 | 0.083 | 0.020 | 0.58 | 23.59 | 2 |
| 25 | 17 - G to 17 - F | 0.00 | 0.0 | 0.00 | 0.00 | 1.21* | 0.00 | 1.21 | 0.00 | Curb | 0.4 | 2.50 | 0.00 | 0.00 | 0.00 | Sag | 1.67 | 0.083 | 0.020 | 0.35 | 12.34 | 2 |

Project File: Stonehouse Glen System 2.stm | I-D-F File: Norfolk.IDF | Total number of lines: 25 | Run Date: 10-18-2004

NOTES: Inlet N-Values = 0.016 ; Design depth for grate(s) = 0.3 (ft); Intensity = 128.59 / (Inlet time + 17.70) ^ 0.89; Return period = 10 Yrs. ; * Indicates Known Q added

# Hydraflow 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 | 24 | 17.11 | 79.87 | 81.62 | 1.75 | 2.91 | 5.87 | 0.54 | 82.16 | 0.518 | 89.0 | 80.60 | 82.07 | 1.47** | 2.47 | 6.94 | 0.75 | 82.81 | 0.728 | 0.623 | N/A | 1.10 | 0.82 |
| 2 | 24 | 19.40 | 80.70 | 82.89 | 2.00 | 3.14 | 6.18 | 0.59 | 83.48 | 0.736 | 28.0 | 80.92 | 83.09 | 2.00 | 3.14 | 6.18 | 0.59 | 83.69 | 0.736 | 0.736 | 0.206 | 0.85 | 0.50 |
| 3 | 18 | 6.98 | 81.51 | 83.60 | 1.50 | 1.77 | 3.95 | 0.24 | 83.84 | 0.442 | 33.0 | 81.67 | 83.74 | 1.50 | 1.77 | 3.95 | 0.24 | 83.99 | 0.442 | 0.442 | 0.146 | 1.50 | 0.36 |
| 4 | 15 | 0.74 | 81.92 | 84.11 | 1.25 | 1.23 | 0.60 | 0.01 | 84.11 | 0.013 | 70.0 | 82.50 | 84.12 | 1.25 | 1.23 | 0.60 | 0.01 | 84.12 | 0.013 | 0.013 | 0.009 | 1.00 | 0.01 |
| 5 | 15 | 5.28 | 81.92 | 84.11 | 1.25 | 1.23 | 4.30 | 0.29 | 84.40 | 0.669 | 20.0 | 82.10 | 84.24 | 1.25 | 1.23 | 4.30 | 0.29 | 84.53 | 0.669 | 0.669 | 0.134 | 0.50 | 0.14 |
| 6 | 15 | 4.34 | 82.20 | 84.39 | 1.25 | 1.23 | 3.54 | 0.19 | 84.58 | 0.452 | 123 | 84.70 | 85.53 | 0.83** | 0.87 | 4.99 | 0.39 | 85.92 | 0.734 | 0.593 | N/A | 0.70 | 0.27 |
| 7 | 15 | 2.67 | 87.70 | 88.04 | 0.34* | 0.27 | 9.82 | 1.50 | 89.54 | 6.423 | 35.0 | 90.00 | 90.65 | 0.65** | 0.65 | 4.11 | 0.26 | 90.92 | 0.587 | 3.505 | N/A | 0.85 | 0.22 |
| 8 | 15 | 2.67 | 94.25 | 94.61 | 0.36* | 0.29 | 9.29 | 1.34 | 95.95 | 5.487 | 105 | 100.62 | 101.27 | 0.65** | 0.65 | 4.11 | 0.26 | 101.54 | 0.587 | 3.037 | N/A | 0.50 | 0.13 |
| 9 | 15 | 1.69 | 104.73 | 105.23 | 0.50* | 0.46 | 3.65 | 0.21 | 105.44 | 0.588 | 40.0 | 104.97 | 105.49 | 0.52 | 0.49 | 3.47 | 0.19 | 105.68 | 0.511 | 0.550 | 0.220 | 1.00 | 0.19 |
| 10 | 24 | 11.99 | 81.02 | 83.60 | 2.00 | 3.14 | 3.82 | 0.23 | 83.82 | 0.281 | 205 | 82.09 | 84.17 | 2.00 | 3.14 | 3.82 | 0.23 | 84.40 | 0.281 | 0.281 | 0.576 | 1.25 | 0.28 |
| 11 | 15 | 4.52 | 86.53 | 87.54 | 1.01* | 1.06 | 4.27 | 0.28 | 87.82 | 0.507 | 33.0 | 86.70 | 87.70 | 1.00 | 1.05 | 4.29 | 0.29 | 87.99 | 0.512 | 0.510 | 0.168 | 1.25 | 0.36 |
| 12 | 15 | 3.87 | 86.80 | 88.06 | 1.25 | 1.23 | 3.15 | 0.15 | 88.21 | 0.359 | 44.0 | 87.09 | 88.18 | 1.09 | 1.14 | 3.40 | 0.18 | 88.36 | 0.325 | 0.342 | 0.151 | 1.10 | 0.20 |
| 13 | 15 | 0.69 | 87.41 | 88.38 | 0.97 | 1.02 | 0.67 | 0.01 | 88.39 | 0.013 | 32.0 | 87.60 | 88.38 | 0.78 | 0.81 | 0.86 | 0.01 | 88.39 | 0.022 | 0.018 | 0.006 | 1.00 | 0.01 |
| 14 | 15 | 2.34 | 87.19 | 88.38 | 1.19 | 1.21 | 1.94 | 0.06 | 88.44 | 0.114 | 113 | 98.12 | 98.73 | 0.61** | 0.60 | 3.92 | 0.24 | 98.97 | 0.564 | 0.339 | N/A | 1.00 | 0.24 |
| 15 | 18 | 7.72 | 82.59 | 84.46 | 1.50 | 1.77 | 4.37 | 0.30 | 84.75 | 0.541 | 292 | 84.31 | 86.04 | 1.50 | 1.77 | 4.37 | 0.30 | 86.33 | 0.540 | 0.541 | 1.579 | 1.25 | 0.37 |
| 16 | 18 | 7.21 | 84.41 | 86.41 | 1.50 | 1.77 | 4.08 | 0.26 | 86.67 | 0.472 | 41.0 | 84.62 | 86.60 | 1.50 | 1.77 | 4.08 | 0.26 | 86.86 | 0.471 | 0.472 | 0.193 | 0.70 | 0.18 |
| 17 | 15 | 5.99 | 84.87 | 86.78 | 1.25 | 1.23 | 4.88 | 0.37 | 87.15 | 0.861 | 140 | 89.70 | 90.68 | 0.98** | 1.03 | 5.81 | 0.52 | 91.20 | 0.939 | 0.900 | N/A | 1.50 | 0.79 |
| 18 | 15 | 5.35 | 90.79 | 92.04 | 1.25* | 1.23 | 4.36 | 0.30 | 92.34 | 0.687 | 286 | 92.16 | 94.00 | 1.25 | 1.23 | 4.36 | 0.30 | 94.30 | 0.686 | 0.687 | 1.964 | 1.00 | 0.30 |
| 19 | 15 | 4.28 | 95.65 | 96.11 | 0.46* | 0.41 | 10.51 | 1.72 | 97.83 | 5.360 | 52.0 | 98.75 | 99.58 | 0.83** | 0.86 | 4.96 | 0.38 | 99.96 | 0.728 | 3.044 | N/A | 0.75 | 0.29 |
| 20 | 15 | 4.28 | 98.85 | 99.86 | 1.01 | 1.07 | 4.01 | 0.25 | 100.11 | 0.447 | 101 | 101.00 | 101.83 | 0.83** | 0.86 | 4.96 | 0.38 | 102.21 | 0.728 | 0.587 | N/A | 0.50 | 0.19 |
| 21 | 15 | 3.47 | 101.10 | 102.02 | 0.92 | 0.97 | 3.59 | 0.20 | 102.22 | 0.364 | 32.0 | 101.25 | 102.12 | 0.87 | 0.91 | 3.82 | 0.23 | 102.34 | 0.421 | 0.392 | 0.126 | 1.50 | 0.34 |

| | | | |
|---|---|---|---|
| Project File: Stonehouse Glen System 2.stm | I-D-F File: Norfolk.IDF | Total number of lines: 25 | Run Date: 10-18-2004 |

NOTES: Initial tailwater elevation = 81.62 (ft), * Normal depth assumed., ** Critical depth assumed.

# Hydraflow 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) |
| 22 | 15 | 3.16 | 101.35 | 102.46 | 1.11 | 1.15 | 2.75 | 0.12 | 102.57 | 0.214 | 112 | 101.93 | 102.72 | 0.79 | 0.81 | 3.88 | 0.23 | 102.95 | 0.457 | 0.336 | 0.376 | 1.00 | 0.23 |
| 23 | 15 | 3.19 | 102.03 | 102.95 | 0.92 | 0.97 | 3.29 | 0.17 | 103.12 | 0.305 | 148 | 102.80 | 103.52 | 0.72 | 0.73 | 4.37 | 0.30 | 103.82 | 0.619 | 0.462 | 0.684 | 1.50 | 0.45 |
| 24 | 15 | 2.53 | 102.90 | 103.96 | 1.06 | 1.11 | 2.27 | 0.08 | 104.04 | 0.144 | 32.0 | 103.05 | 104.00 | 0.95 | 1.00 | 2.54 | 0.10 | 104.10 | 0.181 | 0.163 | 0.052 | 1.50 | 0.15 |
| 25 | 15 | 1.21 | 103.15 | 104.15 | 1.00 | 1.05 | 1.15 | 0.02 | 104.17 | 0.037 | 268 | 104.76 | 105.20 | 0.44** | 0.39 | 3.13 | 0.15 | 105.35 | 0.496 | 0.267 | N/A | 1.00 | 0.15 |

Project File: Stonehouse Glen System 2.stm | I-D-F File: Norfolk.IDF | Total number of lines: 25 | Run Date: 10-18-2004

NOTES: Initial tailwater elevation = 81.62 (ft) , * Normal depth assumed., ** Critical depth assumed.

# Appendix 9B-2 LD-229 Storm Drain Design Computations

LD-229
July 2000

STORM SEWER DESIGN
COMPUTATIONS

ROUTE: _____ PROJ: STONEHOUSE GLEN SECTION I
COUNTY: _____ DISTRICT: CURB & GUTTER
DESCRIPTION: _____
SHEET ____ OF ____

| FROM POINT (1) | TO POINT (2) | AREA DRAIN "A" ACRES (3) | RUN-OFF COEF. C (4) | CA INCREMENT (5) | CA ACCUMULATED (6) | INLET TIME MINUTES (7) | RAIN FALL IN./HR. (8) | RUN-OFF Q C.F.S. (9) | INVERT ELEVATIONS UPPER END (10) | INVERT ELEVATIONS LOWER END (11) | LENGTH FT. (12) | SLOPE FT./FT. (13) | DIA. IN. (14) | CAPA-CITY C.F.S. (15) | VEL. F.P.S. (16) | FLOW TIME MINUTES INCREMENT / ACCUMULATED (17) | REMARKS (18) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ~~13~~ | ~~14~~ | ~~0.27~~ | ~~0.6~~ | ~~0.16~~ | ~~2.25~~ | ~~16.81~~ | ~~5.07~~ | ~~11.41~~ | ~~81.00~~ | ~~70.62~~ | ~~173'~~ | ~~0.060~~ | ~~18"~~ | ~~25.73~~ | ~~14.12~~ | ~~0.84~~ | |
| ~~14A~~ | ~~14~~ | ~~0.73~~ | ~~0.35~~ | ~~0.26~~ | ~~—~~ | ~~18~~ | ~~5.54~~ | ~~1.44~~ | ~~76.17~~ | ~~72.88~~ | ~~28'~~ | ~~0.113~~ | ~~15"~~ | ~~21.71~~ | ~~10.03~~ | | |
| ~~14~~ | ~~15~~ | ~~—~~ | ~~—~~ | ~~—~~ | ~~3.51~~ | ~~15.81~~ | ~~5.07~~ | ~~12.73~~ | ~~65.38~~ | ~~62.00~~ | ~~34'~~ | ~~0.080~~ | ~~18"~~ | ~~29.71~~ | ~~16.16~~ | | |
| ~~15~~ | ~~16~~ | ~~—~~ | ~~—~~ | ~~—~~ | ~~—~~ | | | ~~12.73~~ | ~~56.39~~ | ~~56.25~~ | ~~31'~~ | ~~0.0045~~ | ~~24"~~ | ~~15.17~~ | ~~5.41~~ | | |
| | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| 27 | 28 | 1.33 | 0.45 | 0.60 | 1.07 | 14.7 | 5.29 | 5.66 | 66.67 | 65.08 | 199' | 0.0080 | 15" | 5.78 | 5.34 | | |
| 28 | 29 | — | — | — | — | — | — | 5.66 | 64.00 | 60.40 | 45' | 0.08 | 15" | 18.27 | 13.13 | | |
| 29 | 29A | — | — | — | — | — | — | 5.66 | 56.40 | 56.25 | 30' | 0.005 | 18" | 7.43 | 4.63 | | |

# Worksheet
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | 27 to 28 |
| Flow Element | Circular Channel |
| Method | Manning's Formul: |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Slope | 0.008000 | ft/ft |
| Diameter | 15 | in |
| Discharge | 5.29 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.94 | ft |
| Flow Area | 1.0 | ft² |
| Wetted Perimeter | 2.63 | ft |
| Top Width | 1.08 | ft |
| Critical Depth | 0.93 | ft |
| Percent Full | 75.3 | % |
| Critical Slope | 0.008167 | ft/ft |
| Velocity | 5.34 | ft/s |
| Velocity Head | 0.44 | ft |
| Specific Energy | 1.38 | ft |
| Froude Number | 0.98 | |
| Maximum Discharg | 6.21 | cfs |
| Discharge Full | 5.78 | cfs |
| Slope Full | 0.006707 | ft/ft |
| Flow Type | Subcritical | |

# Worksheet
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | 28 to 29 |
| Flow Element | Circular Channel |
| Method | Manning's Formul |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Slope | 0.080000 | ft/ft |
| Diameter | 15 | in |
| Discharge | 5.66 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.48 | ft |
| Flow Area | 0.4 | ft² |
| Wetted Perimeter | 1.67 | ft |
| Top Width | 1.21 | ft |
| Critical Depth | 0.96 | ft |
| Percent Full | 38.2 | % |
| Critical Slope | 0.008679 | ft/ft |
| Velocity | 13.13 | ft/s |
| Velocity Head | 2.68 | ft |
| Specific Energy | 3.16 | ft |
| Froude Number | 3.89 | |
| Maximum Discharg | 19.65 | cfs |
| Discharge Full | 18.27 | cfs |
| Slope Full | 0.007678 | ft/ft |
| Flow Type | Supercritical | |

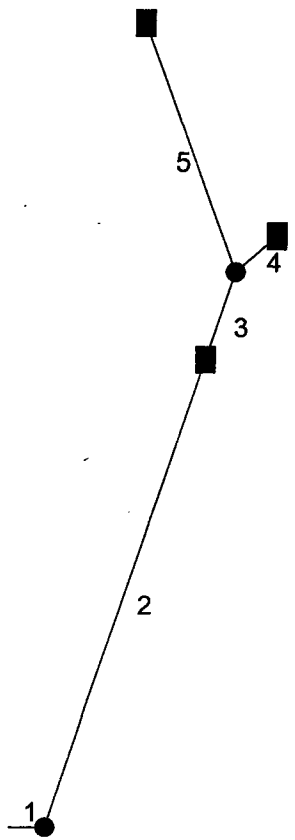
# Worksheet
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | 29 to 29 - A |
| Flow Element | Circular Channel |
| Method | Manning's Formul |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Slope | 0.005000 | ft/ft |
| Diameter | 18 | in |
| Discharge | 5.66 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.98 | ft |
| Flow Area | 1.2 | ft² |
| Wetted Perimeter | 2.82 | ft |
| Top Width | 1.43 | ft |
| Critical Depth | 0.92 | ft |
| Percent Full | 65.3 | % |
| Critical Slope | 0.006061 | ft/ft |
| Velocity | 4.63 | ft/s |
| Velocity Head | 0.33 | ft |
| Specific Energy | 1.31 | ft |
| Froude Number | 0.88 | |
| Maximum Discharg | 7.99 | cfs |
| Discharge Full | 7.43 | cfs |
| Slope Full | 0.002904 | ft/ft |
| Flow Type | Subcritical | |

# Hydraflow Plan View




| | | | |
|---|---|---|---|
| Project file: Stonehouse Glen System 4.stm | IDF file: Norfolk.IDF | No. Lines: 5 | 10-20-2004 |

# Hydraflow Storm Sewer Inventory Report



| Line No. | Alignment | | | | Flow Data | | | | Physical Data | | | | | | | | Line ID |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Dnstr line No. | Line length (ft) | Defl angle (deg) | Junc type | Known Q (cfs) | Drng area (ac) | Runoff coeff (C) | Inlet time (min) | Invert El Dn (ft) | Line slope (%) | Invert El Up (ft) | Line size (in) | Line type | N value (n) | J-loss coeff (K) | Inlet/ Rim El (ft) | |
| 1 | End | 23.0 | 0.0 | MH | 5.66 | 0.00 | 0.00 | 0.0 | 61.00 | 3.78 | 61.87 | 15 | Cir | 0.013 | 0.85 | 73.17 | 29 to 28 |
| 2 | 1 | 240.0 | -65.0 | Curb | 5.66 | 0.00 | 0.00 | 0.0 | 66.18 | 0.79 | 68.08 | 15 | Cir | 0.013 | 0.50 | 73.25 | 27 to 28 |
| 3 | 2 | 45.0 | 0.0 | MH | 2.49 | 0.00 | 0.00 | 0.0 | 68.18 | 0.49 | 68.40 | 15 | Cir | 0.013 | 0.75 | 74.83 | 26 to 27 |
| 4 | 3 | 31.0 | 33.0 | Curb | 0.82 | 0.00 | 0.00 | 0.0 | 71.08 | 1.00 | 71.39 | 15 | Cir | 0.013 | 1.00 | 75.31 | 26 A to 26 |
| 5 | 3 | 128.0 | -52.0 | Curb | 1.70 | 0.00 | 0.00 | 0.0 | 68.50 | 8.01 | 78.75 | 15 | Cir | 0.013 | 1.00 | 82.67 | 25 to 26 |

Project File: Stonehouse Glen System 4.stm | I-D-F File: Norfolk.IDF | Total number of lines: 5 | Date: 10-20-2004

# Hydraflow Summary Report



| Line No. | Line ID | Flow rate (cfs) | Line size (in) | Line length (ft) | Invert EL Dn (ft) | Invert EL Up (ft) | Line slope (%) | HGL down (ft) | HGL up (ft) | Minor loss (ft) | Dns line No. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 29 to 28 | 5.66 | 15 c | 23.0 | 61.00 | 61.87 | 3.783 | 62.00 | 62.82 | 0.42 | End |
| 2 | 27 to 28 | 5.66 | 15 c | 240.0 | 66.18 | 68.08 | 0.792 | 67.20 | 69.08 | 0.22 | 1 |
| 3 | 26 to 27 | 2.49 | 15 c | 45.0 | 68.18 | 68.40 | 0.489 | 69.31 | 69.35 | 0.07 | 2 |
| 4 | 26 A to 26 | 0.82 | 15 c | 31.0 | 71.08 | 71.39 | 1.000 | 71.39 | 71.75 | 0.12 | 3 |
| 5 | 25 to 26 | 1.70 | 15 c | 128.0 | 68.50 | 78.75 | 8.008 | 69.42 | 79.27 | 0.19 | 3 |

Project File: Stonehouse Glen System 4I-D-F File: Norfolk.IDF | Total No. Lines: 5 | Run Date: 10-20-2004

NOTES: c = circular; e = elliptical; b = box; Return period = 10 Yrs.; * Indicates surcharge condition.

# Hydraflow Storm Sewer Tabulation



| Station | | Len | Drng Area | | Rnoff coeff | Area x C | | Tc | | Rain (I) | Total flow | Cap full | Vel | Pipe | | Invert Elev | | HGL Elev | | Grnd / Rim Elev | | Line ID |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Line | To Line | (ft) | Incr (ac) | Total (ac) | (C) | Incr | Total | Inlet (min) | Syst (min) | (in/hr) | (cfs) | (cfs) | (ft/s) | Size (in) | Slope (%) | Up (ft) | Dn (ft) | Up (ft) | Dn (ft) | Up (ft) | Dn (ft) | |
| 1 | End | 23.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.0 | 2.3 | 0.0 | 5.66 | 12.56 | 5.51 | 15 | 3.78 | 61.87 | 61.00 | 62.82 | 62.00 | 73.17 | 0.00 | 29 to 28 |
| 2 | 1 | 240.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.0 | 1.0 | 0.0 | 5.66 | 5.75 | 5.33 | 15 | 0.79 | 68.08 | 66.18 | 69.08 | 67.20 | 73.25 | 73.17 | 27 to 28 |
| 3 | 2 | 45.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.0 | 0.7 | 0.0 | 2.49 | 4.52 | 2.31 | 15 | 0.49 | 68.40 | 68.18 | 69.35 | 69.31 | 74.83 | 73.25 | 26 to 27 |
| 4 | 3 | 31.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.0 | 0.0 | 0.0 | 0.82 | 6.46 | 3.09 | 15 | 1.00 | 71.39 | 71.08 | 71.75 | 71.39 | 75.31 | 74.83 | 26 A to 26 |
| 5 | 3 | 128.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.0 | 0.0 | 0.0 | 1.70 | 18.27 | 2.63 | 15 | 8.01 | 78.75 | 68.50 | 79.27 | 69.42 | 82.67 | 74.83 | 25 to 26 |

Project File: Stonehouse Glen System 4.stm | I-D-F File: Norfolk.IDF | Total number of lines: 5 | Run Date: 10-20-2004

NOTES: Intensity = 128.59 / (Tc + 17.70) ^ 0.89; Return period = 10 Yrs. ; Initial tailwater elevation = 62.00 (ft)

# Hydraflow Inlet Report



| Line No | Line ID | A (ac) | Inlet time (min) | I (in/hr) | C | Q = CIA (cfs) | Q carry (cfs) | Q capt (cfs) | Q byp (cfs) | Junc type | Curb Inlet Ht (in) | Curb Inlet L (ft) | Grate Inlet area (sqft) | Grate Inlet L (ft) | Grate Inlet W (ft) | Gutter So (ft/ft) | Gutter W (ft) | Gutter Sw (ft/ft) | Gutter Sx (ft/ft) | Flow depth (ft) | Flow spread (ft) | Byp line No |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 29 to 28 | 0.00 | 0.0 | 0.00 | 0.00 | 5.66* | 0.79 | 0.00 | 6.45 | MH | 0.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 | 0.00 | 0.000 | 0.000 | 0.00 | 0.00 | Offsite |
| 2 | 27 to 28 | 0.00 | 0.0 | 0.00 | 0.00 | 5.66* | 2.49 | 8.15 | 0.00 | Curb | 4.0 | 8.00 | 0.00 | 0.00 | 0.00 | Sag | 1.67 | 0.083 | 0.020 | 0.58 | 23.71 | 1 |
| 3 | 26 to 27 | 0.00 | 0.0 | 0.00 | 0.00 | 2.49* | 0.00 | 0.00 | 2.49 | MH | 0.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 | 0.00 | 0.000 | 0.000 | 0.00 | 0.00 | 2 |
| 4 | 26 A to 26 | 0.00 | 0.0 | 0.00 | 0.00 | 0.82* | 0.00 | 0.62 | 0.20 | Curb | 4.0 | 6.00 | 0.00 | 0.00 | 0.00 | 0.040 | 1.67 | 0.083 | 0.020 | 0.18 | 3.74 | 1 |
| 5 | 25 to 26 | 0.00 | 0.0 | 0.00 | 0.00 | 1.70* | 0.00 | 1.11 | 0.59 | Curb | 4.0 | 8.00 | 0.00 | 0.00 | 0.00 | 0.055 | 1.67 | 0.083 | 0.020 | 0.21 | 5.24 | 1 |

Project File: Stonehouse Glen System 4.stm | I-D-F File: Norfo!k.IDF | Total number of lines: 5 | Run Date: 10-20-2004

NOTES: Inlet N-Values = 0.016 ; Design depth for grate(s) = 0.3 (ft); Intensity = 128.59 / (Inlet time + 17.70) ^ 0.89; Return period = 10 Yrs. ; * Indicates Known Q added

# Hydraflow 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 | 15 | 5.66 | 61.00 | 62.00 | 1.00 | 1.05 | 5.38 | 0.45 | 62.45 | 0.804 | 23.0 | 61.87 | 62.82 | 0.95** | 1.00 | 5.64 | 0.50 | 63.32 | 0.892 | 0.848 | N/A | 0.85 | 0.42 |
| 2 | 15 | 5.66 | 66.18 | 67.20 | 1.02* | 1.07 | 5.29 | 0.44 | 67.63 | 0.778 | 240 | 68.08 | 69.08 | 1.00 | 1.05 | 5.37 | 0.45 | 69.53 | 0.802 | 0.790 | 1.896 | 0.50 | 0.22 |
| 3 | 15 | 2.49 | 68.18 | 69.31 | 1.13 | 1.16 | 2.14 | 0.07 | 69.38 | 0.131 | 45.0 | 68.40 | 69.35 | 0.95 | 1.00 | 2.49 | 0.10 | 69.45 | 0.174 | 0.152 | 0.069 | 0.75 | 0.07 |
| 4 | 15 | 0.82 | 71.08 | 71.39 | 0.31* | 0.24 | 3.39 | 0.18 | 71.57 | 0.843 | 31.0 | 71.39 | 71.75 | 0.36** | 0.30 | 2.78 | 0.12 | 71.87 | 0.480 | 0.662 | N/A | 1.00 | 0.12 |
| 5 | 15 | 1.70 | 68.50 | 69.42 | 0.92 | 0.97 | 1.75 | 0.05 | 69.47 | 0.087 | 128 | 78.75 | 79.27 | 0.52** | 0.49 | 3.50 | 0.19 | 79.46 | 0.523 | 0.305 | N/A | 1.00 | 0.19 |

| | | | |
|---|---|---|---|
| Project File: Stonehouse Glen System 4.stm | I-D-F File: Norfolk.IDF | Total number of lines: 5 | Run Date: 10-20-2004 |

NOTES: Initial tailwater elevation = 62 (ft), * Normal depth assumed., ** Critical depth assumed.

6

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# Appendix IV

## Flexible Pavement Design Worksheet for New Subdivision Streets

This sheet is intended for use and submission in conjunction with VDOT's Subdivision Street Requirements

| | | | |
|---|---|---|---|
| County | JAMES CITY COUNTY | Date: | 10/28/03 |
| Subdivision | STONEHOUSE GLEN | | |
| Street Name | HOMESTEAD DRIVE | | |
| Developer | STONEHOUSE AT WILLIAMSBURG, K. McDermott | Phone: | 908-234-2620 x2 |

| | |
|---|---|
| ADT | Projected traffic for the street segment considered, as defined in the Subdivision Street Requirements. |
| $CBR_D$ | Design CBR = Average of $CBR_T$ x 2/3 and modified only as discussed in the Pavement Design Guide. |
| $CBR_T$ | CBR value of the subgrade sample, taken and tested as specified in the Pavement Design Guide |
| DME | VDOT District Materials Engineer |
| EPT | Equivalent projected traffic |
| HCV | Number of Heavy Commercial Vehicles (e.g. trucks, buses, etc., with 2 or more axles and 6 or more tires). |
| %HCV | Percentage of the total traffic volume composed of Heavy Commercial Vehicles. |
| RF | Resiliency Factor = Relative value of the subgrade soil's ability to withstand repeated loading. |
| SSV | Soil support value of subgrade (SSV = $CBR_D$ x RF) |
| $D_P$ | Thickness index of proposed pavement design computed by the Conventional Pavement Design Method |
| $D_R$ | Thickness index required, based on Design ADT and SSV, determined by Appendix II. |

### Step 1: Determine Design ADT

| | |
|---|---|
| ADT | 1600 |
| %HCV = 100 x HCV x ADT)<br>or<br>~~20 x HCV~~<br>Note: For %HCV ≤ 5%, use ADT | Note: For %HCV>5%, EPT>ADT |
| Design ADT<br>Use greater of ADT or EPT | 1600 |

### Step 2: Determine Design Values CBR, RF, and SSV

| Sample | $DBR_T$ | Resiliency Factor | (RF) |
|---|---|---|---|
| # 1 | | Source | Value |
| # 2 | | Table 1 | |
| # 3 | | Appendix I | 3 |
| # | | ~~DME approved RF~~ | |
| # | | For preliminary designs, use the lowest RF value in the equation | |
| # | | | |

| $CBR_D$ | x | RF | = | SSV |
|---|---|---|---|---|
| (6) | x | (3) | = | 18 |

### Step 3: Pavement Design (Check appropriate box and show proposed pavement design below.)

☐ (A) Limited to Design ADT ≤ 400 - Show pavement material notations and thickness from Appendix IV Tables A and B.

☑ (B) Show pavement section as developed in the Pavement Design Guide. (See Appendix III for material notations and thickness equivalency values (a)).

$D_R$ = 14.5 from Appendix II

### Description of Proposed Pavement Section

| | Material Notation | Thickness, h | a | (a x h) |
|---|---|---|---|---|
| Surface | SM 9.5A | 2 | 2.25 | 4.5 |
| Base | BM-25 37.5 | 3 | 2.15 | 6.45 |
| Subbase | TYPE I SIZE 21B | 8 | 0.5 | 4.0 |

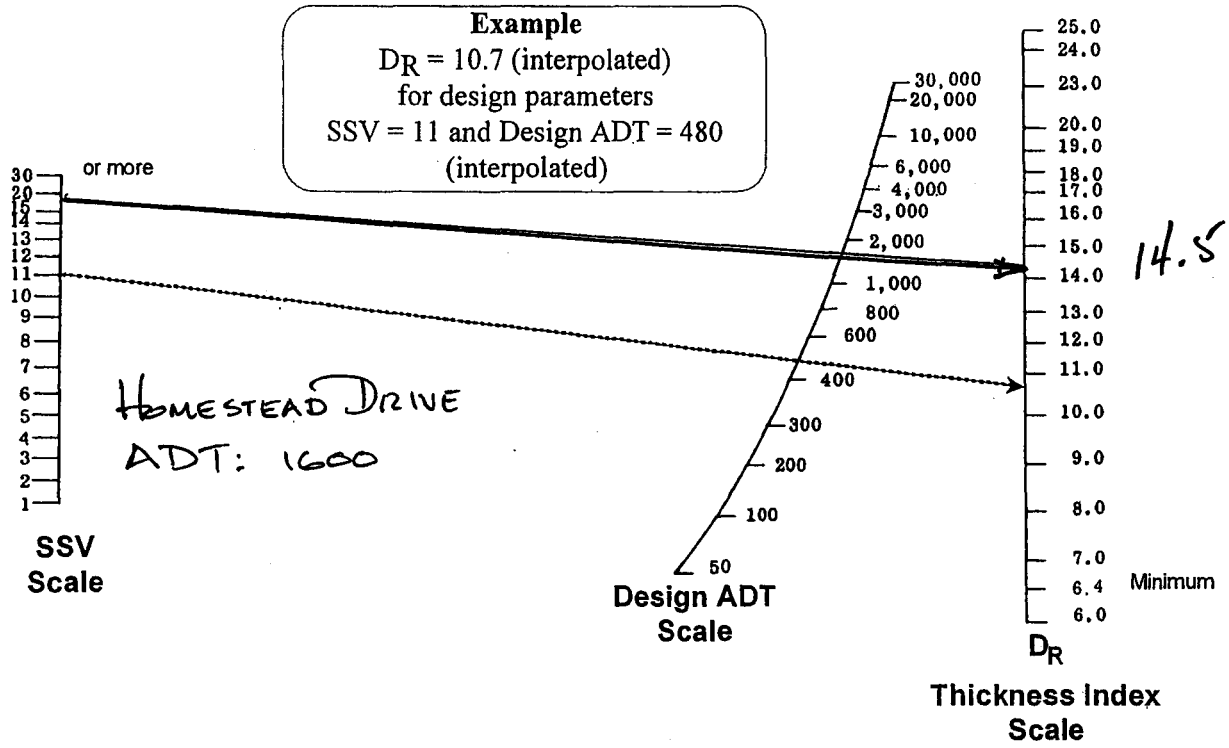
$D_P$ must equal or exceed the value of $D_R$. $D_P = \Sigma(a \times h)$ = 14.95

# Appendix II
## Nomograph for Determining Required Pavement Thickness Index $D_R$

(Note: An enlarged version of this nomograph is provided on the last page of this reference.)

Final pavement design must be based on the results of appropriate soil tests.

Preliminary designs may be based on values established in Appendix I.




To determine $D_R$, project a line from the value for SSV through the value for the Design ADT.

The nomograph depicted correlates the soil support value of the subgrade (SSV = Design CBR x RF), the traffic volume (Design ADT), and the minimum required pavement design thickness index ($D_R$) for subdivision streets and secondary road pavement, based on AASHO design equations. This nomograph assumes the following:

1. Use of Design ADT for two way traffic, equally distributed, thereby deriving the thickness index ($D_R$) required for any portion of the pavement to support one-half of the design ADT.
2. For $D_R$ greater than 20, staged construction providing an initial stage $D_R$ value of 20 may be permitted.
3. The District Materials Engineer may consider reducing the minimum $D_R$ value of 6.4 for secondary system facilities having a Design ADT <50.

# APPENDIX III

## Paving Materials & Allowable Values

| Location & Notation | Material | Material Notation | Thickness Equivalency Value | Lift Thickness Min. inches | Lift Thickness Max. inches |
|---|---|---|---|---|---|
| Surface $a_1$ | Asphalt Concrete (SM-9.0A, D)[1] | A.C. | 1.67 * | 1 | 1.5 |
| | Asphalt Concrete (SM-9.5A, D)[1] | | | 2 [2] | 3 |
| | Prime & Double Seal or Class "C" or D" Blotted Seal Coat Surface Treatments [3] | D.S. | 0.84 | — | — |
| Intermediate $a_1$ | Asphalt Concrete (IM-19.0) [1] | A.C. | 1.67 * | 2 | 3 |
| Base $a_2$ | Asphalt Concrete (BM-2537.5) [1] | A.C. | 1.67 * | 3 | — |
| | Full Depth Asphalt Concrete (BM-25.0 or BM 37.5) over Subgrade[1] | A.C. | 1.60 ** | 6 | — |
| | Untreated Aggregate [4] | Agg. | 1.00 | 6 | 8 [4] |
| | Cement Treated Aggregate [4] | CTA | 1.67 | | |
| | Cement Treated Select Material, Type II, min. CBR = 20 | Sel. Mat. C | 1.50 | | |
| | Select Material Type I & II, non-plastic, min. CBR = 30 | Sel. Mat. | 0.84 | | |
| | Select Material, Type II, non-plastic, min. CBR = 20 | Sel. Mat. | 0.60 | | |
| | Soil Cement | S.C. | 1.00 | | |
| | Cement Treated Select Material, Type II | Sel. Mat. C | 1.17 | | |
| | Cement Treated Select Borrow | Sel. Bor. C | 1.00 | | |
| | Open Graded Drainage Layer | OGDL | 0.60 | 3 | 3 |
| Subase $a_3$ | Untreated Aggregate [4] | Agg. | 0.60 | 4 | 8 [4] |
| | Cement Treated Aggregate [4] | CTA | 1.33 | | |
| | Select Material Type I, non-plastic, min. CBR = 30 | Sel. Mat. | 0.50 | | |
| | Select Material Type II, non-plastic, min. CBR = 20 | Sel. Mat. | 0.40 | | |
| | Soil Cement | S.C. | 1.00 | 6 | 8 |
| | Soil Lime | S.L. | 0.92 | | |
| | Cement Treated Select Material, Type II | Sel. Mat. C | 1.17 | | |
| | Cement Treated Select Borrow | Sel. Bor. C | 1.00 | | |

## Footnotes for Appendix III

[1] When 4½ inches or more of any combination of Asphalt Concrete (surface + intermediate + base) is called for, the following thickness equivalency values should be used * = 2.25 and ** = 2.15

[2] 1½ inches is acceptable when placed on an asphalt concrete base material.

[3] Prime and Double Seal Surface Treatment, in lieu of blotted seal coat surface treatment, may only be used as outlined in Appendix IV (for new subdivision streets) and the current Location and Design Division I&I Memorandum (for secondary road projects).

[4] For aggregate materials, the maximum combined thickness of base and subbase layers considered for the purpose of calculating the thickness index value shall be 12 inches.

[5] An intermediate mix is required between the surface and base mix when BM-37.5 is used.

# Appendix IV

## Flexible Pavement Design Worksheet for New Subdivision Streets

This sheet is intended for use and submission in conjunction with VDOT's Subdivision Street Requirements

| | | | |
|---|---|---|---|
| County | JAMES CITY COUNTY | Date: | 10/28/03 |
| Subdivision | Stonehouse Glen | | |
| Street Name | BUCKINGHAM | | |
| Developer | STONEHOUSE AT WILLIAMSBURG | Phone: | 908-234-2620 x 27 |

| | |
|---|---|
| ADT | Projected traffic for the street segment considered, as defined in the Subdivision Street Requirements. |
| $CBR_D$ | Design CBR = Average of $CBR_T$ x 2/3 and modified only as discussed in the Pavement Design Guide. |
| $CBR_T$ | CBR value of the subgrade sample, taken and tested as specified in the Pavement Design Guide |
| DME | VDOT District Materials Engineer |
| EPT | Equivalent projected traffic |
| HCV | Number of Heavy Commercial Vehicles (e.g. trucks, buses, etc., with 2 or more axles and 6 or more tires). |
| %HCV | Percentage of the total traffic volume composed of Heavy Commercial Vehicles. |
| RF | Resiliency Factor = Relative value of the subgrade soil's ability to withstand repeated loading. |
| SSV | Soil support value of subgrade (SSV = $CBR_D$ x RF) |
| $D_P$ | Thickness index of proposed pavement design computed by the Conventional Pavement Design Method |
| $D_R$ | Thickness index required, based on Design ADT and SSV, determined by Appendix II. |

### Step 1: Determine Design ADT

| | |
|---|---|
| ADT | 760 |
| %HCV = 100 x HCV x ADT) or 20 x HCV (Note: For %HCV ≤ 5%, use ADT) | Note: For %HCV>5%, EPT>ADT |
| Design ADT Use greater of ADT or EPT | 760 |

### Step 2: Determine Design Values CBR, RF, and SSV

| Sample | $DBR_T$ |
|---|---|
| # 1 | |
| # 2 | |
| # 3 | |
| # | |
| # | |
| # | |

| Resiliency Factor | (RF) |
|---|---|
| Source | Value |
| Table 1 | |
| Appendix I | 3 |
| DME approved RF | |

For preliminary designs, use the lowest RF value in the equation

$CBR_D$ x RF = SSV

( 6 ) x ( 3 ) = 18

### Step 3: Pavement Design (Check appropriate box and show proposed pavement design below.)

☐ (A) Limited to Design ADT ≤ 400 - Show pavement material notations and thickness from Appendix IV Tables A and B.

☑ (B) Show pavement section as developed in the Pavement Design Guide. (See Appendix III for material notations and thickness equivalency values (a)).

$D_R$ = 12 from Appendix II

### Description of Proposed Pavement Section

| | Material Notation | Thickness, h | a | (a x h) |
|---|---|---|---|---|
| Surface | SM 9.5 A | 1.5 | 2.25 | 3.375 |
| Base | BM-25 37.5 | 3. | 2.15 | 6.45 |
| Subbase | TYPE I SIZE 21B | 6 | 0.5 | 3.0 |

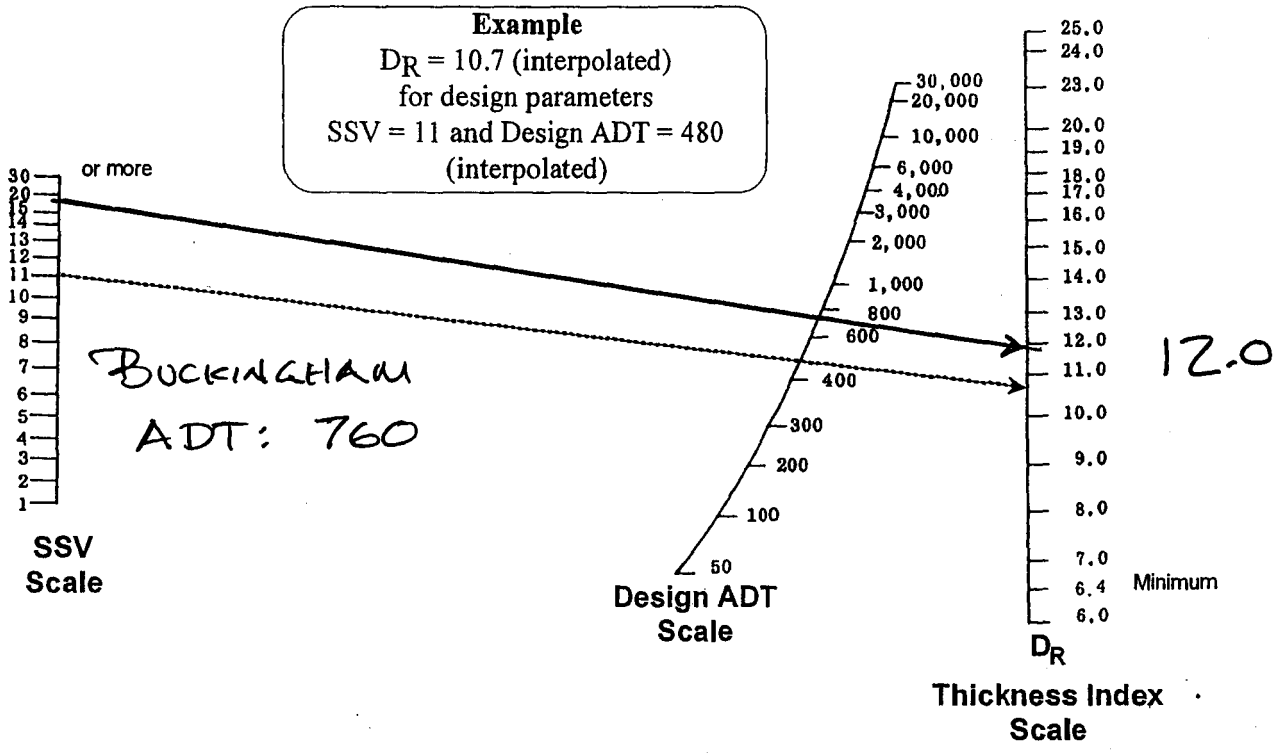
$D_P$ must equal or exceed the value of $D_R$. $D_P = \Sigma(a \times h)$ = 13.2

# Appendix II
## Nomograph for Determining Required Pavement Thickness Index $D_R$

(Note: An enlarged version of this nomograph is provided on the last page of this reference.)

Final pavement design must be based on the results of appropriate soil tests.

Preliminary designs may be based on values established in Appendix I.




To determine $D_R$, project a line from the value for SSV through the value for the Design ADT.

The nomograph depicted correlates the soil support value of the subgrade (SSV = Design CBR x RF), the traffic volume (Design ADT), and the minimum required pavement design thickness index ($D_R$) for subdivision streets and secondary road pavement, based on AASHO design equations. This nomograph assumes the following:

1. Use of Design ADT for two way traffic, equally distributed, thereby deriving the thickness index ($D_R$) required for any portion of the pavement to support one-half of the design ADT.
2. For $D_R$ greater than 20, staged construction providing an initial stage $D_R$ value of 20 may be permitted.
3. The District Materials Engineer may consider reducing the minimum $D_R$ value of 6.4 for secondary system facilities having a Design ADT <50.

# APPENDIX III

## Paving Materials & Allowable Values

| Location & Notation | Material | Material Notation | Thickness Equivalency Value | Lift Thickness Min. inches | Lift Thickness Max. inches |
|---|---|---|---|---|---|
| Surface $a_1$ | Asphalt Concrete (SM-9.0A, D)[1] | A.C. | 1.67 * | 1 | 1.5 |
| | Asphalt Concrete (SM-9.5A, D)[1] | | | 2 [2] | 3 |
| | Prime & Double Seal or Class "C" or D" Blotted Seal Coat Surface Treatments [3] | D.S. | 0.84 | — | — |
| Intermediate $a_1$ | Asphalt Concrete (IM-19.0) [1] | A.C. | 1.67 * | 2 | 3 |
| Base $a_2$ | Asphalt Concrete (BM-2537.5) [1] | A.C. | 1.67 * | 3 | — |
| | Full Depth Asphalt Concrete (BM-25.0 or BM 37.5) over Subgrade[1] | A.C. | 1.60 ** | 6 | — |
| | Untreated Aggregate [4] | Agg. | 1.00 | 6 | 8 [4] |
| | Cement Treated Aggregate [4] | CTA | 1.67 | | |
| | Cement Treated Select Material, Type II, min. CBR = 20 | Sel. Mat. C | 1.50 | | |
| | Select Material Type I & II, non-plastic, min. CBR = 30 | Sel. Mat. | 0.84 | | |
| | Select Material, Type II, non-plastic, min. CBR = 20 | Sel. Mat. | 0.60 | | |
| | Soil Cement | S.C. | 1.00 | | |
| | Cement Treated Select Material, Type II | Sel. Mat. C | 1.17 | | |
| | Cement Treated Select Borrow | Sel. Bor. C | 1.00 | | |
| | Open Graded Drainage Layer | OGDL | 0.60 | 3 | 3 |
| Subase $a_3$ | Untreated Aggregate [4] | Agg. | 0.60 | 4 | 8 [4] |
| | Cement Treated Aggregate [4] | CTA | 1.33 | | |
| | Select Material Type I, non-plastic, min. CBR = 30 | Sel. Mat. | 0.50 | | |
| | Select Material Type II, non-plastic, min. CBR = 20 | Sel. Mat. | 0.40 | | |
| | Soil Cement | S.C. | 1.00 | 6 | 8 |
| | Soil Lime | S.L. | 0.92 | | |
| | Cement Treated Select Material, Type II | Sel. Mat. C | 1.17 | | |
| | Cement Treated Select Borrow | Sel. Bor. C | 1.00 | | |

## Footnotes for Appendix III

[1] When 4½ inches or more of any combination of Asphalt Concrete (surface + intermediate + base) is called for, the following thickness equivalency values should be used * = 2.25 and ** = 2.15

[2] 1½ inches is acceptable when placed on an asphalt concrete base material.

[3] Prime and Double Seal Surface Treatment, in lieu of blotted seal coat surface treatment, may only be used as outlined in Appendix IV (for new subdivision streets) and the current Location and Design Division I&I Memorandum (for secondary road projects).

[4] For aggregate materials, the maximum combined thickness of base and subbase layers considered for the purpose of calculating the thickness index value shall be 12 inches.

[5] An intermediate mix is required between the surface and base mix when BM-37.5 is used.

# Appendix IV

## Flexible Pavement Design Worksheet for New Subdivision Streets

This sheet is intended for use and submission in conjunction with VDOT's Subdivision Street Requirements

| | | | |
|---|---|---|---|
| County | JAMES CITY COUNTY | Date: | 10/23/03 |
| Subdivision | STONEHOUSE GLEN | | |
| Street Name | OTDOWAY COURT, MARRIN COURT, STAFFORD LANE & ASHLOCK COURT | | |
| Developer | STONEHOUSE AT WILLIAMSBURG, K. McDERMOTT | Phone: | 908-234-2620 x27 |

| | |
|---|---|
| ADT | Projected traffic for the street segment considered, as defined in the Subdivision Street Requirements. |
| $CBR_D$ | Design CBR = Average of $CBR_T$ x 2/3 and modified only as discussed in the Pavement Design Guide. |
| $CBR_T$ | CBR value of the subgrade sample, taken and tested as specified in the Pavement Design Guide |
| DME | VDOT District Materials Engineer |
| EPT | Equivalent projected traffic |
| HCV | Number of Heavy Commercial Vehicles (e.g. trucks, buses, etc., with 2 or more axles and 6 or more tires). |
| %HCV | Percentage of the total traffic volume composed of Heavy Commercial Vehicles. |
| RF | Resiliency Factor = Relative value of the subgrade soil's ability to withstand repeated loading. |
| SSV | Soil support value of subgrade (SSV = $CBR_D$ x RF) |
| $D_P$ | Thickness index of proposed pavement design computed by the Conventional Pavement Design Method |
| $D_R$ | Thickness index required, based on Design ADT and SSV, determined by Appendix II. |

### Step 1: Determine Design ADT

| | |
|---|---|
| ADT | ≤ 280 |
| %HCV = 100 x HCV x ADT)<br>or<br>20 x HCV<br>Note: For %HCV ≤ 5%, use ADT | ~~≤280~~<br>Note: For %HCV>5%, EPT>ADT |
| Design ADT<br>Use greater of ADT or EPT | 280 |

### Step 2: Determine Design Values CBR, RF, and SSV

| Sample | $DBR_T$ |
|---|---|
| # 1 | |
| # 2 | |
| # 3 | |
| # | |
| # | |
| # | |

| Resiliency Factor | (RF) |
|---|---|
| Source | Value |
| Table 1 | |
| Appendix I | 3 |
| DME approved RF | 3 |

For preliminary designs, use the lowest RF value in the equation

| $CBR_D$ | x | RF | = | SSV |
|---|---|---|---|---|
| (6) | x | (3) | = | 18 |

### Step 3: Pavement Design (Check appropriate box and show proposed pavement design below.)

☐ (A) Limited to Design ADT ≤ 400 - Show pavement material notations and thickness from Appendix IV Tables A and B.

☑ (B) Show pavement section as developed in the Pavement Design Guide.
(See Appendix III for material notations and thickness equivalency values (a)).

$D_R$ = 7.8 from Appendix II

### Description of Proposed Pavement Section

| | Material Notation | Thickness, h | a | (a x h) |
|---|---|---|---|---|
| Surface | SM 9.5 A | 1.5 | 2.25 | 3.375 |
| Base | BM-25 375 | 3 | 2.15 | 6.45 |
| Subbase | TYPE I - SIZE 21B | 4 | 0.5 | 2.00 |

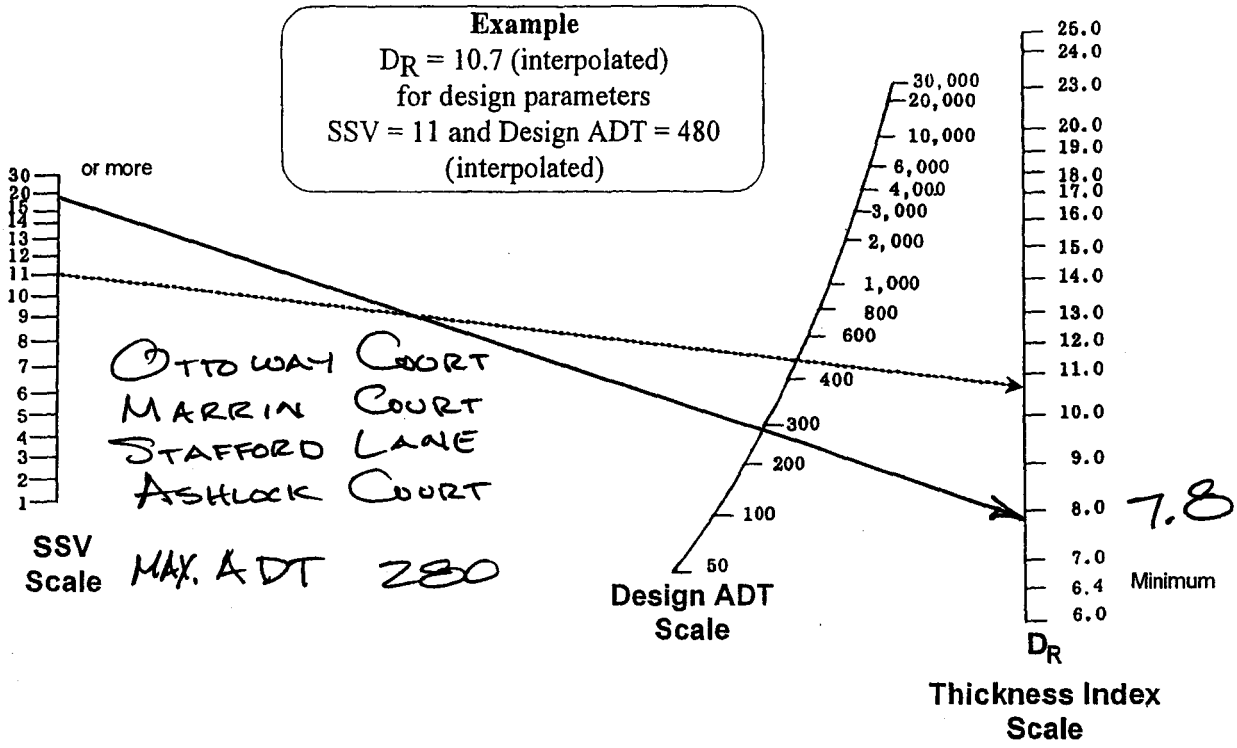
$D_P$ must equal or exceed the value of $D_R$. $D_P = \Sigma(a \times h) =$ 11.825

# Appendix II
## Nomograph for Determining Required Pavement Thickness Index $D_R$

(Note: An enlarged version of this nomograph is provided on the last page of this reference.)

Final pavement design must be based on the results of appropriate soil tests.

Preliminary designs may be based on values established in Appendix I.




To determine $D_R$, project a line from the value for SSV through the value for the Design ADT.

The nomograph depicted correlates the soil support value of the subgrade (SSV = Design CBR x RF), the traffic volume (Design ADT), and the minimum required pavement design thickness index ($D_R$) for subdivision streets and secondary road pavement, based on AASHO design equations. This nomograph assumes the following:

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2. For $D_R$ greater than 20, staged construction providing an initial stage $D_R$ value of 20 may be permitted.
3. The District Materials Engineer may consider reducing the minimum $D_R$ value of 6.4 for secondary system facilities having a Design ADT <50.

# APPENDIX III

## Paving Materials & Allowable Values

| Location & Notation | Material | Material Notation | Thickness Equivalency Value | Lift Thickness Min. inches | Lift Thickness Max. inches |
|---|---|---|---|---|---|
| Surface $a_1$ | Asphalt Concrete (SM-9.0A, D)[1] | A.C. | 1.67 * | 1 | 1.5 |
| | Asphalt Concrete (SM-9.5A, D)[1] | | | 2 [2] | 3 |
| | Prime & Double Seal or Class "C" or D" Blotted Seal Coat Surface Treatments [3] | D.S. | 0.84 | — | — |
| Intermediate $a_1$ | Asphalt Concrete (IM-19.0) [1] | A.C. | 1.67 * | 2 | 3 |
| Base $a_2$ | Asphalt Concrete (BM-2537.5) [1] | A.C. | 1.67 * | 3 | — |
| | Full Depth Asphalt Concrete (BM-25.0 or BM 37.5) over Subgrade[1] | A.C. | 1.60 ** | 6 | — |
| | Untreated Aggregate [4] | Agg. | 1.00 | 6 | 8 [4] |
| | Cement Treated Aggregate [4] | CTA | 1.67 | | |
| | Cement Treated Select Material, Type II, min. CBR = 20 | Sel. Mat. C | 1.50 | | |
| | Select Material Type I & II, non-plastic, min. CBR = 30 | Sel. Mat. | 0.84 | | |
| | Select Material, Type II, non-plastic, min. CBR = 20 | Sel. Mat. | 0.60 | | |
| | Soil Cement | S.C. | 1.00 | | |
| | Cement Treated Select Material, Type II | Sel. Mat. C | 1.17 | | |
| | Cement Treated Select Borrow | Sel. Bor. C | 1.00 | | |
| | Open Graded Drainage Layer | OGDL | 0.60 | 3 | 3 |
| Subase $a_3$ | Untreated Aggregate [4] | Agg. | 0.60 | 4 | 8 [4] |
| | Cement Treated Aggregate [4] | CTA | 1.33 | | |
| | Select Material Type I, non-plastic, min. CBR = 30 | Sel. Mat. | 0.50 | | |
| | Select Material Type II, non-plastic, min. CBR = 20 | Sel. Mat. | 0.40 | | |
| | Soil Cement | S.C. | 1.00 | 6 | 8 |
| | Soil Lime | S.L. | 0.92 | | |
| | Cement Treated Select Material, Type II | Sel. Mat. C | 1.17 | | |
| | Cement Treated Select Borrow | Sel. Bor. C | 1.00 | | |

## Footnotes for Appendix III

[1] When 4½ inches or more of any combination of Asphalt Concrete (surface + intermediate + base) is called for, the following thickness equivalency values should be used * = 2.25 and ** = 2.15

[2] 1½ inches is acceptable when placed on an asphalt concrete base material.

[3] Prime and Double Seal Surface Treatment, in lieu of blotted seal coat surface treatment, may only be used as outlined in Appendix IV (for new subdivision streets) and the current Location and Design Division I&I Memorandum (for secondary road projects).

[4] For aggregate materials, the maximum combined thickness of base and subbase layers considered for the purpose of calculating the thickness index value shall be 12 inches.

[5] An intermediate mix is required between the surface and base mix when BM-37.5 is used.

# Supporting Engineering Documents
# For
# Stonehouse Glen Subdivision
# *Section II*

## James City County, Virginia

December 30, 2003
Revised December 28, 2004
Revised March 16, 2005
Revised May 12, 2005
**Revised July 15, 2005**

S-116-03

COMMONWEALTH OF VIRGINIA
JAMES W. BRAWLEY III
No. 024785
7-15-05
PROFESSIONAL ENGINEER

JUL 2005
RECEIVED
PLANNING DEPARTMENT

5th submission
FINAL COMPS.

**LMDG Project No.**
**2002261-504.04**


LANDMARK
DESIGN GROUP

Engineers ♦ Planners ♦ Surveyors ♦ Landscape Architects ♦ Environmental Scientists
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lmdg@landmarkdg.com

# Supporting Engineering Documents

## Table of Contents


- Project Description / Existing Site Conditions / Adjacent Area Description
- Stormwater Management Narrative
- Erosion & Sediment Control and Stormwater Management Design Plan Checklist
- Sediment Basin Calculations
- Channel Adequacy Calculations
- Pre and Post Developed Calculations
- Drainage Calculations
- Road Pavement Calculations
- Sewer and Water Data Sheets
- Drainage Area Maps

# PROJECT DESCRIPTION/EXISTING SITE CONDITIONS/ADJACENT AREA DESCRIPTION

Stonehouse Glen Subdivision

Revised December 28, 2004, December 30, 2003

## PROJECT DESCRIPTION:

Section 2 of the Stonehouse Glen subdivision proposes the construction of 62 single-family detached residential homesites and 2 stormwater management facility designed for channel adequacy protection only. To effect this plan, disturbance to approximately 9.3 acres of land will be required for construction of proposed public streets, on-site public utilities, the stormwater management facilities and other erosion and sediment control devices.

## EXISTING SITE CONDITIONS:

Existing topography is characterized by relatively narrow ridgetops with intervening ravine systems. Elevations range from approximately 50 feet above MSL to approximately 115 feet above MSL. The existing land use is vacant. The existing cover is forested with a combination of mixed deciduous and evergreen species; the majority of the site has been repeatedly timbered over the past 50+ years. Surface drainage flows generally from the south to the north through a series of ravines which coalesce at Bird Swamp, and thereafter, flows enter the Ware Creek and ultimately the York River.

## ADJACENT AREA DESCRIPTION:

Adjacent on-site areas (Land Bays 19, 20 and 22) are characterized by the same topographic features and drainage patterns, with surface drainage flowing along the same path as described above. All land east, west, north and south of the subject site is undeveloped, wooded and characterized by ridgetops dissected by ravines. The floodplain of Bird Swamp is broad with a braided channel; all other ravine systems are restricted in width and depth and with fairly direct flow lines. Substantial undisturbed land separates the proposed land disturbance activities associated with the subject project with the majority of post-development flow being directed to the many ravine systems, well below erosive velocities. Potential impacts to receiving waters are expected to be negligible given structural E&S practices and the sequence of construction proposed.

# STORMWATER MANAGEMENT NARRATIVE

**STONEHOUSE GLEN - SECTION 2**
**STORMWATER MANAGEMENT NARRATIVE**

The Stonehouse Glen area lies within the watershed of Richardson Mill Pond. Consequently, it is provided with water quality requirements by Richardson Mill Pond, as are all other developments in that watershed.

The area of the development drains to several different ravine systems. The stormwater management plan was developed to provide minimal increases in flow depth and velocity in the major ravine system draining 18 of the subdivision lots, and most of the roadways. The remaining lots all drain directly to natural drainage systems.

The post development drainage flows to three points of discharge from this project. The two largest drainage areas flow to BMP 4 and BMP5. These two Basins will serve as temporary sediment basins during construction, and will be converted to permanent BMPs upon final stabilization. These Basins have been designed to provide for Channel adequacy by controlling the one- year storm event. The remaining outfall will drain into an existing reach (13); which will be improved to handle the increased velocities and provide for Channel adequacy. Virtually all of the soils within the drainage area lie within Soil Horizon Group C.

# EROSION & SEDIMENT CONTROL AND STORMWATER MANAGEMENT DESIGN PLAN CHECKLIST

**James City County, Virginia**
**Environmental Division**

# Erosion and Sediment Control and Stormwater Management Design Plan Checklists

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GENERAL INFORMATION

Project Name: STONEHOUSE GLEN \ PHASE II
Owner / Applicant: LANDMARK DESIGN GROUP
Plan Preparer: LANDMARK DESIGN GROUP Email: _____
Project Location: STONE HOUSE DISTRICT WARE CREEK WATERSHED
Tax Map / Parcel: _____
County Plan No. (if known): _____
County BMP Type: _____ ( - )
Other information submitted in addition to this checklist (Check all that apply):

- ■ Design or Construction Drawings (Plans, Profiles, Details, etc.).
- ■ Erosion & Sediment Control Plan (Plans, Details, etc.).
- ■ Erosion & Sediment Control Plan Design Report.
- ■ Stormwater Management Design Plan (Plans, Profiles, Details, etc.).
- ■ Stormwater Management Design Report.
- ☐ Other, List: _____

***Issue Date***
***March 1, 2001***

*JAMES CITY COUNTY, VIRGINIA*
*ENVIRONMENTAL DIVISION*

# *EROSION AND SEDIMENT CONTROL PLAN CHECKLIST*

## I. *GENERAL:*

| Yes | No | N/A | |
|---|---|---|---|
| ■ | ☐ | ☐ | *FAMILIARITY* with current versions of Chapter 8, Erosion and Sedimentation Control and Chapter 23, Chesapeake Bay Preservation ordinances of the Code of James City County, Virginia and the Virginia Erosion and Sediment Control Handbook (VESCH). |
| ■ | ☐ | ☐ | *LAND DISTURBING PERMIT AND SILTATION AGREEMENT* with surety are required for the project. |
| ■ | ☐ | ☐ | *VARIANCE* if necessary, requested in writing, for the plan approving authority to waive or modify any of the minimum standards and specifications of the VESCH deemed inappropriate based on site conditions specific to this review case only. Variances which are approved shall be properly documented in the plan and become part of the approved erosion and sediment control plan for the site. |

## II. *SITE PLAN:*

| Yes | No | N/A | |
|---|---|---|---|
| ■ | ☐ | ☐ | *VICINITY MAP* locating the site in relation to the surrounding area. Include any major landmarks which might assist in physically locating the site. |
| ■ | ☐ | ☐ | *INDICATE NORTH* direction in relation to the site. |
| ■ | ☐ | ☐ | *LIMITS OF CLEARING AND GRADING* for the site including that required for implementation of erosion and sediment controls, stockpile areas and utilities. |
| ■ | ☐ | ☐ | *DISTURBED AREA ESTIMATES* in acres or square feet for the project. |
| ■ | ☐ | ☐ | *EXISTING TOPOGRAPHY* or contours for the site at no more than 5 foot contour interval. |
| ■ | ☐ | ☐ | *FINAL TOPOGRAPHY*, contours or proposed site grading in accordance with the design plan which indicates changes to existing topography and drainage patterns at no more than 2 foot contour interval (or 1 foot contours where required). |
| ■ | ☐ | ☐ | *EXISTING AND PROPOSED SPOT ELEVATIONS* to supplement existing and proposed contours, topography or site grading information. Spot elevations may replace final contours in some instances, especially if terrain is in a low lying area or relatively flat. |
| ■ | ☐ | ☐ | *EXISTING VEGETATION* including existing tree lines, grassed or unique vegetation areas. |

| Yes | No | N/A | |
|---|---|---|---|
| ■ | ☐ | ☐ | *EXISTING SITE FEATURES* including roads, buildings, homes, utilities, streams, fences, structures and other important surface features of the site. |
| ■ | ☐ | ☐ | *SOILS MAP* with soil symbols, boundaries and legend in accordance with the current Soil Survey of James City and York Counties and the City of Williamsburg, Virginia. |
| ■ | ☐ | ☐ | *ENVIRONMENTAL INVENTORY* in accordance with Section 23-10(2) of the Chesapeake Bay Preservation Ordinance of James City County. Inventory generally includes: tidal shores and wetlands, non-tidal wetlands, resource protection area, hydric soils and slopes steeper than 25 percent. For wetlands, provide a copy of issued permits or satisfactory evidence that appropriate permits are being pursued for the entire project. |
| ☐ | ☐ | ■ | *100-YEAR FLOODPLAIN LIMITS* or any special flood hazard areas or flood zones based on appropriate Federal Management Agency Flood Insurance Rate Maps (FIRMs) or Flood Hazard Boundary Maps (FHBMs) of James City County, Virginia. |
| ■ | ☐ | ☐ | *DRAINAGE AREAS* for offsite and onsite areas, existing or proposed as applicable. Include drainage divides and directional labels for all subareas at points of interest and size (in acres), weighted runoff coefficient or curve number and times of concentration for each subarea. |
| ■ | ☐ | ☐ | *CRITICAL EROSION AREAS* which require special consideration or unique erosion and sediment control measures. Refer to the VESCH, Chapter 6 for criteria. |
| ■ | ☐ | ☐ | *DEVELOPMENT PLAN* for the site showing all improvements such as buildings, structures, parking areas, access roadways, above and below ground utilities, stormwater management and drainage facilities, trails or sidewalks, proposed vegetation and landscaping, amenities, etc. |
| ■ | ☐ | ☐ | *LOCATION OF PRACTICES* proposed for erosion and sediment control, tree protection and temporary stormwater management due to land disturbance activities at the site. Use standard abbreviations, labels and symbols consistent for plan views based on minimum standards and specifications in Chapter 3 of the VESCH. |
| ■ | ☐ | ☐ | *TEMPORARY STOCKPILE AREAS* or staging and equipment storage areas as required for onsite or offsite construction activities or indicate that none are anticipated for this project. |
| ☐ | ☐ | ■ | *OFFSITE LAND DISTURBING AREAS* including borrow sites, waste areas, utility extensions, etc. and required erosion and sediment controls. If none are anticipated for the project, then indicate on the plans by general or erosion and sediment control notes. |
| ■ | ☐ | ☐ | *DETAILS* or alternately, appropriate reference to current minimum standards and specifications of the VESCH for each measure proposed for the project. Non-modified, standard duplicated details (silt fence, diversion dikes, etc.) may be referenced to the current version of the VESCH. Specific dimensional or modified standards (basins, traps, outlet protections, check dams, etc.) require presentation on detail sheets. Schedules or tables may be used for multiple site measures such as sediment traps, basins, channels, slope drains, etc. Any modification to standard details should be clearly defined, explained and illustrated. |

Yes No N/A

■ ☐ ☐ *MAINTENANCE PLAN* or alternately, appropriate reference to current minimum standards and specifications of the VESCH, outlining the inspection frequency and maintenance requirements for all erosion and sediment control measures proposed for the project.

■ ☐ ☐ *TRENCH DEWATERING* methods and erosion and sediment controls, if anticipated for the project.

■ ☐ ☐ *CONSTRUCTION SEQUENCE* outlining the anticipated sequence for installation of erosion and sediment controls and site, grading and utility work to be performed for the project by the site contractor.

■ ☐ ☐ *PHASING PLAN* if required for larger project sites that are to be developed in stages or phases.

■ ☐ ☐ *STANDARD COUNTY NOTES* are required to be placed on the erosion and sediment control plan. Refer to the standard James City County Erosion and Sediment Control Notes dated May 5, 1999.

☐ ■ ☐ *PROFESSIONAL SEAL AND SIGNATURE* required on final and complete approved plans, drawings, technical reports and specifications.

## III. *NARRATIVE:*

Yes No N/A

■ ☐ ☐ *PROJECT DESCRIPTION* briefly describing the nature and purpose of the land disturbing activity and the acreage to be disturbed.

■ ☐ ☐ *EXISTING SITE CONDITIONS* description of existing topography, land use, cover and drainage patterns at the site.

■ ☐ ☐ *ADJACENT AREA* descriptions of neighboring onsite or offsite areas such as streams, lakes, property, roads, etc. and potential impacts due to concentrated flow or runoff from the land disturbing activity.

☐ ■ ☐ *OFFSITE DISTURBED AREA* descriptions of proposed borrow sites, waste or surplus areas, utility extensions and erosion and sediment controls to be implemented.

■ ☐ ☐ *SOILS DESCRIPTION* briefly summarizing site, disturbed area and drainage basin soils including name, unit, hydrologic soil group (HSG) classification, surface runoff potential, erodibility, permeability, depth, texture, structure, erosion hazards, shrink-swell potential, limitations for use and anticipated depths to bedrock and the seasonal water table, as applicable.

■ ☐ ☐ *CRITICAL AREAS* on the site which many have potentially serious erosion and sediment control problems and special considerations required (ie. steep slopes, hydric soils, channels, springs, sinkholes, water supply reservoirs, groundwater recharge areas, etc.)

Yes No N/A

■ ☐ ☐ *PROPOSED EROSION & SEDIMENT CONTROL MEASURES* inclusive to the specific erosion and sediment control plan as proposed for the land disturbing activity. Measures should be consistent with those proposed on the site drawings. Address general use, installation, limitations, sequencing and maintenance requirements for each control measure.

■ ☐ ☐ *STABILIZATION MEASURES* required for the site, either temporary or permanent, and during and following construction including temporary and permanent seeding and mulching, paving, stone, soil stabilization blankets and matting, sodding, landscaping or special stabilization techniques to be utilized at the site.

■ ☐ ☐ *STORMWATER MANAGEMENT CONSIDERATIONS* for the site, either of temporary or permanent nature, and strategies, sequences and measures required for control. May reference the stormwater management plan for the site, if prepared, for permanent stormwater management facilities and control of drainage once the site is stabilized.

## IV. *CALCULATIONS:*

Yes No N/A

■ ☐ ☐ *CALCULATIONS AND COMPUTATIONS* associated with hydrology, hydraulics and design of proposed temporary and permanent erosion and sediment control measures including: sediment traps and basins, diversions, stormwater conveyance channels, culverts, slope drains, outlet protections, etc. Computations are not required on the construction plan and may be attached in a supplemental erosion and sediment control plan design report, if presented in a clear and organized format.

■ ☐ ☐ *TEMPORARY SEDIMENT BASIN DESIGN DATA SHEET* submitted for each basin along with schematic or sketch cross-section showing applicable design and construction data, storage volumes (wet-dry), dimensions and elevations. Peak design runoff to be based on the 2- or 25-year design storm event based on maximum disturbed site conditions (existing, interim or proposed conditions) in accordance with Minimum Standard 3.14 of the VESCH.

*JAMES CITY COUNTY, VIRGINIA*
*ENVIRONMENTAL DIVISION*

# *STORMWATER MANAGEMENT DESIGN PLAN CHECKLIST*

## I. *GENERAL:*

| Yes | No | N/A | |
|---|---|---|---|
| ■ | ☐ | ☐ | *FAMILIARITY* with current versions of the James City County Guidelines for Design and Construction of Stormwater Management BMPs manual; Chapter 8, Erosion and Sediment Control and Chapter 23, Chesapeake Bay Preservation ordinances of the Code of James City County, Virginia; the Virginia Erosion and Sediment Control Handbook (VESCH); and the Virginia Stormwater Management Handbook (VSMH). |
| ☐ | ■ | ☐ | *WAIVER OR EXCEPTION* if necessary, requested in writing, for the plan approving authority to waive or except the requirements of Chapter 23, Chesapeake Bay Preservation ordinance in accordance with procedure established in Sections 23-14 through 23-17 of the ordinance. Applies to this review case only. |
| ☐ | ■ | ☐ | *VARIANCE REQUEST* if necessary, requested in writing for the plan approving authority to waive or modify any of the minimum standards and specifications of the VESCH deemed inappropriate based on site conditions specific to this review case only. Variances which are approved shall be properly documented in the plan and become part of the approved erosion and sediment control plan for the site. |
| ☐ | ■ | ☐ | *PROFESSIONAL SEAL AND SIGNATURE* required on final and complete approved stormwater management plans, drawings, technical reports and specifications. |
| ☐ | ☐ | ■ | *WORKSHEET FOR BMP POINT SYSTEM* to ensure the stormwater management plan for the project attains at least 10 BMP points (New Development) or traditional pollutant load reduction computations per the Chesapeake Bay Local Assistance Manual (Redevelopment Only). |
| ☐ | ☐ | ■ | *PROPOSED CONSERVATION EASEMENT AREAS* for any natural open space points claimed in the BMP worksheet. |
| ☐ | ■ | ☐ | *INSPECTION/MAINTENANCE AGREEMENT* is required to be prepared and executed with the County for the project. |
| ☐ | ☐ | ■ | *FEMA FIRM PANEL* reference with designated special flood hazard areas or zone designations associated with the site, as applicable. |
| ■ | ☐ | ☐ | *DRAINAGE AREA MAP* at a maximum scale of 1"=200' scale showing drainage area boundaries for pre- and postdevelopment conditions and associated time of concentration flow paths. Labels to include drainage area size, runoff coefficient or curve number and time of concentration for each subarea shown on the map. |

Yes No N/A

■ ☐ ☐ *SOILS MAP* with soil symbols, boundaries and legend in accordance with the current Soil Survey of James City and York Counties and the City of Williamsburg, Virginia with approximate locations of the project site, BMPs and applicable drainage basins.

■ ☐ ☐ *STORMWATER MANAGEMENT NARRATIVE* in a brief and simple format which describes the project; location; site and drainage basin soil characteristics; receiving water or drainage facility; existing site and drainage basin conditions (topography, land use, cover, slopes, etc.); proposed site development; proposed stormwater management and drainage plan including County BMP type selected; summary of hydrology and hydraulics; maintenance program; and any special assumptions utilized for development of the stormwater management and drainage design plan or computations.

■ ☐ ☐ *TEMPORARY STORMWATER MANAGEMENT* (if applicable) for control of stormwater runoff encountered during construction activities in addition to measures provided in the erosion and sediment control plan or stormwater management/drainage plan for the site. Adequate protection measures or sequencing provided.

■ ☐ ☐ *MODIFICATION PLAN* clearly defined for temporary sediment control structures which will be converted to permanent SWM/BMP structures. Includes appropriate hydrologic and hydraulic computations, conversions, sequencing and cleanout information or details. Normally related to primary control structures associated with dry detention or wet retention ponds. Normally not permitted for Group C or D categories such as bioretention, infiltration and filtering system facilities.

■ ☐ ☐ *STORMWATER MANAGEMENT and DRAINAGE DESIGN REPORT* in a bound 8-1/2 x 11 inch size format. Report shall generally include a title sheet, date, project identification, owner and preparer information, table of contents, narrative, summaries and computations as required. Computations may include: backwater, closed conduit, headwater, hydraulic, hydraulic grade line, hydrology, inlet, open channel, storm sewer, water quality, extended detention or stream channel protection and muti-stage storm routing calculations, as applicable, for the project. Computation data may include hand or computer generated computations, maps or schematics. All information should be presented in a clear, easy to follow format and should closely match construction plan information.

☐ ☐ ☐ *PLAN VIEW* at 1 inch = 50 ft. scale or less (1" = 40', 1" = 30', etc.)

- ■ ☐ ☐ North arrow and plan legend.
- ■ ☐ ☐ Property lines.
- ■ ☐ ☐ Adjacent property information.
- ■ ☐ ☐ Existing site features and existing impervious cover areas.
- ■ ☐ ☐ Impervious cover tabulations.
- ■ ☐ ☐ Existing drainage facilities (natural or manmade).
- ■ ☐ ☐ Existing environmentally sensitive areas (RPA, wetlands, floodplain, steep slopes, critical soils, buffers, etc.).
- ■ ☐ ☐ Existing and proposed contours (1' or 2' contour interval) and spot elevations as necessary to define high and low topography.
- ■ ☐ ☐ Existing and proposed easement locations.

| Yes | No | N/A | |
|---|---|---|---|
| ■ | ☐ | ☐ | Proposed site improvements and proposed impervious cover areas. |
| ■ | ☐ | ☐ | Proposed stormwater conveyance, drainage and management facilities with appropriate labeled construction data and information. |
| ☐ | ☐ | ■ | Proposed landscaping and seeding plans (disturbed areas, pond interior, etc.). |
| ■ | ☐ | ☐ | Proposed slope stabilization areas (riprap, blankets, mattings, walls, etc.). |
| ■ | ☐ | ☐ | Delineation of permanent pools and the 1-, 2-, 10- and 100-year Design Water Surface Elevations. |
| ☐ | ☐ | ■ | Delineation of ponding, headwater, surcharge or backwater areas which may affect adjacent existing or proposed buildings, structures or upstream adjacent properties. |
| ☐ | ☐ | ■ | Test boring locations with reference surface elevations (if known). |
| ■ | ☐ | ☐ | Risers, barrels, underdrains, overflows and outlet protections. |
| ☐ | ☐ | ■ | Emergency spillway level section and outlet channel. |
| ■ | ☐ | ☐ | Existing and proposed site utilities and protection measures. |
| ■ | ☐ | ☐ | Erosion and sediment control measures (for site or BMP). |
| ■ | ☐ | ☐ | Maintenance or access corridors to permanent stormwater management, BMP or drainage facilities. |

## II. *STORMWATER CONVEYANCE SYSTEMS:*

| Yes | No | N/A | |
|---|---|---|---|
| ■ | ☐ | ☐ | *PLAN VIEWS* |
| | | | ■ ☐ ☐ Storm drain lengths, sizes, types, classes and slopes for all segments. Label directly on plan or use structure/pipe schedule. |
| | | | ■ ☐ ☐ Access structure (inlets, manholes, junctions, etc.) rim elevations, inverts, type and required grate or top unit and lengths labeled. |
| | | | ■ ☐ ☐ All structure numbers labeled. |
| | | | ■ ☐ ☐ Adequate horizontal clearance from other site utilities or structures. |
| ■ | ☐ | ☐ | *PROFILES* generally are not required but are encouraged to expedite review. If not provided, ensure all pipe segments have adequate minimum cover, do not exceed maximum depths of cover for the type/class of pipe specified and do not conflict with other site utilities or excavation areas. |
| ■ | ☐ | ☐ | *DETAILS* |
| | | | ■ ☐ ☐ Typical storm drain bedding details or reference note. |
| | | | ■ ☐ ☐ Standard details or reference note for all proposed access structure types (inlets, manholes, junctions, etc.). |
| | | | ■ ☐ ☐ Inlet shaping detail or applicable reference note. |
| | | | ■ ☐ ☐ Step detail or applicable reference note (if depth 4 ft. or more). |
| | | | ☐ ☐ ■ Typical open channel details with designation, location, shape, type, bottom width, top width, lining, slope, length, side slope, and installation depth required for construction. Channel design data as necessary may also be included. |
| | | | ■ ☐ ☐ Outlet protections at all pipe outfalls. |

Yes No N/A

■ ☐ ☐ *STORMWATER CONVEYANCE SYSTEM COMPUTATIONS*

- ■ ☐ ☐ Storm Sewer Design computations based on 10-year design event.
- ■ ☐ ☐ Hydraulic Grade Line computations based on 10-year design event.
- ■ ☐ ☐ Inlet computations based on current VDOT procedure for spread, ponding depth and grate size required.
- ☐ ☐ ■ Culvert Headwater computations. Design based on 10-year design storm event and check only for 100-year storm event.
- ■ ☐ ☐ Open Channel computations based on 2-year design event for velocity and 10-year design event for capacity.
- ■ ☐ ☐ Standard outlet protection or special energy dissipators.
- ☐ ☐ ■ Pipe thickness design computations, as required, for selected pipe type (live load, minimum cover, maximum height of cover, etc.).
- ■ ☐ ☐ Adequate channel computations for receiving channels (based on field measured channel section data).

## III. *STORMWATER MANAGEMENT / BMP FACILITIES:*

Yes No N/A

■ ☐ ☐ *HYDROLOGY* - An SCS based methodology is required for the design of stormwater management/BMP facilities with watersheds exceeding 20 acres. Under 20 acres, other generally accepted methodologies such as the modified rational, critical storm are allowable. Refer to Chapter 5 of the VESCH or Chapter 5 of the VSMH.

- ■ ☐ ☐ Runoff Curve Number or Coefficient determinations: predeveloped and ultimate development land use scenarios.
- ■ ☐ ☐ Time of concentration: predeveloped and ultimate development indicating overland, shallow concentrated, and channel flow components (200 ft. maximum length for overland flow).
- ■ ☐ ☐ Hydrograph generation (tabular or graphical): pre- and postdevelopment conditions for the 1-, 2-, 10-, and 100-year design storm events.

■ ☐ ☐ *FACILITY CONFIGURATION and MINIMUM SEPARATIONS*

- ☐ ■ ☐ Screening and layout consistent with Section 24-98(d) of the Chapter 24 Zoning ordinance (landscaping, screening, visibility, etc.).
- ■ ☐ ☐ Basic considerations for safety and unauthorized entry.
- ■ ☐ ☐ Proper length to width ratio (Typically 2H:1V).
- ☐ ☐ ■ Facilities with deep pools (4 feet or more in depth) provided with two benches. Fifteen (15) ft. safety bench outward from normal pool at maximum 6 percent slope and aquatic bench inward from normal shoreline below normal pool. Narrower widths may be considered on a case-by-case basis.
- ■ ☐ ☐ Pond buffer minimum 25 feet outward from maximum design WSEL. Additional setbacks may be required to permanent structures.
- ■ ☐ ☐ No trees, shrubs or woody plants within 15 feet of embankment toe or 25 feet from principal spillway structure.

| Yes | No | N/A | |
|---|---|---|---|
| ☐ | ☐ | ■ | Infiltration and filtering system facilities generally located at least 100 feet horizontally from any water supply well; 100 feet from any downslope building; and 25 feet from any upslope buildings, unless site specific investigation allows for reduced separation. |

| Yes | No | N/A | |
|---|---|---|---|
| ■ | ☐ | ☐ | *HYDRAULIC COMPUTATIONS* |
| ■ | ☐ | ☐ | Elevation- or Stage- Storage curve and/or tabular data. |
| ■ | ☐ | ☐ | Weir / Orifice Control - Extended Detention. |
| ■ | ☐ | ☐ | Weir / Orifice Control - riser 1-year control for channel protection. |
| ■ | ☐ | ☐ | Weir / Orifice Control - riser 2-year control for quantity (if required). |
| ■ | ☐ | ☐ | Weir / Orifice Control - riser 10-year control for quantity (if required). |
| ■ | ☐ | ☐ | Inlet / Outlet (barrel) control - (All Storms). |
| ■ | ☐ | ☐ | Check for barrel control prior to riser orifice flow to prevent slug flow-water hammer conditions. |
| ☐ | ☐ | ■ | Emergency spillway capacity and depth of flow. |
| ■ | ☐ | ☐ | Elevation - Discharge (Outlet Rating) curve and/or table. Provide all supporting calculations and/or design assumptions. |
| ■ | ☐ | ☐ | Adequate channel computations for receiving channel. May be waived if facility is designed based on current Stream Channel Protection criteria. |
| ■ | ☐ | ☐ | *POND or RESERVOIR ROUTING* |
| ■ | ☐ | ☐ | Storage-Indication Routing of postdeveloped inflow hydrographs for the 1-, 2-, 10-, and 100-year design storms. Preference is for structure to discharge up to the 10-year storm through the principal spillway and pass the 100-year storm with a minimum 1 foot of freeboard through a combination principal and emergency spillways. If no emergency spillway is provided, riser must be large enough to pass the design high water flow and trash without overtopping the facility, have 3 square feet or more of cross-sectional area, contain a hood type inlet and have a minimum freeboard of 2 feet. Token spillways with minimum 8 ft. width are also recommended at or above the design 100-year storm elevation. |
| ☐ | ☐ | ■ | Downstream hydrographs at established study points, if conditions warrant (ie. facility discharge combined with uncontrolled bypass). |
| ■ | ☐ | ☐ | *MISCELLANEOUS COMPUTATIONS* |
| ☐ | ☐ | ■ | Water quality volume for permanent pool based on selected BMP treatment volume (WQv). |
| ☐ | ☐ | ■ | Water quality volume for extended detention based on selected BMP treatment volume (WQv) with drawdown computations. |
| ■ | ☐ | ☐ | Drawdown computations for the 1-year, 24 hour detention for stream channel protection criteria. |
| ■ | ☐ | ☐ | Pond drain computations (within 24 hours). |
| ■ | ☐ | ☐ | Anti-seep collar design (concrete preferred) or match material type. |
| ☐ | ☐ | ■ | Filter diaphragm design (or alternative method of controlling seepage). |

| Yes | No | N/A | |
|---|---|---|---|
| ☐ | ■ | ☐ | Riser / base structure flotation analyses. FS = 1.25 minimum. |
| ☐ | ■ | ■ | Downstream danger reach study and/or emergency action plan (if conditions warrant). |
| ☐ | ☐ | ■ | Upstream backwater analyses onto offsite adjacent property (if conditions warrant). |
| ☐ | ☐ | ■ | 100 year floodplain impacts (if conditions warrant). |

| Yes | No | N/A | |
|---|---|---|---|
| ■ | ☐ | ☐ | *GEOTECHNICAL REQUIREMENTS* |
| ☐ | ■ | ■ | Geotechnical Report with recommendations specific to BMP facility type selected. Report prepared by a registered professional engineer. Requires submission, review and approval prior to issuance of Land Disturbance Permit. |
| ☐ | ■ | ☐ | Initial Feasibility Testing requirements satisfied as per Appendix E of the James City County Guidelines for Design and Construction of Stormwater Management BMPs manual. (Infiltration, Bioretention and Filtering System BMP types only). |
| ☐ | ■ | ☐ | Concept Design Testing requirements satisfied as per Appendix E of the James City County Guidelines for Design and Construction of Stormwater Management BMPs manual. (Infiltration, Bioretention and Filtering System BMP types only). |
| ☐ | ■ | ☐ | Minimum Boring locations: borrow area, pool area, principal control structure, top of facility near one abutment and emergency spillway if provided. |
| ☐ | ■ | ☐ | Boring logs with Unified Soil Classification (ASTM D2487), soils descriptions and depths to bedrock and the seasonal water table indicated. |
| ■ | ☐ | ☐ | Standard County Record Drawing/Construction Certification note provided on plan. *Note: It is understood that preparation of record drawings and construction certifications as required for project facilities may not necessarily be performed by the plan preparer. These components may be performed by others.* |
| ■ | ☐ | ☐ | *PRINCIPAL SPILLWAY PROFILE AND ASSOCIATED DETAILS* |
| ■ | ☐ | ☐ | *EXISTING GROUND AND PROPOSED GRADE* |
| ■ | ☐ | ☐ | Embankment or excavation side slopes labeled (3H:1V maximum). |
| ■ | ☐ | ☐ | Minimum top width labeled (per VESCH or VSMH requirements). |
| ■ | ☐ | ☐ | Removal of unsuitable material under proposed facility (per Geotechnical Report requirements). |

Yes No N/A

■ ☐ ☐ *CORE TRENCH*

- ■ ☐ ☐ Material (per plan or Geotechnical Report).
- ■ ☐ ☐ Bottom width (4' minimum or greater as dictated by Geotechnical Report recommendations).
- ■ ☐ ☐ Side slopes (1:1 maximum steepness)
- ■ ☐ ☐ Depth (4' minimum or greater as dictated by Geotechnical Report).

■ ☐ ☐ *PRINCIPAL CONTROL STRUCTURE. RISER OR SIMILAR STRUCTURE (DETAILS REQUIRED FOR ALL ITEMS)*

- ■ ☐ ☐ Durable, watertight, resistant material (concrete preferred).
- ■ ☐ ☐ Riser diameter is at least 1.25 times larger than barrel diameter.
- ■ ☐ ☐ All pertinent dimensions and elevations shown.
- ■ ☐ ☐ Control orifice or weir dimensions and elevations shown.
- ■ ☐ ☐ Trash rack - removable - for each release.
- ■ ☐ ☐ Anti-vortex device, baffle or plate.
- ■ ☐ ☐ Riser base structure with dimensions and embedment specifications (concrete preferred).
- ■ ☐ ☐ Interior access (steps, ladders, etc.) for maintenance for structures over 4 feet in height. Excessively high risers may need some form of exterior access on top portion.
- ■ ☐ ☐ Low flow orifice with trash rack device.

■ ☐ ☐ *PRINCIPAL CONTROL STRUCTURE OUTLET BARREL*

- ■ ☐ ☐ Material (ASTM C-361 reinforced concrete pipe) with watertight joints. Prior approval required for all other pipe material (other RCP types, CMP, CPP, PVC, etc.).
- ■ ☐ ☐ Support and bedding requirements for barrel - concrete cradles, etc. or as recommended by the Geotechnical Report.
- ■ ☐ ☐ Pipe inverts, length, size, class and slope shown.
- ■ ☐ ☐ Flared end section or endwall provided on barrel outlet.

■ ☐ ☐ *SEEPAGE CONTROL*

- ☐ ■ ☐ Phreatic line shown (4:1 slope measured from the intersection of the embankment and the principal spillway design high water).

- ■ ☐ ☐ *ANTI-SEEP COLLARS*
  - ■ ☐ ☐ Anti-seep collar, concrete preferred.
  - ■ ☐ ☐ Size - 15 percent increase in length of saturation using outside pipe diameter.
  - ■ ☐ ☐ Spacing and location on barrel (located at least 2 feet from a pipe joint).

☐ ☐ ■ *FILTER DIAPHRAGMS*

☐ ☐ ☐ Design based on latest NRCS design methods and certified by a professional engineer.

Yes No N/A

■ ☐ ☐ *ELEVATION AND DIMENSIONAL DESIGN DATA*

■ ☐ ☐ Top of facility - construction height and settled height (10 percent settlement).

■ ☐ ☐ Crest of principal control structure spillway at least one (1) foot below crest of emergency spillway, if provided.

☐ ☐ ■ Minimum freeboard of one (1) foot above the 100-year design high water elevation for facilities <u>with</u> an emergency spillway.

■ ☐ ☐ Minimum freeboard of two (2) feet above the 100-year design high water elevation for facilities <u>without</u> an emergency spillway or in accordance with the SCS National Engineering Handbook (prior approval required).

■ ☐ ☐ Basin Sediment Clean-Out elevation (permanent mode). Typically 10 to 25 percent of water quality volume.

■ ☐ ☐ *CROSS SECTION THROUGH FACILITY*

■ ☐ ☐ Existing Ground.

■ ☐ ☐ Proposed grade.

■ ☐ ☐ Top of facility - constructed and settled.

☐ ☐ ■ Location of emergency spillway with side slopes labeled (emergency spillway in cut).

■ ☐ ☐ Bottom of core trench (4' minimum).

☐ ☐ ■ Location of each soil boring.

■ ☐ ☐ Barrel location.

☐ ☐ ■ Existing and proposed utility location/protection.

☐ ☐ ■ *EMERGENCY SPILLWAY PROFILE*

☐ ☐ ☐ Existing ground.

☐ ☐ ☐ Inlet, level (control) and outlet sections per SCS.

☐ ☐ ☐ Spillway and crest elevations.

■ ☐ ☐ *PRETREATMENT DEVICES* of adequate depth and properly designed using required pretreatment volumes for the selected County BMP facility type. Including, but not limited to: sediment forebays, sediment basins, sumps, grass channels, gravel diaphragms, plunge pools, chamber separators, manufactured systems or other acceptable methods.

| Yes | No | N/A | |
|---|---|---|---|
| ■ | ☐ | ☐ | *CONSTRUCTION SPECIFICATIONS and NOTES* |
| ■ | ☐ | ☐ | Anticipated sequence of construction for BMP (consistent with erosion and sediment control plan). |
| ■ | ☐ | ☐ | Provisions to control base stream or storm flow conditions encountered during construction. |
| ■ | ☐ | ☐ | Site and subgrade preparation requirements. |
| ■ | ☐ | ☐ | Embankment, fill and backfill material soil and placement (lift) thickness requirements. |
| ■ | ☐ | ☐ | Compaction and soil moisture content requirements. |
| ■ | ☐ | ☐ | Geosynthetics for drainage, filtration, moisture barrier, separation, and reinforcement purposes. |
| ☐ | ☐ | ■ | Clay or synthetic (PVC or HDPE) pond liners. |
| ■ | ☐ | ☐ | Storm drain, underdrain and pipe conduit requirements. |
| ☐ | ☐ | ■ | Minimum depth of pipe cover for temporary (construction) and final cover conditions. |
| ☐ | ☐ | ■ | Permanent shutoff valve and pond drain. |
| ■ | ☐ | ☐ | Concrete requirements for structural components. |
| ■ | ☐ | ☐ | Riprap and slope protection. |
| ■ | ☐ | ☐ | Access or maintenance road surface, base, subbase. |
| ■ | ☐ | ☐ | Temporary and permanent stabilization measures. |
| ■ | ☐ | ☐ | Temporary or permanent safety fencing. |
| ☐ | ☐ | ■ | BMP Landscaping (deep, shallow, fringe, perimeter,etc.) |
| ☐ | ☐ | ■ | Dust and traffic control (if warranted). |
| ■ | ☐ | ☐ | Construction monitoring and certification by professional. |
| ☐ | ☐ | ☐ | Other: _____ |
| ☐ | ☐ | ☐ | Other: _____. |
| ■ | ☐ | ☐ | *MAINTENANCE PROVISIONS* |
| ■ | ☐ | ☐ | Entity responsible for maintenance identified.. |
| ■ | ☐ | ☐ | Maintenance Plan which outlines the long-term schedule for inspection/maintenance of the facility and forebays |
| ■ | ☐ | ☐ | Maintenance access from public right-of-way or publicly traveled road. |
| ■ | ☐ | ☐ | Maintenance easement provided encompassing high water pool and buffer, principal and emergency spillways, outlet structures, forebays, embankment area and possible sediment-removal stockpile areas. |
| ☐ | ☐ | ■ | Minimum 6 foot wide public safety shelf (landing) or alternative fencing. |

## IV. *OUTLET PROTECTIONS:*

| Yes | No | N/A | |
|---|---|---|---|
| ■ | ☐ | ☐ | Sized for maximum design release (generally 10-year storm). |
| ■ | ☐ | ☐ | Flared end section or endwall. |
| ■ | ☐ | ☐ | Dimensions. |
| ■ | ☐ | ☐ | Rock or riprap size, quantity and placement thickness. |
| ■ | ☐ | ☐ | Slope at 0 percent (Level Grade). |
| ☐ | ☐ | ■ | Geotextiles (nonwoven). |
| ☐ | ☐ | ■ | Special energy dissipators are required for design discharge velocities that exceed eighteen (18) feet per second; or if use of standard outlet protection would result in velocities exceeding permissible channel velocities; or if space restricts or limits their use. |

## V. *ADDITIONAL COMMENTS OR INFORMATION SPECIFIC TO THE PLAN:*

Plan Preparer: A. RAMSAY

Date: 11/27/04.

SWMProg/BMP/Checklist/ChkList

# SEDIMENT BASIN CALCULATIONS

## Pond 3: sed trap 3

[43] Hint: Has no inflow (Outflow=Zero)

Routing by Stor-Ind method
Peak Elev= 0.00' @ 0.00 hrs Surf.Area= 0 sf Storage= 0 cf
Plug-Flow detention time= (not calculated)
Center-of-Mass det. time= (not calculated)

| # | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| 1 | 81.00' | 3,170 cf | **Custom Stage Data (Prismatic)** Listed below |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 81.00 | 210 | 0 | 0 |
| 82.00 | 342 | 276 | 276 |
| 83.00 | 507 | 425 | 701 |
| 84.00 | 701 | 604 | 1,305 |
| 85.00 | 925 | 813 | 2,118 |
| 86.00 | 1,180 | 1,053 | 3,170 |

## Stage-Area-Storage for Pond 3: sed trap 3

| Elevation (feet) | Surface (sq-ft) | Storage (cubic-feet) | Elevation (feet) | Surface (sq-ft) | Storage (cubic-feet) |
|---|---|---|---|---|---|
| 81.00 | 210 | 0 | 81.52 | 279 | 144 |
| 81.01 | 211 | 3 | 81.53 | 280 | 146 |
| 81.02 | 213 | 6 | 81.54 | 281 | 149 |
| 81.03 | 214 | 8 | 81.55 | 283 | 152 |
| 81.04 | 215 | 11 | 81.56 | 284 | 155 |
| 81.05 | 217 | 14 | 81.57 | 285 | 157 |
| 81.06 | 218 | 17 | 81.58 | 287 | 160 |
| 81.07 | 219 | 19 | 81.59 | 288 | 163 |
| 81.08 | 221 | 22 | 81.60 | 289 | 166 |
| 81.09 | 222 | 25 | 81.61 | 291 | 168 |
| 81.10 | 223 | 28 | 81.62 | 292 | 171 |
| 81.11 | 225 | 30 | 81.63 | 293 | 174 |
| 81.12 | 226 | 33 | 81.64 | 294 | 177 |
| 81.13 | 227 | 36 | 81.65 | 296 | 179 |
| 81.14 | 228 | 39 | 81.66 | 297 | 182 |
| 81.15 | 230 | 41 | 81.67 | 298 | 185 |
| 81.16 | 231 | 44 | 81.68 | 300 | 188 |
| 81.17 | 232 | 47 | 81.69 | 301 | 190 |
| 81.18 | 234 | 50 | 81.70 | 302 | 193 |
| 81.19 | 235 | 52 | 81.71 | 304 | 196 |
| 81.20 | 236 | 55 | 81.72 | 305 | 199 |
| 81.21 | 238 | 58 | 81.73 | 306 | 201 |
| 81.22 | 239 | 61 | 81.74 | 308 | 204 |
| 81.23 | 240 | 63 | 81.75 | 309 | 207 |
| 81.24 | 242 | 66 | 81.76 | 310 | 210 |
| 81.25 | 243 | 69 | 81.77 | 312 | 213 |
| 81.26 | 244 | 72 | 81.78 | 313 | 215 |
| 81.27 | 246 | 75 | 81.79 | 314 | 218 |
| 81.28 | 247 | 77 | 81.80 | 316 | 221 |
| 81.29 | 248 | 80 | 81.81 | 317 | 224 |
| 81.30 | 250 | 83 | 81.82 | 318 | 226 |
| 81.31 | 251 | 86 | 81.83 | 320 | 229 |
| 81.32 | 252 | 88 | 81.84 | 321 | 232 |
| 81.33 | 254 | 91 | 81.85 | 322 | 235 |
| 81.34 | 255 | 94 | 81.86 | 324 | 237 |
| 81.35 | 256 | 97 | 81.87 | 325 | 240 |
| 81.36 | 258 | 99 | 81.88 | 326 | 243 |
| 81.37 | 259 | 102 | 81.89 | 327 | 246 |
| 81.38 | 260 | 105 | 81.90 | 329 | 248 |
| 81.39 | 261 | 108 | 81.91 | 330 | 251 |
| 81.40 | 263 | 110 | 81.92 | 331 | 254 |
| 81.41 | 264 | 113 | 81.93 | 333 | 257 |
| 81.42 | 265 | 116 | 81.94 | 334 | 259 |
| 81.43 | 267 | 119 | 81.95 | 335 | 262 |
| 81.44 | 268 | 121 | 81.96 | 337 | 265 |
| 81.45 | 269 | 124 | 81.97 | 338 | 268 |
| 81.46 | 271 | 127 | 81.98 | 339 | 270 |
| 81.47 | 272 | 130 | 81.99 | 341 | 273 |
| 81.48 | 273 | 132 | 82.00 | 342 | 276 |
| 81.49 | 275 | 135 | 82.01 | 344 | 280 |
| 81.50 | 276 | 138 | 82.02 | 345 | 284 |
| 81.51 | 277 | 141 | 82.03 | 347 | 289 |

## Stage-Area-Storage for Pond 3: sed trap 3 (continued)

| Elevation (feet) | Surface (sq-ft) | Storage (cubic-feet) | Elevation (feet) | Surface (sq-ft) | Storage (cubic-feet) |
|---|---|---|---|---|---|
| 82.04 | 349 | 293 | 82.56 | 434 | 514 |
| 82.05 | 350 | 297 | 82.57 | 436 | 518 |
| 82.06 | 352 | 301 | 82.58 | 438 | 522 |
| 82.07 | 354 | 306 | 82.59 | 439 | 526 |
| 82.08 | 355 | 310 | 82.60 | 441 | 531 |
| 82.09 | 357 | 314 | 82.61 | 443 | 535 |
| 82.10 | 358 | 318 | 82.62 | 444 | 539 |
| 82.11 | 360 | 323 | 82.63 | 446 | 543 |
| 82.12 | 362 | 327 | 82.64 | 448 | 548 |
| 82.13 | 363 | 331 | 82.65 | 449 | 552 |
| 82.14 | 365 | 335 | 82.66 | 451 | 556 |
| 82.15 | 367 | 340 | 82.67 | 453 | 560 |
| 82.16 | 368 | 344 | 82.68 | 454 | 565 |
| 82.17 | 370 | 348 | 82.69 | 456 | 569 |
| 82.18 | 372 | 352 | 82.70 | 458 | 573 |
| 82.19 | 373 | 357 | 82.71 | 459 | 577 |
| 82.20 | 375 | 361 | 82.72 | 461 | 582 |
| 82.21 | 377 | 365 | 82.73 | 462 | 586 |
| 82.22 | 378 | 369 | 82.74 | 464 | 590 |
| 82.23 | 380 | 374 | 82.75 | 466 | 594 |
| 82.24 | 382 | 378 | 82.76 | 467 | 599 |
| 82.25 | 383 | 382 | 82.77 | 469 | 603 |
| 82.26 | 385 | 386 | 82.78 | 471 | 607 |
| 82.27 | 387 | 391 | 82.79 | 472 | 611 |
| 82.28 | 388 | 395 | 82.80 | 474 | 616 |
| 82.29 | 390 | 399 | 82.81 | 476 | 620 |
| 82.30 | 391 | 403 | 82.82 | 477 | 624 |
| 82.31 | 393 | 408 | 82.83 | 479 | 628 |
| 82.32 | 395 | 412 | 82.84 | 481 | 633 |
| 82.33 | 396 | 416 | 82.85 | 482 | 637 |
| 82.34 | 398 | 420 | 82.86 | 484 | 641 |
| 82.35 | 400 | 425 | 82.87 | 486 | 645 |
| 82.36 | 401 | 429 | 82.88 | 487 | 650 |
| 82.37 | 403 | 433 | 82.89 | 489 | 654 |
| 82.38 | 405 | 437 | 82.90 | 491 | 658 |
| 82.39 | 406 | 442 | 82.91 | 492 | 662 |
| 82.40 | 408 | 446 | 82.92 | 494 | 667 |
| 82.41 | 410 | 450 | 82.93 | 495 | 671 |
| 82.42 | 411 | 454 | 82.94 | 497 | 675 |
| 82.43 | 413 | 459 | 82.95 | 499 | 679 |
| 82.44 | 415 | 463 | 82.96 | 500 | 684 |
| 82.45 | 416 | 467 | 82.97 | 502 | 688 |
| 82.46 | 418 | 471 | 82.98 | 504 | 692 |
| 82.47 | 420 | 476 | 82.99 | 505 | 696 |
| 82.48 | 421 | 480 | 83.00 | 507 | 701 |
| 82.49 | 423 | 484 | 83.01 | 509 | 707 |
| 82.50 | 425 | 488 | 83.02 | 511 | 713 |
| 82.51 | 426 | 492 | 83.03 | 513 | 719 |
| 82.52 | 428 | 497 | 83.04 | 515 | 725 |
| 82.53 | 429 | 501 | 83.05 | 517 | 731 |
| 82.54 | 431 | 505 | 83.06 | 519 | 737 |
| 82.55 | 433 | 509 | 83.07 | 521 | 743 |

## Stage-Area-Storage for Pond 3: sed trap 3 (continued)

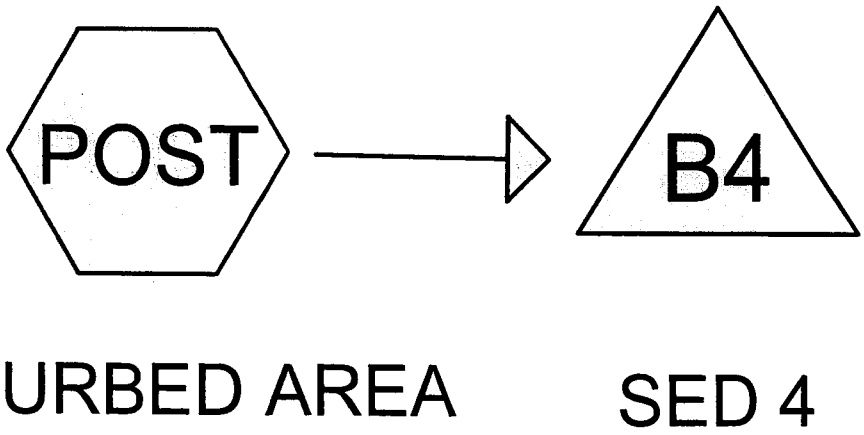
| Elevation (feet) | Surface (sq-ft) | Storage (cubic-feet) | Elevation (feet) | Surface (sq-ft) | Storage (cubic-feet) |
|---|---|---|---|---|---|
| 83.08 | 523 | 749 | 83.60 | 623 | 1,063 |
| 83.09 | 524 | 755 | 83.61 | 625 | 1,069 |
| 83.10 | 526 | 761 | 83.62 | 627 | 1,075 |
| 83.11 | 528 | 767 | 83.63 | 629 | 1,081 |
| 83.12 | 530 | 773 | 83.64 | 631 | 1,087 |
| 83.13 | 532 | 779 | 83.65 | 633 | 1,093 |
| 83.14 | 534 | 785 | 83.66 | 635 | 1,099 |
| 83.15 | 536 | 791 | 83.67 | 637 | 1,105 |
| 83.16 | 538 | 797 | 83.68 | 639 | 1,111 |
| 83.17 | 540 | 803 | 83.69 | 641 | 1,117 |
| 83.18 | 542 | 809 | 83.70 | 643 | 1,123 |
| 83.19 | 544 | 815 | 83.71 | 645 | 1,129 |
| 83.20 | 546 | 821 | 83.72 | 647 | 1,135 |
| 83.21 | 548 | 827 | 83.73 | 649 | 1,141 |
| 83.22 | 550 | 833 | 83.74 | 651 | 1,147 |
| 83.23 | 552 | 839 | 83.75 | 653 | 1,154 |
| 83.24 | 554 | 845 | 83.76 | 654 | 1,160 |
| 83.25 | 556 | 852 | 83.77 | 656 | 1,166 |
| 83.26 | 557 | 858 | 83.78 | 658 | 1,172 |
| 83.27 | 559 | 864 | 83.79 | 660 | 1,178 |
| 83.28 | 561 | 870 | 83.80 | 662 | 1,184 |
| 83.29 | 563 | 876 | 83.81 | 664 | 1,190 |
| 83.30 | 565 | 882 | 83.82 | 666 | 1,196 |
| 83.31 | 567 | 888 | 83.83 | 668 | 1,202 |
| 83.32 | 569 | 894 | 83.84 | 670 | 1,208 |
| 83.33 | 571 | 900 | 83.85 | 672 | 1,214 |
| 83.34 | 573 | 906 | 83.86 | 674 | 1,220 |
| 83.35 | 575 | 912 | 83.87 | 676 | 1,226 |
| 83.36 | 577 | 918 | 83.88 | 678 | 1,232 |
| 83.37 | 579 | 924 | 83.89 | 680 | 1,238 |
| 83.38 | 581 | 930 | 83.90 | 682 | 1,244 |
| 83.39 | 583 | 936 | 83.91 | 684 | 1,250 |
| 83.40 | 585 | 942 | 83.92 | 685 | 1,256 |
| 83.41 | 587 | 948 | 83.93 | 687 | 1,262 |
| 83.42 | 588 | 954 | 83.94 | 689 | 1,268 |
| 83.43 | 590 | 960 | 83.95 | 691 | 1,274 |
| 83.44 | 592 | 966 | 83.96 | 693 | 1,280 |
| 83.45 | 594 | 972 | 83.97 | 695 | 1,286 |
| 83.46 | 596 | 978 | 83.98 | 697 | 1,292 |
| 83.47 | 598 | 984 | 83.99 | 699 | 1,298 |
| 83.48 | 600 | 990 | 84.00 | 701 | 1,305 |
| 83.49 | 602 | 996 | 84.01 | 703 | 1,313 |
| 83.50 | 604 | 1,003 | 84.02 | 705 | 1,321 |
| 83.51 | 606 | 1,009 | 84.03 | 708 | 1,329 |
| 83.52 | 608 | 1,015 | 84.04 | 710 | 1,337 |
| 83.53 | 610 | 1,021 | 84.05 | 712 | 1,345 |
| 83.54 | 612 | 1,027 | 84.06 | 714 | 1,353 |
| 83.55 | 614 | 1,033 | 84.07 | 717 | 1,361 |
| 83.56 | 616 | 1,039 | 84.08 | 719 | 1,370 |
| 83.57 | 618 | 1,045 | 84.09 | 721 | 1,378 |
| 83.58 | 620 | 1,051 | 84.10 | 723 | 1,386 |
| 83.59 | 621 | 1,057 | 84.11 | 726 | 1,394 |

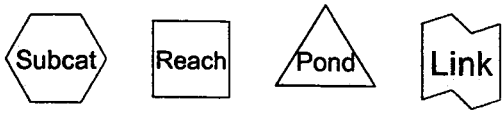
## Stage-Area-Storage for Pond 3: sed trap 3 (continued)

| Elevation (feet) | Surface (sq-ft) | Storage (cubic-feet) | Elevation (feet) | Surface (sq-ft) | Storage (cubic-feet) |
|---|---|---|---|---|---|
| 84.12 | 728 | 1,402 | 84.64 | 844 | 1,825 |
| 84.13 | 730 | 1,410 | 84.65 | 847 | 1,833 |
| 84.14 | 732 | 1,418 | 84.66 | 849 | 1,841 |
| 84.15 | 735 | 1,426 | 84.67 | 851 | 1,849 |
| 84.16 | 737 | 1,435 | 84.68 | 853 | 1,857 |
| 84.17 | 739 | 1,443 | 84.69 | 856 | 1,865 |
| 84.18 | 741 | 1,451 | 84.70 | 858 | 1,874 |
| 84.19 | 744 | 1,459 | 84.71 | 860 | 1,882 |
| 84.20 | 746 | 1,467 | 84.72 | 862 | 1,890 |
| 84.21 | 748 | 1,475 | 84.73 | 865 | 1,898 |
| 84.22 | 750 | 1,483 | 84.74 | 867 | 1,906 |
| 84.23 | 753 | 1,491 | 84.75 | 869 | 1,914 |
| 84.24 | 755 | 1,500 | 84.76 | 871 | 1,922 |
| 84.25 | 757 | 1,508 | 84.77 | 873 | 1,931 |
| 84.26 | 759 | 1,516 | 84.78 | 876 | 1,939 |
| 84.27 | 761 | 1,524 | 84.79 | 878 | 1,947 |
| 84.28 | 764 | 1,532 | 84.80 | 880 | 1,955 |
| 84.29 | 766 | 1,540 | 84.81 | 882 | 1,963 |
| 84.30 | 768 | 1,548 | 84.82 | 885 | 1,971 |
| 84.31 | 770 | 1,557 | 84.83 | 887 | 1,979 |
| 84.32 | 773 | 1,565 | 84.84 | 889 | 1,987 |
| 84.33 | 775 | 1,573 | 84.85 | 891 | 1,996 |
| 84.34 | 777 | 1,581 | 84.86 | 894 | 2,004 |
| 84.35 | 779 | 1,589 | 84.87 | 896 | 2,012 |
| 84.36 | 782 | 1,597 | 84.88 | 898 | 2,020 |
| 84.37 | 784 | 1,605 | 84.89 | 900 | 2,028 |
| 84.38 | 786 | 1,613 | 84.90 | 903 | 2,036 |
| 84.39 | 788 | 1,622 | 84.91 | 905 | 2,044 |
| 84.40 | 791 | 1,630 | 84.92 | 907 | 2,052 |
| 84.41 | 793 | 1,638 | 84.93 | 909 | 2,061 |
| 84.42 | 795 | 1,646 | 84.94 | 912 | 2,069 |
| 84.43 | 797 | 1,654 | 84.95 | 914 | 2,077 |
| 84.44 | 800 | 1,662 | 84.96 | 916 | 2,085 |
| 84.45 | 802 | 1,670 | 84.97 | 918 | 2,093 |
| 84.46 | 804 | 1,678 | 84.98 | 921 | 2,101 |
| 84.47 | 806 | 1,687 | 84.99 | 923 | 2,109 |
| 84.48 | 809 | 1,695 | 85.00 | 925 | 2,118 |
| 84.49 | 811 | 1,703 | 85.01 | 928 | 2,128 |
| 84.50 | 813 | 1,711 | 85.02 | 930 | 2,139 |
| 84.51 | 815 | 1,719 | 85.03 | 933 | 2,149 |
| 84.52 | 817 | 1,727 | 85.04 | 935 | 2,160 |
| 84.53 | 820 | 1,735 | 85.05 | 938 | 2,170 |
| 84.54 | 822 | 1,744 | 85.06 | 940 | 2,181 |
| 84.55 | 824 | 1,752 | 85.07 | 943 | 2,191 |
| 84.56 | 826 | 1,760 | 85.08 | 945 | 2,202 |
| 84.57 | 829 | 1,768 | 85.09 | 948 | 2,212 |
| 84.58 | 831 | 1,776 | 85.10 | 950 | 2,223 |
| 84.59 | 833 | 1,784 | 85.11 | 953 | 2,233 |
| 84.60 | 835 | 1,792 | 85.12 | 956 | 2,244 |
| 84.61 | 838 | 1,800 | 85.13 | 958 | 2,254 |
| 84.62 | 840 | 1,809 | 85.14 | 961 | 2,265 |
| 84.63 | 842 | 1,817 | 85.15 | 963 | 2,275 |

## Stage-Area-Storage for Pond 3: sed trap 3 (continued)

| Elevation (feet) | Surface (sq-ft) | Storage (cubic-feet) |
|---|---|---|
| 85.16 | 966 | 2,286 |
| 85.17 | 968 | 2,296 |
| 85.18 | 971 | 2,307 |
| 85.19 | 973 | 2,317 |
| 85.20 | 976 | 2,328 |
| 85.21 | 979 | 2,339 |
| 85.22 | 981 | 2,349 |
| 85.23 | 984 | 2,360 |
| 85.24 | 986 | 2,370 |
| 85.25 | 989 | 2,381 |
| 85.26 | 991 | 2,391 |
| 85.27 | 994 | 2,402 |
| 85.28 | 996 | 2,412 |
| 85.29 | 999 | 2,423 |
| 85.30 | 1,001 | 2,433 |
| 85.31 | 1,004 | 2,444 |
| 85.32 | 1,007 | 2,454 |
| 85.33 | 1,009 | 2,465 |
| 85.34 | 1,012 | 2,475 |
| 85.35 | 1,014 | 2,486 |
| 85.36 | 1,017 | 2,496 |
| 85.37 | 1,019 | 2,507 |
| 85.38 | 1,022 | 2,517 |
| 85.39 | 1,024 | 2,528 |
| 85.40 | 1,027 | 2,539 |
| 85.41 | 1,030 | 2,549 |
| 85.42 | 1,032 | 2,560 |
| 85.43 | 1,035 | 2,570 |
| 85.44 | 1,037 | 2,581 |
| 85.45 | 1,040 | 2,591 |
| 85.46 | 1,042 | 2,602 |
| 85.47 | 1,045 | 2,612 |
| 85.48 | 1,047 | 2,623 |
| 85.49 | 1,050 | 2,633 |
| 85.50 | 1,053 | 2,644 |
| 85.51 | 1,055 | 2,654 |
| 85.52 | 1,058 | 2,665 |
| 85.53 | 1,060 | 2,675 |
| 85.54 | 1,063 | 2,686 |
| 85.55 | 1,065 | 2,696 |
| 85.56 | 1,068 | 2,707 |
| 85.57 | 1,070 | 2,717 |
| 85.58 | 1,073 | 2,728 |
| 85.59 | 1,075 | 2,738 |
| 85.60 | 1,078 | 2,749 |
| 85.61 | 1,081 | 2,760 |
| 85.62 | 1,083 | 2,770 |
| 85.63 | 1,086 | 2,781 |
| 85.64 | 1,088 | 2,791 |
| 85.65 | 1,091 | 2,802 |
| 85.66 | 1,093 | 2,812 |
| 85.67 | 1,096 | 2,823 |
| 85.68 | 1,098 | 2,833 |
| 85.69 | 1,101 | 2,844 |
| 85.70 | 1,104 | 2,854 |
| 85.71 | 1,106 | 2,865 |
| 85.72 | 1,109 | 2,875 |
| 85.73 | 1,111 | 2,886 |
| 85.74 | 1,114 | 2,896 |
| 85.75 | 1,116 | 2,907 |
| 85.76 | 1,119 | 2,917 |
| 85.77 | 1,121 | 2,928 |
| 85.78 | 1,124 | 2,938 |
| 85.79 | 1,126 | 2,949 |
| 85.80 | 1,129 | 2,959 |
| 85.81 | 1,132 | 2,970 |
| 85.82 | 1,134 | 2,981 |
| 85.83 | 1,137 | 2,991 |
| 85.84 | 1,139 | 3,002 |
| 85.85 | 1,142 | 3,012 |
| 85.86 | 1,144 | 3,023 |
| 85.87 | 1,147 | 3,033 |
| 85.88 | 1,149 | 3,044 |
| 85.89 | 1,152 | 3,054 |
| 85.90 | 1,155 | 3,065 |
| 85.91 | 1,157 | 3,075 |
| 85.92 | 1,160 | 3,086 |
| 85.93 | 1,162 | 3,096 |
| 85.94 | 1,165 | 3,107 |
| 85.95 | 1,167 | 3,117 |
| 85.96 | 1,170 | 3,128 |
| 85.97 | 1,172 | 3,138 |
| 85.98 | 1,175 | 3,149 |
| 85.99 | 1,177 | 3,159 |
| 86.00 | **1,180** | **3,170** |




**Drainage Diagram for SED 4**
Prepared by Landmark Design Group 05/09/2005
HydroCAD® 7.00 s/n 001765 © 1986-2003 Applied Microcomputer Systems

# TEMPORARY SEDIMENT BASIN DESIGN DATA SHEET

(with or without an emergency spillway)

Project STONEHOUSE GLEN SECTION II

Basin # 5 Location _____

Total area draining to basin: 4.9 acres.

Basin Volume Design

**Wet Storage:**

1. Minimum required volume = 67 cu. yds. x Total Drainage Area (acres).

   67 cu. yds. x 4.9 acres = 328.3 cu. yds.

2. Available basin volume = 329 cu. yds. at elevation 70.80. (From storage - elevation curve)

3. Excavate N/A cu. yds. to obtain required volume*.

   * Elevation corresponding to required volume = invert of the dewatering orifice.

4. Available volume before cleanout required.

   33 cu. yds. x 4.9 acres = 161.7 cu. yds.

5. Elevation corresponding to cleanout level = 69.30.

   (From Storage - Elevation Curve)

6. Distance from invert of the dewatering orifice to cleanout level = 1.5 ft. (Min. = 1.0 ft.)

**Dry Storage:**

7. Minimum required volume = 67 cu. yds. x Total Drainage Area (acres).

   67 cu. yds. x 4.9 acres = 328.3 cu. yds.

8. Total available basin volume at crest of riser* = 690 cu. yds. at elevation 73.25. (From Storage - Elevation Curve)

* Minimum = 134 cu. yds./acre of total drainage area.

9. Diameter of dewatering orifice = 3 in.

10. Diameter of flexible tubing = 5 in. (diameter of dewatering orifice plus 2 inches).

Preliminary Design Elevations

11. Crest of Riser = 73.25

Top of Dam = 77

Design High Water = 73.90 (25YR)

Upstream Toe of Dam = 67.00

Basin Shape

12. Length of Flow / Effective Width — L / We = 60/20

If > 2, baffles are not required ✓

If < 2, baffles are required _____

Runoff

13. $Q_2$ = 8.8 cfs (From Chapter 5)

14. $Q_{25}$ = 22.1 cfs (From Chapter 5)

Principal Spillway Design

15. With emergency spillway, required spillway capacity $Q_p = Q_2$ = _____ cfs. (riser and barrel)

Without emergency spillway, required spillway capacity $Q_p = Q_{25}$ = 22.1 cfs. (riser and barrel)

16. With emergency spillway:

Assumed available head (h) = _____ ft. (Using $Q_2$)

h = Crest of Emergency Spillway Elevation - Crest of Riser Elevation

Without emergency spillway:

Assumed available head (h) = 0.65 ft. (Using $Q_{25}$)

h = Design High Water Elevation - Crest of Riser Elevation

17. Riser diameter ($D_r$) = 48 in. Actual head (h) = 0.65 ft.

(From Plate 3.14-8.)

Note: Avoid orifice flow conditions.

18. Barrel length (l) = 64 ft.

Head (H) on barrel through embankment = 8.66 ft.

(From Plate 3.14-7).

19. Barrel diameter = 24 in.

(From Plate 3.14-B [concrete pipe] or Plate 3.14-A [corrugated pipe]).

20. Trash rack and anti-vortex device

Diameter = 72 inches.

Height = 21 inches.

(From Table 3.14-D).

Emergency Spillway Design

21. Required spillway capacity $Q_e = Q_{25} - Q_p$ = _____cfs.

22. Bottom width (b) = _____ ft.; the slope of the exit channel (s) = _____ ft./foot; and the minimum length of the exit channel (x) = _____ ft.
(From Table 3.14-C).

Anti-Seep Collar Design

23. Depth of water at principal spillway crest (Y) = 6.25 ft.

Slope of upstream face of embankment (Z) = 3 :1.

Slope of principal spillway barrel ($S_b$) = 1.26 %

Length of barrel in saturated zone ($L_s$) = 46.69 ft.

24. Number of collars required = 3 dimensions = 3'-6" x 3'-6"

(from Plate 3.14-12).

Final Design Elevations

25. Top of Dam = $77^{00}$

Design High Water = $73.^{90}$

Emergency Spillway Crest = N/A

Principal Spillway Crest = $73^{25}$

Dewatering Orifice Invert = $70.^{80}$

Cleanout Elevation = $69^{30}$

Elevation of Upstream Toe of Dam or Excavated Bottom of "Wet Storage Area" (if excavation was performed) = $67^{00}$

Subject _____

Computed _____ Checked _____

LANDMARK DESIGN GROUP

Project # _____

Client _____

Date _____ Sheet # _____

Engineers • Planners • Surveyors • Landscape Architects • Environmental Scientists

BMP #5

LENGTH OF PIPE IN SATURATED ZONE

$$L_S = Y(Z+4)\left(1+\frac{S}{0.25-S}\right)$$

$Y = 6.25'$

$Z = 3:1$

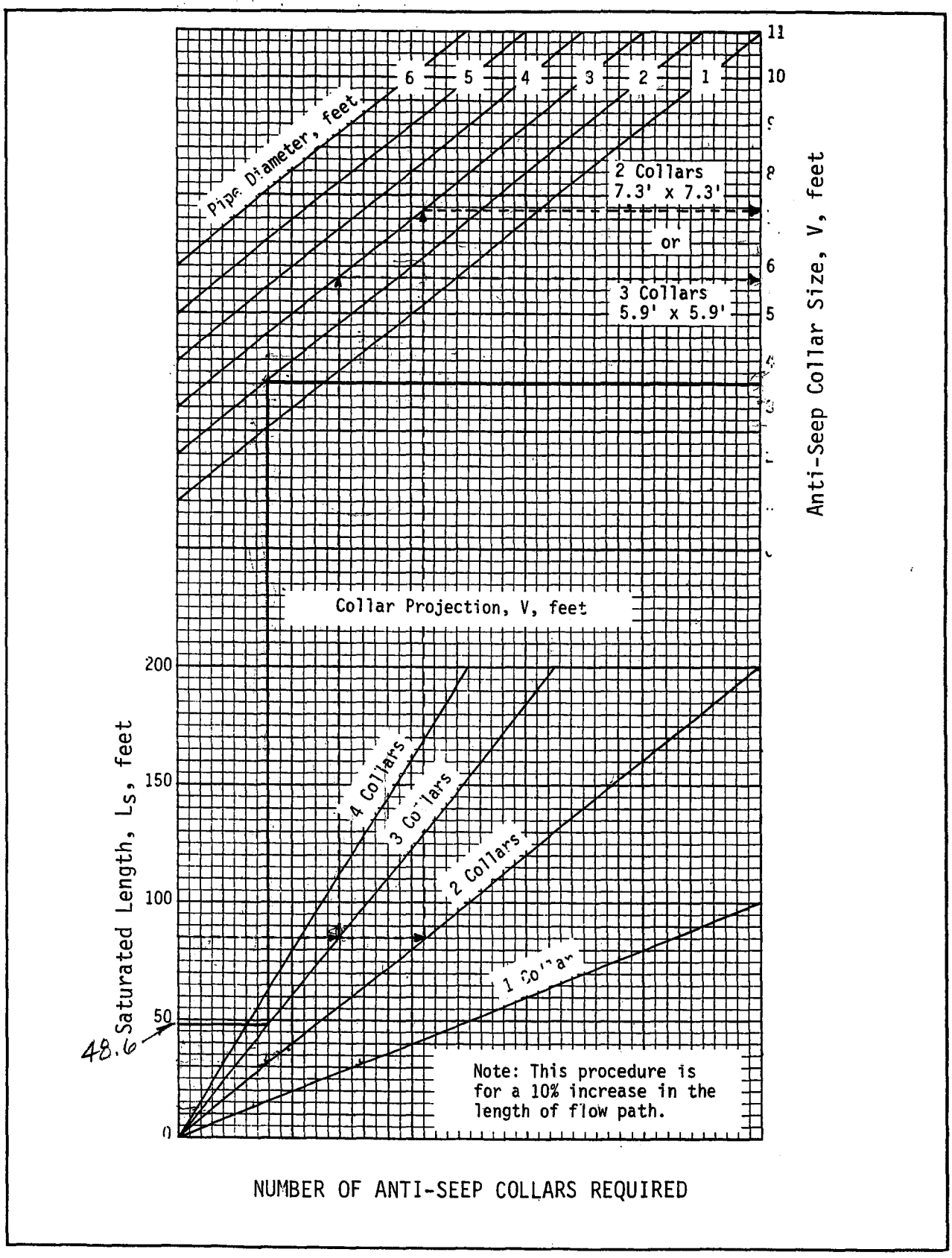
$S = 1.26\%$ $.0126\%$

$$L_S = 6.25(3+4)\left(1+\frac{0.0126}{0.25-0.0126}\right)$$

$L_S = 6.25 \times 7 \times 1.053$

$L_S = 46.07$

USE 3 ANTI-SEEP COLLARS 3'-6" X 3'-6"




Source: USDA-SCS

Plate 3.14-12

## Subcatchment POST: DISTURBED AREA

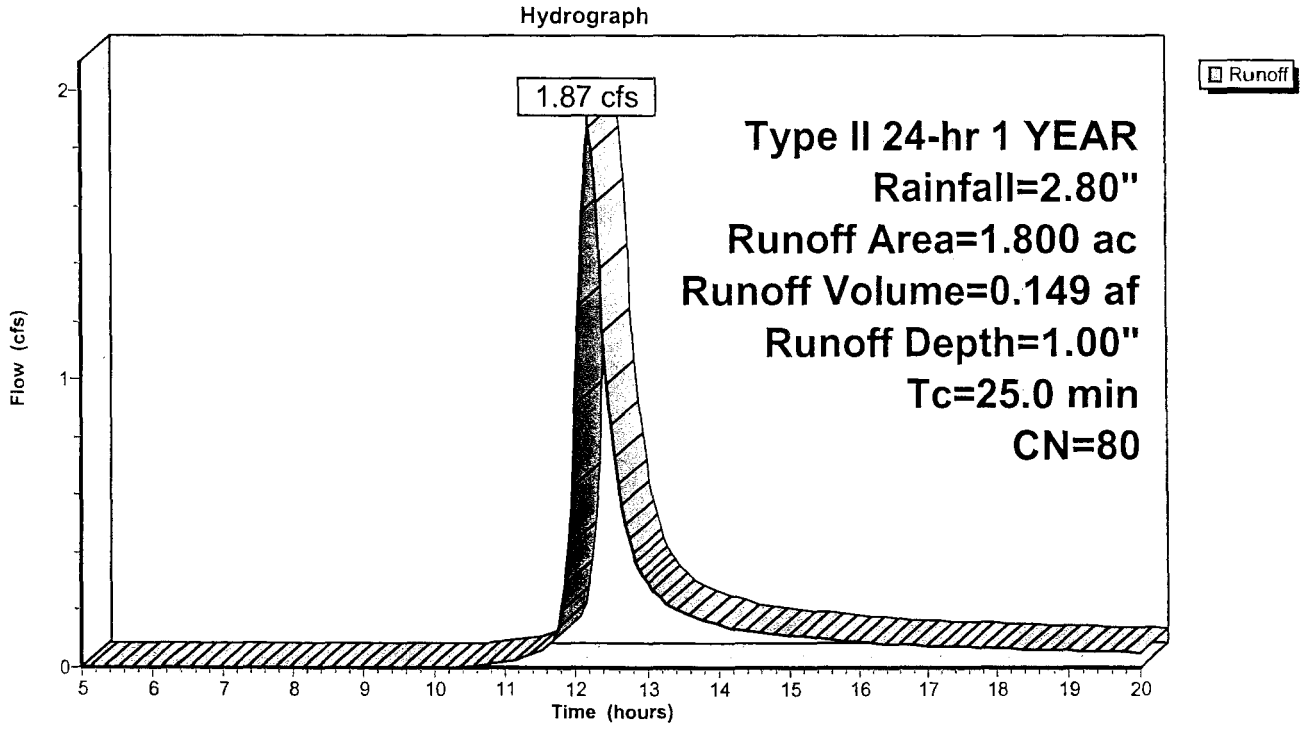
Runoff = 1.87 cfs @ 12.20 hrs, Volume= 0.149 af, Depth= 1.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 1 YEAR Rainfall=2.80"

| Area (ac) | CN | Description |
|---|---|---|
| 1.800 | 80 | 1/2 acre lots, 25% imp, HSG C |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 25.0 | | | | | **Direct Entry,** |

## Subcatchment POST: DISTURBED AREA



## Pond B4: SED 4

Inflow Area = 1.800 ac, Inflow Depth = 1.00" for 1 YEAR event
Inflow = 1.87 cfs @ 12.20 hrs, Volume= 0.149 af
Outflow = 0.31 cfs @ 12.96 hrs, Volume= 0.139 af, Atten= 84%, Lag= 46.1 min
Primary = 0.31 cfs @ 12.96 hrs, Volume= 0.139 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Starting Elev= 49.50' Surf.Area= 1,197 sf Storage= 3,285 cf
Peak Elev= 51.32' @ 12.96 hrs Surf.Area= 1,847 sf Storage= 6,280 cf (2,995 cf above start)
Plug-Flow detention time= 307.8 min calculated for 0.064 af (43% of inflow)
Center-of-Mass det. time= 102.3 min ( 916.7 - 814.4 )

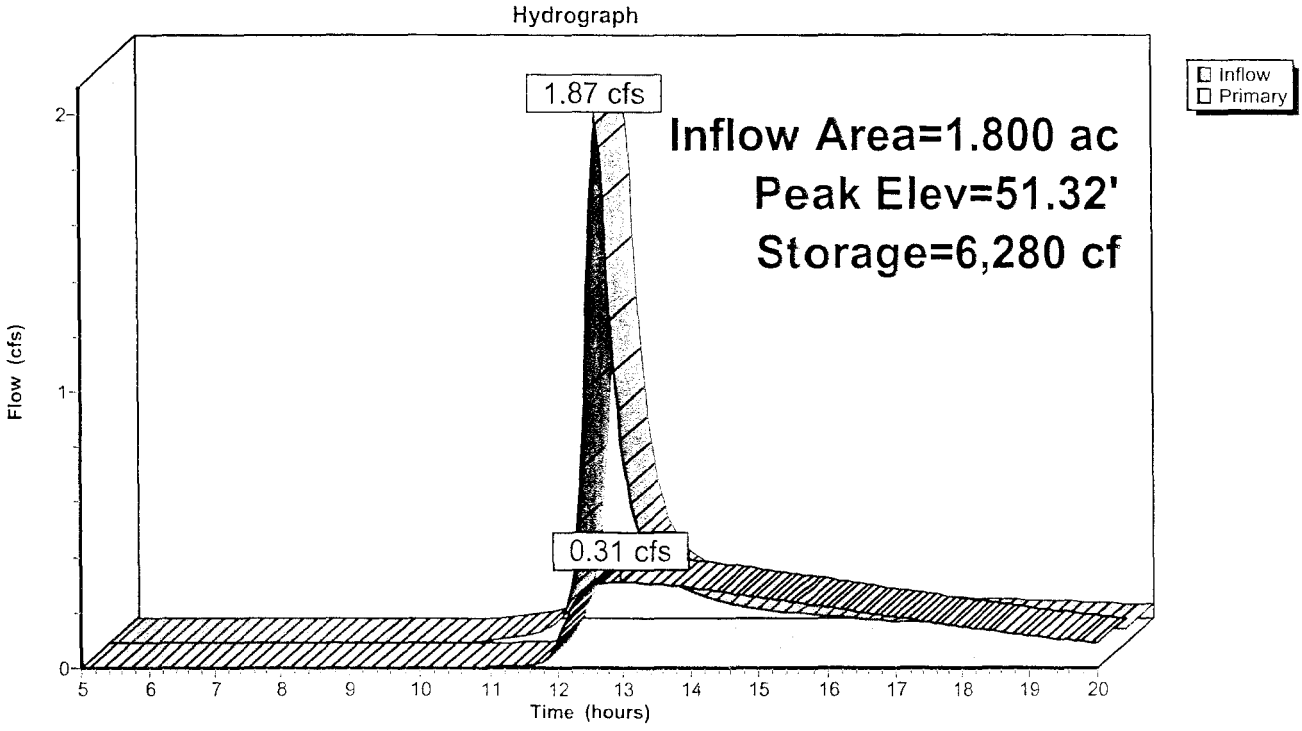
| # | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| 1 | 47.50' | 23,684 cf | **Custom Stage Data (Prismatic)** Listed below |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 47.50 | 485 | 0 | 0 |
| 54.00 | 2,800 | 10,676 | 10,676 |
| 57.50 | 4,633 | 13,008 | 23,684 |

| # | Routing | Invert | Outlet Devices |
|---|---|---|---|
| 1 | Primary | 45.00' | **24.0" x 62.0' long Culvert** RCP, square edge headwall, Ke= 0.500<br>Outlet Invert= 44.00' S= 0.0161 '/' n= 0.012 Cc= 0.900 |
| 2 | Device 1 | 49.50' | **3.0" Vert. Orifice/Grate** C= 0.600 |
| 3 | Device 1 | 54.00' | **48.0" Horiz. Orifice/Grate** Limited to weir flow C= 0.600 |

**Primary OutFlow** Max=0.31 cfs @ 12.96 hrs HW=51.32' (Free Discharge)
└**1=Culvert** (Passes 0.31 cfs of 34.90 cfs potential flow)
├**2=Orifice/Grate** (Orifice Controls 0.31 cfs @ 6.3 fps)
└**3=Orifice/Grate** ( Controls 0.00 cfs)

**Pond B4: SED 4**


Hydrograph
1.87 cfs
0.31 cfs
Inflow Area=1.800 ac
Peak Elev=51.32'
Storage=6,280 cf
Inflow
Primary
Flow (cfs)
Time (hours)
0
1
2
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20

## Stage-Discharge for Pond B4: SED 4

| Elevation (feet) | Primary (cfs) | Elevation (feet) | Primary (cfs) |
|---|---|---|---|
| 47.50 | 0.00 | 52.80 | 0.42 |
| 47.60 | 0.00 | 52.90 | 0.43 |
| 47.70 | 0.00 | 53.00 | 0.43 |
| 47.80 | 0.00 | 53.10 | 0.44 |
| 47.90 | 0.00 | 53.20 | 0.45 |
| 48.00 | 0.00 | 53.30 | 0.45 |
| 48.10 | 0.00 | 53.40 | 0.46 |
| 48.20 | 0.00 | 53.50 | 0.47 |
| 48.30 | 0.00 | 53.60 | 0.47 |
| 48.40 | 0.00 | 53.70 | 0.48 |
| 48.50 | 0.00 | 53.80 | 0.48 |
| 48.60 | 0.00 | 53.90 | 0.49 |
| 48.70 | 0.00 | 54.00 | 0.49 |
| 48.80 | 0.00 | 54.10 | 1.80 |
| 48.90 | 0.00 | 54.20 | 4.18 |
| 49.00 | 0.00 | 54.30 | 7.26 |
| 49.10 | 0.00 | 54.40 | 10.91 |
| 49.20 | 0.00 | 54.50 | 15.05 |
| 49.30 | 0.00 | 54.60 | 19.63 |
| 49.40 | 0.00 | 54.70 | 24.60 |
| 49.50 | 0.00 | 54.80 | 29.94 |
| 49.60 | 0.02 | 54.90 | 35.63 |
| 49.70 | 0.06 | 55.00 | 41.64 |
| 49.80 | 0.10 | 55.10 | 45.63 |
| 49.90 | 0.12 | 55.20 | 45.88 |
| 50.00 | 0.14 | 55.30 | 46.13 |
| 50.10 | 0.16 | 55.40 | 46.38 |
| 50.20 | 0.18 | 55.50 | 46.62 |
| 50.30 | 0.19 | 55.60 | 46.87 |
| 50.40 | 0.21 | 55.70 | 47.11 |
| 50.50 | 0.22 | 55.80 | 47.35 |
| 50.60 | 0.23 | 55.90 | 47.60 |
| 50.70 | 0.25 | 56.00 | 47.83 |
| 50.80 | 0.26 | 56.10 | 48.07 |
| 50.90 | 0.27 | 56.20 | 48.31 |
| 51.00 | 0.28 | 56.30 | 48.55 |
| 51.10 | 0.29 | 56.40 | 48.78 |
| 51.20 | 0.30 | 56.50 | 49.02 |
| 51.30 | 0.31 | 56.60 | 49.25 |
| 51.40 | 0.31 | 56.70 | 49.48 |
| 51.50 | 0.32 | 56.80 | 49.71 |
| 51.60 | 0.33 | 56.90 | 49.94 |
| 51.70 | 0.34 | 57.00 | 50.17 |
| 51.80 | 0.35 | 57.10 | 50.40 |
| 51.90 | 0.36 | 57.20 | 50.62 |
| 52.00 | 0.36 | 57.30 | 50.85 |
| 52.10 | 0.37 | 57.40 | 51.07 |
| 52.20 | 0.38 | 57.50 | **51.30** |
| 52.30 | 0.39 | | |
| 52.40 | 0.39 | | |
| 52.50 | 0.40 | | |
| 52.60 | 0.41 | | |
| 52.70 | 0.41 | | |

## Subcatchment POST: DISTURBED AREA

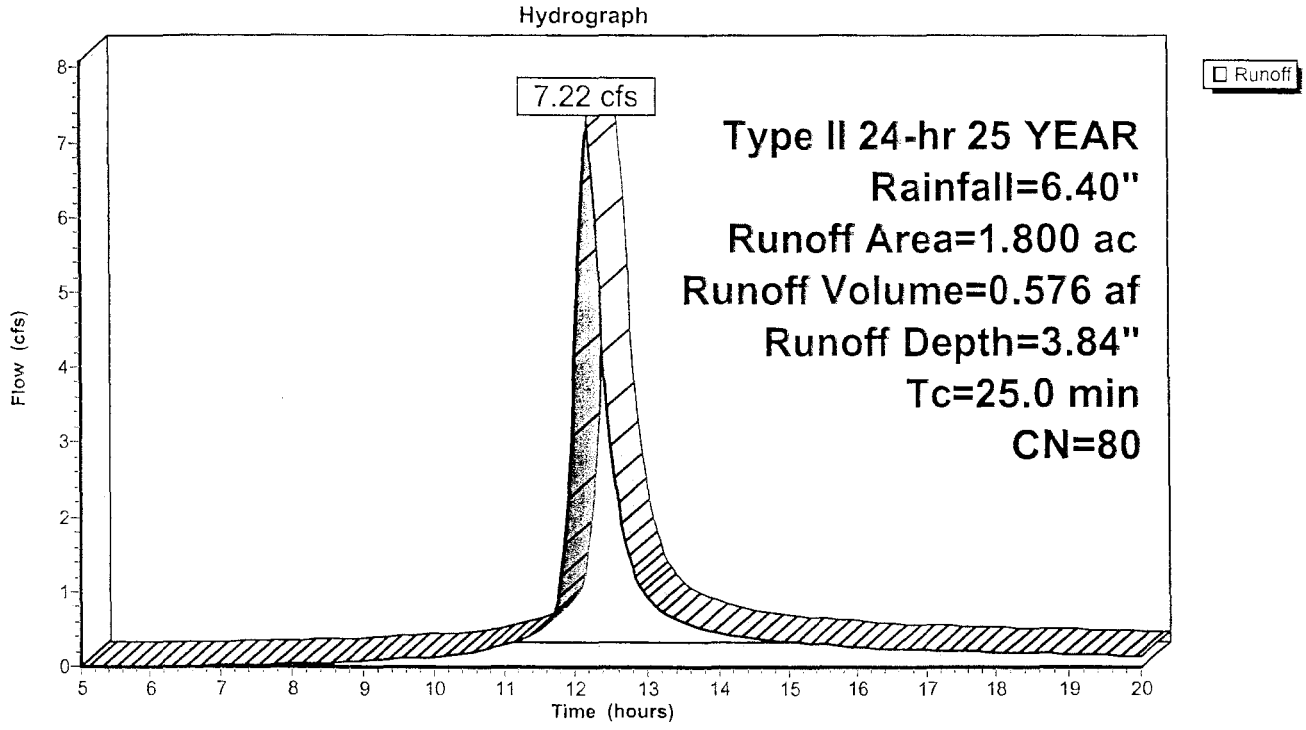
Runoff = 7.22 cfs @ 12.18 hrs, Volume= 0.576 af, Depth= 3.84"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 YEAR Rainfall=6.40"

| Area (ac) | CN | Description |
|---|---|---|
| 1.800 | 80 | 1/2 acre lots, 25% imp, HSG C |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 25.0 | | | | | **Direct Entry,** |

## Subcatchment POST: DISTURBED AREA



## Pond B4: SED 4

| | | | | | |
|---|---|---|---|---|---|
| Inflow Area = | 1.800 ac, | Inflow Depth = | 3.84" | for | 25 YEAR event |
| Inflow = | 7.22 cfs @ | 12.18 hrs, | Volume= | 0.576 af | |
| Outflow = | 6.14 cfs @ | 12.31 hrs, | Volume= | 0.495 af, | Atten= 15%, Lag= 7.9 min |
| Primary = | 6.14 cfs @ | 12.31 hrs, | Volume= | 0.495 af | |

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Starting Elev= 49.50' Surf.Area= 1,197 sf Storage= 3,285 cf
Peak Elev= 54.26' @ 12.31 hrs Surf.Area= 2,938 sf Storage= 11,656 cf (8,371 cf above start)
Plug-Flow detention time= 164.7 min calculated for 0.419 af (73% of inflow)
Center-of-Mass det. time= 74.3 min ( 860.2 - 785.8 )

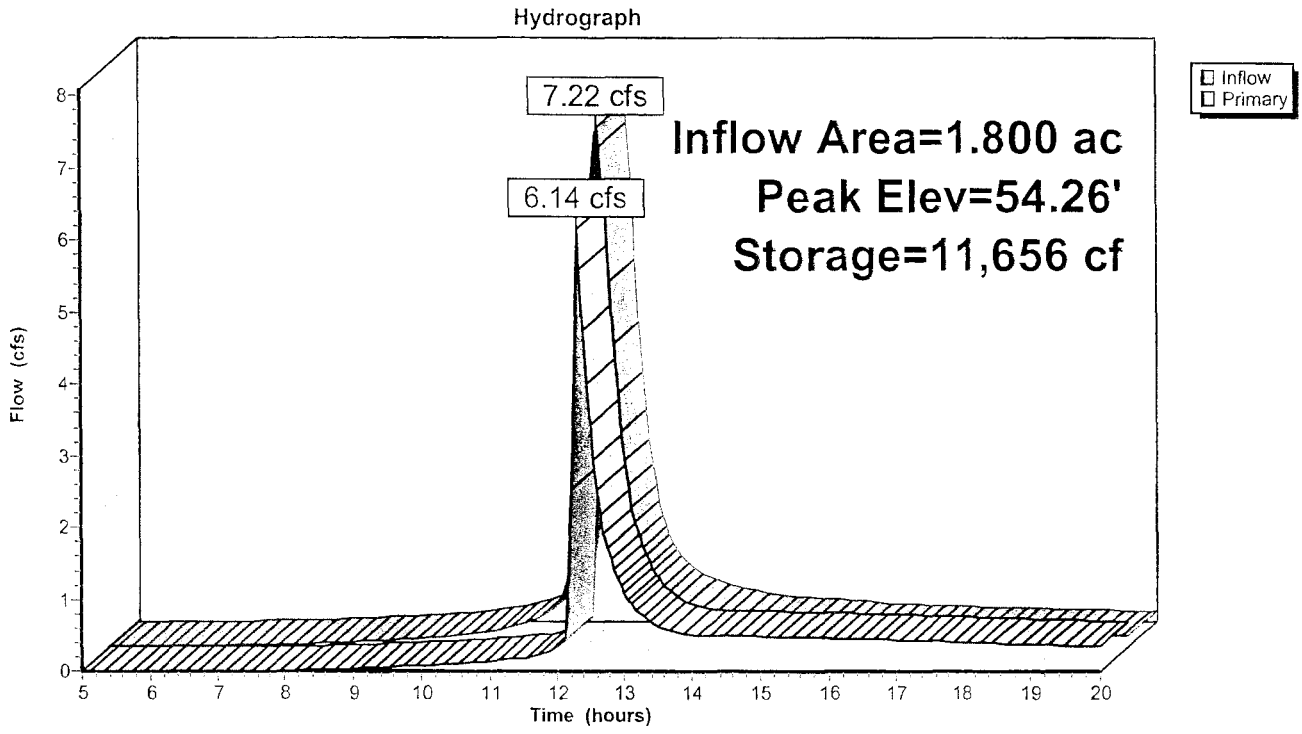
| # | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| 1 | 47.50' | 23,684 cf | **Custom Stage Data (Prismatic)** Listed below |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 47.50 | 485 | 0 | 0 |
| 54.00 | 2,800 | 10,676 | 10,676 |
| 57.50 | 4,633 | 13,008 | 23,684 |

| # | Routing | Invert | Outlet Devices |
|---|---|---|---|
| 1 | Primary | 45.00' | **24.0" x 62.0' long Culvert** RCP, square edge headwall, Ke= 0.500<br>Outlet Invert= 44.00' S= 0.0161 '/' n= 0.012 Cc= 0.900 |
| 2 | Device 1 | 49.50' | **3.0" Vert. Orifice/Grate** C= 0.600 |
| 3 | Device 1 | 54.00' | **48.0" Horiz. Orifice/Grate** Limited to weir flow C= 0.600 |

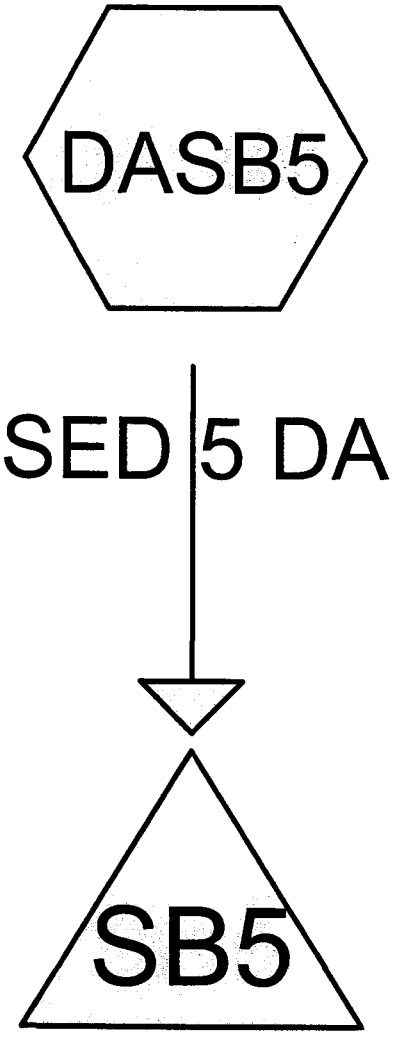
**Primary OutFlow** Max=5.88 cfs @ 12.31 hrs HW=54.26' (Free Discharge)
└**1=Culvert** (Passes 5.88 cfs of 43.47 cfs potential flow)
  ├**2=Orifice/Grate** (Orifice Controls 0.51 cfs @ 10.4 fps)
  └**3=Orifice/Grate** (Weir Controls 5.37 cfs @ 1.7 fps)

## Pond B4: SED 4

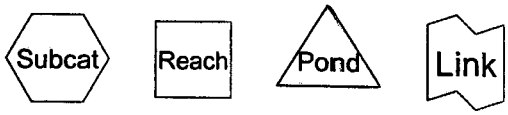

Hydrograph
7.22 cfs
6.14 cfs
Inflow Area=1.800 ac
Peak Elev=54.26'
Storage=11,656 cf
Inflow
Primary
Flow (cfs)
Time (hours)
0
1
2
3
4
5
6
7
8
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20

## Stage-Discharge for Pond B4: SED 4

| Elevation (feet) | Primary (cfs) | Elevation (feet) | Primary (cfs) |
|---|---|---|---|
| 47.50 | 0.00 | 52.80 | 0.42 |
| 47.60 | 0.00 | 52.90 | 0.43 |
| 47.70 | 0.00 | 53.00 | 0.43 |
| 47.80 | 0.00 | 53.10 | 0.44 |
| 47.90 | 0.00 | 53.20 | 0.45 |
| 48.00 | 0.00 | 53.30 | 0.45 |
| 48.10 | 0.00 | 53.40 | 0.46 |
| 48.20 | 0.00 | 53.50 | 0.47 |
| 48.30 | 0.00 | 53.60 | 0.47 |
| 48.40 | 0.00 | 53.70 | 0.48 |
| 48.50 | 0.00 | 53.80 | 0.48 |
| 48.60 | 0.00 | 53.90 | 0.49 |
| 48.70 | 0.00 | 54.00 | 0.49 |
| 48.80 | 0.00 | 54.10 | 1.80 |
| 48.90 | 0.00 | 54.20 | 4.18 |
| 49.00 | 0.00 | 54.30 | 7.26 |
| 49.10 | 0.00 | 54.40 | 10.91 |
| 49.20 | 0.00 | 54.50 | 15.05 |
| 49.30 | 0.00 | 54.60 | 19.63 |
| 49.40 | 0.00 | 54.70 | 24.60 |
| 49.50 | 0.00 | 54.80 | 29.94 |
| 49.60 | 0.02 | 54.90 | 35.63 |
| 49.70 | 0.06 | 55.00 | 41.64 |
| 49.80 | 0.10 | 55.10 | 45.63 |
| 49.90 | 0.12 | 55.20 | 45.88 |
| 50.00 | 0.14 | 55.30 | 46.13 |
| 50.10 | 0.16 | 55.40 | 46.38 |
| 50.20 | 0.18 | 55.50 | 46.62 |
| 50.30 | 0.19 | 55.60 | 46.87 |
| 50.40 | 0.21 | 55.70 | 47.11 |
| 50.50 | 0.22 | 55.80 | 47.35 |
| 50.60 | 0.23 | 55.90 | 47.60 |
| 50.70 | 0.25 | 56.00 | 47.83 |
| 50.80 | 0.26 | 56.10 | 48.07 |
| 50.90 | 0.27 | 56.20 | 48.31 |
| 51.00 | 0.28 | 56.30 | 48.55 |
| 51.10 | 0.29 | 56.40 | 48.78 |
| 51.20 | 0.30 | 56.50 | 49.02 |
| 51.30 | 0.31 | 56.60 | 49.25 |
| 51.40 | 0.31 | 56.70 | 49.48 |
| 51.50 | 0.32 | 56.80 | 49.71 |
| 51.60 | 0.33 | 56.90 | 49.94 |
| 51.70 | 0.34 | 57.00 | 50.17 |
| 51.80 | 0.35 | 57.10 | 50.40 |
| 51.90 | 0.36 | 57.20 | 50.62 |
| 52.00 | 0.36 | 57.30 | 50.85 |
| 52.10 | 0.37 | 57.40 | 51.07 |
| 52.20 | 0.38 | 57.50 | **51.30** |
| 52.30 | 0.39 | | |
| 52.40 | 0.39 | | |
| 52.50 | 0.40 | | |
| 52.60 | 0.41 | | |
| 52.70 | 0.41 | | |




# SED BASIN 5




**Drainage Diagram for bmp5**
Prepared by Landmark Design Group 05/09/2005
HydroCAD® 7.00 s/n 001765 © 1986-2003 Applied Microcomputer Systems

# TEMPORARY SEDIMENT BASIN DESIGN DATA SHEET

(with or without an emergency spillway)

Project STONEHOUSE GLEN SECTION II

Basin # 5 Location _____

Total area draining to basin: 4.9 acres.

## Basin Volume Design

**Wet Storage:**

1. Minimum required volume = 67 cu. yds. x Total Drainage Area (acres).

   67 cu. yds. x 4.9 acres = 328.3 cu. yds.

2. Available basin volume = 329 cu. yds. at elevation 70.80. (From storage - elevation curve)

3. Excavate N/A cu. yds. to obtain required volume*.

   * Elevation corresponding to required volume = invert of the dewatering orifice.

4. Available volume before cleanout required.

   33 cu. yds. x 4.9 acres = 161.7 cu. yds.

5. Elevation corresponding to cleanout level = 69.30.

   (From Storage - Elevation Curve)

6. Distance from invert of the dewatering orifice to cleanout level = 1.5 ft. (Min. = 1.0 ft.)

**Dry Storage:**

7. Minimum required volume = 67 cu. yds. x Total Drainage Area (acres).

   67 cu. yds. x 4.9 acres = 328.3 cu. yds.

8. Total available basin volume at crest of riser* = 690 cu. yds. at elevation 73.25. (From Storage - Elevation Curve)

* Minimum = 134 cu. yds./acre of total drainage area.

9. Diameter of dewatering orifice = 3 in.

10. Diameter of flexible tubing = 5 in. (diameter of dewatering orifice plus 2 inches).

Preliminary Design Elevations

11. Crest of Riser = 73.25

Top of Dam = 77

Design High Water = 78.70 (25YR)

Upstream Toe of Dam = 67.00

Basin Shape

12. Length of Flow / Effective Width — L / We = 60/20

If > 2, baffles are not required ✓

If < 2, baffles are required _____

Runoff

13. $Q_2$ = 8.8 cfs (From Chapter 5)

14. $Q_{25}$ = 22.1 cfs (From Chapter 5)

Principal Spillway Design

15. With emergency spillway, required spillway capacity $Q_p = Q_2$ = _____ cfs. (riser and barrel)

Without emergency spillway, required spillway capacity $Q_p = Q_{25}$ = 22.1 cfs. (riser and barrel)

16. With emergency spillway:

Assumed available head (h) = _____ ft. (Using $Q_2$)

h = Crest of Emergency Spillway Elevation - Crest of Riser Elevation

Without emergency spillway:

Assumed available head (h) = 0.65 ft. (Using $Q_{25}$)

h = Design High Water Elevation - Crest of Riser Elevation

17. Riser diameter ($D_r$) = 48 in. Actual head (h) = 0.65 ft.

(From Plate 3.14-8.)

Note: Avoid orifice flow conditions.

18. Barrel length (l) = 64 ft.

Head (H) on barrel through embankment = 8.66 ft.

(From Plate 3.14-7).

19. Barrel diameter = 24 in.

(From Plate 3.14-B [concrete pipe] or Plate 3.14-A [corrugated pipe]).

20. Trash rack and anti-vortex device

Diameter = 72 inches.

Height = 21 inches.

(From Table 3.14-D).

Emergency Spillway Design

21. Required spillway capacity $Q_e = Q_{25} - Q_p$ = _____cfs.

22. Bottom width (b) = _____ ft.; the slope of the exit channel (s) = _____ ft./foot; and the minimum length of the exit channel (x) = _____ ft.
(From Table 3.14-C).

Anti-Seep Collar Design

23. Depth of water at principal spillway crest (Y) = 6.25 ft.

Slope of upstream face of embankment (Z) = 3 :1.

Slope of principal spillway barrel ($S_b$) = 1.26 %

Length of barrel in saturated zone ($L_s$) = 46.69 ft.

24. Number of collars required = 3 dimensions = 3'-6" x 3'-6"

(from Plate 3.14-12).

Final Design Elevations

25. Top of Dam = $77^{00}$

Design High Water = $73.^{90}$

Emergency Spillway Crest = N/A

Principal Spillway Crest = $73^{25}$

Dewatering Orifice Invert = $70.^{80}$

Cleanout Elevation = $69^{80}$

Elevation of Upstream Toe of Dam or Excavated Bottom of "Wet Storage Area" (if excavation was performed) = $67^{00}$

Subject _____

Computed _____ Checked _____

LANDMARK DESIGN GROUP

Project # _____

Client _____

Date _____ Sheet # _____

Engineers • Planners • Surveyors • Landscape Architects • Environmental Scientists

BMP #5

LENGTH OF PIPE IN SATURATED ZONE

$$L_s = Y(Z+4)\left(1+\frac{S}{0.25-S}\right)$$

$Y = 6.25'$

$Z = 3:1$

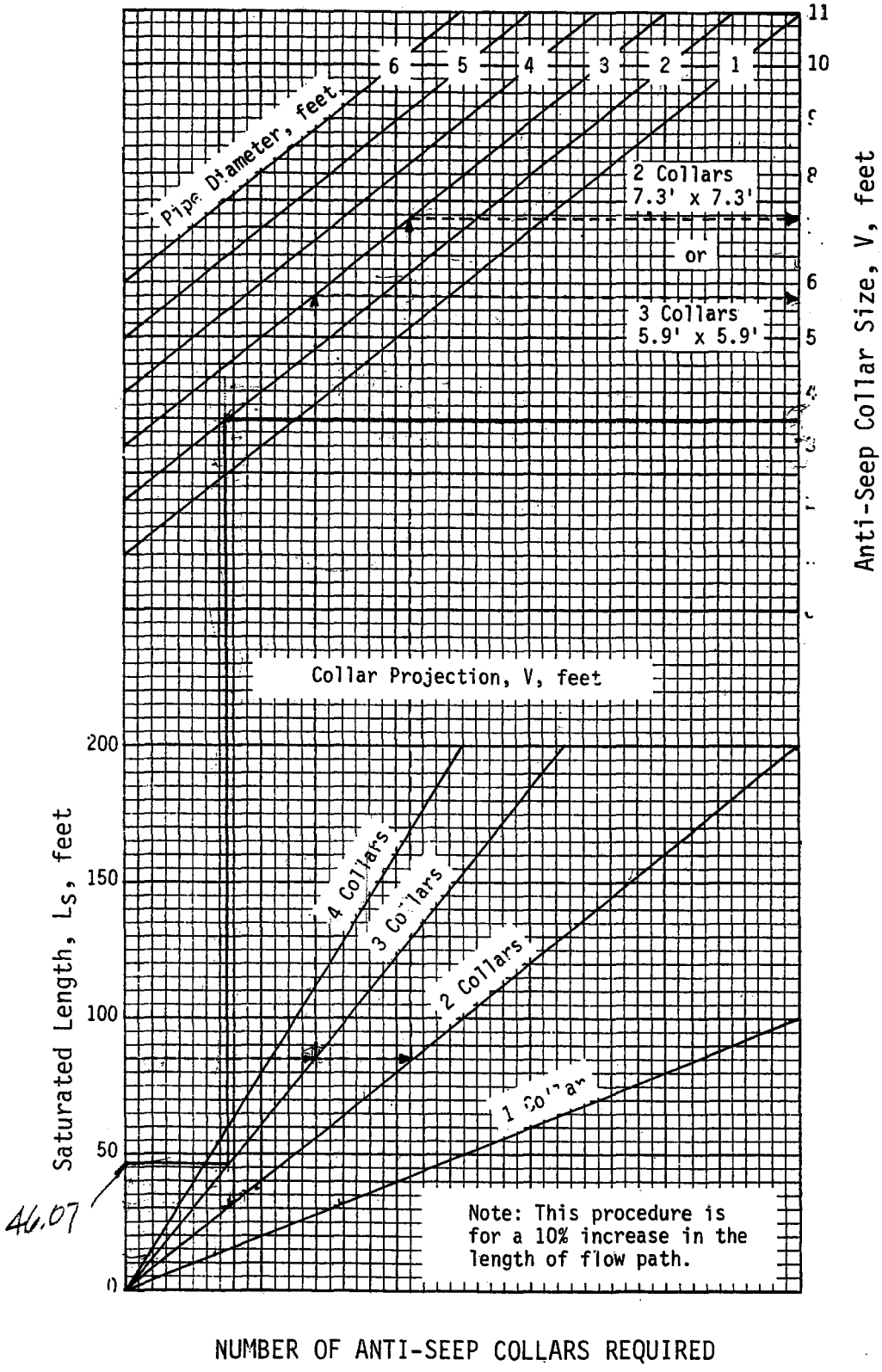
$S = 1.26\%$ $.0126\%$

$$L_s = 6.25(3+4)\left(1+\frac{0.0126}{0.25-0.0126}\right)$$

$L_s = 6.25 \times 7 \times 1.053$

$L_s = 46.07$

USE 3 ANTI-SEEP COLLARS 3'-6" X 3'-6"




Source: USDA-SCS

Plate 3.14-12

## Subcatchment DASB5: SED 5 DA

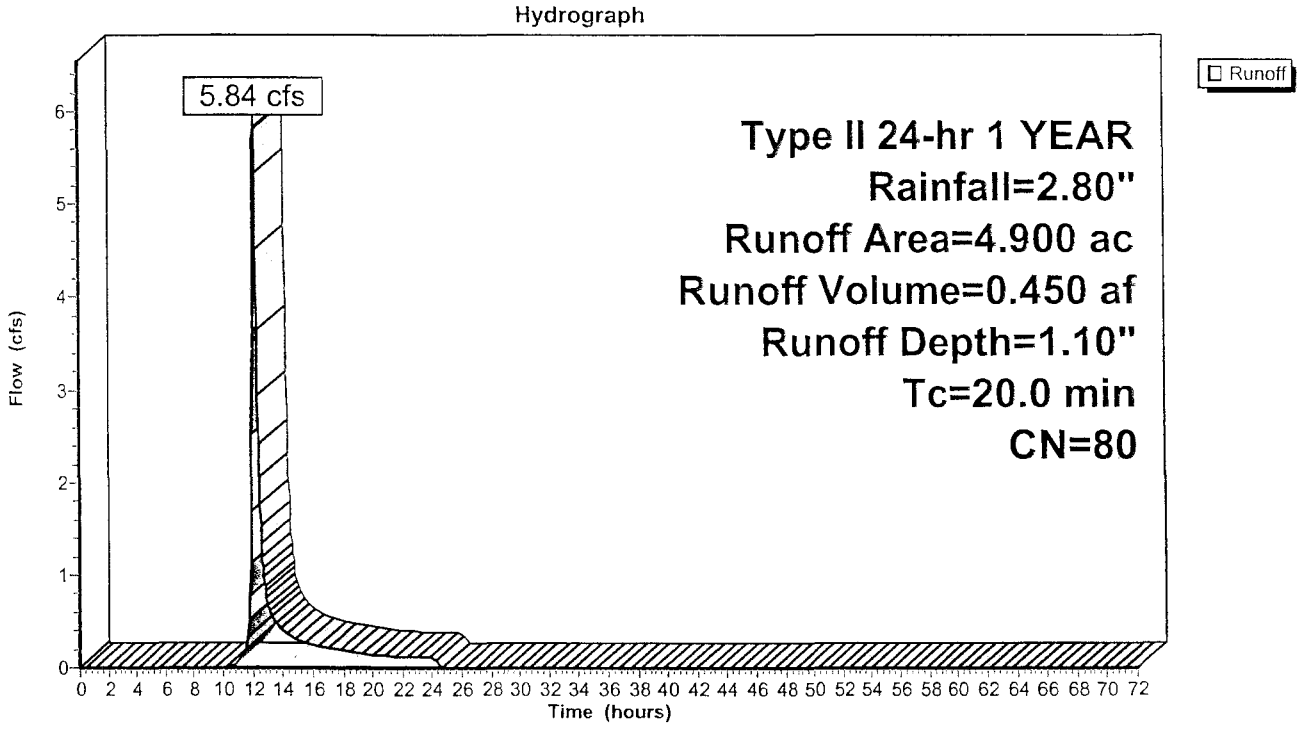
Runoff = 5.84 cfs @ 12.14 hrs, Volume= 0.450 af, Depth= 1.10"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 1 YEAR Rainfall=2.80"

| Area (ac) | CN | Description |
|---|---|---|
| 4.900 | 80 | 1/2 acre lots, 25% imp, HSG C |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 20.0 | | | | | **Direct Entry,** |

## Subcatchment DASB5: SED 5 DA



## Pond SB5: SED BASIN 5

| | | | | | |
|---|---|---|---|---|---|
| Inflow Area = | 4.900 ac, | Inflow Depth = | 1.10" | for | 1 YEAR event |
| Inflow = | 5.84 cfs @ | 12.14 hrs, | Volume= | 0.450 af | |
| Outflow = | 0.68 cfs @ | 13.03 hrs, | Volume= | 0.450 af, | Atten= 88%, Lag= 53.4 min |
| Primary = | 0.68 cfs @ | 13.03 hrs, | Volume= | 0.450 af | |

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Starting Elev= 70.84' Surf.Area= 2,997 sf Storage= 9,043 cf
Peak Elev= 73.28' @ 13.03 hrs Surf.Area= 4,445 sf Storage= 18,773 cf (9,730 cf above start)
Plug-Flow detention time= 747.8 min calculated for 0.242 af (54% of inflow)
Center-of-Mass det. time= 353.8 min ( 1,213.3 - 859.5 )

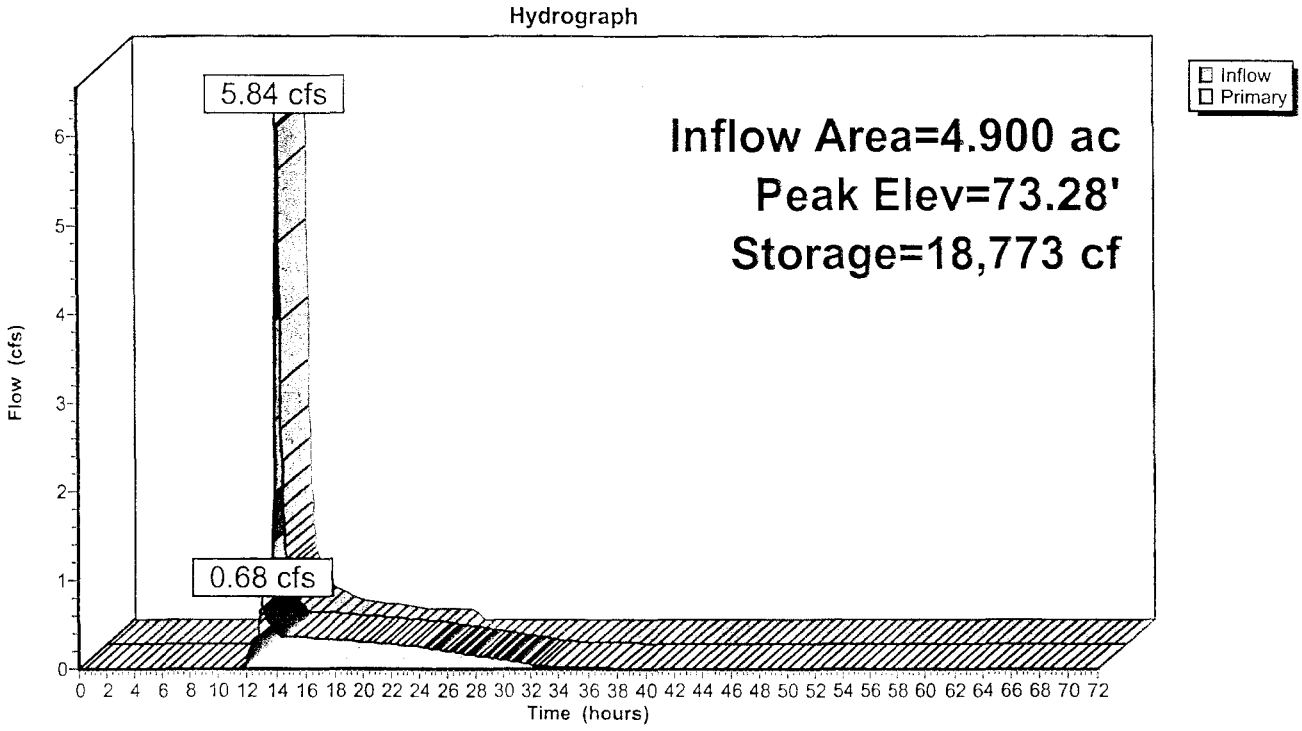
| # | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| 1 | 67.00' | 31,425 cf | **Custom Stage Data (Prismatic)** Listed below |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 67.00 | 1,300 | 0 | 0 |
| 70.00 | 2,500 | 5,700 | 5,700 |
| 75.00 | 5,460 | 19,900 | 25,600 |
| 76.00 | 6,190 | 5,825 | 31,425 |

| # | Routing | Invert | Outlet Devices |
|---|---|---|---|
| 1 | Primary | 66.00' | **24.0" x 64.0' long Culvert** RCP, square edge headwall, Ke= 0.500<br>Outlet Invert= 65.22' S= 0.0122 '/' n= 0.012 Cc= 0.900 |
| 2 | Device 1 | 70.84' | **3.0" Vert. Orifice/Grate** C= 0.600 |
| 3 | Device 1 | 73.25' | **48.0" Horiz. Orifice/Grate** Limited to weir flow C= 0.600 |

**Primary OutFlow** Max=0.62 cfs @ 13.03 hrs HW=73.28' (Free Discharge)
└**1=Culvert** (Passes 0.62 cfs of 37.92 cfs potential flow)
  ├**2=Orifice/Grate** (Orifice Controls 0.36 cfs @ 7.3 fps)
  └**3=Orifice/Grate** (Weir Controls 0.26 cfs @ 0.6 fps)

## Pond SB5: SED BASIN 5



## Stage-Discharge for Pond SB5: SED BASIN 5

| Elevation (feet) | Primary (cfs) | Elevation (feet) | Primary (cfs) |
|---|---|---|---|
| 67.00 | 0.00 | 72.30 | 0.27 |
| 67.10 | 0.00 | 72.40 | 0.28 |
| 67.20 | 0.00 | 72.50 | 0.29 |
| 67.30 | 0.00 | 72.60 | 0.30 |
| 67.40 | 0.00 | 72.70 | 0.31 |
| 67.50 | 0.00 | 72.80 | 0.32 |
| 67.60 | 0.00 | 72.90 | 0.33 |
| 67.70 | 0.00 | 73.00 | 0.34 |
| 67.80 | 0.00 | 73.10 | 0.35 |
| 67.90 | 0.00 | 73.20 | 0.35 |
| 68.00 | 0.00 | 73.30 | 0.82 |
| 68.10 | 0.00 | 73.40 | 2.76 |
| 68.20 | 0.00 | 73.50 | 5.51 |
| 68.30 | 0.00 | 73.60 | 8.89 |
| 68.40 | 0.00 | 73.70 | 12.80 |
| 68.50 | 0.00 | 73.80 | 17.16 |
| 68.60 | 0.00 | 73.90 | 21.94 |
| 68.70 | 0.00 | 74.00 | 27.10 |
| 68.80 | 0.00 | 74.10 | 32.62 |
| 68.90 | 0.00 | 74.20 | 38.47 |
| 69.00 | 0.00 | 74.30 | 40.87 |
| 69.10 | 0.00 | 74.40 | 41.15 |
| 69.20 | 0.00 | 74.50 | 41.43 |
| 69.30 | 0.00 | 74.60 | 41.70 |
| 69.40 | 0.00 | 74.70 | 41.97 |
| 69.50 | 0.00 | 74.80 | 42.25 |
| 69.60 | 0.00 | 74.90 | 42.52 |
| 69.70 | 0.00 | 75.00 | 42.78 |
| 69.80 | 0.00 | 75.10 | 43.05 |
| 69.90 | 0.00 | 75.20 | 43.32 |
| 70.00 | 0.00 | 75.30 | 43.58 |
| 70.10 | 0.00 | 75.40 | 43.84 |
| 70.20 | 0.00 | 75.50 | 44.10 |
| 70.30 | 0.00 | 75.60 | 44.36 |
| 70.40 | 0.00 | 75.70 | 44.62 |
| 70.50 | 0.00 | 75.80 | 44.87 |
| 70.60 | 0.00 | 75.90 | 45.13 |
| 70.70 | 0.00 | 76.00 | **45.38** |
| 70.80 | 0.00 | | |
| 70.90 | 0.01 | | |
| 71.00 | 0.05 | | |
| 71.10 | 0.09 | | |
| 71.20 | 0.11 | | |
| 71.30 | 0.14 | | |
| 71.40 | 0.16 | | |
| 71.50 | 0.17 | | |
| 71.60 | 0.19 | | |
| 71.70 | 0.20 | | |
| 71.80 | 0.22 | | |
| 71.90 | 0.23 | | |
| 72.00 | 0.24 | | |
| 72.10 | 0.25 | | |
| 72.20 | 0.26 | | |

## Subcatchment DASB5: SED 5 DA

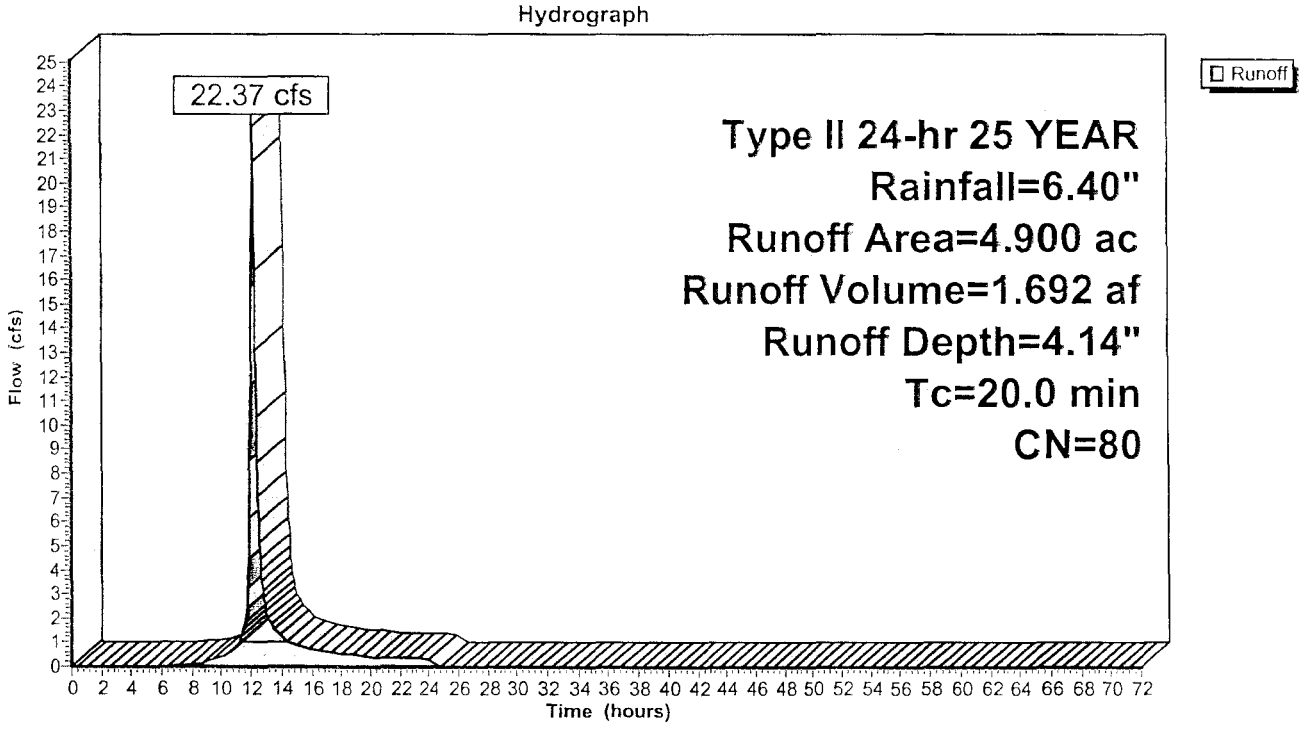
Runoff = 22.37 cfs @ 12.12 hrs, Volume= 1.692 af, Depth= 4.14"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 YEAR Rainfall=6.40"

| Area (ac) | CN | Description |
|---|---|---|
| 4.900 | 80 | 1/2 acre lots, 25% imp, HSG C |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 20.0 | | | | | **Direct Entry,** |

## Subcatchment DASB5: SED 5 DA



## Pond SB5: SED BASIN 5

| | | | | | |
|---|---|---|---|---|---|
| Inflow Area = | 4.900 ac, | Inflow Depth = 4.14" | for 25 YEAR event | | |
| Inflow = | 22.37 cfs @ | 12.12 hrs, Volume= | 1.692 af | | |
| Outflow = | 22.11 cfs @ | 12.15 hrs, Volume= | 1.691 af, | Atten= 1%, | Lag= 1.5 min |
| Primary = | 22.11 cfs @ | 12.15 hrs, Volume= | 1.691 af | | |

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Starting Elev= 70.84' Surf.Area= 2,997 sf Storage= 9,043 cf
Peak Elev= 73.90' @ 12.15 hrs Surf.Area= 4,810 sf Storage= 21,233 cf (12,190 cf above start)
Plug-Flow detention time= 241.7 min calculated for 1.483 af (88% of inflow)
Center-of-Mass det. time= 146.7 min ( 968.1 - 821.4 )

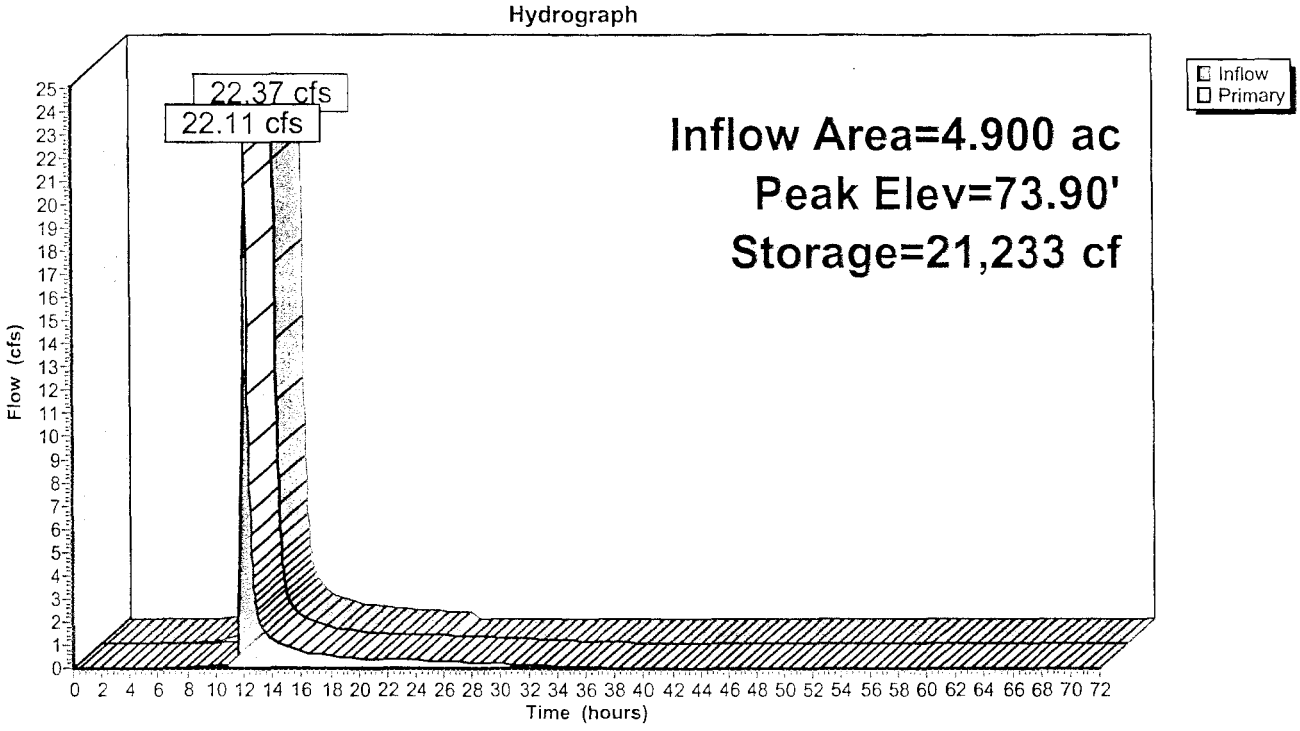
| # | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| 1 | 67.00' | 31,425 cf | **Custom Stage Data (Prismatic)** Listed below |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 67.00 | 1,300 | 0 | 0 |
| 70.00 | 2,500 | 5,700 | 5,700 |
| 75.00 | 5,460 | 19,900 | 25,600 |
| 76.00 | 6,190 | 5,825 | 31,425 |

| # | Routing | Invert | Outlet Devices |
|---|---|---|---|
| 1 | Primary | 66.00' | **24.0" x 64.0' long Culvert** RCP, square edge headwall, Ke= 0.500<br>Outlet Invert= 65.22' S= 0.0122 '/' n= 0.012 Cc= 0.900 |
| 2 | Device 1 | 70.84' | **3.0" Vert. Orifice/Grate** C= 0.600 |
| 3 | Device 1 | 73.25' | **48.0" Horiz. Orifice/Grate** Limited to weir flow C= 0.600 |

**Primary OutFlow** Max=22.03 cfs @ 12.15 hrs HW=73.90' (Free Discharge)
└**1=Culvert** (Passes 22.03 cfs of 39.74 cfs potential flow)
├**2=Orifice/Grate** (Orifice Controls 0.41 cfs @ 8.3 fps)
└**3=Orifice/Grate** (Weir Controls 21.62 cfs @ 2.6 fps)

## Pond SB5: SED BASIN 5



## Stage-Discharge for Pond SB5: SED BASIN 5

| Elevation (feet) | Primary (cfs) | Elevation (feet) | Primary (cfs) |
|---|---|---|---|
| 67.00 | 0.00 | 72.30 | 0.27 |
| 67.10 | 0.00 | 72.40 | 0.28 |
| 67.20 | 0.00 | 72.50 | 0.29 |
| 67.30 | 0.00 | 72.60 | 0.30 |
| 67.40 | 0.00 | 72.70 | 0.31 |
| 67.50 | 0.00 | 72.80 | 0.32 |
| 67.60 | 0.00 | 72.90 | 0.33 |
| 67.70 | 0.00 | 73.00 | 0.34 |
| 67.80 | 0.00 | 73.10 | 0.35 |
| 67.90 | 0.00 | 73.20 | 0.35 |
| 68.00 | 0.00 | 73.30 | 0.82 |
| 68.10 | 0.00 | 73.40 | 2.76 |
| 68.20 | 0.00 | 73.50 | 5.51 |
| 68.30 | 0.00 | 73.60 | 8.89 |
| 68.40 | 0.00 | 73.70 | 12.80 |
| 68.50 | 0.00 | 73.80 | 17.16 |
| 68.60 | 0.00 | 73.90 | 21.94 |
| 68.70 | 0.00 | 74.00 | 27.10 |
| 68.80 | 0.00 | 74.10 | 32.62 |
| 68.90 | 0.00 | 74.20 | 38.47 |
| 69.00 | 0.00 | 74.30 | 40.87 |
| 69.10 | 0.00 | 74.40 | 41.15 |
| 69.20 | 0.00 | 74.50 | 41.43 |
| 69.30 | 0.00 | 74.60 | 41.70 |
| 69.40 | 0.00 | 74.70 | 41.97 |
| 69.50 | 0.00 | 74.80 | 42.25 |
| 69.60 | 0.00 | 74.90 | 42.52 |
| 69.70 | 0.00 | 75.00 | 42.78 |
| 69.80 | 0.00 | 75.10 | 43.05 |
| 69.90 | 0.00 | 75.20 | 43.32 |
| 70.00 | 0.00 | 75.30 | 43.58 |
| 70.10 | 0.00 | 75.40 | 43.84 |
| 70.20 | 0.00 | 75.50 | 44.10 |
| 70.30 | 0.00 | 75.60 | 44.36 |
| 70.40 | 0.00 | 75.70 | 44.62 |
| 70.50 | 0.00 | 75.80 | 44.87 |
| 70.60 | 0.00 | 75.90 | 45.13 |
| 70.70 | 0.00 | 76.00 | **45.38** |
| 70.80 | 0.00 | | |
| 70.90 | 0.01 | | |
| 71.00 | 0.05 | | |
| 71.10 | 0.09 | | |
| 71.20 | 0.11 | | |
| 71.30 | 0.14 | | |
| 71.40 | 0.16 | | |
| 71.50 | 0.17 | | |
| 71.60 | 0.19 | | |
| 71.70 | 0.20 | | |
| 71.80 | 0.22 | | |
| 71.90 | 0.23 | | |
| 72.00 | 0.24 | | |
| 72.10 | 0.25 | | |
| 72.20 | 0.26 | | |

# CHANNEL ADEQUACY CALCULATIONS

# SUMMARY

This section details channel adequacy for channels/reaches within this subdivision. An exhibit has been prepared showing the locations where sections were taken and is located at the back of this section. Upon field observation all channels were found to be similar in characteristic and a n-value determination form has been provided following this summary. In all cases the post-developed velocities did not exceed the allowable 2.5 fps.

# N value Determination

**Project:** Stonehouse Glen Phase 2 **Project No.** 2002261-500.04

**Date:** 3/16/2005 **Prepared By:** AJR

**Date Of Field Survey** 3/4/2005
**Crew:** wp/bw

**Conditions Noted:**

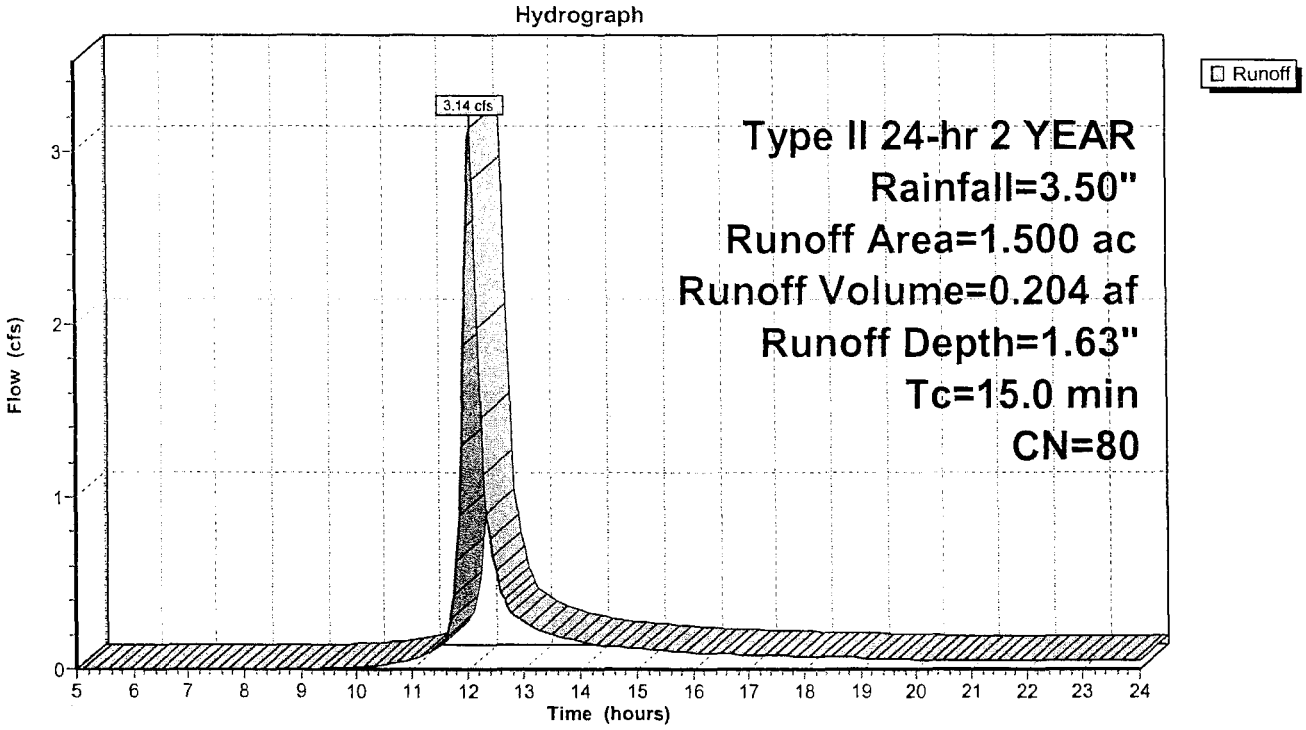
**Channel 1**
section a

| | Reference | n | Description |
|---|---|---|---|
| Basic n Value | Table 5-16 | 0.02 | Channel cut into earth |
| Surface irregularity | Table 5-17 | 0.01 | Moderate |
| Shape variations | Table 5-18 | 0 | Occasional |
| Obstructions | Table 5-19 | 0.01 | minor |
| Vegetation | Table 5-20 | 0.015 | Dense Growth of Grasses and tree seedlings along outside edge of flow pattern. |
| Sinuosity | Table 5-21 | 0 | Ratio 156/150 = 1.04 Minor |
| | Total | 0.055 | |

Permissible Velociy Based upon Field Observation 2.5'/sec sandy loam

# CHANNEL 1
# REACH 13

## Subcatchment 0+00: DA AT 0+00



LandMark Design Group Inc.
4029 Ironbound Road Suite 100
Williamsburg, Va. 23188
757-253-2975
Mon Dec 27 11:07:57 2004

PROJECT: 4.04 Stonehouse Glen Sec.II with curb\dwg\SURFACE\SHGLENPH2SURFACE.pro

---

Record: 121491 Name:
Layer: EX-DA Color: 11 View: Profile Linetype: SOLID

| CP# | Sta | Elev | Attributes |
|---|---|---|---|
| 1 | -25.0000 | 74.6445 | |
| 2 | -11.5631 | 70.5606 | |
| 3 | 1.9231 | 66.7192 | |
| 4 | 10.3059 | 66.0435 | |
| 5 | 15.8717 | 65.7247 | |
| 6 | 25.0000 | 68.6190 | |

# 0+00
## Worksheet for Irregular Channel

| Project Description | |
|---|---|
| Project File | k:\l&m\projects\2002261-504.04 stonehouse glen sec.ii with curb\engineering\reach13.fm2 |
| Worksheet | OUTFALL AT 13 |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Water Elevation |

| Input Data | | |
|---|---|---|
| Channel Slope | 0.118000 | ft/ft |

Elevation range: 65.72 ft to 74.60 ft.

| Station (ft) | Elevation (ft) | Start Station | End Station | Roughness |
|---|---|---|---|---|
| -25.00 | 74.60 | -25.00 | 25.00 | 0.055 |
| -11.00 | 70.56 | | | |
| 1.92 | 66.72 | | | |
| 10.31 | 66.04 | | | |
| 15.87 | 65.72 | | | |
| 25.00 | 68.62 | | | |

| Discharge | 3.14 | cfs |
|---|---|---|

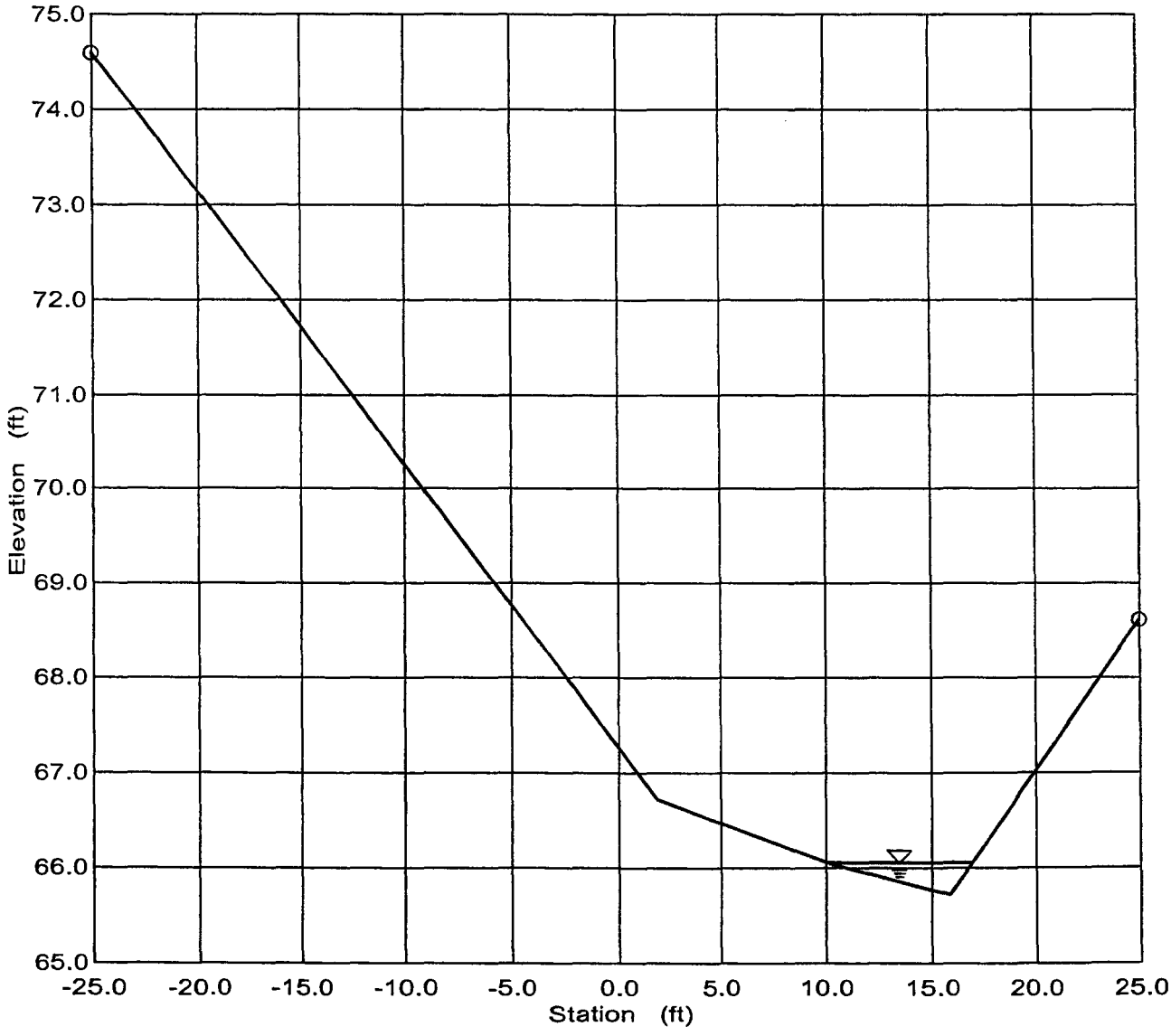
| Results | | |
|---|---|---|
| Wtd. Mannings Coefficient | 0.055 | |
| Water Surface Elevation | 66.05 | ft |
| Flow Area | 1.12 | ft² |
| Wetted Perimeter | 6.80 | ft |
| Top Width | 6.74 | ft |
| Height | 0.33 | ft |
| Critical Depth | 66.08 | ft |
| Critical Slope | 0.078743 | ft/ft |
| Velocity | 2.79 | ft/s |
| Velocity Head | 0.12 | ft |
| Specific Energy | 66.17 | ft |
| Froude Number | 1.21 | |

Flow is supercritical.

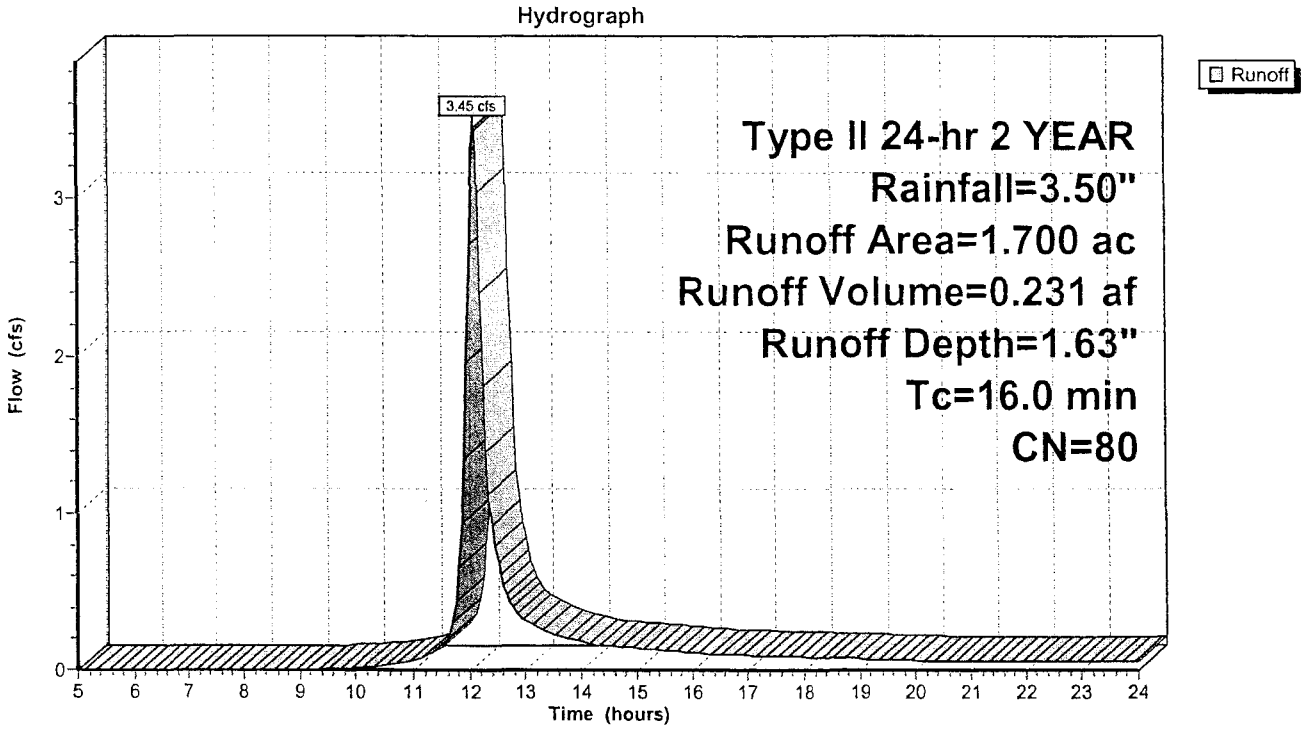
# 0+00
## Cross Section for Irregular Channel

| Project Description | |
|---|---|
| Project File | k:\l&m\projects\2002261-504.04 stonehouse glen sec.ii with curb\engineering\reach13.fm2 |
| Worksheet | OUTFALL AT 13 |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Water Elevation |

| Section Data | | |
|---|---|---|
| Wtd. Mannings Coefficient | 0.055 | |
| Channel Slope | 0.118000 | ft/ft |
| Water Surface Elevation | 66.05 | ft |
| Discharge | 3.14 | cfs |



## Subcatchment 0+50: DA AT 0+50



LandMark Design Group Inc.
4029 Ironbound Road Suite 100
Williamsburg, Va. 23188
757-253-2975
Mon Dec 27 11:38:37 2004

PROJECT: 4.04 Stonehouse Glen Sec.II with curb\dwg\SURFACE\SHGLENPH2SURFACE.pro

---

Record: 121497 Name:
Layer: EX-DA Color: 11 View: Profile Linetype: SOLID

| CP# | Sta | Elev | Attributes |
|---|---|---|---|
| 1 | 0.0000 | 66.9198 | |
| 2 | 15.8836 | 61.4877 | |
| 3 | 18.0643 | 60.7226 | |
| 4 | 18.8960 | 60.6480 | |
| 5 | 31.9817 | 59.1293 | |
| 6 | 46.2017 | 64.8085 | |
| 7 | 50.0000 | 66.4198 | |

# 0+50
## Worksheet for Irregular Channel

| Project Description | |
|---|---|
| Project File | k:\l&m\projects\2002261-504.04 stonehouse glen sec.ii with curb\engineering\reach13.fm2 |
| Worksheet | 1+00 |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Water Elevation |

| Input Data | | |
|---|---|---|
| Channel Slope | 0.140000 | ft/ft |

Elevation range: 59.10 ft to 66.90 ft.

| Station (ft) | Elevation (ft) | Start Station | End Station | Roughness |
|---|---|---|---|---|
| 0.00 | 66.90 | 0.00 | 50.00 | 0.055 |
| 15.90 | 61.50 | | | |
| 18.10 | 60.70 | | | |
| 18.90 | 60.60 | | | |
| 32.00 | 59.10 | | | |
| 46.20 | 64.80 | | | |
| 50.00 | 66.40 | | | |

| Discharge | 3.45 | cfs |
|---|---|---|

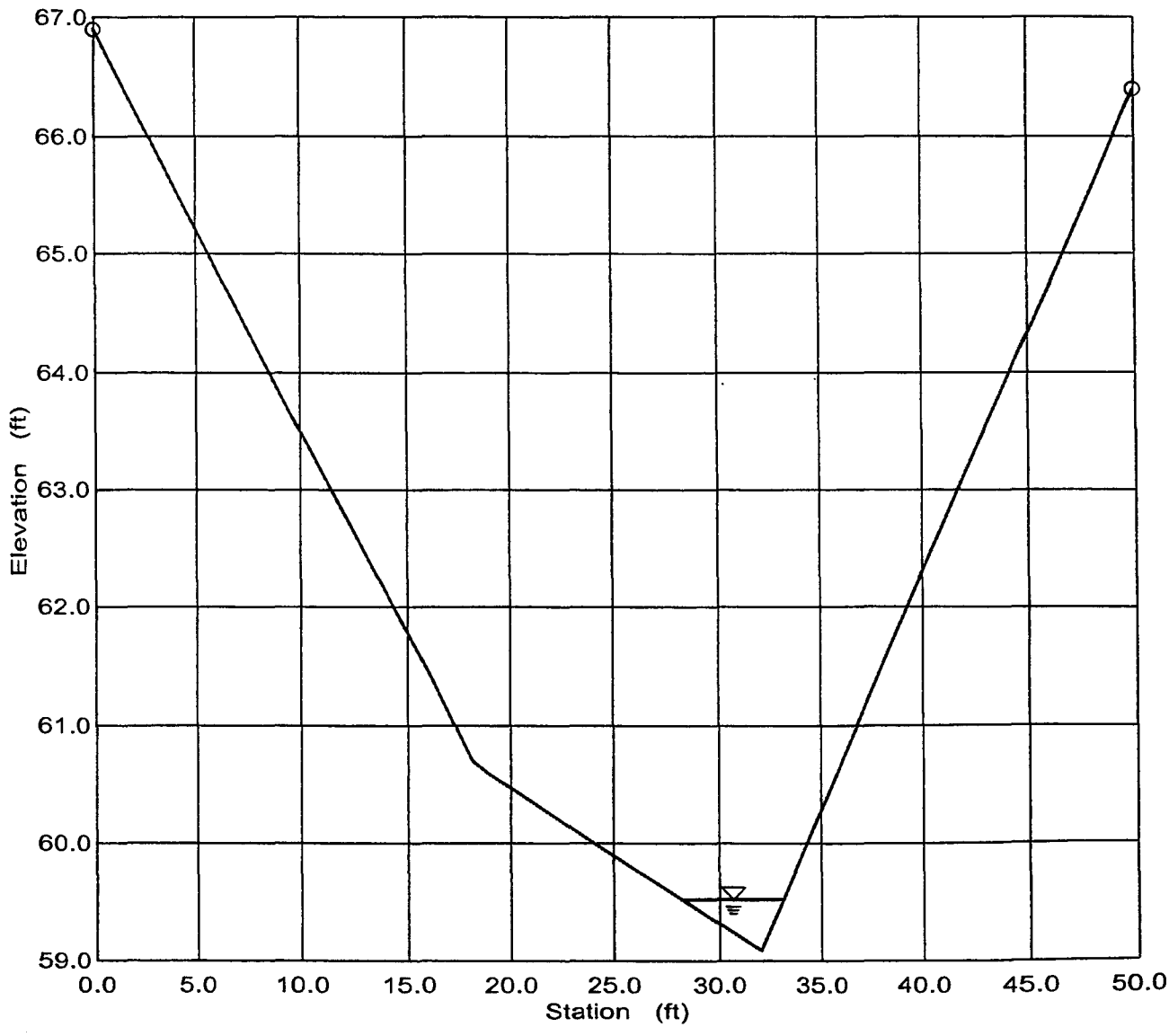
| Results | | |
|---|---|---|
| Wtd. Mannings Coefficient | 0.055 | |
| Water Surface Elevation | 59.52 | ft |
| Flow Area | 0.98 | $ft^2$ |
| Wetted Perimeter | 4.80 | ft |
| Top Width | 4.70 | ft |
| Height | 0.42 | ft |
| Critical Depth | 59.57 | ft |
| Critical Slope | 0.073445 | ft/ft |
| Velocity | 3.51 | ft/s |
| Velocity Head | 0.19 | ft |
| Specific Energy | 59.71 | ft |
| Froude Number | 1.35 | |
| Flow is supercritical. | | |

0+50

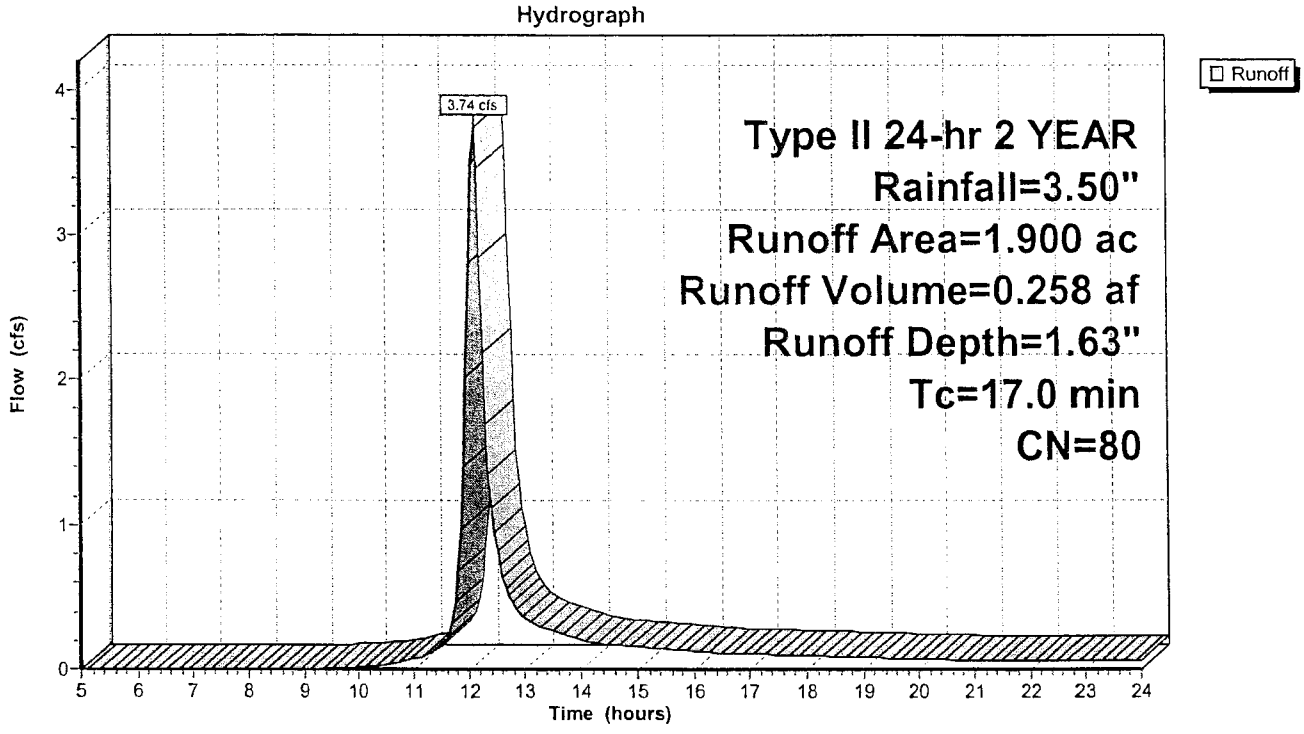
Cross Section for Irregular Channel

| Project Description | |
|---|---|
| Project File | k:\l&m\projects\2002261-504.04 stonehouse glen sec.ii with curb\engineering\reach13.fm2 |
| Worksheet | 1+00 |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Water Elevation |

| Section Data | | |
|---|---|---|
| Wtd. Mannings Coefficient | 0.055 | |
| Channel Slope | 0.140000 | ft/ft |
| Water Surface Elevation | 59.52 | ft |
| Discharge | 3.45 | cfs |



## Subcatchment 1+00: (new Subcat)



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4029 Ironbound Road Suite 100
Williamsburg, Va. 23188
757-253-2975
Mon Dec 27 11:22:45 2004

PROJECT: 4.04 Stonehouse Glen Sec.II with curb\dwg\SURFACE\SHGLENPH2SURFACE.pro

---

Record: 121494 Name:
Layer: EX-DA Color: 11 View: Profile Linetype: SOLID

| CP# | Sta | Elev | Attributes |
|---|---|---|---|
| 1 | 0.0000 | 56.5259 | |
| 2 | 23.3979 | 50.0559 | |
| 3 | 25.9754 | 49.3533 | |
| 4 | 31.3180 | 52.0327 | |
| 5 | 50.0000 | 61.0393 | |

# 1+00
## Worksheet for Irregular Channel

| Project Description | |
|---|---|
| Project File | k:\l&m\projects\2002261-504.04 stonehouse glen sec.ii with curb\engineering\reach13.fm2 |
| Worksheet | OUTFALL @ 1+00 |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Water Elevation |

| Input Data | | |
|---|---|---|
| Channel Slope | 0.250000 | ft/ft |

Elevation range: 49.35 ft to 61.04 ft.

| Station (ft) | Elevation (ft) | Start Station | End Station | Roughness |
|---|---|---|---|---|
| 0.00 | 56.52 | 0.00 | 50.00 | 0.055 |
| 23.40 | 50.06 | | | |
| 25.97 | 49.35 | | | |
| 31.32 | 52.03 | | | |
| 50.00 | 61.04 | | | |

| Discharge | 3.74 | cfs |
|---|---|---|

| Results | | |
|---|---|---|
| Wtd. Mannings Coefficient | 0.055 | |
| Water Surface Elevation | 49.86 | ft |
| Flow Area | 0.72 | ft² |
| Wetted Perimeter | 3.04 | ft |
| Top Width | 2.85 | ft |
| Height | 0.51 | ft |
| Critical Depth | 49.99 | ft |
| Critical Slope | 0.070078 | ft/ft |
| Velocity | 5.18 | ft/s |
| Velocity Head | 0.42 | ft |
| Specific Energy | 50.27 | ft |
| Froude Number | 1.82 | |

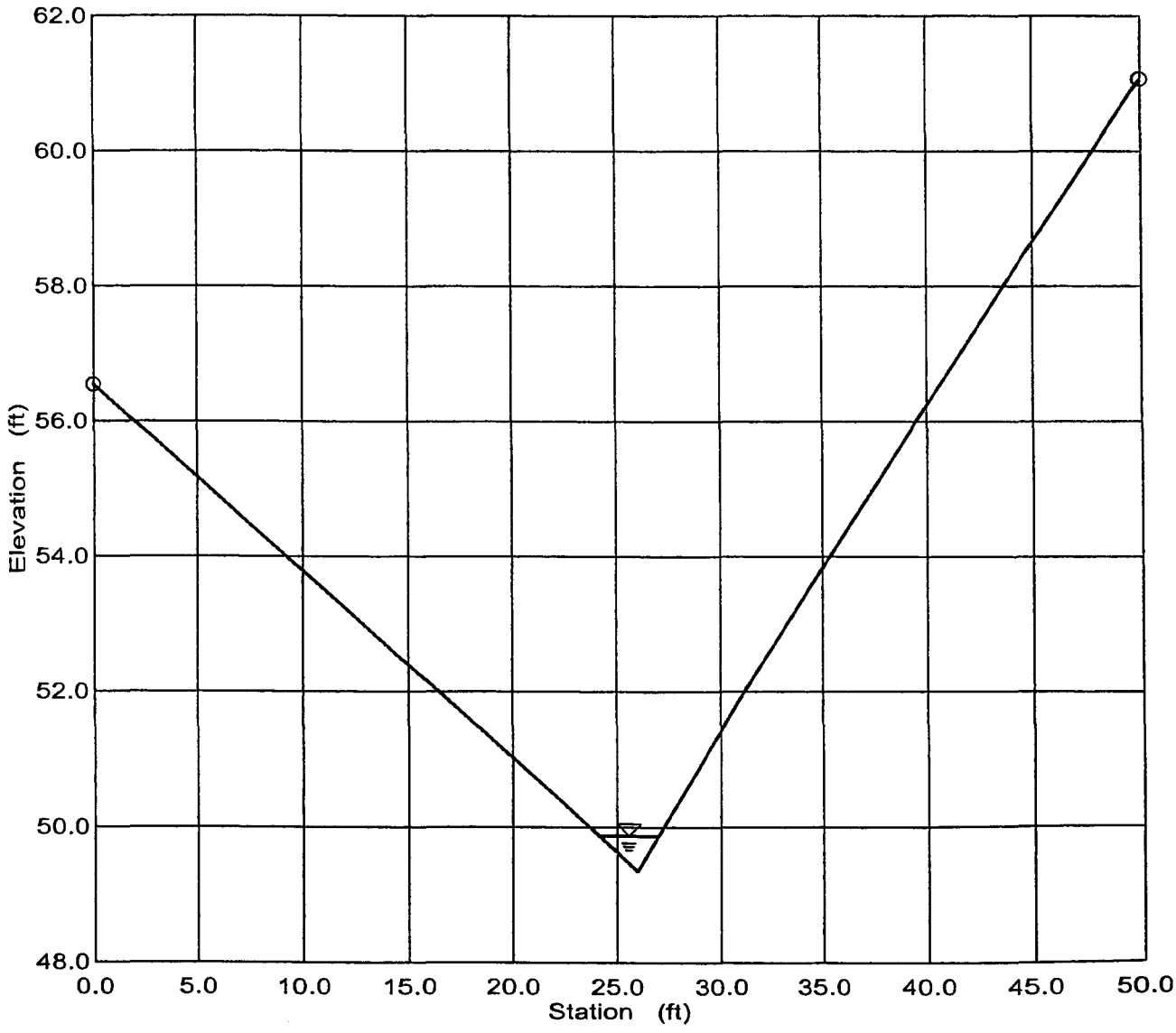
Flow is supercritical.

1+00

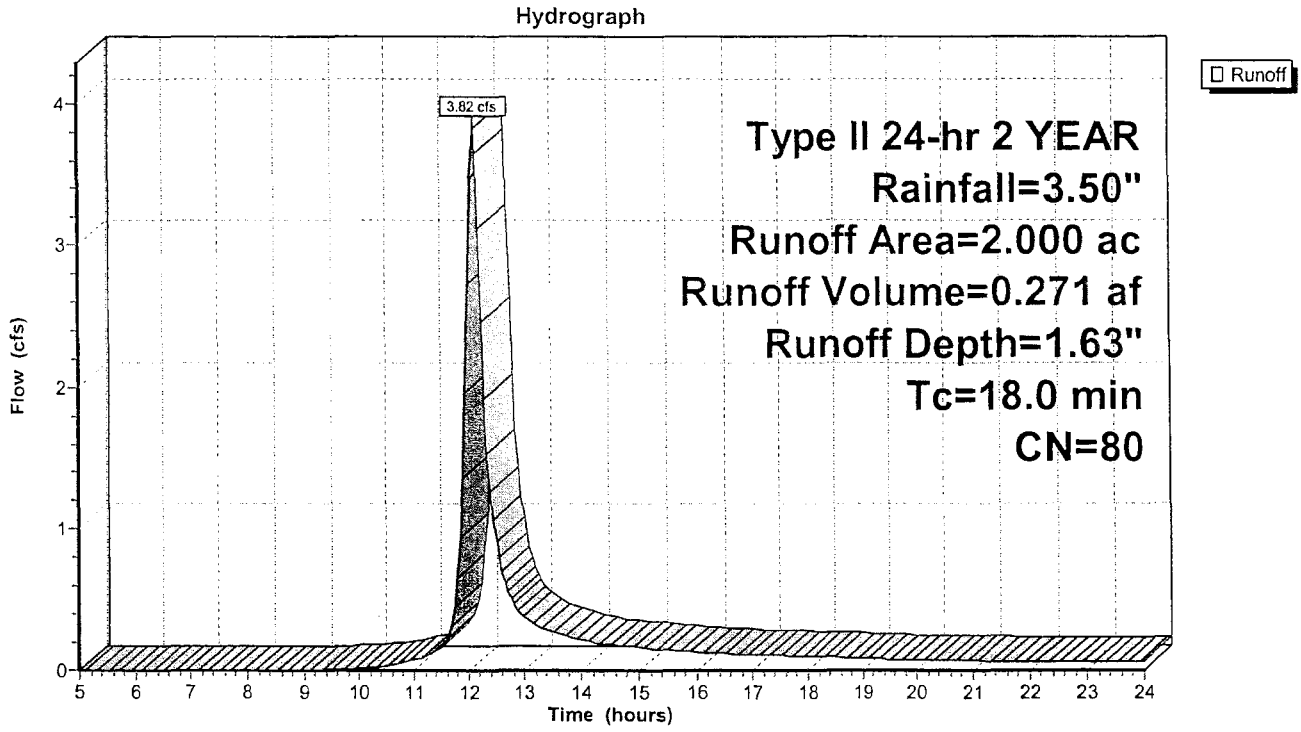
Cross Section for Irregular Channel

| Project Description | |
|---|---|
| Project File | k:\l&m\projects\2002261-504.04 stonehouse glen sec.ii with curb\engineering\reach13.fm2 |
| Worksheet | OUTFALL @ 1+00 |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Water Elevation |

| Section Data | | |
|---|---|---|
| Wtd. Mannings Coefficient | 0.055 | |
| Channel Slope | 0.250000 | ft/ft |
| Water Surface Elevation | 49.86 | ft |
| Discharge | 3.74 | cfs |



## Subcatchment 1+25: DA AT 1+25



# 1+25
## Worksheet for Irregular Channel

| Project Description | |
|---|---|
| Project File | k:\l&m\projects\2002261-504.04 stonehouse glen sec.ii with curb\engineering\reach13.fm2 |
| Worksheet | 1+25 |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Water Elevation |

| Input Data | | |
|---|---|---|
| Channel Slope | 0.060000 | ft/ft |

Elevation range: 47.25 ft to 48.00 ft.

| Station (ft) | Elevation (ft) | Start Station | End Station | Roughness |
|---|---|---|---|---|
| -8.00 | 48.00 | -8.00 | 7.50 | 0.055 |
| 0.00 | 47.25 | | | |
| 7.50 | 48.00 | | | |

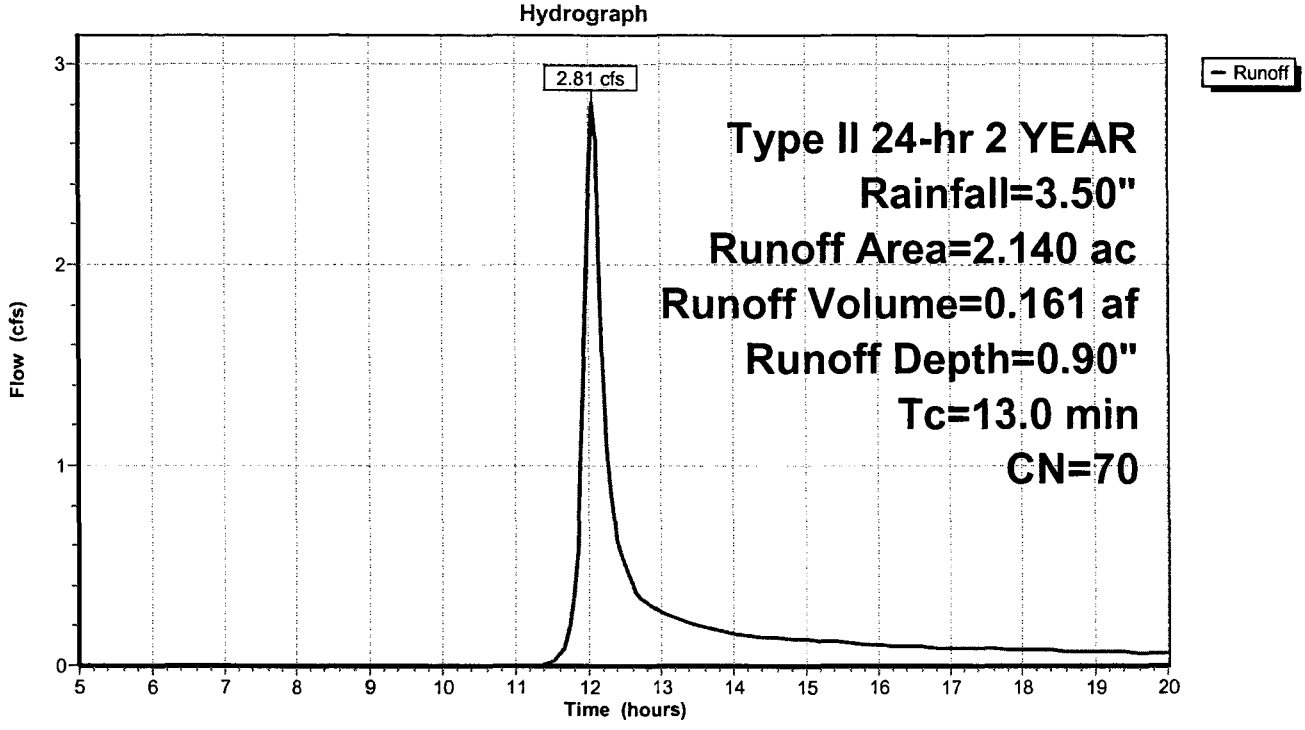
| | | |
|---|---|---|
| Discharge | 3.82 | cfs |

| Results | | |
|---|---|---|
| Wtd. Mannings Coefficient | 0.055 | |
| Water Surface Elevation | 47.65 | ft |
| Flow Area | 1.68 | ft² |
| Wetted Perimeter | 8.38 | ft |
| Top Width | 8.34 | ft |
| Height | 0.40 | ft |
| Critical Depth | 47.64 | ft |
| Critical Slope | 0.076797 | ft/ft |
| Velocity | 2.27 | ft/s |
| Velocity Head | 0.08 | ft |
| Specific Energy | 47.73 | ft |
| Froude Number | 0.89 | |

Flow is subcritical.

# CHANNEL 2
# REACH BCD

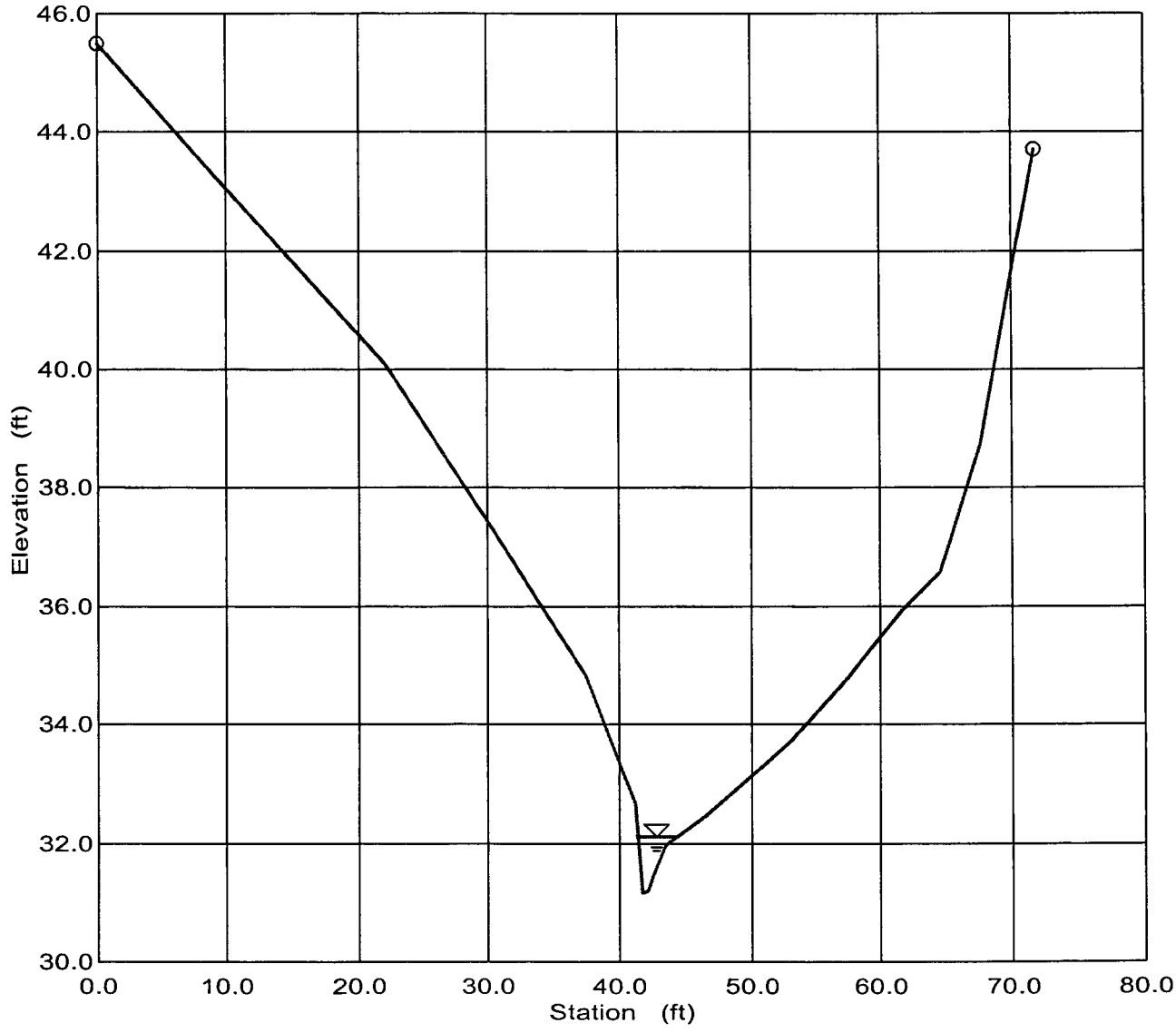
## Subcatchment 2S: DA TO SECTION B



Section B PRE
Cross Section for Irregular Channel

| Project Description | |
|---|---|
| Project File | c:\haestad\fmw\shg2.fm2 |
| Worksheet | SECTION B |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Water Elevation |

| Section Data | | |
|---|---|---|
| Wtd. Mannings Coefficient | 0.055 | |
| Channel Slope | 0.025700 | ft/ft |
| Water Surface Elevation | 32.10 | ft |
| Discharge | 2.81 | cfs |



# CHANNEL 2 STA 0+60 PRE
## Worksheet for Irregular Channel

| Project Description | |
|---|---|
| Project File | c:\haestad\fmw\shg2.fm2 |
| Worksheet | SECTION B |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Water Elevation |

| Input Data | | |
|---|---|---|
| Channel Slope | 0.025700 | ft/ft |

Elevation range: 31.15 ft to 45.48 ft.

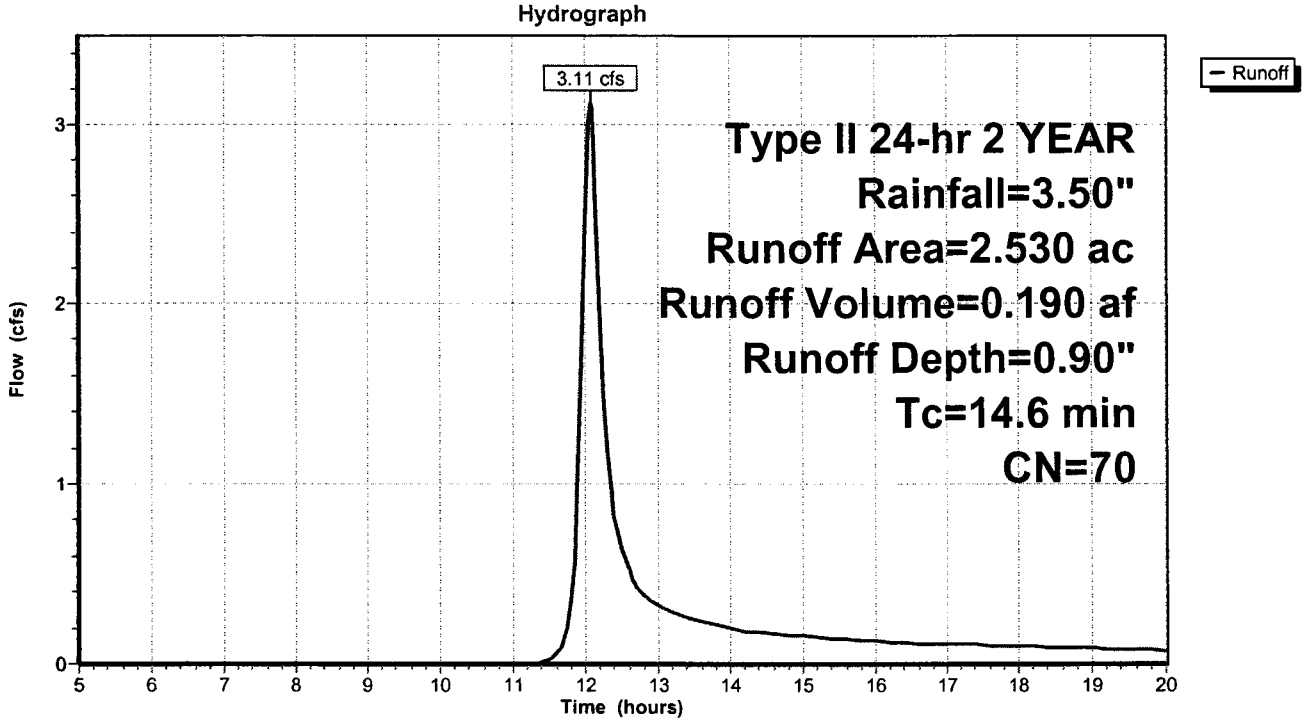
| Station (ft) | Elevation (ft) | Start Station | End Station | Roughness |
|---|---|---|---|---|
| 0.00 | 45.48 | 0.00 | 71.74 | 0.055 |
| 11.33 | 42.74 | | | |
| 22.06 | 40.10 | | | |
| 30.21 | 37.35 | | | |
| 37.46 | 34.83 | | | |
| 41.14 | 32.68 | | | |
| 41.69 | 31.15 | | | |
| 42.16 | 31.17 | | | |
| 42.53 | 31.44 | | | |
| 43.49 | 31.97 | | | |
| 46.58 | 32.46 | | | |
| 53.01 | 33.72 | | | |
| 57.56 | 34.80 | | | |
| 61.61 | 35.89 | | | |
| 64.49 | 36.56 | | | |
| 67.56 | 38.74 | | | |
| 71.74 | 43.70 | | | |

| Discharge | 2.81 | cfs |
|---|---|---|

| Results | | |
|---|---|---|
| Wtd. Mannings Coefficient | 0.055 | |
| Water Surface Elevation | 32.10 | ft |
| Flow Area | 1.32 | ft² |
| Wetted Perimeter | 3.84 | ft |
| Top Width | 2.94 | ft |
| Height | 0.95 | ft |
| Critical Depth | 31.85 | ft |
| Critical Slope | 0.090084 | ft/ft |
| Velocity | 2.13 | ft/s |
| Velocity Head | 0.07 | ft |
| Specific Energy | 32.17 | ft |
| Froude Number | 0.56 | |

Flow is subcritical.

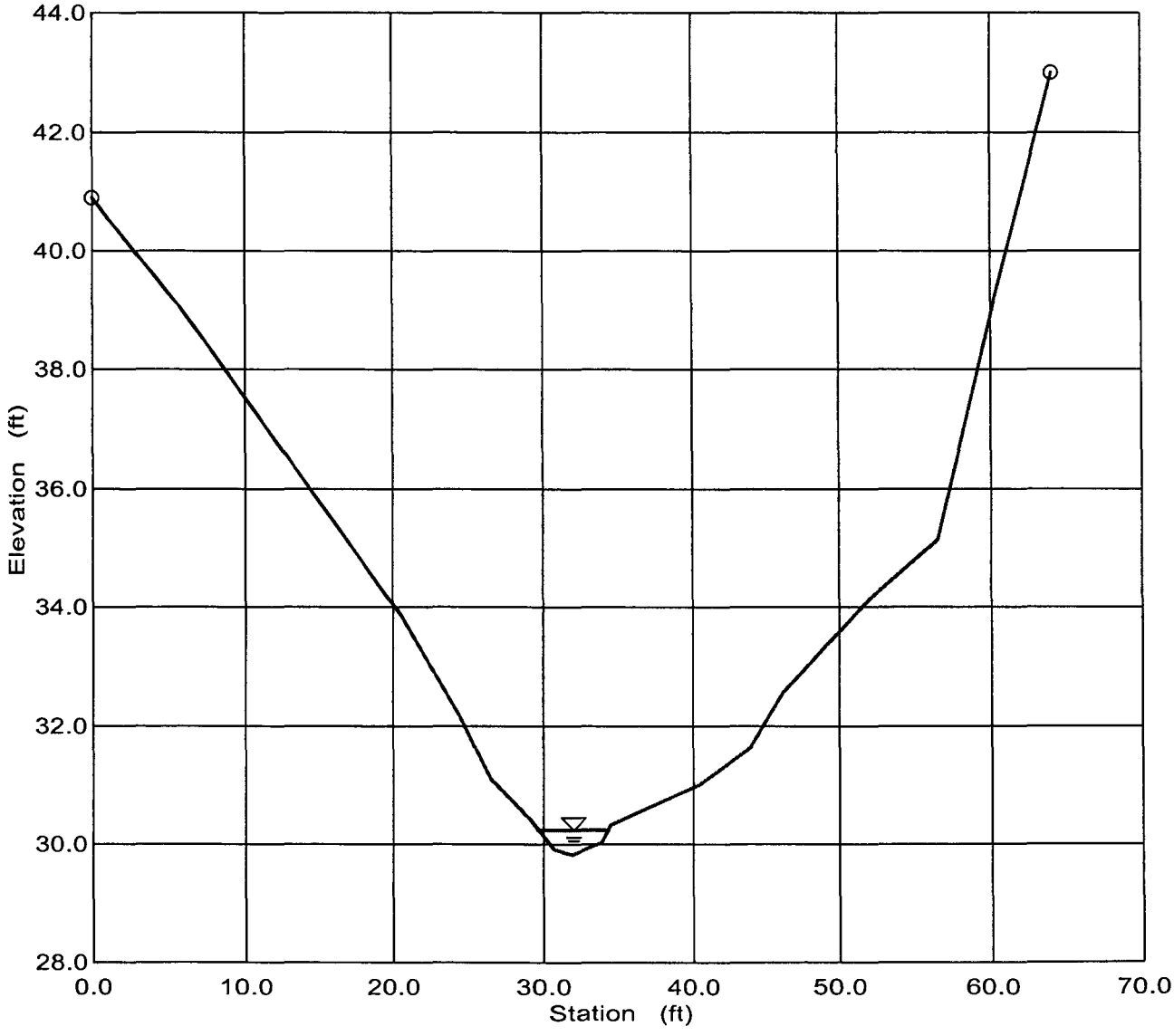
## Subcatchment 3S: DA TO SECTION C



# Section C PRE
## Cross Section for Irregular Channel

| Project Description | |
|---|---|
| Project File | c:\haestad\fmw\shg2.fm2 |
| Worksheet | SECTION C |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Water Elevation |

| Section Data | | |
|---|---|---|
| Wtd. Mannings Coefficient | 0.055 | |
| Channel Slope | 0.043400 | ft/ft |
| Water Surface Elevation | 30.25 | ft |
| Discharge | 3.11 | cfs |



# CHANNEL 2 STA 1+13 PRE
## Worksheet for Irregular Channel

| Project Description | |
|---|---|
| Project File | c:\haestad\fmw\shg2.fm2 |
| Worksheet | SECTION C |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Water Elevation |

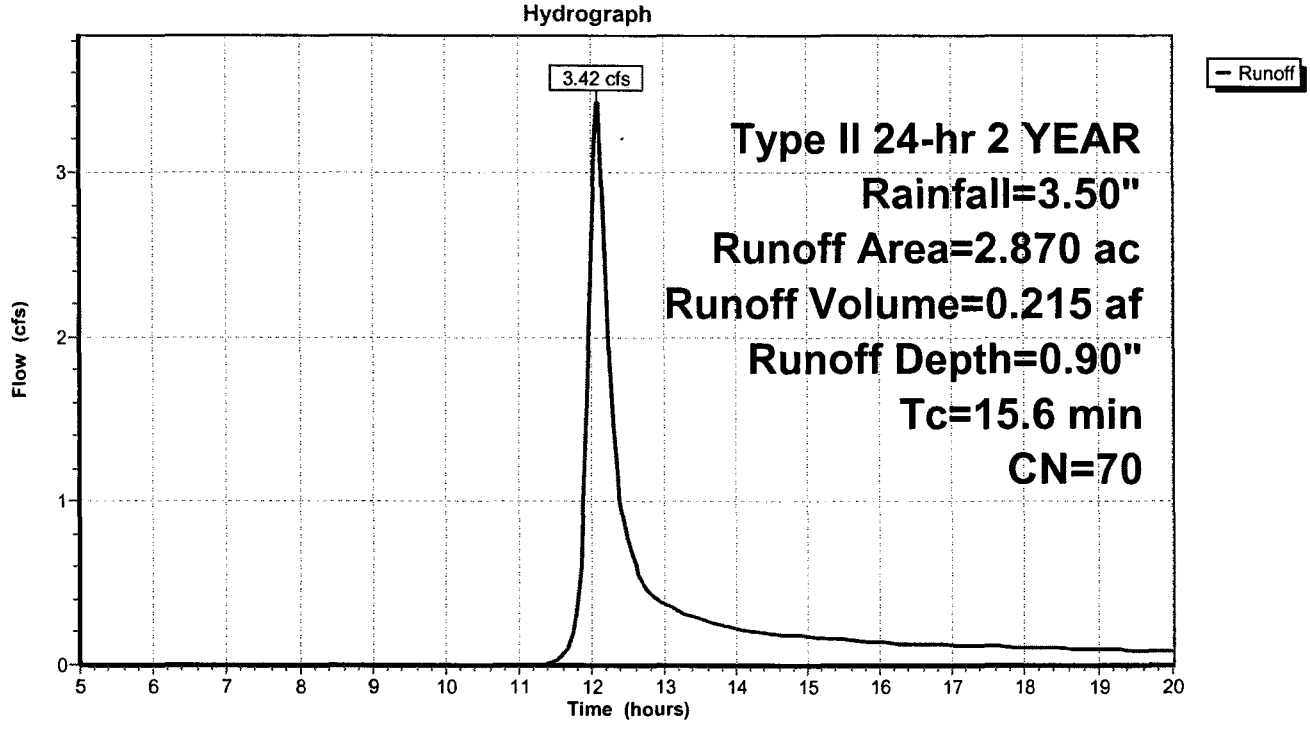
| Input Data | | |
|---|---|---|
| Channel Slope | 0.043400 | ft/ft |

Elevation range: 29.81 ft to 43.00 ft.

| Station (ft) | Elevation (ft) | Start Station | End Station | Roughness |
|---|---|---|---|---|
| 0.00 | 40.89 | 0.00 | 64.06 | 0.055 |
| 5.55 | 39.15 | | | |
| 13.57 | 36.28 | | | |
| 20.56 | 33.85 | | | |
| 24.60 | 32.14 | | | |
| 26.50 | 31.10 | | | |
| 29.12 | 30.42 | | | |
| 30.63 | 29.92 | | | |
| 31.82 | 29.81 | | | |
| 33.82 | 30.04 | | | |
| 34.43 | 30.31 | | | |
| 40.56 | 31.00 | | | |
| 44.03 | 31.63 | | | |
| 46.30 | 32.55 | | | |
| 51.94 | 34.10 | | | |
| 56.46 | 35.14 | | | |
| 60.13 | 39.05 | | | |
| 64.06 | 43.00 | | | |
| Discharge | 3.11 | cfs | | |

| Results | | |
|---|---|---|
| Wtd. Mannings Coefficient | 0.055 | |
| Water Surface Elevation | 30.25 | ft |
| Flow Area | 1.31 | $ft^2$ |
| Wetted Perimeter | 4.76 | ft |
| Top Width | 4.64 | ft |
| Height | 0.44 | ft |
| Critical Depth | 30.20 | ft |
| Critical Slope | 0.072089 | ft/ft |
| Velocity | 2.38 | ft/s |
| Velocity Head | 0.09 | ft |
| Specific Energy | 30.33 | ft |
| Froude Number | 0.79 | |
| Flow is subcritical. | | |

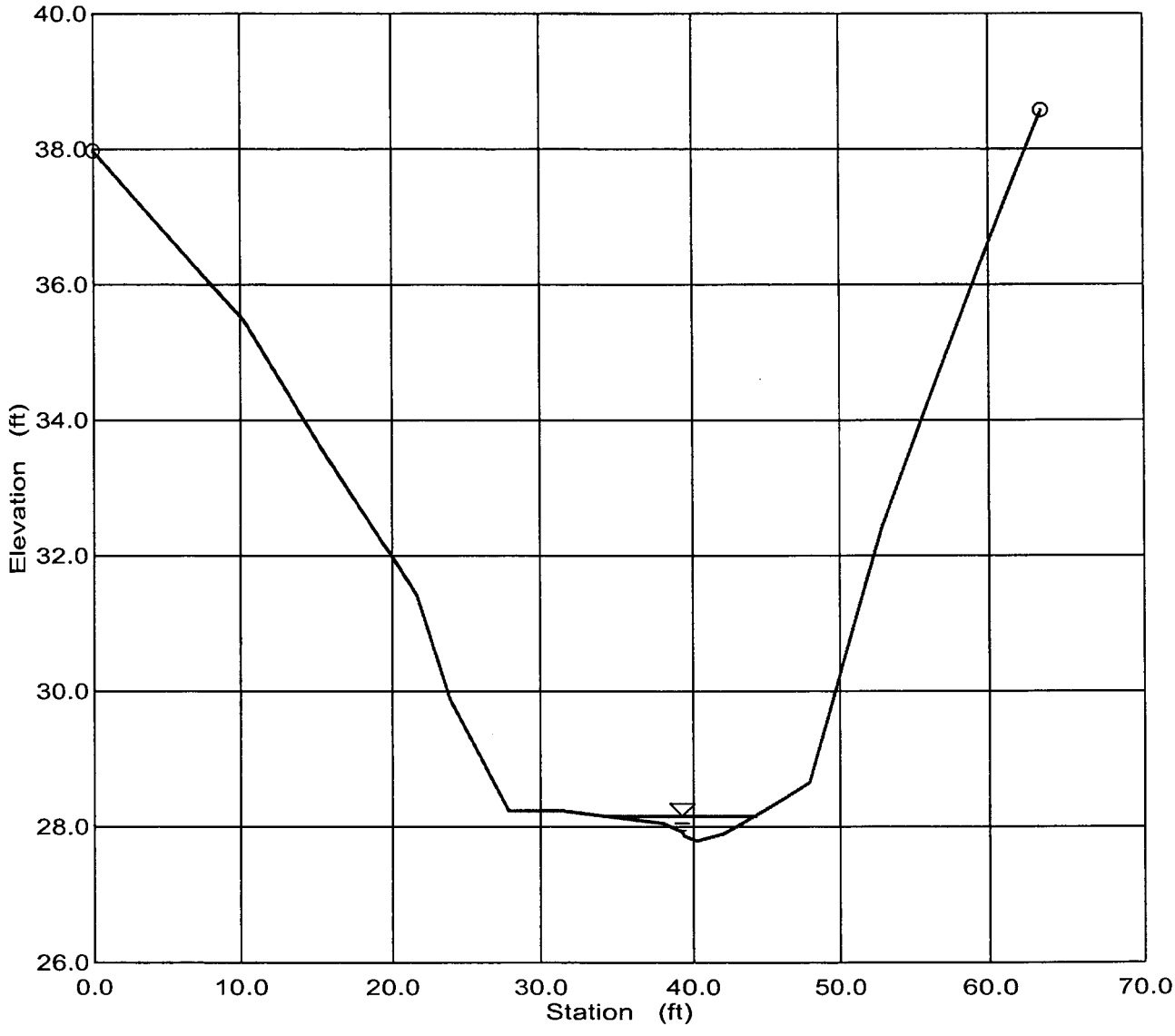
## Subcatchment 4S: DA TO SECTION D



Cross Section D PRE
Cross Section for Irregular Channel

| Project Description | |
|---|---|
| Project File | c:\haestad\fmw\shg2.fm2 |
| Worksheet | SECTION D |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Water Elevation |

| Section Data | | |
|---|---|---|
| Wtd. Mannings Coefficient | 0.040 | |
| Channel Slope | 0.040000 | ft/ft |
| Water Surface Elevation | 28.15 | ft |
| Discharge | 3.42 | cfs |



# CHANNEL 2 STA 1+50 PRE
## Worksheet for Irregular Channel

| Project Description | |
|---|---|
| Project File | c:\haestad\fmw\shg2.fm2 |
| Worksheet | SECTION D |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Water Elevation |

| Input Data | | |
|---|---|---|
| Channel Slope | 0.040000 | ft/ft |

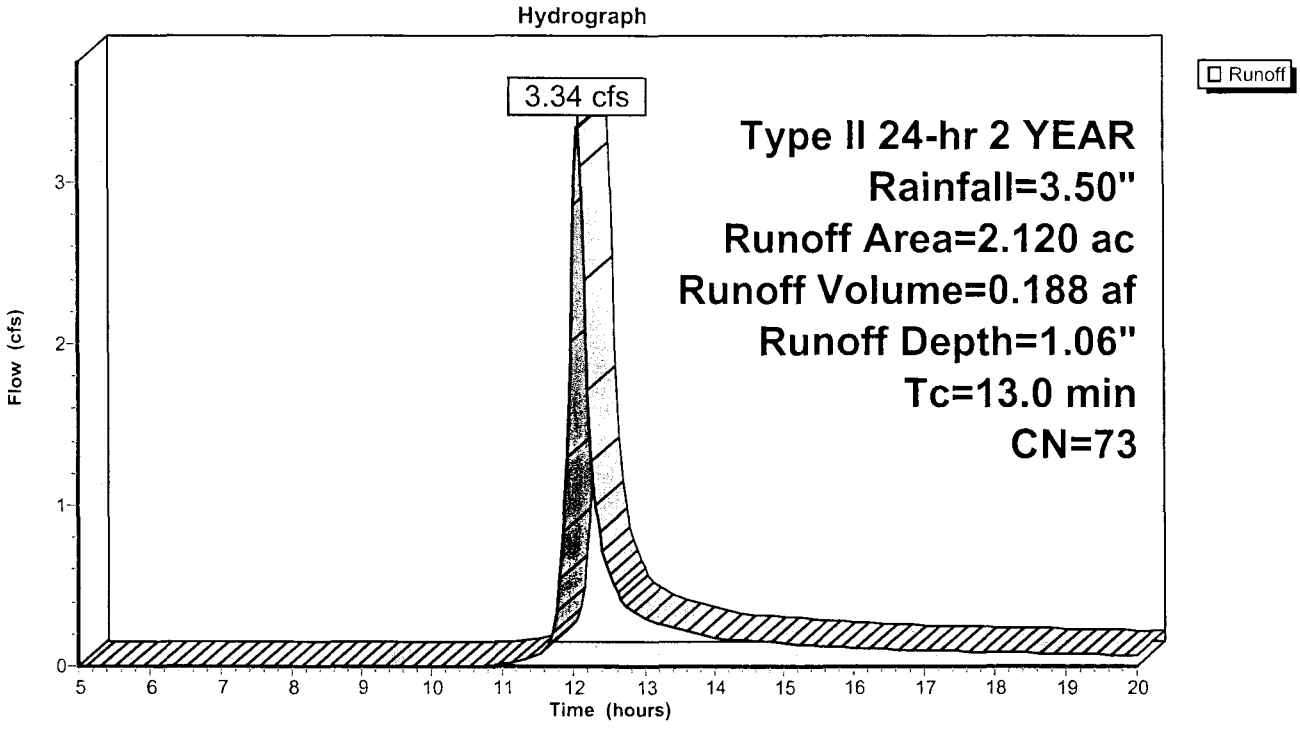
Elevation range: 27.77 ft to 38.57 ft.

| Station (ft) | Elevation (ft) | Start Station | End Station | Roughness |
|---|---|---|---|---|
| 0.00 | 37.95 | 0.00 | 63.40 | 0.040 |
| 10.21 | 35.47 | | | |
| 15.66 | 33.47 | | | |
| 21.58 | 31.41 | | | |
| 23.87 | 29.89 | | | |
| 27.88 | 28.23 | | | |
| 31.54 | 28.23 | | | |
| 38.10 | 28.04 | | | |
| 39.30 | 27.92 | | | |
| 39.49 | 27.87 | | | |
| 40.25 | 27.77 | | | |
| 42.00 | 27.88 | | | |
| 42.71 | 27.95 | | | |
| 46.37 | 28.42 | | | |
| 47.91 | 28.64 | | | |
| 52.99 | 32.43 | | | |
| 61.66 | 37.58 | | | |
| 63.40 | 38.57 | | | |

| | | |
|---|---|---|
| Discharge | 3.42 | cfs |

| Results | | |
|---|---|---|
| Wtd. Mannings Coefficient | 0.040 | |
| Water Surface Elevation | 28.15 | ft |
| Flow Area | 1.57 | ft² |
| Wetted Perimeter | 9.85 | ft |
| Top Width | 9.81 | ft |
| Height | 0.38 | ft |
| Critical Depth | 28.14 | ft |
| Critical Slope | 0.043350 | ft/ft |
| Velocity | 2.18 | ft/s |
| Velocity Head | 0.07 | ft |
| Specific Energy | 28.22 | ft |
| Froude Number | 0.96 | |
| Flow is subcritical. | | |

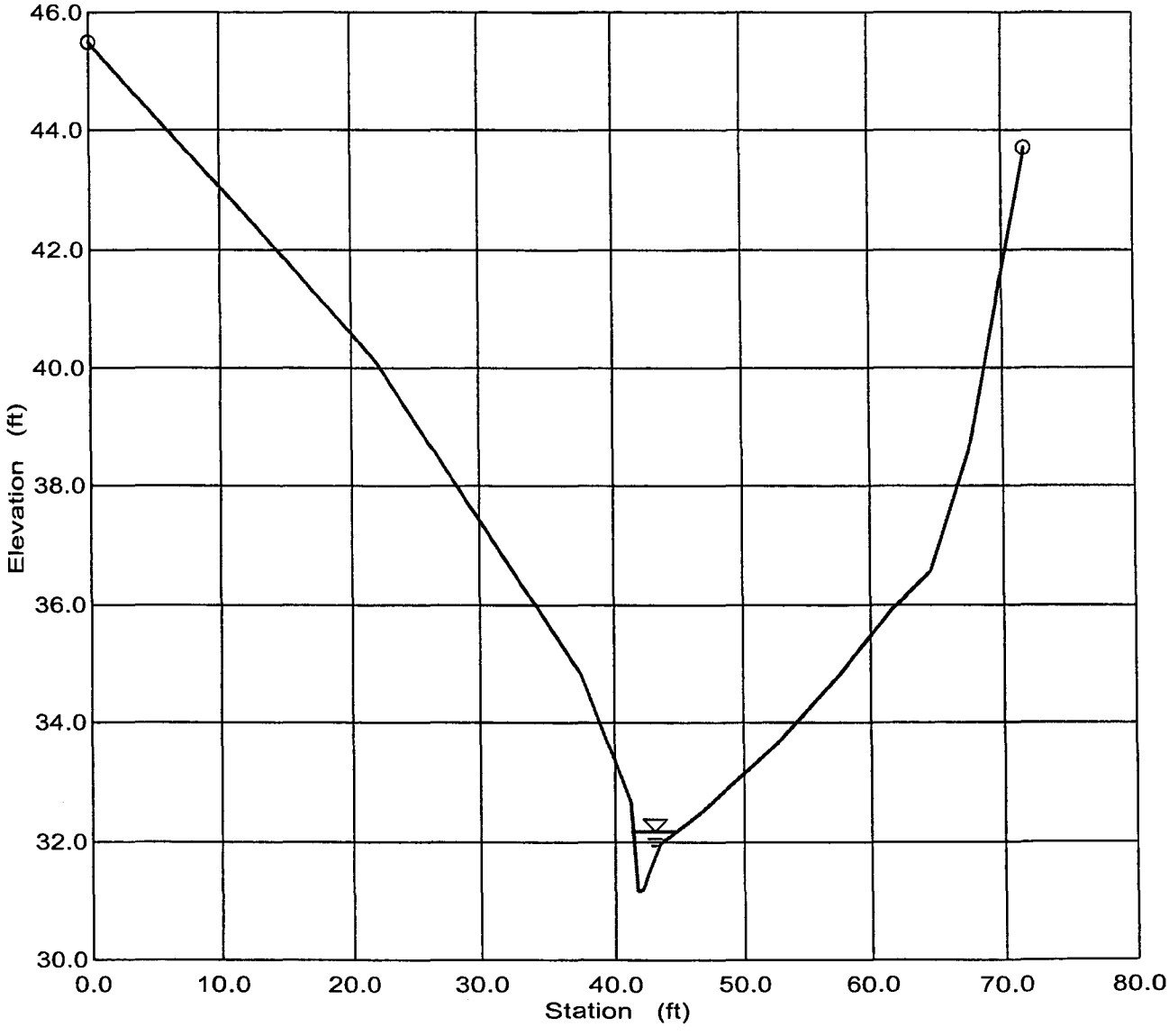
## Subcatchment 12S: DA TO SECTION B



# Section B POST
## Cross Section for Irregular Channel

| Project Description | |
|---|---|
| Project File | k:\l&m\projects\2002261-504.04 stonehouse glen sec.ii with curb\engineering\shg2.fm2 |
| Worksheet | SECTION B POST |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Water Elevation |

| Section Data | | |
|---|---|---|
| Wtd. Mannings Coefficient | 0.055 | |
| Channel Slope | 0.025700 | ft/ft |
| Water Surface Elevation | 32.17 | ft |
| Discharge | 3.34 | cfs |



# CHANNEL 2 STA 0+60 POST
## Worksheet for Irregular Channel

| Project Description | |
|---|---|
| Project File | k:\l&m\projects\2002261-504.04 stonehouse glen sec.ii with curb\engineering\shg2.fm2 |
| Worksheet | SECTION B POST |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Water Elevation |

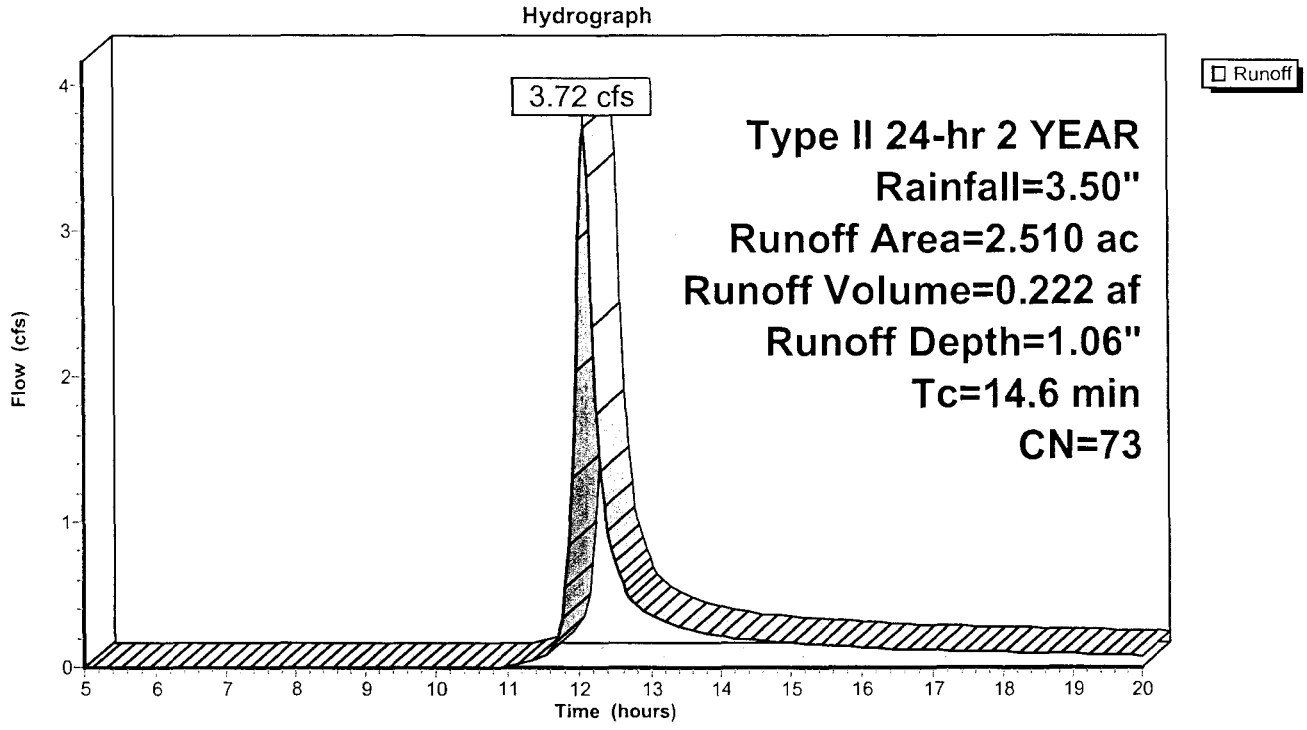
| Input Data | | |
|---|---|---|
| Channel Slope | 0.025700 | ft/ft |

Elevation range: 31.15 ft to 45.48 ft.

| Station (ft) | Elevation (ft) | Start Station | End Station | Roughness |
|---|---|---|---|---|
| 0.00 | 45.48 | 0.00 | 71.74 | 0.055 |
| 11.33 | 42.74 | | | |
| 22.06 | 40.10 | | | |
| 30.21 | 37.35 | | | |
| 37.46 | 34.83 | | | |
| 41.14 | 32.68 | | | |
| 41.69 | 31.15 | | | |
| 42.16 | 31.17 | | | |
| 42.53 | 31.44 | | | |
| 43.49 | 31.97 | | | |
| 46.58 | 32.46 | | | |
| 53.01 | 33.72 | | | |
| 57.56 | 34.80 | | | |
| 61.61 | 35.89 | | | |
| 64.49 | 36.56 | | | |
| 67.56 | 38.74 | | | |
| 71.74 | 43.70 | | | |
| Discharge | 3.34 | cfs | | |

| Results | | |
|---|---|---|
| Wtd. Mannings Coefficient | 0.055 | |
| Water Surface Elevation | 32.17 | ft |
| Flow Area | 1.54 | ft² |
| Wetted Perimeter | 4.36 | ft |
| Top Width | 3.40 | ft |
| Height | 1.02 | ft |
| Critical Depth | 31.91 | ft |
| Critical Slope | 0.088399 | ft/ft |
| Velocity | 2.17 | ft/s |
| Velocity Head | 0.07 | ft |
| Specific Energy | 32.24 | ft |
| Froude Number | 0.57 | |
| Flow is subcritical. | | |

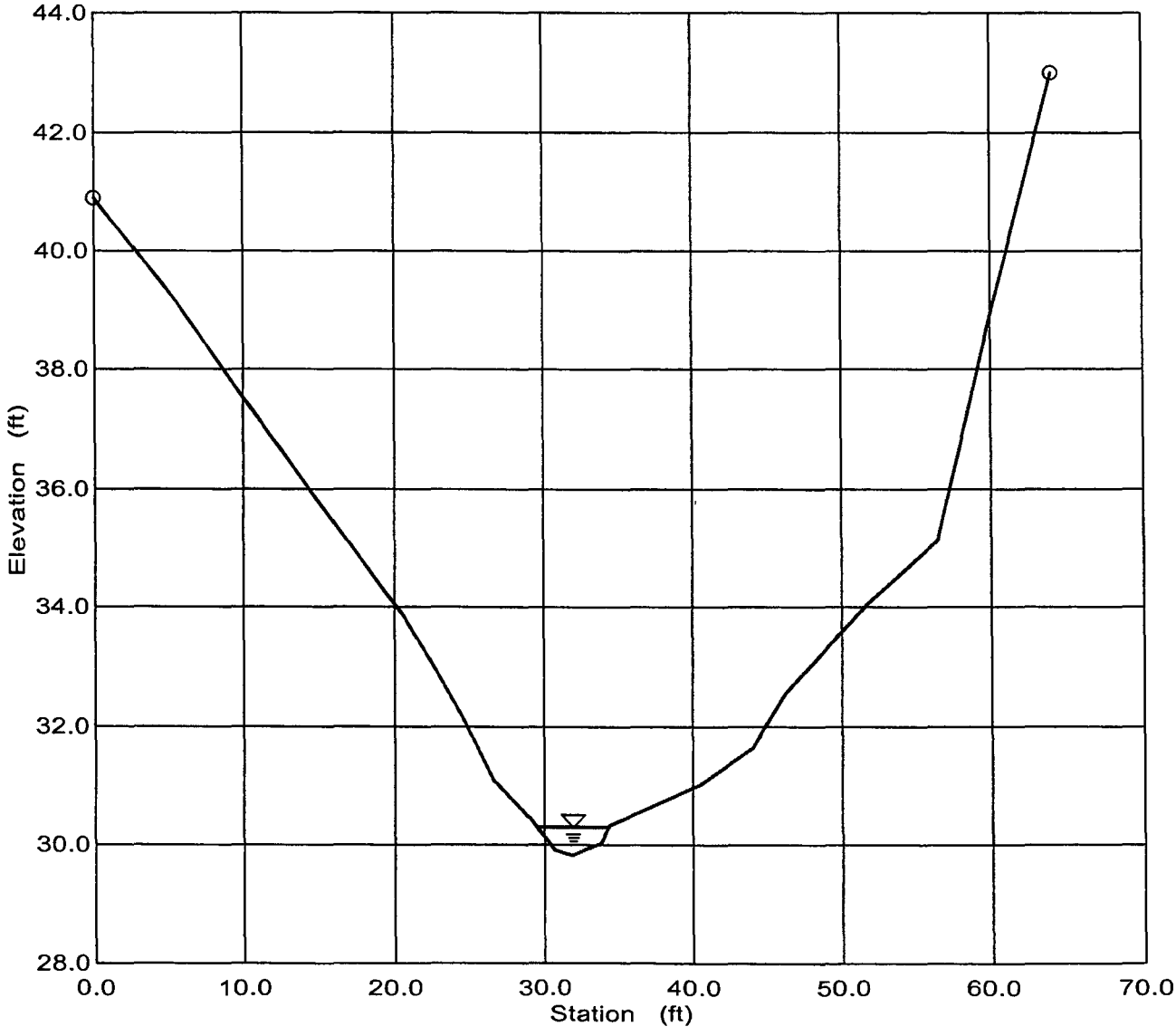
## Subcatchment 13S: DA TO SECTION C



# Section C POST
## Cross Section for Irregular Channel

| Project Description | |
|---|---|
| Project File | k:\l&m\projects\2002261-504.04 stonehouse glen sec.ii with curb\engineering\shg2.fm2 |
| Worksheet | SECTION C POST |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Water Elevation |

| Section Data | | |
|---|---|---|
| Wtd. Mannings Coefficient | 0.055 | |
| Channel Slope | 0.043400 | ft/ft |
| Water Surface Elevation | 30.28 | ft |
| Discharge | 3.72 | cfs |



# CHANNEL 2 STA 1+13 POST
## Worksheet for Irregular Channel

| Project Description | |
|---|---|
| Project File | k:\l&m\projects\2002261-504.04 stonehouse glen sec.ii with curb\engineering\shg2.fm2 |
| Worksheet | SECTION C POST |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Water Elevation |

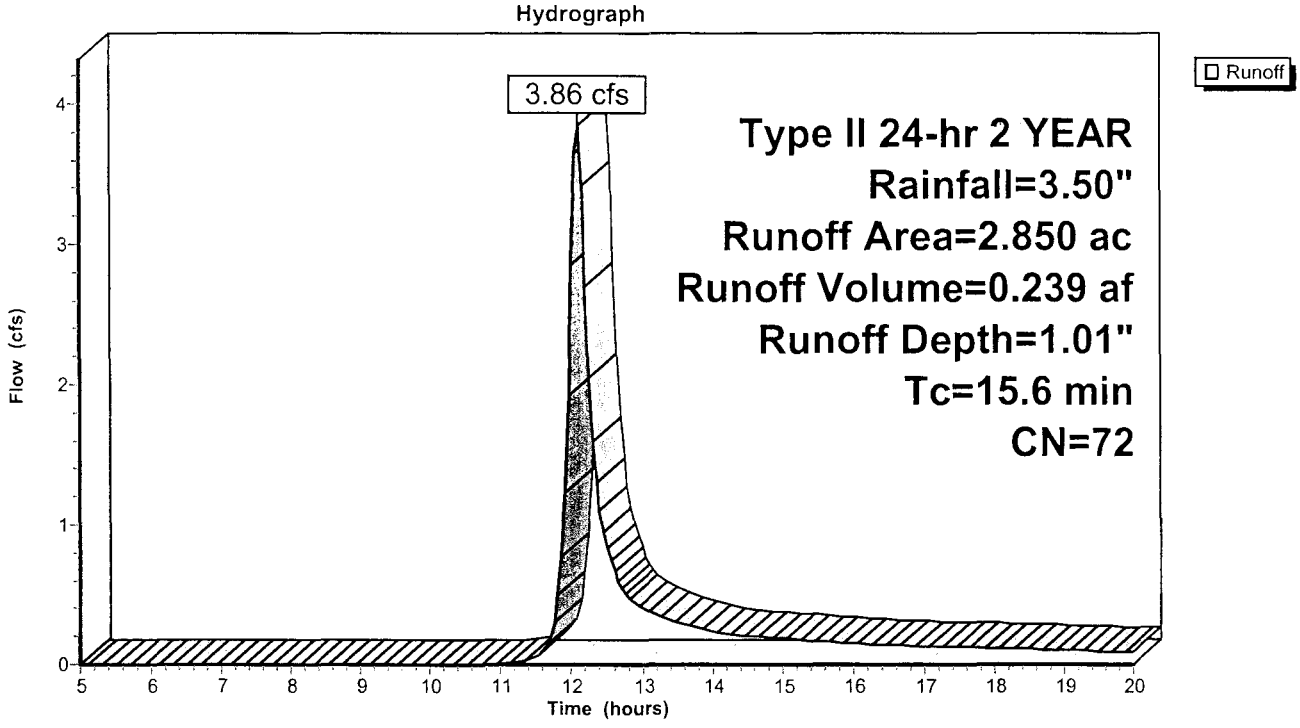
| Input Data | | |
|---|---|---|
| Channel Slope | 0.043400 | ft/ft |

Elevation range: 29.81 ft to 43.00 ft.

| Station (ft) | Elevation (ft) | Start Station | End Station | Roughness |
|---|---|---|---|---|
| 0.00 | 40.89 | 0.00 | 64.06 | 0.055 |
| 5.55 | 39.15 | | | |
| 13.57 | 36.28 | | | |
| 20.56 | 33.85 | | | |
| 24.60 | 32.14 | | | |
| 26.50 | 31.10 | | | |
| 29.12 | 30.42 | | | |
| 30.63 | 29.92 | | | |
| 31.82 | 29.81 | | | |
| 33.82 | 30.04 | | | |
| 34.43 | 30.31 | | | |
| 40.56 | 31.00 | | | |
| 44.03 | 31.63 | | | |
| 46.30 | 32.55 | | | |
| 51.94 | 34.10 | | | |
| 56.46 | 35.14 | | | |
| 60.13 | 39.05 | | | |
| 64.06 | 43.00 | | | |
| Discharge | 3.72 | cfs | | |

| Results | | |
|---|---|---|
| Wtd. Mannings Coefficient | 0.055 | |
| Water Surface Elevation | 30.28 | ft |
| Flow Area | 1.48 | $ft^2$ |
| Wetted Perimeter | 4.97 | ft |
| Top Width | 4.84 | ft |
| Height | 0.47 | ft |
| Critical Depth | 30.24 | ft |
| Critical Slope | 0.070085 | ft/ft |
| Velocity | 2.51 | ft/s |
| Velocity Head | 0.10 | ft |
| Specific Energy | 30.38 | ft |
| Froude Number | 0.80 | |
| Flow is subcritical. | | |

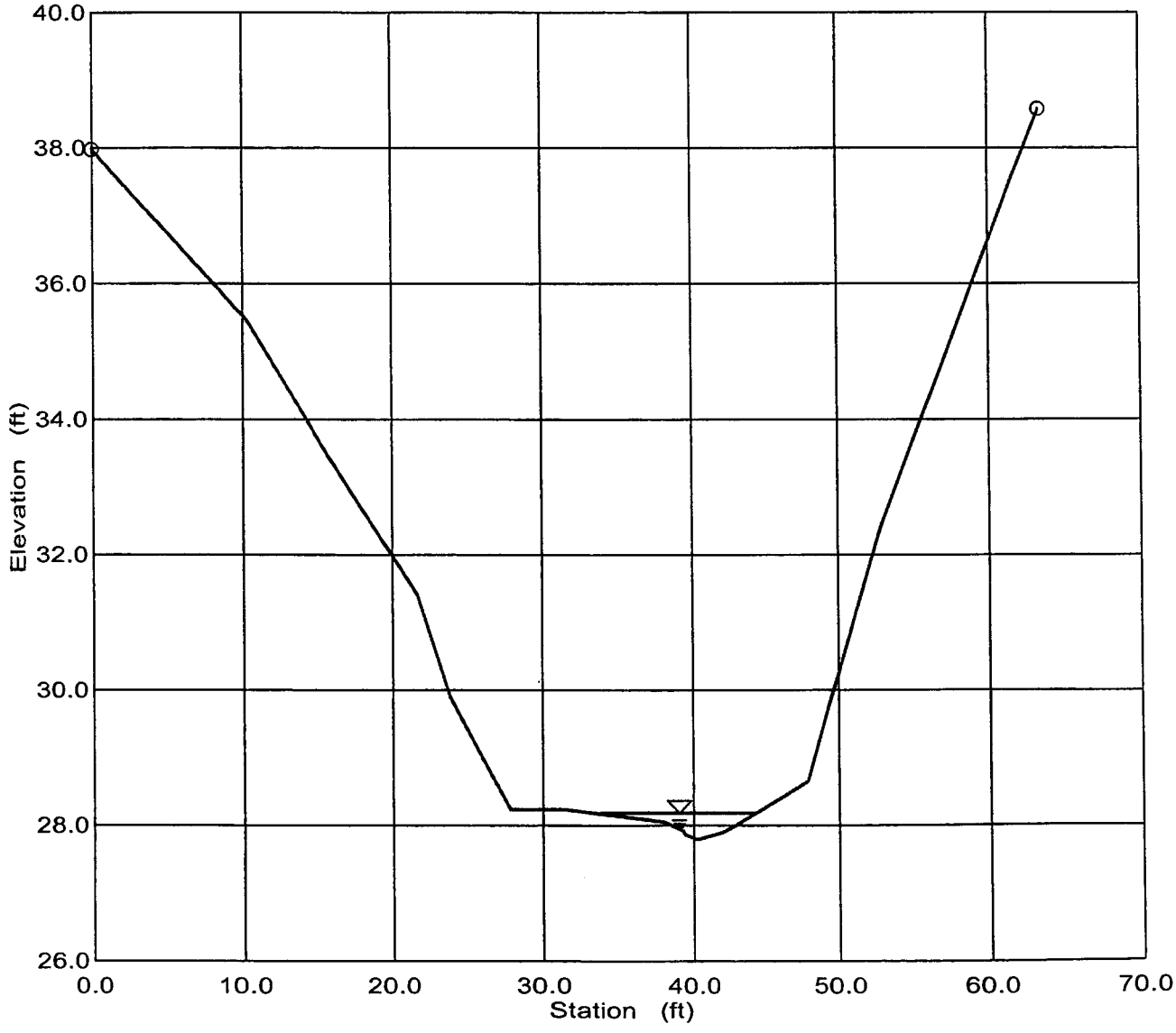
## Subcatchment 14S: DA TO SECTION D



# Section D POST
## Cross Section for Irregular Channel

| Project Description | |
|---|---|
| Project File | k:\l&m\projects\2002261-504.04 stonehouse glen sec.ii with curb\engineering\shg2.fm2 |
| Worksheet | SECTION D POST |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Water Elevation |

| Section Data | | |
|---|---|---|
| Wtd. Mannings Coefficient | 0.040 | |
| Channel Slope | 0.040000 | ft/ft |
| Water Surface Elevation | 28.16 | ft |
| Discharge | 3.86 | cfs |



# CHANNEL 2 STA 1+50 POST
## Worksheet for Irregular Channel

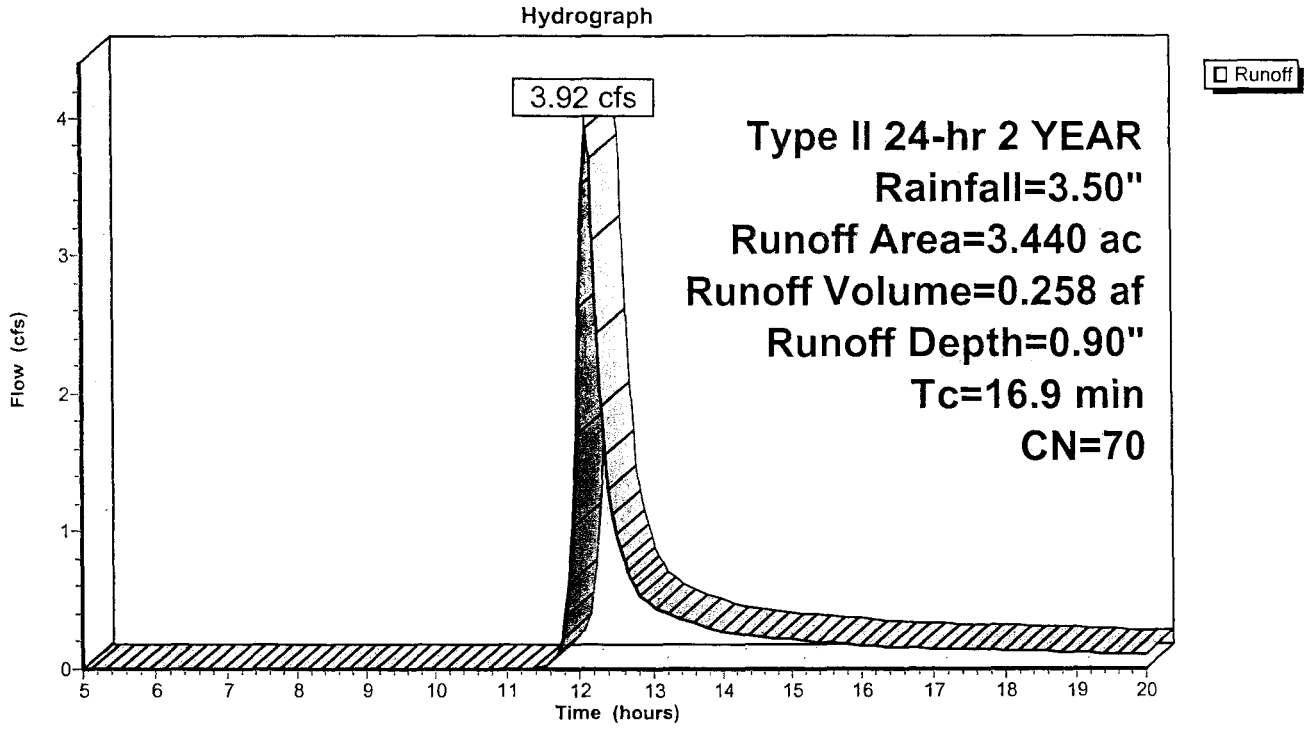
| Project Description | |
|---|---|
| Project File | k:\l&m\projects\2002261-504.04 stonehouse glen sec.ii with curb\engineering\shg2.fm2 |
| Worksheet | SECTION D POST |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Water Elevation |

| Input Data | | | | |
|---|---|---|---|---|
| Channel Slope | 0.040000 ft/ft | | | |
| Elevation range: 27.77 ft to 38.57 ft. | | | | |
| Station (ft) | Elevation (ft) | Start Station | End Station | Roughness |
| 0.00 | 37.95 | 0.00 | 63.40 | 0.040 |
| 10.21 | 35.47 | | | |
| 15.66 | 33.47 | | | |
| 21.58 | 31.41 | | | |
| 23.87 | 29.89 | | | |
| 27.88 | 28.23 | | | |
| 31.54 | 28.23 | | | |
| 38.10 | 28.04 | | | |
| 39.30 | 27.92 | | | |
| 39.49 | 27.87 | | | |
| 40.25 | 27.77 | | | |
| 42.00 | 27.88 | | | |
| 42.71 | 27.95 | | | |
| 46.37 | 28.42 | | | |
| 47.91 | 28.64 | | | |
| 52.99 | 32.43 | | | |
| 61.66 | 37.58 | | | |
| 63.40 | 38.57 | | | |
| Discharge | 3.86 | cfs | | |

| Results | | |
|---|---|---|
| Wtd. Mannings Coefficient | 0.040 | |
| Water Surface Elevation | 28.16 | ft |
| Flow Area | 1.73 | ft² |
| Wetted Perimeter | 10.54 | ft |
| Top Width | 10.50 | ft |
| Height | 0.39 | ft |
| Critical Depth | 28.16 | ft |
| Critical Slope | 0.042867 | ft/ft |
| Velocity | 2.23 | ft/s |
| Velocity Head | 0.08 | ft |
| Specific Energy | 28.24 | ft |
| Froude Number | 0.97 | |
| Flow is subcritical. | | |

# CHANNEL 3
# REACH KLN

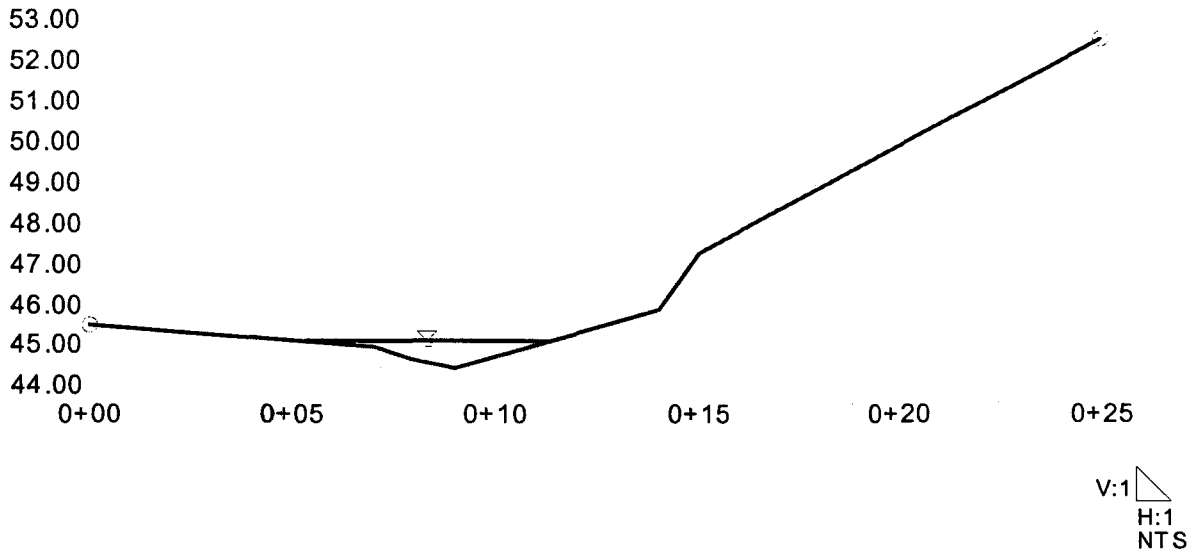
## Subcatchment 3S: DA to DSECTION 'N'



# Cross Section
## Cross Section for Irregular Channel

| Project Description | |
|---|---|
| Worksheet | Section N Pre |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Section Data | | |
|---|---|---|
| Mannings Coefficient | 0.055 | |
| Slope | 0.036300 | ft/ft |
| Water Surface Elevation | 45.09 | ft |
| Elevation Range | 44.42 to 52.53 | |
| Discharge | 3.92 | cfs |



# Worksheet
## Worksheet for Irregular Channel

| Project Description | |
|---|---|
| Worksheet | Section N Pre |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Slope | 0.036300 | ft/ft |
| Discharge | 3.92 | cfs |

| Options | |
|---|---|
| Current Roughness Method | Improved Lotter's Method |
| Open Channel Weighting Method | Improved Lotter's Method |
| Closed Channel Weighting Meth | Pavlovskii's Method |

| Results | | |
|---|---|---|
| Mannings Coefficient | 0.055 | |
| Water Surface Elevation | 45.09 | ft |
| Elevation Range | 44.42 to 52.53 | |
| Flow Area | 1.752 | ft² |
| Wetted Perimeter | 6.11 | ft |
| Top Width | 5.93 | ft |
| Actual Depth | 0.67 | ft |
| Critical Elevation | 45.00 | ft |
| Critical Slope | 0.069715 | ft/ft |
| Velocity | 2.24 | ft/s |
| Velocity Head | 0.08 | ft |
| Specific Energy | 45.17 | ft |
| Froude Number | 0.73 | |
| Flow Type | Subcritical | |

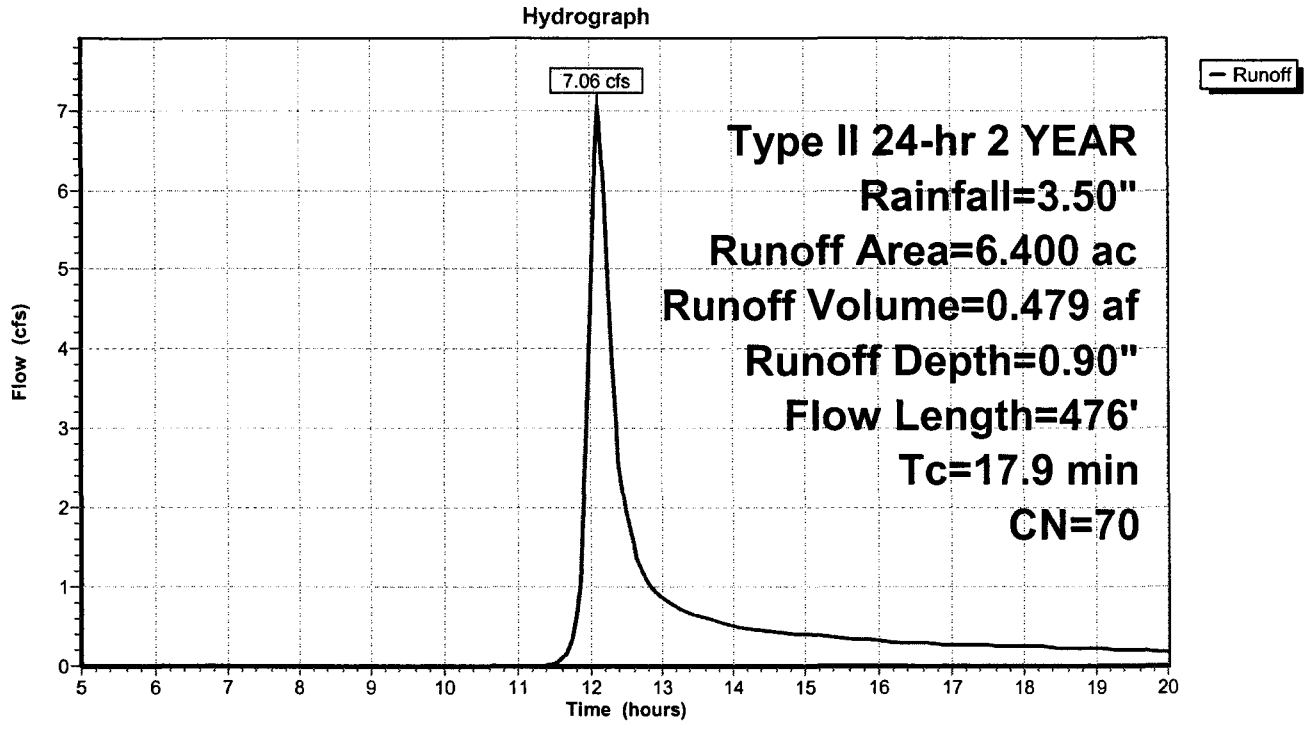
Roughness Segments

| Start Station | End Station | Mannings Coefficient |
|---|---|---|
| 0+00 | 0+25 | 0.055 |

Natural Channel Points

| Station (ft) | Elevation (ft) |
|---|---|
| 0+00 | 45.48 |
| 0+07 | 44.97 |
| 0+08 | 44.60 |
| 0+09 | 44.42 |
| 0+10 | 44.71 |
| 0+12 | 45.30 |
| 0+14 | 45.86 |
| 0+15 | 47.23 |
| 0+25 | 52.53 |

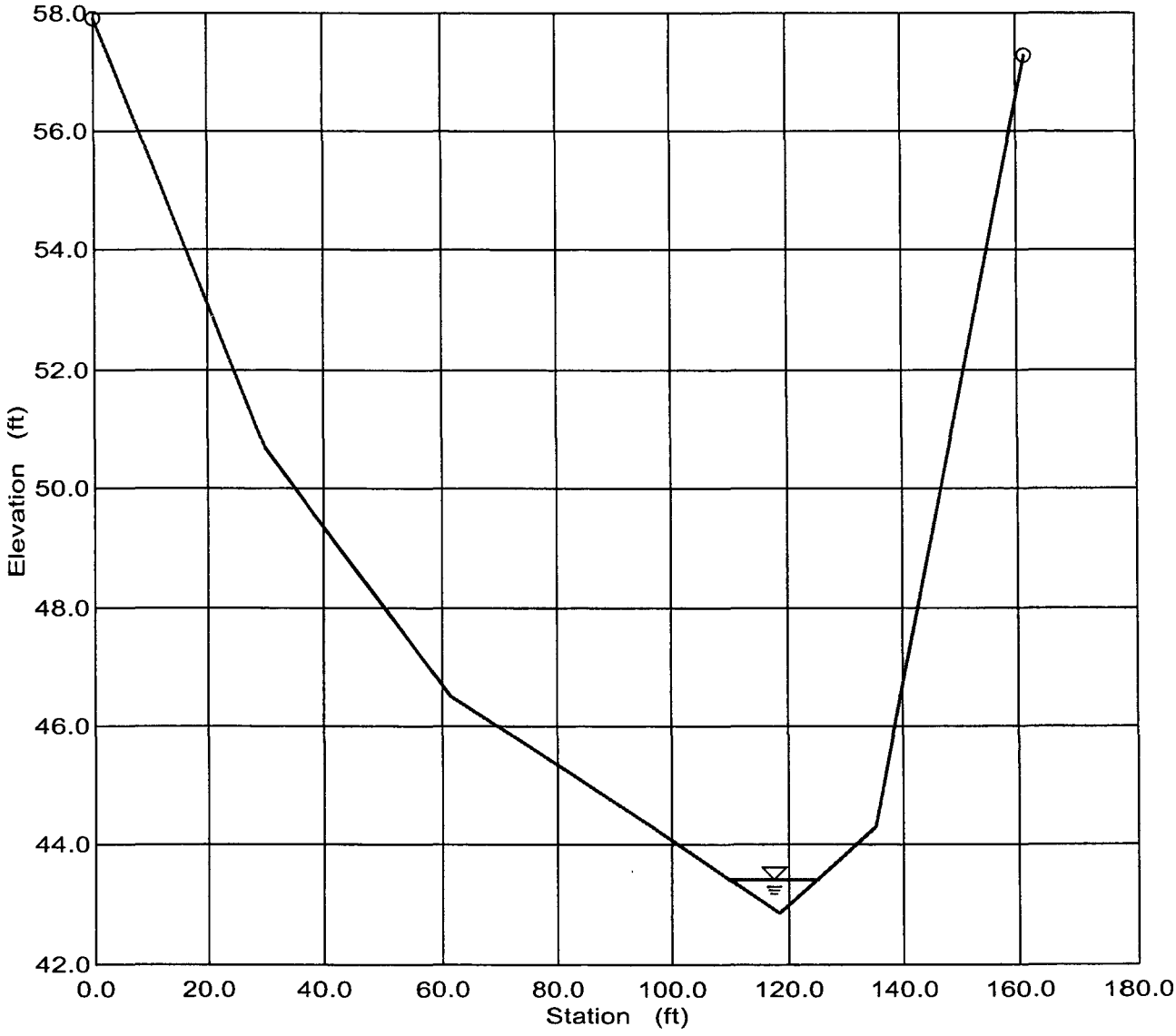
## Subcatchment 1S: DA TO SECTION L



Section L PRE
Cross Section for Irregular Channel

| Project Description | |
|---|---|
| Project File | c:\haestad\fmw\shg2.fm2 |
| Worksheet | SECTION L |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Water Elevation |

| Section Data | | |
|---|---|---|
| Wtd. Mannings Coefficient | 0.055 | |
| Channel Slope | 0.021700 | ft/ft |
| Water Surface Elevation | 43.42 | ft |
| Discharge | 7.28 | cfs |



# CHANNEL 3 STA 0+00 PRE
## Worksheet for Irregular Channel

| Project Description | |
|---|---|
| Project File | c:\haestad\fmw\shg2.fm2 |
| Worksheet | SECTION L |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Water Elevation |

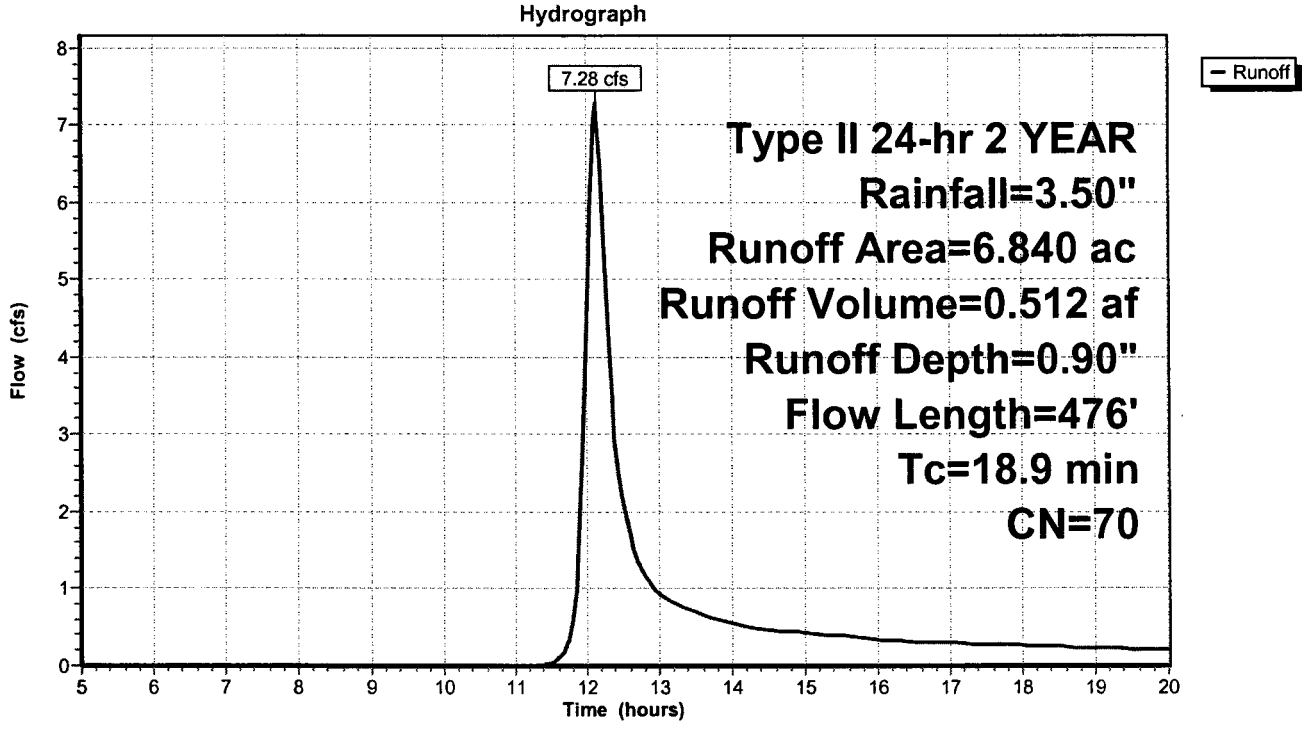
| Input Data | | |
|---|---|---|
| Channel Slope | 0.021700 ft/ft | |
| Elevation range: 42.86 ft to 57.89 ft. | | |

| Station (ft) | Elevation (ft) | Start Station | End Station | Roughness |
|---|---|---|---|---|
| 0.00 | 57.89 | 0.00 | 161.70 | 0.055 |
| 29.83 | 50.68 | | | |
| 61.34 | 46.50 | | | |
| 96.55 | 44.29 | | | |
| 118.55 | 42.86 | | | |
| 135.23 | 44.30 | | | |
| 161.70 | 57.29 | | | |

| Discharge | 7.28 | cfs |
|---|---|---|

| Results | | |
|---|---|---|
| Wtd. Mannings Coefficient | 0.055 | |
| Water Surface Elevation | 43.42 | ft |
| Flow Area | 4.27 | ft² |
| Wetted Perimeter | 15.22 | ft |
| Top Width | 15.17 | ft |
| Height | 0.56 | ft |
| Critical Depth | 43.31 | ft |
| Critical Slope | 0.072829 | ft/ft |
| Velocity | 1.71 | ft/s |
| Velocity Head | 0.05 | ft |
| Specific Energy | 43.47 | ft |
| Froude Number | 0.57 | |
| Flow is subcritical. | | |

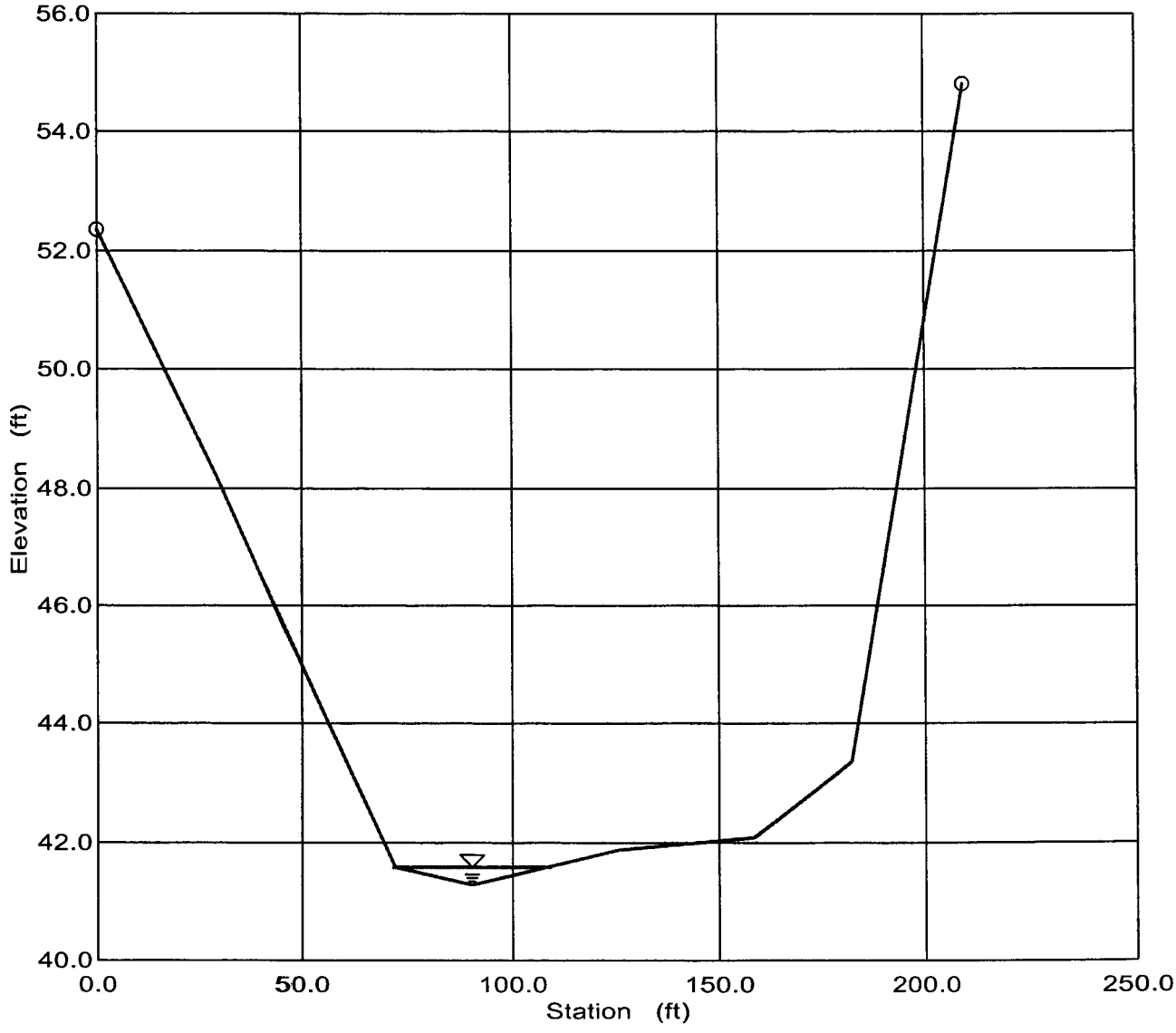
## Subcatchment 2S: DA TO SECTION K



Section K PRE
Cross Section for Irregular Channel

| Project Description | |
|---|---|
| Project File | c:\haestad\fmw\shg2.fm2 |
| Worksheet | SECTION K |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Water Elevation |

| Section Data | | |
|---|---|---|
| Wtd. Mannings Coefficient | 0.055 | |
| Channel Slope | 0.021700 | ft/ft |
| Water Surface Elevation | 41.58 | ft |
| Discharge | 7.06 | cfs |



# CHANNEL 3 STA 0+46 PRE
## Worksheet for Irregular Channel

| Project Description | |
|---|---|
| Project File | c:\haestad\fmw\shg2.fm2 |
| Worksheet | SECTION K |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Water Elevation |

| Input Data | | |
|---|---|---|
| Channel Slope | 0.021700 | ft/ft |

Elevation range: 41.27 ft to 54.82 ft.

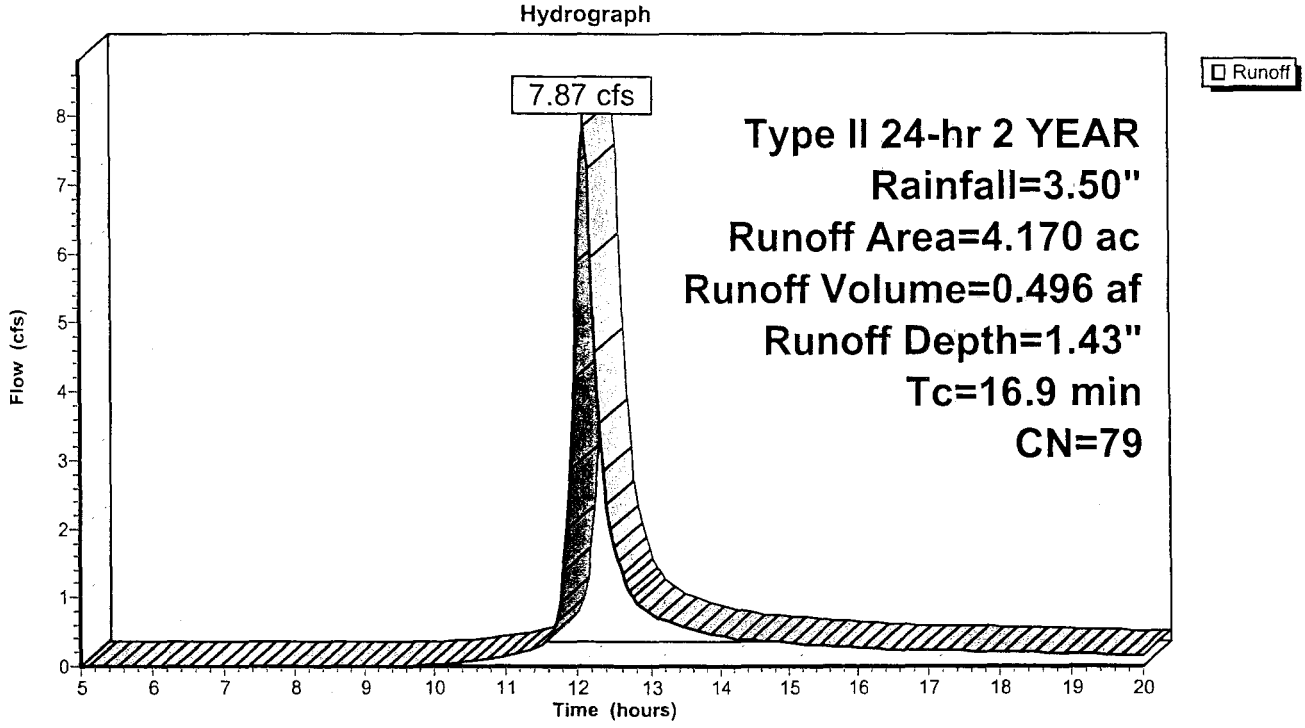
| Station (ft) | Elevation (ft) | Start Station | End Station | Roughness |
|---|---|---|---|---|
| 0.00 | 52.34 | 0.00 | 209.83 | 0.055 |
| 29.56 | 48.16 | | | |
| 71.70 | 41.56 | | | |
| 90.28 | 41.27 | | | |
| 126.20 | 41.86 | | | |
| 158.29 | 42.07 | | | |
| 182.06 | 43.35 | | | |
| 209.83 | 54.82 | | | |

| Discharge | 7.06 | cfs |
|---|---|---|

| Results | | |
|---|---|---|
| Wtd. Mannings Coefficient | 0.055 | |
| Water Surface Elevation | 41.58 | ft |
| Flow Area | 6.02 | ft² |
| Wetted Perimeter | 37.64 | ft |
| Top Width | 37.63 | ft |
| Height | 0.31 | ft |
| Critical Depth | 41.51 | ft |
| Critical Slope | 0.089391 | ft/ft |
| Velocity | 1.17 | ft/s |
| Velocity Head | 0.02 | ft |
| Specific Energy | 41.60 | ft |
| Froude Number | 0.52 | |

Flow is subcritical.

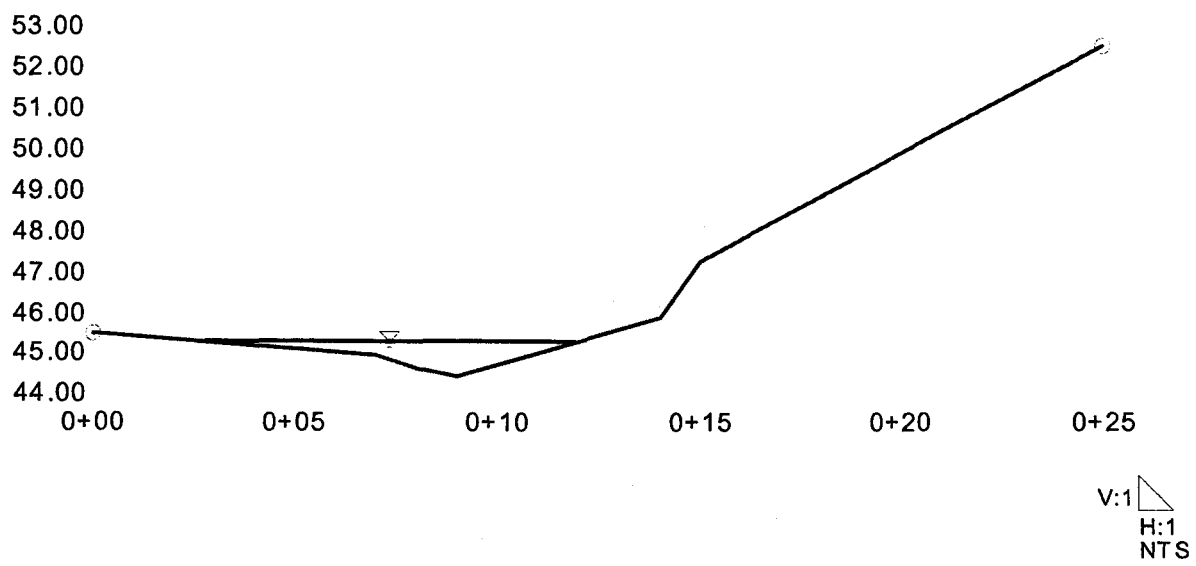
## Subcatchment 13S: DA TO SECTION 'N'



# Cross Section
## Cross Section for Irregular Channel

| Project Description | |
|---|---|
| Worksheet | Section N Post |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Section Data | | |
|---|---|---|
| Mannings Coefficient | 0.055 | |
| Slope | 0.036300 | ft/ft |
| Water Surface Elevation | 45.28 | ft |
| Elevation Range | 44.42 to 52.53 | |
| Discharge | 7.87 | cfs |



# Worksheet
## Worksheet for Irregular Channel

| Project Description | |
|---|---|
| Worksheet | Section N Post |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Slope | 0.036300 | ft/ft |
| Discharge | 7.87 | cfs |

| Options | |
|---|---|
| Current Roughness Method | Improved Lotter's Method |
| Open Channel Weighting Method | Improved Lotter's Method |
| Closed Channel Weighting Meth | Horton's Method |

| Results | | |
|---|---|---|
| Mannings Coefficient | 0.055 | |
| Water Surface Elevation | 45.28 | ft |
| Elevation Range | 44.42 to 52.53 | |
| Flow Area | 3.152 | ft² |
| Wetted Perimeter | 9.33 | ft |
| Top Width | 9.12 | ft |
| Actual Depth | 0.86 | ft |
| Critical Elevation | 45.19 | ft |
| Critical Slope | 0.066770 | ft/ft |
| Velocity | 2.50 | ft/s |
| Velocity Head | 0.10 | ft |
| Specific Energy | 45.37 | ft |
| Froude Number | 0.75 | |
| Flow Type | Subcritical | |

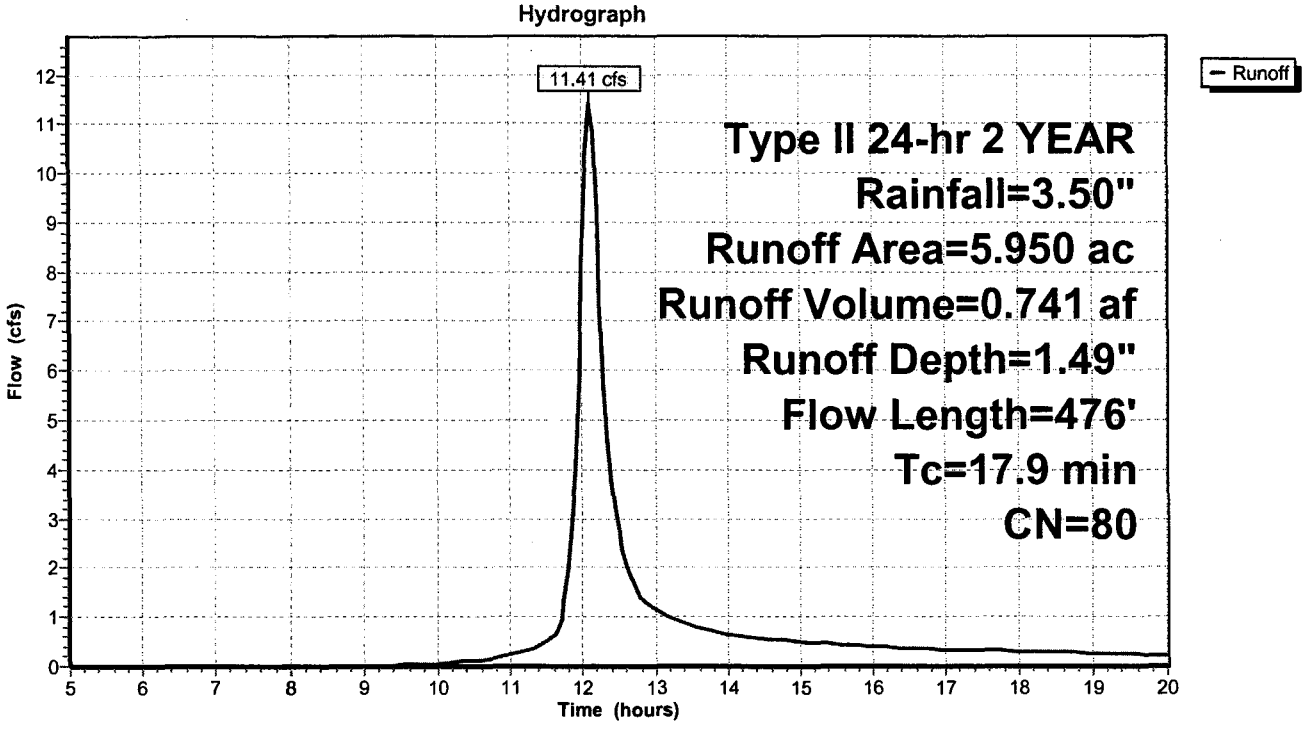
Roughness Segments

| Start Station | End Station | Mannings Coefficient |
|---|---|---|
| 0+00 | 0+25 | 0.055 |

Natural Channel Points

| Station (ft) | Elevation (ft) |
|---|---|
| 0+00 | 45.48 |
| 0+07 | 44.97 |
| 0+08 | 44.60 |
| 0+09 | 44.42 |
| 0+10 | 44.71 |
| 0+12 | 45.30 |
| 0+14 | 45.86 |
| 0+15 | 47.23 |
| 0+25 | 52.53 |

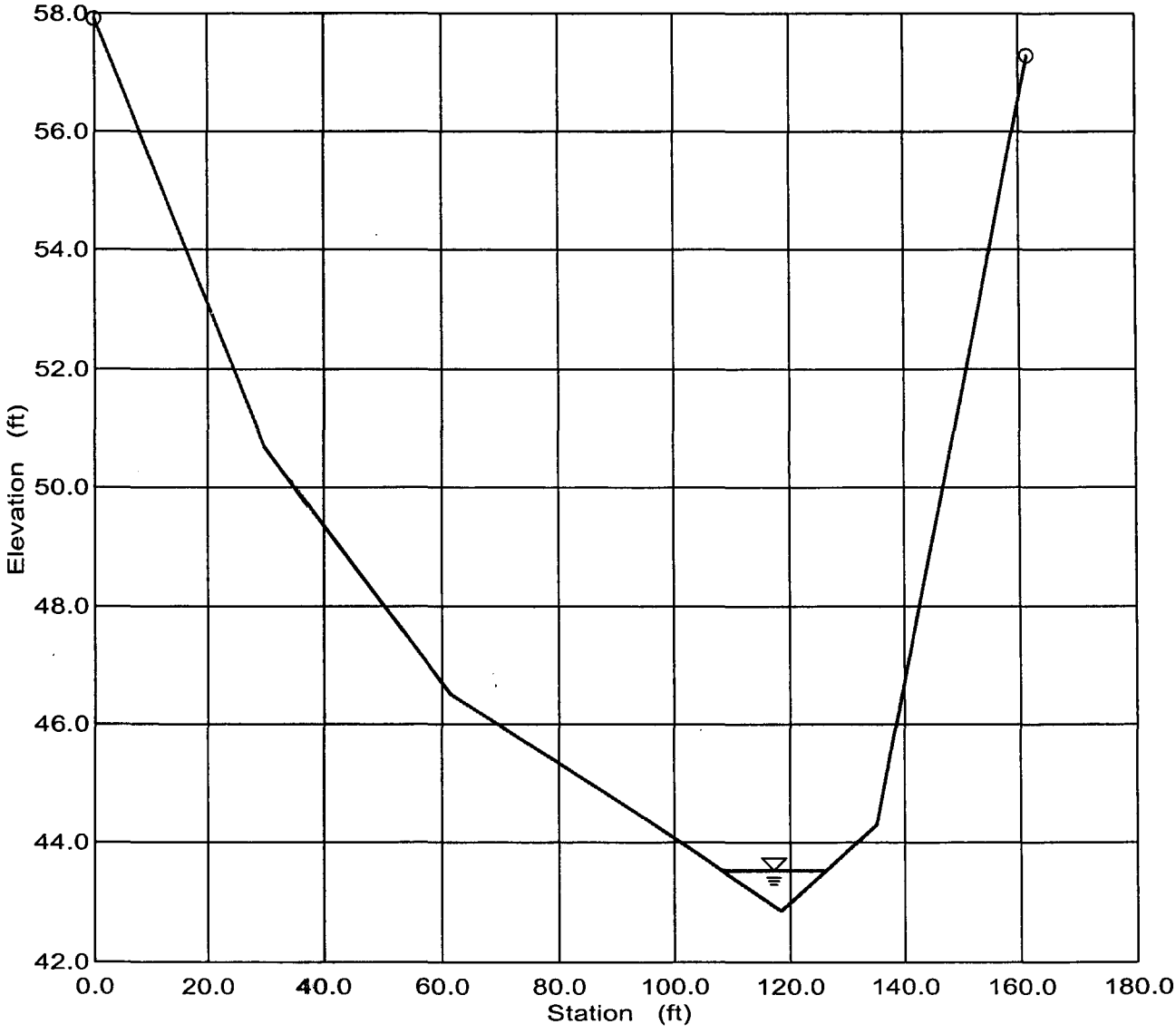
## Subcatchment 11S: DA TO SECTION L



Section L POST
Cross Section for Irregular Channel

| Project Description | |
|---|---|
| Project File | c:\haestad\fmw\shg2.fm2 |
| Worksheet | SECTION L POST |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Water Elevation |

| Section Data | | |
|---|---|---|
| Wtd. Mannings Coefficient | 0.055 | |
| Channel Slope | 0.021700 | ft/ft |
| Water Surface Elevation | 43.53 | ft |
| Discharge | 11.41 | cfs |



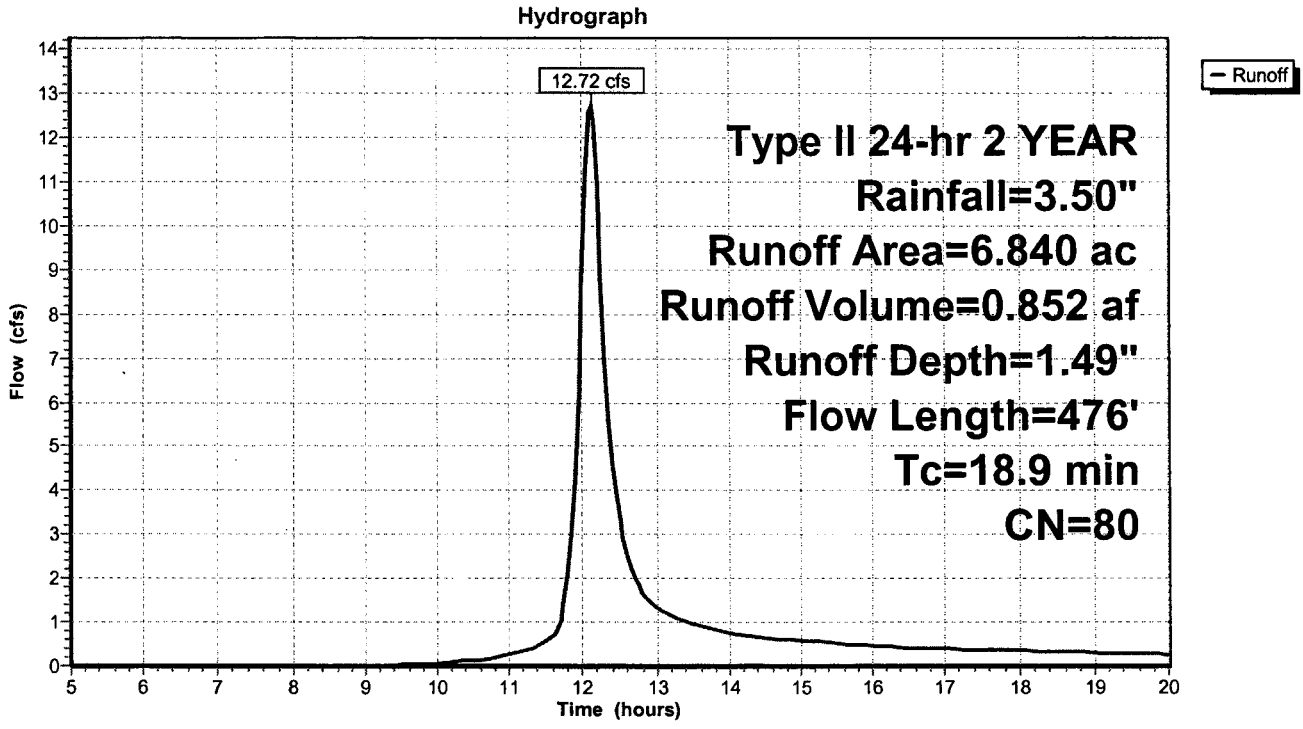
# CHANNEL 3 STA 0+00 POST
## Worksheet for Irregular Channel

| Project Description | |
|---|---|
| Project File | c:\haestad\fmw\shg2.fm2 |
| Worksheet | SECTION L POST |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Water Elevation |

| Input Data | | | | | |
|---|---|---|---|---|---|
| Channel Slope | 0.021700 ft/ft | | | | |
| Elevation range: 42.86 ft to 57.89 ft. | | | | | |
| Station (ft) | Elevation (ft) | | Start Station | End Station | Roughness |
| 0.00 | 57.89 | | 0.00 | 161.70 | 0.055 |
| 29.83 | 50.68 | | | | |
| 61.34 | 46.50 | | | | |
| 96.55 | 44.29 | | | | |
| 118.55 | 42.86 | | | | |
| 135.23 | 44.30 | | | | |
| 161.70 | 57.29 | | | | |
| Discharge | 11.41 | cfs | | | |

| Results | | |
|---|---|---|
| Wtd. Mannings Coefficient | 0.055 | |
| Water Surface Elevation | 43.53 | ft |
| Flow Area | 5.98 | $ft^2$ |
| Wetted Perimeter | 18.01 | ft |
| Top Width | 17.96 | ft |
| Height | 0.67 | ft |
| Critical Depth | 43.40 | ft |
| Critical Slope | 0.068592 | ft/ft |
| Velocity | 1.91 | ft/s |
| Velocity Head | 0.06 | ft |
| Specific Energy | 43.58 | ft |
| Froude Number | 0.58 | |
| Flow is subcritical. | | |

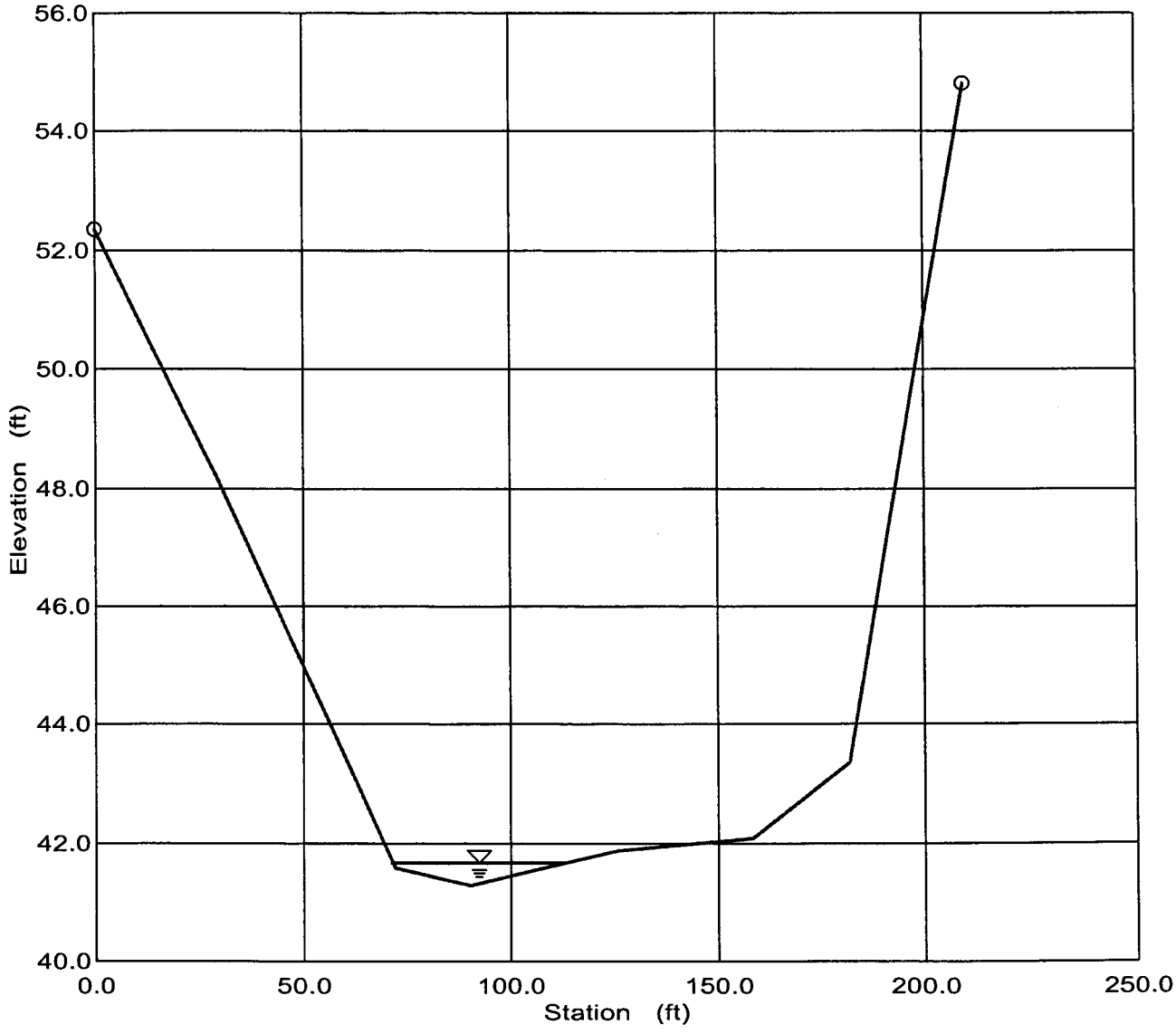
## Subcatchment 12S: DA TO SECTION K



Section K POST
Cross Section for Irregular Channel

| Project Description | |
|---|---|
| Project File | c:\haestad\fmw\shg2.fm2 |
| Worksheet | SECTION K POST |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Water Elevation |

| Section Data | | |
|---|---|---|
| Wtd. Mannings Coefficient | 0.055 | |
| Channel Slope | 0.021700 | ft/ft |
| Water Surface Elevation | 41.66 | ft |
| Discharge | 12.72 | cfs |



# CHANNEL 3 STA 0+46 POST
## Worksheet for Irregular Channel

| Project Description | |
|---|---|
| Project File | c:\haestad\fmw\shg2.fm2 |
| Worksheet | SECTION K POST |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Water Elevation |

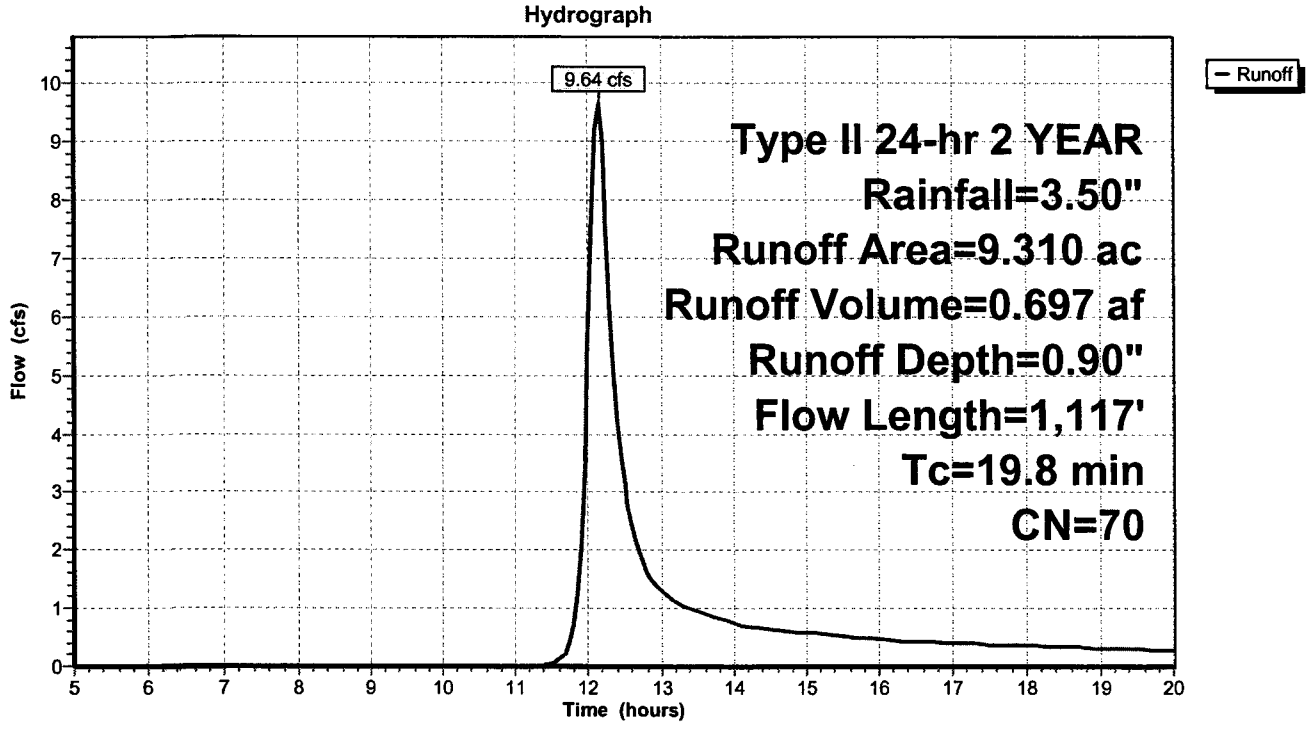
| Input Data | | |
|---|---|---|
| Channel Slope | 0.021700 ft/ft | |
| Elevation range: 41.27 ft to 54.82 ft. | | |
| Station (ft) | Elevation (ft) | |
| 0.00 | 52.34 | |
| 29.56 | 48.16 | |
| 71.70 | 41.56 | |
| 90.28 | 41.27 | |
| 126.20 | 41.86 | |
| 158.29 | 42.07 | |
| 182.06 | 43.35 | |
| 209.83 | 54.82 | |
| Discharge | 12.72 | cfs |

| Start Station | End Station | Roughness |
|---|---|---|
| 0.00 | 209.83 | 0.055 |

| Results | | |
|---|---|---|
| Wtd. Mannings Coefficient | 0.055 | |
| Water Surface Elevation | 41.66 | ft |
| Flow Area | 9.01 | ft² |
| Wetted Perimeter | 42.66 | ft |
| Top Width | 42.64 | ft |
| Height | 0.39 | ft |
| Critical Depth | 41.57 | ft |
| Critical Slope | 0.082247 | ft/ft |
| Velocity | 1.41 | ft/s |
| Velocity Head | 0.03 | ft |
| Specific Energy | 41.69 | ft |
| Froude Number | 0.54 | |
| Flow is subcritical. | | |

# CHANNEL 4
# REACH EFG

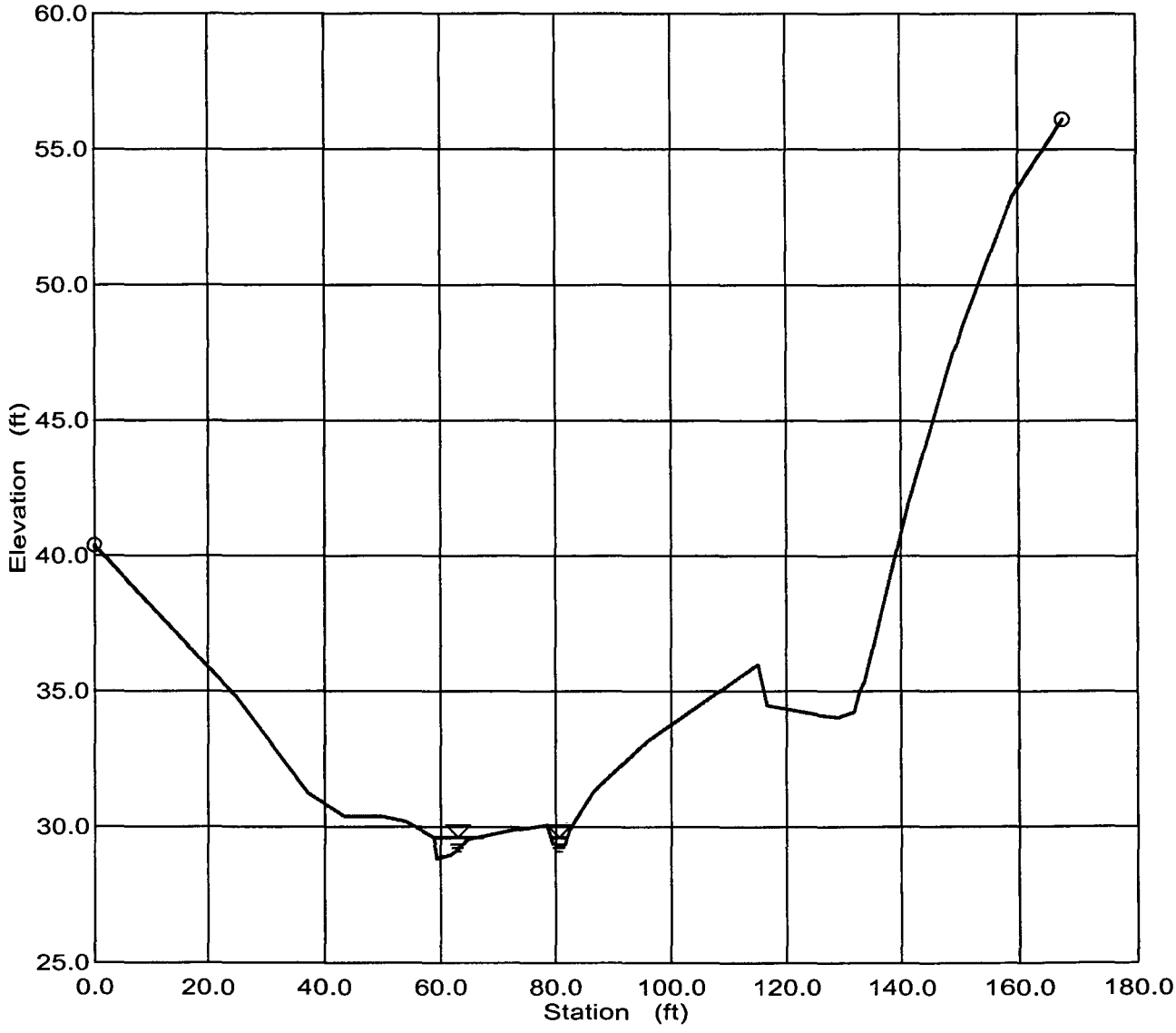
## Subcatchment 1S: DA TO SECTION G



Section G PRE
Cross Section for Irregular Channel

| Project Description | |
|---|---|
| Project File | c:\haestad\fmw\shg2.fm2 |
| Worksheet | SECTION G |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Water Elevation |

| Section Data | | |
|---|---|---|
| Wtd. Mannings Coefficient | 0.055 | |
| Channel Slope | 0.034800 | ft/ft |
| Water Surface Elevation | 29.60 | ft |
| Discharge | 9.64 | cfs |



# CHANNEL 4 STA 0+00 PRE
## Worksheet for Irregular Channel

| Project Description | |
|---|---|
| Project File | c:\haestad\fmw\shg2.fm2 |
| Worksheet | SECTION G |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Water Elevation |

| Input Data | | | | |
|---|---|---|---|---|
| Channel Slope | 0.034800 ft/ft | | | |
| Elevation range: 28.81 ft to 56.05 ft. | | | | |
| Station (ft) | Elevation (ft) | Start Station | End Station | Roughness |
| 0.00 | 40.35 | 0.00 | 167.65 | 0.055 |
| 24.63 | 34.76 | | | |
| 37.14 | 31.18 | | | |
| 43.26 | 30.37 | | | |
| 49.70 | 30.38 | | | |
| 53.78 | 30.19 | | | |
| 58.85 | 29.57 | | | |
| 59.23 | 28.81 | | | |
| 61.79 | 28.96 | | | |
| 62.56 | 29.08 | | | |
| 64.82 | 29.49 | | | |
| 71.98 | 29.82 | | | |
| 78.33 | 30.04 | | | |
| 79.45 | 29.39 | | | |
| 80.47 | 29.28 | | | |
| 81.38 | 29.25 | | | |
| 82.33 | 29.86 | | | |
| 86.77 | 31.27 | | | |
| 96.11 | 33.14 | | | |
| 115.14 | 35.95 | | | |
| 116.60 | 34.47 | | | |
| 118.15 | 34.38 | | | |
| 126.53 | 34.07 | | | |
| 129.30 | 34.01 | | | |
| 131.93 | 34.16 | | | |
| 132.88 | 34.92 | | | |
| 133.67 | 35.32 | | | |
| 141.38 | 41.82 | | | |
| 149.27 | 47.49 | | | |
| 149.74 | 47.77 | | | |
| 150.67 | 48.43 | | | |
| 159.33 | 53.24 | | | |
| 167.65 | 56.05 | | | |
| Discharge | 9.64 | cfs | | |

Results

CHANNEL 4 STA 0+00 PRE

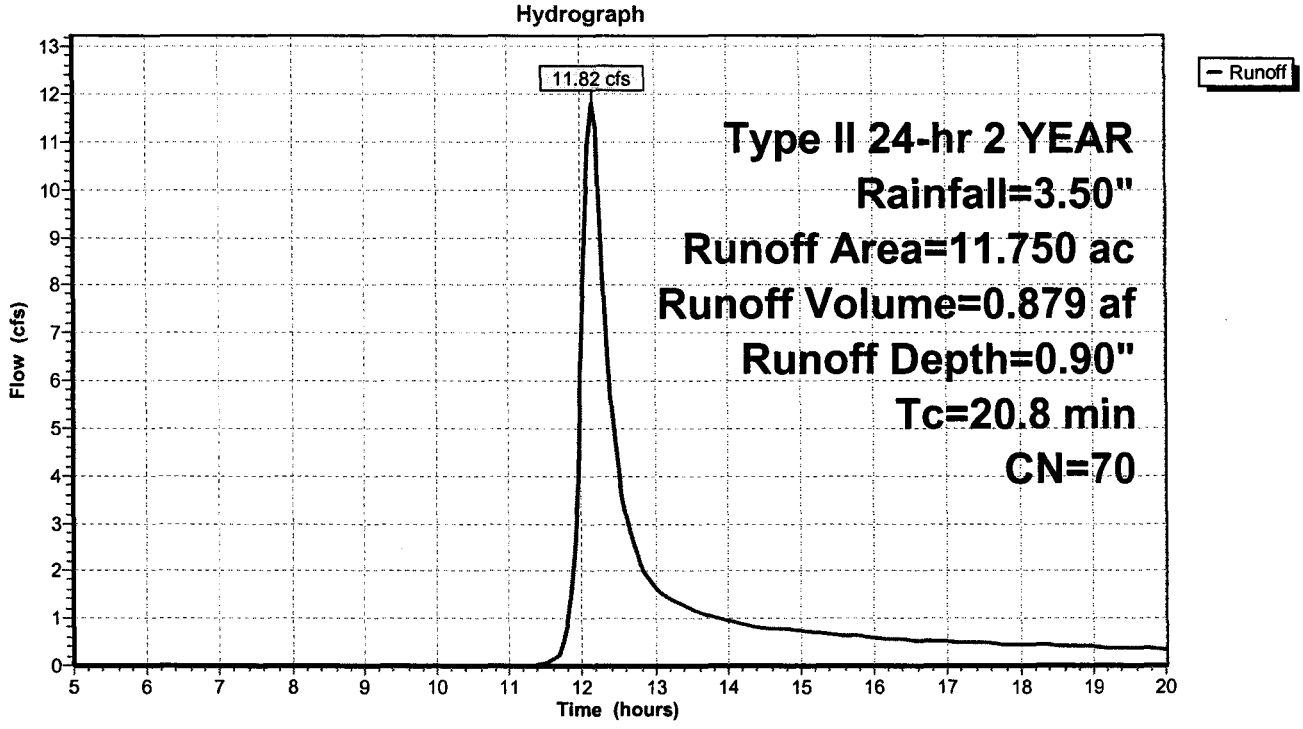
Worksheet for Irregular Channel

| | | |
|---|---|---|
| Wtd. Mannings Coefficient | 0.055 | |
| Water Surface Elevation | 29.60 | ft |
| Flow Area | 4.01 | $ft^2$ |
| Wetted Perimeter | 12.21 | ft |
| Top Width | 11.51 | ft |
| Height | 0.79 | ft |
| Critical Depth | 29.49 | ft |
| Critical Slope | 0.068644 | ft/ft |
| Velocity | 2.40 | ft/s |
| Velocity Head | 0.09 | ft |
| Specific Energy | 29.69 | ft |
| Froude Number | 0.72 | |

Flow is subcritical.

Flow is divided.

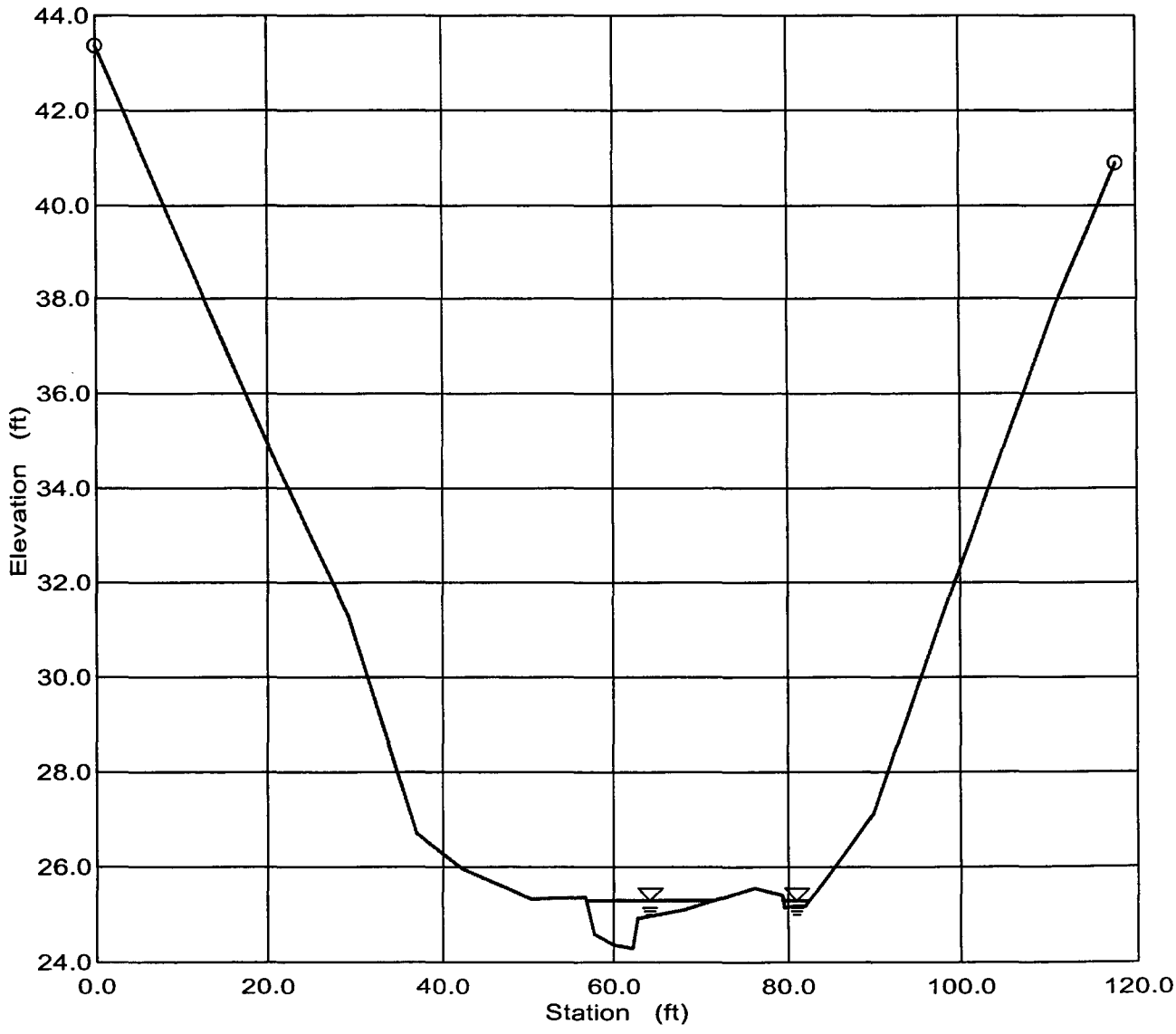
## Subcatchment 2S: AREA TO SECTION F



Section F PRE
Cross Section for Irregular Channel

| Project Description | |
|---|---|
| Project File | c:\haestad\fmw\shg2.fm2 |
| Worksheet | SECTION F |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Water Elevation |

| Section Data | | |
|---|---|---|
| Wtd. Mannings Coefficient | 0.055 | |
| Channel Slope | 0.014400 | ft/ft |
| Water Surface Elevation | 25.30 | ft |
| Discharge | 11.82 | cfs |



# CHANNEL 4 STA 1+10 PRE
## Worksheet for Irregular Channel

| Project Description | |
|---|---|
| Project File | c:\haestad\fmw\shg2.fm2 |
| Worksheet | SECTION F |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Water Elevation |

| Input Data | | |
|---|---|---|
| Channel Slope | 0.014400 | ft/ft |

Elevation range: 24.27 ft to 43.37 ft.

| Station (ft) | Elevation (ft) | Start Station | End Station | Roughness |
|---|---|---|---|---|
| 0.00 | 43.37 | 0.00 | 117.90 | 0.055 |
| 19.81 | 35.03 | | | |
| 29.21 | 31.29 | | | |
| 36.96 | 26.69 | | | |
| 42.14 | 25.94 | | | |
| 50.37 | 25.31 | | | |
| 56.79 | 25.36 | | | |
| 57.87 | 24.57 | | | |
| 59.92 | 24.35 | | | |
| 62.32 | 24.27 | | | |
| 62.75 | 24.91 | | | |
| 68.24 | 25.11 | | | |
| 76.15 | 25.54 | | | |
| 79.33 | 25.41 | | | |
| 79.68 | 25.15 | | | |
| 80.87 | 25.17 | | | |
| 82.02 | 25.19 | | | |
| 87.10 | 26.41 | | | |
| 90.02 | 27.12 | | | |
| 98.81 | 31.69 | | | |
| 111.48 | 38.05 | | | |
| 117.90 | 40.89 | | | |

| Discharge | 11.82 | cfs |
|---|---|---|

| Results | | |
|---|---|---|
| Wtd. Mannings Coefficient | 0.055 | |
| Water Surface Elevation | 25.30 | ft |
| Flow Area | 6.97 | $ft^2$ |
| Wetted Perimeter | 18.43 | ft |
| Top Width | 17.77 | ft |
| Height | 1.03 | ft |
| Critical Depth | 25.02 | ft |
| Critical Slope | 0.064988 | ft/ft |
| Velocity | 1.70 | ft/s |
| Velocity Head | 0.04 | ft |
| Specific Energy | 25.34 | ft |

CHANNEL 4 STA 1+10 PRE

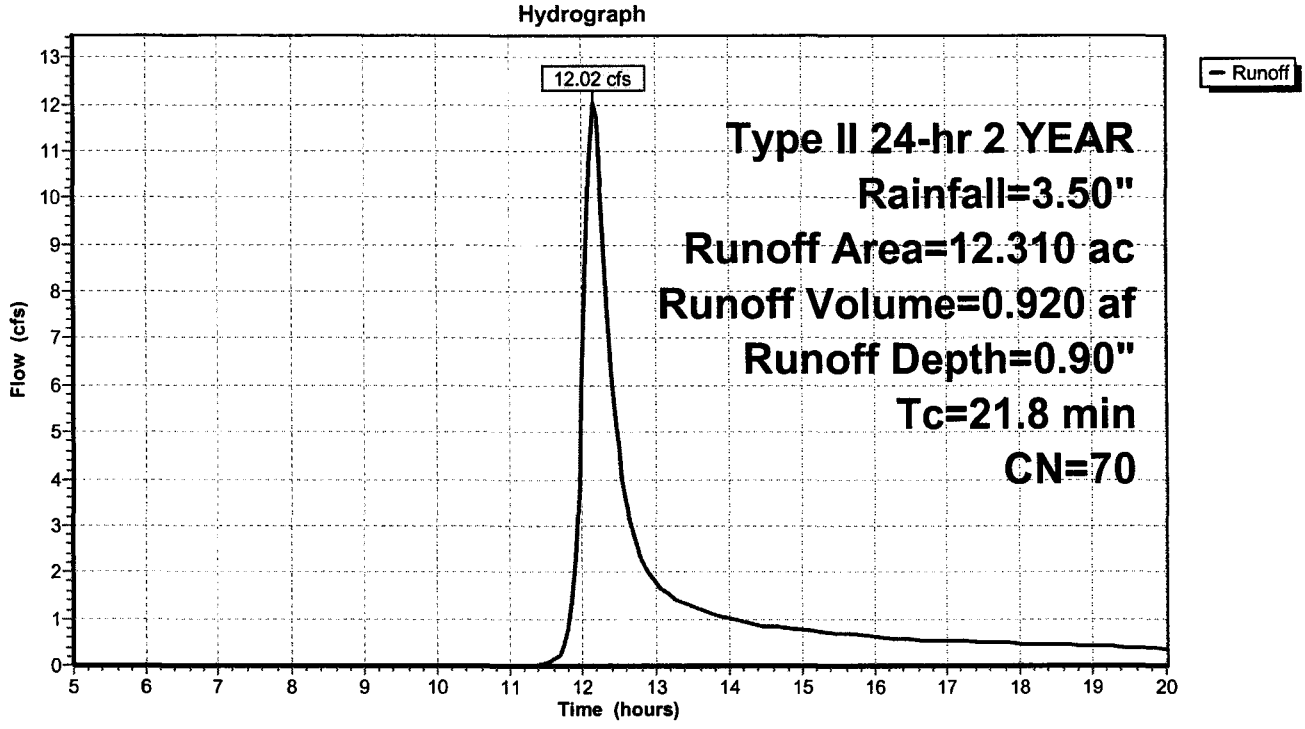
Worksheet for Irregular Channel

| | |
|---|---|
| Froude Number | 0.48 |

Flow is subcritical.

Flow is divided.

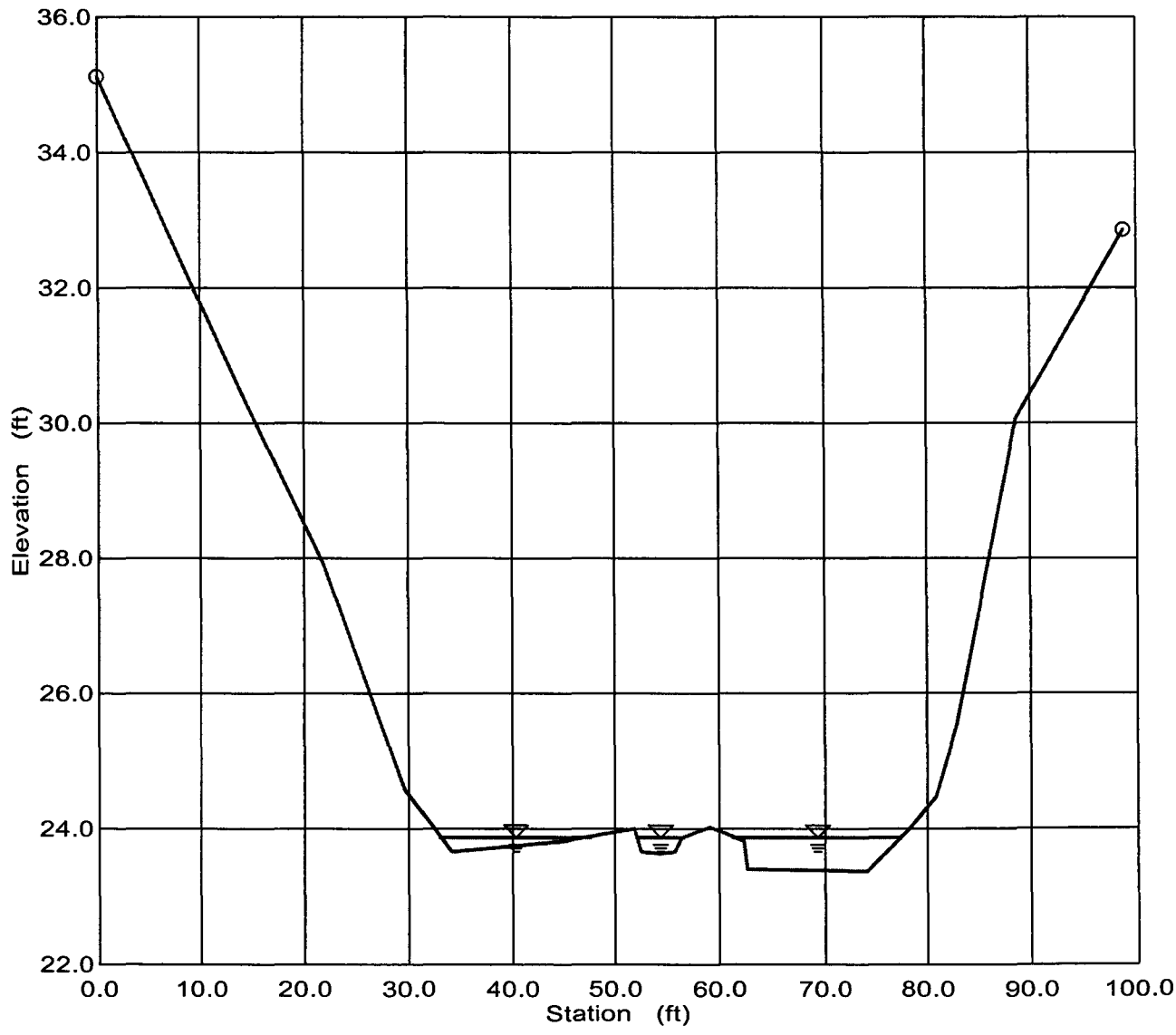
## Subcatchment 3S: AREA TO SECTION E



Section E PRE
Cross Section for Irregular Channel

| Project Description | |
|---|---|
| Project File | c:\haestad\fmw\shg2.fm2 |
| Worksheet | SECTION E |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Water Elevation |

| Section Data | | |
|---|---|---|
| Wtd. Mannings Coefficient | 0.055 | |
| Channel Slope | 0.014400 | ft/ft |
| Water Surface Elevation | 23.87 | ft |
| Discharge | 12.02 | cfs |



# CHANNEL 4 STA 1+60 PRE
## Worksheet for Irregular Channel

| Project Description | |
|---|---|
| Project File | c:\haestad\fmw\shg2.fm2 |
| Worksheet | SECTION E |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Water Elevation |

| Input Data | | |
|---|---|---|
| Channel Slope | 0.014400 | ft/ft |

Elevation range: 23.37 ft to 35.10 ft.

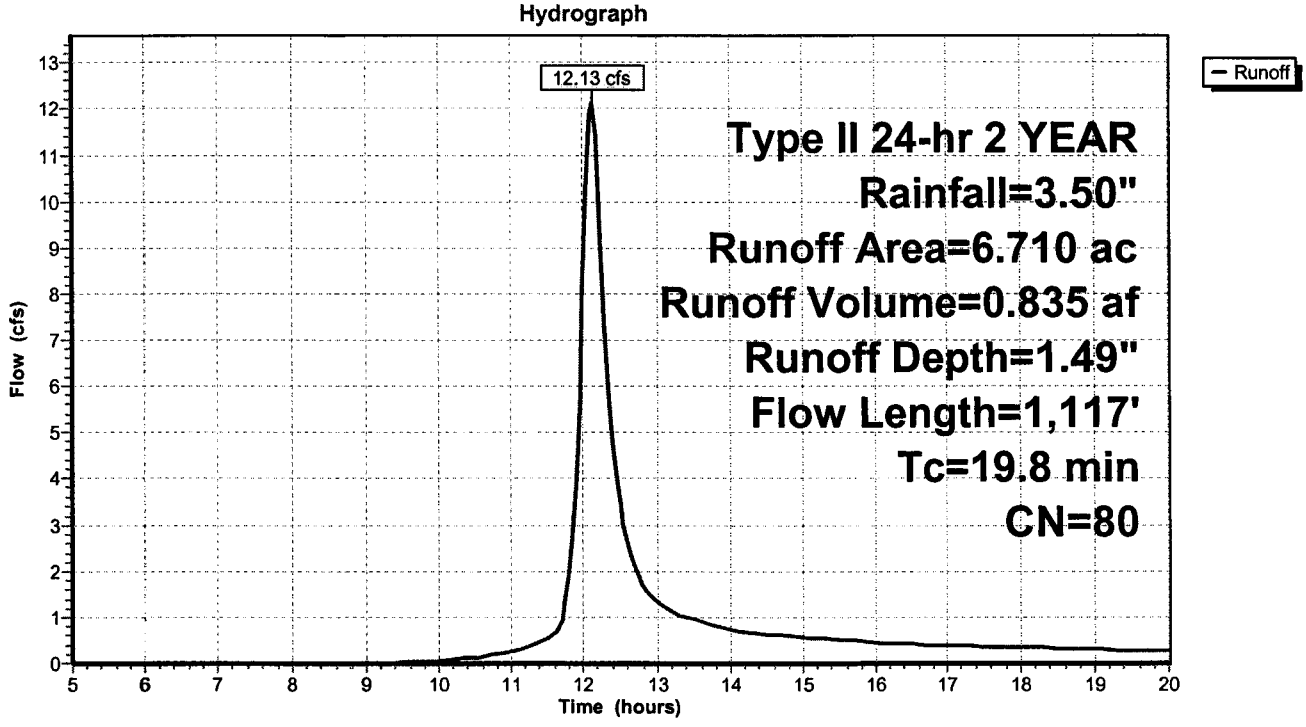
| Station (ft) | Elevation (ft) | Start Station | End Station | Roughness |
|---|---|---|---|---|
| 0.00 | 35.10 | 0.00 | 98.85 | 0.055 |
| 13.85 | 30.48 | | | |
| 21.76 | 27.90 | | | |
| 29.59 | 24.55 | | | |
| 34.07 | 23.66 | | | |
| 44.99 | 23.80 | | | |
| 51.91 | 23.98 | | | |
| 52.59 | 23.65 | | | |
| 54.42 | 23.63 | | | |
| 55.66 | 23.66 | | | |
| 56.34 | 23.85 | | | |
| 59.16 | 24.02 | | | |
| 62.24 | 23.80 | | | |
| 62.60 | 23.39 | | | |
| 74.32 | 23.37 | | | |
| 78.34 | 23.99 | | | |
| 80.92 | 24.45 | | | |
| 82.81 | 25.51 | | | |
| 88.64 | 30.05 | | | |
| 98.85 | 32.84 | | | |

| Discharge | 12.02 | cfs |
|---|---|---|

| Results | | |
|---|---|---|
| Wtd. Mannings Coefficient | 0.055 | |
| Water Surface Elevation | 23.87 | ft |
| Flow Area | 9.17 | ft² |
| Wetted Perimeter | 35.63 | ft |
| Top Width | 35.31 | ft |
| Height | 0.50 | ft |
| Critical Depth | 23.71 | ft |
| Critical Slope | 0.074815 | ft/ft |
| Velocity | 1.31 | ft/s |
| Velocity Head | 0.03 | ft |
| Specific Energy | 23.89 | ft |
| Froude Number | 0.45 | |

Flow is subcritical.

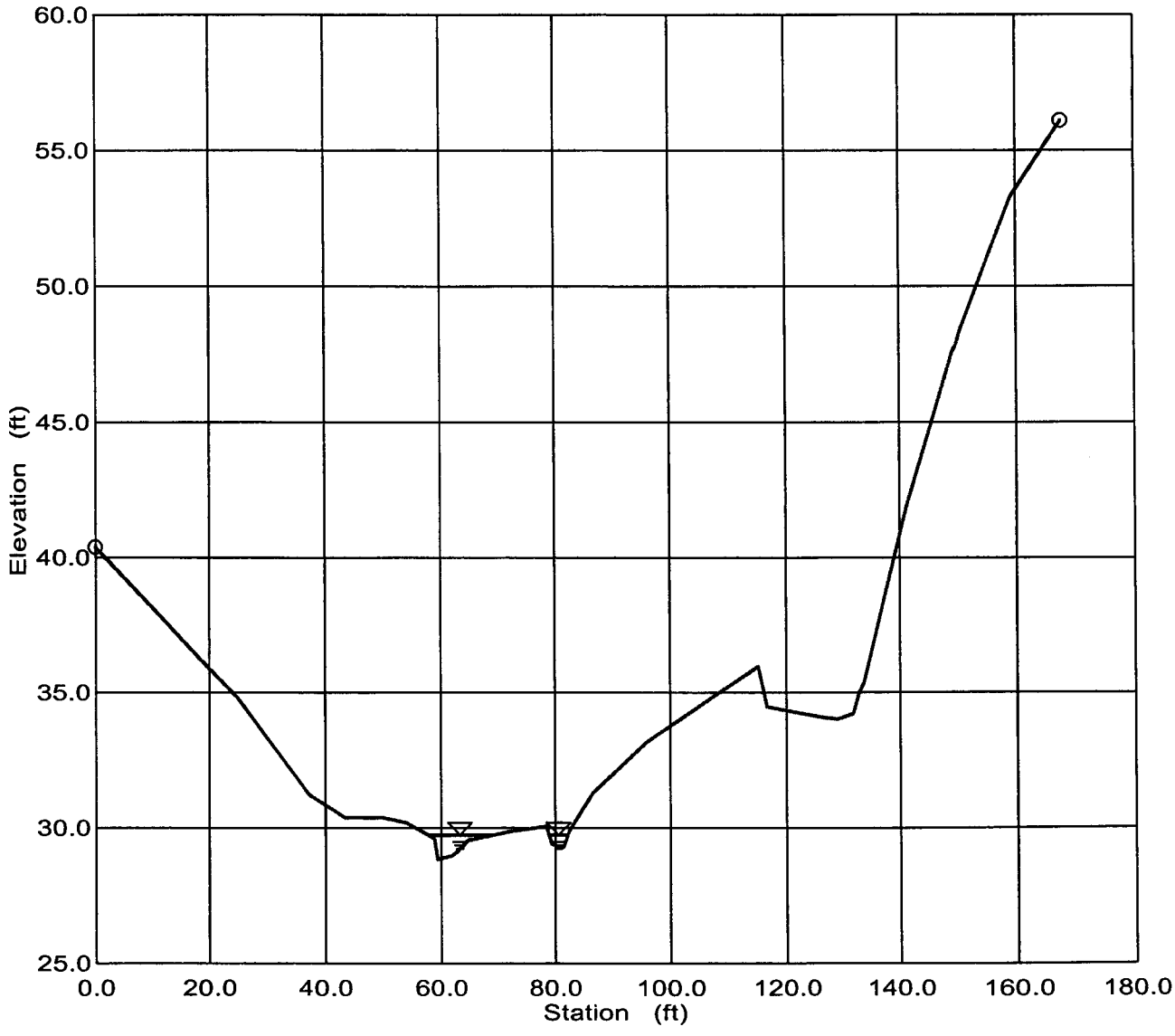
## Subcatchment 11S: DA TO SECTION G



Section G POST
Cross Section for Irregular Channel

| Project Description | |
|---|---|
| Project File | c:\haestad\fmw\shg2.fm2 |
| Worksheet | SECTION G POST |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Water Elevation |

| Section Data | | |
|---|---|---|
| Wtd. Mannings Coefficient | 0.055 | |
| Channel Slope | 0.034800 | ft/ft |
| Water Surface Elevation | 29.68 | ft |
| Discharge | 12.13 | cfs |



# CHANNEL 4 STA 0+00 POST
## Worksheet for Irregular Channel

| Project Description | |
|---|---|
| Project File | c:\haestad\fmw\shg2.fm2 |
| Worksheet | SECTION G POST |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Water Elevation |

| Input Data | | | | |
|---|---|---|---|---|
| Channel Slope | 0.034800 ft/ft | | | |
| Elevation range: 28.81 ft to 56.05 ft. | | | | |
| Station (ft) | Elevation (ft) | Start Station | End Station | Roughness |
| 0.00 | 40.35 | 0.00 | 167.65 | 0.055 |
| 24.63 | 34.76 | | | |
| 37.14 | 31.18 | | | |
| 43.26 | 30.37 | | | |
| 49.70 | 30.38 | | | |
| 53.78 | 30.19 | | | |
| 58.85 | 29.57 | | | |
| 59.23 | 28.81 | | | |
| 61.79 | 28.96 | | | |
| 62.56 | 29.08 | | | |
| 64.82 | 29.49 | | | |
| 71.98 | 29.82 | | | |
| 78.33 | 30.04 | | | |
| 79.45 | 29.39 | | | |
| 80.47 | 29.28 | | | |
| 81.38 | 29.25 | | | |
| 82.33 | 29.86 | | | |
| 86.77 | 31.27 | | | |
| 96.11 | 33.14 | | | |
| 115.14 | 35.95 | | | |
| 116.60 | 34.47 | | | |
| 118.15 | 34.38 | | | |
| 126.53 | 34.07 | | | |
| 129.30 | 34.01 | | | |
| 131.93 | 34.16 | | | |
| 132.88 | 34.92 | | | |
| 133.67 | 35.32 | | | |
| 141.38 | 41.82 | | | |
| 149.27 | 47.49 | | | |
| 149.74 | 47.77 | | | |
| 150.67 | 48.43 | | | |
| 159.33 | 53.24 | | | |
| 167.65 | 56.05 | | | |
| Discharge | 12.13 | cfs | | |

Results

CHANNEL 4 STA 0+00 POST

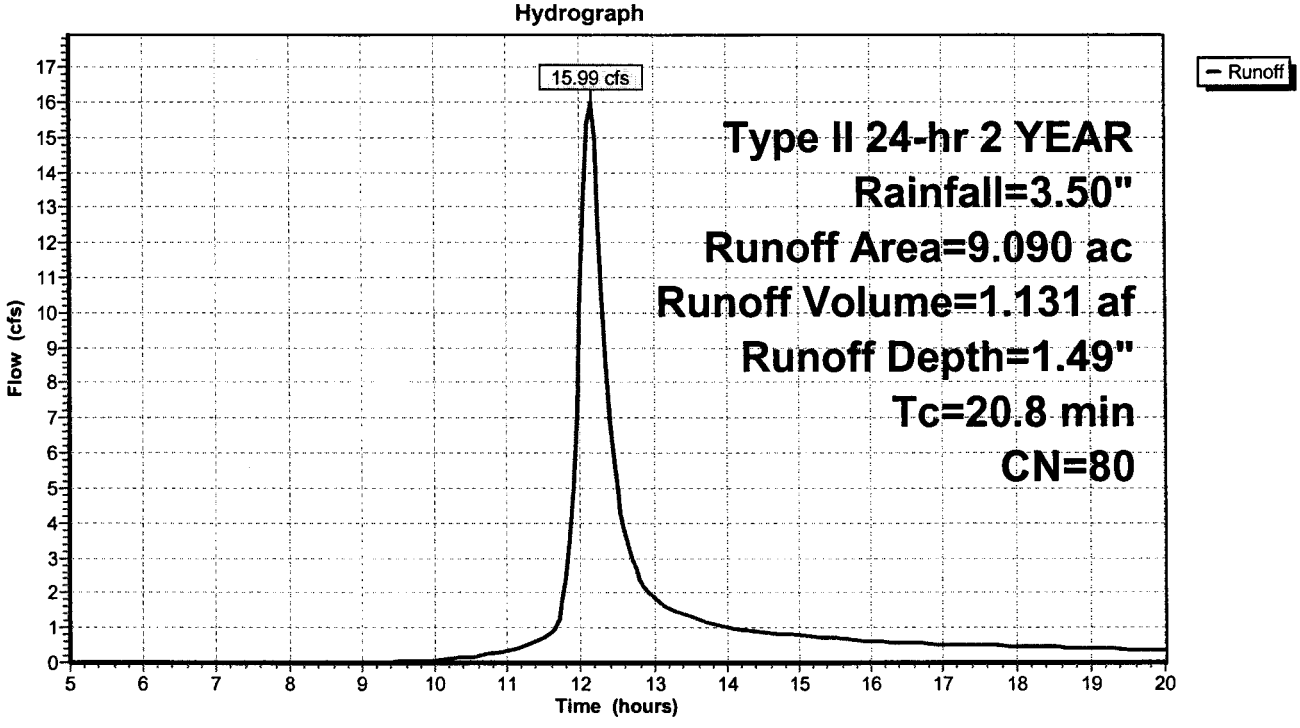
Worksheet for Irregular Channel

| | | |
|---|---|---|
| Wtd. Mannings Coefficient | 0.055 | |
| Water Surface Elevation | 29.68 | ft |
| Flow Area | 4.97 | $ft^2$ |
| Wetted Perimeter | 14.73 | ft |
| Top Width | 13.99 | ft |
| Height | 0.87 | ft |
| Critical Depth | 29.57 | ft |
| Critical Slope | 0.067987 | ft/ft |
| Velocity | 2.44 | ft/s |
| Velocity Head | 0.09 | ft |
| Specific Energy | 29.77 | ft |
| Froude Number | 0.72 | |

Flow is subcritical.

Flow is divided.

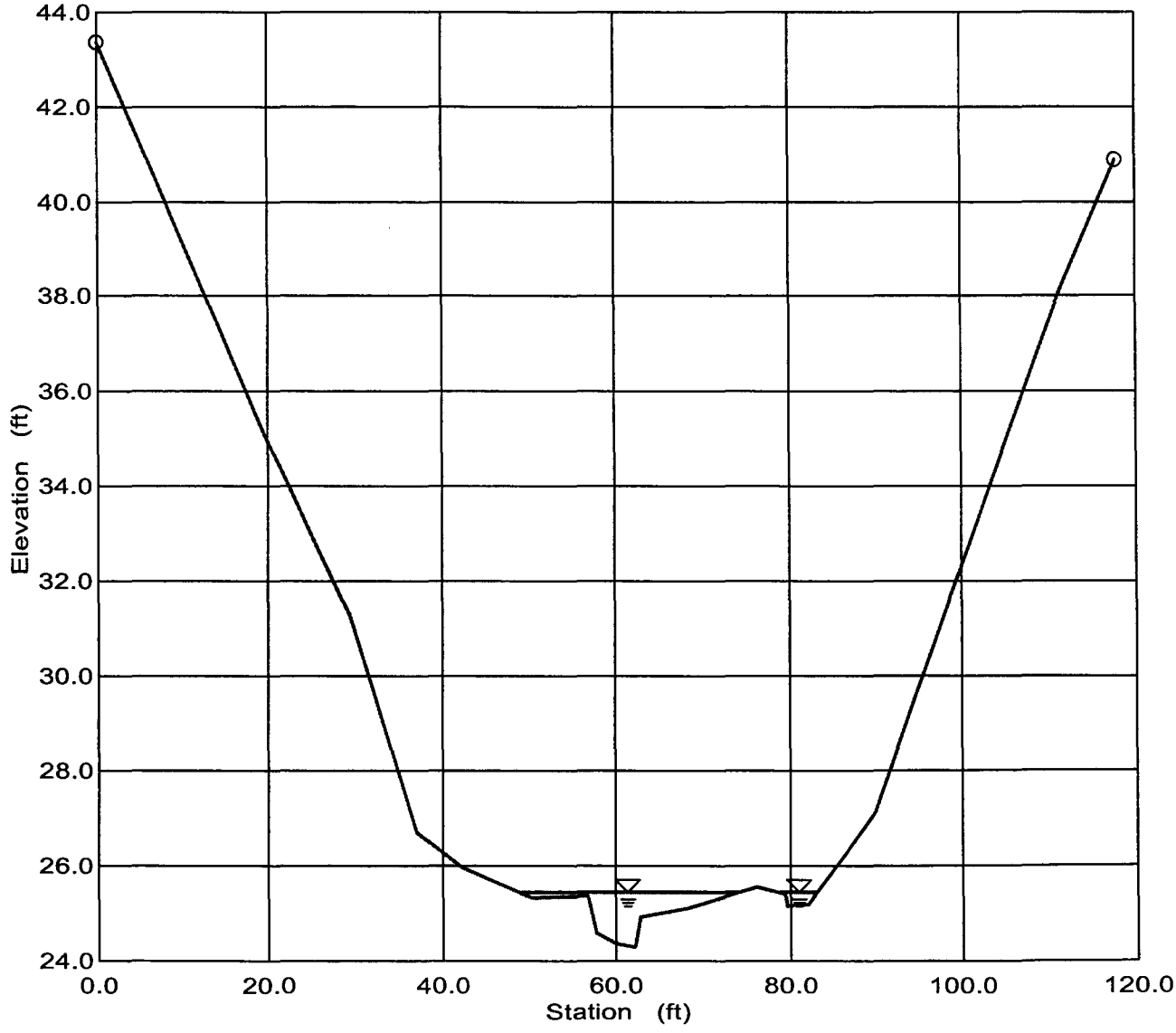
## Subcatchment 12S: AREA TO SECTION F



Section F POST
Cross Section for Irregular Channel

| Project Description | |
|---|---|
| Project File | c:\haestad\fmw\shg2.fm2 |
| Worksheet | SECTION F POST |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Water Elevation |

| Section Data | | |
|---|---|---|
| Wtd. Mannings Coefficient | 0.055 | |
| Channel Slope | 0.014400 | ft/ft |
| Water Surface Elevation | 25.43 | ft |
| Discharge | 15.99 | cfs |



# CHANNEL 4 STA 1+10 POST
## Worksheet for Irregular Channel

| Project Description | |
|---|---|
| Project File | c:\haestad\fmw\shg2.fm2 |
| Worksheet | SECTION F POST |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Water Elevation |

| Input Data | | |
|---|---|---|
| Channel Slope | 0.014400 | ft/ft |

Elevation range: 24.27 ft to 43.37 ft.

| Station (ft) | Elevation (ft) | Start Station | End Station | Roughness |
|---|---|---|---|---|
| 0.00 | 43.37 | 0.00 | 117.90 | 0.055 |
| 19.81 | 35.03 | | | |
| 29.21 | 31.29 | | | |
| 36.96 | 26.69 | | | |
| 42.14 | 25.94 | | | |
| 50.37 | 25.31 | | | |
| 56.79 | 25.36 | | | |
| 57.87 | 24.57 | | | |
| 59.92 | 24.35 | | | |
| 62.32 | 24.27 | | | |
| 62.75 | 24.91 | | | |
| 68.24 | 25.11 | | | |
| 76.15 | 25.54 | | | |
| 79.33 | 25.41 | | | |
| 79.68 | 25.15 | | | |
| 80.87 | 25.17 | | | |
| 82.02 | 25.19 | | | |
| 87.10 | 26.41 | | | |
| 90.02 | 27.12 | | | |
| 98.81 | 31.69 | | | |
| 111.48 | 38.05 | | | |
| 117.90 | 40.89 | | | |
| Discharge | 15.99 | cfs | | |

| Results | | |
|---|---|---|
| Wtd. Mannings Coefficient | 0.055 | |
| Water Surface Elevation | 25.43 | ft |
| Flow Area | 10.15 | $ft^2$ |
| Wetted Perimeter | 29.99 | ft |
| Top Width | 29.25 | ft |
| Height | 1.16 | ft |
| Critical Depth | 25.14 | ft |
| Critical Slope | 0.064180 | ft/ft |
| Velocity | 1.57 | ft/s |
| Velocity Head | 0.04 | ft |
| Specific Energy | 25.46 | ft |

CHANNEL 4 STA 1+10 POST

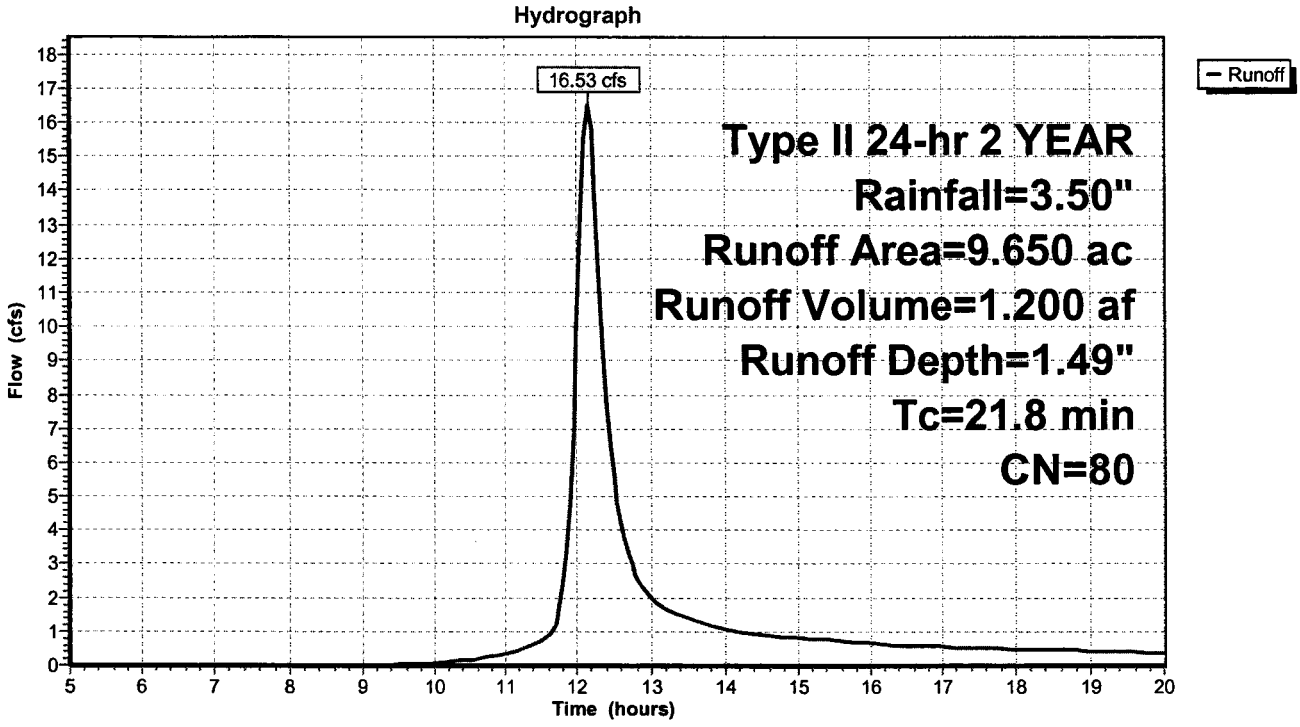
Worksheet for Irregular Channel

| | |
|---|---|
| Froude Number | 0.47 |

Flow is subcritical.

Flow is divided.

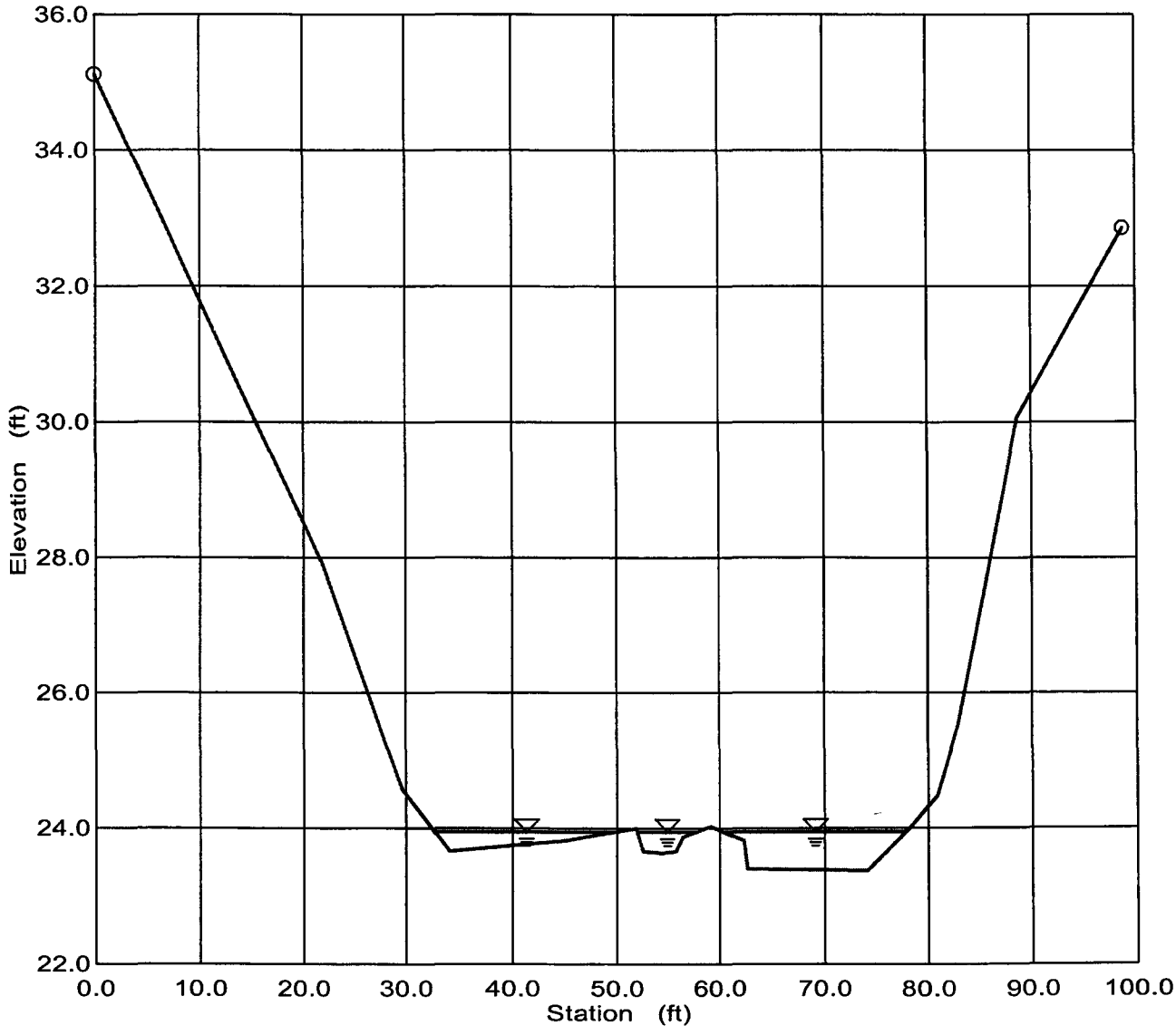
## Subcatchment 13S: AREA TO SECTION E



# Section E POST
## Cross Section for Irregular Channel

| Project Description | |
|---|---|
| Project File | c:\haestad\fmw\shg2.fm2 |
| Worksheet | SECTION E POST |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Water Elevation |

| Section Data | | |
|---|---|---|
| Wtd. Mannings Coefficient | 0.055 | |
| Channel Slope | 0.014400 | ft/ft |
| Water Surface Elevation | 23.94 | ft |
| Discharge | 16.53 | cfs |



# CHANNEL 4 STA 1+60 POST
## Worksheet for Irregular Channel

| Project Description | |
|---|---|
| Project File | c:\haestad\fmw\shg2.fm2 |
| Worksheet | SECTION E POST |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Water Elevation |

**Input Data**

Channel Slope 0.014400 ft/ft

Elevation range: 23.37 ft to 35.10 ft.

| Station (ft) | Elevation (ft) | Start Station | End Station | Roughness |
|---|---|---|---|---|
| 0.00 | 35.10 | 0.00 | 98.85 | 0.055 |
| 13.85 | 30.48 | | | |
| 21.76 | 27.90 | | | |
| 29.59 | 24.55 | | | |
| 34.07 | 23.66 | | | |
| 44.99 | 23.80 | | | |
| 51.91 | 23.98 | | | |
| 52.59 | 23.65 | | | |
| 54.42 | 23.63 | | | |
| 55.66 | 23.66 | | | |
| 56.34 | 23.85 | | | |
| 59.16 | 24.02 | | | |
| 62.24 | 23.80 | | | |
| 62.60 | 23.39 | | | |
| 74.32 | 23.37 | | | |
| 78.34 | 23.99 | | | |
| 80.92 | 24.45 | | | |
| 82.81 | 25.51 | | | |
| 88.64 | 30.05 | | | |
| 98.85 | 32.84 | | | |

Discharge 16.53 cfs

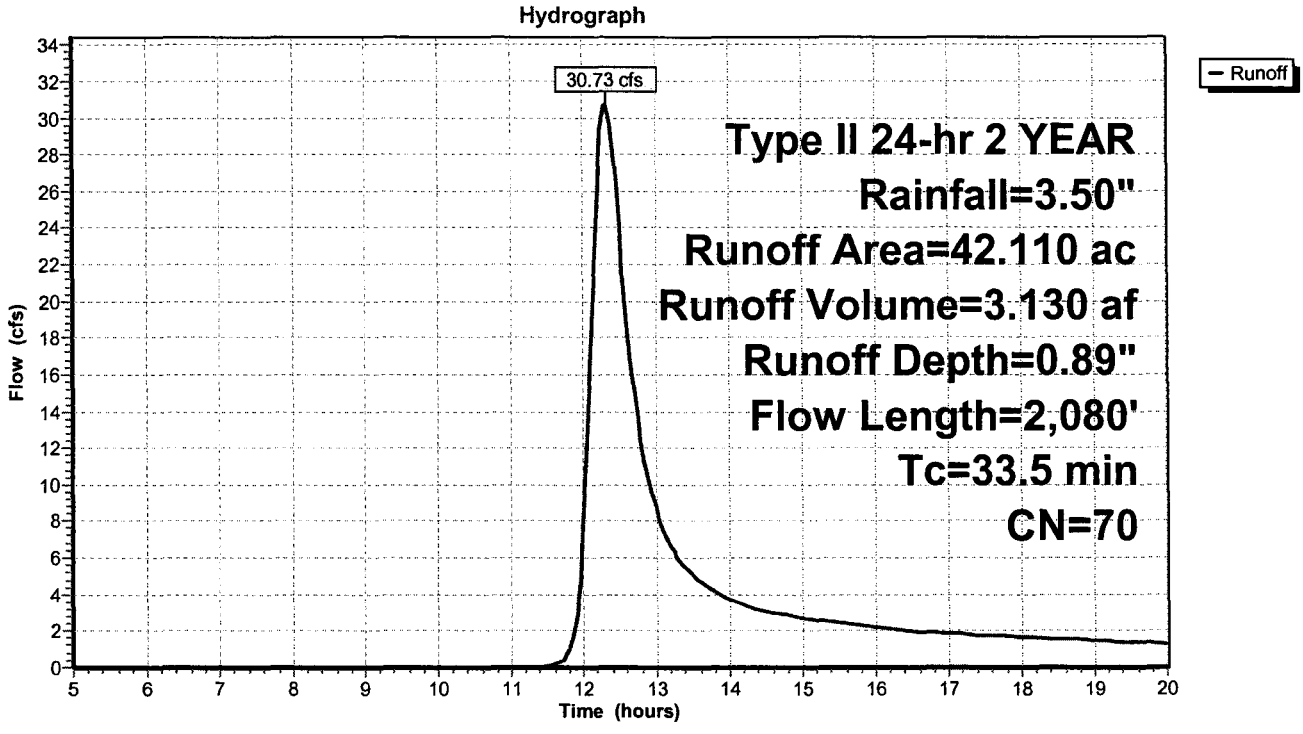
**Results**

| | | |
|---|---|---|
| Wtd. Mannings Coefficient | 0.055 | |
| Water Surface Elevation | 23.94 | ft |
| Flow Area | 11.77 | $ft^2$ |
| Wetted Perimeter | 41.31 | ft |
| Top Width | 40.95 | ft |
| Height | 0.57 | ft |
| Critical Depth | 23.77 | ft |
| Critical Slope | 0.073690 | ft/ft |
| Velocity | 1.40 | ft/s |
| Velocity Head | 0.03 | ft |
| Specific Energy | 23.97 | ft |
| Froude Number | 0.46 | |

Flow is subcritical.

# CHANNEL 5
# REACH HIJ

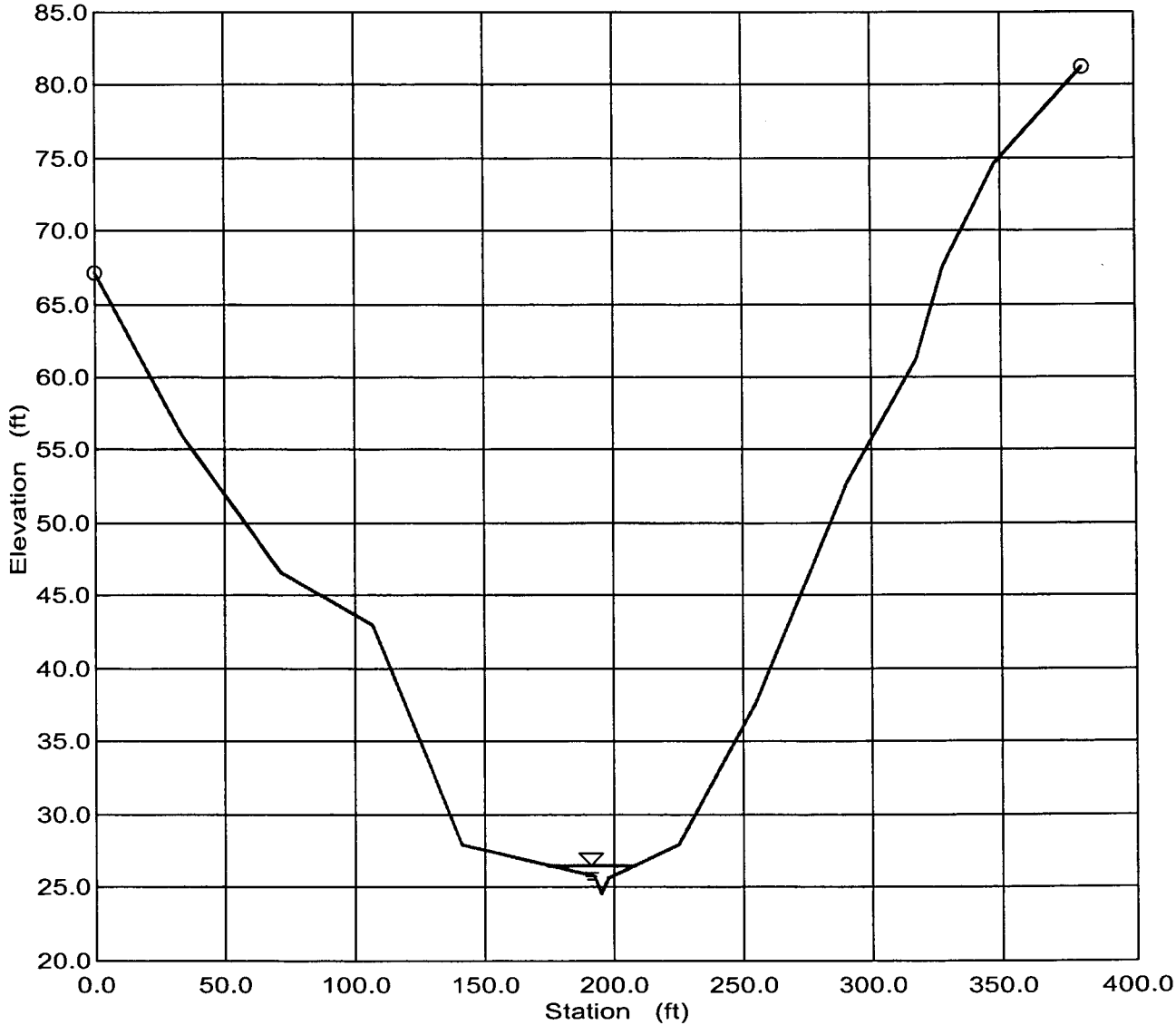
## Subcatchment 1S: DA TO SECTION J



Section J PRE
Cross Section for Irregular Channel

| Project Description | |
|---|---|
| Project File | c:\haestad\fmw\shg2.fm2 |
| Worksheet | SECTION J |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Water Elevation |

| Section Data | | |
|---|---|---|
| Wtd. Mannings Coefficient | 0.055 | |
| Channel Slope | 0.007739 | ft/ft |
| Water Surface Elevation | 26.53 | ft |
| Discharge | 30.73 | cfs |



# CHANNEL 5 STA 0+00 PRE
## Worksheet for Irregular Channel

| Project Description | |
|---|---|
| Project File | c:\haestad\fmw\shg2.fm2 |
| Worksheet | SECTION J |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Water Elevation |

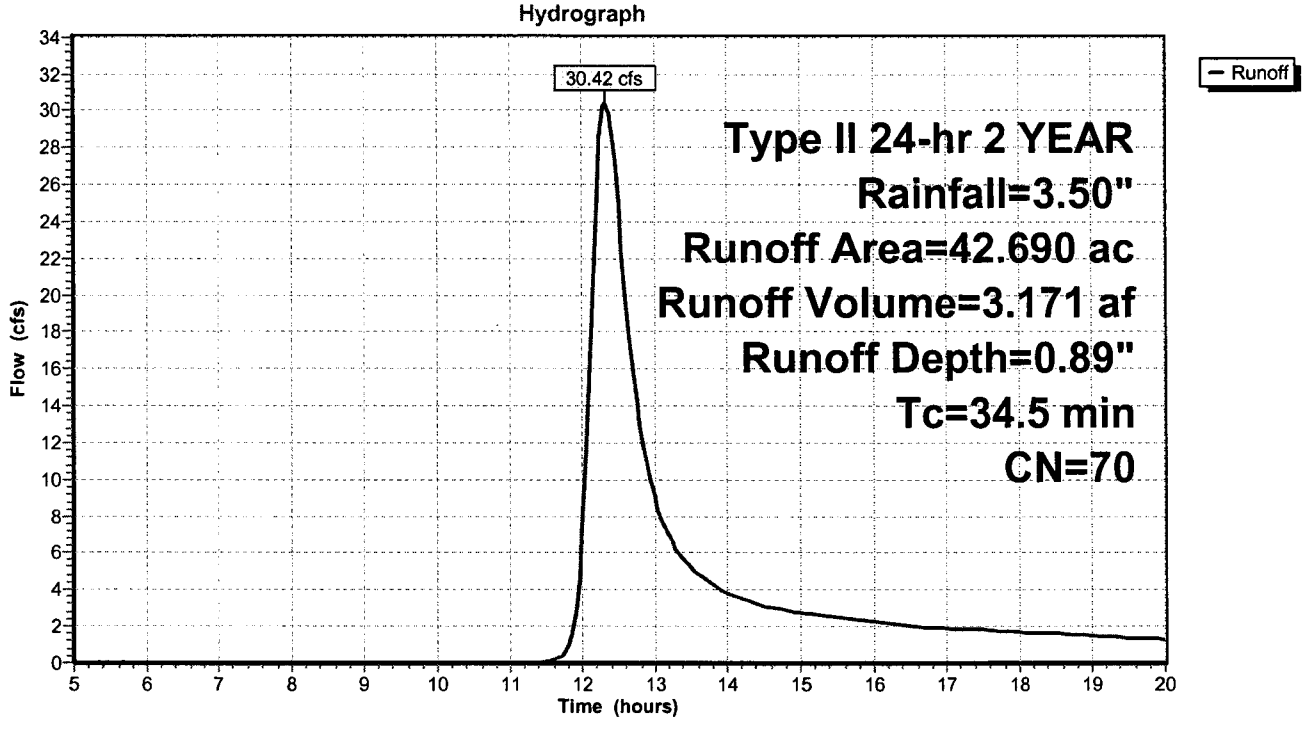
| Input Data | | |
|---|---|---|
| Channel Slope | 0.007739 | ft/ft |

Elevation range: 24.53 ft to 81.26 ft.

| Station (ft) | Elevation (ft) | Start Station | End Station | Roughness |
|---|---|---|---|---|
| 0.00 | 67.07 | 0.00 | 380.57 | 0.055 |
| 34.02 | 55.96 | | | |
| 71.76 | 46.55 | | | |
| 106.69 | 42.96 | | | |
| 141.53 | 27.92 | | | |
| 192.30 | 25.77 | | | |
| 195.00 | 24.53 | | | |
| 197.99 | 25.67 | | | |
| 224.67 | 27.97 | | | |
| 254.79 | 37.53 | | | |
| 290.17 | 52.81 | | | |
| 317.48 | 61.22 | | | |
| 327.63 | 67.48 | | | |
| 347.81 | 74.53 | | | |
| 380.57 | 81.26 | | | |
| Discharge | 30.73 | cfs | | |

| Results | | |
|---|---|---|
| Wtd. Mannings Coefficient | 0.055 | |
| Water Surface Elevation | 26.53 | ft |
| Flow Area | 19.05 | $ft^2$ |
| Wetted Perimeter | 34.09 | ft |
| Top Width | 33.55 | ft |
| Height | 2.00 | ft |
| Critical Depth | 26.12 | ft |
| Critical Slope | 0.060396 | ft/ft |
| Velocity | 1.61 | ft/s |
| Velocity Head | 0.04 | ft |
| Specific Energy | 26.57 | ft |
| Froude Number | 0.38 | |
| Flow is subcritical. | | |

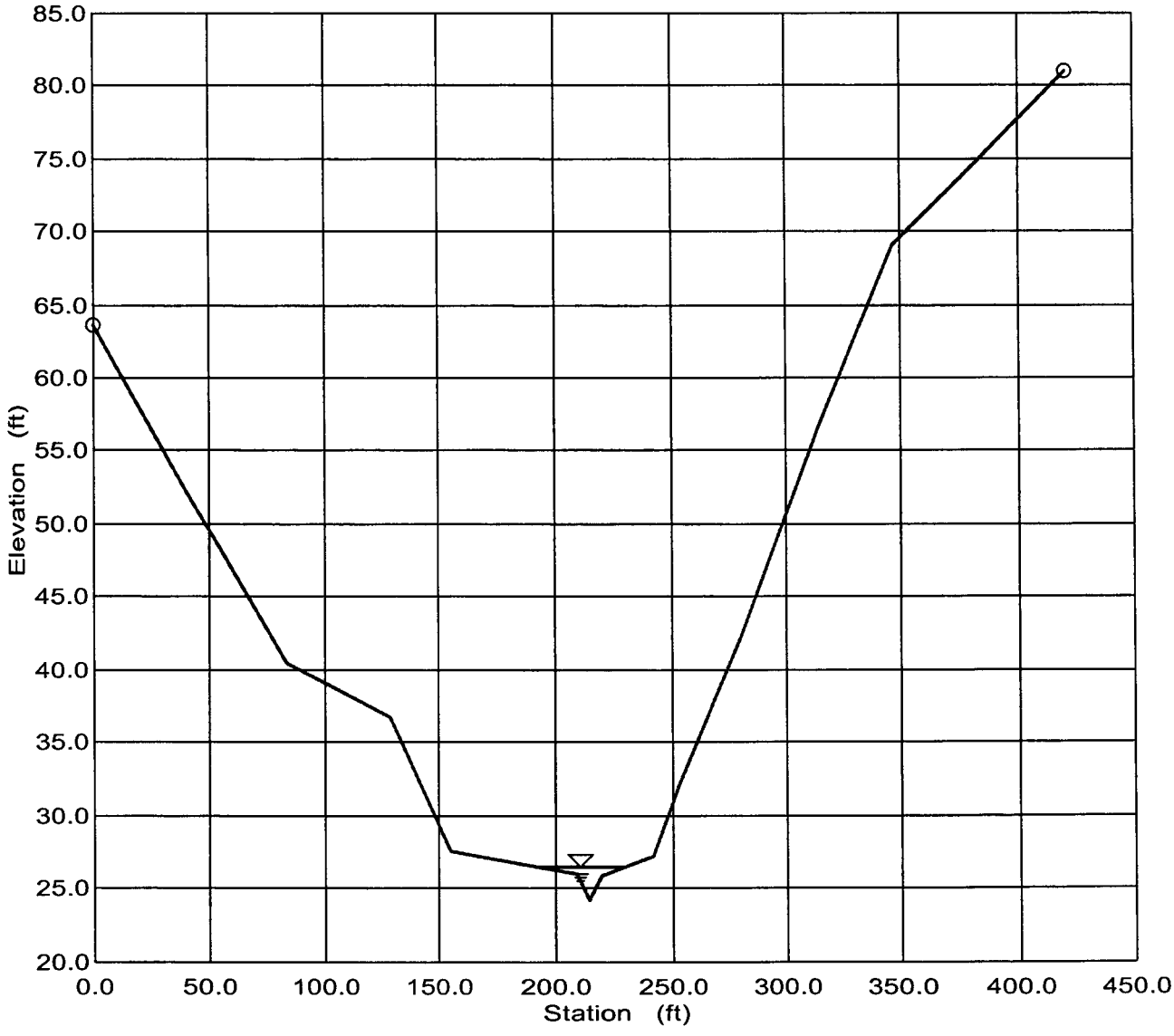
## Subcatchment 2S: DA TO SECTION I



Section I PRE
Cross Section for Irregular Channel

| Project Description | |
|---|---|
| Project File | c:\haestad\fmw\shg2.fm2 |
| Worksheet | SECTION I |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Water Elevation |

| Section Data | | |
|---|---|---|
| Wtd. Mannings Coefficient | 0.055 | |
| Channel Slope | 0.005519 | ft/ft |
| Water Surface Elevation | 26.43 | ft |
| Discharge | 30.42 | cfs |



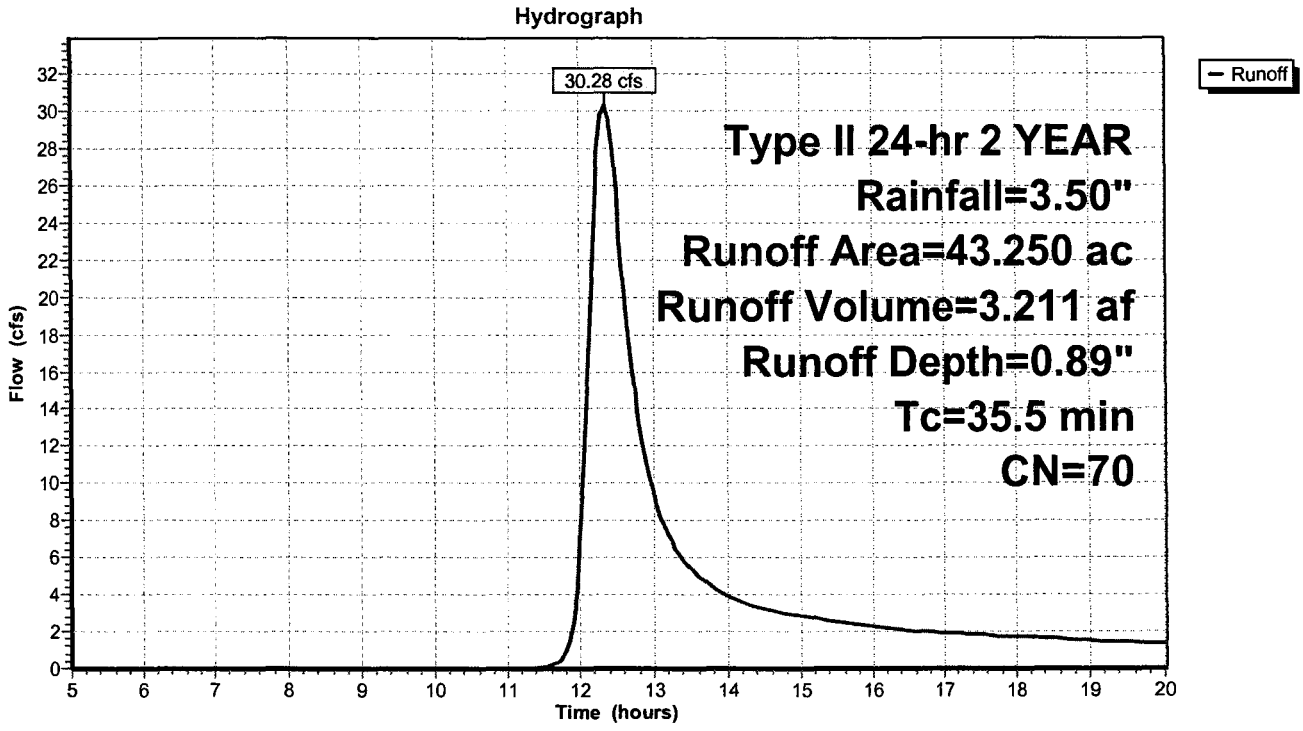
# CHANNEL 5 STA 0+49 PRE
## Worksheet for Irregular Channel

| Project Description | |
|---|---|
| Project File | c:\haestad\fmw\shg2.fm2 |
| Worksheet | SECTION I |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Water Elevation |

| Input Data | | | | |
|---|---|---|---|---|
| Channel Slope | 0.005519 ft/ft | | | |
| Elevation range: 24.15 ft to 80.96 ft. | | | | |
| Station (ft) | Elevation (ft) | Start Station | End Station | Roughness |
| 0.00 | 63.63 | 0.00 | 420.85 | 0.055 |
| 38.85 | 52.56 | | | |
| 83.31 | 40.41 | | | |
| 128.99 | 36.78 | | | |
| 154.92 | 27.50 | | | |
| 209.19 | 25.95 | | | |
| 214.68 | 24.15 | | | |
| 219.66 | 25.81 | | | |
| 241.99 | 27.25 | | | |
| 252.21 | 31.89 | | | |
| 279.97 | 41.98 | | | |
| 313.46 | 56.38 | | | |
| 347.45 | 69.08 | | | |
| 420.85 | 80.96 | | | |
| Discharge | 30.42 cfs | | | |

| Results | | |
|---|---|---|
| Wtd. Mannings Coefficient | 0.055 | |
| Water Surface Elevation | 26.43 | ft |
| Flow Area | 21.75 | ft² |
| Wetted Perimeter | 37.39 | ft |
| Top Width | 36.81 | ft |
| Height | 2.28 | ft |
| Critical Depth | 25.59 | ft |
| Critical Slope | 0.052650 | ft/ft |
| Velocity | 1.40 | ft/s |
| Velocity Head | 0.03 | ft |
| Specific Energy | 26.46 | ft |
| Froude Number | 0.32 | |
| Flow is subcritical. | | |

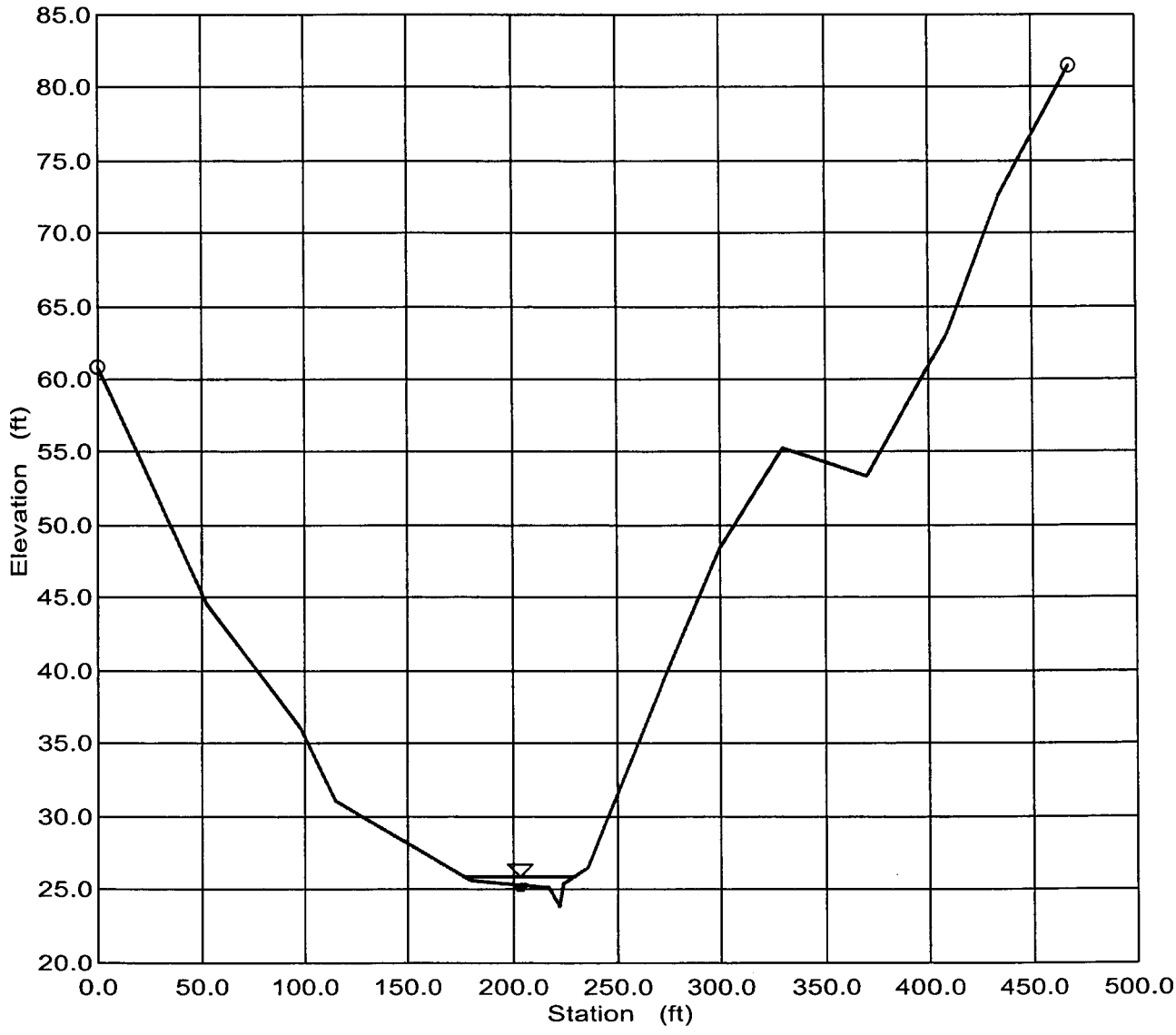
## Subcatchment 3S: DA TO SECTION H



Section H PRE
Cross Section for Irregular Channel

| Project Description | |
|---|---|
| Project File | c:\haestad\fmw\shg2.fm2 |
| Worksheet | SECTION H |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Water Elevation |

| Section Data | | |
|---|---|---|
| Wtd. Mannings Coefficient | 0.055 | |
| Channel Slope | 0.005500 | ft/ft |
| Water Surface Elevation | 25.89 | ft |
| Discharge | 38.90 | cfs |



# CHANNEL 5 STA 1+03 PRE
## Worksheet for Irregular Channel

| Project Description | |
|---|---|
| Project File | c:\haestad\fmw\shg2.fm2 |
| Worksheet | SECTION H |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Water Elevation |

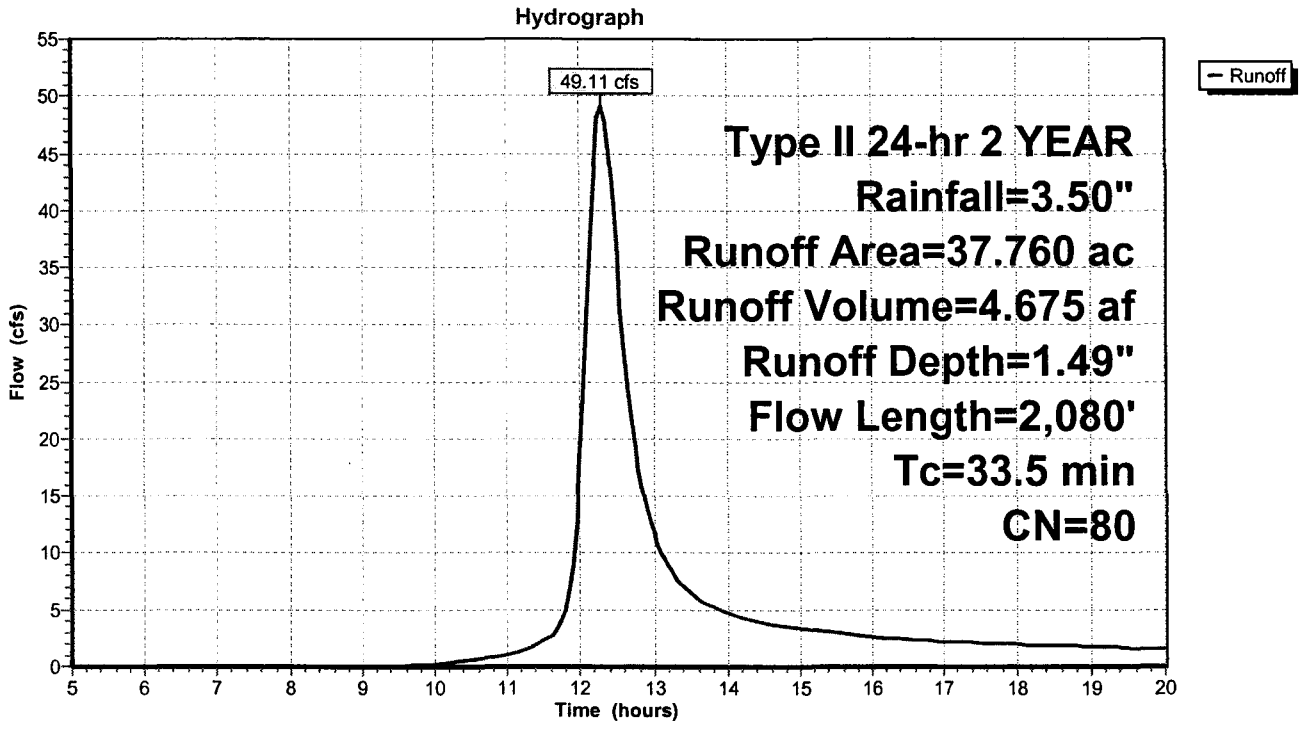
| Input Data | | |
|---|---|---|
| Channel Slope | 0.005500 | ft/ft |

Elevation range: 23.85 ft to 81.44 ft.

| Station (ft) | Elevation (ft) | Start Station | End Station | Roughness |
|---|---|---|---|---|
| 0.00 | 60.82 | 0.00 | 468.29 | 0.055 |
| 52.66 | 44.51 | | | |
| 98.00 | 36.03 | | | |
| 115.30 | 31.08 | | | |
| 179.90 | 25.64 | | | |
| 217.41 | 25.17 | | | |
| 222.01 | 23.85 | | | |
| 224.20 | 25.40 | | | |
| 235.54 | 26.42 | | | |
| 271.89 | 39.25 | | | |
| 300.08 | 48.45 | | | |
| 330.02 | 55.25 | | | |
| 370.26 | 53.40 | | | |
| 408.60 | 62.99 | | | |
| 433.86 | 72.48 | | | |
| 468.29 | 81.44 | | | |
| Discharge | 38.90 | cfs | | |

| Results | | |
|---|---|---|
| Wtd. Mannings Coefficient | 0.055 | |
| Water Surface Elevation | 25.89 | ft |
| Flow Area | 29.12 | ft² |
| Wetted Perimeter | 53.47 | ft |
| Top Width | 52.76 | ft |
| Height | 2.04 | ft |
| Critical Depth | 25.53 | ft |
| Critical Slope | 0.065789 | ft/ft |
| Velocity | 1.34 | ft/s |
| Velocity Head | 0.03 | ft |
| Specific Energy | 25.92 | ft |
| Froude Number | 0.32 | |
| Flow is subcritical. | | |

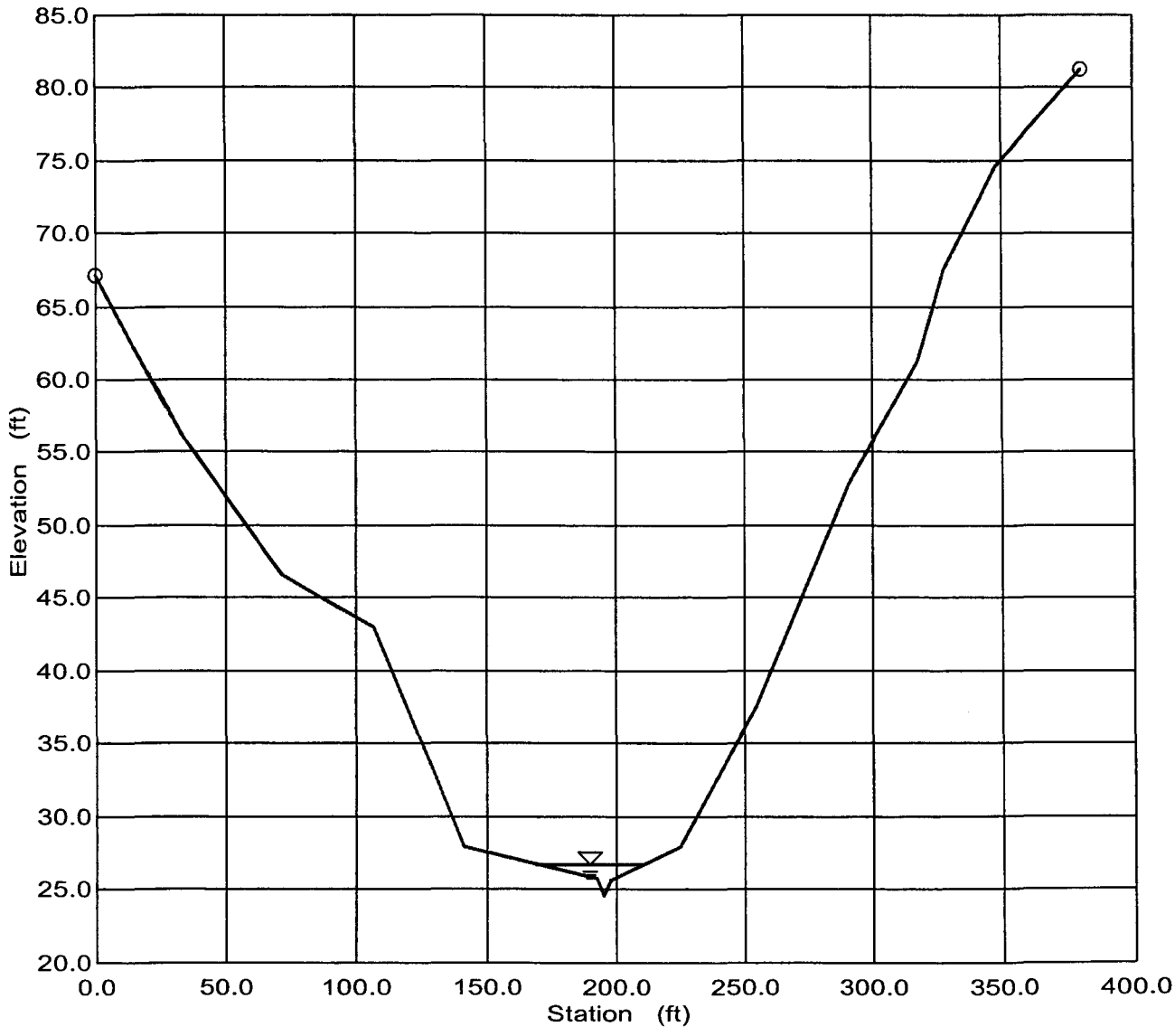
## Subcatchment 11S: DA TO SECTION J



Section J POST
Cross Section for Irregular Channel

| Project Description | |
|---|---|
| Project File | c:\haestad\fmw\shg2.fm2 |
| Worksheet | SECTION J POST |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Water Elevation |

| Section Data | | |
|---|---|---|
| Wtd. Mannings Coefficient | 0.055 | |
| Channel Slope | 0.007739 | ft/ft |
| Water Surface Elevation | 26.75 | ft |
| Discharge | 49.11 | cfs |



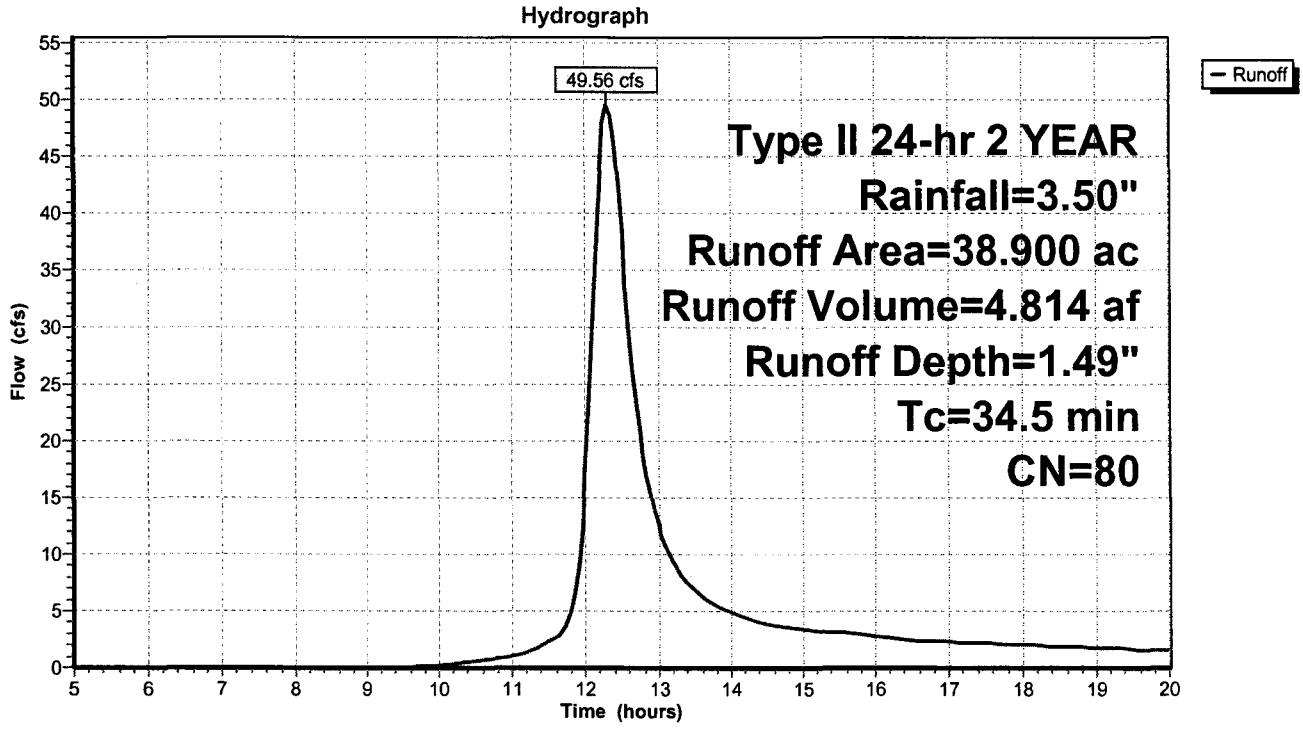
# CHANNEL 5 STA 0+00 POST
## Worksheet for Irregular Channel

| Project Description | |
|---|---|
| Project File | c:\haestad\fmw\shg2.fm2 |
| Worksheet | SECTION J POST |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Water Elevation |

| Input Data | | | | |
|---|---|---|---|---|
| Channel Slope | 0.007739 ft/ft | | | |
| Elevation range: 24.53 ft to 81.26 ft. | | | | |
| Station (ft) | Elevation (ft) | Start Station | End Station | Roughness |
| 0.00 | 67.07 | 0.00 | 380.57 | 0.055 |
| 34.02 | 55.96 | | | |
| 71.76 | 46.55 | | | |
| 106.69 | 42.96 | | | |
| 141.53 | 27.92 | | | |
| 192.30 | 25.77 | | | |
| 195.00 | 24.53 | | | |
| 197.99 | 25.67 | | | |
| 224.67 | 27.97 | | | |
| 254.79 | 37.53 | | | |
| 290.17 | 52.81 | | | |
| 317.48 | 61.22 | | | |
| 327.63 | 67.48 | | | |
| 347.81 | 74.53 | | | |
| 380.57 | 81.26 | | | |
| Discharge | 49.11 cfs | | | |

| Results | | |
|---|---|---|
| Wtd. Mannings Coefficient | 0.055 | |
| Water Surface Elevation | 26.75 | ft |
| Flow Area | 27.43 | ft² |
| Wetted Perimeter | 41.97 | ft |
| Top Width | 41.42 | ft |
| Height | 2.22 | ft |
| Critical Depth | 26.31 | ft |
| Critical Slope | 0.057651 | ft/ft |
| Velocity | 1.79 | ft/s |
| Velocity Head | 0.05 | ft |
| Specific Energy | 26.80 | ft |
| Froude Number | 0.39 | |
| Flow is subcritical. | | |

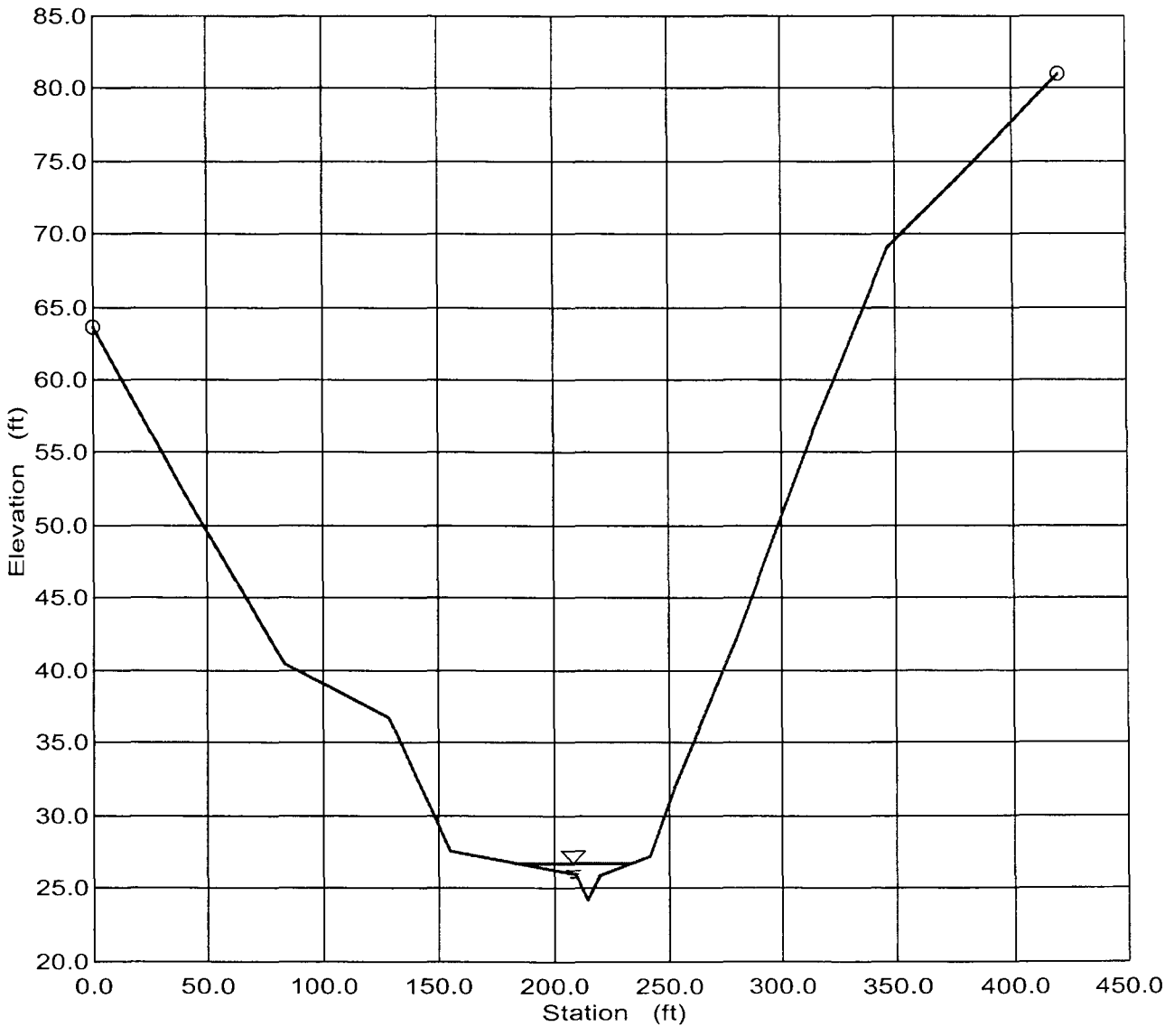
## Subcatchment 12S: DA TO SECTION I



Section I POST
Cross Section for Irregular Channel

| Project Description | |
|---|---|
| Project File | c:\haestad\fmw\shg2.fm2 |
| Worksheet | SECTION I POST |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Water Elevation |

| Section Data | | |
|---|---|---|
| Wtd. Mannings Coefficient | 0.055 | |
| Channel Slope | 0.005519 | ft/ft |
| Water Surface Elevation | 26.68 | ft |
| Discharge | 49.56 | cfs |



# CHANNEL 5 STA 0+49 POST
## Worksheet for Irregular Channel

| Project Description | |
|---|---|
| Project File | c:\haestad\fmw\shg2.fm2 |
| Worksheet | SECTION I POST |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Water Elevation |

| Input Data | | |
|---|---|---|
| Channel Slope | 0.005519 | ft/ft |

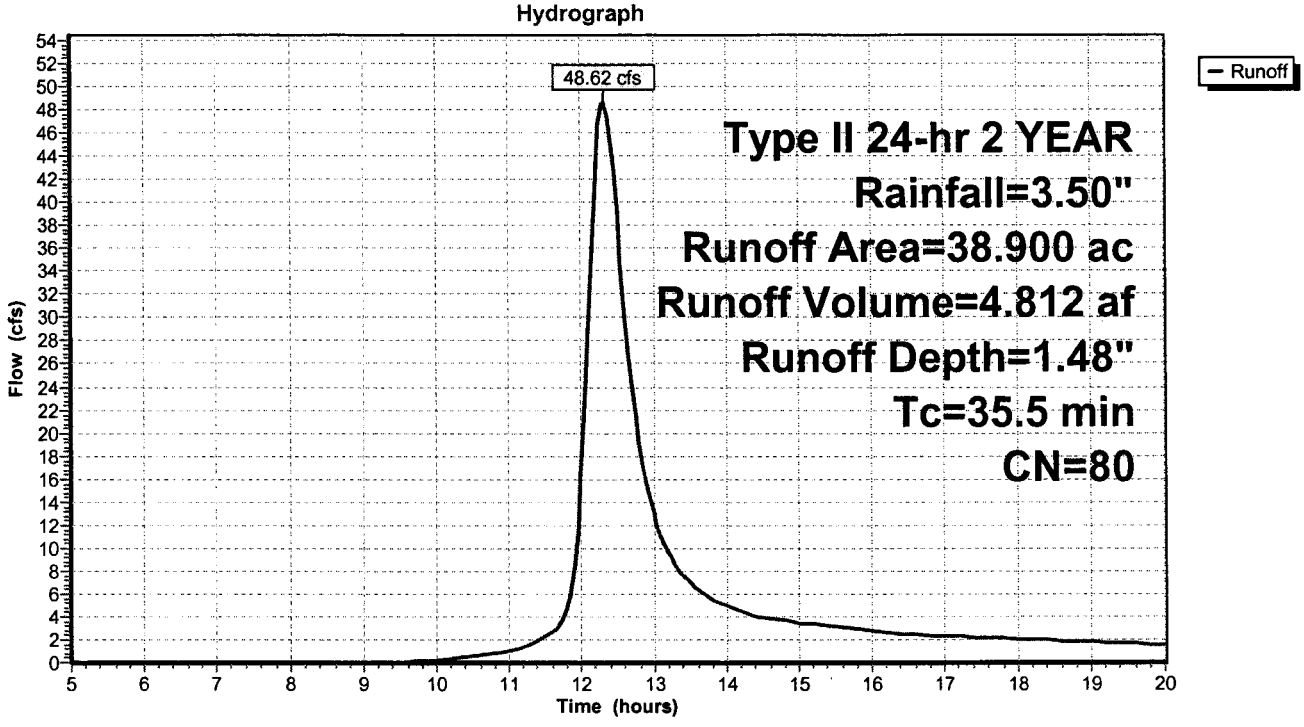
Elevation range: 24.15 ft to 80.96 ft.

| Station (ft) | Elevation (ft) | Start Station | End Station | Roughness |
|---|---|---|---|---|
| 0.00 | 63.63 | 0.00 | 420.85 | 0.055 |
| 38.85 | 52.56 | | | |
| 83.31 | 40.41 | | | |
| 128.99 | 36.78 | | | |
| 154.92 | 27.50 | | | |
| 209.19 | 25.95 | | | |
| 214.68 | 24.15 | | | |
| 219.66 | 25.81 | | | |
| 241.99 | 27.25 | | | |
| 252.21 | 31.89 | | | |
| 279.97 | 41.98 | | | |
| 313.46 | 56.38 | | | |
| 347.45 | 69.08 | | | |
| 420.85 | 80.96 | | | |

| Discharge | 49.56 | cfs |
|---|---|---|

| Results | | |
|---|---|---|
| Wtd. Mannings Coefficient | 0.055 | |
| Water Surface Elevation | 26.68 | ft |
| Flow Area | 32.83 | $ft^2$ |
| Wetted Perimeter | 50.34 | ft |
| Top Width | 49.75 | ft |
| Height | 2.53 | ft |
| Critical Depth | 25.94 | ft |
| Critical Slope | 0.050633 | ft/ft |
| Velocity | 1.51 | ft/s |
| Velocity Head | 0.04 | ft |
| Specific Energy | 26.72 | ft |
| Froude Number | 0.33 | |
| Flow is subcritical. | | |

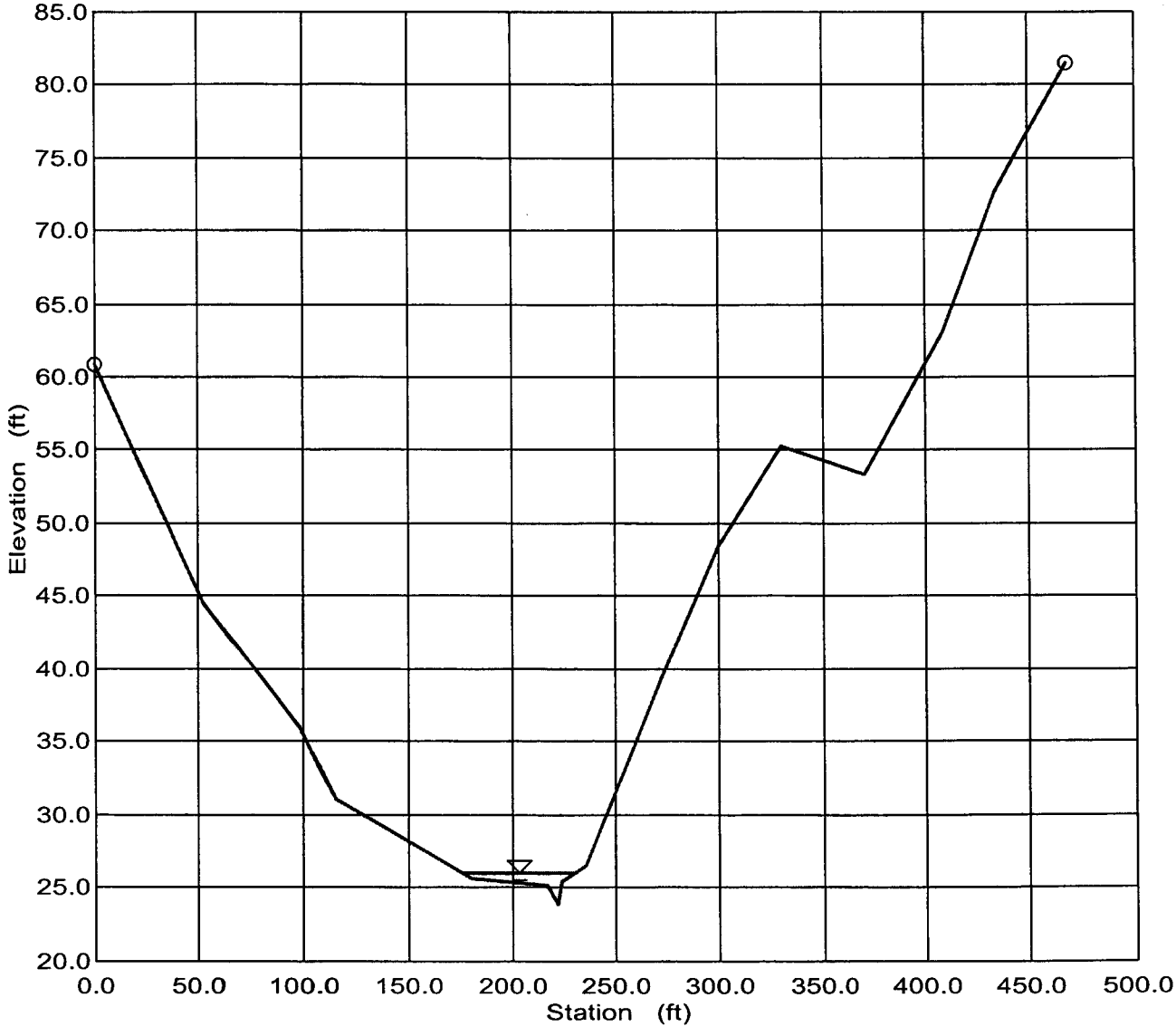
## Subcatchment 13S: DA TO SECTION H



Section H POST
Cross Section for Irregular Channel

| Project Description | |
|---|---|
| Project File | c:\haestad\fmw\shg2.fm2 |
| Worksheet | SECTION H POST |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Water Elevation |

| Section Data | | |
|---|---|---|
| Wtd. Mannings Coefficient | 0.055 | |
| Channel Slope | 0.005500 | ft/ft |
| Water Surface Elevation | 25.98 | ft |
| Discharge | 48.62 | cfs |



# CHANNEL 5 STA 1+03 POST
## Worksheet for Irregular Channel

| Project Description | |
|---|---|
| Project File | c:\haestad\fmw\shg2.fm2 |
| Worksheet | SECTION H POST |
| Flow Element | Irregular Channel |
| Method | Manning's Formula |
| Solve For | Water Elevation |

| Input Data | | |
|---|---|---|
| Channel Slope | 0.005500 | ft/ft |

Elevation range: 23.85 ft to 81.44 ft.

| Station (ft) | Elevation (ft) | Start Station | End Station | Roughness |
|---|---|---|---|---|
| 0.00 | 60.82 | 0.00 | 468.29 | 0.055 |
| 52.66 | 44.51 | | | |
| 98.00 | 36.03 | | | |
| 115.30 | 31.08 | | | |
| 179.90 | 25.64 | | | |
| 217.41 | 25.17 | | | |
| 222.01 | 23.85 | | | |
| 224.20 | 25.40 | | | |
| 235.54 | 26.42 | | | |
| 271.89 | 39.25 | | | |
| 300.08 | 48.45 | | | |
| 330.02 | 55.25 | | | |
| 370.26 | 53.40 | | | |
| 408.60 | 62.99 | | | |
| 433.86 | 72.48 | | | |
| 468.29 | 81.44 | | | |

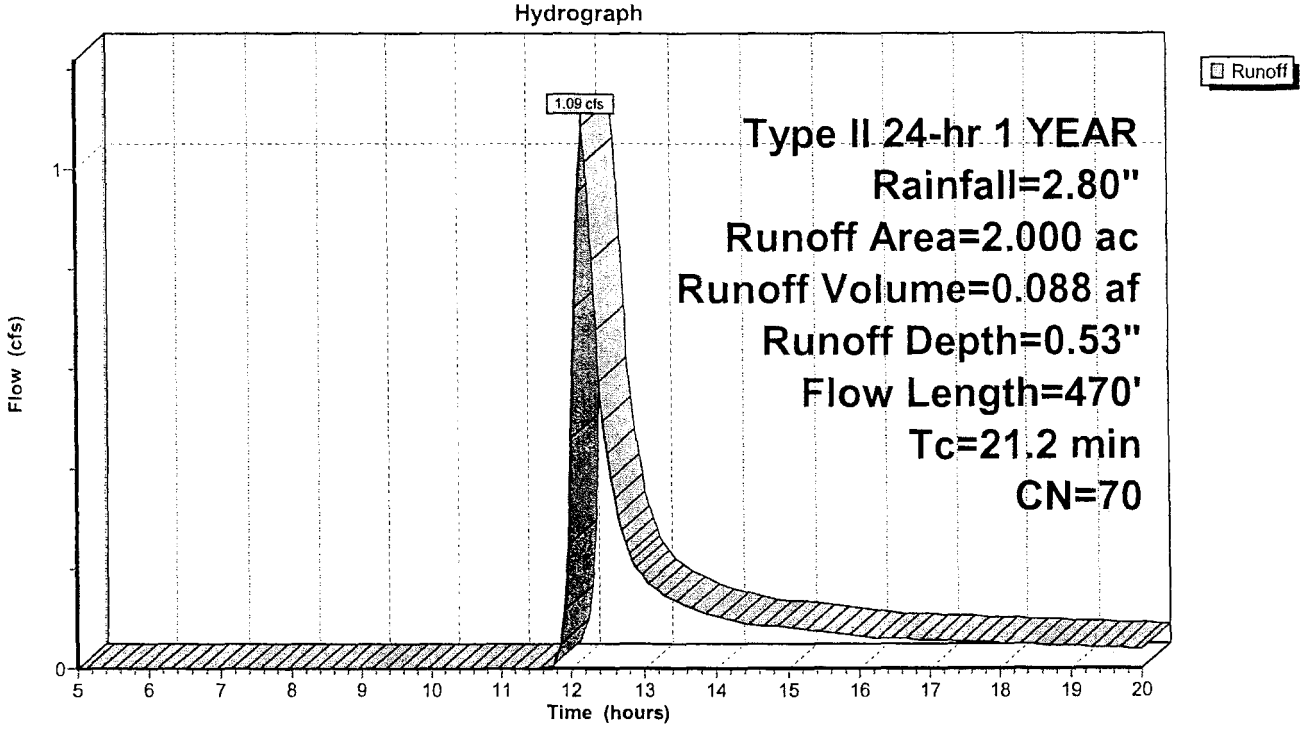
| Discharge | 48.62 | cfs |
|---|---|---|

| Results | | |
|---|---|---|
| Wtd. Mannings Coefficient | 0.055 | |
| Water Surface Elevation | 25.98 | ft |
| Flow Area | 33.78 | ft² |
| Wetted Perimeter | 55.48 | ft |
| Top Width | 54.75 | ft |
| Height | 2.13 | ft |
| Critical Depth | 25.60 | ft |
| Critical Slope | 0.064502 | ft/ft |
| Velocity | 1.44 | ft/s |
| Velocity Head | 0.03 | ft |
| Specific Energy | 26.01 | ft |
| Froude Number | 0.32 | |

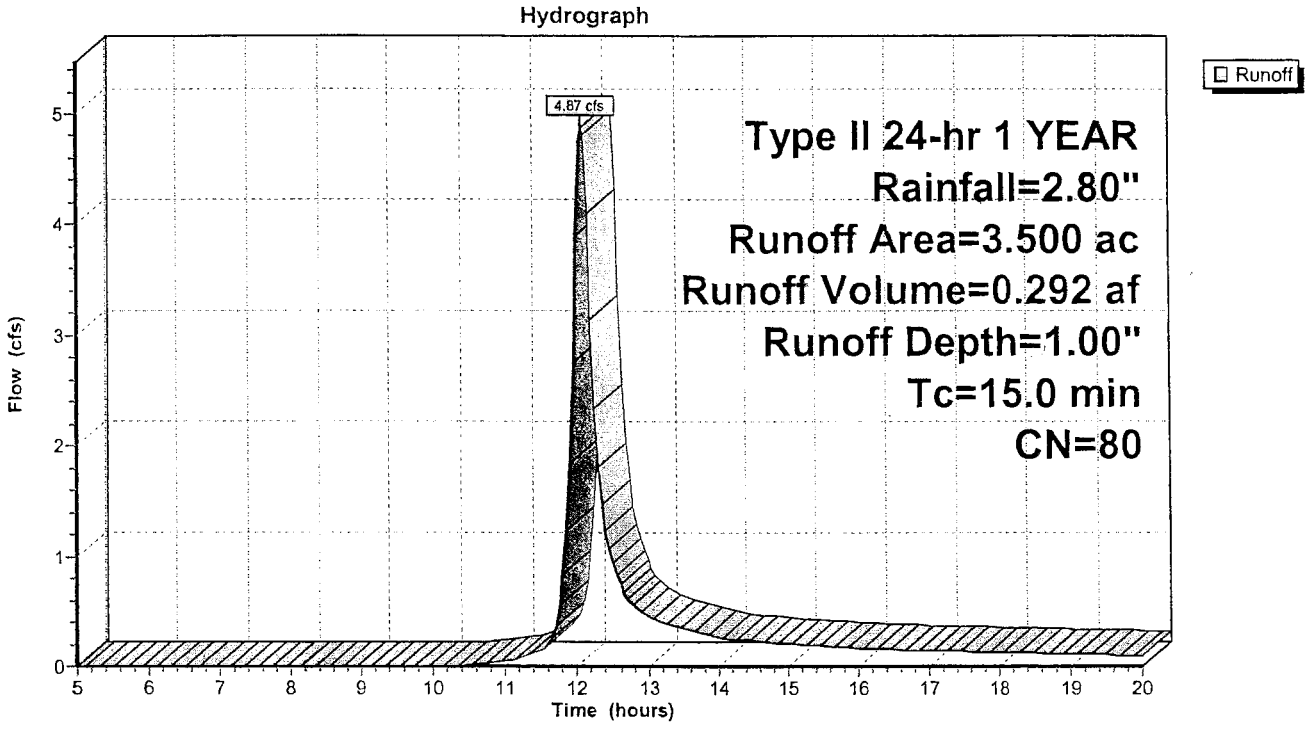
Flow is subcritical.

# BMP 4

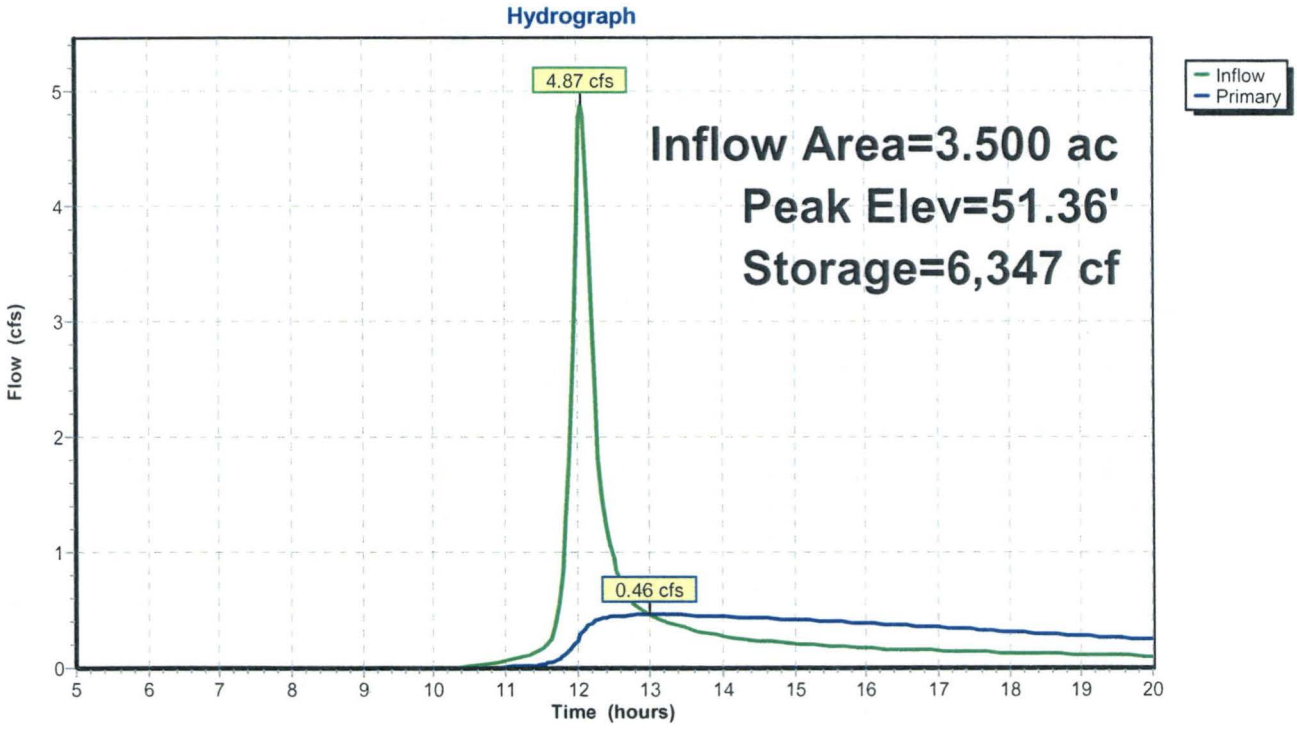
## Subcatchment DA4 PRE: PRE-DEVELOPED



## Subcatchment DA4 POST: DA4 POST



## Pond B4: BMP 4


Hydrograph
4.87 cfs
0.46 cfs
Inflow Area=3.500 ac
Peak Elev=51.36'
Storage=6,347 cf
Inflow
Primary
Flow (cfs)
Time (hours)
0
1
2
3
4
5
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20

## Hydrograph for Pond B4: BMP 4

| Time (hours) | Inflow (cfs) | Storage (cubic-feet) | Elevation (feet) | Primary (cfs) |
|---|---|---|---|---|
| 0.00 | 0.00 | 0 | 47.50 | 0.00 |
| 0.25 | 0.00 | 0 | 47.50 | 0.00 |
| 0.50 | 0.00 | 0 | 47.50 | 0.00 |
| 0.75 | 0.00 | 0 | 47.50 | 0.00 |
| 1.00 | 0.00 | 0 | 47.50 | 0.00 |
| 1.25 | 0.00 | 0 | 47.50 | 0.00 |
| 1.50 | 0.00 | 0 | 47.50 | 0.00 |
| 1.75 | 0.00 | 0 | 47.50 | 0.00 |
| 2.00 | 0.00 | 0 | 47.50 | 0.00 |
| 2.25 | 0.00 | 0 | 47.50 | 0.00 |
| 2.50 | 0.00 | 0 | 47.50 | 0.00 |
| 2.75 | 0.00 | 0 | 47.50 | 0.00 |
| 3.00 | 0.00 | 0 | 47.50 | 0.00 |
| 3.25 | 0.00 | 0 | 47.50 | 0.00 |
| 3.50 | 0.00 | 0 | 47.50 | 0.00 |
| 3.75 | 0.00 | 0 | 47.50 | 0.00 |
| 4.00 | 0.00 | 0 | 47.50 | 0.00 |
| 4.25 | 0.00 | 0 | 47.50 | 0.00 |
| 4.50 | 0.00 | 0 | 47.50 | 0.00 |
| 4.75 | 0.00 | 0 | 47.50 | 0.00 |
| 5.00 | 0.00 | 0 | 47.50 | 0.00 |
| 5.25 | 0.00 | 0 | 47.50 | 0.00 |
| 5.50 | 0.00 | 0 | 47.50 | 0.00 |
| 5.75 | 0.00 | 0 | 47.50 | 0.00 |
| 6.00 | 0.00 | 0 | 47.50 | 0.00 |
| 6.25 | 0.00 | 0 | 47.50 | 0.00 |
| 6.50 | 0.00 | 0 | 47.50 | 0.00 |
| 6.75 | 0.00 | 0 | 47.50 | 0.00 |
| 7.00 | 0.00 | 0 | 47.50 | 0.00 |
| 7.25 | 0.00 | 0 | 47.50 | 0.00 |
| 7.50 | 0.00 | 0 | 47.50 | 0.00 |
| 7.75 | 0.00 | 0 | 47.50 | 0.00 |
| 8.00 | 0.00 | 0 | 47.50 | 0.00 |
| 8.25 | 0.00 | 0 | 47.50 | 0.00 |
| 8.50 | 0.00 | 0 | 47.50 | 0.00 |
| 8.75 | 0.00 | 0 | 47.50 | 0.00 |
| 9.00 | 0.00 | 0 | 47.50 | 0.00 |
| 9.25 | 0.00 | 0 | 47.50 | 0.00 |
| 9.50 | 0.00 | 0 | 47.50 | 0.00 |
| 9.75 | 0.00 | 0 | 47.50 | 0.00 |
| 10.00 | 0.00 | 0 | 47.50 | 0.00 |
| 10.25 | 0.00 | 2 | 47.50 | 0.00 |
| 10.50 | 0.01 | 10 | 47.51 | 0.00 |
| 10.75 | 0.03 | 28 | 47.52 | 0.00 |
| 11.00 | 0.05 | 61 | 47.54 | 0.01 |
| 11.25 | 0.09 | 117 | 47.57 | 0.01 |
| 11.50 | 0.16 | 208 | 47.63 | 0.03 |
| 11.75 | 0.65 | 510 | 47.81 | 0.10 |
| 12.00 | **3.61** | 2,261 | 48.88 | 0.26 |
| 12.25 | 2.57 | 4,747 | 50.39 | 0.39 |
| 12.50 | 0.97 | 5,963 | 51.13 | 0.44 |
| 12.75 | 0.58 | 6,256 | 51.31 | 0.45 |

BEGIN TIME

DRAWDOWN CALCULATION

33.00 HRS
- 10.50 HRS
22.5 HRS

## Hydrograph for Pond B4: BMP 4 (continued)

| Time (hours) | Inflow (cfs) | Storage (cubic-feet) | Elevation (feet) | Primary (cfs) |
|---|---|---|---|---|
| 13.00 | 0.46 | **6,314** | **51.34** | **0.46** |
| 13.25 | 0.39 | 6,286 | 51.33 | 0.45 |
| 13.50 | 0.34 | 6,207 | 51.28 | 0.45 |
| 13.75 | 0.30 | 6,092 | 51.21 | 0.45 |
| 14.00 | 0.27 | 5,950 | 51.12 | 0.44 |
| 14.25 | 0.24 | 5,787 | 51.02 | 0.44 |
| 14.50 | 0.23 | 5,612 | 50.92 | 0.43 |
| 14.75 | 0.22 | 5,433 | 50.81 | 0.42 |
| 15.00 | 0.21 | 5,251 | 50.70 | 0.41 |
| 15.25 | 0.20 | 5,066 | 50.58 | 0.41 |
| 15.50 | 0.19 | 4,878 | 50.47 | 0.40 |
| 15.75 | 0.18 | 4,688 | 50.35 | 0.39 |
| 16.00 | 0.17 | 4,495 | 50.24 | 0.38 |
| 16.25 | 0.16 | 4,301 | 50.12 | 0.37 |
| 16.50 | 0.15 | 4,108 | 50.00 | 0.36 |
| 16.75 | 0.15 | 3,919 | 49.89 | 0.36 |
| 17.00 | 0.14 | 3,735 | 49.77 | 0.35 |
| 17.25 | 0.14 | 3,555 | 49.66 | 0.34 |
| 17.50 | 0.14 | 3,380 | 49.56 | 0.33 |
| 17.75 | 0.13 | 3,210 | 49.45 | 0.32 |
| 18.00 | 0.13 | 3,043 | 49.35 | 0.31 |
| 18.25 | 0.12 | 2,882 | 49.25 | 0.30 |
| 18.50 | 0.12 | 2,725 | 49.16 | 0.29 |
| 18.75 | 0.12 | 2,572 | 49.07 | 0.28 |
| 19.00 | 0.11 | 2,424 | 48.98 | 0.27 |
| 19.25 | 0.11 | 2,280 | 48.89 | 0.27 |
| 19.50 | 0.10 | 2,140 | 48.80 | 0.26 |
| 19.75 | 0.10 | 2,005 | 48.72 | 0.25 |
| 20.00 | 0.10 | 1,874 | 48.64 | 0.24 |
| 20.25 | 0.09 | 1,749 | 48.56 | 0.23 |
| 20.50 | 0.09 | 1,629 | 48.49 | 0.22 |
| 20.75 | 0.09 | 1,516 | 48.42 | 0.21 |
| 21.00 | 0.09 | 1,411 | 48.36 | 0.20 |
| 21.25 | 0.09 | 1,313 | 48.30 | 0.19 |
| 21.50 | 0.09 | 1,221 | 48.24 | 0.19 |
| 21.75 | 0.09 | 1,136 | 48.19 | 0.18 |
| 22.00 | 0.09 | 1,057 | 48.14 | 0.17 |
| 22.25 | 0.09 | 985 | 48.10 | 0.16 |
| 22.50 | 0.08 | 918 | 48.06 | 0.16 |
| 22.75 | 0.08 | 857 | 48.02 | 0.15 |
| 23.00 | 0.08 | 801 | 47.99 | 0.14 |
| 23.25 | 0.08 | 751 | 47.96 | 0.14 |
| 23.50 | 0.08 | 705 | 47.93 | 0.13 |
| 23.75 | 0.08 | 663 | 47.90 | 0.12 |
| 24.00 | 0.08 | 625 | 47.88 | 0.12 |
| 24.25 | 0.03 | 572 | 47.85 | 0.11 |
| 24.50 | 0.00 | 493 | 47.80 | 0.10 |
| 24.75 | 0.00 | 413 | 47.75 | 0.08 |
| 25.00 | 0.00 | 346 | 47.71 | 0.07 |
| 25.25 | 0.00 | 291 | 47.68 | 0.05 |
| 25.50 | 0.00 | 248 | 47.65 | 0.04 |
| 25.75 | 0.00 | 214 | 47.63 | 0.03 |

## Hydrograph for Pond B4: BMP 4 (continued)

| Time (hours) | Inflow (cfs) | Storage (cubic-feet) | Elevation (feet) | Primary (cfs) | |
|---|---|---|---|---|---|
| 26.00 | 0.00 | 187 | 47.61 | 0.03 | |
| 26.25 | 0.00 | 166 | 47.60 | 0.02 | |
| 26.50 | 0.00 | 149 | 47.59 | 0.02 | |
| 26.75 | 0.00 | 134 | 47.58 | 0.02 | |
| 27.00 | 0.00 | 120 | 47.57 | 0.01 | |
| 27.25 | 0.00 | 108 | 47.57 | 0.01 | |
| 27.50 | 0.00 | 97 | 47.56 | 0.01 | |
| 27.75 | 0.00 | 87 | 47.55 | 0.01 | |
| 28.00 | 0.00 | 78 | 47.55 | 0.01 | |
| 28.25 | 0.00 | 70 | 47.54 | 0.01 | |
| 28.50 | 0.00 | 63 | 47.54 | 0.01 | |
| 28.75 | 0.00 | 56 | 47.53 | 0.01 | |
| 29.00 | 0.00 | 51 | 47.53 | 0.01 | |
| 29.25 | 0.00 | 45 | 47.53 | 0.01 | |
| 29.50 | 0.00 | 41 | 47.52 | 0.00 | |
| 29.75 | 0.00 | 37 | 47.52 | 0.00 | |
| 30.00 | 0.00 | 33 | 47.52 | 0.00 | |
| 30.25 | 0.00 | 29 | 47.52 | 0.00 | |
| 30.50 | 0.00 | 26 | 47.52 | 0.00 | |
| 30.75 | 0.00 | 24 | 47.51 | 0.00 | |
| 31.00 | 0.00 | 21 | 47.51 | 0.00 | |
| 31.25 | 0.00 | 19 | 47.51 | 0.00 | |
| 31.50 | 0.00 | 17 | 47.51 | 0.00 | |
| 31.75 | 0.00 | 15 | 47.51 | 0.00 | |
| 32.00 | 0.00 | 14 | 47.51 | 0.00 | |
| 32.25 | 0.00 | 12 | 47.51 | 0.00 | |
| 32.50 | 0.00 | 11 | 47.51 | 0.00 | |
| 32.75 | 0.00 | 10 | 47.51 | 0.00 | |
| 33.00 | 0.00 | 9 | 47.51 | 0.00 | END TIME |
| 33.25 | 0.00 | 8 | 47.50 | 0.00 | |
| 33.50 | 0.00 | 7 | 47.50 | 0.00 | |
| 33.75 | 0.00 | 6 | 47.50 | 0.00 | |
| 34.00 | 0.00 | 6 | 47.50 | 0.00 | |
| 34.25 | 0.00 | 5 | 47.50 | 0.00 | |
| 34.50 | 0.00 | 5 | 47.50 | 0.00 | |
| 34.75 | 0.00 | 4 | 47.50 | 0.00 | |
| 35.00 | 0.00 | 4 | 47.50 | 0.00 | |
| 35.25 | 0.00 | 3 | 47.50 | 0.00 | |
| 35.50 | 0.00 | 3 | 47.50 | 0.00 | |
| 35.75 | 0.00 | 3 | 47.50 | 0.00 | |
| 36.00 | 0.00 | 2 | 47.50 | 0.00 | |
| 36.25 | 0.00 | 2 | 47.50 | 0.00 | |
| 36.50 | 0.00 | 2 | 47.50 | 0.00 | |
| 36.75 | 0.00 | 2 | 47.50 | 0.00 | |
| 37.00 | 0.00 | 2 | 47.50 | 0.00 | |
| 37.25 | 0.00 | 1 | 47.50 | 0.00 | |
| 37.50 | 0.00 | 1 | 47.50 | 0.00 | |
| 37.75 | 0.00 | 1 | 47.50 | 0.00 | |
| 38.00 | 0.00 | 1 | 47.50 | 0.00 | |
| 38.25 | 0.00 | 1 | 47.50 | 0.00 | |
| 38.50 | 0.00 | 1 | 47.50 | 0.00 | |
| 38.75 | 0.00 | 1 | 47.50 | 0.00 | |

## Hydrograph for Pond B4: BMP 4 (continued)

| Time (hours) | Inflow (cfs) | Storage (cubic-feet) | Elevation (feet) | Primary (cfs) |
|---|---|---|---|---|
| 39.00 | 0.00 | 1 | 47.50 | 0.00 |
| 39.25 | 0.00 | 1 | 47.50 | 0.00 |
| 39.50 | 0.00 | 1 | 47.50 | 0.00 |
| 39.75 | 0.00 | 0 | 47.50 | 0.00 |
| 40.00 | 0.00 | 0 | 47.50 | 0.00 |
| 40.25 | 0.00 | 0 | 47.50 | 0.00 |
| 40.50 | 0.00 | 0 | 47.50 | 0.00 |
| 40.75 | 0.00 | 0 | 47.50 | 0.00 |
| 41.00 | 0.00 | 0 | 47.50 | 0.00 |
| 41.25 | 0.00 | 0 | 47.50 | 0.00 |
| 41.50 | 0.00 | 0 | 47.50 | 0.00 |
| 41.75 | 0.00 | 0 | 47.50 | 0.00 |
| 42.00 | 0.00 | 0 | 47.50 | 0.00 |
| 42.25 | 0.00 | 0 | 47.50 | 0.00 |
| 42.50 | 0.00 | 0 | 47.50 | 0.00 |
| 42.75 | 0.00 | 0 | 47.50 | 0.00 |
| 43.00 | 0.00 | 0 | 47.50 | 0.00 |
| 43.25 | 0.00 | 0 | 47.50 | 0.00 |
| 43.50 | 0.00 | 0 | 47.50 | 0.00 |
| 43.75 | 0.00 | 0 | 47.50 | 0.00 |
| 44.00 | 0.00 | 0 | 47.50 | 0.00 |
| 44.25 | 0.00 | 0 | 47.50 | 0.00 |
| 44.50 | 0.00 | 0 | 47.50 | 0.00 |
| 44.75 | 0.00 | 0 | 47.50 | 0.00 |
| 45.00 | 0.00 | 0 | 47.50 | 0.00 |
| 45.25 | 0.00 | 0 | 47.50 | 0.00 |
| 45.50 | 0.00 | 0 | 47.50 | 0.00 |
| 45.75 | 0.00 | 0 | 47.50 | 0.00 |
| 46.00 | 0.00 | 0 | 47.50 | 0.00 |
| 46.25 | 0.00 | 0 | 47.50 | 0.00 |
| 46.50 | 0.00 | 0 | 47.50 | 0.00 |
| 46.75 | 0.00 | 0 | 47.50 | 0.00 |
| 47.00 | 0.00 | 0 | 47.50 | 0.00 |
| 47.25 | 0.00 | 0 | 47.50 | 0.00 |
| 47.50 | 0.00 | 0 | 47.50 | 0.00 |
| 47.75 | 0.00 | 0 | 47.50 | 0.00 |
| 48.00 | 0.00 | 0 | 47.50 | 0.00 |
| 48.25 | 0.00 | 0 | 47.50 | 0.00 |
| 48.50 | 0.00 | 0 | 47.50 | 0.00 |
| 48.75 | 0.00 | 0 | 47.50 | 0.00 |
| 49.00 | 0.00 | 0 | 47.50 | 0.00 |
| 49.25 | 0.00 | 0 | 47.50 | 0.00 |
| 49.50 | 0.00 | 0 | 47.50 | 0.00 |
| 49.75 | 0.00 | 0 | 47.50 | 0.00 |
| 50.00 | 0.00 | 0 | 47.50 | 0.00 |
| 50.25 | 0.00 | 0 | 47.50 | 0.00 |
| 50.50 | 0.00 | 0 | 47.50 | 0.00 |
| 50.75 | 0.00 | 0 | 47.50 | 0.00 |
| 51.00 | 0.00 | 0 | 47.50 | 0.00 |
| 51.25 | 0.00 | 0 | 47.50 | 0.00 |
| 51.50 | 0.00 | 0 | 47.50 | 0.00 |
| 51.75 | 0.00 | 0 | 47.50 | 0.00 |

## Hydrograph for Pond B4: BMP 4 (continued)

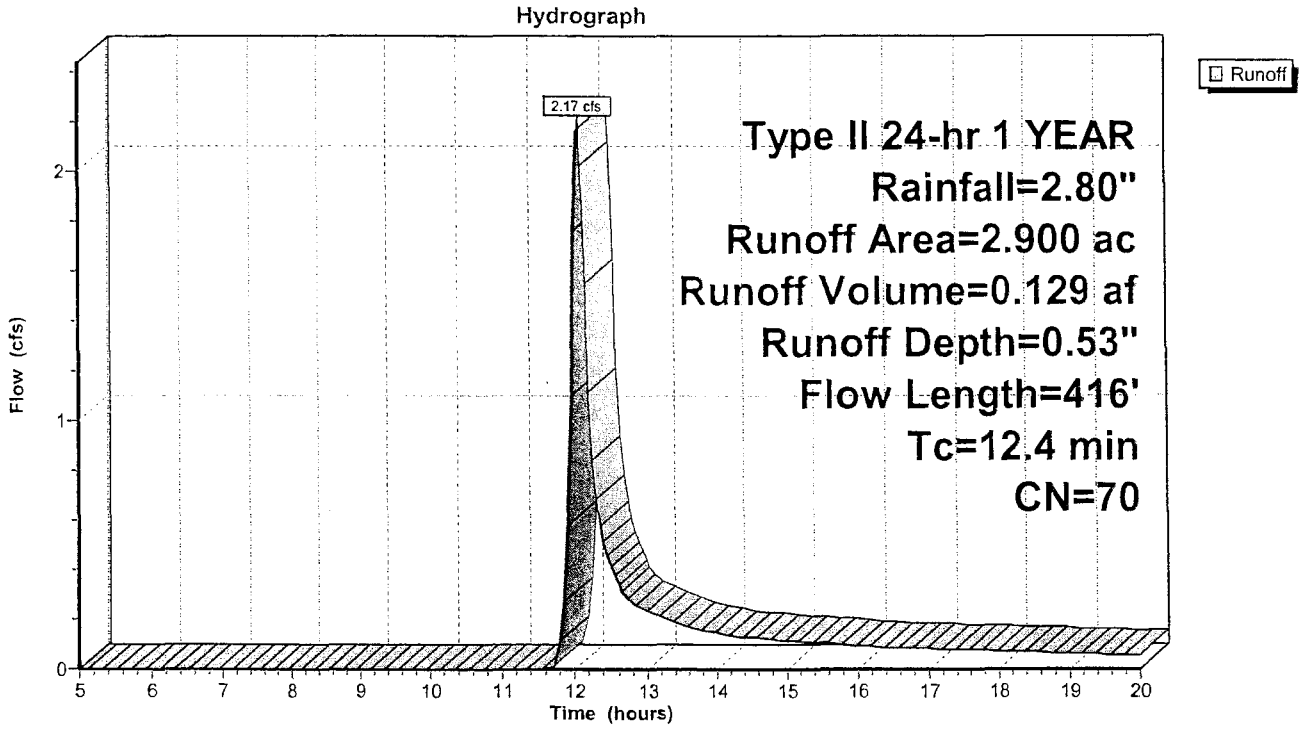
| Time (hours) | Inflow (cfs) | Storage (cubic-feet) | Elevation (feet) | Primary (cfs) |
|---|---|---|---|---|
| 52.00 | 0.00 | 0 | 47.50 | 0.00 |
| 52.25 | 0.00 | 0 | 47.50 | 0.00 |
| 52.50 | 0.00 | 0 | 47.50 | 0.00 |
| 52.75 | 0.00 | 0 | 47.50 | 0.00 |
| 53.00 | 0.00 | 0 | 47.50 | 0.00 |
| 53.25 | 0.00 | 0 | 47.50 | 0.00 |
| 53.50 | 0.00 | 0 | 47.50 | 0.00 |
| 53.75 | 0.00 | 0 | 47.50 | 0.00 |
| 54.00 | 0.00 | 0 | 47.50 | 0.00 |
| 54.25 | 0.00 | 0 | 47.50 | 0.00 |
| 54.50 | 0.00 | 0 | 47.50 | 0.00 |
| 54.75 | 0.00 | 0 | 47.50 | 0.00 |
| 55.00 | 0.00 | 0 | 47.50 | 0.00 |
| 55.25 | 0.00 | 0 | 47.50 | 0.00 |
| 55.50 | 0.00 | 0 | 47.50 | 0.00 |
| 55.75 | 0.00 | 0 | 47.50 | 0.00 |
| 56.00 | 0.00 | 0 | 47.50 | 0.00 |
| 56.25 | 0.00 | 0 | 47.50 | 0.00 |
| 56.50 | 0.00 | 0 | 47.50 | 0.00 |
| 56.75 | 0.00 | 0 | 47.50 | 0.00 |
| 57.00 | 0.00 | 0 | 47.50 | 0.00 |
| 57.25 | 0.00 | 0 | 47.50 | 0.00 |
| 57.50 | 0.00 | 0 | 47.50 | 0.00 |
| 57.75 | 0.00 | 0 | 47.50 | 0.00 |
| 58.00 | 0.00 | 0 | 47.50 | 0.00 |
| 58.25 | 0.00 | 0 | 47.50 | 0.00 |
| 58.50 | 0.00 | 0 | 47.50 | 0.00 |
| 58.75 | 0.00 | 0 | 47.50 | 0.00 |
| 59.00 | 0.00 | 0 | 47.50 | 0.00 |
| 59.25 | 0.00 | 0 | 47.50 | 0.00 |
| 59.50 | 0.00 | 0 | 47.50 | 0.00 |
| 59.75 | 0.00 | 0 | 47.50 | 0.00 |
| 60.00 | 0.00 | 0 | 47.50 | 0.00 |
| 60.25 | 0.00 | 0 | 47.50 | 0.00 |
| 60.50 | 0.00 | 0 | 47.50 | 0.00 |
| 60.75 | 0.00 | 0 | 47.50 | 0.00 |
| 61.00 | 0.00 | 0 | 47.50 | 0.00 |
| 61.25 | 0.00 | 0 | 47.50 | 0.00 |
| 61.50 | 0.00 | 0 | 47.50 | 0.00 |
| 61.75 | 0.00 | 0 | 47.50 | 0.00 |
| 62.00 | 0.00 | 0 | 47.50 | 0.00 |
| 62.25 | 0.00 | 0 | 47.50 | 0.00 |
| 62.50 | 0.00 | 0 | 47.50 | 0.00 |
| 62.75 | 0.00 | 0 | 47.50 | 0.00 |
| 63.00 | 0.00 | 0 | 47.50 | 0.00 |
| 63.25 | 0.00 | 0 | 47.50 | 0.00 |
| 63.50 | 0.00 | 0 | 47.50 | 0.00 |
| 63.75 | 0.00 | 0 | 47.50 | 0.00 |
| 64.00 | 0.00 | 0 | 47.50 | 0.00 |
| 64.25 | 0.00 | 0 | 47.50 | 0.00 |
| 64.50 | 0.00 | 0 | 47.50 | 0.00 |
| 64.75 | 0.00 | 0 | 47.50 | 0.00 |

## Hydrograph for Pond B4: BMP 4 (continued)

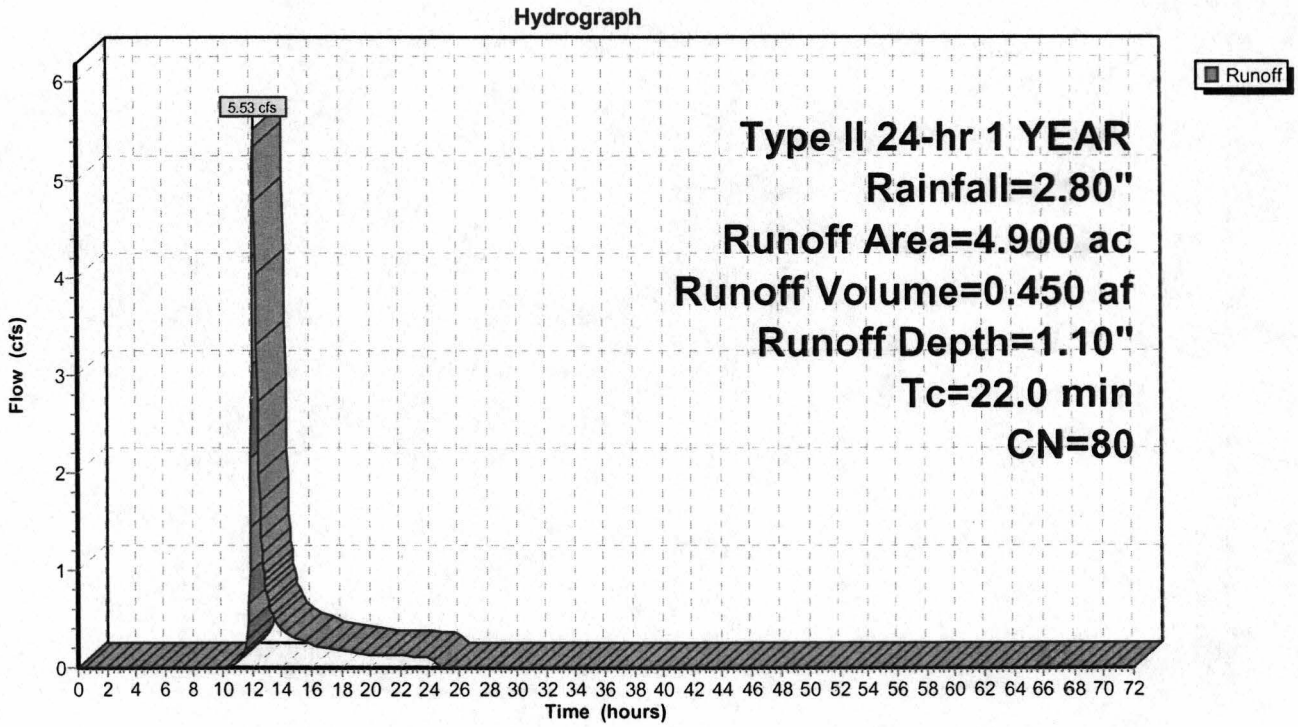
| Time (hours) | Inflow (cfs) | Storage (cubic-feet) | Elevation (feet) | Primary (cfs) |
|---|---|---|---|---|
| 65.00 | 0.00 | 0 | 47.50 | 0.00 |
| 65.25 | 0.00 | 0 | 47.50 | 0.00 |
| 65.50 | 0.00 | 0 | 47.50 | 0.00 |
| 65.75 | 0.00 | 0 | 47.50 | 0.00 |
| 66.00 | 0.00 | 0 | 47.50 | 0.00 |
| 66.25 | 0.00 | 0 | 47.50 | 0.00 |
| 66.50 | 0.00 | 0 | 47.50 | 0.00 |
| 66.75 | 0.00 | 0 | 47.50 | 0.00 |
| 67.00 | 0.00 | 0 | 47.50 | 0.00 |
| 67.25 | 0.00 | 0 | 47.50 | 0.00 |
| 67.50 | 0.00 | 0 | 47.50 | 0.00 |
| 67.75 | 0.00 | 0 | 47.50 | 0.00 |
| 68.00 | 0.00 | 0 | 47.50 | 0.00 |
| 68.25 | 0.00 | 0 | 47.50 | 0.00 |
| 68.50 | 0.00 | 0 | 47.50 | 0.00 |
| 68.75 | 0.00 | 0 | 47.50 | 0.00 |
| 69.00 | 0.00 | 0 | 47.50 | 0.00 |
| 69.25 | 0.00 | 0 | 47.50 | 0.00 |
| 69.50 | 0.00 | 0 | 47.50 | 0.00 |
| 69.75 | 0.00 | 0 | 47.50 | 0.00 |
| 70.00 | 0.00 | 0 | 47.50 | 0.00 |
| 70.25 | 0.00 | 0 | 47.50 | 0.00 |
| 70.50 | 0.00 | 0 | 47.50 | 0.00 |
| 70.75 | 0.00 | 0 | 47.50 | 0.00 |
| 71.00 | 0.00 | 0 | 47.50 | 0.00 |
| 71.25 | 0.00 | 0 | 47.50 | 0.00 |
| 71.50 | 0.00 | 0 | 47.50 | 0.00 |
| 71.75 | 0.00 | 0 | 47.50 | 0.00 |
| 72.00 | 0.00 | 0 | 47.50 | 0.00 |

# BMP 5

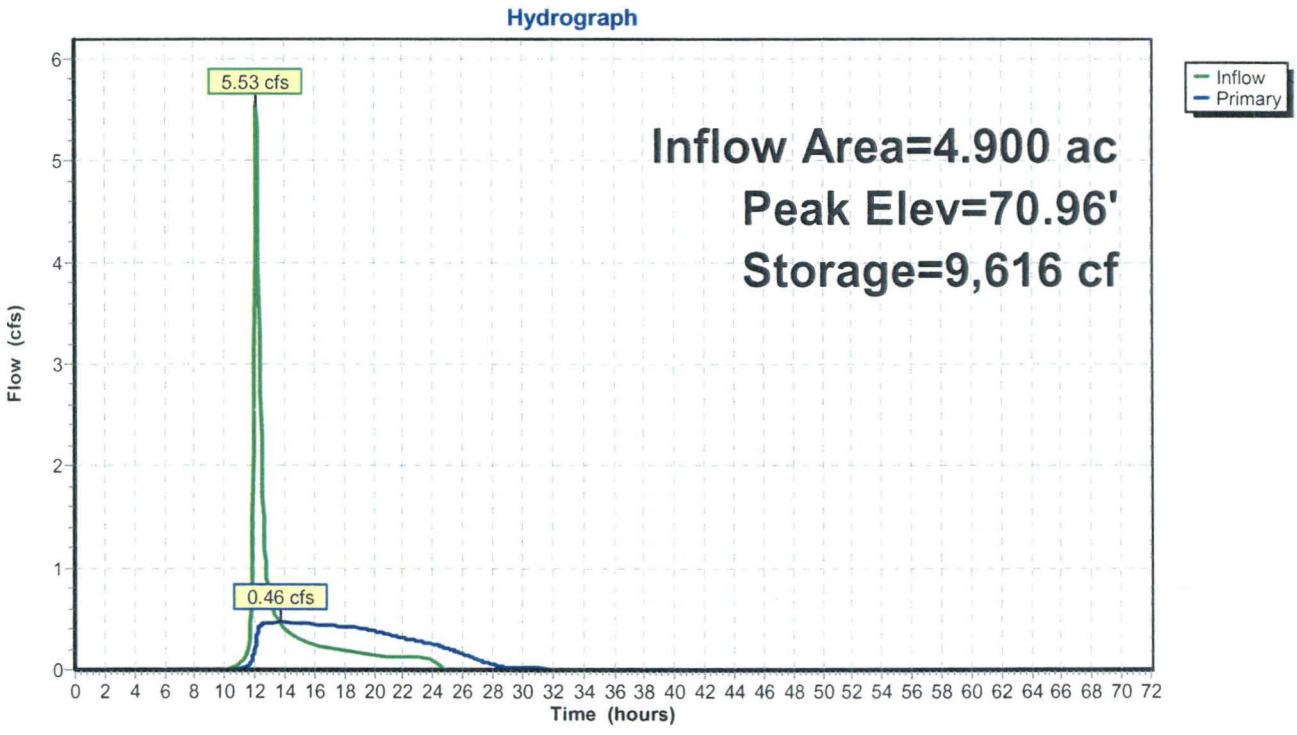
## Subcatchment DA B5: PRE-DEVELOPED



## Subcatchment DA5 POST: DA5 POST



## Pond B5: BMP 5


Hydrograph
5.53 cfs
0.46 cfs
Inflow Area=4.900 ac
Peak Elev=70.96'
Storage=9,616 cf
Inflow
Primary
Flow (cfs)
Time (hours)
0 1 2 3 4 5 6
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66 68 70 72

## Hydrograph for Pond B5: BMP 5

| Time (hours) | Inflow (cfs) | Storage (cubic-feet) | Elevation (feet) | Primary (cfs) |
|---|---|---|---|---|
| 0.00 | 0.00 | 0 | 67.00 | 0.00 |
| 0.25 | 0.00 | 0 | 67.00 | 0.00 |
| 0.50 | 0.00 | 0 | 67.00 | 0.00 |
| 0.75 | 0.00 | 0 | 67.00 | 0.00 |
| 1.00 | 0.00 | 0 | 67.00 | 0.00 |
| 1.25 | 0.00 | 0 | 67.00 | 0.00 |
| 1.50 | 0.00 | 0 | 67.00 | 0.00 |
| 1.75 | 0.00 | 0 | 67.00 | 0.00 |
| 2.00 | 0.00 | 0 | 67.00 | 0.00 |
| 2.25 | 0.00 | 0 | 67.00 | 0.00 |
| 2.50 | 0.00 | 0 | 67.00 | 0.00 |
| 2.75 | 0.00 | 0 | 67.00 | 0.00 |
| 3.00 | 0.00 | 0 | 67.00 | 0.00 |
| 3.25 | 0.00 | 0 | 67.00 | 0.00 |
| 3.50 | 0.00 | 0 | 67.00 | 0.00 |
| 3.75 | 0.00 | 0 | 67.00 | 0.00 |
| 4.00 | 0.00 | 0 | 67.00 | 0.00 |
| 4.25 | 0.00 | 0 | 67.00 | 0.00 |
| 4.50 | 0.00 | 0 | 67.00 | 0.00 |
| 4.75 | 0.00 | 0 | 67.00 | 0.00 |
| 5.00 | 0.00 | 0 | 67.00 | 0.00 |
| 5.25 | 0.00 | 0 | 67.00 | 0.00 |
| 5.50 | 0.00 | 0 | 67.00 | 0.00 |
| 5.75 | 0.00 | 0 | 67.00 | 0.00 |
| 6.00 | 0.00 | 0 | 67.00 | 0.00 |
| 6.25 | 0.00 | 0 | 67.00 | 0.00 |
| 6.50 | 0.00 | 0 | 67.00 | 0.00 |
| 6.75 | 0.00 | 0 | 67.00 | 0.00 |
| 7.00 | 0.00 | 0 | 67.00 | 0.00 |
| 7.25 | 0.00 | 0 | 67.00 | 0.00 |
| 7.50 | 0.00 | 0 | 67.00 | 0.00 |
| 7.75 | 0.00 | 0 | 67.00 | 0.00 |
| 8.00 | 0.00 | 0 | 67.00 | 0.00 |
| 8.25 | 0.00 | 0 | 67.00 | 0.00 |
| 8.50 | 0.00 | 0 | 67.00 | 0.00 |
| 8.75 | 0.00 | 0 | 67.00 | 0.00 |
| 9.00 | 0.00 | 0 | 67.00 | 0.00 |
| 9.25 | 0.00 | 0 | 67.00 | 0.00 |
| 9.50 | 0.00 | 0 | 67.00 | 0.00 |
| 9.75 | 0.00 | 0 | 67.00 | 0.00 |
| 10.00 | 0.00 | 0 | 67.00 | 0.00 |
| 10.25 | 0.00 | 1 | 67.00 | 0.00 |
| 10.50 | 0.01 | 7 | 67.00 | 0.00 |
| 10.75 | 0.03 | 26 | 67.01 | 0.00 |
| 11.00 | 0.06 | 64 | 67.03 | 0.01 |
| 11.25 | 0.10 | 128 | 67.07 | 0.01 |
| 11.50 | 0.18 | 233 | 67.12 | 0.03 |
| 11.75 | 0.45 | 427 | 67.22 | 0.07 |
| 12.00 | **3.11** | 1,574 | 67.83 | 0.20 |
| 12.25 | **4.77** | 5,641 | 69.97 | 0.40 |
| 12.50 | 1.97 | 8,086 | 70.59 | 0.44 |
| 12.75 | 1.06 | 8,985 | 70.81 | 0.45 |

BEGIN TIME

DRAWDOWN TIME

37.75 hrs
- 10.75 hr
27.0 hrs

## Hydrograph for Pond B5: BMP 5 (continued)

| Time (hours) | Inflow (cfs) | Storage (cubic-feet) | Elevation (feet) | Primary (cfs) |
|---|---|---|---|---|
| 13.00 | 0.73 | 9,356 | 70.90 | 0.46 |
| 13.25 | 0.59 | 9,528 | 70.94 | 0.46 |
| 13.50 | 0.51 | **9,602** | **70.96** | **0.46** |
| 13.75 | 0.45 | **9,614** | **70.96** | **0.46** |
| 14.00 | 0.40 | 9,578 | 70.95 | 0.46 |
| 14.25 | 0.36 | 9,501 | 70.93 | 0.46 |
| 14.50 | 0.33 | 9,395 | 70.91 | 0.46 |
| 14.75 | 0.32 | 9,273 | 70.88 | 0.46 |
| 15.00 | 0.30 | 9,140 | 70.85 | 0.46 |
| 15.25 | 0.29 | 8,994 | 70.81 | 0.45 |
| 15.50 | 0.27 | 8,837 | 70.77 | 0.45 |
| 15.75 | 0.26 | 8,669 | 70.73 | 0.45 |
| 16.00 | 0.24 | 8,489 | 70.69 | 0.45 |
| 16.25 | 0.22 | 8,298 | 70.64 | 0.44 |
| 16.50 | 0.22 | 8,099 | 70.59 | 0.44 |
| 16.75 | 0.21 | 7,896 | 70.54 | 0.44 |
| 17.00 | 0.20 | 7,691 | 70.49 | 0.43 |
| 17.25 | 0.20 | 7,483 | 70.44 | 0.43 |
| 17.50 | 0.19 | 7,274 | 70.39 | 0.43 |
| 17.75 | 0.19 | 7,063 | 70.33 | 0.42 |
| 18.00 | 0.18 | 6,851 | 70.28 | 0.42 |
| 18.25 | 0.18 | 6,636 | 70.23 | 0.42 |
| 18.50 | 0.17 | 6,419 | 70.18 | 0.41 |
| 18.75 | 0.17 | 6,201 | 70.12 | 0.41 |
| 19.00 | 0.16 | 5,980 | 70.07 | 0.41 |
| 19.25 | 0.15 | 5,758 | 70.01 | 0.40 |
| 19.50 | 0.15 | 5,535 | 69.91 | 0.39 |
| 19.75 | 0.14 | 5,314 | 69.80 | 0.39 |
| 20.00 | 0.14 | 5,096 | 69.68 | 0.38 |
| 20.25 | 0.13 | 4,880 | 69.57 | 0.37 |
| 20.50 | 0.13 | 4,667 | 69.46 | 0.36 |
| 20.75 | 0.13 | 4,461 | 69.35 | 0.35 |
| 21.00 | 0.13 | 4,261 | 69.24 | 0.34 |
| 21.25 | 0.12 | 4,067 | 69.14 | 0.34 |
| 21.50 | 0.12 | 3,881 | 69.04 | 0.33 |
| 21.75 | 0.12 | 3,700 | 68.95 | 0.32 |
| 22.00 | 0.12 | 3,526 | 68.86 | 0.31 |
| 22.25 | 0.12 | 3,359 | 68.77 | 0.30 |
| 22.50 | 0.12 | 3,197 | 68.68 | 0.29 |
| 22.75 | 0.12 | 3,042 | 68.60 | 0.29 |
| 23.00 | 0.12 | 2,893 | 68.52 | 0.28 |
| 23.25 | 0.12 | 2,750 | 68.45 | 0.27 |
| 23.50 | 0.11 | 2,612 | 68.37 | 0.26 |
| 23.75 | 0.11 | 2,480 | 68.31 | 0.26 |
| 24.00 | 0.11 | 2,354 | 68.24 | 0.25 |
| 24.25 | 0.08 | 2,225 | 68.17 | 0.24 |
| 24.50 | 0.02 | 2,049 | 68.08 | 0.23 |
| 24.75 | 0.00 | 1,854 | 67.98 | 0.22 |
| 25.00 | 0.00 | 1,665 | 67.88 | 0.20 |
| 25.25 | 0.00 | 1,487 | 67.78 | 0.19 |
| 25.50 | 0.00 | 1,320 | 67.69 | 0.18 |
| 25.75 | 0.00 | 1,166 | 67.61 | 0.17 |

## Hydrograph for Pond B5: BMP 5 (continued)

| Time (hours) | Inflow (cfs) | Storage (cubic-feet) | Elevation (feet) | Primary (cfs) |
|---|---|---|---|---|
| 26.00 | 0.00 | 1,023 | 67.54 | 0.15 |
| 26.25 | 0.00 | 892 | 67.47 | 0.14 |
| 26.50 | 0.00 | 774 | 67.41 | 0.13 |
| 26.75 | 0.00 | 667 | 67.35 | 0.11 |
| 27.00 | 0.00 | 572 | 67.30 | 0.10 |
| 27.25 | 0.00 | 489 | 67.26 | 0.09 |
| 27.50 | 0.00 | 419 | 67.22 | 0.07 |
| 27.75 | 0.00 | 361 | 67.19 | 0.06 |
| 28.00 | 0.00 | 313 | 67.16 | 0.05 |
| 28.25 | 0.00 | 274 | 67.14 | 0.04 |
| 28.50 | 0.00 | 242 | 67.13 | 0.03 |
| 28.75 | 0.00 | 216 | 67.11 | 0.03 |
| 29.00 | 0.00 | 194 | 67.10 | 0.02 |
| 29.25 | 0.00 | 177 | 67.09 | 0.02 |
| 29.50 | 0.00 | 162 | 67.09 | 0.02 |
| 29.75 | 0.00 | 149 | 67.08 | 0.01 |
| 30.00 | 0.00 | 137 | 67.07 | 0.01 |
| 30.25 | 0.00 | 125 | 67.07 | 0.01 |
| 30.50 | 0.00 | 115 | 67.06 | 0.01 |
| 30.75 | 0.00 | 106 | 67.06 | 0.01 |
| 31.00 | 0.00 | 97 | 67.05 | 0.01 |
| 31.25 | 0.00 | 89 | 67.05 | 0.01 |
| 31.50 | 0.00 | 82 | 67.04 | 0.01 |
| 31.75 | 0.00 | 75 | 67.04 | 0.01 |
| 32.00 | 0.00 | 69 | 67.04 | 0.01 |
| 32.25 | 0.00 | 63 | 67.03 | 0.01 |
| 32.50 | 0.00 | 58 | 67.03 | 0.01 |
| 32.75 | 0.00 | 53 | 67.03 | 0.01 |
| 33.00 | 0.00 | 49 | 67.03 | 0.00 |
| 33.25 | 0.00 | 45 | 67.02 | 0.00 |
| 33.50 | 0.00 | 41 | 67.02 | 0.00 |
| 33.75 | 0.00 | 38 | 67.02 | 0.00 |
| 34.00 | 0.00 | 35 | 67.02 | 0.00 |
| 34.25 | 0.00 | 32 | 67.02 | 0.00 |
| 34.50 | 0.00 | 29 | 67.02 | 0.00 |
| 34.75 | 0.00 | 27 | 67.01 | 0.00 |
| 35.00 | 0.00 | 25 | 67.01 | 0.00 |
| 35.25 | 0.00 | 23 | 67.01 | 0.00 |
| 35.50 | 0.00 | 21 | 67.01 | 0.00 |
| 35.75 | 0.00 | 19 | 67.01 | 0.00 |
| 36.00 | 0.00 | 18 | 67.01 | 0.00 |
| 36.25 | 0.00 | 16 | 67.01 | 0.00 |
| 36.50 | 0.00 | 15 | 67.01 | 0.00 |
| 36.75 | 0.00 | 14 | 67.01 | 0.00 |
| 37.00 | 0.00 | 12 | 67.01 | 0.00 |
| 37.25 | 0.00 | 11 | 67.01 | 0.00 |
| 37.50 | 0.00 | 11 | 67.01 | 0.00 |
| ~~37.75~~ | ~~0.00~~ | ~~10~~ | ~~67.01~~ | ~~0.00~~ — END TIME |
| 38.00 | 0.00 | 9 | 67.00 | 0.00 |
| 38.25 | 0.00 | 8 | 67.00 | 0.00 |
| 38.50 | 0.00 | 7 | 67.00 | 0.00 |
| 38.75 | 0.00 | 7 | 67.00 | 0.00 |

## Hydrograph for Pond B5: BMP 5 (continued)

| Time (hours) | Inflow (cfs) | Storage (cubic-feet) | Elevation (feet) | Primary (cfs) |
|---|---|---|---|---|
| 39.00 | 0.00 | 6 | 67.00 | 0.00 |
| 39.25 | 0.00 | 6 | 67.00 | 0.00 |
| 39.50 | 0.00 | 5 | 67.00 | 0.00 |
| 39.75 | 0.00 | 5 | 67.00 | 0.00 |
| 40.00 | 0.00 | 4 | 67.00 | 0.00 |
| 40.25 | 0.00 | 4 | 67.00 | 0.00 |
| 40.50 | 0.00 | 4 | 67.00 | 0.00 |
| 40.75 | 0.00 | 3 | 67.00 | 0.00 |
| 41.00 | 0.00 | 3 | 67.00 | 0.00 |
| 41.25 | 0.00 | 3 | 67.00 | 0.00 |
| 41.50 | 0.00 | 3 | 67.00 | 0.00 |
| 41.75 | 0.00 | 2 | 67.00 | 0.00 |
| 42.00 | 0.00 | 2 | 67.00 | 0.00 |
| 42.25 | 0.00 | 2 | 67.00 | 0.00 |
| 42.50 | 0.00 | 2 | 67.00 | 0.00 |
| 42.75 | 0.00 | 2 | 67.00 | 0.00 |
| 43.00 | 0.00 | 2 | 67.00 | 0.00 |
| 43.25 | 0.00 | 1 | 67.00 | 0.00 |
| 43.50 | 0.00 | 1 | 67.00 | 0.00 |
| 43.75 | 0.00 | 1 | 67.00 | 0.00 |
| 44.00 | 0.00 | 1 | 67.00 | 0.00 |
| 44.25 | 0.00 | 1 | 67.00 | 0.00 |
| 44.50 | 0.00 | 1 | 67.00 | 0.00 |
| 44.75 | 0.00 | 1 | 67.00 | 0.00 |
| 45.00 | 0.00 | 1 | 67.00 | 0.00 |
| 45.25 | 0.00 | 1 | 67.00 | 0.00 |
| 45.50 | 0.00 | 1 | 67.00 | 0.00 |
| 45.75 | 0.00 | 1 | 67.00 | 0.00 |
| 46.00 | 0.00 | 1 | 67.00 | 0.00 |
| 46.25 | 0.00 | 1 | 67.00 | 0.00 |
| 46.50 | 0.00 | 0 | 67.00 | 0.00 |
| 46.75 | 0.00 | 0 | 67.00 | 0.00 |
| 47.00 | 0.00 | 0 | 67.00 | 0.00 |
| 47.25 | 0.00 | 0 | 67.00 | 0.00 |
| 47.50 | 0.00 | 0 | 67.00 | 0.00 |
| 47.75 | 0.00 | 0 | 67.00 | 0.00 |
| 48.00 | 0.00 | 0 | 67.00 | 0.00 |
| 48.25 | 0.00 | 0 | 67.00 | 0.00 |
| 48.50 | 0.00 | 0 | 67.00 | 0.00 |
| 48.75 | 0.00 | 0 | 67.00 | 0.00 |
| 49.00 | 0.00 | 0 | 67.00 | 0.00 |
| 49.25 | 0.00 | 0 | 67.00 | 0.00 |
| 49.50 | 0.00 | 0 | 67.00 | 0.00 |
| 49.75 | 0.00 | 0 | 67.00 | 0.00 |
| 50.00 | 0.00 | 0 | 67.00 | 0.00 |
| 50.25 | 0.00 | 0 | 67.00 | 0.00 |
| 50.50 | 0.00 | 0 | 67.00 | 0.00 |
| 50.75 | 0.00 | 0 | 67.00 | 0.00 |
| 51.00 | 0.00 | 0 | 67.00 | 0.00 |
| 51.25 | 0.00 | 0 | 67.00 | 0.00 |
| 51.50 | 0.00 | 0 | 67.00 | 0.00 |
| 51.75 | 0.00 | 0 | 67.00 | 0.00 |

## Hydrograph for Pond B5: BMP 5 (continued)

| Time (hours) | Inflow (cfs) | Storage (cubic-feet) | Elevation (feet) | Primary (cfs) |
|---|---|---|---|---|
| 52.00 | 0.00 | 0 | 67.00 | 0.00 |
| 52.25 | 0.00 | 0 | 67.00 | 0.00 |
| 52.50 | 0.00 | 0 | 67.00 | 0.00 |
| 52.75 | 0.00 | 0 | 67.00 | 0.00 |
| 53.00 | 0.00 | 0 | 67.00 | 0.00 |
| 53.25 | 0.00 | 0 | 67.00 | 0.00 |
| 53.50 | 0.00 | 0 | 67.00 | 0.00 |
| 53.75 | 0.00 | 0 | 67.00 | 0.00 |
| 54.00 | 0.00 | 0 | 67.00 | 0.00 |
| 54.25 | 0.00 | 0 | 67.00 | 0.00 |
| 54.50 | 0.00 | 0 | 67.00 | 0.00 |
| 54.75 | 0.00 | 0 | 67.00 | 0.00 |
| 55.00 | 0.00 | 0 | 67.00 | 0.00 |
| 55.25 | 0.00 | 0 | 67.00 | 0.00 |
| 55.50 | 0.00 | 0 | 67.00 | 0.00 |
| 55.75 | 0.00 | 0 | 67.00 | 0.00 |
| 56.00 | 0.00 | 0 | 67.00 | 0.00 |
| 56.25 | 0.00 | 0 | 67.00 | 0.00 |
| 56.50 | 0.00 | 0 | 67.00 | 0.00 |
| 56.75 | 0.00 | 0 | 67.00 | 0.00 |
| 57.00 | 0.00 | 0 | 67.00 | 0.00 |
| 57.25 | 0.00 | 0 | 67.00 | 0.00 |
| 57.50 | 0.00 | 0 | 67.00 | 0.00 |
| 57.75 | 0.00 | 0 | 67.00 | 0.00 |
| 58.00 | 0.00 | 0 | 67.00 | 0.00 |
| 58.25 | 0.00 | 0 | 67.00 | 0.00 |
| 58.50 | 0.00 | 0 | 67.00 | 0.00 |
| 58.75 | 0.00 | 0 | 67.00 | 0.00 |
| 59.00 | 0.00 | 0 | 67.00 | 0.00 |
| 59.25 | 0.00 | 0 | 67.00 | 0.00 |
| 59.50 | 0.00 | 0 | 67.00 | 0.00 |
| 59.75 | 0.00 | 0 | 67.00 | 0.00 |
| 60.00 | 0.00 | 0 | 67.00 | 0.00 |
| 60.25 | 0.00 | 0 | 67.00 | 0.00 |
| 60.50 | 0.00 | 0 | 67.00 | 0.00 |
| 60.75 | 0.00 | 0 | 67.00 | 0.00 |
| 61.00 | 0.00 | 0 | 67.00 | 0.00 |
| 61.25 | 0.00 | 0 | 67.00 | 0.00 |
| 61.50 | 0.00 | 0 | 67.00 | 0.00 |
| 61.75 | 0.00 | 0 | 67.00 | 0.00 |
| 62.00 | 0.00 | 0 | 67.00 | 0.00 |
| 62.25 | 0.00 | 0 | 67.00 | 0.00 |
| 62.50 | 0.00 | 0 | 67.00 | 0.00 |
| 62.75 | 0.00 | 0 | 67.00 | 0.00 |
| 63.00 | 0.00 | 0 | 67.00 | 0.00 |
| 63.25 | 0.00 | 0 | 67.00 | 0.00 |
| 63.50 | 0.00 | 0 | 67.00 | 0.00 |
| 63.75 | 0.00 | 0 | 67.00 | 0.00 |
| 64.00 | 0.00 | 0 | 67.00 | 0.00 |
| 64.25 | 0.00 | 0 | 67.00 | 0.00 |
| 64.50 | 0.00 | 0 | 67.00 | 0.00 |
| 64.75 | 0.00 | 0 | 67.00 | 0.00 |

## Hydrograph for Pond B5: BMP 5 (continued)

| Time (hours) | Inflow (cfs) | Storage (cubic-feet) | Elevation (feet) | Primary (cfs) |
|---|---|---|---|---|
| 65.00 | 0.00 | 0 | 67.00 | 0.00 |
| 65.25 | 0.00 | 0 | 67.00 | 0.00 |
| 65.50 | 0.00 | 0 | 67.00 | 0.00 |
| 65.75 | 0.00 | 0 | 67.00 | 0.00 |
| 66.00 | 0.00 | 0 | 67.00 | 0.00 |
| 66.25 | 0.00 | 0 | 67.00 | 0.00 |
| 66.50 | 0.00 | 0 | 67.00 | 0.00 |
| 66.75 | 0.00 | 0 | 67.00 | 0.00 |
| 67.00 | 0.00 | 0 | 67.00 | 0.00 |
| 67.25 | 0.00 | 0 | 67.00 | 0.00 |
| 67.50 | 0.00 | 0 | 67.00 | 0.00 |
| 67.75 | 0.00 | 0 | 67.00 | 0.00 |
| 68.00 | 0.00 | 0 | 67.00 | 0.00 |
| 68.25 | 0.00 | 0 | 67.00 | 0.00 |
| 68.50 | 0.00 | 0 | 67.00 | 0.00 |
| 68.75 | 0.00 | 0 | 67.00 | 0.00 |
| 69.00 | 0.00 | 0 | 67.00 | 0.00 |
| 69.25 | 0.00 | 0 | 67.00 | 0.00 |
| 69.50 | 0.00 | 0 | 67.00 | 0.00 |
| 69.75 | 0.00 | 0 | 67.00 | 0.00 |
| 70.00 | 0.00 | 0 | 67.00 | 0.00 |
| 70.25 | 0.00 | 0 | 67.00 | 0.00 |
| 70.50 | 0.00 | 0 | 67.00 | 0.00 |
| 70.75 | 0.00 | 0 | 67.00 | 0.00 |
| 71.00 | 0.00 | 0 | 67.00 | 0.00 |
| 71.25 | 0.00 | 0 | 67.00 | 0.00 |
| 71.50 | 0.00 | 0 | 67.00 | 0.00 |
| 71.75 | 0.00 | 0 | 67.00 | 0.00 |
| 72.00 | 0.00 | 0 | 67.00 | 0.00 |

# CHANNEL ADEQUACY EXHIBIT

GRAPHIC SCALE

0 100 200 400

( IN FEET )
1 inch = 100ft.

COMMONWEALTH OF VIRGINIA
JAMES W. BRAWLEY III
No. 024305
PROFESSIONAL ENGINEER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LANDMARK DESIGN GROUP
Engineers • Planners • Surveyors
Landscape Architects • Environmental Scientists


REVISIONS:

| No. | Date | Comment | By |
|---|---|---|---|
| 2 | 3/16/05 | REVISED PER COUNTY COMMENTS | RRJ |

DRAWING STATUS
- Interoffice Review
- Client for Review
- Pre Approval Bidding

COUNTY APPROVAL
- 1/27/04 1st Submittal
- 3/16/05 2nd Submittal
- 3rd Submittal
- Approved

CHANNEL ADEQUACY EXHIBIT

STONEHOUSE GLEN
SECTION II
STONEHOUSE AT WILLIAMSBURG, L.L.C.

JAMES CITY COUNTY VIRGINIA

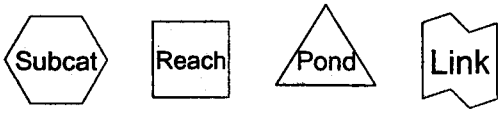
| | |
|---|---|
| Designed: LMDG | Date: 03/16/05 |
| Checked: CRO | Scale: 1"=200' |
| File Mgr./Drawn: LMDG | CADD File name: EX-1.dwg |
| Project Number: 2002261-504.04 | Dwg. File No.: XXXX W |
| Drawing Number: EX-1 | |

1 OF 1

JCC CASE #S-116-03

# PRE AND POST DEVELOPMENT CALCULATIONS

# PRE-DEVELOPED




**Drainage Diagram for bmp4**
Prepared by Landmark Design Group 05/09/2005
HydroCAD® 7.00 s/n 001765 © 1986-2003 Applied Microcomputer Systems

## Subcatchment DA4 PRE: PRE-DEVELOPED

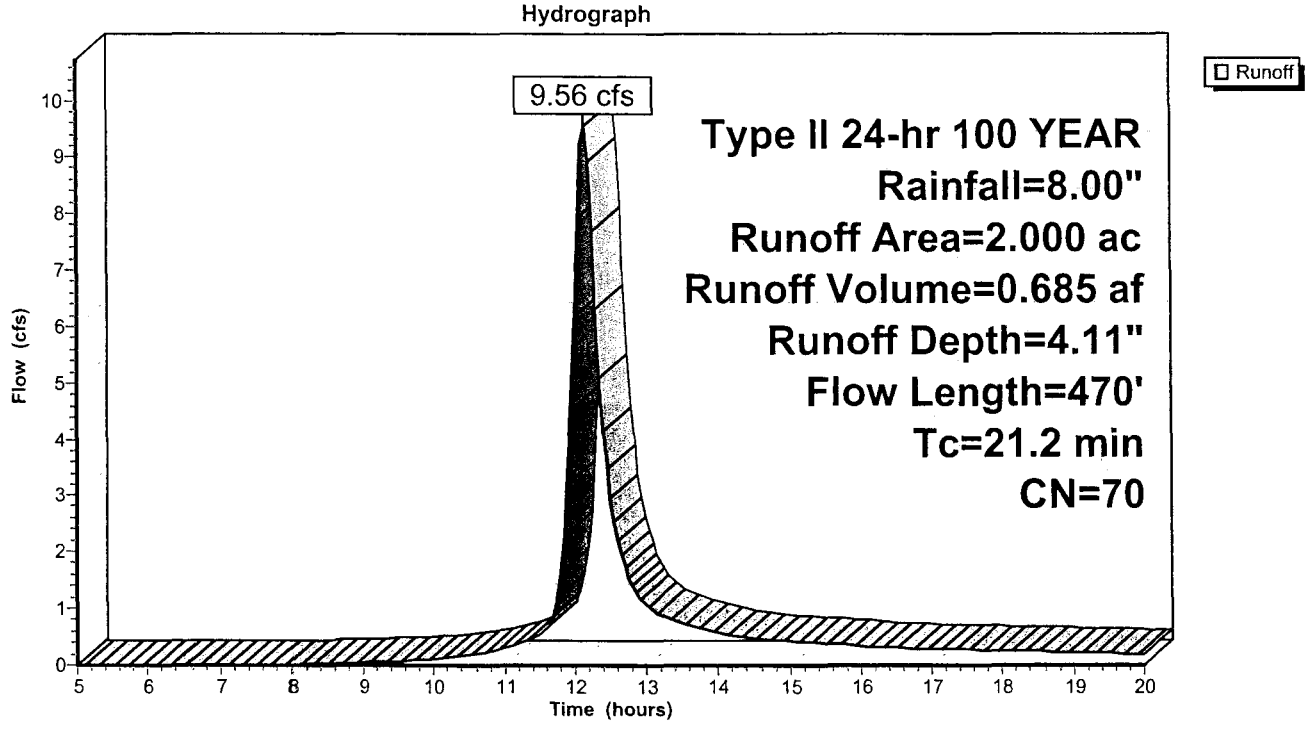
Runoff = 9.56 cfs @ 12.14 hrs, Volume= 0.685 af, Depth= 4.11"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100 YEAR Rainfall=8.00"

| Area (ac) | CN | Description |
|---|---|---|
| 2.000 | 70 | Woods, Good, HSG C |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 19.0 | 100 | 0.0320 | 0.1 | | **Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.80" |
| 1.8 | 200 | 0.1390 | 1.9 | | **Shallow Concentrated Flow,** Woodland Kv= 5.0 fps |
| 0.4 | 170 | 0.1300 | 6.4 | 42.88 | **Parabolic Channel,** W=20.00' D=0.50' Area=6.7 sf Perim=20.0' n= 0.040 |
| 21.2 | 470 | Total | | | |

## Subcatchment DA4 PRE: PRE-DEVELOPED



## Subcatchment DA4 PRE: PRE-DEVELOPED

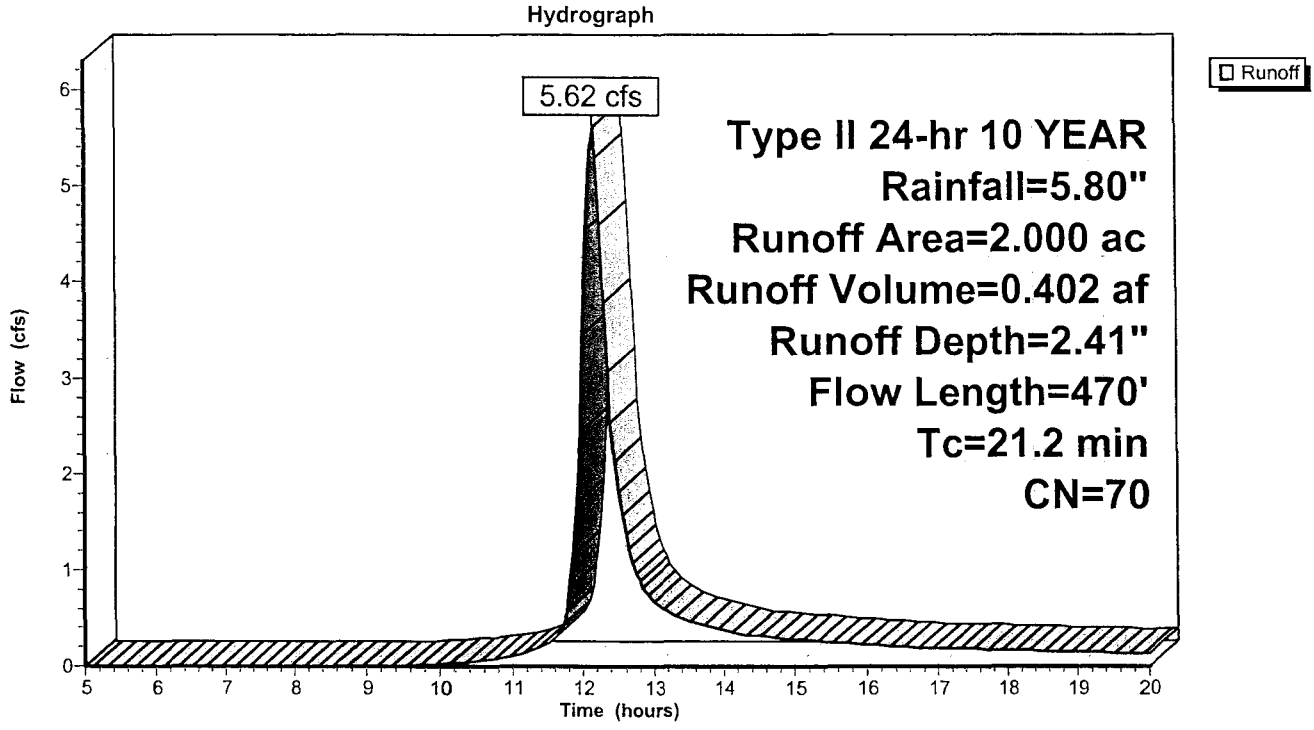
Runoff = 5.62 cfs @ 12.15 hrs, Volume= 0.402 af, Depth= 2.41"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 10 YEAR Rainfall=5.80"

| Area (ac) | CN | Description |
|---|---|---|
| 2.000 | 70 | Woods, Good, HSG C |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 19.0 | 100 | 0.0320 | 0.1 | | **Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.80" |
| 1.8 | 200 | 0.1390 | 1.9 | | **Shallow Concentrated Flow,** Woodland Kv= 5.0 fps |
| 0.4 | 170 | 0.1300 | 6.4 | 42.88 | **Parabolic Channel,** W=20.00' D=0.50' Area=6.7 sf Perim=20.0' n= 0.040 |
| 21.2 | 470 | Total | | | |

## Subcatchment DA4 PRE: PRE-DEVELOPED



## Subcatchment DA4 PRE: PRE-DEVELOPED

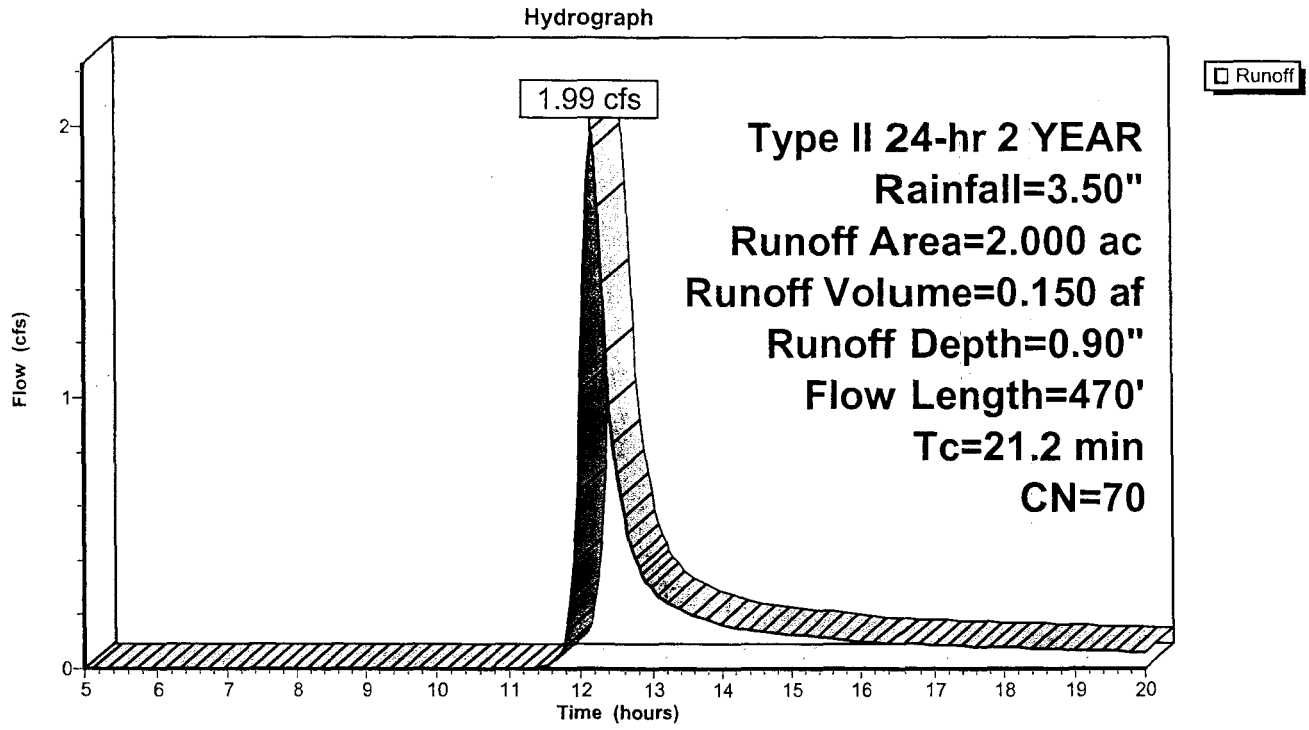
Runoff = 1.99 cfs @ 12.16 hrs, Volume= 0.150 af, Depth= 0.90"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 YEAR Rainfall=3.50"

| Area (ac) | CN | Description |
|---|---|---|
| 2.000 | 70 | Woods, Good, HSG C |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 19.0 | 100 | 0.0320 | 0.1 | | **Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.80" |
| 1.8 | 200 | 0.1390 | 1.9 | | **Shallow Concentrated Flow,** Woodland Kv= 5.0 fps |
| 0.4 | 170 | 0.1300 | 6.4 | 42.88 | **Parabolic Channel,** W=20.00' D=0.50' Area=6.7 sf Perim=20.0' n= 0.040 |
| 21.2 | 470 | Total | | | |

## Subcatchment DA4 PRE: PRE-DEVELOPED



## Subcatchment DA4 PRE: PRE-DEVELOPED

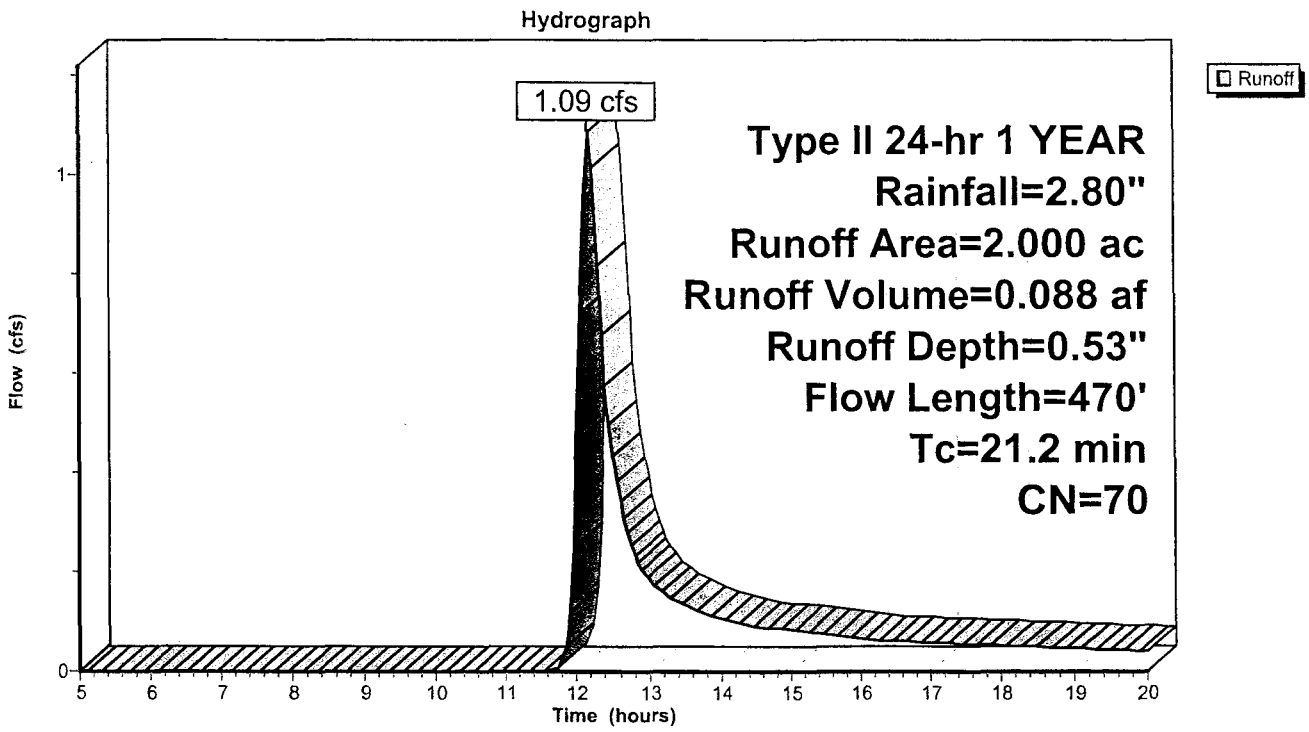
Runoff = 1.09 cfs @ 12.17 hrs, Volume= 0.088 af, Depth= 0.53"

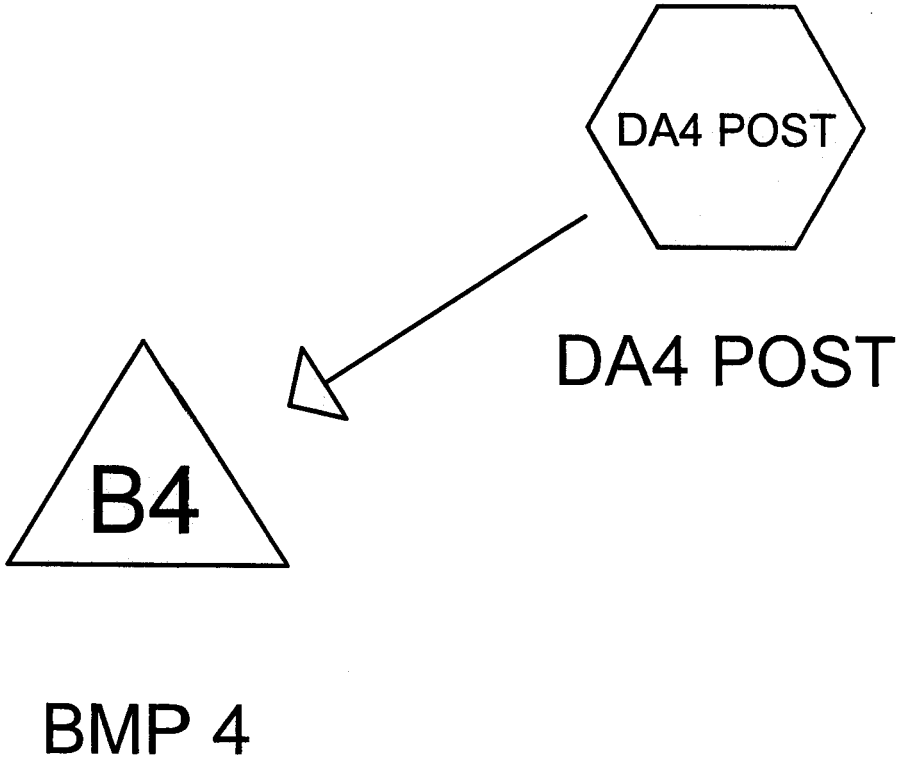
Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 1 YEAR Rainfall=2.80"

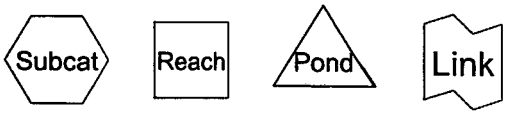
| Area (ac) | CN | Description |
|---|---|---|
| 2.000 | 70 | Woods, Good, HSG C |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 19.0 | 100 | 0.0320 | 0.1 | | **Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.80" |
| 1.8 | 200 | 0.1390 | 1.9 | | **Shallow Concentrated Flow,** Woodland Kv= 5.0 fps |
| 0.4 | 170 | 0.1300 | 6.4 | 42.88 | **Parabolic Channel,** W=20.00' D=0.50' Area=6.7 sf Perim=20.0' n= 0.040 |
| 21.2 | 470 | Total | | | |

## Subcatchment DA4 PRE: PRE-DEVELOPED






**Drainage Diagram for bmp4**
Prepared by Landmark Design Group 05/10/2005
HydroCAD® 7.00 s/n 001765 © 1986-2003 Applied Microcomputer Systems

## Subcatchment DA4 POST: DA4 POST

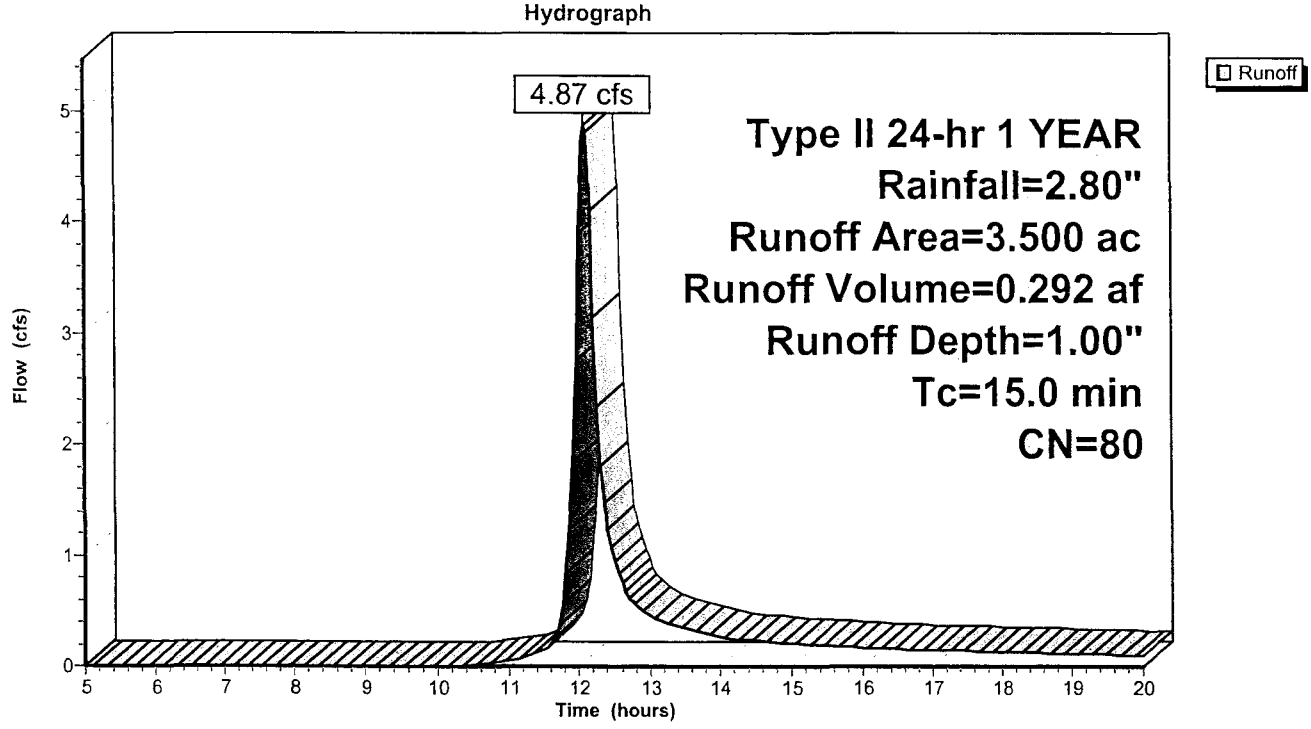
Runoff = 4.87 cfs @ 12.08 hrs, Volume= 0.292 af, Depth= 1.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 1 YEAR Rainfall=2.80"

| Area (ac) | CN | Description |
|---|---|---|
| 3.500 | 80 | 1/2 acre lots, 25% imp, HSG C |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 15.0 | | | | | **Direct Entry,** |

## Subcatchment DA4 POST: DA4 POST



## Pond B4: BMP 4

| | | | | | |
|---|---|---|---|---|---|
| Inflow Area = | 3.500 ac, | Inflow Depth = | 1.00" | for | 1 YEAR event |
| Inflow = | 4.87 cfs @ | 12.08 hrs, | Volume= | 0.292 af | |
| Outflow = | 0.46 cfs @ | 13.00 hrs, | Volume= | 0.249 af, | Atten= 91%, Lag= 55.5 min |
| Primary = | 0.46 cfs @ | 13.00 hrs, | Volume= | 0.249 af | |

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 51.36' @ 13.00 hrs Surf.Area= 1,861 sf Storage= 6,347 cf
Plug-Flow detention time= 171.3 min calculated for 0.249 af (85% of inflow)
Center-of-Mass det. time= 126.0 min ( 932.8 - 806.8 )

| # | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| 1 | 47.50' | 23,684 cf | **Custom Stage Data (Prismatic)** Listed below |

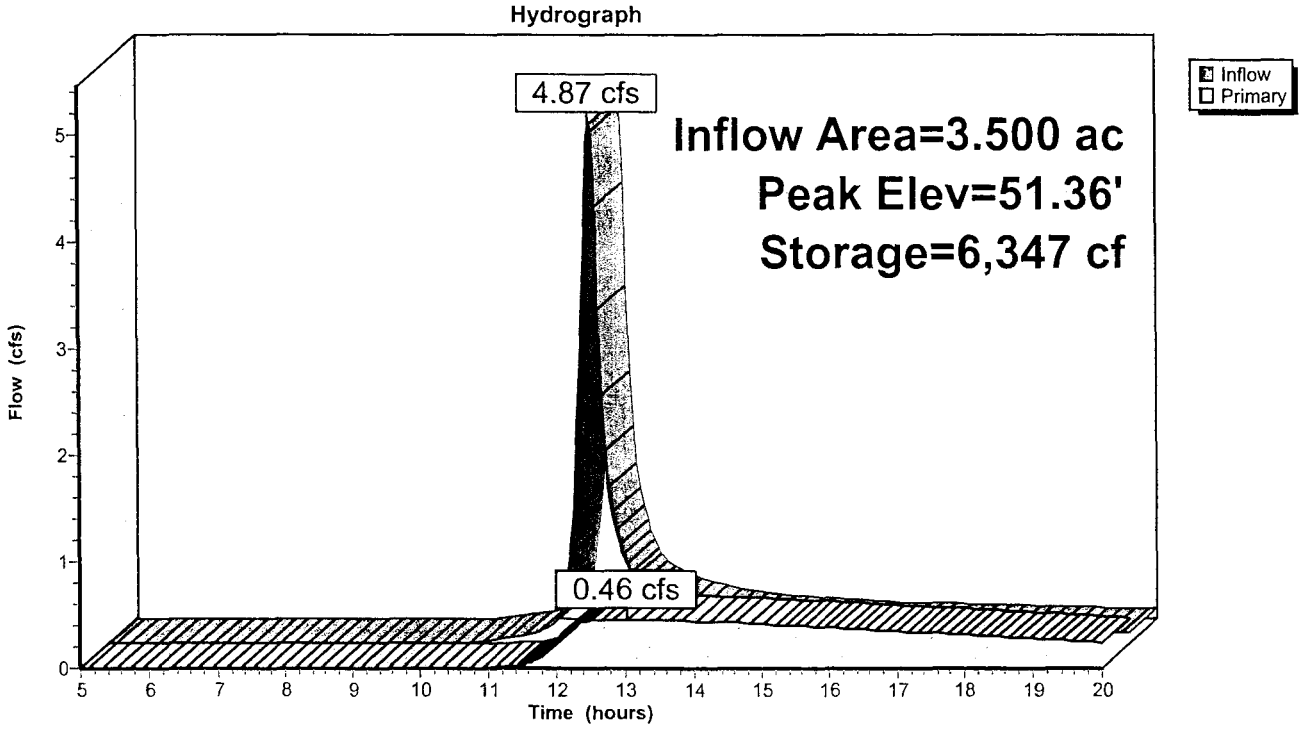
| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 47.50 | 485 | 0 | 0 |
| 54.00 | 2,800 | 10,676 | 10,676 |
| 57.50 | 4,633 | 13,008 | 23,684 |

PERFECTLY LINEAR @ 7' DEPTH !?

| # | Routing | Invert | Outlet Devices |
|---|---|---|---|
| 1 | Primary | 45.00' | **24.0" x 62.0' long Culvert** RCP, square edge headwall, Ke= 0.500<br>Outlet Invert= 44.00' S= 0.0161 '/' n= 0.012 Cc= 0.900 |
| 2 | Device 1 | 47.50' | **3.0" x 3.0' long Culvert** RCP, square edge headwall, Ke= 0.500<br>Outlet Invert= 47.10' S= 0.1333 '/' n= 0.013 Cc= 0.900 |
| 3 | Device 1 | 54.00' | **48.0" Horiz. Orifice/Grate** Limited to weir flow C= 0.600 |

**Primary OutFlow** Max=0.46 cfs @ 13.00 hrs HW=51.36' (Free Discharge)
└**1=Culvert** (Passes 0.46 cfs of 35.04 cfs potential flow)
├**2=Culvert** (Inlet Controls 0.46 cfs @ 9.3 fps)
└**3=Orifice/Grate** ( Controls 0.00 cfs)

## Pond B4: BMP 4


Hydrograph
4.87 cfs
0.46 cfs
Inflow Area=3.500 ac
Peak Elev=51.36'
Storage=6,347 cf
Inflow
Primary
Flow (cfs)
Time (hours)
0
1
2
3
4
5
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20

## Subcatchment DA4 POST: DA4 POST

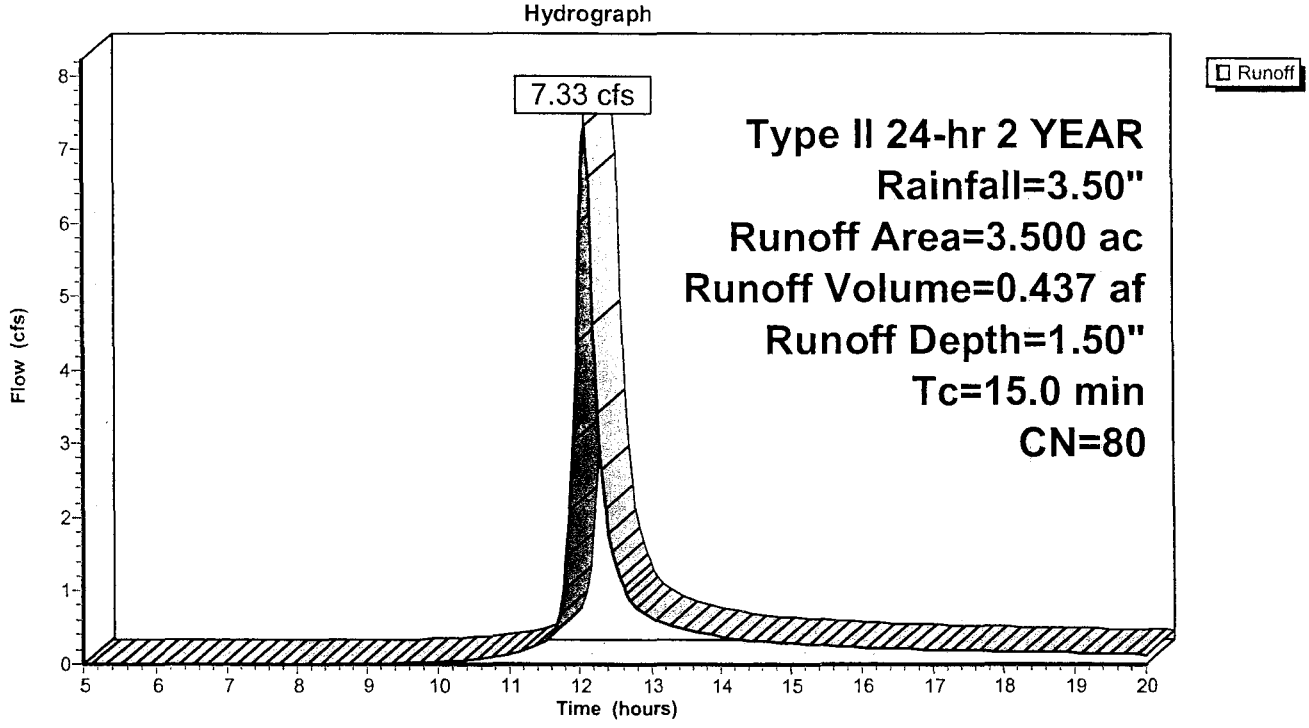
Runoff = 7.33 cfs @ 12.07 hrs, Volume= 0.437 af, Depth= 1.50"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 YEAR Rainfall=3.50"

| Area (ac) | CN | Description |
|---|---|---|
| 3.500 | 80 | 1/2 acre lots, 25% imp, HSG C |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 15.0 | | | | | **Direct Entry,** |

## Subcatchment DA4 POST: DA4 POST



## Pond B4: BMP 4

| | | | | | |
|---|---|---|---|---|---|
| Inflow Area = | 3.500 ac, | Inflow Depth = | 1.50" | for | 2 YEAR event |
| Inflow = | 7.33 cfs @ | 12.07 hrs, | Volume= | 0.437 af | |
| Outflow = | 0.58 cfs @ | 13.14 hrs, | Volume= | 0.341 af, | Atten= 92%, Lag= 64.0 min |
| Primary = | 0.58 cfs @ | 13.14 hrs, | Volume= | 0.341 af | |

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 53.69' @ 13.14 hrs Surf.Area= 2,691 sf Storage= 10,173 cf
Plug-Flow detention time= 195.8 min calculated for 0.341 af (78% of inflow)
Center-of-Mass det. time= 137.2 min ( 935.6 - 798.4 )

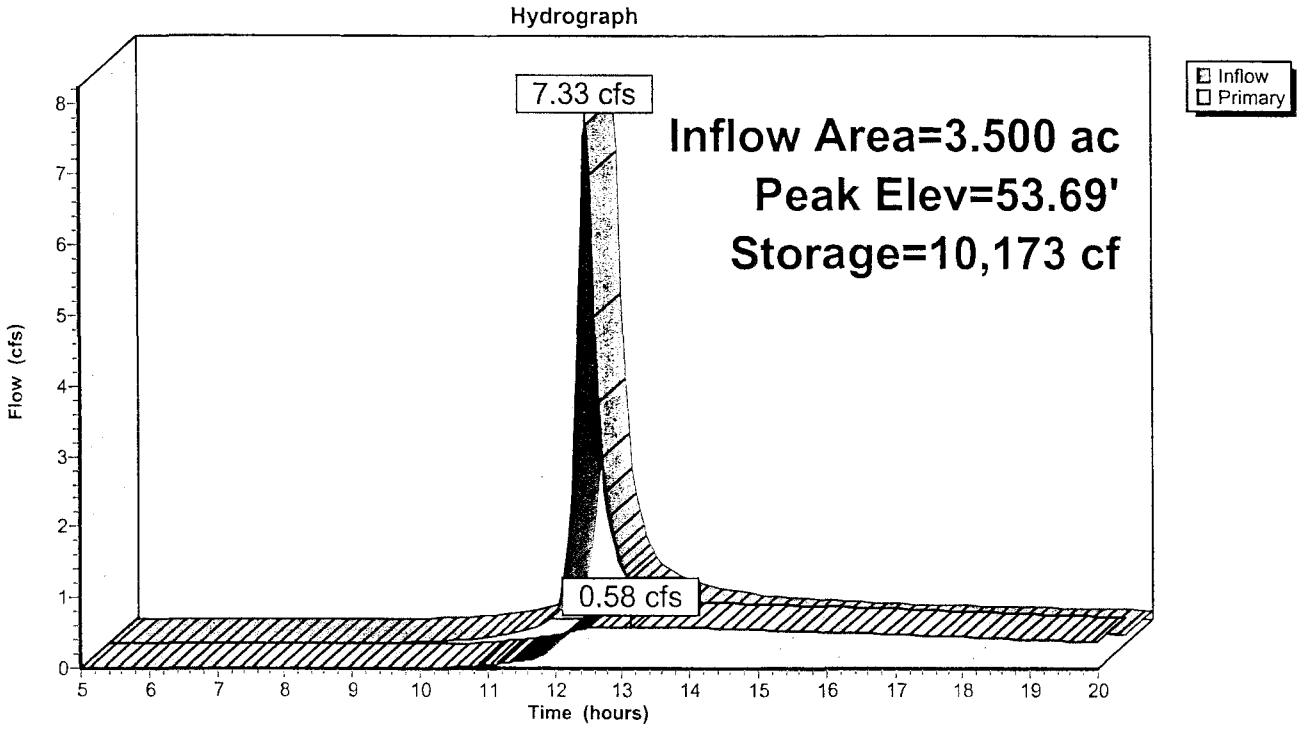
| # | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| 1 | 47.50' | 23,684 cf | **Custom Stage Data (Prismatic)** Listed below |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 47.50 | 485 | 0 | 0 |
| 54.00 | 2,800 | 10,676 | 10,676 |
| 57.50 | 4,633 | 13,008 | 23,684 |

| # | Routing | Invert | Outlet Devices |
|---|---|---|---|
| 1 | Primary | 45.00' | **24.0" x 62.0' long Culvert** RCP, square edge headwall, Ke= 0.500<br>Outlet Invert= 44.00' S= 0.0161 '/' n= 0.012 Cc= 0.900 |
| 2 | Device 1 | 47.50' | **3.0" x 3.0' long Culvert** RCP, square edge headwall, Ke= 0.500<br>Outlet Invert= 47.10' S= 0.1333 '/' n= 0.013 Cc= 0.900 |
| 3 | Device 1 | 54.00' | **48.0" Horiz. Orifice/Grate** Limited to weir flow C= 0.600 |

**Primary OutFlow** Max=0.58 cfs @ 13.14 hrs HW=53.69' (Free Discharge)
└**1=Culvert** (Passes 0.58 cfs of 41.96 cfs potential flow)
  ├**2=Culvert** (Inlet Controls 0.58 cfs @ 11.9 fps)
  └**3=Orifice/Grate** ( Controls 0.00 cfs)

## Pond B4: BMP 4


Hydrograph
7.33 cfs
0.58 cfs
Inflow Area=3.500 ac
Peak Elev=53.69'
Storage=10,173 cf
Inflow
Primary
Flow (cfs)
Time (hours)
0
1
2
3
4
5
6
7
8
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20

## Subcatchment DA4 POST: DA4 POST

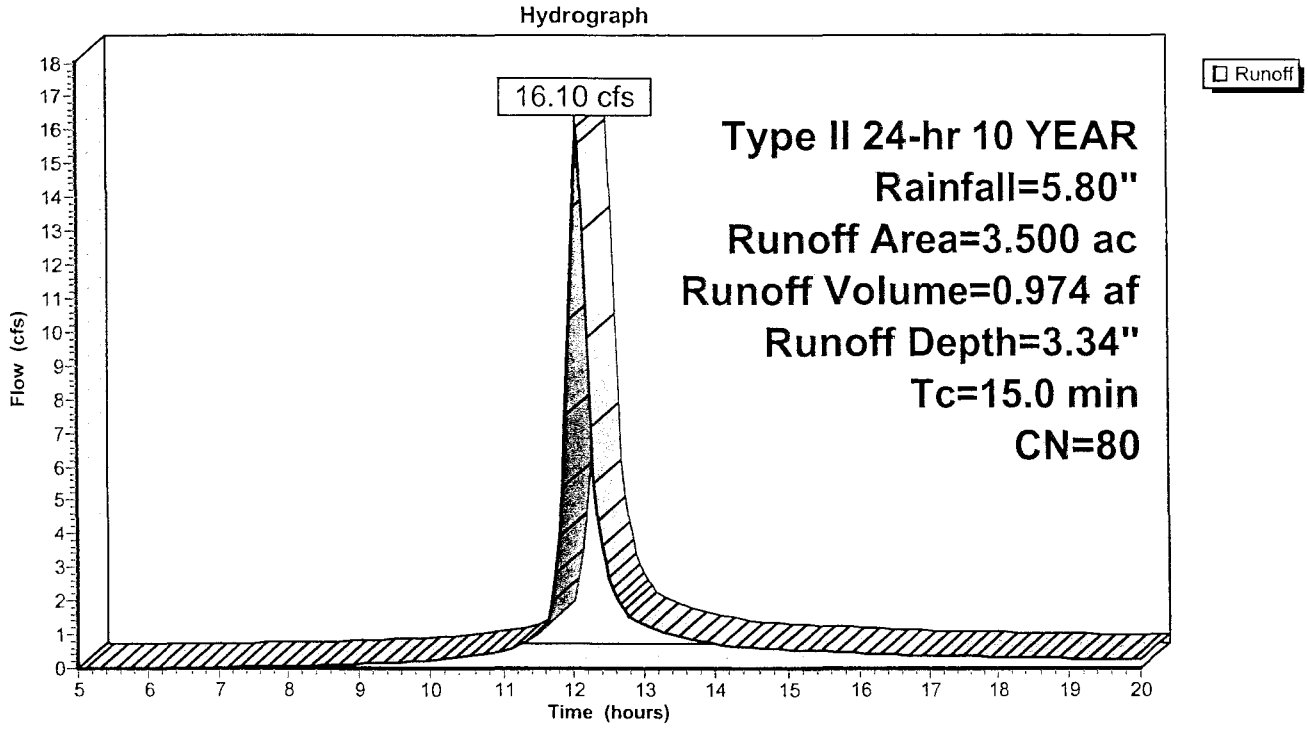
Runoff = 16.10 cfs @ 12.07 hrs, Volume= 0.974 af, Depth= 3.34"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 10 YEAR Rainfall=5.80"

| Area (ac) | CN | Description |
|---|---|---|
| 3.500 | 80 | 1/2 acre lots, 25% imp, HSG C |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 15.0 | | | | | **Direct Entry,** |

## Subcatchment DA4 POST: DA4 POST



## Pond B4: BMP 4

| | | | | | |
|---|---|---|---|---|---|
| Inflow Area = | 3.500 ac, | Inflow Depth = | 3.34" | for | 10 YEAR event |
| Inflow = | 16.10 cfs @ | 12.07 hrs, | Volume= | 0.974 af | |
| Outflow = | 16.10 cfs @ | 12.12 hrs, | Volume= | 0.806 af, | Atten= 0%, Lag= 3.2 min |
| Primary = | 16.10 cfs @ | 12.12 hrs, | Volume= | 0.806 af | |

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 54.53' @ 12.12 hrs Surf.Area= 3,076 sf Storage= 12,635 cf
Plug-Flow detention time= 105.2 min calculated for 0.806 af (83% of inflow)
Center-of-Mass det. time= 55.7 min ( 836.8 - 781.1 )

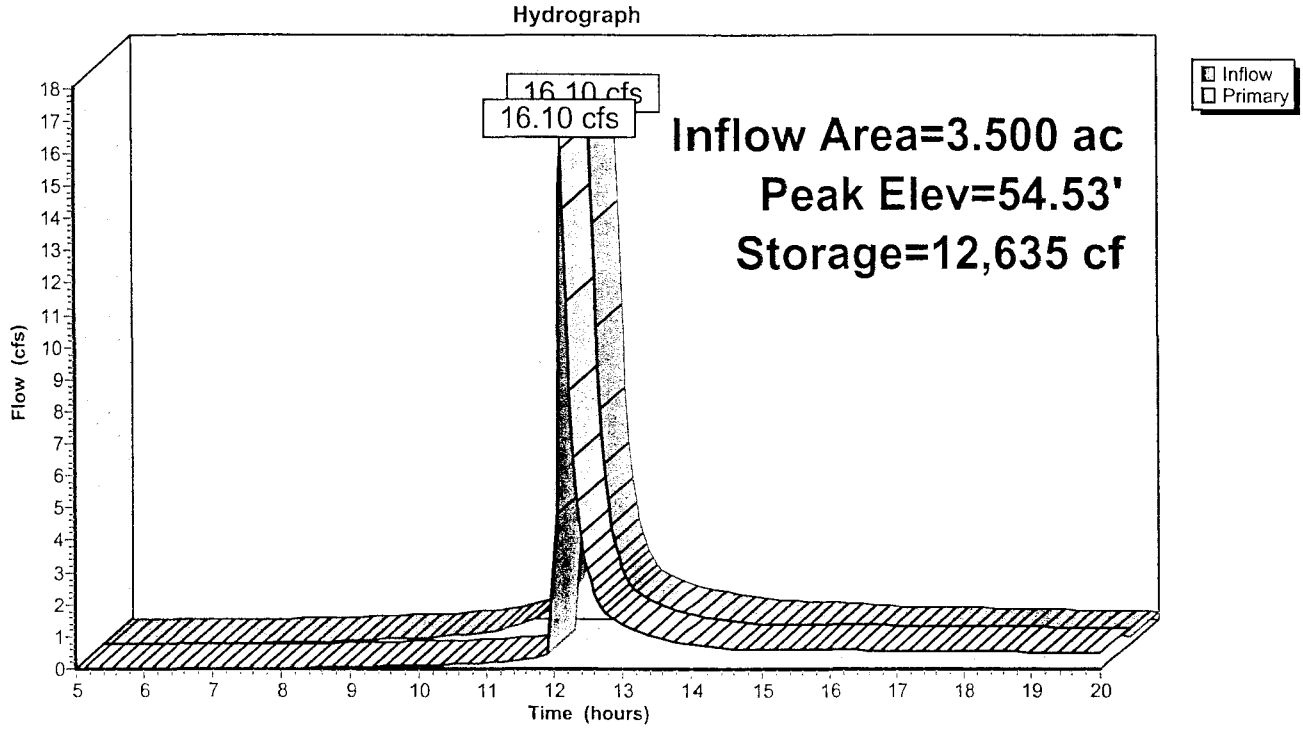
| # | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| 1 | 47.50' | 23,684 cf | **Custom Stage Data (Prismatic)** Listed below |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 47.50 | 485 | 0 | 0 |
| 54.00 | 2,800 | 10,676 | 10,676 |
| 57.50 | 4,633 | 13,008 | 23,684 |

| # | Routing | Invert | Outlet Devices |
|---|---|---|---|
| 1 | Primary | 45.00' | **24.0" x 62.0' long Culvert** RCP, square edge headwall, Ke= 0.500<br>Outlet Invert= 44.00' S= 0.0161 '/' n= 0.012 Cc= 0.900 |
| 2 | Device 1 | 47.50' | **3.0" x 3.0' long Culvert** RCP, square edge headwall, Ke= 0.500<br>Outlet Invert= 47.10' S= 0.1333 '/' n= 0.013 Cc= 0.900 |
| 3 | Device 1 | 54.00' | **48.0" Horiz. Orifice/Grate** Limited to weir flow C= 0.600 |

**Primary OutFlow** Max=14.73 cfs @ 12.12 hrs HW=54.49' (Free Discharge)
└**1=Culvert** (Passes 14.73 cfs of 44.08 cfs potential flow)
  ├**2=Culvert** (Inlet Controls 0.62 cfs @ 12.6 fps)
  └**3=Orifice/Grate** (Weir Controls 14.11 cfs @ 2.3 fps)

## Pond B4: BMP 4


Hydrograph
Inflow
Primary
16.10 cfs
16.10 cfs
Inflow Area=3.500 ac
Peak Elev=54.53'
Storage=12,635 cf
Flow (cfs)
Time (hours)

## Subcatchment DA4 POST: DA4 POST

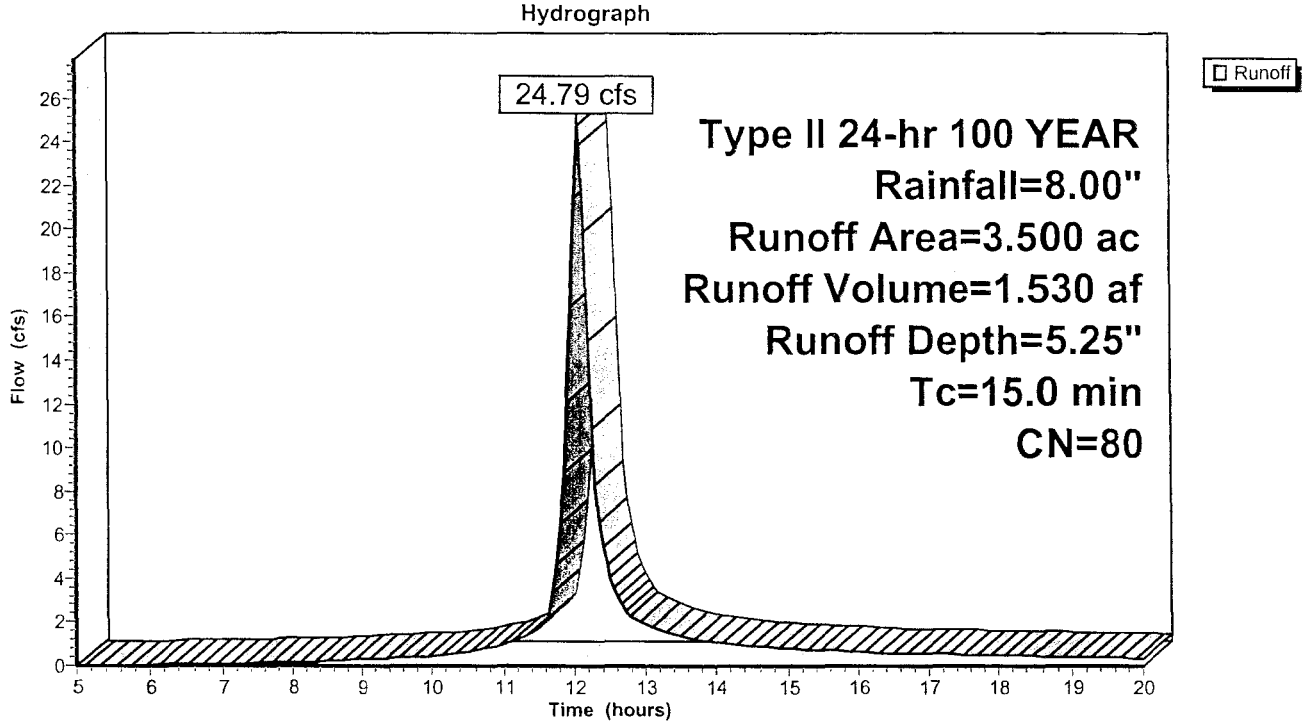
Runoff = 24.79 cfs @ 12.07 hrs, Volume= 1.530 af, Depth= 5.25"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100 YEAR Rainfall=8.00"

| Area (ac) | CN | Description |
|---|---|---|
| 3.500 | 80 | 1/2 acre lots, 25% imp, HSG C |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 15.0 | | | | | **Direct Entry,** |

## Subcatchment DA4 POST: DA4 POST



## Pond B4: BMP 4

| | | | | | |
|---|---|---|---|---|---|
| Inflow Area = | 3.500 ac, | Inflow Depth = | 5.25" | for | 100 YEAR event |
| Inflow = | 24.79 cfs @ | 12.07 hrs, | Volume= | 1.530 af | |
| Outflow = | 24.42 cfs @ | 12.09 hrs, | Volume= | 1.317 af, | Atten= 1%, Lag= 1.4 min |
| Primary = | 24.42 cfs @ | 12.09 hrs, | Volume= | 1.317 af | |

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 54.69' @ 12.09 hrs Surf.Area= 3,164 sf Storage= 13,257 cf
Plug-Flow detention time= 73.3 min calculated for 1.317 af (86% of inflow)
Center-of-Mass det. time= 30.4 min ( 801.2 - 770.8 )

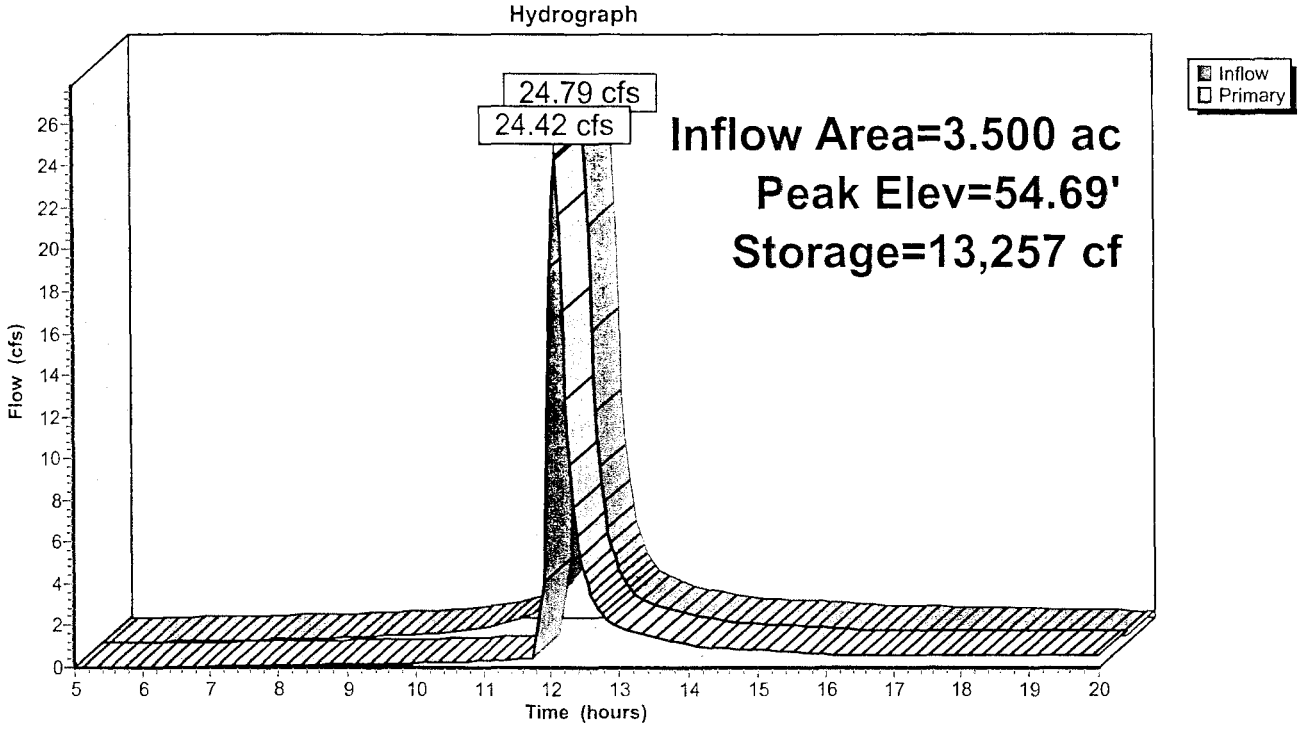
| # | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| 1 | 47.50' | 23,684 cf | **Custom Stage Data (Prismatic)** Listed below |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 47.50 | 485 | 0 | 0 |
| 54.00 | 2,800 | 10,676 | 10,676 |
| 57.50 | 4,633 | 13,008 | 23,684 |

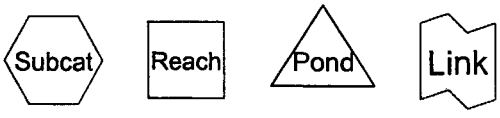
| # | Routing | Invert | Outlet Devices |
|---|---|---|---|
| 1 | Primary | 45.00' | **24.0" x 62.0' long Culvert** RCP, square edge headwall, Ke= 0.500<br>Outlet Invert= 44.00' S= 0.0161 '/' n= 0.012 Cc= 0.900 |
| 2 | Device 1 | 47.50' | **3.0" x 3.0' long Culvert** RCP, square edge headwall, Ke= 0.500<br>Outlet Invert= 47.10' S= 0.1333 '/' n= 0.013 Cc= 0.900 |
| 3 | Device 1 | 54.00' | **48.0" Horiz. Orifice/Grate** Limited to weir flow C= 0.600 |

**Primary OutFlow** Max=24.07 cfs @ 12.09 hrs HW=54.69' (Free Discharge)
└**1=Culvert** (Passes 24.07 cfs of 44.59 cfs potential flow)
  ├**2=Culvert** (Inlet Controls 0.63 cfs @ 12.8 fps)
  └**3=Orifice/Grate** (Weir Controls 23.44 cfs @ 2.7 fps)

## Pond B4: BMP 4


Hydrograph
24.79 cfs
24.42 cfs
Inflow Area=3.500 ac
Peak Elev=54.69'
Storage=13,257 cf
Inflow
Primary
Flow (cfs)
Time (hours)

# PRE-DEVELOPED




**Drainage Diagram for bmp5**
Prepared by Landmark Design Group 05/09/2005
HydroCAD® 7.00 s/n 001765 © 1986-2003 Applied Microcomputer Systems

## Subcatchment DA B5: PRE-DEVELOPED

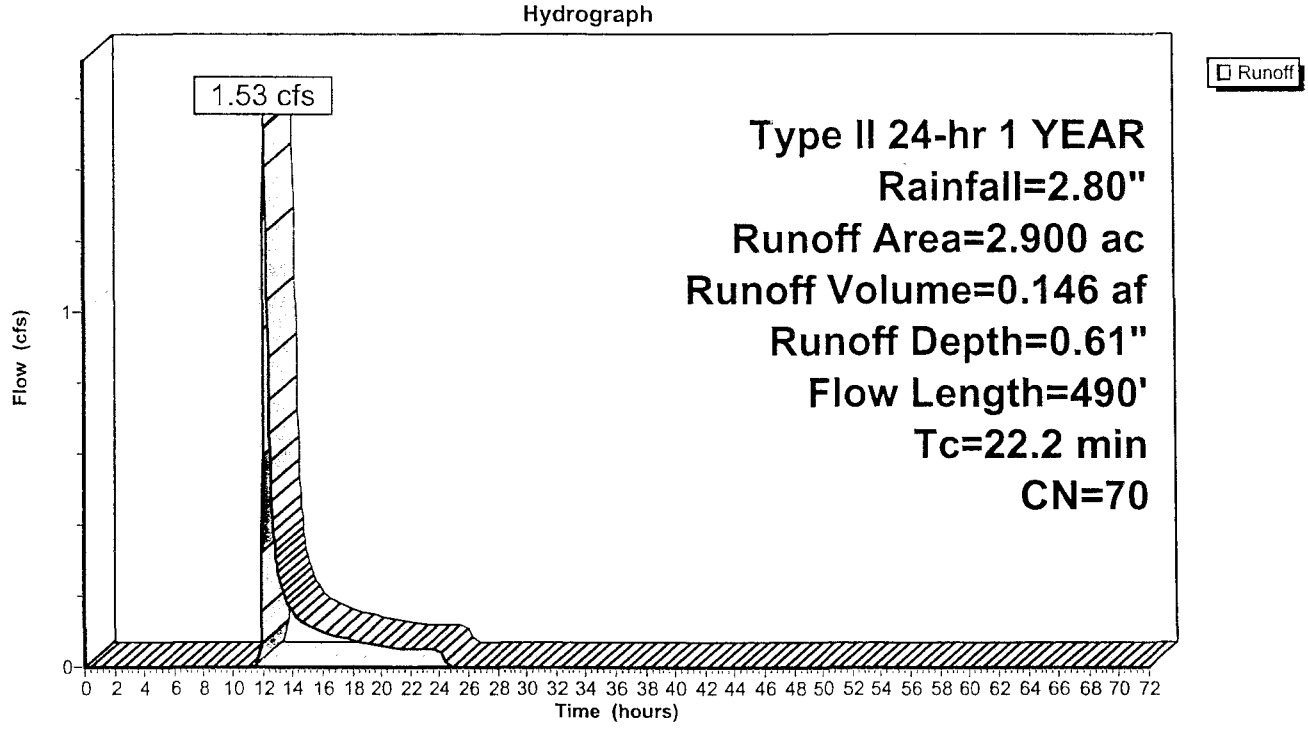
Runoff = 1.53 cfs @ 12.19 hrs, Volume= 0.146 af, Depth= 0.61"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 1 YEAR Rainfall=2.80"

| Area (ac) | CN | Description |
|---|---|---|
| 2.900 | 70 | Woods, Good, HSG C |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 19.8 | 100 | 0.0290 | 0.1 | | **Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.80" |
| 2.0 | 220 | 0.1390 | 1.9 | | **Shallow Concentrated Flow,** Woodland Kv= 5.0 fps |
| 0.4 | 170 | 0.1300 | 6.4 | 42.88 | **Parabolic Channel,** W=20.00' D=0.50' Area=6.7 sf Perim=20.0' n= 0.040 |
| 22.2 | 490 | Total | | | |

## Subcatchment DA B5: PRE-DEVELOPED



## Subcatchment DA B5: PRE-DEVELOPED

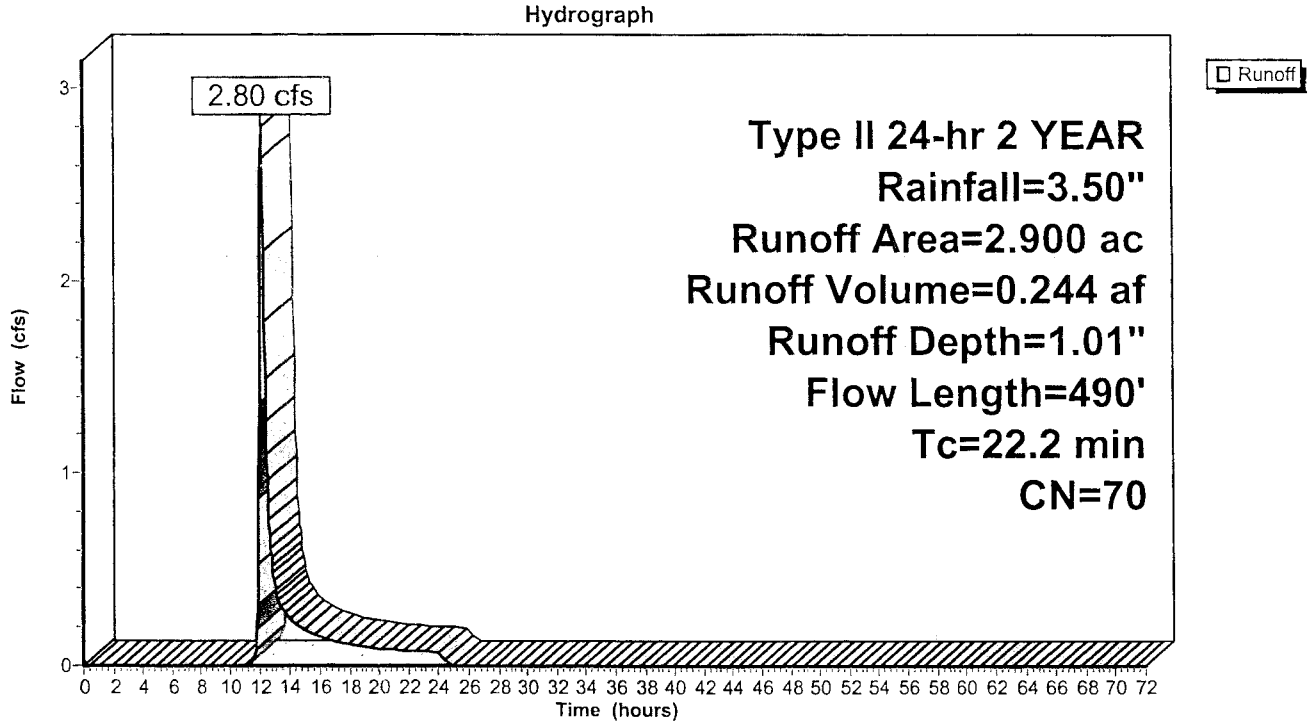
Runoff = 2.80 cfs @ 12.17 hrs, Volume= 0.244 af, Depth= 1.01"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 YEAR Rainfall=3.50"

| Area (ac) | CN | Description |
|---|---|---|
| 2.900 | 70 | Woods, Good, HSG C |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 19.8 | 100 | 0.0290 | 0.1 | | **Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.80" |
| 2.0 | 220 | 0.1390 | 1.9 | | **Shallow Concentrated Flow,** Woodland Kv= 5.0 fps |
| 0.4 | 170 | 0.1300 | 6.4 | 42.88 | **Parabolic Channel,** W=20.00' D=0.50' Area=6.7 sf Perim=20.0' n= 0.040 |
| 22.2 | 490 | Total | | | |

## Subcatchment DA B5: PRE-DEVELOPED



## Subcatchment DA B5: PRE-DEVELOPED

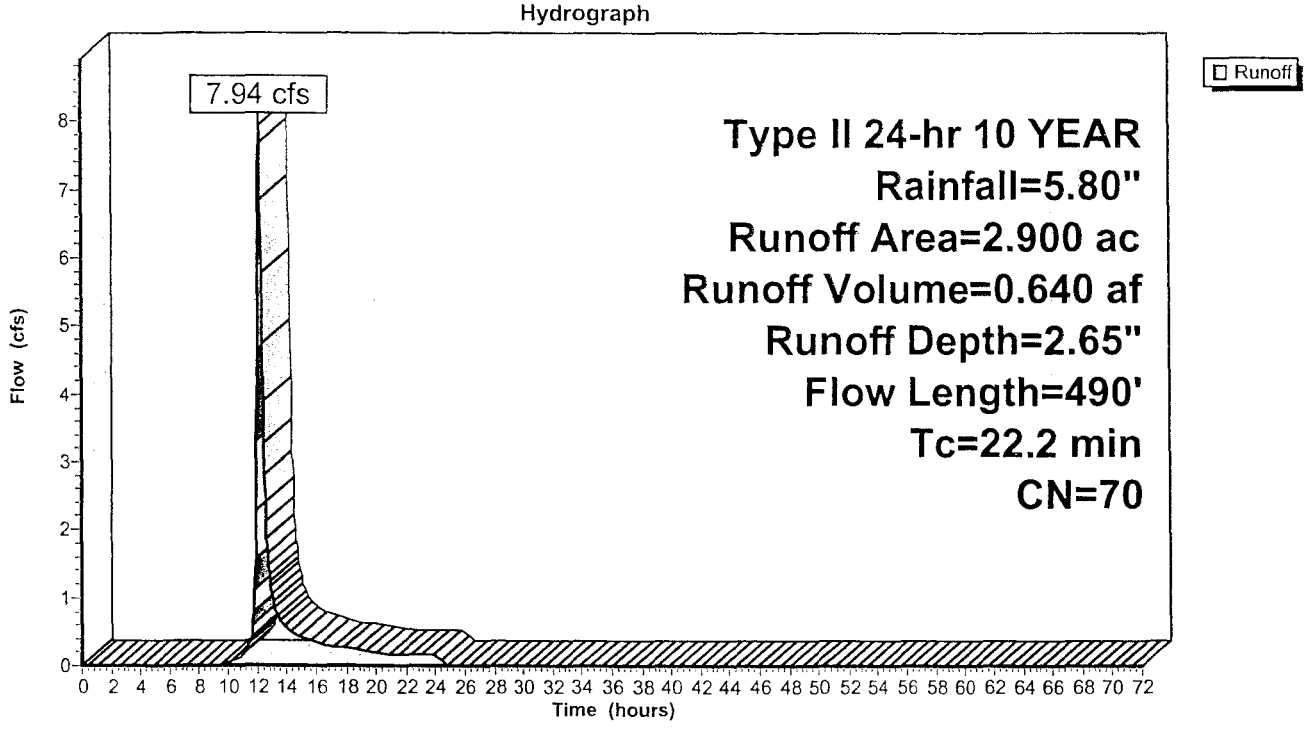
Runoff = 7.94 cfs @ 12.16 hrs, Volume= 0.640 af, Depth= 2.65"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 10 YEAR Rainfall=5.80"

| Area (ac) | CN | Description |
|---|---|---|
| 2.900 | 70 | Woods, Good, HSG C |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 19.8 | 100 | 0.0290 | 0.1 | | **Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.80" |
| 2.0 | 220 | 0.1390 | 1.9 | | **Shallow Concentrated Flow,** Woodland Kv= 5.0 fps |
| 0.4 | 170 | 0.1300 | 6.4 | 42.88 | **Parabolic Channel,** W=20.00' D=0.50' Area=6.7 sf Perim=20.0' n= 0.040 |
| 22.2 | 490 | Total | | | |

## Subcatchment DA B5: PRE-DEVELOPED



## Subcatchment DA B5: PRE-DEVELOPED

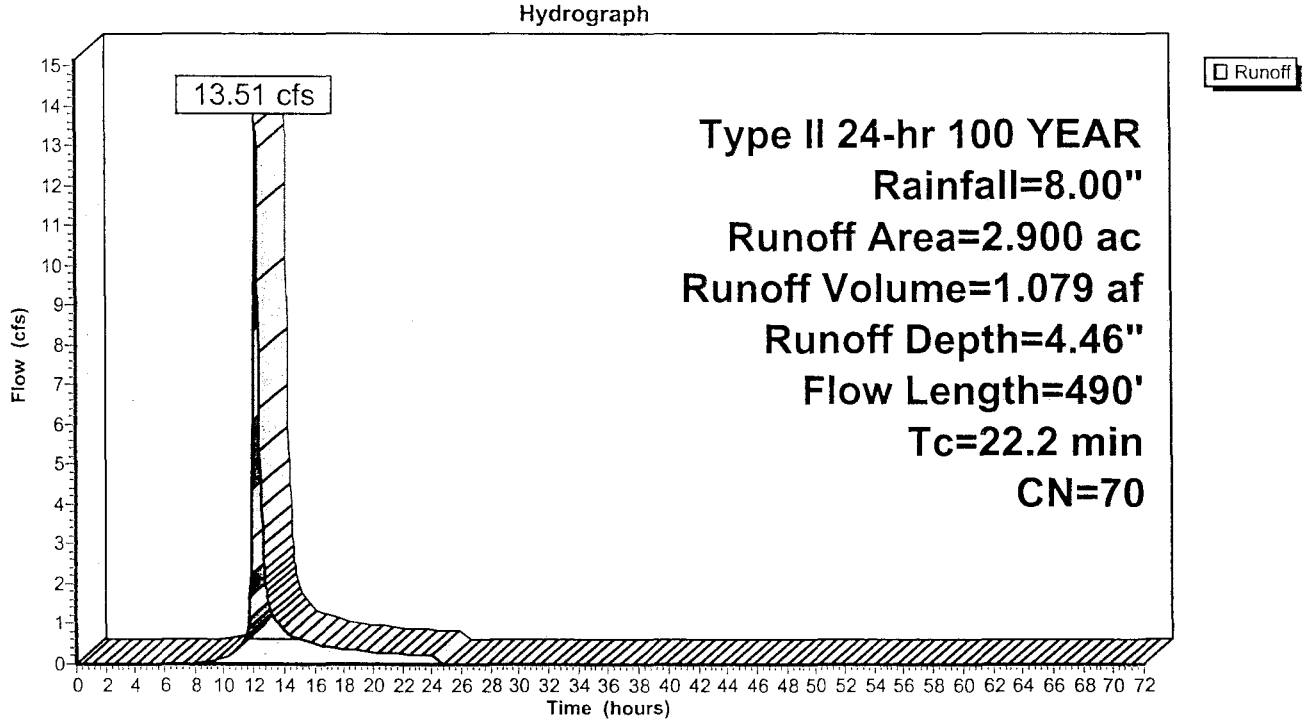
Runoff = 13.51 cfs @ 12.15 hrs, Volume= 1.079 af, Depth= 4.46"

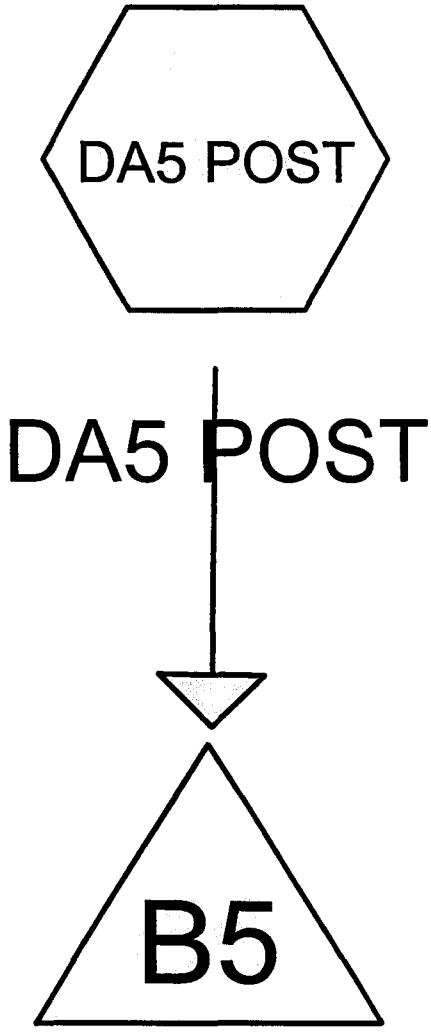
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 100 YEAR Rainfall=8.00"

| Area (ac) | CN | Description |
|---|---|---|
| 2.900 | 70 | Woods, Good, HSG C |

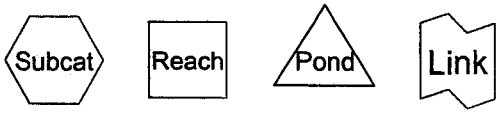
| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 19.8 | 100 | 0.0290 | 0.1 | | **Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.80" |
| 2.0 | 220 | 0.1390 | 1.9 | | **Shallow Concentrated Flow,** Woodland Kv= 5.0 fps |
| 0.4 | 170 | 0.1300 | 6.4 | 42.88 | **Parabolic Channel,** W=20.00' D=0.50' Area=6.7 sf Perim=20.0' n= 0.040 |
| 22.2 | 490 | Total | | | |

## Subcatchment DA B5: PRE-DEVELOPED






BMP 5




**Drainage Diagram for bmp5**
Prepared by Landmark Design Group 05/09/2005
HydroCAD® 7.00 s/n 001765 © 1986-2003 Applied Microcomputer Systems

## Subcatchment DA5 POST: DA5 POST

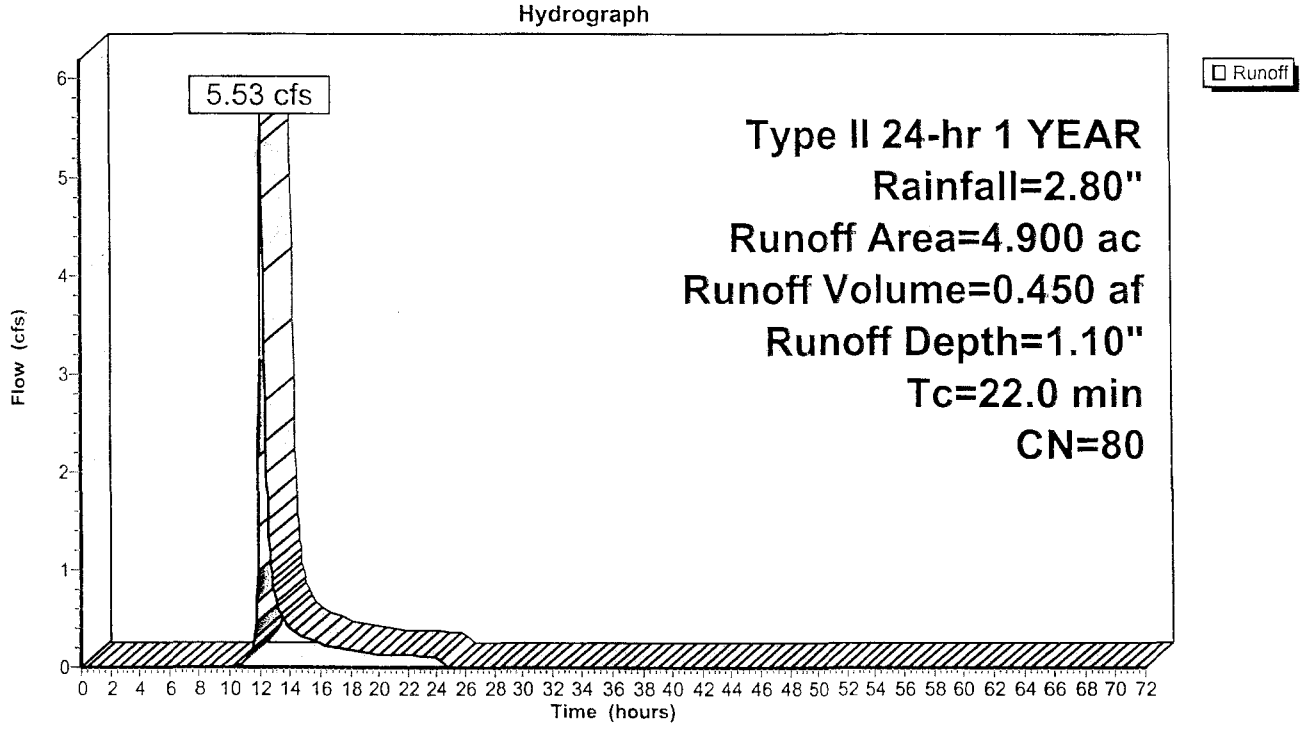
Runoff = 5.53 cfs @ 12.16 hrs, Volume= 0.450 af, Depth= 1.10"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 1 YEAR Rainfall=2.80"

| Area (ac) | CN | Description |
|---|---|---|
| 4.900 | 80 | 1/2 acre lots, 25% imp, HSG C |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 22.0 | | | | | **Direct Entry,** |

## Subcatchment DA5 POST: DA5 POST



## Pond B5: BMP 5

| | | | | | |
|---|---|---|---|---|---|
| Inflow Area = | 4.900 ac, | Inflow Depth = | 1.10" | for | 1 YEAR event |
| Inflow = | 5.53 cfs @ | 12.16 hrs, | Volume= | | 0.450 af |
| Outflow = | 0.46 cfs @ | 13.68 hrs, | Volume= | | 0.450 af, Atten= 92%, Lag= 91.2 min |
| Primary = | 0.46 cfs @ | 13.68 hrs, | Volume= | | 0.450 af |

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 70.96' @ 13.68 hrs Surf.Area= 3,104 sf Storage= 9,616 cf
Plug-Flow detention time= 251.5 min calculated for 0.450 af (100% of inflow)
Center-of-Mass det. time= 251.9 min ( 1,113.3 - 861.4 )

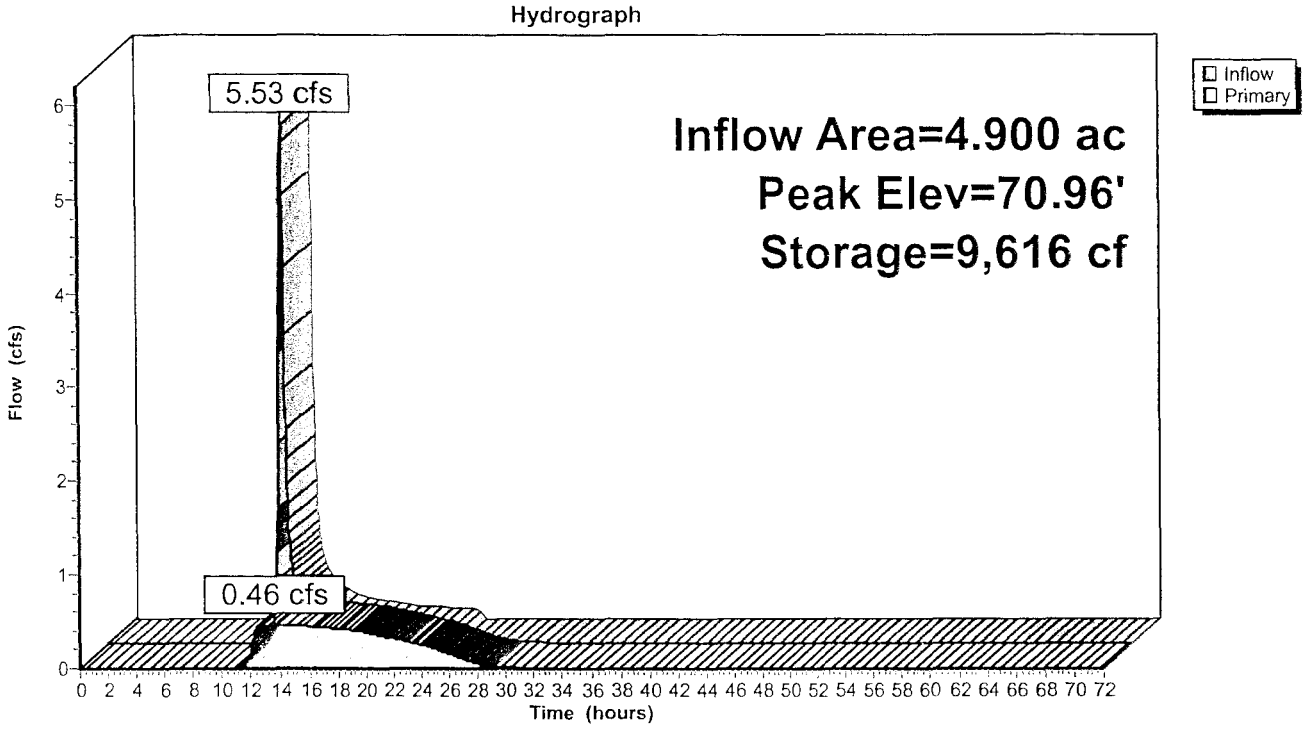
| # | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| 1 | 67.00' | 31,965 cf | **Custom Stage Data (Prismatic)** Listed below |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 67.00 | 1,300 | 0 | 0 |
| 70.00 | 2,500 | 5,700 | 5,700 |
| 75.00 | 5,640 | 20,350 | 26,050 |
| 76.00 | 6,190 | 5,915 | 31,965 |

| # | Routing | Invert | Outlet Devices |
|---|---|---|---|
| 1 | Primary | 66.00' | **24.0" x 62.0' long Culvert** RCP, square edge headwall, Ke= 0.500<br>Outlet Invert= 65.20' S= 0.0129 '/' n= 0.012 Cc= 0.900 |
| 2 | Device 1 | 67.00' | **3.0" Vert. Orifice/Grate** C= 0.600 |
| 3 | Device 1 | 73.25' | **48.0" Horiz. Orifice/Grate** Limited to weir flow C= 0.600 |

**Primary OutFlow** Max=0.46 cfs @ 13.68 hrs HW=70.96' (Free Discharge)
└**1=Culvert** (Passes 0.46 cfs of 30.11 cfs potential flow)
  ├**2=Orifice/Grate** (Orifice Controls 0.46 cfs @ 9.4 fps)
  └**3=Orifice/Grate** ( Controls 0.00 cfs)

## Pond B5: BMP 5


Hydrograph
5.53 cfs
0.46 cfs
Inflow Area=4.900 ac
Peak Elev=70.96'
Storage=9,616 cf
Inflow
Primary
Flow (cfs)
0
1
2
3
4
5
6
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66 68 70 72
Time (hours)

## Subcatchment DA5 POST: DA5 POST

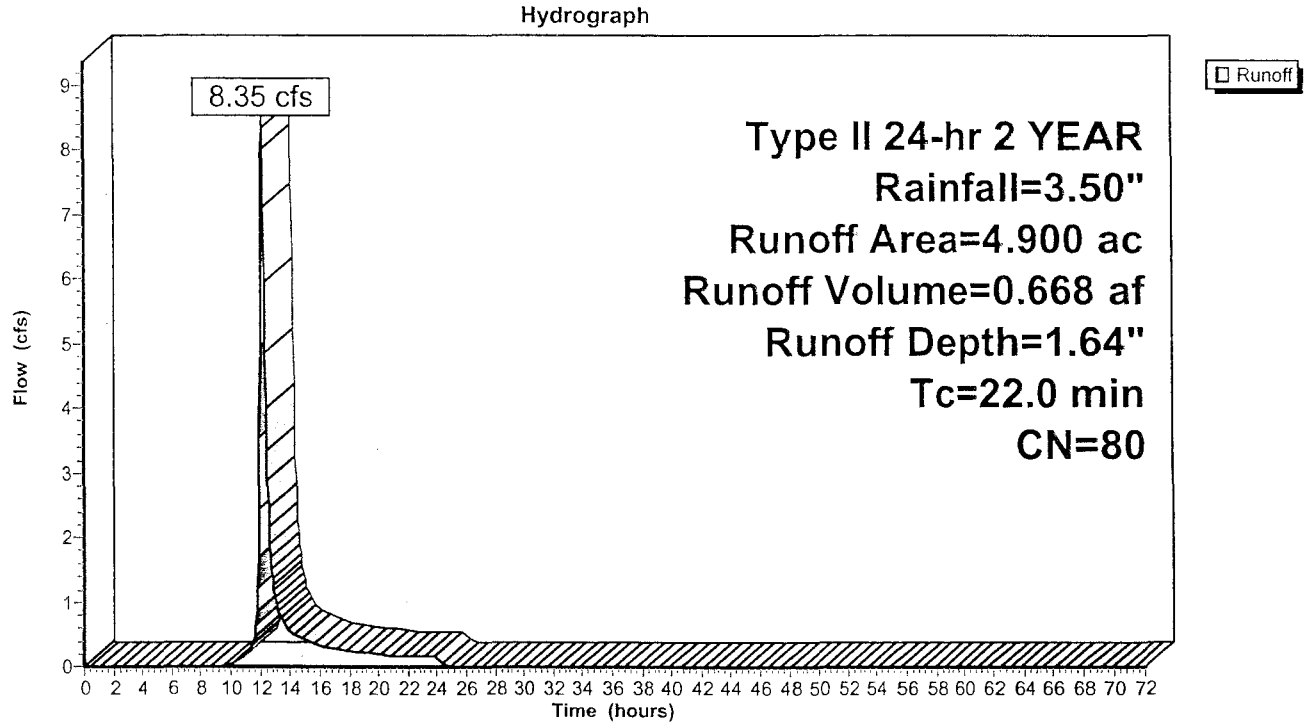
Runoff = 8.35 cfs @ 12.16 hrs, Volume= 0.668 af, Depth= 1.64"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 YEAR Rainfall=3.50"

| Area (ac) | CN | Description |
|---|---|---|
| 4.900 | 80 | 1/2 acre lots, 25% imp, HSG C |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 22.0 | | | | | **Direct Entry,** |

## Subcatchment DA5 POST: DA5 POST



## Pond B5: BMP 5

| | | | | | |
|---|---|---|---|---|---|
| Inflow Area = | 4.900 ac, | Inflow Depth = | 1.64" | for | 2 YEAR event |
| Inflow = | 8.35 cfs @ | 12.16 hrs, | Volume= | 0.668 af | |
| Outflow = | 0.55 cfs @ | 14.04 hrs, | Volume= | 0.668 af, | Atten= 93%, Lag= 113.1 min |
| Primary = | 0.55 cfs @ | 14.04 hrs, | Volume= | 0.668 af | |

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 72.45' @ 14.04 hrs Surf.Area= 4,039 sf Storage= 15,672 cf
Plug-Flow detention time= 347.8 min calculated for 0.668 af (100% of inflow)
Center-of-Mass det. time= 348.3 min ( 1,198.1 - 849.8 )

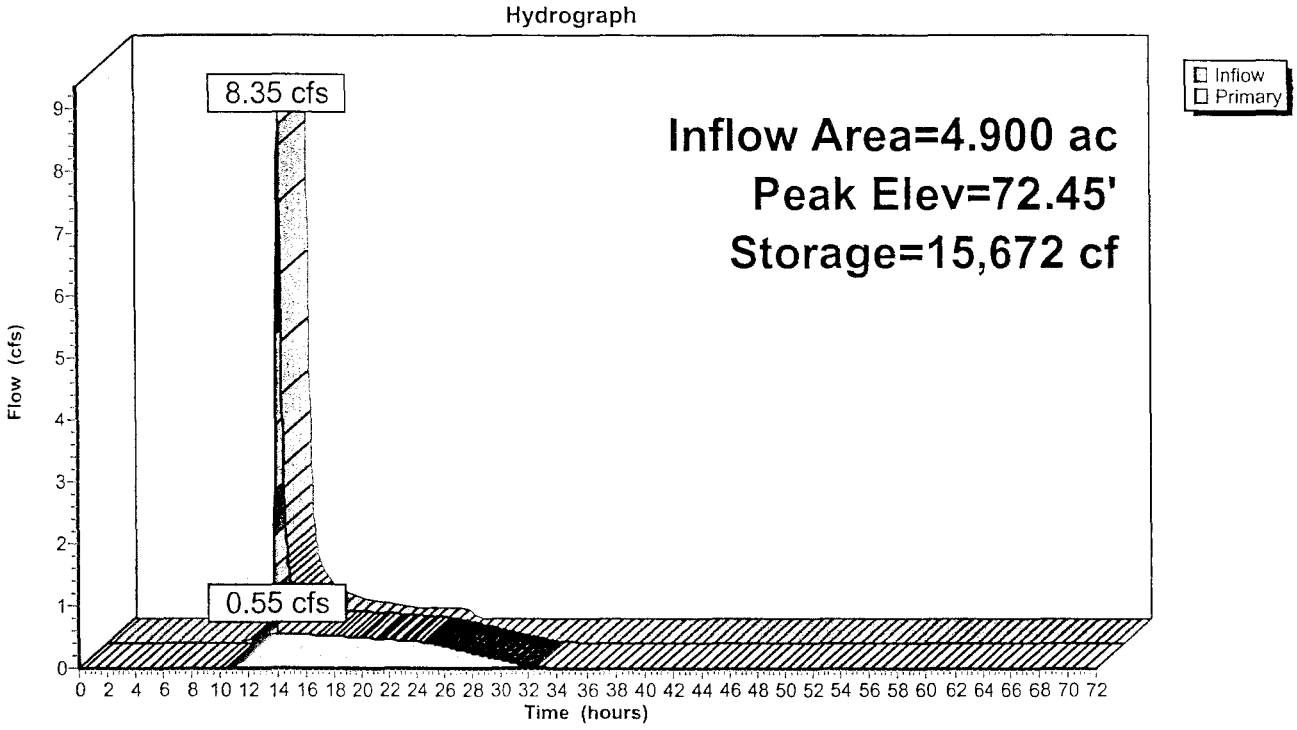
| # | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| 1 | 67.00' | 31,965 cf | **Custom Stage Data (Prismatic)** Listed below |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 67.00 | 1,300 | 0 | 0 |
| 70.00 | 2,500 | 5,700 | 5,700 |
| 75.00 | 5,640 | 20,350 | 26,050 |
| 76.00 | 6,190 | 5,915 | 31,965 |

| # | Routing | Invert | Outlet Devices |
|---|---|---|---|
| 1 | Primary | 66.00' | **24.0" x 62.0' long Culvert** RCP, square edge headwall, Ke= 0.500<br>Outlet Invert= 65.20' S= 0.0129 '/' n= 0.012 Cc= 0.900 |
| 2 | Device 1 | 67.00' | **3.0" Vert. Orifice/Grate** C= 0.600 |
| 3 | Device 1 | 73.25' | **48.0" Horiz. Orifice/Grate** Limited to weir flow C= 0.600 |

**Primary OutFlow** Max=0.55 cfs @ 14.04 hrs HW=72.45' (Free Discharge)
└**1=Culvert** (Passes 0.55 cfs of 35.31 cfs potential flow)
├**2=Orifice/Grate** (Orifice Controls 0.55 cfs @ 11.1 fps)
└**3=Orifice/Grate** ( Controls 0.00 cfs)

## Pond B5: BMP 5


Hydrograph
8.35 cfs
0.55 cfs
Inflow Area=4.900 ac
Peak Elev=72.45'
Storage=15,672 cf
Inflow
Primary
Flow (cfs)
Time (hours)

## Subcatchment DA5 POST: DA5 POST

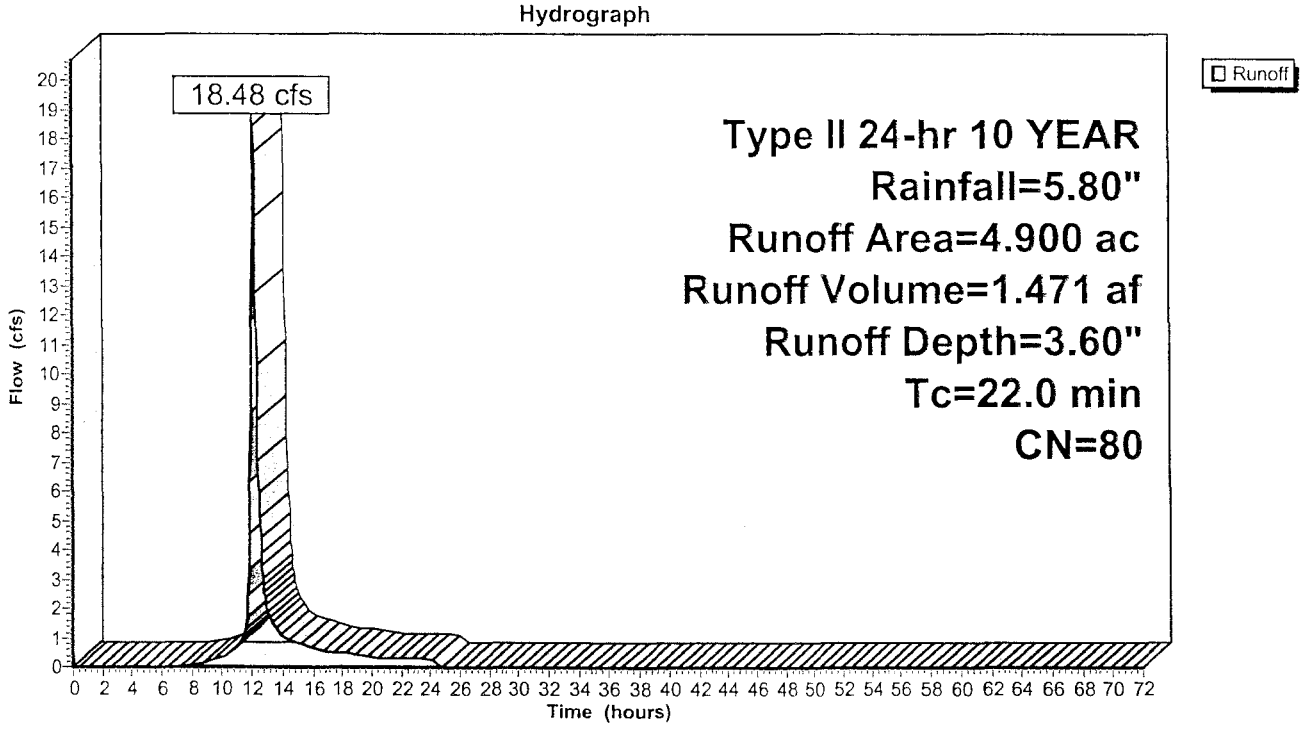
Runoff = 18.48 cfs @ 12.15 hrs, Volume= 1.471 af, Depth= 3.60"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 10 YEAR Rainfall=5.80"

| Area (ac) | CN | Description |
|---|---|---|
| 4.900 | 80 | 1/2 acre lots, 25% imp, HSG C |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 22.0 | | | | | **Direct Entry,** |

## Subcatchment DA5 POST: DA5 POST



## Pond B5: BMP 5

| | | | | | |
|---|---|---|---|---|---|
| Inflow Area = | 4.900 ac, | Inflow Depth = | 3.60" | for | 10 YEAR event |
| Inflow = | 18.48 cfs @ | 12.15 hrs, | Volume= | 1.471 af | |
| Outflow = | 16.34 cfs @ | 12.27 hrs, | Volume= | 1.471 af, | Atten= 12%, Lag= 7.1 min |
| Primary = | 16.34 cfs @ | 12.27 hrs, | Volume= | 1.471 af | |

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 73.78' @ 12.27 hrs Surf.Area= 4,874 sf Storage= 21,083 cf
Plug-Flow detention time= 268.8 min calculated for 1.471 af (100% of inflow)
Center-of-Mass det. time= 268.3 min ( 1,095.6 - 827.3 )

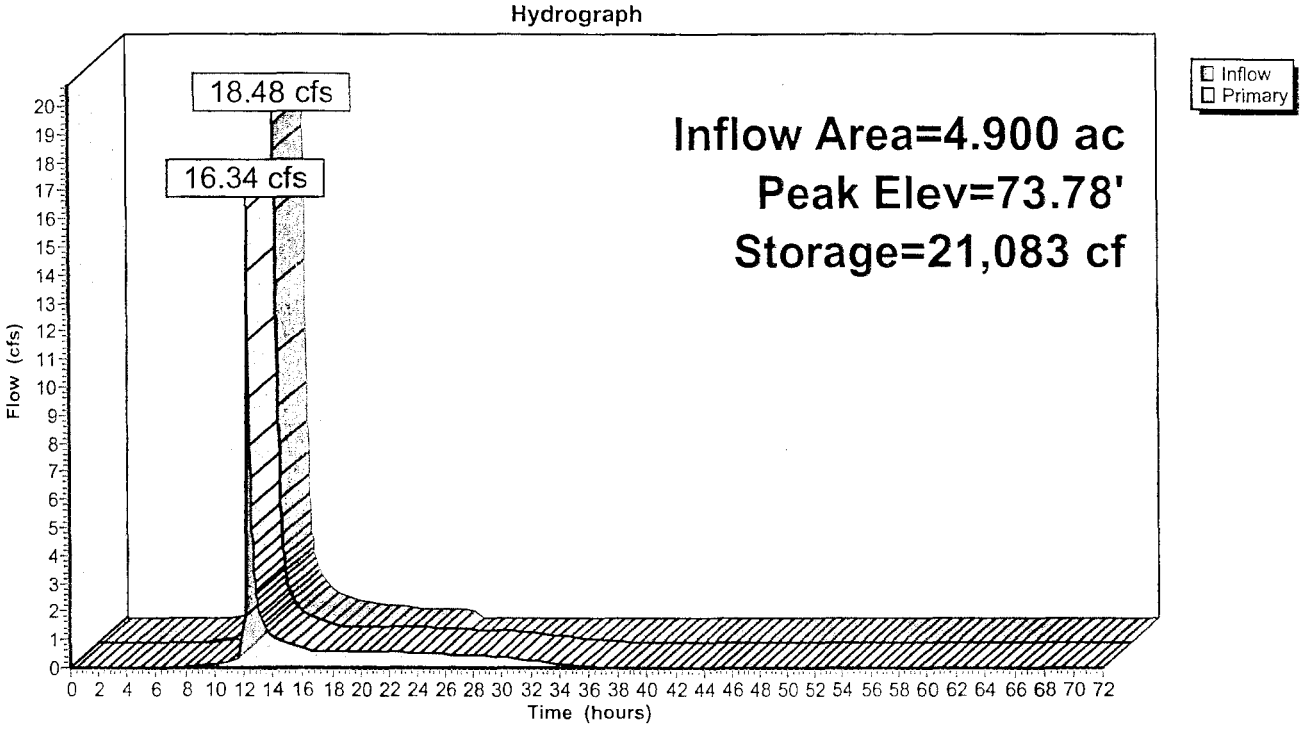
| # | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| 1 | 67.00' | 31,965 cf | **Custom Stage Data (Prismatic)** Listed below |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 67.00 | 1,300 | 0 | 0 |
| 70.00 | 2,500 | 5,700 | 5,700 |
| 75.00 | 5,640 | 20,350 | 26,050 |
| 76.00 | 6,190 | 5,915 | 31,965 |

| # | Routing | Invert | Outlet Devices |
|---|---|---|---|
| 1 | Primary | 66.00' | **24.0" x 62.0' long Culvert** RCP, square edge headwall, Ke= 0.500<br>Outlet Invert= 65.20' S= 0.0129 '/' n= 0.012 Cc= 0.900 |
| 2 | Device 1 | 67.00' | **3.0" Vert. Orifice/Grate** C= 0.600 |
| 3 | Device 1 | 73.25' | **48.0" Horiz. Orifice/Grate** Limited to weir flow C= 0.600 |

**Primary OutFlow** Max=15.18 cfs @ 12.27 hrs HW=73.75' (Free Discharge)
└**1=Culvert** (Passes 15.18 cfs of 39.30 cfs potential flow)
├**2=Orifice/Grate** (Orifice Controls 0.61 cfs @ 12.4 fps)
└**3=Orifice/Grate** (Weir Controls 14.57 cfs @ 2.3 fps)

## Pond B5: BMP 5


Hydrograph
18.48 cfs
16.34 cfs
Inflow Area=4.900 ac
Peak Elev=73.78'
Storage=21,083 cf
Inflow
Primary
Flow (cfs)
Time (hours)

## Subcatchment DA5 POST: DA5 POST

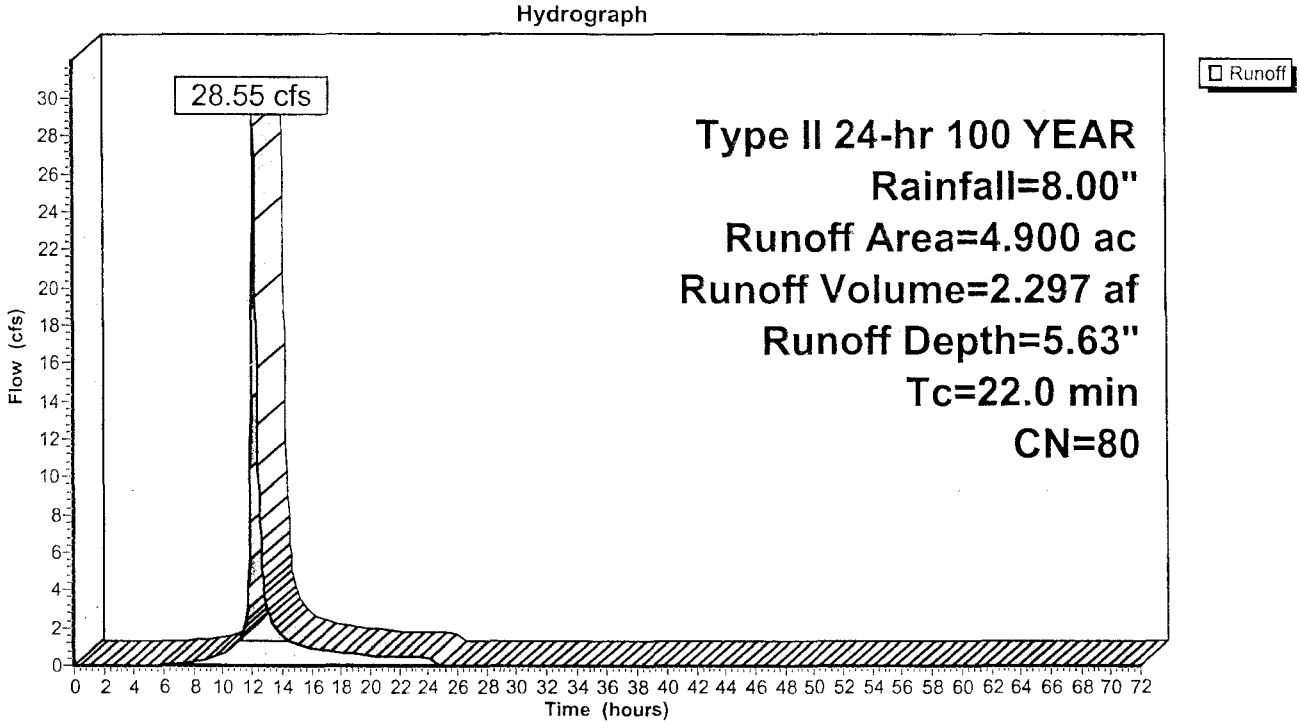
Runoff = 28.55 cfs @ 12.14 hrs, Volume= 2.297 af, Depth= 5.63"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type II 24-hr 100 YEAR Rainfall=8.00"

| Area (ac) | CN | Description |
|---|---|---|
| 4.900 | 80 | 1/2 acre lots, 25% imp, HSG C |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 22.0 | | | | | **Direct Entry,** |

## Subcatchment DA5 POST: DA5 POST



## Pond B5: BMP 5

Inflow Area = 4.900 ac, Inflow Depth = 5.63" for 100 YEAR event
Inflow = 28.55 cfs @ 12.14 hrs, Volume= 2.297 af
Outflow = 28.39 cfs @ 12.17 hrs, Volume= 2.297 af, Atten= 1%, Lag= 1.3 min
Primary = 28.39 cfs @ 12.17 hrs, Volume= 2.297 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 74.02' @ 12.17 hrs Surf.Area= 5,025 sf Storage= 22,062 cf
Plug-Flow detention time= 198.9 min calculated for 2.295 af (100% of inflow)
Center-of-Mass det. time= 199.6 min ( 1,014.2 - 814.6 )

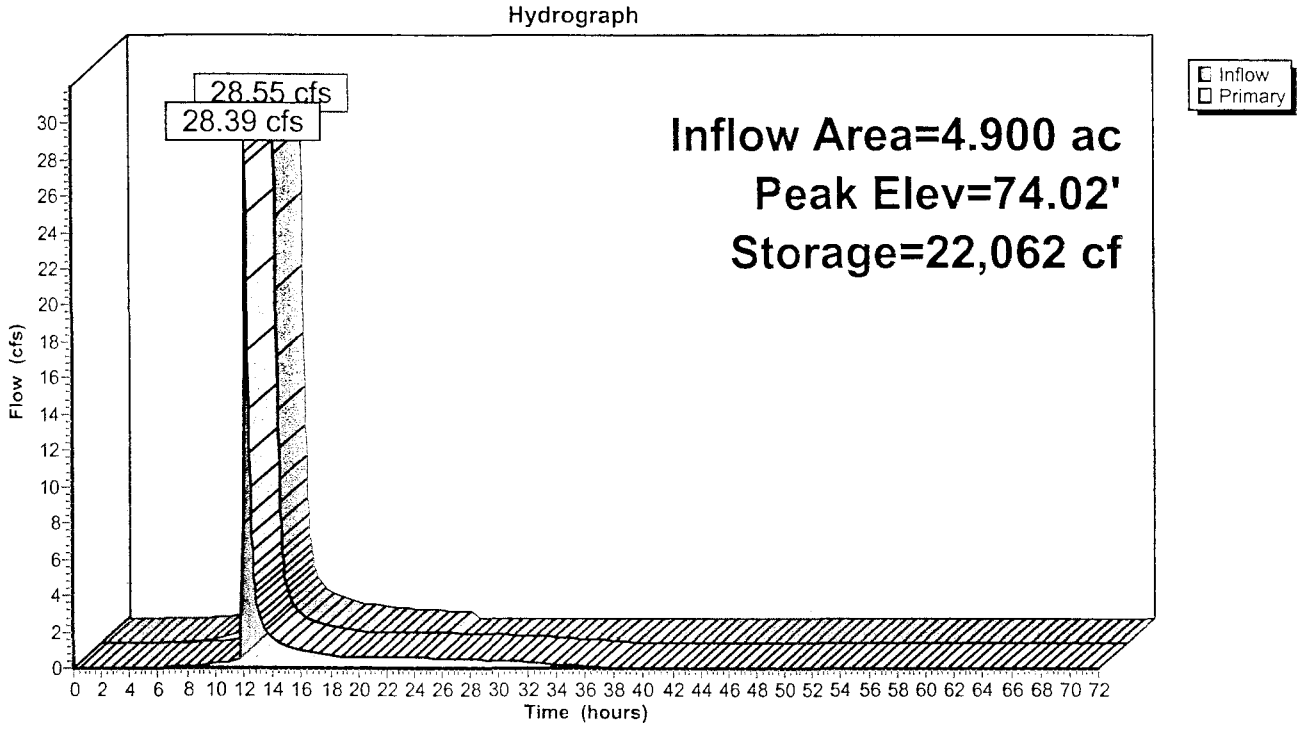
| # | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| 1 | 67.00' | 31,965 cf | **Custom Stage Data (Prismatic)** Listed below |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 67.00 | 1,300 | 0 | 0 |
| 70.00 | 2,500 | 5,700 | 5,700 |
| 75.00 | 5,640 | 20,350 | 26,050 |
| 76.00 | 6,190 | 5,915 | 31,965 |

| # | Routing | Invert | Outlet Devices |
|---|---|---|---|
| 1 | Primary | 66.00' | **24.0" x 62.0' long Culvert** RCP, square edge headwall, Ke= 0.500<br>Outlet Invert= 65.20' S= 0.0129 '/' n= 0.012 Cc= 0.900 |
| 2 | Device 1 | 67.00' | **3.0" Vert. Orifice/Grate** C= 0.600 |
| 3 | Device 1 | 73.25' | **48.0" Horiz. Orifice/Grate** Limited to weir flow C= 0.600 |

**Primary OutFlow** Max=28.01 cfs @ 12.17 hrs HW=74.01' (Free Discharge)
└**1=Culvert** (Passes 28.01 cfs of 40.06 cfs potential flow)
├**2=Orifice/Grate** (Orifice Controls 0.62 cfs @ 12.6 fps)
└**3=Orifice/Grate** (Weir Controls 27.39 cfs @ 2.9 fps)

## Pond B5: BMP 5


Hydrograph
28.55 cfs
28.39 cfs
Inflow Area=4.900 ac
Peak Elev=74.02'
Storage=22,062 cf
Inflow
Primary
Flow (cfs)
Time (hours)

# DRAINAGE CALCULATIONS

# Appendix 9B-2 LD-229 Storm Drain Design Computations

LD-229
July 2000

STORM SEWER DESIGN
COMPUTATIONS

ROUTE: MAR. 10, 2005 PROJ: STONEHOUSE GLEN SECTION II
COUNTY: DISTRICT:
DESCRIPTION:
SHEET OF

| FROM POINT (1) | TO POINT (2) | AREA DRAIN "A" ACRES (3) | RUN-OFF COEF. C (4) | CA INCREMENT (5) | CA ACCUMULATED (6) | INLET TIME MINUTES (7) | RAIN FALL IN./HR. (8) | RUN-OFF Q C.F.S. (9) | INVERT ELEVATIONS UPPER END (10) | INVERT ELEVATIONS LOWER END (11) | LENGTH FT. (12) | SLOPE FT./FT. (13) | DIA. IN. (14) | CAPACITY C.F.S. (15) | VEL. F.P.S. (16) | FLOW TIME MINUTES INCREMENT (17) | FLOW TIME MINUTES ACCUMULATED (17) | REMARKS (18) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ✓ 3F | 3E | 0.43 | 0.55 | — | 0.24 | 14 | 5.3 | 1.27 | 112.79 | 110.77 | 45' | 0.0449 | 15" | 13.69 | 6.98 | 0.11 | — | |
| ✓ 3E | 3D | 0.42 | 0.55 | 0.23 | 0.47 | 14.11 | 5.3 | 2.49 | 110.67 | 110.46 | 32' | 0.0066 | 15" | 5.25 | 4.22 | 0.13 | 0.24 | |
| ✓ 3D | 3C | 0.10 | 0.9 | 0.09 | 0.56 | 14.24 | 5.3 | 2.97 | 110.36 | 109.25 | 134' | 0.0083 | 15" | 5.88 | 4.81 | 0.46 | 0.70 | |
| ✓ 3C-1 | 3C | 0.26 | 0.8 | — | 0.21 | 10 | 5.75 | 1.21 | 109.32 | 109.08 | 40' | 0.0060 | 15" | 5.00 | 3.36 | 0.20 | — | |
| | | | | | | | | | | | | | | | | | | |
| ✓ 3C | 3B-1 | 0.11 | 0.9 | 0.10 | 0.87 | 14.94 | 5.2 | 4.52 | 108.98 | 106.45 | 173' | 0.0146 | 15" | 7.80 | 6.59 | 0.43 | 1.13 | |
| ✓ 3B-1 | 3B | 0.10 | 0.9 | 0.09 | 0.96 | 15.37 | 5.2 | 4.99 | 106.37 | 104.87 | 52' | 0.0287 | 15" | 10.94 | 8.71 | 0.10 | 1.23 | TEMP PLUG |
| START STONEHOUSE GLEN SECTION I | | | | | | | | | | | | | | | | | | |
| 3B | 3A | — | — | — | — | — | | 4.99 | 104.87 | 101.20 | 128' | 0.0287 | 15" | 10.94 | 8.71 | 0.24 | 1.47 | |
| 3A | 3 | 0.02 | 0.65 | 0.40 | 1.36 | 15.61 | 5.20 | 7.14 | 100.94 | 100.75 | 40' | 0.0048 | 18" | 7.28 | 4.69 | 0.14 | 1.61 | |
| 1 | 2 | 0.74 | 0.65 | — | 0.48 | 14 | 5.3 | 2.54 | 101.88 | 101.58 | 40' | 0.0076 | 15" | 5.63 | 4.47 | 0.15 | — | |
| 2 | 3 | 0.31 | 0.85 | 0.26 | 0.74 | 14.1 | 5.3 | 3.92 | 101.48 | 101.07 | 70' | 0.0059 | 15" | 4.96 | 4.48 | 0.26 | 0.41 | |
| 3 | 4 | 0.13 | 0.90 | 0.12 | 2.22 | 15.74 | 5.18 | 11.50 | 100.45 | 99.88 | 151' | 0.0038 | 24" | 13.94 | 4.96 | 0.51 | 2.12 | |
| 4 | 5 | 0.09 | 0.9 | 0.08 | 2.30 | 16.25 | 5.12 | 11.78 | 99.78 | 98.77 | 268' | 0.0038 | 24" | 13.94 | 4.98 | 0.89 | 3.01 | |
| 5 | 6 | 0.13 | 0.9 | 0.12 | 2.42 | 17.23 | 5.02 | 12.15 | 98.67 | 97.96 | 168' | 0.0042 | 24" | 14.66 | 5.22 | 0.54 | 3.55 | |
| 6A | 6 | 0.92 | 0.45 | — | 0.41 | 12 | 5.5 | 2.26 | 100.68 | 100.33 | 38' | 0.0092 | 15" | 6.20 | 4.65 | 0.13 | — | |
| 6 | 7 | 0.66 | 0.45 | 0.30 | 3.13 | 17.78 | 4.97 | 15.56 | 93.34 | 92.53 | 44' | 0.0184 | 24" | 30.68 | 9.80 | 0.07 | 3.62 | |
| 7 | 8 | 0.38 | 0.85 | 0.32 | 3.45 | 17.85 | 4.96 | 17.11 | 87.87 | 86.21 | 93' | 0.0178 | 24" | 30.18 | 9.90 | 0.16 | 3.78 | |

# Worksheet
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | 3F to 3E |
| Flow Element | Circular Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Slope | 0.044900 | ft/ft |
| Diameter | 15 | in |
| Discharge | 1.27 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.26 | ft |
| Flow Area | 0.2 | ft² |
| Wetted Perimeter | 1.18 | ft |
| Top Width | 1.01 | ft |
| Critical Depth | 0.44 | ft |
| Percent Full | 20.6 | % |
| Critical Slope | 0.005255 | ft/ft |
| Velocity | 6.98 | ft/s |
| Velocity Head | 0.76 | ft |
| Specific Energy | 1.01 | ft |
| Froude Number | 2.90 | |
| Maximum Discharg | 14.72 | cfs |
| Discharge Full | 13.69 | cfs |
| Slope Full | 0.000387 | ft/ft |
| Flow Type | Supercritical | |

# Worksheet
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | 3E to 3D |
| Flow Element | Circular Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Slope | 0.006600 | ft/ft |
| Diameter | 15 | in |
| Discharge | 2.49 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.61 | ft |
| Flow Area | 0.6 | $ft^2$ |
| Wetted Perimeter | 1.93 | ft |
| Top Width | 1.25 | ft |
| Critical Depth | 0.63 | ft |
| Percent Full | 48.5 | % |
| Critical Slope | 0.005728 | ft/ft |
| Velocity | 4.22 | ft/s |
| Velocity Head | 0.28 | ft |
| Specific Energy | 0.88 | ft |
| Froude Number | 1.08 | |
| Maximum Discharg | 5.64 | cfs |
| Discharge Full | 5.25 | cfs |
| Slope Full | 0.001486 | ft/ft |
| Flow Type | Supercritical | |

# Worksheet
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | 3D to 3C |
| Flow Element | Circular Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Slope | 0.008300 | ft/ft |
| Diameter | 15 | in |
| Discharge | 2.97 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.63 | ft |
| Flow Area | 0.6 | ft² |
| Wetted Perimeter | 1.97 | ft |
| Top Width | 1.25 | ft |
| Critical Depth | 0.69 | ft |
| Percent Full | 50.3 | % |
| Critical Slope | 0.006006 | ft/ft |
| Velocity | 4.81 | ft/s |
| Velocity Head | 0.36 | ft |
| Specific Energy | 0.99 | ft |
| Froude Number | 1.21 | |
| Maximum Discharg | 6.33 | cfs |
| Discharge Full | 5.88 | cfs |
| Slope Full | 0.002114 | ft/ft |
| Flow Type | Supercritical | |

# Worksheet
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | 3C-1 to 3C |
| Flow Element | Circular Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Slope | 0.006000 | ft/ft |
| Diameter | 15 | in |
| Discharge | 1.21 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.42 | ft |
| Flow Area | 0.4 | $ft^2$ |
| Wetted Perimeter | 1.54 | ft |
| Top Width | 1.18 | ft |
| Critical Depth | 0.43 | ft |
| Percent Full | 33.5 | % |
| Critical Slope | 0.005240 | ft/ft |
| Velocity | 3.36 | ft/s |
| Velocity Head | 0.18 | ft |
| Specific Energy | 0.59 | ft |
| Froude Number | 1.07 | |
| Maximum Discharg | 5.38 | cfs |
| Discharge Full | 5.00 | cfs |
| Slope Full | 0.000351 | ft/ft |
| Flow Type | Supercritical | |

# Worksheet
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | 3C to 3B-1 |
| Flow Element | Circular Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Slope | 0.014600 | ft/ft |
| Diameter | 15 | in |
| Discharge | 4.52 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.68 | ft |
| Flow Area | 0.7 | ft² |
| Wetted Perimeter | 2.08 | ft |
| Top Width | 1.24 | ft |
| Critical Depth | 0.86 | ft |
| Percent Full | 54.6 | % |
| Critical Slope | 0.007271 | ft/ft |
| Velocity | 6.59 | ft/s |
| Velocity Head | 0.68 | ft |
| Specific Energy | 1.36 | ft |
| Froude Number | 1.57 | |
| Maximum Discharg | 8.40 | cfs |
| Discharge Full | 7.80 | cfs |
| Slope Full | 0.004897 | ft/ft |
| Flow Type | Supercritical | |

# Worksheet
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | 3B-1 to 3B |
| Flow Element | Circular Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Slope | 0.028700 | ft/ft |
| Diameter | 15 | in |
| Discharge | 4.99 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.59 | ft |
| Flow Area | 0.6 | ft² |
| Wetted Perimeter | 1.90 | ft |
| Top Width | 1.25 | ft |
| Critical Depth | 0.91 | ft |
| Percent Full | 47.4 | % |
| Critical Slope | 0.007797 | ft/ft |
| Velocity | 8.71 | ft/s |
| Velocity Head | 1.18 | ft |
| Specific Energy | 1.77 | ft |
| Froude Number | 2.27 | |
| Maximum Discharg | 11.77 | cfs |
| Discharge Full | 10.94 | cfs |
| Slope Full | 0.005968 | ft/ft |
| Flow Type | Supercritical | |

# Worksheet
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | 3B to 3A |
| Flow Element | Circular Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Slope | 0.028700 | ft/ft |
| Diameter | 15 | in |
| Discharge | 4.99 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.59 | ft |
| Flow Area | 0.6 | $ft^2$ |
| Wetted Perimeter | 1.90 | ft |
| Top Width | 1.25 | ft |
| Critical Depth | 0.91 | ft |
| Percent Full | 47.4 | % |
| Critical Slope | 0.007797 | ft/ft |
| Velocity | 8.71 | ft/s |
| Velocity Head | 1.18 | ft |
| Specific Energy | 1.77 | ft |
| Froude Number | 2.27 | |
| Maximum Discharg | 11.77 | cfs |
| Discharge Full | 10.94 | cfs |
| Slope Full | 0.005968 | ft/ft |
| Flow Type | Supercritical | |

# Worksheet
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | 3A to 3 |
| Flow Element | Circular Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Slope | 0.004800 | ft/ft |
| Diameter | 18 | in |
| Discharge | 7.14 | cfs |

| Results | | |
|---|---|---|
| Depth | 1.20 | ft |
| Flow Area | 1.5 | ft² |
| Wetted Perimeter | 3.33 | ft |
| Top Width | 1.19 | ft |
| Critical Depth | 1.03 | ft |
| Percent Full | 80.3 | % |
| Critical Slope | 0.006848 | ft/ft |
| Velocity | 4.69 | ft/s |
| Velocity Head | 0.34 | ft |
| Specific Energy | 1.55 | ft |
| Froude Number | 0.73 | |
| Maximum Discharg | 7.83 | cfs |
| Discharge Full | 7.28 | cfs |
| Slope Full | 0.004621 | ft/ft |
| Flow Type | Subcritical | |

# Worksheet
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | 1 to 2 |
| Flow Element | Circular Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Slope | 0.007600 | ft/ft |
| Diameter | 15 | in |
| Discharge | 2.54 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.59 | ft |
| Flow Area | 0.6 | ft² |
| Wetted Perimeter | 1.89 | ft |
| Top Width | 1.25 | ft |
| Critical Depth | 0.64 | ft |
| Percent Full | 47.1 | % |
| Critical Slope | 0.005750 | ft/ft |
| Velocity | 4.47 | ft/s |
| Velocity Head | 0.31 | ft |
| Specific Energy | 0.90 | ft |
| Froude Number | 1.17 | |
| Maximum Discharg | 6.06 | cfs |
| Discharge Full | 5.63 | cfs |
| Slope Full | 0.001546 | ft/ft |
| Flow Type | Supercritical | |

# Worksheet
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | 2 to 3 |
| Flow Element | Circular Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Slope | 0.005900 | ft/ft |
| Diameter | 15 | in |
| Discharge | 3.92 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.84 | ft |
| Flow Area | 0.9 | $ft^2$ |
| Wetted Perimeter | 2.40 | ft |
| Top Width | 1.18 | ft |
| Critical Depth | 0.80 | ft |
| Percent Full | 67.0 | % |
| Critical Slope | 0.006705 | ft/ft |
| Velocity | 4.48 | ft/s |
| Velocity Head | 0.31 | ft |
| Specific Energy | 1.15 | ft |
| Froude Number | 0.92 | |
| Maximum Discharg | 5.34 | cfs |
| Discharge Full | 4.96 | cfs |
| Slope Full | 0.003683 | ft/ft |
| Flow Type | Subcritical | |

# Worksheet
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | 3 to 4 |
| Flow Element | Circular Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Slope | 0.003800 | ft/ft |
| Diameter | 24 | in |
| Discharge | 11.50 | cfs |

| Results | | |
|---|---|---|
| Depth | 1.38 | ft |
| Flow Area | 2.3 | ft² |
| Wetted Perimeter | 3.93 | ft |
| Top Width | 1.85 | ft |
| Critical Depth | 1.22 | ft |
| Percent Full | 69.2 | % |
| Critical Slope | 0.005482 | ft/ft |
| Velocity | 4.96 | ft/s |
| Velocity Head | 0.38 | ft |
| Specific Energy | 1.77 | ft |
| Froude Number | 0.78 | |
| Maximum Discharg | 15.00 | cfs |
| Discharge Full | 13.94 | cfs |
| Slope Full | 0.002584 | ft/ft |
| Flow Type | Subcritical | |

# Worksheet
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | 4 to 5 |
| Flow Element | Circular Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Slope | 0.003800 | ft/ft |
| Diameter | 24 | in |
| Discharge | 11.78 | cfs |

| Results | | |
|---|---|---|
| Depth | 1.41 | ft |
| Flow Area | 2.4 | ft² |
| Wetted Perimeter | 3.99 | ft |
| Top Width | 1.82 | ft |
| Critical Depth | 1.23 | ft |
| Percent Full | 70.5 | % |
| Critical Slope | 0.005539 | ft/ft |
| Velocity | 4.98 | ft/s |
| Velocity Head | 0.39 | ft |
| Specific Energy | 1.79 | ft |
| Froude Number | 0.77 | |
| Maximum Discharg | 15.00 | cfs |
| Discharge Full | 13.94 | cfs |
| Slope Full | 0.002712 | ft/ft |
| Flow Type | Subcritical | |

# Worksheet
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | 5 to 6 |
| Flow Element | Circular Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Slope | 0.004200 | ft/ft |
| Diameter | 24 | in |
| Discharge | 12.15 | cfs |

| Results | | |
|---|---|---|
| Depth | 1.39 | ft |
| Flow Area | 2.3 | $ft^2$ |
| Wetted Perimeter | 3.94 | ft |
| Top Width | 1.84 | ft |
| Critical Depth | 1.25 | ft |
| Percent Full | 69.5 | % |
| Critical Slope | 0.005617 | ft/ft |
| Velocity | 5.22 | ft/s |
| Velocity Head | 0.42 | ft |
| Specific Energy | 1.81 | ft |
| Froude Number | 0.82 | |
| Maximum Discharg | 15.77 | cfs |
| Discharge Full | 14.66 | cfs |
| Slope Full | 0.002885 | ft/ft |
| Flow Type | Subcritical | |

# Worksheet
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | 6A to 6 |
| Flow Element | Circular Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Slope | 0.009200 | ft/ft |
| Diameter | 15 | in |
| Discharge | 2.26 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.52 | ft |
| Flow Area | 0.5 | ft² |
| Wetted Perimeter | 1.76 | ft |
| Top Width | 1.23 | ft |
| Critical Depth | 0.60 | ft |
| Percent Full | 41.8 | % |
| Critical Slope | 0.005616 | ft/ft |
| Velocity | 4.65 | ft/s |
| Velocity Head | 0.34 | ft |
| Specific Energy | 0.86 | ft |
| Froude Number | 1.31 | |
| Maximum Discharg | 6.66 | cfs |
| Discharge Full | 6.20 | cfs |
| Slope Full | 0.001224 | ft/ft |
| Flow Type | Supercritical | |

# Worksheet
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | 6 to 7 |
| Flow Element | Circular Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Slope | 0.018400 | ft/ft |
| Diameter | 24 | in |
| Discharge | 15.56 | cfs |

| Results | | |
|---|---|---|
| Depth | 1.01 | ft |
| Flow Area | 1.6 | ft² |
| Wetted Perimeter | 3.16 | ft |
| Top Width | 2.00 | ft |
| Critical Depth | 1.42 | ft |
| Percent Full | 50.4 | % |
| Critical Slope | 0.006480 | ft/ft |
| Velocity | 9.80 | ft/s |
| Velocity Head | 1.49 | ft |
| Specific Energy | 2.50 | ft |
| Froude Number | 1.94 | |
| Maximum Discharg | 33.01 | cfs |
| Discharge Full | 30.68 | cfs |
| Slope Full | 0.004731 | ft/ft |
| Flow Type | Supercritical | |

# Worksheet
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | 7 to 8 |
| Flow Element | Circular Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Slope | 0.017800 | ft/ft |
| Diameter | 24 | in |
| Discharge | 17.08 | cfs |

| Results | | |
|---|---|---|
| Depth | 1.08 | ft |
| Flow Area | 1.7 | ft² |
| Wetted Perimeter | 3.30 | ft |
| Top Width | 1.99 | ft |
| Critical Depth | 1.49 | ft |
| Percent Full | 53.9 | % |
| Critical Slope | 0.006964 | ft/ft |
| Velocity | 9.90 | ft/s |
| Velocity Head | 1.52 | ft |
| Specific Energy | 2.60 | ft |
| Froude Number | 1.88 | |
| Maximum Discharg | 32.47 | cfs |
| Discharge Full | 30.18 | cfs |
| Slope Full | 0.005701 | ft/ft |
| Flow Type | Supercritical | |

PROJECT 2002261-504.04
HEC12 Version: V2.91 Run Date: 11-29-2004

==========

INLET NUMBER 3F LENGTH 6.0 STATION

DRAINAGE AREA = 0.430 ACRES C VALUE = .550 CA = 0.237
SUM CA= 0.237 INT= 4.00 CFS= 0.946 CO= 0.000 GUTTER FLOW= 0.946

GUTTER SLOPE = 0.0229 FT/FT PAVEMENT CROSS SLOPE = 0.0208 FT/FT

| SPREAD | W | W/T | SW | SW/SX | Eo | a | S'W | SE |
|---|---|---|---|---|---|---|---|---|
| 3.59 | 2.0 | 0.56 | 0.0833 | 4.0 | 0.97 | 3.5 | 0.146 | 0.162 |

XXXXXXXXXX CURB INLET ON A CONTINUOUS GRADE XXXXXXXXXX
REQUIRED LENGTH (ft) = 7.0 EFFICIENCY= 0.97
CFS INTERCEPTED= 0.92 CFS CARRYOVER= 0.03

PROJECT 2002261-504.04
HEC12 Version: V2.91 Run Date: 11-29-2004

==========

INLET NUMBER 3E LENGTH 8.0 STATION

DRAINAGE AREA = 0.080 ACRES C VALUE = .550 CA = 0.044
DRAINAGE AREA = 0.340 ACRES C VALUE = .550 CA = 0.187

FOR THE FIRST SIDE
SUM CA= 0.044 INT= 4.00 CFS= 0.176 CO= 0.030 GUTTER FLOW= 0.206
FOR THE OTHER SIDE
SUM CA= 0.187 INT= 4.00 CFS= 0.748 CO= 0.000 GUTTER FLOW= 0.748
AT THE INLET

SUM CA= 0.231 INT= 4.00 CFS= 0.924 CO= 0.030 GUTTER FLOW= 0.954

GUTTER SLOPE = 0.0040 FT/FT PAVEMENT CROSS SLOPE = 0.0208 FT/FT

SPREAD AT A SLOPE OF .004 (ft./ft.) AND 0.75 (cfs) IS 5.71 (ft.)

XXXXXXXXXX CURB INLET IN A SUMP XXXXXXXXXX
P EFFEC. LENGTH (ft) = 11.60 H (ft) = 0.385
DEPTH OF WATER (ft) = 0.11 SPREAD (ft) = 5.21

PROJECT 2002261-504.04
HEC12 Version: V2.91 Run Date: 11-29-2004

==========

INLET NUMBER 3D LENGTH 2.5 STATION

DRAINAGE AREA = 0.030 ACRES C VALUE = .900 CA = 0.027
DRAINAGE AREA = 0.070 ACRES C VALUE = .900 CA = 0.063

FOR THE FIRST SIDE
SUM CA= 0.027 INT= 4.00 CFS= 0.108 CO= 0.000 GUTTER FLOW= 0.108
FOR THE OTHER SIDE
SUM CA= 0.063 INT= 4.00 CFS= 0.252 CO= 0.000 GUTTER FLOW= 0.252
AT THE INLET

SUM CA= 0.090 INT= 4.00 CFS= 0.360 CO= 0.000 GUTTER FLOW= 0.360

GUTTER SLOPE = 0.0040 FT/FT PAVEMENT CROSS SLOPE = 0.0208 FT/FT

SPREAD AT A SLOPE OF .004 (ft./ft.) AND 0.25 (cfs) IS 2.17 (ft.)

XXXXXXXXXX CURB INLET IN A SUMP XXXXXXXXXX
P EFFEC. LENGTH (ft) = 6.10 H (ft) = 0.385
DEPTH OF WATER (ft) = 0.09 SPREAD (ft) = 4.18

PROJECT 2002261-504.04
HEC12 Version: V2.91 Run Date: 11-29-2004

==========

INLET NUMBER 3C-1 LENGTH 6.0 STATION

DRAINAGE AREA = 0.060 ACRES C VALUE = .800 CA = 0.048
DRAINAGE AREA = 0.200 ACRES C VALUE = .800 CA = 0.160

FOR THE FIRST SIDE
SUM CA= 0.048 INT= 4.00 CFS= 0.192 CO= 0.000 GUTTER FLOW= 0.192
FOR THE OTHER SIDE
SUM CA= 0.160 INT= 4.00 CFS= 0.640 CO= 0.000 GUTTER FLOW= 0.640
AT THE INLET

SUM CA= 0.208 INT= 4.00 CFS= 0.832 CO= 0.000 GUTTER FLOW= 0.832

GUTTER SLOPE = 0.0040 FT/FT PAVEMENT CROSS SLOPE = 0.0208 FT/FT

SPREAD AT A SLOPE OF .004 (ft./ft.) AND 0.64 (cfs) IS 5.17 (ft.)

XXXXXXXXXX CURB INLET IN A SUMP XXXXXXXXXX
P EFFEC. LENGTH (ft) = 9.60 H (ft) = 0.385
DEPTH OF WATER (ft) = 0.11 SPREAD (ft) = 5.40

PROJECT 2002261-504.04
HEC12 Version: V2.91 Run Date: 11-29-2004

==========

INLET NUMBER 3C LENGTH 2.5 STATION

DRAINAGE AREA = 0.030 ACRES C VALUE = .900 CA = 0.027
DRAINAGE AREA = 0.080 ACRES C VALUE = .900 CA = 0.072

FOR THE FIRST SIDE
SUM CA= 0.027 INT= 4.00 CFS= 0.108 CO= 0.000 GUTTER FLOW= 0.108
FOR THE OTHER SIDE
SUM CA= 0.072 INT= 4.00 CFS= 0.288 CO= 0.000 GUTTER FLOW= 0.288
AT THE INLET

SUM CA= 0.099 INT= 4.00 CFS= 0.396 CO= 0.000 GUTTER FLOW= 0.396

GUTTER SLOPE = 0.0010 FT/FT PAVEMENT CROSS SLOPE = 0.0208 FT/FT

SPREAD AT A SLOPE OF .001 (ft./ft.) AND 0.29 (cfs) IS 4.82 (ft.)

XXXXXXXXXX CURB INLET IN A SUMP XXXXXXXXXX
P EFFEC. LENGTH (ft) = 6.10 H (ft) = 0.385
DEPTH OF WATER (ft) = 0.09 SPREAD (ft) = 4.45

PROJECT 2002261-504.04
HEC12 Version: V2.91 Run Date: 11-29-2004

==========

INLET NUMBER 3B-1 LENGTH 4.0 STATION

DRAINAGE AREA = 0.100 ACRES C VALUE = .900 CA = 0.090
SUM CA= 0.090 INT= 4.00 CFS= 0.360 CO= 0.000 GUTTER FLOW= 0.360

GUTTER SLOPE = 0.0350 FT/FT PAVEMENT CROSS SLOPE = 0.0208 FT/FT

| SPREAD | W | W/T | SW | SW/SX | Eo | a | S'W | SE |
|---|---|---|---|---|---|---|---|---|
| 1.56 | 2.0 | 1.28 | 0.0833 | 4.0 | 1.00 | 3.5 | 0.146 | 0.167 |

XXXXXXXXXX CURB INLET ON A CONTINUOUS GRADE XXXXXXXXXX
REQUIRED LENGTH (ft) = 5.2 EFFICIENCY= 0.93
CFS INTERCEPTED= 0.33 CFS CARRYOVER= 0.03

# Appendix 9B-2 LD-229 Storm Drain Design Computations

LD-229
July 2000

STORM SEWER DESIGN
COMPUTATIONS

ROUTE: MAR 11 2005 PROJ: STONEHOUSE GLEN SECTION II
COUNTY: DISTRICT:
DESCRIPTION:
SHEET ____ OF ____

| FROM POINT (1) | TO POINT (2) | AREA DRAIN "A" ACRES (3) | RUN-OFF COEF. C (4) | CA INCREMENT (5) | CA ACCUMULATED (6) | INLET TIME MINUTES (7) | RAIN FALL IN./HR. (8) | RUN-OFF Q C.F.S. (9) | INVERT ELEVATIONS UPPER END (10) | INVERT ELEVATIONS LOWER END (11) | LENGTH FT. (12) | SLOPE FT./FT. (13) | DIA. IN. (14) | CAPACITY C.F.S. (15) | VEL. F.P.S. (16) | FLOW TIME MINUTES INCREMENT (17) | FLOW TIME MINUTES ACCUMULATED (17) | REMARKS (18) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ✓ 11A | 11 | 0.39 | 0.61 | — | 0.24 | 10 | 6.00 | 1.44 | 80.92 | 79.84 | 56' | 0.0193 | 15" | 8.97 | 5.36 | 0.17 | — | |
| ✓ 12 | 11 | 0.36 | 0.80 | — | 0.29 | 12 | 5.67 | 1.64 | 80.05 | 79.84 | 32' | 0.0066 | 15" | 5.25 | 3.78 | 0.14 | — | |
| ✓ 11 | 10 | 0.41 | 0.51 | 0.21 | 0.74 | 12 | 5.67 | 4.20 | 79.74 | 78.97 | 146' | 0.0053 | 15" | 4.70 | 4.33 | 0.56 | 0.73 | |
| ✓ 10 | 9 | 0.15 | 0.64 | 0.10 | 0.84 | 13 | 5.50 | 4.62 | 78.87 | 61.90 | 193' | 0.0879 | 15" | 19.15 | 12.84 | 0.25 | 0.98 | |
| ✓ 9 | 8 | 0.17 | 0.3 | 0.05 | 0.89 | 14 | 5.30 | 4.72 | 56.26 | 54.46 | 57' | 0.0316 | 15" | 11.48 | 8.90 | 0.11 | 1.09 | |
| | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | |
| ✓ 15C | 15B | 0.34 | 0.54 | — | 0.18 | 10 | 6.00 | 1.08 | 90.50 | 89.86 | 32' | 0.020 | 15" | 9.14 | 5.00 | 0.11 | — | |
| ✓ 15B | 15 | 0.50 | 0.58 | 0.29 | 0.47 | 10.6 | 5.92 | 2.78 | 89.76 | 82.29 | 158' | 0.0473 | 15" | 14.05 | 8.91 | 0.30 | 0.41 | |
| ✓ 15A | 15 | 0.21 | 0.64 | — | 0.13 | 10 | 6.00 | 0.78 | 84.00 | 82.72 | 32' | 0.040 | 15" | 12.92 | 5.80 | 0.09 | — | |
| ✓ 15 | 14 | 0.14 | 0.78 | 0.11 | 0.71 | 11. | 5.83 | 4.14 | 78.74 | 75.81 | 45' | 0.0650 | 15" | 16.47 | 11.17 | 0.07 | 0.48 | |
| ✓ 14 | 13 | — | — | — | | | | 4.14 | 70.00 | 65.00 | 79' | 0.0633 | 15" | 16.25 | 11.07 | 0.12 | 0.60 | |
| | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | |
| ✓ 34 | 33 | 0.31 | 0.73 | — | 0.23 | 10 | 6.00 | 1.38 | 104.00 | 100.50 | 40' | 0.0875 | 15" | 19.11 | 9.05 | 0.07 | — | |
| ✓ 33 | 32 | 0.23 | 0.70 | 0.16 | 0.39 | 10 | 6.00 | 2.34 | 96.54 | 93.25 | 38' | 0.0866 | 15" | 19.01 | 10.52 | 0.06 | 0.13 | |
| ✓ 32 | 31 | — | — | — | 0.39 | 10 | 6.00 | 2.34 | 86.25 | 78.14 | 123' | 0.066 | 15" | 16.59 | 9.55 | 0.21 | 0.34 | |
| | | | | | | | | | | | | | | | | | | |

# Worksheet
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | 11 - A to 11 |
| Flow Element | Circular Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Slope | 0.019300 | ft/ft |
| Diameter | 15 | in |
| Discharge | 1.44 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.34 | ft |
| Flow Area | 0.3 | ft² |
| Wetted Perimeter | 1.37 | ft |
| Top Width | 1.11 | ft |
| Critical Depth | 0.47 | ft |
| Percent Full | 27.1 | % |
| Critical Slope | 0.005288 | ft/ft |
| Velocity | 5.36 | ft/s |
| Velocity Head | 0.45 | ft |
| Specific Energy | 0.79 | ft |
| Froude Number | 1.92 | |
| Maximum Discharg | 9.65 | cfs |
| Discharge Full | 8.97 | cfs |
| Slope Full | 0.000497 | ft/ft |
| Flow Type | Supercritical | |

# Worksheet
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | 12 to 11 |
| Flow Element | Circular Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Slope | 0.006600 | ft/ft |
| Diameter | 15 | in |
| Discharge | 1.64 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.48 | ft |
| Flow Area | 0.4 | ft² |
| Wetted Perimeter | 1.67 | ft |
| Top Width | 1.22 | ft |
| Critical Depth | 0.51 | ft |
| Percent Full | 38.4 | % |
| Critical Slope | 0.005353 | ft/ft |
| Velocity | 3.78 | ft/s |
| Velocity Head | 0.22 | ft |
| Specific Energy | 0.70 | ft |
| Froude Number | 1.12 | |
| Maximum Discharg | 5.64 | cfs |
| Discharge Full | 5.25 | cfs |
| Slope Full | 0.000645 | ft/ft |
| Flow Type | Supercritical | |

# Worksheet
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | 11 to 10 |
| Flow Element | Circular Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Slope | 0.005300 | ft/ft |
| Diameter | 15 | in |
| Discharge | 4.20 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.92 | ft |
| Flow Area | 1.0 | ft² |
| Wetted Perimeter | 2.58 | ft |
| Top Width | 1.10 | ft |
| Critical Depth | 0.83 | ft |
| Percent Full | 73.7 | % |
| Critical Slope | 0.006956 | ft/ft |
| Velocity | 4.33 | ft/s |
| Velocity Head | 0.29 | ft |
| Specific Energy | 1.21 | ft |
| Froude Number | 0.81 | |
| Maximum Discharg | 5.06 | cfs |
| Discharge Full | 4.70 | cfs |
| Slope Full | 0.004228 | ft/ft |
| Flow Type | Subcritical | |

# Worksheet
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | 10 to 9 |
| Flow Element | Circular Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Slope | 0.087900 | ft/ft |
| Diameter | 15 | in |
| Discharge | 4.62 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.42 | ft |
| Flow Area | 0.4 | ft² |
| Wetted Perimeter | 1.54 | ft |
| Top Width | 1.18 | ft |
| Critical Depth | 0.87 | ft |
| Percent Full | 33.4 | % |
| Critical Slope | 0.007376 | ft/ft |
| Velocity | 12.84 | ft/s |
| Velocity Head | 2.56 | ft |
| Specific Energy | 2.98 | ft |
| Froude Number | 4.10 | |
| Maximum Discharg | 20.60 | cfs |
| Discharge Full | 19.15 | cfs |
| Slope Full | 0.005116 | ft/ft |
| Flow Type | Supercritical | |

# Worksheet
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | 9 to 8 |
| Flow Element | Circular Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Slope | 0.031600 | ft/ft |
| Diameter | 15 | in |
| Discharge | 4.72 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.56 | ft |
| Flow Area | 0.5 | ft² |
| Wetted Perimeter | 1.83 | ft |
| Top Width | 1.24 | ft |
| Critical Depth | 0.88 | ft |
| Percent Full | 44.7 | % |
| Critical Slope | 0.007484 | ft/ft |
| Velocity | 8.90 | ft/s |
| Velocity Head | 1.23 | ft |
| Specific Energy | 1.79 | ft |
| Froude Number | 2.40 | |
| Maximum Discharg | 12.35 | cfs |
| Discharge Full | 11.48 | cfs |
| Slope Full | 0.005339 | ft/ft |
| Flow Type | Supercritical | |

PROJECT 2002261-504.04
HEC12 Version: V2.91 Run Date: 11-29-2004

==========

INLET NUMBER 11A LENGTH 6.0 STATION

DRAINAGE AREA = 0.390 ACRES C VALUE = .610 CA = 0.238
SUM CA= 0.238 INT= 4.00 CFS= 0.952 CO= 0.000 GUTTER FLOW= 0.952

GUTTER SLOPE = 0.0314 FT/FT PAVEMENT CROSS SLOPE = 0.0208 FT/FT

| SPREAD | W | W/T | SW | SW/SX | Eo | a | S'W | SE |
|---|---|---|---|---|---|---|---|---|
| 3.11 | 2.0 | 0.64 | 0.0833 | 4.0 | 0.99 | 3.5 | 0.146 | 0.165 |

XXXXXXXXXX CURB INLET ON A CONTINUOUS GRADE XXXXXXXXXX
REQUIRED LENGTH (ft) = 7.6 EFFICIENCY= 0.94
CFS INTERCEPTED= 0.89 CFS CARRYOVER= 0.06

PROJECT 2002261-504.04
HEC12 Version: V2.91 Run Date: 11-29-2004

==========

INLET NUMBER 12 LENGTH 6.0 STATION

DRAINAGE AREA = 0.210 ACRES C VALUE = .800 CA = 0.168
DRAINAGE AREA = 0.150 ACRES C VALUE = .750 CA = 0.113

FOR THE FIRST SIDE
SUM CA= 0.168 INT= 4.00 CFS= 0.672 CO= 0.000 GUTTER FLOW= 0.672
FOR THE OTHER SIDE
SUM CA= 0.113 INT= 4.00 CFS= 0.450 CO= 0.000 GUTTER FLOW= 0.450
AT THE INLET

SUM CA= 0.280 INT= 4.00 CFS= 1.122 CO= 0.000 GUTTER FLOW= 1.122

GUTTER SLOPE = 0.0010 FT/FT PAVEMENT CROSS SLOPE = 0.0208 FT/FT

SPREAD AT A SLOPE OF .001 (ft./ft.) AND 0.67 (cfs) IS 7.87 (ft.)

XXXXXXXXXX CURB INLET IN A SUMP XXXXXXXXXX
P EFFEC. LENGTH (ft) = 9.60 H (ft) = 0.385
DEPTH OF WATER (ft) = 0.14 SPREAD (ft) = 6.59

PROJECT 2002261-504.04
HEC12 Version: V2.91 Run Date: 11-29-2004

==========

INLET NUMBER 11 LENGTH 8.0 STATION

DRAINAGE AREA = 0.170 ACRES C VALUE = .510 CA = 0.087
DRAINAGE AREA = 0.240 ACRES C VALUE = .510 CA = 0.122

FOR THE FIRST SIDE
SUM CA= 0.087 INT= 4.00 CFS= 0.347 CO= 0.060 GUTTER FLOW= 0.407
FOR THE OTHER SIDE
SUM CA= 0.122 INT= 4.00 CFS= 0.490 CO= 0.004 GUTTER FLOW= 0.494
AT THE INLET

SUM CA= 0.209 INT= 4.00 CFS= 0.836 CO= 0.064 GUTTER FLOW= 0.900

GUTTER SLOPE = 0.0040 FT/FT PAVEMENT CROSS SLOPE = 0.0208 FT/FT

SPREAD AT A SLOPE OF .004 (ft./ft.) AND 0.49 (cfs) IS 4.31 (ft.)

XXXXXXXXXX CURB INLET IN A SUMP XXXXXXXXXX
P EFFEC. LENGTH (ft) = 11.60 H (ft) = 0.385
DEPTH OF WATER (ft) = 0.10 SPREAD (ft) = 5.02

PROJECT 2002261-504.04
HEC12 Version: V2.91 Run Date: 11-29-2004

==========

INLET NUMBER 10 LENGTH 6.0 STATION

DRAINAGE AREA = 0.150 ACRES C VALUE = .640 CA = 0.096
SUM CA= 0.096 INT= 4.00 CFS= 0.384 CO= 0.000 GUTTER FLOW= 0.384

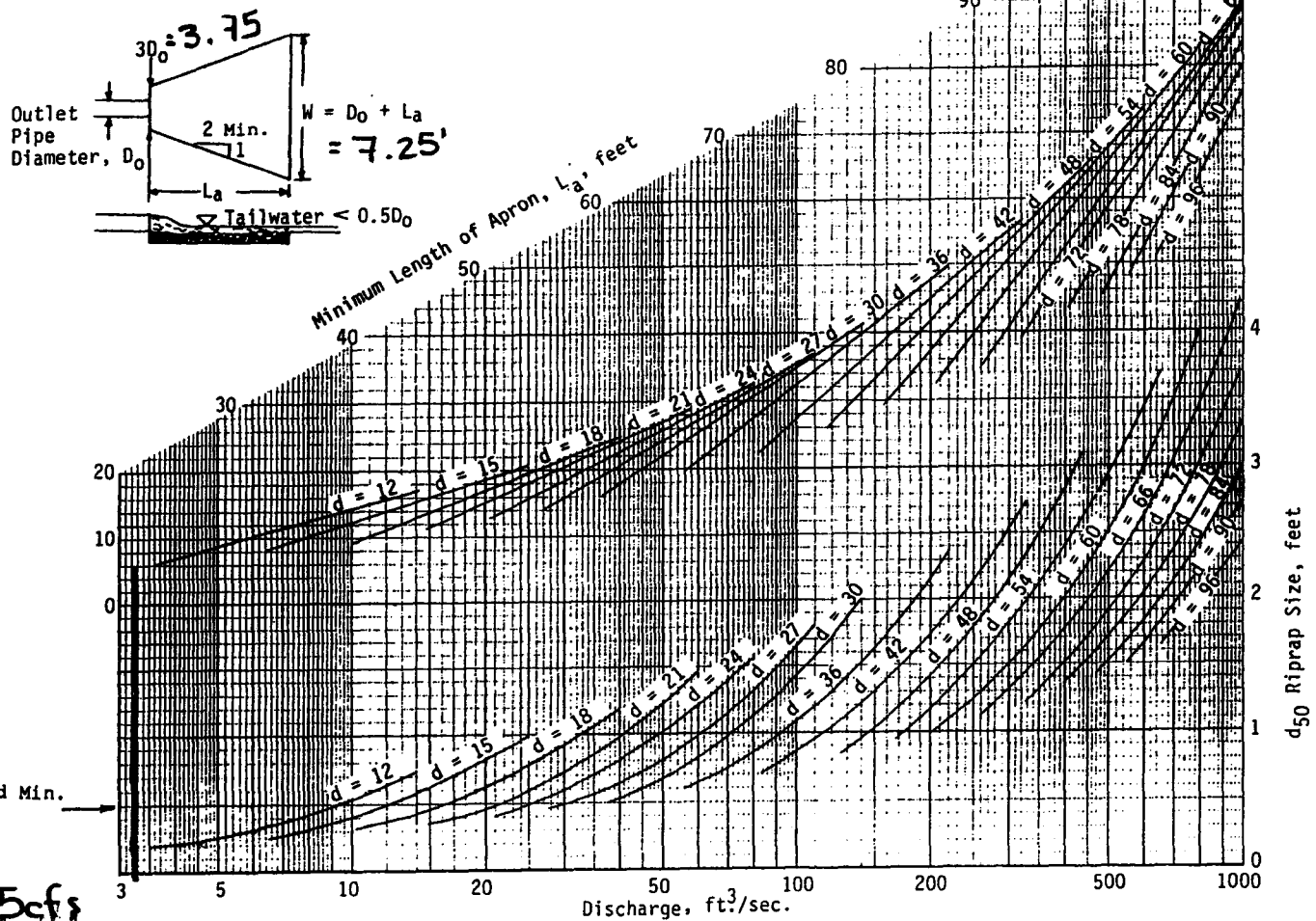
GUTTER SLOPE = 0.0600 FT/FT PAVEMENT CROSS SLOPE = 0.0208 FT/FT

| SPREAD | W | W/T | SW | SW/SX | Eo | a | S'W | SE |
|---|---|---|---|---|---|---|---|---|
| 1.44 | 2.0 | 1.39 | 0.0833 | 4.0 | 1.00 | 3.5 | 0.146 | 0.167 |

XXXXXXXXXX CURB INLET ON A CONTINUOUS GRADE XXXXXXXXXX
REQUIRED LENGTH (ft) = 6.3 EFFICIENCY= 1.00
CFS INTERCEPTED= 0.38 CFS CARRYOVER= 0.00

OUTLET PROTECTION 8

DESIGN OF OUTLET PROTECTION FROM A ROUND PIPE FLOWING FULL
MINIMUM TAILWATER CONDITION ($T_w$ < 0.5 DIAMETER)




$L_a$=6'

$Q_2 \approx 3.5$ cfs

# Worksheet
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | 15C to 15B |
| Flow Element | Circular Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Slope | 0.020000 | ft/ft |
| Diameter | 15 | in |
| Discharge | 1.08 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.29 | ft |
| Flow Area | 0.2 | ft² |
| Wetted Perimeter | 1.26 | ft |
| Top Width | 1.06 | ft |
| Critical Depth | 0.41 | ft |
| Percent Full | 23.2 | % |
| Critical Slope | 0.005226 | ft/ft |
| Velocity | 5.00 | ft/s |
| Velocity Head | 0.39 | ft |
| Specific Energy | 0.68 | ft |
| Froude Number | 1.95 | |
| Maximum Discharg | 9.83 | cfs |
| Discharge Full | 9.14 | cfs |
| Slope Full | 0.000280 | ft/ft |
| Flow Type | Supercritical | |

# Worksheet
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | 15B to 15 |
| Flow Element | Circular Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Slope | 0.047300 | ft/ft |
| Diameter | 15 | in |
| Discharge | 2.78 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.38 | ft |
| Flow Area | 0.3 | ft² |
| Wetted Perimeter | 1.45 | ft |
| Top Width | 1.15 | ft |
| Critical Depth | 0.67 | ft |
| Percent Full | 30.2 | % |
| Critical Slope | 0.005895 | ft/ft |
| Velocity | 8.91 | ft/s |
| Velocity Head | 1.23 | ft |
| Specific Energy | 1.61 | ft |
| Froude Number | 3.01 | |
| Maximum Discharg | 15.11 | cfs |
| Discharge Full | 14.05 | cfs |
| Slope Full | 0.001852 | ft/ft |
| Flow Type | Supercritical | |

# Worksheet
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | 15A to 15 |
| Flow Element | Circular Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Slope | 0.040000 | ft/ft |
| Diameter | 15 | in |
| Discharge | 0.78 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.21 | ft |
| Flow Area | 0.1 | ft² |
| Wetted Perimeter | 1.05 | ft |
| Top Width | 0.93 | ft |
| Critical Depth | 0.35 | ft |
| Percent Full | 16.7 | % |
| Critical Slope | 0.005214 | ft/ft |
| Velocity | 5.80 | ft/s |
| Velocity Head | 0.52 | ft |
| Specific Energy | 0.73 | ft |
| Froude Number | 2.69 | |
| Maximum Discharg | 13.90 | cfs |
| Discharge Full | 12.92 | cfs |
| Slope Full | 0.000146 | ft/ft |
| Flow Type | Supercritical | |

# Worksheet
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | 15 to 14 |
| Flow Element | Circular Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Slope | 0.065000 | ft/ft |
| Diameter | 15 | in |
| Discharge | 4.14 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.43 | ft |
| Flow Area | 0.4 | $ft^2$ |
| Wetted Perimeter | 1.56 | ft |
| Top Width | 1.19 | ft |
| Critical Depth | 0.82 | ft |
| Percent Full | 34.2 | % |
| Critical Slope | 0.006900 | ft/ft |
| Velocity | 11.17 | ft/s |
| Velocity Head | 1.94 | ft |
| Specific Energy | 2.37 | ft |
| Froude Number | 3.52 | |
| Maximum Discharg | 17.72 | cfs |
| Discharge Full | 16.47 | cfs |
| Slope Full | 0.004108 | ft/ft |
| Flow Type | Supercritical | |

# Worksheet
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | 14 to 13 |
| Flow Element | Circular Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Slope | 0.063300 | ft/ft |
| Diameter | 15 | in |
| Discharge | 4.14 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.43 | ft |
| Flow Area | 0.4 | ft² |
| Wetted Perimeter | 1.57 | ft |
| Top Width | 1.19 | ft |
| Critical Depth | 0.82 | ft |
| Percent Full | 34.4 | % |
| Critical Slope | 0.006900 | ft/ft |
| Velocity | 11.07 | ft/s |
| Velocity Head | 1.90 | ft |
| Specific Energy | 2.33 | ft |
| Froude Number | 3.48 | |
| Maximum Discharg | 17.48 | cfs |
| Discharge Full | 16.25 | cfs |
| Slope Full | 0.004108 | ft/ft |
| Flow Type | Supercritical | |

PROJECT 2002261-504.04
HEC12 Version: V2.91 Run Date: 11-29-2004

==========

INLET NUMBER 15C LENGTH 8.0 STATION

DRAINAGE AREA = 0.200 ACRES C VALUE = .490 CA = 0.098
DRAINAGE AREA = 0.070 ACRES C VALUE = .520 CA = 0.036
DRAINAGE AREA = 0.070 ACRES C VALUE = .690 CA = 0.048
SUM CA= 0.183 INT= 4.00 CFS= 0.731 CO= 0.000 GUTTER FLOW= 0.731

GUTTER SLOPE = 0.0562 FT/FT PAVEMENT CROSS SLOPE = 0.0208 FT/FT

| SPREAD | W | W/T | SW | SW/SX | Eo | a | S'W | SE |
|---|---|---|---|---|---|---|---|---|
| 1.86 | 2.0 | 1.07 | 0.0833 | 4.0 | 1.00 | 3.5 | 0.146 | 0.167 |

XXXXXXXXXX CURB INLET ON A CONTINUOUS GRADE XXXXXXXXXX
REQUIRED LENGTH (ft) = 8.1 EFFICIENCY= 1.00
CFS INTERCEPTED= 0.73 CFS CARRYOVER= 0.00

PROJECT 2002261-504.04
HEC12 Version: V2.91 Run Date: 11-29-2004

==========

INLET NUMBER 15B LENGTH 10.0 STATION

DRAINAGE AREA = 0.500 ACRES C VALUE = .580 CA = 0.290
SUM CA= 0.290 INT= 4.00 CFS= 1.160 CO= 0.000 GUTTER FLOW= 1.160

GUTTER SLOPE = 0.0562 FT/FT PAVEMENT CROSS SLOPE = 0.0208 FT/FT

| SPREAD | W | W/T | SW | SW/SX | Eo | a | S'W | SE |
|---|---|---|---|---|---|---|---|---|
| 2.36 | 2.0 | 0.85 | 0.0833 | 4.0 | 1.00 | 3.5 | 0.146 | 0.167 |

XXXXXXXXXX CURB INLET ON A CONTINUOUS GRADE XXXXXXXXXX
REQUIRED LENGTH (ft) = 10.7 EFFICIENCY= 0.99
CFS INTERCEPTED= 1.15 CFS CARRYOVER= 0.01

PROJECT 2002261-504.04
HEC12 Version: V2.91 Run Date: 11-29-2004

==========

INLET NUMBER 15A LENGTH 8.0 STATION

DRAINAGE AREA = 0.090 ACRES C VALUE = .720 CA = 0.065
DRAINAGE AREA = 0.120 ACRES C VALUE = .580 CA = 0.070

FOR THE FIRST SIDE
SUM CA= 0.065 INT= 4.00 CFS= 0.259 CO= 0.000 GUTTER FLOW= 0.259
FOR THE OTHER SIDE
SUM CA= 0.070 INT= 4.00 CFS= 0.278 CO= 0.000 GUTTER FLOW= 0.278
AT THE INLET

SUM CA= 0.134 INT= 4.00 CFS= 0.538 CO= 0.000 GUTTER FLOW= 0.538

GUTTER SLOPE = 0.0010 FT/FT PAVEMENT CROSS SLOPE = 0.0208 FT/FT

SPREAD AT A SLOPE OF .001 (ft./ft.) AND 0.28 (cfs) IS 4.71 (ft.)

XXXXXXXXXX CURB INLET IN A SUMP XXXXXXXXXX
P EFFEC. LENGTH (ft) = 11.60 H (ft) = 0.385
DEPTH OF WATER (ft) = 0.07 SPREAD (ft) = 3.56

PROJECT 2002261-504.04
HEC12 Version: V2.91 Run Date: 11-29-2004

==========

INLET NUMBER 15 LENGTH 6.0 STATION

DRAINAGE AREA = 0.070 ACRES C VALUE = .710 CA = 0.050
DRAINAGE AREA = 0.070 ACRES C VALUE = .840 CA = 0.059

FOR THE FIRST SIDE
SUM CA= 0.050 INT= 4.00 CFS= 0.199 CO= 0.000 GUTTER FLOW= 0.199
FOR THE OTHER SIDE
SUM CA= 0.059 INT= 4.00 CFS= 0.235 CO= 0.000 GUTTER FLOW= 0.235
AT THE INLET

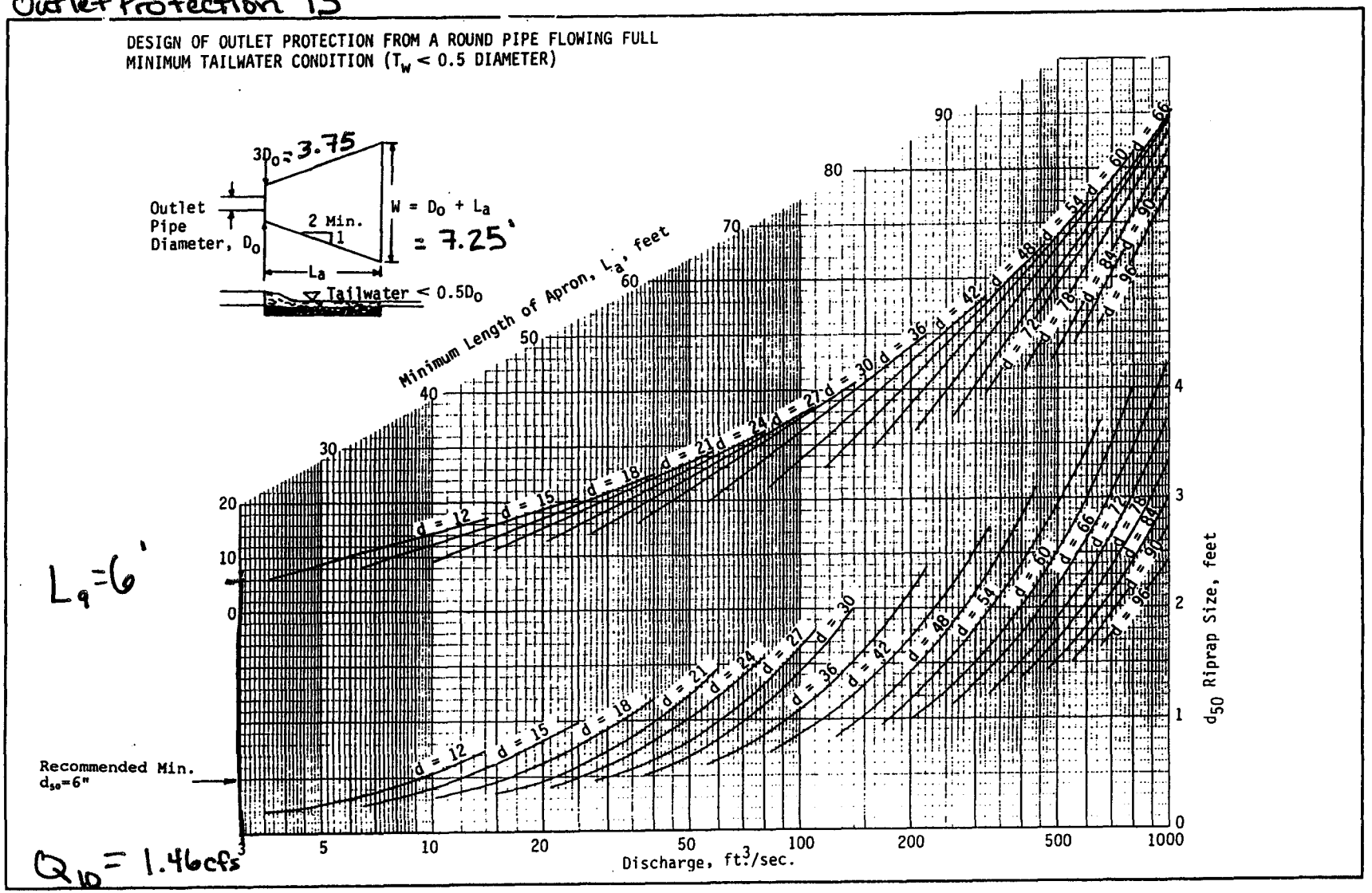
SUM CA= 0.108 INT= 4.00 CFS= 0.434 CO= 0.000 GUTTER FLOW= 0.434

GUTTER SLOPE = 0.0010 FT/FT PAVEMENT CROSS SLOPE = 0.0208 FT/FT

SPREAD AT A SLOPE OF .001 (ft./ft.) AND 0.24 (cfs) IS 4.15 (ft.)

XXXXXXXXXX CURB INLET IN A SUMP XXXXXXXXXX
P EFFEC. LENGTH (ft) = 9.60 H (ft) = 0.385
DEPTH OF WATER (ft) = 0.07 SPREAD (ft) = 3.50

Outlet Protection 13



# Worksheet
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | 34 to 33 |
| Flow Element | Circular Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Slope | 0.087500 | ft/ft |
| Diameter | 15 | in |
| Discharge | 1.38 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.23 | ft |
| Flow Area | 0.2 | ft² |
| Wetted Perimeter | 1.10 | ft |
| Top Width | 0.96 | ft |
| Critical Depth | 0.46 | ft |
| Percent Full | 18.2 | % |
| Critical Slope | 0.005285 | ft/ft |
| Velocity | 9.05 | ft/s |
| Velocity Head | 1.27 | ft |
| Specific Energy | 1.50 | ft |
| Froude Number | 4.01 | |
| Maximum Discharg | 20.55 | cfs |
| Discharge Full | 19.11 | cfs |
| Slope Full | 0.000456 | ft/ft |
| Flow Type | Supercritical | |

# Worksheet
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | 33 to 32 |
| Flow Element | Circular Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Slope | 0.086600 | ft/ft |
| Diameter | 15 | in |
| Discharge | 2.34 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.30 | ft |
| Flow Area | 0.2 | ft² |
| Wetted Perimeter | 1.27 | ft |
| Top Width | 1.06 | ft |
| Critical Depth | 0.61 | ft |
| Percent Full | 23.7 | % |
| Critical Slope | 0.005653 | ft/ft |
| Velocity | 10.52 | ft/s |
| Velocity Head | 1.72 | ft |
| Specific Energy | 2.02 | ft |
| Froude Number | 4.06 | |
| Maximum Discharg | 20.45 | cfs |
| Discharge Full | 19.01 | cfs |
| Slope Full | 0.001312 | ft/ft |
| Flow Type | Supercritical | |

# Worksheet
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | 32 to 31 |
| Flow Element | Circular Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Slope | 0.066000 | ft/ft |
| Diameter | 15 | in |
| Discharge | 2.34 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.32 | ft |
| Flow Area | 0.2 | ft² |
| Wetted Perimeter | 1.32 | ft |
| Top Width | 1.09 | ft |
| Critical Depth | 0.61 | ft |
| Percent Full | 25.4 | % |
| Critical Slope | 0.005653 | ft/ft |
| Velocity | 9.55 | ft/s |
| Velocity Head | 1.42 | ft |
| Specific Energy | 1.74 | ft |
| Froude Number | 3.55 | |
| Maximum Discharg | 17.85 | cfs |
| Discharge Full | 16.59 | cfs |
| Slope Full | 0.001312 | ft/ft |
| Flow Type | Supercritical | |

PROJECT 2002261-504.04
HEC12 Version: V2.91 Run Date: 11-29-2004

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INLET NUMBER 34 LENGTH 6.0 STATION

DRAINAGE AREA = 0.260 ACRES C VALUE = .730 CA = 0.190
DRAINAGE AREA = 0.050 ACRES C VALUE = .710 CA = 0.036

FOR THE FIRST SIDE
SUM CA= 0.190 INT= 4.00 CFS= 0.759 CO= 0.000 GUTTER FLOW= 0.759
FOR THE OTHER SIDE
SUM CA= 0.036 INT= 4.00 CFS= 0.142 CO= 0.000 GUTTER FLOW= 0.142
AT THE INLET

SUM CA= 0.225 INT= 4.00 CFS= 0.901 CO= 0.000 GUTTER FLOW= 0.901

GUTTER SLOPE = 0.0040 FT/FT PAVEMENT CROSS SLOPE = 0.0208 FT/FT

SPREAD AT A SLOPE OF .004 (ft./ft.) AND 0.76 (cfs) IS 5.76 (ft.)

XXXXXXXXXX CURB INLET IN A SUMP XXXXXXXXXX
P EFFEC. LENGTH (ft) = 9.60 H (ft) = 0.385
DEPTH OF WATER (ft) = 0.12 SPREAD (ft) = 5.69

PROJECT 2002261-504.04
HEC12 Version: V2.91 Run Date: 11-29-2004

==========

INLET NUMBER 33 LENGTH 6.0 STATION

DRAINAGE AREA = 0.030 ACRES C VALUE = .700 CA = 0.021
DRAINAGE AREA = 0.200 ACRES C VALUE = .700 CA = 0.140

FOR THE FIRST SIDE
SUM CA= 0.021 INT= 4.00 CFS= 0.084 CO= 0.000 GUTTER FLOW= 0.084
FOR THE OTHER SIDE
SUM CA= 0.140 INT= 4.00 CFS= 0.560 CO= 0.000 GUTTER FLOW= 0.560
AT THE INLET

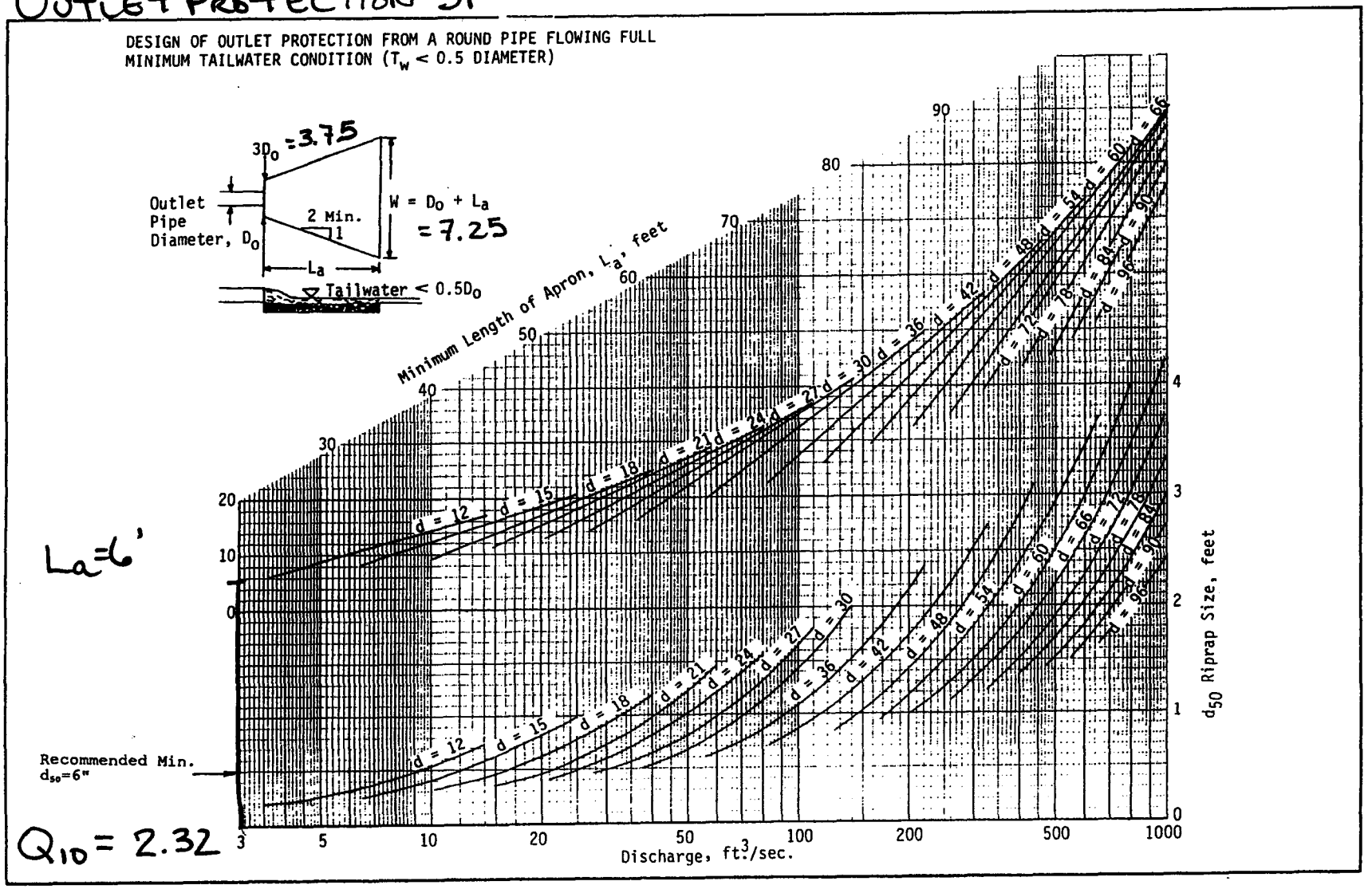
SUM CA= 0.161 INT= 4.00 CFS= 0.644 CO= 0.000 GUTTER FLOW= 0.644

GUTTER SLOPE = 0.0040 FT/FT PAVEMENT CROSS SLOPE = 0.0208 FT/FT

SPREAD AT A SLOPE OF .004 (ft./ft.) AND 0.56 (cfs) IS 4.25 (ft.)

XXXXXXXXXX CURB INLET IN A SUMP XXXXXXXXXX
P EFFEC. LENGTH (ft) = 9.60 H (ft) = 0.458
DEPTH OF WATER (ft) = 0.09 SPREAD (ft) = 4.55

OUTLET PROTECTION 31



LANDMARK
DESIGN GROUP

May 4, 2004

Mr. Scott J. Thomas, P.E.
Civil Engineer
Environmental Division
P.O. Box 8784
Williamsburg, VA 23187-8784

Re.: Fieldstone Parkway Extension
JCC Case No SP-108-03

Dear Mr. Thomas:

LandMark Design Group has reviewed the comment letter from your department dated February 26,2004 concerning the aforementioned project. The site plan and supporting engineering documents are being revised accordingly.

Please find enclosed an exhibit and drainage calculations for System F at the existing intersection of Mill Pond Run & Fieldstone Parkway. The proposed modifications to the existing 42" outfall are presented as an alternative to any downstream improvements. The current 2 and 10-year flows would be reduced from 15 CFS and 20 CFS to 4 CFS and 5.4 CFS respectively. This reduction would be generated by diverting 2.2 acres of drainage from existing Fieldstone Parkway, 11.1 acres of drainage from the south side of Fieldstone Parkway, and 3 acres of the proposed Fieldstone Parkway extension, to a storm water management pond.

Although the existing receiving channel shows signs of erosion, it is our opinion that left alone the channel will heal itself. The disturbance to the existing area, if detention facilities were considered in the ravine bottom, particularly wetlands impact would be more intrusive and detrimental to the watershed. The proposed drainage modifications and detention basin between the ravine and Fieldstone Extension would reduce the current flow to the existing outfall dramatically, promoting a more suitable condition for the channel to stabilize.

LMDG is also proposing to provide attenuation of the 1 yr 24 hr storm at each of the proposed outfalls to meet channel adequacy requirements. This decision was based upon the economy of construction, the desire to minimize intrusion within the natural channels, and to provide potential additional on-site borrow material.

We are available at your convenience to meet or discuss these proposed drainage enhancements.

Sincerely,

The LandMark Design Group, Inc.

Alistair J. Ramsay, L.S.
Senior Project Manager

Enclosure
Copy: 2002261-500.01

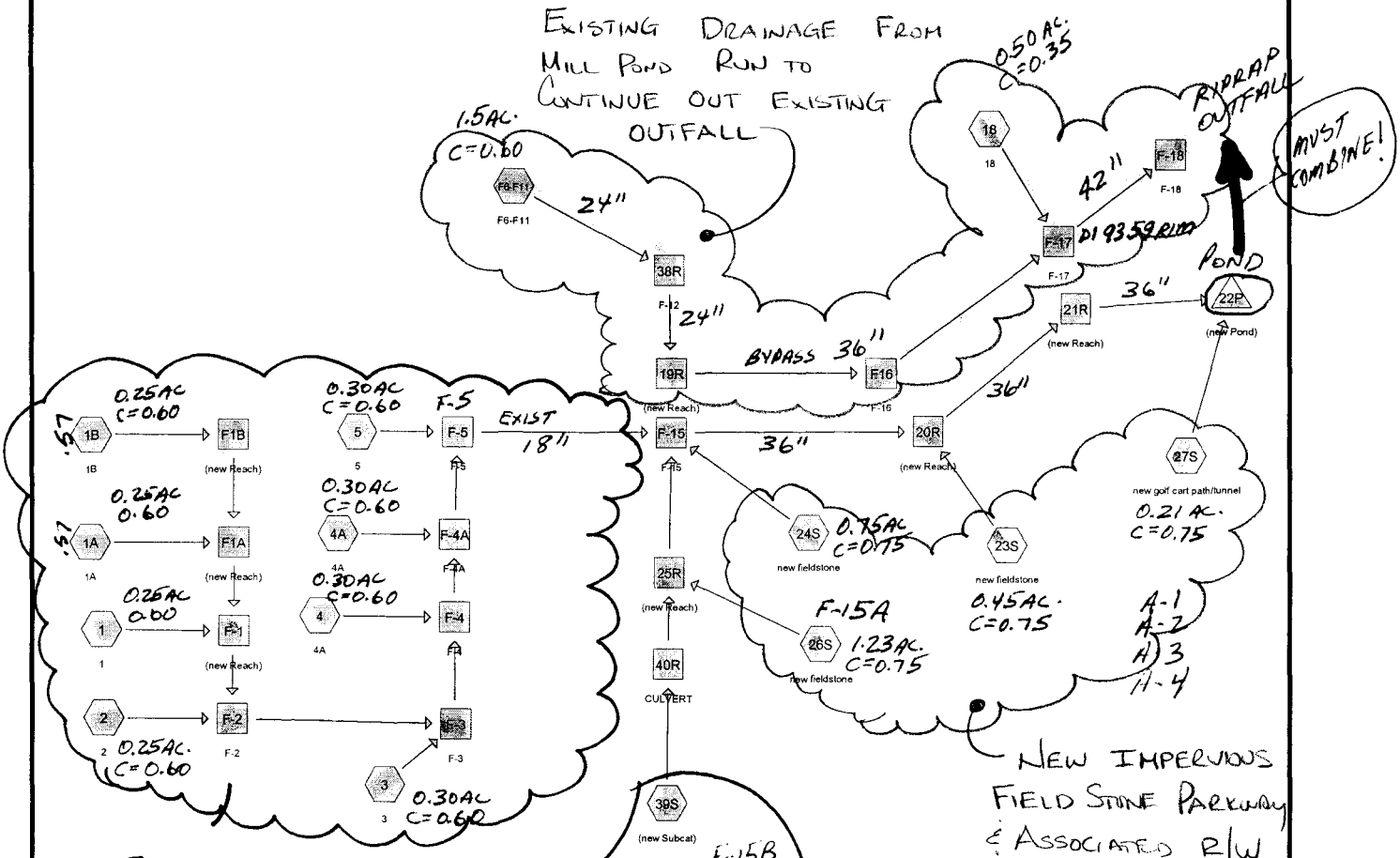

4029 Ironbound Road, Suite 100, Williamsburg, VA 23188 (757) 253-2975 FAX: (757) 229-0049 lmdg@landmarkdg.com

PRE 2- 15.06 CFS
PRE 10- 19.99 CFS

2-YR
4.03 CFS, V=3.6 FPS
CAP 60.92

10-YR
5.43 CFS, V=3.9 FPS
CAP 60.92

EXISTING DRAINAGE FROM MILL POND RUN TO CONTINUE OUT EXISTING OUTFALL




Subcat Reach Pond Link

**Drainage Diagram for system f POST DEVELOP**
Prepared by {enter your company name here} 5/4/04
HydroCAD® 7.00 s/n 001765 © 1986-2003 Applied Microcomputer Systems

Time span=0.00-3.00 hrs, dt=0.01 hrs, 301 points
Runoff by Rational method, Rise/Fall=1.0/1.0 xTc
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment 1: 1** Runoff Area=0.250 ac Runoff Depth=0.57"
Tc=5.0 min C=0.60 Runoff=0.57 cfs 0.012 af

**Subcatchment 1A: 1A** Runoff Area=0.250 ac Runoff Depth=0.59"
Tc=0.0 min C=0.60 Runoff=0.57 cfs 0.012 af

**Subcatchment 1B: 1B** Runoff Area=0.250 ac Runoff Depth=0.57"
Tc=5.0 min C=0.60 Runoff=0.57 cfs 0.012 af

**Subcatchment 2: 2** Runoff Area=0.250 ac Runoff Depth=0.57"
Tc=5.0 min C=0.60 Runoff=0.57 cfs 0.012 af

**Subcatchment 3: 3** Runoff Area=0.300 ac Runoff Depth=0.57"
Tc=5.0 min C=0.60 Runoff=0.69 cfs 0.014 af

**Subcatchment 4: 4A** Runoff Area=0.300 ac Runoff Depth=0.57"
Tc=5.0 min C=0.60 Runoff=0.69 cfs 0.014 af

**Subcatchment 4A: 4A** Runoff Area=0.300 ac Runoff Depth=0.57"
Tc=5.0 min C=0.60 Runoff=0.69 cfs 0.014 af

**Subcatchment 5: 5** Runoff Area=0.300 ac Runoff Depth=0.57"
Tc=5.0 min C=0.60 Runoff=0.69 cfs 0.014 af

**Subcatchment 18: 18** Runoff Area=0.500 ac Runoff Depth=0.33"
Tc=15.0 min C=0.35 Runoff=0.67 cfs 0.014 af

**Subcatchment 23S: new fieldstone** Runoff Area=0.450 ac Runoff Depth=0.71"
Tc=5.0 min C=0.75 Runoff=1.29 cfs 0.027 af

**Subcatchment 24S: new fieldstone** Runoff Area=0.750 ac Runoff Depth=0.71"
Tc=5.0 min C=0.75 Runoff=2.16 cfs 0.045 af

**Subcatchment 26S: new fieldstone** Runoff Area=1.230 ac Runoff Depth=0.71"
Tc=5.0 min C=0.75 Runoff=3.54 cfs 0.073 af

**Subcatchment 27S: new golf cart path/tunnel** Runoff Area=0.210 ac Runoff Depth=0.71"
Tc=5.8 min C=0.75 Runoff=0.60 cfs 0.012 af

**Subcatchment 39S: (new Subcat)** Runoff Area=11.100 ac Runoff Depth=0.14"
Tc=35.0 min C=0.35 Runoff=6.38 cfs 0.132 af

IF AREA MAY BE DEVELOPED, THIS SHOULD REFLECT USE.

**Subcatchment F6-F11: F6-F11** Runoff Area=1.500 ac Runoff Depth=0.57"
Tc=10.0 min C=0.60 Runoff=3.45 cfs 0.071 af

**Reach 19R: (new Reach)** Peak Depth=0.47' Max Vel=4.9 fps Inflow=3.45 cfs 0.071 af
D=36.0" n=0.013 L=125.0' S=0.0096 '/' Capacity=65.35 cfs Outflow=3.45 cfs 0.071 af

**Reach 20R: (new Reach)** Peak Depth=1.48' Max Vel=5.1 fps Inflow=17.93 cfs 0.381 af
D=36.0" n=0.013 L=276.0' S=0.0030 '/' Capacity=36.58 cfs Outflow=17.77 cfs 0.381 af

**Reach 21R: (new Reach)** Peak Depth=1.36' Max Vel=5.7 fps Inflow=17.77 cfs 0.381 af
D=36.0" n=0.013 L=150.0' S=0.0040 '/' Capacity=42.18 cfs Outflow=17.70 cfs 0.381 af

**Reach 25R: (new Reach)** Peak Depth=0.77' Max Vel=10.7 fps Inflow=9.82 cfs 0.205 af
D=18.0" n=0.013 L=95.0' S=0.0314 '/' Capacity=18.60 cfs Outflow=9.70 cfs 0.205 af

**Reach 38R: F-12** Peak Depth=0.61' Max Vel=4.3 fps Inflow=3.45 cfs 0.071 af
D=24.0" n=0.013 L=118.0' S=0.0057 '/' Capacity=17.05 cfs Outflow=3.45 cfs 0.071 af

**Reach 40R: CULVERT** Peak Depth=0.70' Max Vel=7.8 fps Inflow=6.38 cfs 0.132 af
D=18.0" n=0.013 L=68.0' S=0.0182 '/' Capacity=14.18 cfs Outflow=6.30 cfs 0.132 af

**Reach F-1: (new Reach)** Peak Depth=0.44' Max Vel=4.5 fps Inflow=1.72 cfs 0.036 af
D=15.0" n=0.013 L=32.0' S=0.0100 '/' Capacity=6.46 cfs Outflow=1.72 cfs 0.036 af

**Reach F-15: F-15** Peak Depth=1.43' Max Vel=5.0 fps Inflow=16.92 cfs 0.354 af
D=36.0" n=0.013 L=125.0' S=0.0030 '/' Capacity=36.29 cfs Outflow=16.76 cfs 0.354 af

**Reach F-17: F-17** Peak Depth=0.27' Max Vel=11.6 fps Inflow=4.03 cfs 0.085 af
D=42.0" n=0.013 L=104.0' S=0.1057 '/' Capacity=327.06 cfs Outflow=4.03 cfs 0.085 af

**Reach F-18: F-18** OUTFALL Peak Depth=0.61' Max Vel=3.6 fps Inflow=4.03 cfs 0.085 af
D=42.0" n=0.013 L=120.0' S=0.0037 '/' Capacity=60.92 cfs Outflow=4.03 cfs 0.085 af

**Reach F-2: F-2** Peak Depth=0.46' Max Vel=5.6 fps Inflow=2.30 cfs 0.048 af
D=15.0" n=0.013 L=225.0' S=0.0150 '/' Capacity=7.91 cfs Outflow=2.30 cfs 0.048 af

**Reach F-3: F-3** Peak Depth=0.55' Max Vel=5.1 fps Inflow=2.99 cfs 0.062 af
D=18.0" n=0.013 L=32.0' S=0.0100 '/' Capacity=10.50 cfs Outflow=2.99 cfs 0.062 af

**Reach F-4: F-4** Peak Depth=0.61' Max Vel=5.4 fps Inflow=3.68 cfs 0.076 af
D=18.0" n=0.013 L=24.0' S=0.0100 '/' Capacity=10.50 cfs Outflow=3.68 cfs 0.076 af

**Reach F-4A: F-4A** Peak Depth=0.67' Max Vel=5.7 fps Inflow=4.37 cfs 0.091 af
D=18.0" n=0.013 L=32.0' S=0.0100 '/' Capacity=10.50 cfs Outflow=4.37 cfs 0.091 af

**Reach F-5: F-5** Peak Depth=0.53' Max Vel=9.1 fps Inflow=5.06 cfs 0.105 af
D=18.0" n=0.013 L=200.0' S=0.0324 '/' Capacity=18.91 cfs Outflow=5.06 cfs 0.105 af

**Reach F16: F-16** Peak Depth=0.66' Max Vel=3.0 fps Inflow=3.45 cfs 0.071 af
D=36.0" n=0.013 L=290.0' S=0.0024 '/' Capacity=32.77 cfs Outflow=3.43 cfs 0.071 af

**Reach F1A: (new Reach)** Peak Depth=0.43' Max Vel=3.1 fps Inflow=1.15 cfs 0.024 af
D=15.0" n=0.013 L=24.0' S=0.0050 '/' Capacity=4.57 cfs Outflow=1.15 cfs 0.024 af

**Reach F1B: (new Reach)** Peak Depth=0.30' Max Vel=2.5 fps Inflow=0.57 cfs 0.012 af
D=15.0" n=0.013 L=32.0' S=0.0050 '/' Capacity=4.57 cfs Outflow=0.57 cfs 0.012 af

**Pond 22P: (new Pond)** Peak Elev=76.31' Storage=17,137 cf Inflow=18.08 cfs 0.393 af
Outflow=0.00 cfs 0.000 af

**Total Runoff Area = 17.940 ac Runoff Volume = 0.479 af Average Runoff Depth = 0.32"**

Time span=0.00-3.00 hrs, dt=0.01 hrs, 301 points
Runoff by Rational method, Rise/Fall=1.0/1.0 xTc
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment 1: 1** Runoff Area=0.250 ac Runoff Depth=0.76"
Tc=5.0 min C=0.60 Runoff=0.77 cfs 0.016 af

**Subcatchment 1A: 1A** Runoff Area=0.250 ac Runoff Depth=0.79"
Tc=0.0 min C=0.60 Runoff=0.77 cfs 0.017 af

why same

**Subcatchment 1B: 1B** Runoff Area=0.250 ac Runoff Depth=0.76"
Tc=5.0 min C=0.60 Runoff=0.77 cfs 0.016 af

**Subcatchment 2: 2** Runoff Area=0.250 ac Runoff Depth=0.76"
Tc=5.0 min C=0.60 Runoff=0.77 cfs 0.016 af

**Subcatchment 3: 3** Runoff Area=0.300 ac Runoff Depth=0.76"
Tc=5.0 min C=0.60 Runoff=0.92 cfs 0.019 af

**Subcatchment 4: 4A** Runoff Area=0.300 ac Runoff Depth=0.76"
Tc=5.0 min C=0.60 Runoff=0.92 cfs 0.019 af

**Subcatchment 4A: 4A** Runoff Area=0.300 ac Runoff Depth=0.76"
Tc=5.0 min C=0.60 Runoff=0.92 cfs 0.019 af

**Subcatchment 5: 5** Runoff Area=0.300 ac Runoff Depth=0.76"
Tc=5.0 min C=0.60 Runoff=0.92 cfs 0.019 af

**Subcatchment 18: 18** Runoff Area=0.500 ac Runoff Depth=0.45"
Tc=15.0 min C=0.35 Runoff=0.90 cfs 0.019 af

**Subcatchment 23S: new fieldstone** Runoff Area=0.450 ac Runoff Depth=0.96"
Tc=5.0 min C=0.75 Runoff=1.73 cfs 0.036 af

**Subcatchment 24S: new fieldstone** Runoff Area=0.750 ac Runoff Depth=0.96"
Tc=5.0 min C=0.75 Runoff=2.89 cfs 0.060 af

**Subcatchment 26S: new fieldstone** Runoff Area=1.230 ac Runoff Depth=0.96"
Tc=5.0 min C=0.75 Runoff=4.74 cfs 0.098 af

**Subcatchment 27S: new golf cart path/tunnel** Runoff Area=0.210 ac Runoff Depth=0.96"
Tc=5.8 min C=0.75 Runoff=0.81 cfs 0.017 af

**Subcatchment 39S: (new Subcat)** Runoff Area=11.100 ac Runoff Depth=0.19"
Tc=35.0 min C=0.35 Runoff=8.55 cfs 0.177 af

**Subcatchment F6-F11: F6-F11** Runoff Area=1.500 ac Runoff Depth=0.76"
Tc=10.0 min C=0.60 Runoff=4.62 cfs 0.096 af

**Reach 19R: (new Reach)** Peak Depth=0.54' Max Vel=5.3 fps Inflow=4.62 cfs 0.096 af
D=36.0" n=0.013 L=125.0' S=0.0096 '/' Capacity=65.35 cfs Outflow=4.62 cfs 0.096 af

**Reach 20R: (new Reach)** Peak Depth=1.77' Max Vel=5.5 fps Inflow=24.06 cfs 0.511 af
D=36.0" n=0.013 L=276.0' S=0.0030 '/' Capacity=36.58 cfs Outflow=23.85 cfs 0.511 af

**Reach 21R: (new Reach)** Peak Depth=1.61' Max Vel=6.1 fps Inflow=23.85 cfs 0.511 af
D=36.0" n=0.013 L=150.0' S=0.0040 '/' Capacity=42.18 cfs Outflow=23.76 cfs 0.511 af

**Reach 25R: (new Reach)** Peak Depth=0.93' Max Vel=11.4 fps Inflow=13.16 cfs 0.275 af
D=18.0" n=0.013 L=95.0' S=0.0314 '/' Capacity=18.60 cfs Outflow=13.02 cfs 0.275 af

**Reach 38R: F-12** Peak Depth=0.71' Max Vel=4.6 fps Inflow=4.62 cfs 0.096 af
D=24.0" n=0.013 L=118.0' S=0.0057 '/' Capacity=17.05 cfs Outflow=4.62 cfs 0.096 af

**Reach 40R: CULVERT** Peak Depth=0.84' Max Vel=8.4 fps Inflow=8.55 cfs 0.177 af
D=18.0" n=0.013 L=68.0' S=0.0182 '/' Capacity=14.18 cfs Outflow=8.44 cfs 0.177 af

**Reach F-1: (new Reach)** Peak Depth=0.52' Max Vel=4.8 fps Inflow=2.31 cfs 0.048 af
D=15.0" n=0.013 L=32.0' S=0.0100 '/' Capacity=6.46 cfs Outflow=2.31 cfs 0.048 af

**Reach F-15: F-15** Peak Depth=1.71' Max Vel=5.4 fps Inflow=22.69 cfs 0.475 af
D=36.0" n=0.013 L=125.0' S=0.0030 '/' Capacity=36.29 cfs Outflow=22.48 cfs 0.475 af

**Reach F-17: F-17** Peak Depth=0.31' Max Vel=12.7 fps Inflow=5.44 cfs 0.114 af
D=42.0" n=0.013 L=104.0' S=0.1057 '/' Capacity=327.06 cfs Outflow=5.44 cfs 0.114 af

**Reach F-18: F-18** OUTFALL Peak Depth=0.71' Max Vel=3.9 fps Inflow=5.44 cfs 0.114 af
D=42.0" n=0.013 L=120.0' S=0.0037 '/' Capacity=60.92 cfs Outflow=5.43 cfs 0.114 af

**Reach F-2: F-2** Peak Depth=0.54' Max Vel=6.0 fps Inflow=3.08 cfs 0.064 af
D=15.0" n=0.013 L=225.0' S=0.0150 '/' Capacity=7.91 cfs Outflow=3.08 cfs 0.064 af

**Reach F-3: F-3** Peak Depth=0.64' Max Vel=5.5 fps Inflow=4.01 cfs 0.083 af
D=18.0" n=0.013 L=32.0' S=0.0100 '/' Capacity=10.50 cfs Outflow=4.01 cfs 0.083 af

**Reach F-4: F-4** Peak Depth=0.72' Max Vel=5.9 fps Inflow=4.93 cfs 0.102 af
D=18.0" n=0.013 L=24.0' S=0.0100 '/' Capacity=10.50 cfs Outflow=4.93 cfs 0.102 af

**Reach F-4A: F-4A** Peak Depth=0.80' Max Vel=6.1 fps Inflow=5.86 cfs 0.121 af
D=18.0" n=0.013 L=32.0' S=0.0100 '/' Capacity=10.50 cfs Outflow=5.86 cfs 0.121 af

**Reach F-5: F-5** Peak Depth=0.62' Max Vel=9.8 fps Inflow=6.78 cfs 0.140 af
D=18.0" n=0.013 L=200.0' S=0.0324 '/' Capacity=18.91 cfs Outflow=6.78 cfs 0.140 af

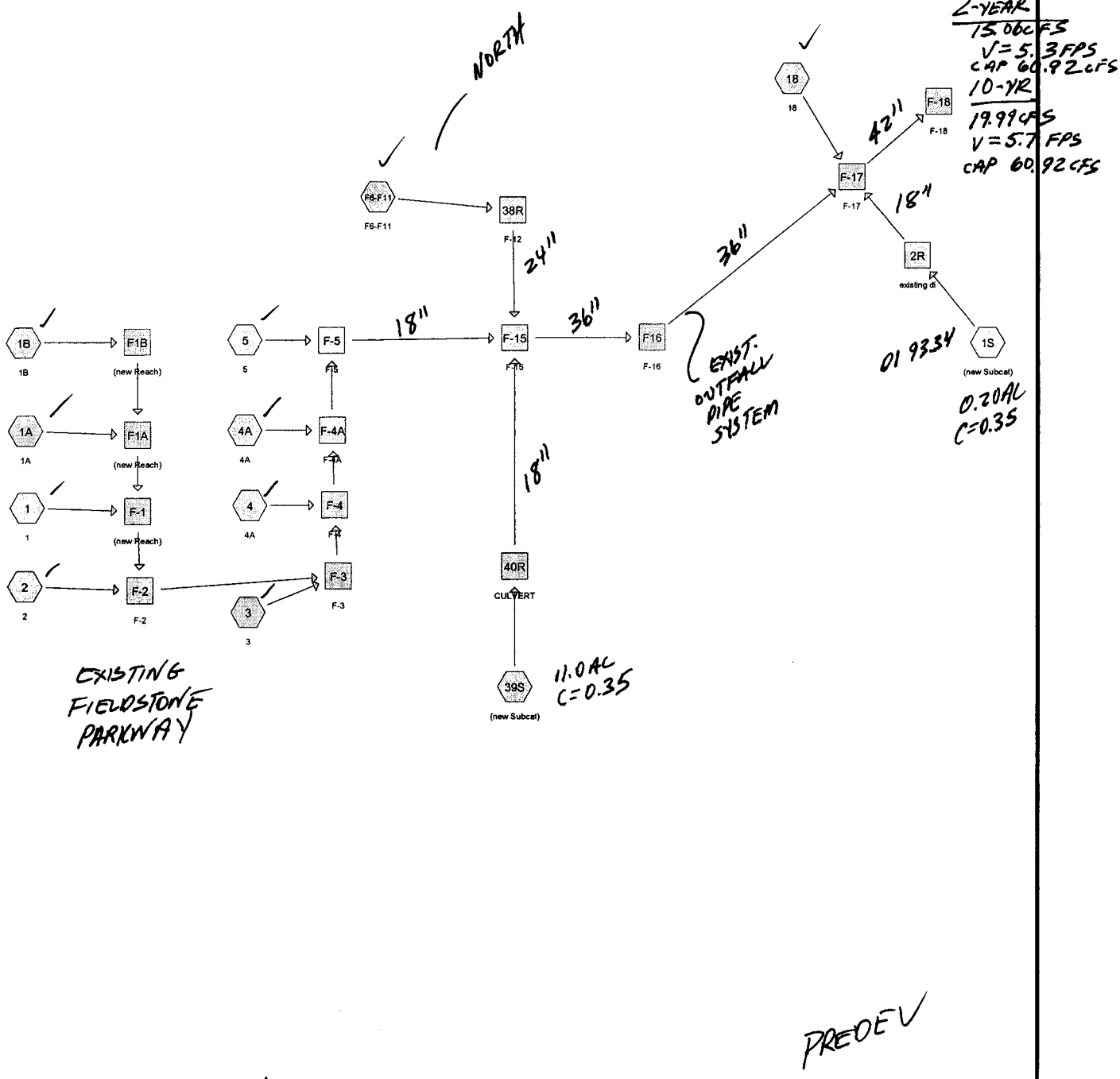
**Reach F16: F-16** Peak Depth=0.76' Max Vel=3.3 fps Inflow=4.62 cfs 0.096 af
D=36.0" n=0.013 L=290.0' S=0.0024 '/' Capacity=32.77 cfs Outflow=4.61 cfs 0.096 af

**Reach F1A: (new Reach)** Peak Depth=0.50' Max Vel=3.4 fps Inflow=1.54 cfs 0.032 af
D=15.0" n=0.013 L=24.0' S=0.0050 '/' Capacity=4.57 cfs Outflow=1.54 cfs 0.032 af

**Reach F1B: (new Reach)** Peak Depth=0.35' Max Vel=2.8 fps Inflow=0.77 cfs 0.016 af
D=15.0" n=0.013 L=32.0' S=0.0050 '/' Capacity=4.57 cfs Outflow=0.77 cfs 0.016 af

**Pond 22P: (new Pond)** Peak Elev=77.21' Storage=22,966 cf Inflow=24.26 cfs 0.527 af
Outflow=0.00 cfs 0.000 af

**Total Runoff Area = 17.940 ac Runoff Volume = 0.642 af Average Runoff Depth = 0.43"**




**Drainage Diagram for system f**
Prepared by {enter your company name here} 5/4/04
HydroCAD® 7.00 s/n 001765 © 1986-2003 Applied Microcomputer Systems

Time span=0.00-3.00 hrs, dt=0.01 hrs, 301 points
Runoff by Rational method, Rise/Fall=1.0/1.0 xTc
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment 1: 1** Runoff Area=0.250 ac Runoff Depth=0.51"
Tc=5.0 min C=0.60 Runoff=0.64 cfs 0.011 af

**Subcatchment 1A: 1A** Runoff Area=0.250 ac Runoff Depth=0.53"
Tc=0.0 min C=0.60 Runoff=0.64 cfs 0.011 af

**Subcatchment 1B: 1B** Runoff Area=0.250 ac Runoff Depth=0.51"
Tc=5.0 min C=0.60 Runoff=0.64 cfs 0.011 af

**Subcatchment 1S: (new Subcat)** Runoff Area=0.200 ac Runoff Depth=0.29"
Tc=5.0 min C=0.35 Runoff=0.30 cfs 0.005 af

**Subcatchment 2: 2** Runoff Area=0.250 ac Runoff Depth=0.51"
Tc=5.0 min C=0.60 Runoff=0.64 cfs 0.011 af

**Subcatchment 3: 3** Runoff Area=0.300 ac Runoff Depth=0.51"
Tc=5.0 min C=0.60 Runoff=0.76 cfs 0.013 af

**Subcatchment 4: 4A** Runoff Area=0.300 ac Runoff Depth=0.51"
Tc=5.0 min C=0.60 Runoff=0.76 cfs 0.013 af

**Subcatchment 4A: 4A** Runoff Area=0.300 ac Runoff Depth=0.51"
Tc=5.0 min C=0.60 Runoff=0.76 cfs 0.013 af

**Subcatchment 5: 5** Runoff Area=0.300 ac Runoff Depth=0.51"
Tc=5.0 min C=0.60 Runoff=0.76 cfs 0.013 af

**Subcatchment 18: 18** Runoff Area=0.500 ac Runoff Depth=0.24"
Tc=15.0 min C=0.35 Runoff=0.59 cfs 0.010 af

**Subcatchment 39S: (new Subcat)** Runoff Area=11.000 ac Runoff Depth=0.10"
Tc=35.0 min C=0.35 Runoff=5.61 cfs 0.093 af

**Subcatchment F6-F11: F6-F11** Runoff Area=1.500 ac Runoff Depth=0.51"
Tc=10.0 min C=0.60 Runoff=3.82 cfs 0.063 af

**Reach 2R: existing di** Peak Depth=0.08' Max Vel=7.5 fps Inflow=0.30 cfs 0.005 af
D=18.0" n=0.013 L=90.0' S=0.2024 '/' Capacity=47.26 cfs ✓Outflow=0.30 cfs 0.005 af

**Reach 38R: F-12** Peak Depth=0.67' Max Vel=4.2 fps Inflow=3.82 cfs 0.063 af
D=24.0" n=0.013 L=128.0' S=0.0050 '/' Capacity=16.00 cfs ✓Outflow=3.82 cfs 0.063 af

**Reach 40R: CULVERT** Peak Depth=0.59' Max Vel=8.6 fps Inflow=5.61 cfs 0.093 af
D=18.0" n=0.013 L=162.0' S=0.0260 '/' Capacity=16.95 cfs ✓Outflow=5.48 cfs 0.093 af

**Reach F-1: (new Reach)** Peak Depth=0.47' Max Vel=4.6 fps Inflow=1.91 cfs 0.032 af
D=15.0" n=0.013 L=32.0' S=0.0100 '/' Capacity=6.46 cfs Outflow=1.91 cfs 0.032 af

**Reach F-15: F-15** Peak Depth=1.33' Max Vel=4.9 fps Inflow=14.88 cfs 0.249 af
D=36.0" n=0.013 L=125.0' S=0.0030 '/' Capacity=36.29 cfs Outflow=14.77 cfs 0.249 af

**Reach F-17: F-17** Peak Depth=0.51' Max Vel=17.3 fps Inflow=15.14 cfs 0.263 af
D=42.0" n=0.013 L=104.0' S=0.1057 '/' Capacity=327.06 cfs Outflow=15.12 cfs 0.263 af

**Reach F-18: F-18** OUTFALL Peak Depth=1.19' Max Vel=5.3 fps Inflow=15.12 cfs 0.263 af
D=42.0" n=0.013 L=120.0' S=0.0037 '/' Capacity=60.92 cfs Outflow=15.06 cfs 0.263 af

**Reach F-2: F-2** Peak Depth=0.49' Max Vel=5.7 fps Inflow=2.55 cfs 0.042 af
D=15.0" n=0.013 L=225.0' S=0.0150 '/' Capacity=7.91 cfs Outflow=2.55 cfs 0.042 af

**Reach F-3: F-3** Peak Depth=0.58' Max Vel=5.3 fps Inflow=3.31 cfs 0.055 af
D=18.0" n=0.013 L=32.0' S=0.0100 '/' Capacity=10.50 cfs Outflow=3.31 cfs 0.055 af

**Reach F-4: F-4** Peak Depth=0.65' Max Vel=5.6 fps Inflow=4.08 cfs 0.068 af
D=18.0" n=0.013 L=24.0' S=0.0100 '/' Capacity=10.50 cfs Outflow=4.08 cfs 0.068 af

**Reach F-4A: F-4A** Peak Depth=0.72' Max Vel=5.8 fps Inflow=4.84 cfs 0.080 af
D=18.0" n=0.013 L=32.0' S=0.0100 '/' Capacity=10.50 cfs Outflow=4.84 cfs 0.080 af

**Reach F-5: F-5** Peak Depth=0.56' Max Vel=9.3 fps Inflow=5.61 cfs 0.093 af
D=18.0" n=0.013 L=200.0' S=0.0324 '/' Capacity=18.91 cfs Outflow=5.61 cfs 0.093 af

**Reach F16: F-16** Peak Depth=1.40' Max Vel=4.5 fps Inflow=14.77 cfs 0.249 af
D=36.0" n=0.013 L=290.0' S=0.0024 '/' Capacity=32.77 cfs Outflow=14.51 cfs 0.249 af

**Reach F1A: (new Reach)** Peak Depth=0.45' Max Vel=3.2 fps Inflow=1.27 cfs 0.022 af
D=15.0" n=0.013 L=24.0' S=0.0050 '/' Capacity=4.57 cfs Outflow=1.27 cfs 0.021 af

**Reach F1B: (new Reach)** Peak Depth=0.32' Max Vel=2.6 fps Inflow=0.64 cfs 0.011 af
D=15.0" n=0.013 L=32.0' S=0.0050 '/' Capacity=4.57 cfs Outflow=0.64 cfs 0.011 af

**Total Runoff Area = 15.400 ac Runoff Volume = 0.264 af Average Runoff Depth = 0.21"**

Time span=0.00-3.00 hrs, dt=0.01 hrs, 301 points
Runoff by Rational method, Rise/Fall=1.0/1.0 xTc
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment 1: 1** Runoff Area=0.250 ac Runoff Depth=0.67"
Tc=5.0 min C=0.60 Runoff=0.84 cfs 0.014 af

**Subcatchment 1A: 1A** Runoff Area=0.250 ac Runoff Depth=0.70"
Tc=0.0 min C=0.60 Runoff=0.84 cfs 0.015 af

**Subcatchment 1B: 1B** Runoff Area=0.250 ac Runoff Depth=0.67"
Tc=5.0 min C=0.60 Runoff=0.84 cfs 0.014 af

**Subcatchment 1S: (new Subcat)** Runoff Area=0.200 ac Runoff Depth=0.39"
Tc=5.0 min C=0.35 Runoff=0.39 cfs 0.007 af

**Subcatchment 2: 2** Runoff Area=0.250 ac Runoff Depth=0.67"
Tc=5.0 min C=0.60 Runoff=0.84 cfs 0.014 af

**Subcatchment 3: 3** Runoff Area=0.300 ac Runoff Depth=0.67"
Tc=5.0 min C=0.60 Runoff=1.01 cfs 0.017 af

**Subcatchment 4: 4A** Runoff Area=0.300 ac Runoff Depth=0.67"
Tc=5.0 min C=0.60 Runoff=1.01 cfs 0.017 af

**Subcatchment 4A: 4A** Runoff Area=0.300 ac Runoff Depth=0.67"
Tc=5.0 min C=0.60 Runoff=1.01 cfs 0.017 af

**Subcatchment 5: 5** Runoff Area=0.300 ac Runoff Depth=0.67"
Tc=5.0 min C=0.60 Runoff=1.01 cfs 0.017 af

**Subcatchment 18: 18** Runoff Area=0.500 ac Runoff Depth=0.31"
Tc=15.0 min C=0.35 Runoff=0.79 cfs 0.013 af

**Subcatchment 39S: (new Subcat)** Runoff Area=11.000 ac Runoff Depth=0.13"
Tc=35.0 min C=0.35 Runoff=7.43 cfs 0.123 af

**Subcatchment F6-F11: F6-F11** Runoff Area=1.500 ac Runoff Depth=0.67"
Tc=10.0 min C=0.60 Runoff=5.06 cfs 0.084 af

**Reach 2R: existing di** Peak Depth=0.10' Max Vel=8.1 fps Inflow=0.39 cfs 0.007 af
D=18.0" n=0.013 L=90.0' S=0.2024 '/' Capacity=47.26 cfs Outflow=0.39 cfs 0.007 af

**Reach 38R: F-12** Peak Depth=0.77' Max Vel=4.5 fps Inflow=5.06 cfs 0.084 af
D=24.0" n=0.013 L=128.0' S=0.0050 '/' Capacity=16.00 cfs Outflow=5.06 cfs 0.084 af

**Reach 40R: CULVERT** Peak Depth=0.69' Max Vel=9.2 fps Inflow=7.43 cfs 0.123 af
D=18.0" n=0.013 L=162.0' S=0.0260 '/' Capacity=16.95 cfs Outflow=7.26 cfs 0.123 af

**Reach F-1: (new Reach)** Peak Depth=0.54' Max Vel=4.9 fps Inflow=2.53 cfs 0.042 af
D=15.0" n=0.013 L=32.0' S=0.0100 '/' Capacity=6.46 cfs ✓Outflow=2.53 cfs 0.042 af

**Reach F-15: F-15** Peak Depth=1.57' Max Vel=5.2 fps Inflow=19.72 cfs 0.330 af
D=36.0" n=0.013 L=125.0' S=0.0030 '/' Capacity=36.29 cfs ✓Outflow=19.57 cfs 0.330 af

**Reach F-17: F-17** Peak Depth=0.59' Max Vel=18.8 fps Inflow=20.10 cfs 0.349 af
D=42.0" n=0.013 L=104.0' S=0.1057 '/' Capacity=327.06 cfs ✓Outflow=20.07 cfs 0.349 af

**Reach F-18: F-18** OUTFALL Peak Depth=1.38' Max Vel=5.7 fps Inflow=20.07 cfs 0.349 af
D=42.0" n=0.013 L=120.0' S=0.0037 '/' Capacity=60.92 cfs ✓Outflow=19.99 cfs 0.349 af

**Reach F-2: F-2** Peak Depth=0.57' Max Vel=6.2 fps Inflow=3.38 cfs 0.056 af
D=15.0" n=0.013 L=225.0' S=0.0150 '/' Capacity=7.91 cfs ✓Outflow=3.38 cfs 0.056 af

**Reach F-3: F-3** Peak Depth=0.68' Max Vel=5.7 fps Inflow=4.39 cfs 0.073 af
D=18.0" n=0.013 L=32.0' S=0.0100 '/' Capacity=10.50 cfs ✓Outflow=4.39 cfs 0.073 af

**Reach F-4: F-4** Peak Depth=0.76' Max Vel=6.0 fps Inflow=5.40 cfs 0.090 af
D=18.0" n=0.013 L=24.0' S=0.0100 '/' Capacity=10.50 cfs ✓Outflow=5.40 cfs 0.090 af

**Reach F-4A: F-4A** Peak Depth=0.85' Max Vel=6.2 fps Inflow=6.41 cfs 0.106 af
D=18.0" n=0.013 L=32.0' S=0.0100 '/' Capacity=10.50 cfs ✓Outflow=6.41 cfs 0.106 af

**Reach F-5: F-5** Peak Depth=0.65' Max Vel=10.1 fps Inflow=7.43 cfs 0.123 af
D=18.0" n=0.013 L=200.0' S=0.0324 '/' Capacity=18.91 cfs ✓Outflow=7.43 cfs 0.123 af

**Reach F16: F-16** Peak Depth=1.65' Max Vel=4.8 fps Inflow=19.57 cfs 0.330 af
D=36.0" n=0.013 L=290.0' S=0.0024 '/' Capacity=32.77 cfs ✓Outflow=19.24 cfs 0.330 af

**Reach F1A: (new Reach)** Peak Depth=0.53' Max Vel=3.4 fps Inflow=1.69 cfs 0.029 af
D=15.0" n=0.013 L=24.0' S=0.0050 '/' Capacity=4.57 cfs ✓Outflow=1.69 cfs 0.028 af

**Reach F1B: (new Reach)** Peak Depth=0.36' Max Vel=2.8 fps Inflow=0.84 cfs 0.014 af
D=15.0" n=0.013 L=32.0' S=0.0050 '/' Capacity=4.57 cfs ✓Outflow=0.84 cfs 0.014 af

**Total Runoff Area = 15.400 ac Runoff Volume = 0.349 af Average Runoff Depth = 0.27"**

AES CONSULTING ENGINEERS
5248 Olde Towne Road, Suite 1
Williamsburg, Virginia 23188
(757) 253-0040
Fax: (757) 220-8994

PROJECT FIELDSTONE PARKWAY
PROJECT NO. 9028-06
SUBJECT DRAINAGE AREAS-WEIGHTED
SHEET NO. 1 OF 1
CALCULATED BY R.D. SMITH DATE 4/6/09

RATIONAL METHOD

CULVERT #1
DRAINAGE AREA = 0.17 AC

GRASS AREA = 0.15 AC C = 0.18 0.18 × 0.15 = 0.027
IMPERVIOUS AREA = 0.02 AC C = 0.95 0.95 × 0.02 = 0.019
0.046

0.15 AC + 0.02 AC = 0.17 AC

$T_c$ = 10 MIN $C_W$ = 0.046/0.17 = 0.27
Q = CIA $I_{10}$ (CITY OF NORFOLK) = 5.9 IN/HR
Q = 0.27 · 5.9 · 0.17 = 0.27 CFS

CULVERT #2
DRAINAGE AREA = 0.16 AC

GRASS AREA = 0.15 AC C = 0.18 0.18 × 0.15 = 0.027
IMPERVIOUS AREA = 0.01 AC C = 0.95 0.95 × 0.01 = 0.010
0.037

0.15 AC + 0.01 AC = 0.16 AC

$T_c$ = 5 MIN $C_W$ = 0.037/0.16 = 0.23
Q = CIA $I_{10}$ (CITY OF NORFOLK) = 6.9 IN/HR
Q = 0.23 · 6.9 · 0.16 = 0.25 CFS

AES CONSULTING ENGINEERS
5248 Olde Towne Road, Suite 1
Williamsburg, Virginia 23188
(757) 253-0040
Fax: (757) 220-8994

PROJECT FIELDSTONE PARKWAY
PROJECT NO. 9028-06
SUBJECT DRAINAGE AREAS-WEIGHTED
SHEET NO. 1 OF 1
CALCULATED BY R.D. SMITH DATE 4/6/09

RATIONAL METHOD

CULVERT #1
DRAINAGE AREA = 0.17 AC

GRASS AREA = 0.15 AC C = 0.18 0.18 × 0.15 = 0.027
IMPERVIOUS AREA = 0.02 AC C = 0.95 0.95 × 0.02 = 0.019
0.046

0.15 AC + 0.02 AC = 0.17 AC

$T_c$ = 10 MIN $C_W$ = 0.046/0.17 = 0.27
Q = CIA $I_{10}$ (CITY OF NORFOLK) = 5.9 IN/HR
Q = 0.27 · 5.9 · 0.17 = 0.27 CFS

CULVERT #2
DRAINAGE AREA = 0.16 AC

GRASS AREA = 0.15 AC C = 0.18 0.18 × 0.15 = 0.027
IMPERVIOUS AREA = 0.01 AC C = 0.95 0.95 × 0.01 = 0.010
0.037

0.15 AC + 0.01 AC = 0.16 AC

$T_c$ = 5 MIN $C_W$ = 0.037/0.16 = 0.23
Q = CIA $I_{10}$ (CITY OF NORFOLK) = 6.9 IN/HR
Q = 0.23 · 6.9 · 0.16 = 0.25 CFS

PROJECT: FIELD STONE PARKWAY
STONEHOUSE COMMUNITY

STATION: _____

SHEET 1 OF 2

# CULVERT DESIGN FORM

DESIGNER / DATE: R. SMITH / 4/6/01

REVIEWER / DATE: _____ / _____

## HYDROLOGICAL DATA

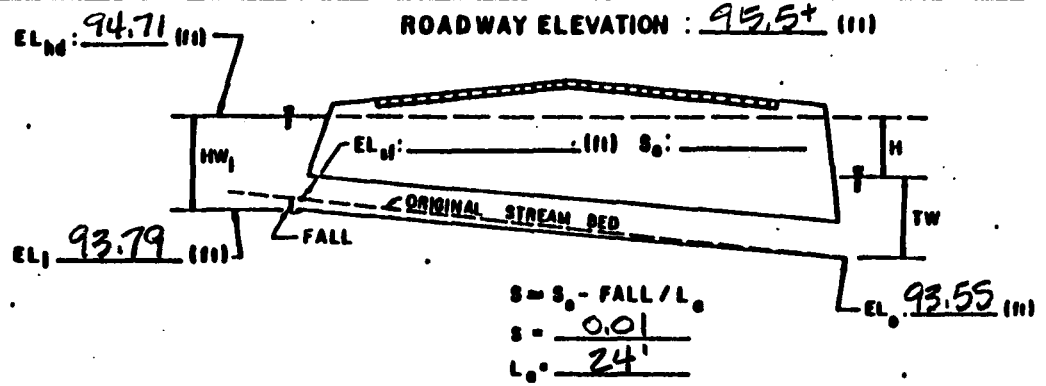
SEE ADD'L. SHTS.

- ☐ METHOD: RATIONAL
- ☐ DRAINAGE AREA: 0.17 ☐ STREAM SLOPE: 19%
- ☐ CHANNEL SHAPE: V-DITCH
- ☐ ROUTING: _____ ☐ OTHER: _____

### DESIGN FLOWS/TAILWATER

| R.I. (YEARS) | FLOW (cfs) | TW (ft) |
|---|---|---|
| 10 | 0.27 | |
| | | |

ROADWAY ELEVATION: 95.5+ (ft)




$S = S_o - FALL / L_o$

$S = 0.01$

$L_o = 24'$

| CULVERT DESCRIPTION: MATERIAL - SHAPE - SIZE - ENTRANCE | TOTAL FLOW Q (cfs) | FLOW PER BARREL Q/N (1) | HEADWATER CALCULATIONS: INLET CONTROL HW_i/D (2) | HW_i | FALL (3) | EL_hi (4) | OUTLET CONTROL TW (5) | d_c | (d_c+D)/2 | h_o (6) | h_o | H (7) | EL_ho (8) | CONTROL HEADWATER ELEVATION | OUTLET VELOCITY | COMMENTS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RCP-CIR-12"Ø-PROJ. | 0.27 | 0.27 | 0.58 | 0.92 | Ø | 94.94 | 0.8 | 0.4 | 0.7 | 0.8 | 0.2 | 0.4 | 94.75 | 94.94 | 2.3 | INLET CONTROL |
| | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |

### TECHNICAL FOOTNOTES:

(1) USE Q/NB FOR BOX CULVERTS

(2) $HW_i/D = HW/D$ OR $HW_i/D$ FROM DESIGN CHARTS

(3) $FALL = HW_i - (EL_{hd} - EL_{tf})$; FALL IS ZERO FOR CULVERTS ON GRADE

(4) $EL_{hi} = HW_i + EL_i$ (INVERT OF INLET CONTROL SECTION)

(5) TW BASED ON DOWN STREAM CONTROL OR FLOW DEPTH IN CHANNEL.

(6) $h_o = TW$ or $(d_c + D/2)$ (WHICHEVER IS GREATER)

(7) $H = \left[1 + h_o + (29n^2 L)/R^{1.33}\right] V^2/2g$

(8) $EL_{ho} = EL_o + H + h_o$

### SUBSCRIPT DEFINITIONS:

a. APPROXIMATE
f CULVERT FACE
hd. DESIGN HEADWATER
hi. HEADWATER IN INLET CONTROL
ho HEADWATER IN OUTLET CONTROL
i INLET CONTROL SECTION
o. OUTLET
sf STREAMBED AT CULVERT FACE
tw. TAILWATER

### COMMENTS / DISCUSSION:

### CULVERT BARREL SELECTED:

SIZE: _____

SHAPE: _____

MATERIAL: _____

ENTRANCE: _____

PROJECT: FIELDSTONE PARKWAY
STONE HOUSE - PARKWAY

STATION: _____

SHEET 2 OF 2

**CULVERT DESIGN FORM**

DESIGNER / DATE: R. SMITH / 4/6/01

REVIEWER / DATE: _____ / _____

## HYDROLOGICAL DATA

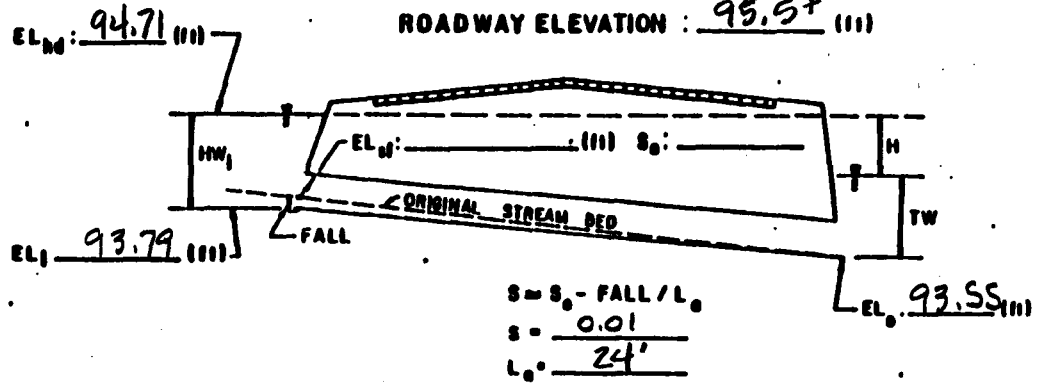
SEE ADD'L. SHTS.

- ☐ METHOD: RATIONAL
- ☐ DRAINAGE AREA: 0.16 ☐ STREAM SLOPE: 19%
- ☐ CHANNEL SHAPE: V-DITCH
- ☐ ROUTING: _____ ☐ OTHER: _____

### DESIGN FLOWS/TAILWATER

| R.I. (YEARS) | FLOW (cfs) | TW (ft) |
|---|---|---|
| 10 | 0.25 | |
| | | |

ROADWAY ELEVATION: 95.5+ (ii)




$S = S_o - FALL / L_o$

$S = 0.01$

$L_o = 24'$

| CULVERT DESCRIPTION: MATERIAL - SHAPE - SIZE - ENTRANCE | TOTAL FLOW Q (cfs) | FLOW PER BARREL Q/N (1) | HEADWATER CALCULATIONS: INLET CONTROL HW_i/D (2) | HW_i | FALL (3) | EL_hi (4) | OUTLET CONTROL TW (5) | d_c | (d_c+D)/2 | h_o (6) | h_o | H (7) | EL_ho (8) | CONTROL HEADWATER ELEVATION | OUTLET VELOCITY | COMMENTS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RCP-CIR-12"Ø-PROJ | 0.25 | 0.25 | 0.58 | 0.92 | Ø | 94.94 | 0.8 | 0.4 | 0.7 | 0.8 | 0.2 | 0.4 | 94.75 | 94.94 | 2.3 | INLET CONTROL |
| | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |

### TECHNICAL FOOTNOTES:

(1) USE Q/NB FOR BOX CULVERTS

(2) $HW_i/D = HW/D$ OR $HW_i/D$ FROM DESIGN CHARTS

(3) $FALL = HW_i - (EL_{hd} - EL_{sf})$; FALL IS ZERO FOR CULVERTS ON GRADE

(4) $EL_{hi} = HW_i + EL_i$ (INVERT OF INLET CONTROL SECTION)

(5) TW BASED ON DOWN STREAM CONTROL OR FLOW DEPTH IN CHANNEL.

(6) $h_o$ = TW or $(d_c + D/2)$ (WHICHEVER IS GREATER)

(7) $H = \left[1 + h_o + (29n^2 L)/R^{1.33}\right] V^2/2g$

(8) $EL_{ho} = EL_o + H + h_o$

### SUBSCRIPT DEFINITIONS:

a. APPROXIMATE
f CULVERT FACE
hd. DESIGN HEADWATER
hi. HEADWATER IN INLET CONTROL
ho HEADWATER IN OUTLET CONTROL
i INLET CONTROL SECTION
o. OUTLET
sf STREAMBED AT CULVERT FACE
tw. TAILWATER

### COMMENTS / DISCUSSION:

### CULVERT BARREL SELECTED:

SIZE: _____

SHAPE: _____

MATERIAL: _____

ENTRANCE: _____

PROJECT: FIELD STONE PARKWAY
STONEHOUSE COMMUNITY

STATION: _____

SHEET 1 OF 2

# CULVERT DESIGN FORM

DESIGNER / DATE: R. SMITH / 4/6/01

REVIEWER / DATE: _____ / _____

## HYDROLOGICAL DATA

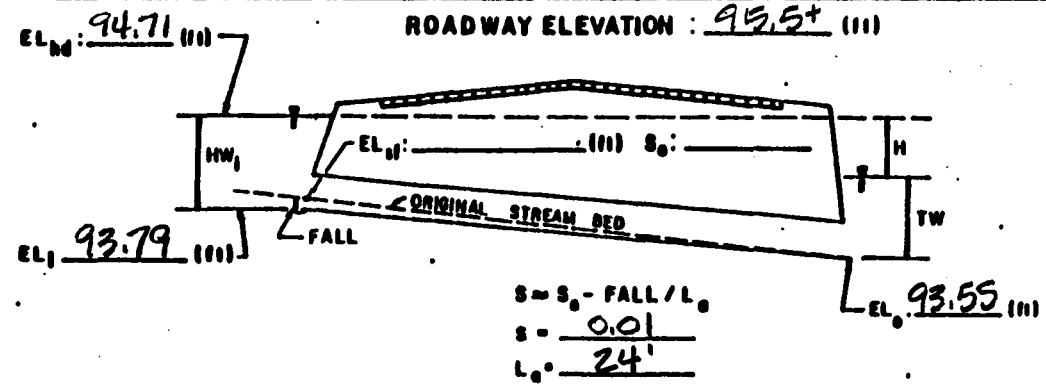
SEE ADD'L. SHTS.

- ☐ METHOD: RATIONAL
- ☐ DRAINAGE AREA: 0.17 ☐ STREAM SLOPE: 19%
- ☐ CHANNEL SHAPE: V-DITCH
- ☐ ROUTING: _____ ☐ OTHER: _____

### DESIGN FLOWS/TAILWATER

| R.I. (YEARS) | FLOW (cfs) | TW (ft) |
|---|---|---|
| 10 | 0.27 | |
| | | |

ROADWAY ELEVATION: 95.5+ (ft)




$S = S_o - FALL / L_o$

$S = 0.01$

$L_o = 24'$

| CULVERT DESCRIPTION: MATERIAL - SHAPE - SIZE - ENTRANCE | TOTAL FLOW Q (cfs) | FLOW PER BARREL Q/N (1) | HEADWATER CALCULATIONS: INLET CONTROL HW_i/D (2) | HW_i | FALL (3) | EL_hi (4) | OUTLET CONTROL TW (5) | d_c | (d_c+D)/2 | h_o (6) | h_o | H (7) | EL_ho (8) | CONTROL HEADWATER ELEVATION | OUTLET VELOCITY | COMMENTS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RCP-CIR-12"Ø-PROJ. | 0.27 | 0.27 | 0.58 | 0.92 | Ø | 94.94 | 0.8 | 0.4 | 0.7 | 0.8 | 0.2 | 0.4 | 94.75 | 94.94 | 2.3 | INLET CONTROL |
| | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |

### TECHNICAL FOOTNOTES:

(1) USE Q/NB FOR BOX CULVERTS

(2) $HW_i/D = HW/D$ OR $HW_i/D$ FROM DESIGN CHARTS

(3) $FALL = HW_i - (EL_{hd} - EL_{tf})$; FALL IS ZERO FOR CULVERTS ON GRADE

(4) $EL_{hi} = HW_i + EL_i$ (INVERT OF INLET CONTROL SECTION)

(5) TW BASED ON DOWN STREAM CONTROL OR FLOW DEPTH IN CHANNEL.

(6) $h_o = TW$ or $(d_c + D/2)$ (WHICHEVER IS GREATER)

(7) $H = \left[1 + h_o + (29n^2 L)/R^{1.33}\right] V^2/2g$

(8) $EL_{ho} = EL_o + H + h_o$

### SUBSCRIPT DEFINITIONS:

- a. APPROXIMATE
- f CULVERT FACE
- hd. DESIGN HEADWATER
- hi. HEADWATER IN INLET CONTROL
- ho HEADWATER IN OUTLET CONTROL
- i INLET CONTROL SECTION
- o. OUTLET
- tf STREAMBED AT CULVERT FACE
- tw. TAILWATER

### COMMENTS / DISCUSSION:

### CULVERT BARREL SELECTED:

SIZE: _____

SHAPE: _____

MATERIAL: _____

ENTRANCE: _____

PROJECT: FIELDSTONE PARKWAY
STONE HOUSE - PARKWAY

STATION: _____

SHEET 2 OF 2

# CULVERT DESIGN FORM

DESIGNER / DATE: R. SMITH / 4/6/01

REVIEWER / DATE: _____ / _____

## HYDROLOGICAL DATA

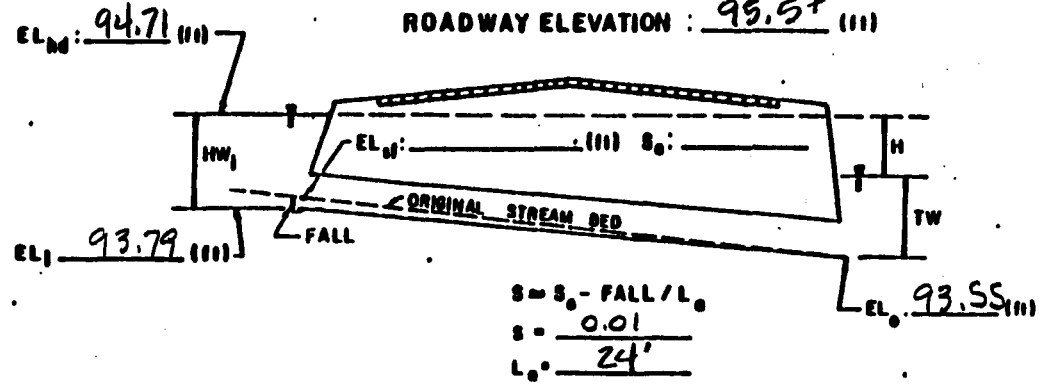
SEE ADD'L. SHTS.

- ☐ METHOD: RATIONAL
- ☐ DRAINAGE AREA: 0.16 ☐ STREAM SLOPE: 19%
- ☐ CHANNEL SHAPE: V-DITCH
- ☐ ROUTING: _____ ☐ OTHER: _____

### DESIGN FLOWS/TAILWATER

| R.I. (YEARS) | FLOW (cfs) | TW (ft) |
|---|---|---|
| 10 | 0.25 | |
| | | |

ROADWAY ELEVATION: 95.57 (ft)




$S = S_o - FALL / L_o$

$S =$ 0.01

$L_o =$ 24'

| CULVERT DESCRIPTION: MATERIAL - SHAPE - SIZE - ENTRANCE | TOTAL FLOW Q (cfs) | FLOW PER BARREL Q/N (1) | HEADWATER CALCULATIONS: INLET CONTROL $HW_i/D$ (2) | $HW_i$ | FALL (3) | $EL_{hi}$ (4) | OUTLET CONTROL TW (5) | $d_c$ | $\frac{d_c+D}{2}$ | $h_o$ (6) | $h_e$ | H (7) | $EL_{ho}$ (8) | CONTROL HEADWATER ELEVATION | OUTLET VELOCITY | COMMENTS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RCP - CIR - 12" Ø - PROJ | 0.25 | 0.25 | 0.58 | 0.92 | Ø | 94.94 | 0.8 | 0.4 | 0.7 | 0.8 | 0.2 | 0.4 | 94.75 | 94.94 | 2.3 | INLET CONTROL |
| | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |

### TECHNICAL FOOTNOTES:

(1) USE Q/NB FOR BOX CULVERTS

(2) $HW_i/D$ = HW /D OR $HW_i/D$ FROM DESIGN CHARTS

(3) FALL = $HW_i - (EL_{hd} - EL_{of})$; FALL IS ZERO FOR CULVERTS ON GRADE

(4) $EL_{hi} = HW_i + EL_i$ (INVERT OF INLET CONTROL SECTION)

(5) TW BASED ON DOWN STREAM CONTROL OR FLOW DEPTH IN CHANNEL.

(6) $h_o$ = TW or $(d_c + D/2)$ (WHICHEVER IS GREATER)

(7) $H = \left[1 + h_o + (29n^2 L)/R^{1.33}\right] V^2/2g$

(8) $EL_{ho} = EL_o + H + h_o$

### SUBSCRIPT DEFINITIONS:

a. APPROXIMATE
f CULVERT FACE
hd. DESIGN HEADWATER
hi. HEADWATER IN INLET CONTROL
ho HEADWATER IN OUTLET CONTROL
i INLET CONTROL SECTION
o. OUTLET
of STREAMBED AT CULVERT FACE
tw. TAILWATER

### COMMENTS / DISCUSSION:

### CULVERT BARREL SELECTED:

SIZE: _____

SHAPE: _____

MATERIAL: _____

ENTRANCE: _____

LD-229
July 2000

STORM SEWER DESIGN
COMPUTATIONS

ROUTE: MAR, 12, 2005 PROJ: STONHOUSE GLEN SECTION II
COUNTY: DISTRICT:
DESCRIPTION:
SHEET ____ OF ____

| | FROM POINT (1) | TO POINT (2) | AREA DRAIN "A" ACRES (3) | RUN-OFF COEF. C (4) | CA INCREMENT (5) | CA ACCUMULATED (6) | INLET TIME MINUTES (7) | RAIN FALL IN./HR. (8) | RUN-OFF Q C.F.S. (9) | INVERT ELEVATIONS UPPER END (10) | INVERT ELEVATIONS LOWER END (11) | LENGTH FT. (12) | SLOPE FT./FT. (13) | DIA. IN. (14) | CAPACITY C.F.S. (15) | VEL. F.P.S. (16) | FLOW TIME MINUTES INCREMENT (17) | FLOW TIME MINUTES ACCUMULATED (17) | REMARKS (18) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ✓ | 30 | 29 | 0.35 | 0.84 | – | 0.29 | 10 | 6.0 | 1.74 | 92.04 | 91.16 | 177' | 0.005 | 15" | 4.57 | 3.47 | 0.85 | – | |
| ✓ | 29 | 28 | 0.25 | 0.53 | 0.13 | 0.42 | 10.85 | 5.86 | 2.46 | 91.06 | 89.28 | 355' | 0.005 | 15" | 4.57 | 3.79 | 1.56 | 2.41 | |
| ✓ | 28 | 27 | 0.05 | 0.9 | 0.05 | 0.48 | 12.41 | 5.70 | 2.74 | 89.18 | 89.02 | 32' | 0.005 | 15" | 4.57 | 3.89 | 0.14 | 2.55 | |
| ✓ | 27 | 26 | 0.04 | 0.89 | 0.04 | 0.52 | 12.55 | 5.61 | 2.92 | 88.92 | 88.33 | 118' | 0.005 | 15" | 4.57 | 3.95 | 0.50 | 3.05 | |
| ✓ | 26 | 25 | 0.12 | 0.56 | 0.07 | 0.59 | 13.05 | 5.49 | 3.24 | 88.23 | 87.74 | 98' | 0.005 | 15" | 4.57 | 4.04 | 0.40 | 3.45 | |
| ✓ | 25 | 24 | 0.31 | 0.69 | 0.21 | 0.80 | 13.45 | 5.41 | 4.32 | 87.64 | 87.15 | 92' | 0.0053 | 15" | 4.70 | 4.35 | 0.35 | 3.80 | |
| ✓ | 24A | 24 | 0.22 | 0.82 | – | 0.18 | 10 | 6.0 | 1.08 | 88.40 | 87.15 | 32' | 0.039 | 15" | 12.76 | 6.33 | 0.08 | – | |
| | | | | | | | | | | | | | | | | | | | |
| ✓ | 24D | 24C | 0.47 | 0.55 | – | 0.26 | 10 | 6.0 | 1.56 | 90.25 | 86.95 | 40' | 0.0825 | 15" | 18.55 | 9.19 | 0.07 | – | |
| ✓ | 24C | 24B | 0.21 | 0.72 | 0.15 | 0.41 | 10.07 | 5.99 | 2.46 | 86.85 | 85.82 | 79' | 0.0130 | 15" | 7.36 | 5.40 | 0.24 | 0.31 | |
| ✓ | 24B | 24 | 0.21 | 0.40 | 0.08 | 0.49 | 10.31 | 5.95 | 2.92 | 85.72 | 85.46 | 51' | 0.0050 | 15" | 4.57 | 3.95 | 0.22 | 0.53 | |
| | | | | | | | | | | | | | | | | | | | |
| ✓ | 24 | 23 | 0.28 | 0.45 | 0.13 | 1.60 | 13.80 | 5.34 | 8.54 | 85.36 | 82.58 | 139' | 0.020 | 15" | 9.14 | 8.46 | 0.27 | 4.15 | |
| ✓ | 23 | 22 | – | – | – | – | – | – | 8.54 | 80.08 | 78.00 | 87' | 0.024 | 15' | 10.01 | 9.16 | 0.16 | 4.31 | |

# Worksheet
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | 30 to 29 |
| Flow Element | Circular Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Slope | 0.005000 | ft/ft |
| Diameter | 15 | in |
| Discharge | 1.74 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.53 | ft |
| Flow Area | 0.5 | ft² |
| Wetted Perimeter | 1.78 | ft |
| Top Width | 1.24 | ft |
| Critical Depth | 0.52 | ft |
| Percent Full | 42.8 | % |
| Critical Slope | 0.005391 | ft/ft |
| Velocity | 3.47 | ft/s |
| Velocity Head | 0.19 | ft |
| Specific Energy | 0.72 | ft |
| Froude Number | 0.96 | |
| Maximum Discharg | 4.91 | cfs |
| Discharge Full | 4.57 | cfs |
| Slope Full | 0.000726 | ft/ft |
| Flow Type | Subcritical | |

# Worksheet
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | 29 to 28 |
| Flow Element | Circular Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Slope | 0.005000 | ft/ft |
| Diameter | 15 | in |
| Discharge | 2.46 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.65 | ft |
| Flow Area | 0.6 | ft² |
| Wetted Perimeter | 2.02 | ft |
| Top Width | 1.25 | ft |
| Critical Depth | 0.63 | ft |
| Percent Full | 52.3 | % |
| Critical Slope | 0.005713 | ft/ft |
| Velocity | 3.79 | ft/s |
| Velocity Head | 0.22 | ft |
| Specific Energy | 0.88 | ft |
| Froude Number | 0.93 | |
| Maximum Discharg | 4.91 | cfs |
| Discharge Full | 4.57 | cfs |
| Slope Full | 0.001450 | ft/ft |
| Flow Type | Subcritical | |

# Worksheet
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | 28 to 27 |
| Flow Element | Circular Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Slope | 0.005000 | ft/ft |
| Diameter | 15 | in |
| Discharge | 2.74 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.70 | ft |
| Flow Area | 0.7 | ft² |
| Wetted Perimeter | 2.11 | ft |
| Top Width | 1.24 | ft |
| Critical Depth | 0.66 | ft |
| Percent Full | 55.8 | % |
| Critical Slope | 0.005867 | ft/ft |
| Velocity | 3.89 | ft/s |
| Velocity Head | 0.24 | ft |
| Specific Energy | 0.93 | ft |
| Froude Number | 0.91 | |
| Maximum Discharg | 4.91 | cfs |
| Discharge Full | 4.57 | cfs |
| Slope Full | 0.001799 | ft/ft |
| Flow Type | Subcritical | |

# Worksheet
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | 27 to 26 |
| Flow Element | Circular Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Slope | 0.005000 | ft/ft |
| Diameter | 15 | in |
| Discharge | 2.92 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.73 | ft |
| Flow Area | 0.7 | ft² |
| Wetted Perimeter | 2.17 | ft |
| Top Width | 1.23 | ft |
| Critical Depth | 0.69 | ft |
| Percent Full | 58.1 | % |
| Critical Slope | 0.005973 | ft/ft |
| Velocity | 3.95 | ft/s |
| Velocity Head | 0.24 | ft |
| Specific Energy | 0.97 | ft |
| Froude Number | 0.90 | |
| Maximum Discharg | 4.91 | cfs |
| Discharge Full | 4.57 | cfs |
| Slope Full | 0.002044 | ft/ft |
| Flow Type | Subcritical | |

# Worksheet
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | 26 to 25 |
| Flow Element | Circular Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Slope | 0.005000 | ft/ft |
| Diameter | 15 | in |
| Discharge | 3.24 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.78 | ft |
| Flow Area | 0.8 | ft² |
| Wetted Perimeter | 2.27 | ft |
| Top Width | 1.21 | ft |
| Critical Depth | 0.73 | ft |
| Percent Full | 62.2 | % |
| Critical Slope | 0.006185 | ft/ft |
| Velocity | 4.04 | ft/s |
| Velocity Head | 0.25 | ft |
| Specific Energy | 1.03 | ft |
| Froude Number | 0.88 | |
| Maximum Discharg | 4.91 | cfs |
| Discharge Full | 4.57 | cfs |
| Slope Full | 0.002516 | ft/ft |
| Flow Type | Subcritical | |

# Worksheet
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | 25 to 24 |
| Flow Element | Circular Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Slope | 0.005300 | ft/ft |
| Diameter | 15 | in |
| Discharge | 4.32 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.94 | ft |
| Flow Area | 1.0 | $ft^2$ |
| Wetted Perimeter | 2.63 | ft |
| Top Width | 1.08 | ft |
| Critical Depth | 0.84 | ft |
| Percent Full | 75.5 | % |
| Critical Slope | 0.007071 | ft/ft |
| Velocity | 4.35 | ft/s |
| Velocity Head | 0.29 | ft |
| Specific Energy | 1.24 | ft |
| Froude Number | 0.80 | |
| Maximum Discharg | 5.06 | cfs |
| Discharge Full | 4.70 | cfs |
| Slope Full | 0.004473 | ft/ft |
| Flow Type | Subcritical | |

# Worksheet
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | 24A to 24 |
| Flow Element | Circular Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Slope | 0.039000 | ft/ft |
| Diameter | 15 | in |
| Discharge | 1.08 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.25 | ft |
| Flow Area | 0.2 | ft² |
| Wetted Perimeter | 1.15 | ft |
| Top Width | 0.99 | ft |
| Critical Depth | 0.41 | ft |
| Percent Full | 19.7 | % |
| Critical Slope | 0.005226 | ft/ft |
| Velocity | 6.33 | ft/s |
| Velocity Head | 0.62 | ft |
| Specific Energy | 0.87 | ft |
| Froude Number | 2.69 | |
| Maximum Discharg | 13.72 | cfs |
| Discharge Full | 12.76 | cfs |
| Slope Full | 0.000280 | ft/ft |
| Flow Type | Supercritical | |

# Worksheet
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | 24D to 24C |
| Flow Element | Circular Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Slope | 0.082500 | ft/ft |
| Diameter | 15 | in |
| Discharge | 1.56 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.25 | ft |
| Flow Area | 0.2 | ft² |
| Wetted Perimeter | 1.15 | ft |
| Top Width | 0.99 | ft |
| Critical Depth | 0.49 | ft |
| Percent Full | 19.6 | % |
| Critical Slope | 0.005337 | ft/ft |
| Velocity | 9.19 | ft/s |
| Velocity Head | 1.31 | ft |
| Specific Energy | 1.56 | ft |
| Froude Number | 3.92 | |
| Maximum Discharg | 19.96 | cfs |
| Discharge Full | 18.55 | cfs |
| Slope Full | 0.000583 | ft/ft |
| Flow Type | Supercritical | |

# Worksheet
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | 24C to 24B |
| Flow Element | Circular Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Slope | 0.013000 | ft/ft |
| Diameter | 15 | in |
| Discharge | 2.46 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.50 | ft |
| Flow Area | 0.5 | ft² |
| Wetted Perimeter | 1.71 | ft |
| Top Width | 1.22 | ft |
| Critical Depth | 0.63 | ft |
| Percent Full | 39.8 | % |
| Critical Slope | 0.005713 | ft/ft |
| Velocity | 5.40 | ft/s |
| Velocity Head | 0.45 | ft |
| Specific Energy | 0.95 | ft |
| Froude Number | 1.56 | |
| Maximum Discharg | 7.92 | cfs |
| Discharge Full | 7.36 | cfs |
| Slope Full | 0.001450 | ft/ft |
| Flow Type | Supercritical | |

# Worksheet
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | 24B to 24 |
| Flow Element | Circular Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Slope | 0.005000 | ft/ft |
| Diameter | 15 | in |
| Discharge | 2.92 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.73 | ft |
| Flow Area | 0.7 | ft² |
| Wetted Perimeter | 2.17 | ft |
| Top Width | 1.23 | ft |
| Critical Depth | 0.69 | ft |
| Percent Full | 58.1 | % |
| Critical Slope | 0.005973 | ft/ft |
| Velocity | 3.95 | ft/s |
| Velocity Head | 0.24 | ft |
| Specific Energy | 0.97 | ft |
| Froude Number | 0.90 | |
| Maximum Discharg | 4.91 | cfs |
| Discharge Full | 4.57 | cfs |
| Slope Full | 0.002044 | ft/ft |
| Flow Type | Subcritical | |

# Worksheet
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | 24 to 23 |
| Flow Element | Circular Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Slope | 0.020000 | ft/ft |
| Diameter | 15 | in |
| Discharge | 8.54 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.96 | ft |
| Flow Area | 1.0 | ft² |
| Wetted Perimeter | 2.67 | ft |
| Top Width | 1.06 | ft |
| Critical Depth | 1.14 | ft |
| Percent Full | 76.7 | % |
| Critical Slope | 0.015256 | ft/ft |
| Velocity | 8.46 | ft/s |
| Velocity Head | 1.11 | ft |
| Specific Energy | 2.07 | ft |
| Froude Number | 1.53 | |
| Maximum Discharg | 9.83 | cfs |
| Discharge Full | 9.14 | cfs |
| Slope Full | 0.017479 | ft/ft |
| Flow Type | Supercritical | |

# Worksheet
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | 23 to 22 |
| Flow Element | Circular Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.013 | |
| Slope | 0.024000 | ft/ft |
| Diameter | 15 | in |
| Discharge | 8.54 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.89 | ft |
| Flow Area | 0.9 | ft² |
| Wetted Perimeter | 2.51 | ft |
| Top Width | 1.13 | ft |
| Critical Depth | 1.14 | ft |
| Percent Full | 71.0 | % |
| Critical Slope | 0.015256 | ft/ft |
| Velocity | 9.16 | ft/s |
| Velocity Head | 1.30 | ft |
| Specific Energy | 2.19 | ft |
| Froude Number | 1.78 | |
| Maximum Discharg | 10.76 | cfs |
| Discharge Full | 10.01 | cfs |
| Slope Full | 0.017479 | ft/ft |
| Flow Type | Supercritical | |

PROJECT 2002261-504.04
HEC12 Version: V2.91 Run Date: 11-29-2004

==========

INLET NUMBER 30 LENGTH 6.0 STATION

DRAINAGE AREA = 0.120 ACRES C VALUE = .810 CA = 0.097
DRAINAGE AREA = 0.230 ACRES C VALUE = .850 CA = 0.196

FOR THE FIRST SIDE
SUM CA= 0.097 INT= 4.00 CFS= 0.389 CO= 0.000 GUTTER FLOW= 0.389
FOR THE OTHER SIDE
SUM CA= 0.196 INT= 4.00 CFS= 0.782 CO= 0.000 GUTTER FLOW= 0.782
AT THE INLET

SUM CA= 0.293 INT= 4.00 CFS= 1.171 CO= 0.000 GUTTER FLOW= 1.171

GUTTER SLOPE = 0.0040 FT/FT PAVEMENT CROSS SLOPE = 0.0208 FT/FT

SPREAD AT A SLOPE OF .004 (ft./ft.) AND 0.78 (cfs) IS 5.86 (ft.)

XXXXXXXXXX CURB INLET IN A SUMP XXXXXXXXXX
P EFFEC. LENGTH (ft) = 9.60 H (ft) = 0.385
DEPTH OF WATER (ft) = 0.14 SPREAD (ft) = 6.78

PROJECT 2002261-504.04
HEC12 Version: V2.91 Run Date: 11-29-2004

==========

INLET NUMBER 29 LENGTH 4.0 STATION

DRAINAGE AREA = 0.250 ACRES C VALUE = .530 CA = 0.132
SUM CA= 0.132 INT= 4.00 CFS= 0.530 CO= 0.000 GUTTER FLOW= 0.530

GUTTER SLOPE = 0.0050 FT/FT PAVEMENT CROSS SLOPE = 0.0208 FT/FT

| SPREAD | W | W/T | SW | SW/SX | Eo | a | S'W | SE |
|---|---|---|---|---|---|---|---|---|
| 4.18 | 2.0 | 0.48 | 0.0833 | 4.0 | 0.94 | 3.5 | 0.146 | 0.158 |

XXXXXXXXXX CURB INLET ON A CONTINUOUS GRADE XXXXXXXXXX
REQUIRED LENGTH (ft) = 3.5 EFFICIENCY= 1.00
CFS INTERCEPTED= 0.53 CFS CARRYOVER= 0.00

PROJECT 2002261-504.04
HEC12 Version: V2.91 Run Date: 11-29-2004

==========

INLET NUMBER 28 LENGTH 2.5 STATION

DRAINAGE AREA = 0.050 ACRES C VALUE = .900 CA = 0.045
SUM CA= 0.045 INT= 4.00 CFS= 0.180 CO= 0.000 GUTTER FLOW= 0.180

GUTTER SLOPE = 0.0075 FT/FT PAVEMENT CROSS SLOPE = 0.0208 FT/FT

| SPREAD | W | W/T | SW | SW/SX | Eo | a | S'W | SE |
|---|---|---|---|---|---|---|---|---|
| 1.52 | 2.0 | 1.31 | 0.0833 | 4.0 | 1.00 | 3.5 | 0.146 | 0.167 |

XXXXXXXXXX CURB INLET ON A CONTINUOUS GRADE XXXXXXXXXX
REQUIRED LENGTH (ft) = 2.7 EFFICIENCY= 0.99
CFS INTERCEPTED= 0.18 CFS CARRYOVER= 0.00

PROJECT 2002261-504.04
HEC12 Version: V2.91 Run Date: 11-29-2004

==========

INLET NUMBER 27 LENGTH 2.5 STATION

DRAINAGE AREA = 0.040 ACRES C VALUE = .890 CA = 0.036
SUM CA= 0.036 INT= 4.00 CFS= 0.142 CO= 0.000 GUTTER FLOW= 0.142

GUTTER SLOPE = 0.0075 FT/FT PAVEMENT CROSS SLOPE = 0.0208 FT/FT

| SPREAD | W | W/T | SW | SW/SX | Eo | a | S'W | SE |
|---|---|---|---|---|---|---|---|---|
| 1.47 | 2.0 | 1.36 | 0.0833 | 4.0 | 1.00 | 3.5 | 0.146 | 0.167 |

XXXXXXXXXX CURB INLET ON A CONTINUOUS GRADE XXXXXXXXXX
REQUIRED LENGTH (ft) = 2.2 EFFICIENCY= 1.00
CFS INTERCEPTED= 0.14 CFS CARRYOVER= 0.00

PROJECT 2002261-504.04
HEC12 Version: V2.91 Run Date: 11-29-2004

==========

INLET NUMBER 26 LENGTH 4.0 STATION

DRAINAGE AREA = 0.120 ACRES C VALUE = .530 CA = 0.064
SUM CA= 0.064 INT= 4.00 CFS= 0.254 CO= 0.000 GUTTER FLOW= 0.254

GUTTER SLOPE = 0.0100 FT/FT PAVEMENT CROSS SLOPE = 0.0208 FT/FT

| SPREAD | W | W/T | SW | SW/SX | Eo | a | S'W | SE |
|---|---|---|---|---|---|---|---|---|
| 1.73 | 2.0 | 1.16 | 0.0833 | 4.0 | 1.00 | 3.5 | 0.146 | 0.167 |

XXXXXXXXXX CURB INLET ON A CONTINUOUS GRADE XXXXXXXXXX
REQUIRED LENGTH (ft) = 3.1 EFFICIENCY= 1.00
CFS INTERCEPTED= 0.25 CFS CARRYOVER= 0.00

PROJECT 2002261-504.04
HEC12 Version: V2.91 Run Date: 11-29-2004

==========

INLET NUMBER 25 LENGTH 6.0 STATION

DRAINAGE AREA = 0.310 ACRES C VALUE = .690 CA = 0.214
SUM CA= 0.214 INT= 4.00 CFS= 0.856 CO= 0.000 GUTTER FLOW= 0.856

GUTTER SLOPE = 0.0094 FT/FT PAVEMENT CROSS SLOPE = 0.0208 FT/FT

| SPREAD | W | W/T | SW | SW/SX | Eo | a | S'W | SE |
|---|---|---|---|---|---|---|---|---|
| 4.24 | 2.0 | 0.47 | 0.0833 | 4.0 | 0.93 | 3.5 | 0.146 | 0.157 |

XXXXXXXXXX CURB INLET ON A CONTINUOUS GRADE XXXXXXXXXX
REQUIRED LENGTH (ft) = 5.7 EFFICIENCY= 1.00
CFS INTERCEPTED= 0.86 CFS CARRYOVER= 0.00

PROJECT 2002261-504.04
HEC12 Version: V2.91 Run Date: 11-29-2004

==========

INLET NUMBER 24A LENGTH 6.0 STATION

DRAINAGE AREA = 0.100 ACRES C VALUE = .790 CA = 0.079
DRAINAGE AREA = 0.120 ACRES C VALUE = .850 CA = 0.102

FOR THE FIRST SIDE
SUM CA= 0.079 INT= 4.00 CFS= 0.316 CO= 0.000 GUTTER FLOW= 0.316
FOR THE OTHER SIDE
SUM CA= 0.102 INT= 4.00 CFS= 0.408 CO= 0.000 GUTTER FLOW= 0.408
AT THE INLET

SUM CA= 0.181 INT= 4.00 CFS= 0.724 CO= 0.000 GUTTER FLOW= 0.724

GUTTER SLOPE = 0.0040 FT/FT PAVEMENT CROSS SLOPE = 0.0208 FT/FT

SPREAD AT A SLOPE OF .004 (ft./ft.) AND 0.41 (cfs) IS 3.69 (ft.)

XXXXXXXXXX CURB INLET IN A SUMP XXXXXXXXXX
P EFFEC. LENGTH (ft) = 9.60 H (ft) = 0.385
DEPTH OF WATER (ft) = 0.10 SPREAD (ft) = 4.92

PROJECT 2002261-504.04
HEC12 Version: V2.91 Run Date: 11-29-2004

==========

INLET NUMBER 24D LENGTH 6.0 STATION

DRAINAGE AREA = 0.260 ACRES C VALUE = .550 CA = 0.143
DRAINAGE AREA = 0.210 ACRES C VALUE = .550 CA = 0.115

FOR THE FIRST SIDE
SUM CA= 0.143 INT= 4.00 CFS= 0.572 CO= 0.000 GUTTER FLOW= 0.572
FOR THE OTHER SIDE
SUM CA= 0.115 INT= 4.00 CFS= 0.462 CO= 0.000 GUTTER FLOW= 0.462
AT THE INLET

SUM CA= 0.258 INT= 4.00 CFS= 1.034 CO= 0.000 GUTTER FLOW= 1.034

GUTTER SLOPE = 0.0040 FT/FT PAVEMENT CROSS SLOPE = 0.0208 FT/FT

SPREAD AT A SLOPE OF .004 (ft./ft.) AND 0.57 (cfs) IS 4.32 (ft.)

XXXXXXXXXX CURB INLET IN A SUMP XXXXXXXXXX
P EFFEC. LENGTH (ft) = 9.60 H (ft) = 0.458
DEPTH OF WATER (ft) = 0.13 SPREAD (ft) = 6.24

PROJECT 2002261-504.04
HEC12 Version: V2.91 Run Date: 11-29-2004

==========

INLET NUMBER 24C LENGTH 2.5 STATION

DRAINAGE AREA = 0.040 ACRES C VALUE = .760 CA = 0.030
DRAINAGE AREA = 0.170 ACRES C VALUE = .710 CA = 0.121

FOR THE FIRST SIDE
SUM CA= 0.030 INT= 4.00 CFS= 0.122 CO= 0.000 GUTTER FLOW= 0.122
FOR THE OTHER SIDE
SUM CA= 0.121 INT= 4.00 CFS= 0.483 CO= 0.000 GUTTER FLOW= 0.483
AT THE INLET

SUM CA= 0.151 INT= 4.00 CFS= 0.604 CO= 0.000 GUTTER FLOW= 0.604

GUTTER SLOPE = 0.0040 FT/FT PAVEMENT CROSS SLOPE = 0.0208 FT/FT

SPREAD AT A SLOPE OF .004 (ft./ft.) AND 0.48 (cfs) IS 4.24 (ft.)

XXXXXXXXXX CURB INLET IN A SUMP XXXXXXXXXX
P EFFEC. LENGTH (ft) = 6.10 H (ft) = 0.385
DEPTH OF WATER (ft) = 0.12 SPREAD (ft) = 5.90

PROJECT 2002261-504.04
HEC12 Version: V2.91 Run Date: 11-29-2004

==========

INLET NUMBER 24B LENGTH 4.0 STATION

DRAINAGE AREA = 0.210 ACRES C VALUE = .400 CA = 0.084
SUM CA= 0.084 INT= 4.00 CFS= 0.336 CO= 0.000 GUTTER FLOW= 0.336

GUTTER SLOPE = 0.0052 FT/FT PAVEMENT CROSS SLOPE = 0.0208 FT/FT

| SPREAD | W | W/T | SW | SW/SX | Eo | a | S'W | SE |
|---|---|---|---|---|---|---|---|---|
| 2.66 | 2.0 | 0.75 | 0.0833 | 4.0 | 1.00 | 3.5 | 0.146 | 0.166 |

XXXXXXXXXX CURB INLET ON A CONTINUOUS GRADE XXXXXXXXXX
REQUIRED LENGTH (ft) = 2.9 EFFICIENCY= 1.00
CFS INTERCEPTED= 0.34 CFS CARRYOVER= 0.00

PROJECT 2002261-504.04
HEC12 Version: V2.91 Run Date: 11-29-2004

==========

INLET NUMBER 24 LENGTH 2.5 STATION

DRAINAGE AREA = 0.170 ACRES C VALUE = .450 CA = 0.076
DRAINAGE AREA = 0.110 ACRES C VALUE = .450 CA = 0.049

FOR THE FIRST SIDE
SUM CA= 0.076 INT= 4.00 CFS= 0.306 CO= 0.000 GUTTER FLOW= 0.306
FOR THE OTHER SIDE
SUM CA= 0.049 INT= 4.00 CFS= 0.198 CO= 0.000 GUTTER FLOW= 0.198
AT THE INLET

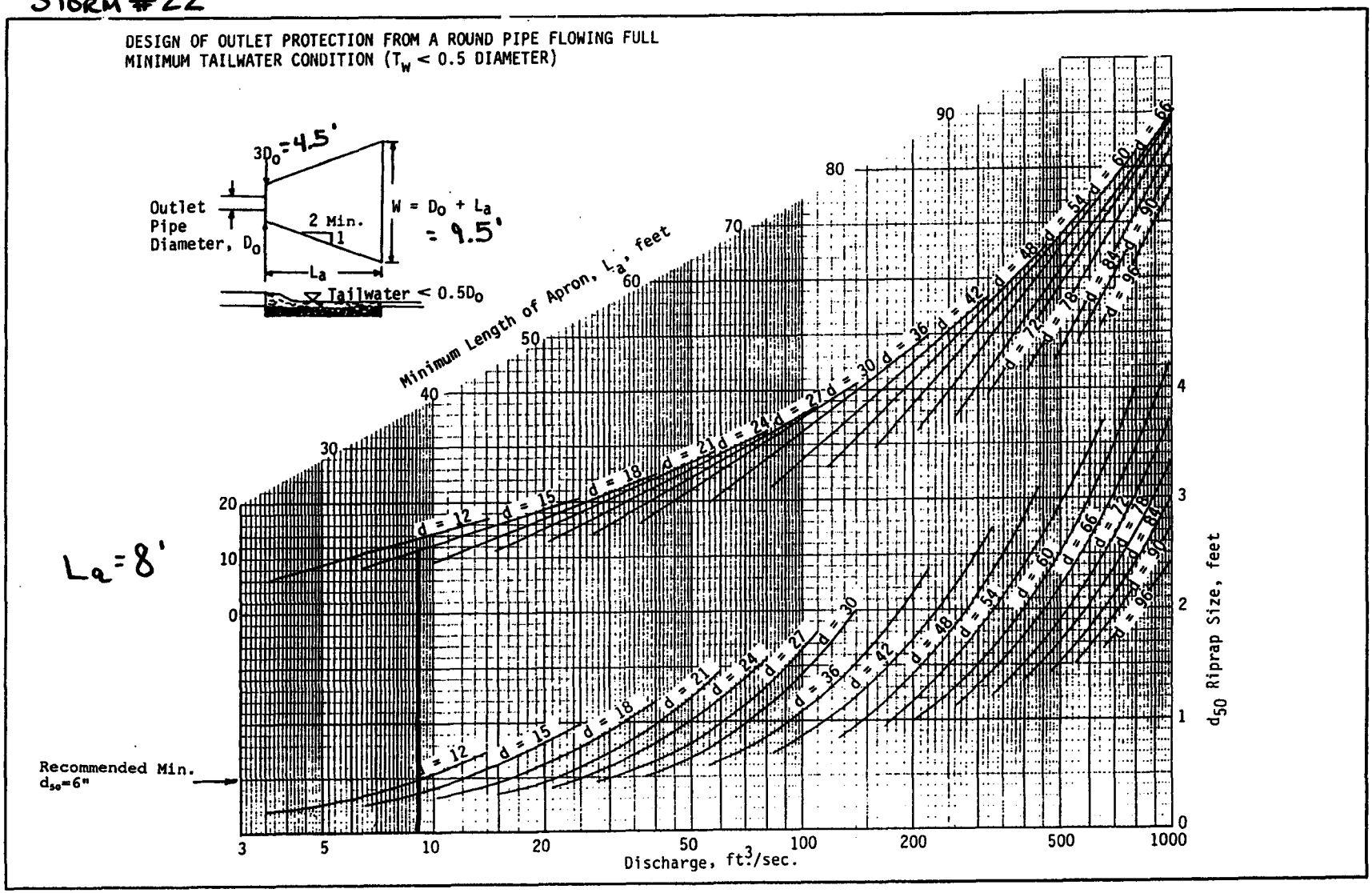
SUM CA= 0.126 INT= 4.00 CFS= 0.504 CO= 0.000 GUTTER FLOW= 0.504

GUTTER SLOPE = 0.0010 FT/FT PAVEMENT CROSS SLOPE = 0.0208 FT/FT

SPREAD AT A SLOPE OF .001 (ft./ft.) AND 0.31 (cfs) IS 5.02 (ft.)

XXXXXXXXXX CURB INLET IN A SUMP XXXXXXXXXX
P EFFEC. LENGTH (ft) = 6.10 H (ft) = 0.385
DEPTH OF WATER (ft) = 0.11 SPREAD (ft) = 5.23

STORM #22


DESIGN OF OUTLET PROTECTION FROM A ROUND PIPE FLOWING FULL
MINIMUM TAILWATER CONDITION ($T_W$ < 0.5 DIAMETER)
$3D_o$ = 4.5'
Outlet Pipe Diameter, $D_o$
2 Min. 1
$W = D_o + L_a$ = 9.5'
$L_a$
Tailwater < $0.5D_o$
Minimum Length of Apron, $L_a$, feet
$L_a$ = 8'
Recommended Min. $d_{50}$=6"
Discharge, $ft^3$/sec.
$d_{50}$ Riprap Size, feet
d = 12
d = 15
d = 18
d = 21
d = 24
d = 27
d = 30
d = 36
d = 42
d = 48
d = 54
d = 60
d = 66
d = 72
d = 78
d = 84
d = 90
d = 96

# ROAD PAVEMENT CALCULATIONS

# Appendix IV

## Flexible Pavement Design Worksheet for New Subdivision Streets

This sheet is intended for use and submission in conjunction with VDOT's Subdivision Street Requirements

| | | | |
|---|---|---|---|
| County | JAMES CITY COUNTY | Date: 12/29/03 | |
| Subdivision | STONEHOUSE GLEN SECTION 2 | | |
| Street Name | STONEHOUSE GLEN | | |
| Developer | STONEHOUSE AT WILLIAMSBURG, K McDermott | (Phone: 908-234-2620 x 27 | |

| | |
|---|---|
| ADT | Projected traffic for the street segment considered, as defined in the Subdivision Street Requirements. |
| $CBR_D$ | Design CBR = Average of $CBR_T$ x 2/3 and modified only as discussed in the Pavement Design Guide. |
| $CBR_T$ | CBR value of the subgrade sample, taken and tested as specified in the Pavement Design Guide |
| DME | VDOT District Materials Engineer |
| EPT | Equivalent projected traffic |
| HCV | Number of Heavy Commercial Vehicles (e.g. trucks, buses, etc., with 2 or more axles and 6 or more tires). |
| %HCV | Percentage of the total traffic volume composed of Heavy Commercial Vehicles. |
| RF | Resiliency Factor = Relative value of the subgrade soil's ability to withstand repeated loading. |
| SSV | Soil support value of subgrade (SSV = $CBR_D$ x RF) |
| $D_P$ | Thickness index of proposed pavement design computed by the Conventional Pavement Design Method |
| $D_R$ | Thickness index required, based on Design ADT and SSV, determined by Appendix II. |

### Step 1: Determine Design ADT

| ADT | |
|---|---|
| %HCV = 100 x HCV x ADT) / 20 x HCV (or) Note: For %HCV ≤ 5%, use ADT | Note: For %HCV>5%, EPT>ADT |
| Design ADT<br>Use greater of ADT or EPT | 1600 |

### Step 2: Determine Design Values CBR, RF, and SSV

| Sample | $DBR_T$ |
|---|---|
| # 1 | |
| # 2 | |
| # 3 | |
| # | |
| # | |
| # | |

| Resiliency Factor | (RF) |
|---|---|
| Source | Value |
| Table 1 | |
| Appendix I | 3 |
| DME approved RF | |

For preliminary designs, use the lowest RF value in the equation

| $CBR_D$ | x | RF | = | SSV |
|---|---|---|---|---|
| (6) | x | (3) | = | 18 |

### Step 3: Pavement Design (Check appropriate box and show proposed pavement design below.)

☐ (A) Limited to Design ADT ≤ 400 - Show pavement material notations and thickness from Appendix IV Tables A and B.

☑ (B) Show pavement section as developed in the Pavement Design Guide. $D_R$ = 14.5 from Appendix II
(See Appendix III for material notations and thickness equivalency values (a)).

### Description of Proposed Pavement Section

| | Material Notation | Thickness, h | a | (a x h) |
|---|---|---|---|---|
| Surface | SM 9.5 A | 2 | 2.25 | 4.5 |
| Base | BM - 25 37.5 | 3 | 2.15 | 6.45 |
| Subbase | TYPE I SIZE 21B | 8 | 0.5 | 4.0 |

$D_P$ must equal or exceed the value of $D_R$. $D_P = \Sigma(a \times h)$ = 14.95

# Appendix IV

**Flexible Pavement Design Worksheet for New Subdivision Streets**

This sheet is intended for use and submission in conjunction with VDOT's Subdivision Street Requirements

| | | | |
|---|---|---|---|
| County | JAMES CITY COUNTY | Date: 12/29/03 | |
| Subdivision | STONEHOUSE GLEN | | |
| Street Name | CROOKSHAW & NEWLAND COURTS | | |
| Developer | STONEHOUSE AT WILLIAMSBURG | Phone: 208-234-2620 x | |

| | |
|---|---|
| ADT | Projected traffic for the street segment considered, as defined in the Subdivision Street Requirements. |
| $CBR_D$ | Design CBR = Average of $CBR_T$ x 2/3 and modified only as discussed in the Pavement Design Guide. |
| $CBR_T$ | CBR value of the subgrade sample, taken and tested as specified in the Pavement Design Guide |
| DME | VDOT District Materials Engineer |
| EPT | Equivalent projected traffic |
| HCV | Number of Heavy Commercial Vehicles (e.g. trucks, buses, etc., with 2 or more axles and 6 or more tires). |
| %HCV | Percentage of the total traffic volume composed of Heavy Commercial Vehicles. |
| RF | Resiliency Factor = Relative value of the subgrade soil's ability to withstand repeated loading. |
| SSV | Soil support value of subgrade (SSV = $CBR_D$ x RF) |
| $D_P$ | Thickness index of proposed pavement design computed by the Conventional Pavement Design Method |
| $D_R$ | Thickness index required, based on Design ADT and SSV, determined by Appendix II. |

**Step 1: Determine Design ADT**

| | |
|---|---|
| ADT | 760 |
| %HCV = 100 x HCV x ADT)<br>or<br>20 x HCV<br>Note: For %HCV ≤ 5%, use ADT | Note: For %HCV>5%, EPT>ADT |
| Design ADT<br>Use greater of ADT or EPT | 760 |

**Step 2: Determine Design Values CBR, RF, and SSV**

| Sample | $DBR_T$ |
|---|---|
| # 1 | |
| # 2 | |
| # 3 | |
| # | |
| # | |
| # | |

| Resiliency Factor | (RF) |
|---|---|
| Source | Value |
| Table 1 | |
| Appendix I | 3 |
| DME approved RF | |

For preliminary designs, use the lowest RF value in the equation

| $CBR_D$ | x | RF | = | SSV |
|---|---|---|---|---|
| (6) | x | (3) | = | 18 |

**Step 3: Pavement Design** (Check appropriate box and show proposed pavement design below.)

☐ (A) Limited to Design ADT ≤ 400 - Show pavement material notations and thickness from Appendix IV Tables A and B.

☐ (B) Show pavement section as developed in the Pavement Design Guide. **$D_R$ =** 12 from Appendix II
(See Appendix III for material notations and thickness equivalency values (a)).

**Description of Proposed Pavement Section**

| | Material Notation | Thickness, h | a | (a x h) |
|---|---|---|---|---|
| Surface | SM 9.5A | 1.5 | 2.25 | 3.375 |
| Base | BM 25 37.5 | 3 | 2.15 | 6.45 |
| Subbase | TYPE I SIZE 21B | 6 | 0.5 | 3.0 |

$D_P$ must equal or exceed the value of $D_R$. $D_P = \Sigma(a \times h) =$ 12.2

# SEWER AND WATER DATA SHEETS

# WATER DATA SHEET

Date: 07/07/05

1. Project Name: Stonehouse Glen Subdivision Section II
2. Project Location: Fieldstone Parkway Extension
3. Engineer: LandMark Design Group
4. Source of Water: JCSA W-25

[a]5. Design Population (Number and Type of Dwellings): 62 Single Family

5a. Industrial: _____ 5b: Domestic: 12.92 gpm

5c. Fire Flow: 1,000 gpm 5d. Pressure Maximum: 64.35 (J-21 – Avg) psi

Minimum: 31.28 psi

5e. Computed Design Flow (Fire + Max. Day Domestic): 1,021.96 gpm avail @ 31.28 (J-20) psi

5f. Computed Flow (Fire + Max. Day Domestic) Available: [b]2,857, [c]4,142 gpm @ 20 psi

5g. Computed Max. Hour Domestic Demand: 51.67 gpm avail @ 52.31 (J-18) psi

5h. Actual Fire Flow Available: 5,600+/- gpm @ 20 psi Hydrant No. (W-25)

6. Water Distribution System Piping:

| Pipe Diameter (Inches) | Length (Feet) | Material (DI, PVC, etc.) |
|---|---|---|
| 4" | 133 | DI |
| 4" | 1150 | PVC |
| 8" | 2670 | PVC |
| 6" | 66 | DI |
| | | |
| | | |

[a] Information for Section 5 of this water data sheet taken from approved water analysis titled Fieldstone Parkway Extension and Stonehouse Glen Subdivision Water System Design and Analysis Revised Dated April 28, 2004

[b] Shows available fire flow in Stonehouse Development Area I

[c] Shows available fire flow at Stonehouse Commerce Park

7. Water Meter Assemblies: 5/8" (Size), 62 (Number)

_____ (Size), _____ (Number)

_____ (Size), _____ (Number)

_____ (Size), _____ (Number)

8. Number of Hydrants Required: 5

Fire Department Approval (County use only):

Approved by:_____ Date:_____

## SANITARY SEWER SYSTEM DATA SHEET

Date: 03/15/05 Revised 05/11/05

1. Project Name: Stonehouse Glen Subdivision Section II

2. Project Location: Fieldstone Parkway Extension

3. Engineer: LandMark Design Group

4. Sanitary Sewer System: JCSA force main to HRSD

5. Design Population (Number and Type of Dwellings): 62 Single Family

5a: Industrial: _____ 5b: Domestic: 12.92 gpm

5c: Other: _____ 5d: Total Average Flow: 12.92 gpm

6. Sanitary Sewer System Piping: 5e: Total Peak Flow: 32.29 gpm

| Pipe Diameter (Inches) | Piping System (Gravity or Force Main) | Length (Feet) | Material (DI, PVC, etc.) |
|---|---|---|---|
| 6" laterals | G | 194 | PVC |
| 2" | FM | 625 | PVC |
| 8" | G | 2195 | PVC |
| 8" | G | 1805 | DI |

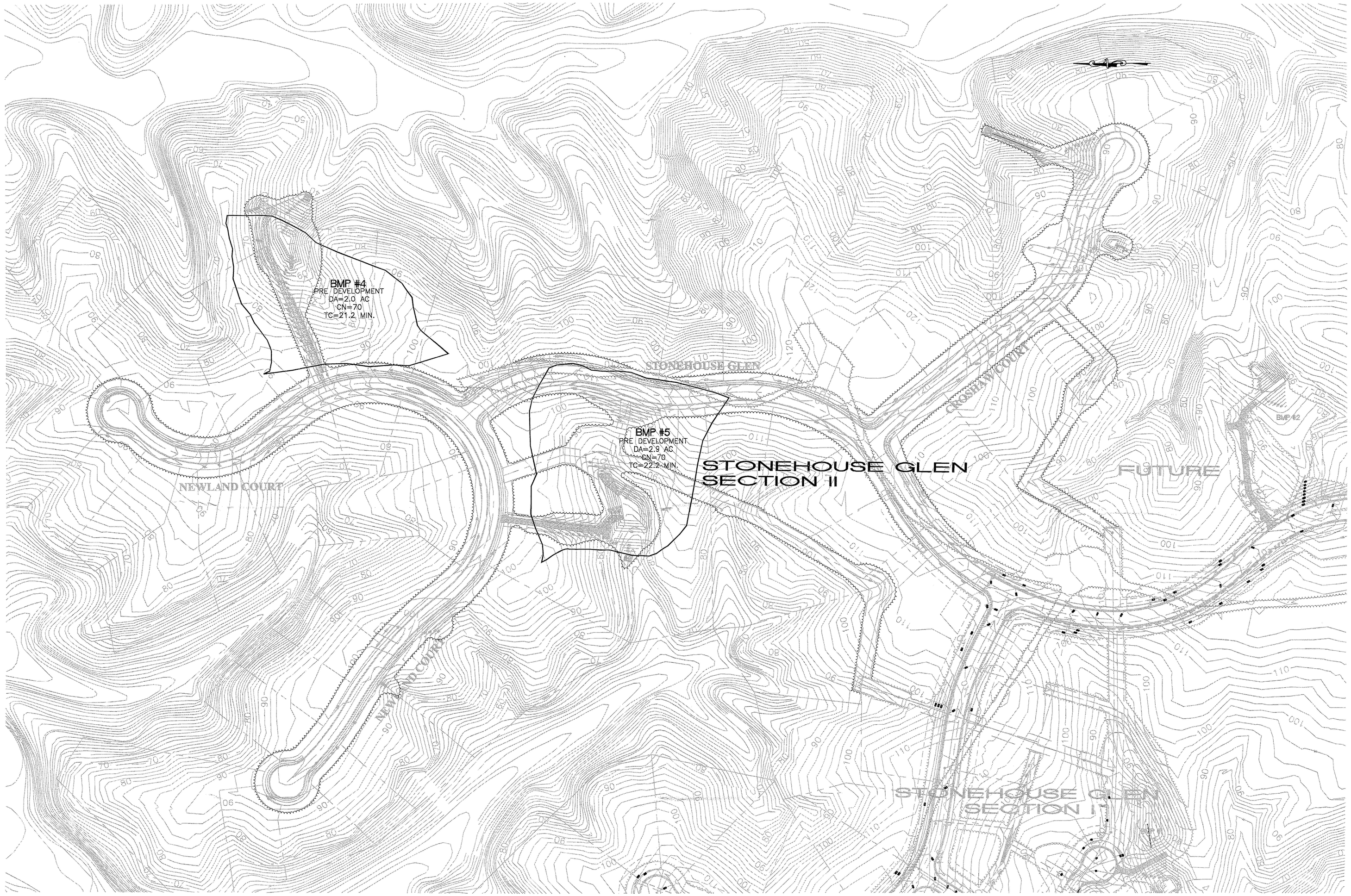
7. Sanitary Sewer Manholes:

Standard Manholes: 25, Average Depth: 10.53'

Watertight Manholes: _____, Average Depth: _____

Drop Manholes: 1, Average Depth: 19.74'

# DRAINAGE AREA MAPS




GRAPHIC SCALE

0 100 200 400

( IN FEET )
1 inch = 100ft.

COMMONWEALTH OF VIRGINIA
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| REVISIONS: | | | |
|---|---|---|---|
| No. | Date | Comment | By |
| | | | |

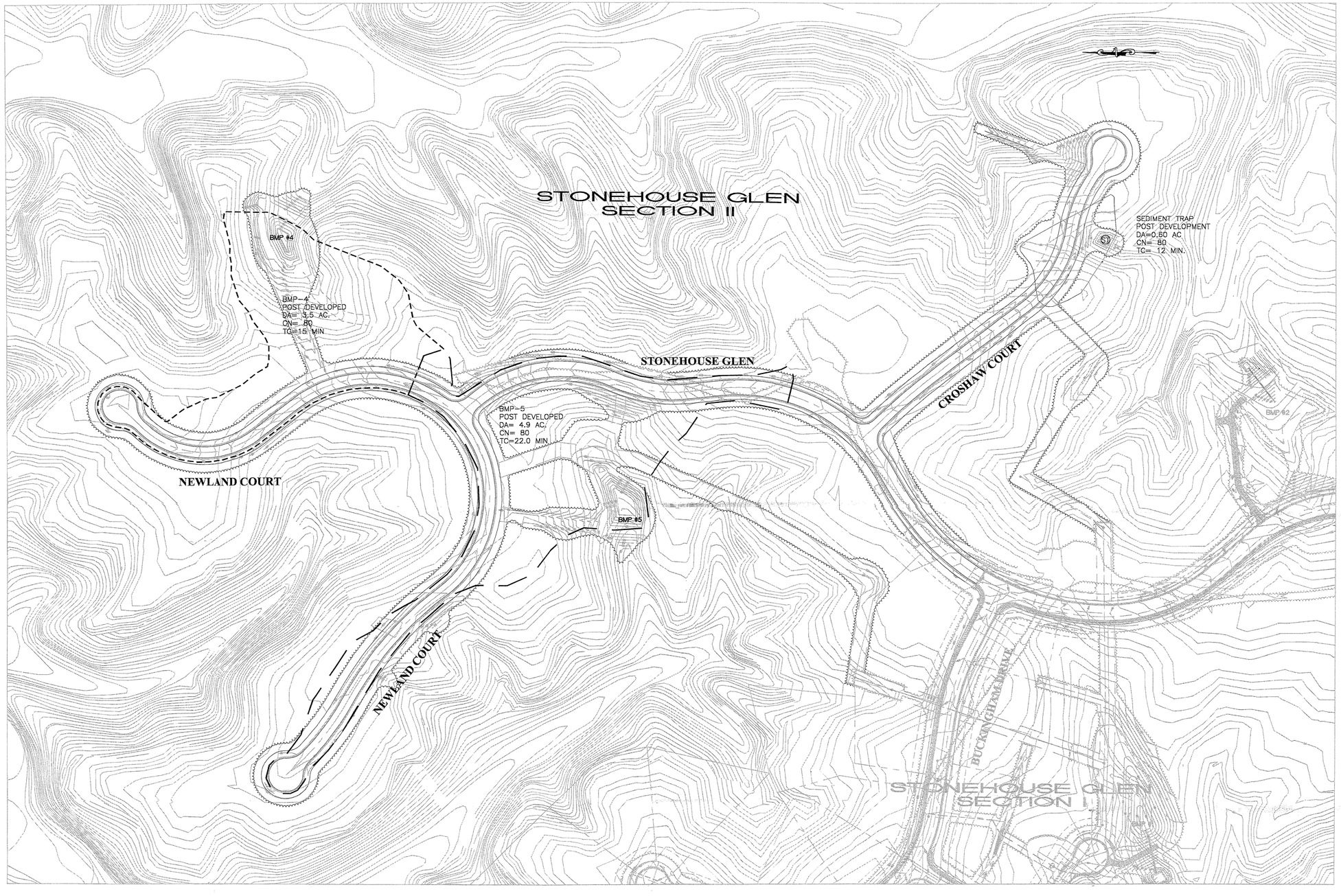
DRAWING STATUS
- Interoffice Review
- Client for Review
- Pre Approval Bidding

COUNTY APPROVAL
- 1st Submittal
- 2nd Submittal
- 3rd Submittal
- Approved

# PRE-DEVELOPMENT DRAINAGE
## STONEHOUSE GLEN
### SECTION II
### STONEHOUSE AT WILLIAMSBURG, L.L.C.

JAMES CITY COUNTY VIRGINIA

| | |
|---|---|
| Designed: LMDG | Date: 12/17/04 |
| Checked: CRO | Scale: 1"=100' |
| File Mgr./Drawn: LMDG | CADD File name: DA-1.dwg |
| Project Number: 2002261-504.04 | Dwg. File No.: |
| Drawing Number: DA-1 OF | |




GRAPHIC SCALE

0 100 200 400

( IN FEET )
1 inch = 100ft.

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|---|---|---|---|
| No. | Date | Comment | By |

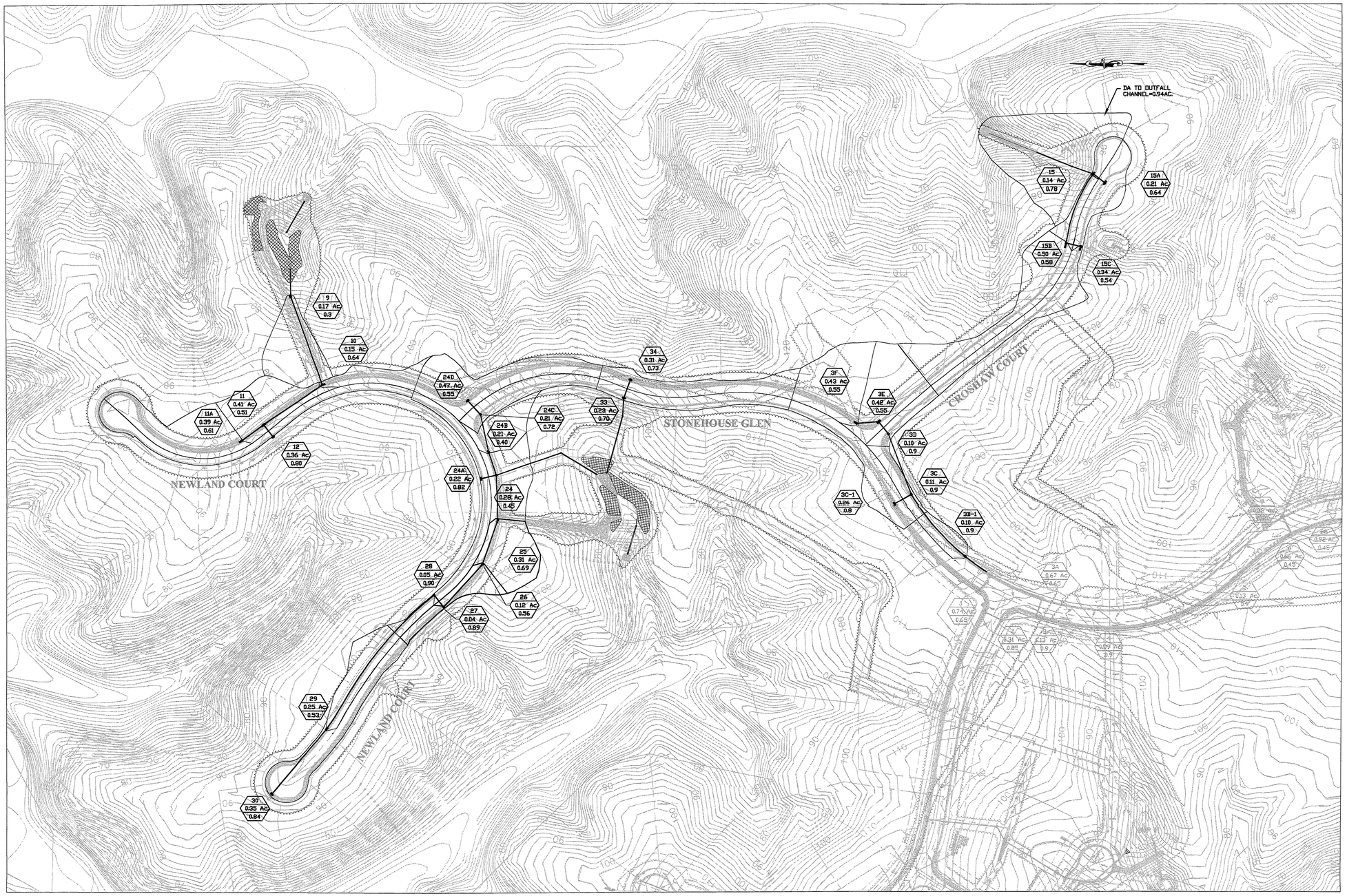
DRAWING STATUS
- Interdiv. Review
- Client for Review
- Pre Approval Bidding

COUNTY APPROVAL
- 1st Submittal
- 2nd Submittal
- 3rd Submittal
- Approved

# POST DEVELOPMENT DRAINAGE
## STONEHOUSE GLEN SECTION II
STONEHOUSE AT WILLIAMSBURG, L.L.C.

JAMES CITY COUNTY VIRGINIA

| | |
|---|---|
| Designed: LMDG | Date: 12/17/04 |
| Checked: AJR | Scale: 1"=100' |
| File Mgr./Drawn: LMDG | CADD File name: DA-POST.dwg |
| Project Number: 2002261-504.04 | Dwg. File No.: |
| Drawing Number: DA-2 | |




STRUCTURE NUMBER XX
DRAINAGE AREA X.XX Ac
WEIGHTED RUNOFF COEFFICIENT X.XX

GRAPHIC SCALE
0 100 200 400
( IN FEET )
1 inch = 100ft.

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| REVISIONS: | | | |
|---|---|---|---|
| No. | Date | Comment | By |

DRAWING STATUS
- Interdiffce Review
- Client for Review
- Pre Approval Bidding

COUNTY APPROVAL
- 1st Submittal
- 2nd Submittal
- 3rd Submittal
- Approved

# STRUCTURE DRAINAGE AREA
# STONEHOUSE GLEN
## SECTION II
## STONEHOUSE AT WILLIAMSBURG, L.L.C.

JAMES CITY COUNTY VIRGINIA

| | |
|---|---|
| Designed: LMDG | Date: 12/28/04 |
| Checked: AJR | Scale: 1"=100' |
| File Mgr./Drawn: LMDG | CADD File name: DA-POST.dwg |
| Project Number: 2002261-504.04 | Dwg. File No.: |
| Drawing Number 3 OF 3 | DA-3 |

Supporting Engineering Documents

# *Stonehouse Glen BMP Outfall Repair*

Toano, Virginia

Prepared for **Vista Venture**
**Contact: Mr. Ken McDermott**
P.O. BOX 61
Gladstone, NJ 07934

Prepared by Piotr Swietuchowski, PE /**Vanasse Hangen Brustlin, Inc.**
Transportation, Land Development, Environmental Services
351 McLaws Circle, Suite 3
Williamsburg, VA 23185-6316
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Lic. No. 044606
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Environmental Division
JUN 29 2012
RECEIVED

PLANNING DIVISION
JUN 26 2012
RECEIVED

06/22/2012

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STILLING BASIN SIZING CALCULATIONS ..... 41

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# PROJECT NARRATIVE

# Project Narrative

**Project Description:**

The purpose of this project is repair of the outfall and receiving channel downstream from an existing BMP WC-092. Based on the field observation the BMP outfall has sustained damage resulting in erosion of receiving channel.

The project proposes installation of stilling basin designed to dissipate energy from BMP outfall for full range of design storm events. In addition an upgrade to the receiving channel, that includes series of step-pool, has been proposed to safely convey runoff from existing BMP to the stable and relatively flat portion of the natural drainage way.

**Existing Site Conditions:**

The project area is 0.14 Ac in size and approximately 0.10 Ac of the site will be disturbed as a part of this project. The site has been previously developed as a part of the Storehouse Glen Development.
The proposed repairs are located within the Chesapeake Bay Preservation Area (CBPA) as defined in the James City County Chesapeake Bay Preservation Ordinance. The repairs will encroach into the RPA Buffer and Corps of Engineers Jurisdictional Wetlands within the property. The impact to those critical parts of the Chesapeake Bay preservations areas has been kept to minimum required to complete proposed repairs. Slopes vary from moderately steep to very steep with elevations ranging from a low of 53.0+ feet to a high of 86.0+ feet. Existing and proposed site elevations, grading and additional details are shown on the attached site plan drawings.

**Demolition:**

The demolition will include removal of the existing outfall protection RipRap. In addition a few existing trees will need to be removed in order to facilitate proposed grading.

**Proposed grading:**

Proposed grading is associated with installation of stilling basin, series of step pools and modifications to the receiving channel side slopes. Existing and proposed site elevations and grading are shown on the attached site plan drawings.

**Drainage:**

The site drains to an existing drainage waterway/channel. The purpose of the proposed modifications is to improve hydraulic characteristics of the channel and prevent future erosion.

**Offsite Disturbed Area:**

No offsite disturbance is anticipated with this project.

**Soils:**

The soils located on site are described and classified in the Soil Survey of James City and York Counties and the City of Williamsburg Virginia (Hodges *et al.*, 1985). Soil mapping units located within the project area are displayed in the plan set. Detailed descriptions of soil mapping units within the RMA impact areas are listed below.

10C - Craven Fine Sandy Loam, 6% to 10%

The Craven soils are moderately well drained.
Typically, the surface layer is dark grayish brown fine sandy loam. The subsurface layer is pale olive fine sandy loam. The sub soil is yellowish brown clay in the upper part and yellowish brown sandy clay loam with gray mottled in the middle and lower parts. The substratum is brownish yellow fine loam mottled with gray in the upper part and gray loamy fine sand mottled with yellow in the lower part.
The shrink/swell potential for the Craven soils are low to moderate. The erosion factor "K" is from 0.32 to 0.37. Craven soils are in Hydrologic Group "C".

11C - Craven-Uchee Complex, 6% to 10% slopes

The Craven soils are moderately well drained and the Uchee soils are well drained. Typically, the surface layer or the Craven soils are dark grayish brown fine sandy loam. The subsurface layer is pale olive sandy loam. The subsoil is a yellowish brown clay in the upper part with yellowish brown sandy clay loam mottled with gray in the middle and lower parts. The substratum is brownish yellow fine sandy loam mottled with gray in the upper part and gray loamy fine sand with yellow mottles in the lower part.
Typically, the surface layer of the Uchee soil are dark grayish brown loamy fine sand. The subsurface layer is light yellowish brown and very pale brown loamy fine sand. The subsurface layer is light yellowish brown and very pale brown loamy fine sand. The subsoil is strong brown sandy clay loam in the upper part and strong brown sandy clay loam and clay mottled with gray and red in the lower part. The substratum is variegated red, brown and gray stratified sandy loam and sandy clay loam.
The shrink/swell potential for the Craven and Uchee soils are low to moderate. The erosion factor "K" is from 0.32 to 0.37 for the Craven soil and 0.20 to 0.28 for the Uchee

soil. Craven soils are in hydrologic soils, Group "C", Uchee soils are in hydrologic soils Group "A".

15F - Emporia Complex, 25% to 50% slopes

The Emporia soil is well drained.
Typically, the surface layer is dark grayish brown fine sandy loam. The subsurface layer is pale brown loam. The subsoil is yellowish brown loam with mostly strong brown mottles in the upper part; yellowish brown, firm sandy loam with strong brown and gray mottles in the middle part; and mottled gray and brown, firm sandy clay loam in the lower part. The substratum is variegated gray, brown and red firm sandy clay loam. The shrink/swell potential for the Emporia soils are low to moderate. The erosion factor "K" is from 0.20 to 0.28. Emporia soils are in hydrologic group "C".

**Critical Erosion Areas:**

Areas with Craven-Uchee and Emporia Complex soils shall be monitored due to the high erodiability factor. All disturbed slopes 3:1 or steeper will receive erosion control blanket matting. Contractor will monitor site condition on daily basis and take all necessary precautions to secure and prevent erosion and sediment disposition.

**Erosion and Sediment Control Measures**

The erosion and sediment control measures will include: outlet protection, check dam, tree protection, silt fence and super silt fence. All disturbed slopes 3:1 or steeper will receive erosion control blanket matting.

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 and Sediment Control Handbook, Third edition dated 1992.

**Structural Practices:**

1. Temporary Construction Entrance (3.02): Construction entrance will be installed to prevent tracking onto the existing roadway.

2. Silt Fence (3.05): Silt fence and silt fence with wire support shall be installed along the toe of all slopes and all other areas that may carry silt beyond the site. Silt fence shall also be installed on the downhill side of the utility extensions.

3. Outlet Protection (3.18): Will be utilized at all outfall points using Class I Riprap.

4. Rock Check Dam (3.20): Install rock check dams in ditches where shown on the plans.

5. Permanent Seeding (3.32): Permanent seeding shall be applied to all disturbed areas on the site once final grades have been established.

6. Slope Stabilization Blankets & Matting (3.36): All ditches shall be lined with treatment 1 matting (VDOT EC-2). All slopes steeper than 3:1 shall be treated with treatment 1 matting (VDOT EC-2) or as otherwise noted on the plans.

7. Tree Protection (3.38): Tree protection shall be installed prior to clearing operations.

**Management Strategies and Sequence of Construction:**

**Suggested Sequence of Construction:**

1. Notify James City County Engineering and Resource Protection Division (E&RPD) and Virginia Department of Conservation and Recreation (DCR) minimum 48-hours in advance of commencement of construction operations.
2. Conduct pre-construction meeting on-site between contractor, the owner, the engineer and James City County E&RPD inspector.
3. Flag the limits of construction as indicated on the E&SC Plan.
4. Install Erosion and Sediment Control measures as indicated on the plans.
5. Clearing, demolition and grading activities may proceed only upon inspection and approval of the construction entrance and all erosion and sediment control measures, indicated on the E&SC Plan, by the JCCE&RPD inspector.
6. Clear, grub and grade as indicated on the plans.
7. Install stilling basin and series of step-pools per approved plans.
8. Proceed with fine grading.
9. Installation planting per mitigation tables and approved shop drawings.
10. Complete permanent seeding, fertilize and mulch as required.
11. After final site stabilization and upon receiving authorization from the assigned JCCE&RPD inspector remove temporary erosion and sediment control measures.
12. During all phases of construction, contractor shall perform daily inspections of the receiving drainage channel. Erosion and sediment control devices shall be inspected and repaired or replaced as necessary after each storm event.
13. Contractor shall be responsible for any additional sediment controls and removal o sediment caused by construction.

Determination of the schedule as to which areas will be cleared, demolished, graded etc. is at the contractor's option. Revised sequencing and erosion control methods shall be submitted to James City County Engineering and Resource Protection Division for approval.

# EROSION AND SEDIMENT CONTROL

# AND STORMWATER MANAGEMENT DESIGN

# PLAN CHECKLIST

**James City County, Virginia**
**Environmental Division**

# Erosion and Sediment Control and Stormwater Management Design Plan Checklists

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GENERAL INFORMATION

Project Name: STONEHOUSE GLEN BMP OUTFALL REPAIR
Owner / Applicant: VANASSE HANGEN BRUSTLIN INC
Plan Preparer: PETER SWIETUCHOWSKI, PE Email: pswietuchowski@vhb.com
Project Location: TOANO, VA
Tax Map / Parcel: 0540400001C
County Plan No. (if known): AMENDMENT TO SP-098-03
County BMP Type: EXTENDED DETENTION BASIN ( - )
Other information submitted in addition to this checklist (Check all that apply):

- ☑ Design or Construction Drawings (Plans, Profiles, Details, etc.).
- ☑ Erosion & Sediment Control Plan (Plans, Details, etc.).
- ☑ Erosion & Sediment Control Plan Design Report.
- ☑ Stormwater Management Design Plan (Plans, Profiles, Details, etc.).
- ☑ Stormwater Management Design Report.
- ☐ Other, List: _____

***Issue Date***
***March 1, 2001***

*JAMES CITY COUNTY, VIRGINIA*
*ENVIRONMENTAL DIVISION*

# *EROSION AND SEDIMENT CONTROL PLAN CHECKLIST*

## I. *GENERAL:*

| Yes | No | N/A | |
|---|---|---|---|
| ☑ | ☐ | ☐ | *FAMILIARITY* with current versions of Chapter 8, Erosion and Sedimentation Control and Chapter 23, Chesapeake Bay Preservation ordinances of the Code of James City County, Virginia and the Virginia Erosion and Sediment Control Handbook (VESCH). |
| ☑ | ☐ | ☐ | *LAND DISTURBING PERMIT AND SILTATION AGREEMENT* with surety are required for the project. |
| ☐ | ☐ | ☑ | *VARIANCE* if necessary, requested in writing, for the plan approving authority to waive or modify any of the minimum standards and specifications of the VESCH deemed inappropriate based on site conditions specific to this review case only. Variances which are approved shall be properly documented in the plan and become part of the approved erosion and sediment control plan for the site. |

## II. *SITE PLAN:*

| Yes | No | N/A | |
|---|---|---|---|
| ☑ | ☐ | ☐ | *VICINITY MAP* locating the site in relation to the surrounding area. Include any major landmarks which might assist in physically locating the site. |
| ☑ | ☐ | ☐ | *INDICATE NORTH* direction in relation to the site. |
| ☑ | ☐ | ☐ | *LIMITS OF CLEARING AND GRADING* for the site including that required for implementation of erosion and sediment controls, stockpile areas and utilities. |
| ☑ | ☐ | ☐ | *DISTURBED AREA ESTIMATES* in acres or square feet for the project. |
| ☑ | ☐ | ☐ | *EXISTING TOPOGRAPHY* or contours for the site at no more than 5 foot contour interval. |
| ☑ | ☐ | ☐ | *FINAL TOPOGRAPHY*, contours or proposed site grading in accordance with the design plan which indicates changes to existing topography and drainage patterns at no more than 2 foot contour interval (or 1 foot contours where required). |
| ☑ | ☐ | ☐ | *EXISTING AND PROPOSED SPOT ELEVATIONS* to supplement existing and proposed contours, topography or site grading information. Spot elevations may replace final contours in some instances, especially if terrain is in a low lying area or relatively flat. |
| ☑ | ☐ | ☐ | *EXISTING VEGETATION* including existing tree lines, grassed or unique vegetation areas. |

| Yes | No | N/A | |
|---|---|---|---|
| ☑ | ☐ | ☐ | *EXISTING SITE FEATURES* including roads, buildings, homes, utilities, streams, fences, structures and other important surface features of the site. |
| ☑ | ☐ | ☐ | *SOILS MAP* with soil symbols, boundaries and legend in accordance with the current Soil Survey of James City and York Counties and the City of Williamsburg, Virginia. |
| ☑ | ☐ | ☐ | *ENVIRONMENTAL INVENTORY* in accordance with Section 23-10(2) of the Chesapeake Bay Preservation Ordinance of James City County. Inventory generally includes: tidal shores and wetlands, non-tidal wetlands, resource protection area, hydric soils and slopes steeper than 25 percent. For wetlands, provide a copy of issued permits or satisfactory evidence that appropriate permits are being pursued for the entire project. |
| ☑ | ☐ | ☐ | *100-YEAR FLOODPLAIN LIMITS* or any special flood hazard areas or flood zones based on appropriate Federal Management Agency Flood Insurance Rate Maps (FIRMs) or Flood Hazard Boundary Maps (FHBMs) of James City County, Virginia. |
| ☑ | ☐ | ☐ | *DRAINAGE AREAS* for offsite and onsite areas, existing or proposed as applicable. Include drainage divides and directional labels for all subareas at points of interest and size (in acres), weighted runoff coefficient or curve number and times of concentration for each subarea. |
| ☑ | ☐ | ☐ | *CRITICAL EROSION AREAS* which require special consideration or unique erosion and sediment control measures. Refer to the VESCH, Chapter 6 for criteria. |
| ☑ | ☐ | ☐ | *DEVELOPMENT PLAN* for the site showing all improvements such as buildings, structures, parking areas, access roadways, above and below ground utilities, stormwater management and drainage facilities, trails or sidewalks, proposed vegetation and landscaping, amenities, etc. |
| ☑ | ☐ | ☐ | *LOCATION OF PRACTICES* proposed for erosion and sediment control, tree protection and temporary stormwater management due to land disturbance activities at the site. Use standard abbreviations, labels and symbols consistent for plan views based on minimum standards and specifications in Chapter 3 of the VESCH. |
| ☐ | ☐ | ☑ | *TEMPORARY STOCKPILE AREAS* or staging and equipment storage areas as required for onsite or offsite construction activities or indicate that none are anticipated for this project. |
| ☐ | ☐ | ☑ | *OFFSITE LAND DISTURBING AREAS* including borrow sites, waste areas, utility extensions, etc. and required erosion and sediment controls. If none are anticipated for the project, then indicate on the plans by general or erosion and sediment control notes. |
| ☑ | ☐ | ☐ | *DETAILS* or alternately, appropriate reference to current minimum standards and specifications of the VESCH for each measure proposed for the project. Non-modified, standard duplicated details (silt fence, diversion dikes, etc.) may be referenced to the current version of the VESCH. Specific dimensional or modified standards (basins, traps, outlet protections, check dams, etc.) require presentation on detail sheets. Schedules or tables may be used for multiple site measures such as sediment traps, basins, channels, slope drains, etc. Any modification to standard details should be clearly defined, explained and illustrated. |

| Yes | No | N/A | |
|---|---|---|---|
| ☐ | ☐ | ☑ | *MAINTENANCE PLAN* or alternately, appropriate reference to current minimum standards and specifications of the VESCH, outlining the inspection frequency and maintenance requirements for all erosion and sediment control measures proposed for the project. |
| ☐ | ☐ | ☑ | *TRENCH DEWATERING* methods and erosion and sediment controls, if anticipated for the project. |
| ☑ | ☐ | ☐ | *CONSTRUCTION SEQUENCE* outlining the anticipated sequence for installation of erosion and sediment controls and site, grading and utility work to be performed for the project by the site contractor. |
| ☐ | ☐ | ☑ | *PHASING PLAN* if required for larger project sites that are to be developed in stages or phases. |
| ☑ | ☐ | ☐ | *STANDARD COUNTY NOTES* are required to be placed on the erosion and sediment control plan. Refer to the standard James City County Erosion and Sediment Control Notes, latest version. |
| ☑ | ☐ | ☐ | *PROFESSIONAL SEAL AND SIGNATURE* required on final and complete approved plans, drawings, technical reports and specifications. |

III. ***NARRATIVE:***

| Yes | No | N/A | |
|---|---|---|---|
| ☑ | ☐ | ☐ | *PROJECT DESCRIPTION* briefly describing the nature and purpose of the land disturbing activity and the acreage to be disturbed. |
| ☑ | ☐ | ☐ | *EXISTING SITE CONDITIONS* description of existing topography, land use, cover and drainage patterns at the site. |
| ☑ | ☐ | ☐ | *ADJACENT AREA* descriptions of neighboring onsite or offsite areas such as streams, lakes, property, roads, etc. and potential impacts due to concentrated flow or runoff from the land disturbing activity. |
| ☑ | ☐ | ☐ | *OFFSITE DISTURBED AREA* descriptions of proposed borrow sites, waste or surplus areas, utility extensions and erosion and sediment controls to be implemented. |
| ☑ | ☐ | ☐ | *SOILS DESCRIPTION* briefly summarizing site, disturbed area and drainage basin soils including name, unit, hydrologic soil group (HSG) classification, surface runoff potential, erodibility, permeability, depth, texture, structure, erosion hazards, shrink-swell potential, limitations for use and anticipated depths to bedrock and the seasonal water table, as applicable. |
| ☑ | ☐ | ☐ | *CRITICAL AREAS* on the site which many have potentially serious erosion and sediment control problems and special considerations required (ie. steep slopes, hydric soils, channels, springs, sinkholes, water supply reservoirs, groundwater recharge areas, etc.) |

| Yes | No | N/A | |
|---|---|---|---|
| ☑ | ☐ | ☐ | *PROPOSED EROSION & SEDIMENT CONTROL MEASURES* inclusive to the specific erosion and sediment control plan as proposed for the land disturbing activity. Measures should be consistent with those proposed on the site drawings. Address general use, installation, limitations, sequencing and maintenance requirements for each control measure. |
| ☑ | ☐ | ☐ | *STABILIZATION MEASURES* required for the site, either temporary or permanent, and during and following construction including temporary and permanent seeding and mulching, paving, stone, soil stabilization blankets and matting, sodding, landscaping or special stabilization techniques to be utilized at the site. |
| ☐ | ☐ | ☑ | *STORMWATER MANAGEMENT CONSIDERATIONS* for the site, either of temporary or permanent nature, and strategies, sequences and measures required for control. May reference the stormwater management plan for the site, if prepared, for permanent stormwater management facilities and control of drainage once the site is stabilized. |

## IV. *CALCULATIONS:*

| Yes | No | N/A | |
|---|---|---|---|
| ☑ | ☐ | ☐ | *CALCULATIONS AND COMPUTATIONS* associated with hydrology, hydraulics and design of proposed temporary and permanent erosion and sediment control measures including: sediment traps and basins, diversions, stormwater conveyance channels, culverts, slope drains, outlet protections, etc. Computations are not required on the construction plan and may be attached in a supplemental erosion and sediment control plan design report, if presented in a clear and organized format. |
| ☐ | ☐ | ☑ | *TEMPORARY SEDIMENT BASIN DESIGN DATA SHEET* submitted for each basin along with schematic or sketch cross-section showing applicable design and construction data, storage volumes (wet-dry), dimensions and elevations. Peak design runoff to be based on the 2- or 25-year design storm event based on maximum disturbed site conditions (existing, interim or proposed conditions) in accordance with Minimum Standard 3.14 of the VESCH. |

*JAMES CITY COUNTY, VIRGINIA*
*ENVIRONMENTAL DIVISION*

# *STORMWATER MANAGEMENT DESIGN PLAN CHECKLIST*

## I. *GENERAL:*

| Yes | No | N/A | |
|---|---|---|---|
| ☑ | ☐ | ☐ | *FAMILIARITY* with current versions of the James City County Guidelines for Design and Construction of Stormwater Management BMPs manual; Chapter 8, Erosion and Sediment Control and Chapter 23, Chesapeake Bay Preservation ordinances of the Code of James City County, Virginia; the Virginia Erosion and Sediment Control Handbook (VESCH); and the Virginia Stormwater Management Handbook (VSMH). |
| ☑ | ☐ | ☐ | *WAIVER OR EXCEPTION* if necessary, requested in writing, for the plan approving authority to waive or except the requirements of Chapter 23, Chesapeake Bay Preservation ordinance in accordance with procedure established in Sections 23-14 through 23-17 of the ordinance. Applies to this review case only. |
| ☐ | ☐ | ☑ | *VARIANCE REQUEST* if necessary, requested in writing for the plan approving authority to waive or modify any of the minimum standards and specifications of the VESCH deemed inappropriate based on site conditions specific to this review case only. Variances which are approved shall be properly documented in the plan and become part of the approved erosion and sediment control plan for the site. |
| ☑ | ☐ | ☐ | *PROFESSIONAL SEAL AND SIGNATURE* required on final and complete approved stormwater management plans, drawings, technical reports and specifications. |
| ☐ | ☐ | ☑ | *WORKSHEET FOR BMP POINT SYSTEM* to ensure the stormwater management plan for the project attains at least 10 BMP points (New Development) or traditional pollutant load reduction computations per the Chesapeake Bay Local Assistance Manual (Redevelopment Only). |
| ☐ | ☐ | ☑ | *PROPOSED CONSERVATION EASEMENT AREAS* for any natural open space points claimed in the BMP worksheet. |
| ☐ | ☐ | ☑ | *INSPECTION/MAINTENANCE AGREEMENT* is required to be prepared and executed with the County for the project. |
| ☑ | ☐ | ☐ | *FEMA FIRM PANEL* reference with designated special flood hazard areas or zone designations associated with the site, as applicable. |
| ☑ | ☐ | ☐ | *DRAINAGE AREA MAP* at a maximum scale of 1"=200' scale showing drainage area boundaries for pre- and postdevelopment conditions and associated time of concentration flow paths. Labels to include drainage area size, runoff coefficient or curve number and time of concentration for each subarea shown on the map. |

| Yes | No | N/A | |
|---|---|---|---|
| ☑ | ☐ | ☐ | *SOILS MAP* with soil symbols, boundaries and legend in accordance with the current Soil Survey of James City and York Counties and the City of Williamsburg, Virginia with approximate locations of the project site, BMPs and applicable drainage basins. |
| ☐ | ☐ | ☑ | *STORMWATER MANAGEMENT NARRATIVE* in a brief and simple format which describes the project; location; site and drainage basin soil characteristics; receiving water or drainage facility; existing site and drainage basin conditions (topography, land use, cover, slopes, etc.); proposed site development; proposed stormwater management and drainage plan including County BMP type selected; summary of hydrology and hydraulics; maintenance program; and any special assumptions utilized for development of the stormwater management and drainage design plan or computations. |
| ☐ | ☐ | ☑ | *TEMPORARY STORMWATER MANAGEMENT* (if applicable) for control of stormwater runoff encountered during construction activities in addition to measures provided in the erosion and sediment control plan or stormwater management/drainage plan for the site. Adequate protection measures or sequencing provided. |
| ☑ | ☐ | ☐ | *MODIFICATION PLAN* clearly defined for temporary sediment control structures which will be converted to permanent SWM/BMP structures. Includes appropriate hydrologic and hydraulic computations, conversions, sequencing and cleanout information or details. Normally related to primary control structures associated with dry detention or wet retention ponds. Normally not permitted for Group C or D categories such as bioretention, infiltration and filtering system facilities. |
| ☑ | ☐ | ☐ | *STORMWATER MANAGEMENT and DRAINAGE DESIGN REPORT* in a bound 8-1/2 x 11 inch size format. Report shall generally include a title sheet, date, project identification, owner and preparer information, table of contents, narrative, summaries and computations as required. Computations may include: backwater, closed conduit, headwater, hydraulic, hydraulic grade line, hydrology, inlet, open channel, storm sewer, water quality, extended detention or stream channel protection and muti-stage storm routing calculations, as applicable, for the project. Computation data may include hand or computer generated computations, maps or schematics. All information should be presented in a clear, easy to follow format and should closely match construction plan information. |
| ☑ | ☐ | ☐ | *PLAN VIEW* at 1 inch = 50 ft. scale or less (1" = 40', 1" = 30', etc.) |
| ☑ | ☐ | ☐ | North arrow and plan legend. |
| ☑ | ☐ | ☐ | Property lines. |
| ☑ | ☐ | ☐ | Adjacent property information. |
| ☑ | ☐ | ☐ | Existing site features and existing impervious cover areas. |
| ☐ | ☐ | ☑ | Impervious cover tabulations. |
| ☑ | ☐ | ☐ | Existing drainage facilities (natural or manmade). |
| ☑ | ☐ | ☐ | Existing environmentally sensitive areas (RPA, wetlands, floodplain, steep slopes, critical soils, buffers, etc.). |
| ☑ | ☐ | ☐ | Existing and proposed contours (1' or 2' contour interval) and spot elevations as necessary to define high and low topography. |
| ☑ | ☐ | ☐ | Existing and proposed easement locations. |

| Yes | No | N/A | |
|---|---|---|---|
| ☑ | ☐ | ☐ | Proposed site improvements and proposed impervious cover areas. |
| ☑ | ☐ | ☐ | Proposed stormwater conveyance, drainage and management facilities with appropriate labeled construction data and information. |
| ☑ | ☐ | ☐ | Proposed landscaping and seeding plans (disturbed areas, pond interior, etc.). |
| ☑ | ☐ | ☐ | Proposed slope stabilization areas (riprap, blankets, mattings, walls, etc.). |
| ☐ | ☐ | ☑ | Delineation of permanent pools and the 1-, 2-, 10- and 100-year Design Water Surface Elevations. |
| ☐ | ☐ | ☑ | Delineation of ponding, headwater, surcharge or backwater areas which may affect adjacent existing or proposed buildings, structures or upstream adjacent properties. |
| ☐ | ☐ | ☑ | Test boring locations with reference surface elevations (if known). |
| ☐ | ☐ | ☑ | Risers, barrels, underdrains, overflows and outlet protections. |
| ☐ | ☐ | ☑ | Emergency spillway level section and outlet channel. |
| ☐ | ☐ | ☑ | Existing and proposed site utilities and protection measures. |
| ☐ | ☐ | ☑ | Erosion and sediment control measures (for site or BMP). |
| ☐ | ☐ | ☑ | Maintenance or access corridors to permanent stormwater management, BMP or drainage facilities. |

## II. *STORMWATER CONVEYANCE SYSTEMS:*

| Yes | No | N/A | |
|---|---|---|---|
| ☐ | ☐ | ☑ | *PLAN VIEWS* |
| | | | ☐ ☐ ☐ Storm drain lengths, sizes, types, classes and slopes for all segments. Label directly on plan or use structure/pipe schedule. |
| | | | ☐ ☐ ☐ Access structure (inlets, manholes, junctions, etc.) rim elevations, inverts, type and required grate or top unit and lengths labeled. |
| | | | ☐ ☐ ☐ All structure numbers labeled. |
| | | | ☐ ☐ ☐ Adequate horizontal clearance from other site utilities or structures. |
| ☐ | ☐ | ☐ | *PROFILES* generally are not required but are encouraged to expedite review. If not provided, ensure all pipe segments have adequate minimum cover, do not exceed maximum depths of cover for the type/class of pipe specified and do not conflict with other site utilities or excavation areas. |
| ☐ | ☐ | ☐ | *DETAILS* |
| | | | ☐ ☐ ☐ Typical storm drain bedding details or reference note. |
| | | | ☐ ☐ ☐ Standard details or reference note for all proposed access structure types (inlets, manholes, junctions, etc.). |
| | | | ☐ ☐ ☐ Inlet shaping detail or applicable reference note. |
| | | | ☐ ☐ ☐ Step detail or applicable reference note (if depth 4 ft. or more). |
| | | | ☐ ☐ ☐ Typical open channel details with designation, location, shape, type, bottom width, top width, lining, slope, length, side slope, and installation depth required for construction. Channel design data as necessary may also be included. |
| | | | ☐ ☐ ☐ Outlet protections at all pipe outfalls. |

Yes No N/A

☐ ☐ ☐ *STORMWATER CONVEYANCE SYSTEM COMPUTATIONS*

- ☐ ☐ ☐ Storm Sewer Design computations based on 10-year design event.
- ☐ ☐ ☐ Hydraulic Grade Line computations based on 10-year design event.
- ☐ ☐ ☐ Inlet computations based on current VDOT procedure for spread, ponding depth and grate size required.
- ☐ ☐ ☐ Culvert Headwater computations. Design based on 10-year design storm event and check only for 100-year storm event.
- ☐ ☐ ☐ Open Channel computations based on 2-year design event for velocity and 10-year design event for capacity.
- ☐ ☐ ☐ Standard outlet protection or special energy dissipators.
- ☐ ☐ ☐ Pipe thickness design computations, as required, for selected pipe type (live load, minimum cover, maximum height of cover, etc.).
- ☐ ☐ ☐ Adequate channel computations for receiving channels (based on field measured channel section data).

## III. *STORMWATER MANAGEMENT / BMP FACILITIES:*

Yes No N/A

☑ ☐ ☐ *HYDROLOGY* - An SCS based methodology is required for the design of stormwater management/BMP facilities with watersheds exceeding 20 acres. Under 20 acres, other generally accepted methodologies such as the modified rational, critical storm are allowable. Refer to Chapter 5 of the VESCH or Chapter 5 of the VSMH.

- ☑ ☐ ☐ Runoff Curve Number or Coefficient determinations: predeveloped and ultimate development land use scenarios.
- ☑ ☐ ☐ Time of concentration: predeveloped and ultimate development indicating overland, shallow concentrated, and channel flow components (200 ft. maximum length for overland flow).
- ☑ ☐ ☐ Hydrograph generation (tabular or graphical): pre- and postdevelopment conditions for the 1-, 2-, 10-, and 100-year design storm events.

☐ ☐ ☑ *FACILITY CONFIGURATION and MINIMUM SEPARATIONS*

- ☐ ☐ ☐ Screening and layout consistent with Section 24-98(d) of the Chapter 24 Zoning ordinance (landscaping, screening, visibility, etc.).
- ☐ ☐ ☐ Basic considerations for safety and unauthorized entry.
- ☐ ☐ ☐ Proper length to width ratio (Typically 2H:1V).
- ☐ ☐ ☐ Facilities with deep pools (4 feet or more in depth) provided with two benches. Fifteen (15) ft. safety bench outward from normal pool at maximum 6 percent slope and aquatic bench inward from normal shoreline below normal pool. Narrower widths may be considered on a case-by-case basis.
- ☐ ☐ ☐ Pond buffer minimum 25 feet outward from maximum design WSEL. Additional setbacks may be required to permanent structures.
- ☐ ☐ ☐ No trees, shrubs or woody plants within 15 feet of embankment toe or 25 feet from principal spillway structure.

| Yes | No | N/A | |
|---|---|---|---|
| ☐ | ☐ | ☐ | Infiltration and filtering system facilities generally located at least 100 feet horizontally from any water supply well; 100 feet from any downslope building; and 25 feet from any upslope buildings, unless site specific investigation allows for reduced separation. |

| Yes | No | N/A | |
|---|---|---|---|
| ☑ | ☐ | ☐ | *HYDRAULIC COMPUTATIONS* |
| ☑ | ☐ | ☐ | Elevation- or Stage- Storage curve and/or tabular data. |
| ☑ | ☐ | ☐ | Weir / Orifice Control - Extended Detention. |
| ☑ | ☐ | ☐ | Weir / Orifice Control - riser 1-year control for channel protection. |
| ☑ | ☐ | ☐ | Weir / Orifice Control - riser 2-year control for quantity (if required). |
| ☑ | ☐ | ☐ | Weir / Orifice Control - riser 10-year control for quantity (if required). |
| ☑ | ☐ | ☐ | Inlet / Outlet (barrel) control - (All Storms). |
| ☐ | ☐ | ☐ | Check for barrel control prior to riser orifice flow to prevent slug flow-water hammer conditions. |
| ☐ | ☐ | ☐ | Emergency spillway capacity and depth of flow. |
| ☐ | ☐ | ☐ | Elevation - Discharge (Outlet Rating) curve and/or table. Provide all supporting calculations and/or design assumptions. |
| ☐ | ☐ | ☐ | Adequate channel computations for receiving channel. May be waived if facility is designed based on current Stream Channel Protection criteria. |
| ☑ | ☐ | ☐ | *POND or RESERVOIR ROUTING* |
| ☑ | ☐ | ☐ | Storage-Indication Routing of postdeveloped inflow hydrographs for the 1-, 2-, 10-, and 100-year design storms. Preference is for structure to discharge up to the 10-year storm through the principal spillway and pass the 100-year storm with a minimum 1 foot of freeboard through a combination principal and emergency spillways. If no emergency spillway is provided, riser must be large enough to pass the design high water flow and trash without overtopping the facility, have 3 square feet or more of cross-sectional area, contain a hood type inlet and have a minimum freeboard of 2 feet. Token spillways with minimum 8 ft. width are also recommended at or above the design 100-year storm elevation. |
| ☑ | ☐ | ☐ | Downstream hydrographs at established study points, if conditions warrant (ie. facility discharge combined with uncontrolled bypass). |
| ☐ | ☐ | ☑ | *MISCELLANEOUS COMPUTATIONS* |
| ☐ | ☐ | ☐ | Water quality volume for permanent pool based on selected BMP treatment volume (WQv). |
| ☐ | ☐ | ☐ | Water quality volume for extended detention based on selected BMP treatment volume (WQv) with drawdown computations. |
| ☐ | ☐ | ☐ | Drawdown computations for the 1-year, 24 hour detention for stream channel protection criteria. |
| ☐ | ☐ | ☐ | Pond drain computations (within 24 hours). |
| ☐ | ☐ | ☐ | Anti-seep collar design (concrete preferred) or match material type. |
| ☐ | ☐ | ☐ | Filter diaphragm design (or alternative method of controlling seepage). |

Yes No N/A

☐ ☐ ☐ Riser / base structure flotation analyses. FS = 1.25 minimum.

☐ ☐ ☐ Downstream danger reach study and/or emergency action plan (if conditions warrant).

☐ ☐ ☐ Upstream backwater analyses onto offsite adjacent property (if conditions warrant).

☐ ☐ ☐ 100 year floodplain impacts (if conditions warrant).

Yes No N/A

☐ ☐ ☑ *GEOTECHNICAL REQUIREMENTS*

☐ ☐ ☐ Geotechnical Report with recommendations specific to BMP facility type selected. Report prepared by a registered professional engineer. Requires submission, review and approval prior to issuance of Land Disturbance Permit.

☐ ☐ ☐ Initial Feasibility Testing requirements satisfied as per Appendix E of the James City County Guidelines for Design and Construction of Stormwater Management BMPs manual. (Infiltration, Bioretention and Filtering System BMP types only).

☐ ☐ ☐ Concept Design Testing requirements satisfied as per Appendix E of the James City County Guidelines for Design and Construction of Stormwater Management BMPs manual. (Infiltration, Bioretention and Filtering System BMP types only).

☐ ☐ ☐ Minimum Boring locations: borrow area, pool area, principal control structure, top of facility near one abutment and emergency spillway if provided.

☐ ☐ ☐ Boring logs with Unified Soil Classification (ASTM D2487), soils descriptions and depths to bedrock and the seasonal water table indicated.

☐ ☐ ☐ Standard County Record Drawing/Construction Certification note provided on plan. *Note: It is understood that preparation of record drawings and construction certifications as required for project facilities may not necessarily be performed by the plan preparer. These components may be performed by others.*

☐ ☐ ☑ *PRINCIPAL SPILLWAY PROFILE AND ASSOCIATED DETAILS*

☐ ☐ ☐ *EXISTING GROUND AND PROPOSED GRADE*

☐ ☐ ☐ Embankment or excavation side slopes labeled (3H:1V maximum).

☐ ☐ ☐ Minimum top width labeled (per VESCH or VSMH requirements).

☐ ☐ ☐ Removal of unsuitable material under proposed facility (per Geotechnical Report requirements).

Yes No N/A

☐ ☐ ☑ *CORE TRENCH*

- ☐ ☐ ☐ Material (per plan or Geotechnical Report).
- ☐ ☐ ☐ Bottom width (4' minimum or greater as dictated by Geotechnical Report recommendations).
- ☐ ☐ ☐ Side slopes (1:1 maximum steepness)
- ☐ ☐ ☐ Depth (4' minimum or greater as dictated by Geotechnical Report).

☐ ☐ ☑ *PRINCIPAL CONTROL STRUCTURE. RISER OR SIMILAR STRUCTURE (DETAILS REQUIRED FOR ALL ITEMS)*

- ☐ ☐ ☐ Durable, watertight, resistant material (concrete preferred).
- ☐ ☐ ☐ Riser diameter is at least 1.25 times larger than barrel diameter.
- ☐ ☐ ☐ All pertinent dimensions and elevations shown.
- ☐ ☐ ☐ Control orifice or weir dimensions and elevations shown.
- ☐ ☐ ☐ Trash rack - removable - for each release.
- ☐ ☐ ☐ Anti-vortex device, baffle or plate.
- ☐ ☐ ☐ Riser base structure with dimensions and embedment specifications (concrete preferred).
- ☐ ☐ ☐ Interior access (steps, ladders, etc.) for maintenance for structures over 4 feet in height. Excessively high risers may need some form of exterior access on top portion.
- ☐ ☐ ☐ Low flow orifice with trash rack device.

☐ ☐ ☑ *PRINCIPAL CONTROL STRUCTURE OUTLET BARREL*

- ☐ ☐ ☐ Material (ASTM C-361 reinforced concrete pipe) with watertight joints. Prior approval required for all other pipe material (other RCP types, CMP, CPP, PVC, etc.).
- ☐ ☐ ☐ Support and bedding requirements for barrel - concrete cradles, etc. or as recommended by the Geotechnical Report.
- ☐ ☐ ☐ Pipe inverts, length, size, class and slope shown.
- ☐ ☐ ☐ Flared end section or endwall provided on barrel outlet.

☐ ☐ ☑ *SEEPAGE CONTROL*

- ☐ ☐ ☐ Phreatic line shown (4:1 slope measured from the intersection of the embankment and the principal spillway design high water).

- ☐ ☐ ☐ *ANTI-SEEP COLLARS*
  - ☐ ☐ ☐ Anti-seep collar, concrete preferred.
  - ☐ ☐ ☐ Size - 15 percent increase in length of saturation using outside pipe diameter.
  - ☐ ☐ ☐ Spacing and location on barrel (located at least 2 feet from a pipe joint).
  - ☐ ☐ ☐ *FILTER DIAPHRAGMS*
  - ☐ ☐ ☐ Design based on latest NRCS design methods and certified by a professional engineer.

| Yes | No | N/A | |
|---|---|---|---|
| ☐ | ☐ | ☑ | *ELEVATION AND DIMENSIONAL DESIGN DATA* |
| | | ☐ ☐ ☐ | Top of facility - construction height and settled height (10 percent settlement). |
| | | ☐ ☐ ☐ | Crest of principal control structure spillway at least one (1) foot below crest of emergency spillway, if provided. |
| | | ☐ ☐ ☐ | Minimum freeboard of one (1) foot above the 100-year design high water elevation for facilities <u>with</u> an emergency spillway. |
| | | ☐ ☐ ☐ | Minimum freeboard of two (2) feet above the 100-year design high water elevation for facilities <u>without</u> an emergency spillway or in accordance with the SCS National Engineering Handbook (prior approval required). |
| | | ☐ ☐ ☐ | Basin Sediment Clean-Out elevation (permanent mode). Typically 10 to 25 percent of water quality volume. |
| ☐ | ☐ | ☑ | *CROSS SECTION THROUGH FACILITY* |
| | | ☐ ☐ ☐ | Existing Ground. |
| | | ☐ ☐ ☐ | Proposed grade. |
| | | ☐ ☐ ☐ | Top of facility - constructed and settled. |
| | | ☐ ☐ ☐ | Location of emergency spillway with side slopes labeled (emergency spillway in cut). |
| | | ☐ ☐ ☐ | Bottom of core trench (4' minimum). |
| | | ☐ ☐ ☐ | Location of each soil boring. |
| | | ☐ ☐ ☐ | Barrel location. |
| | | ☐ ☐ ☐ | Existing and proposed utility location/protection. |
| ☐ | ☐ | ☑ | *EMERGENCY SPILLWAY PROFILE* |
| | | ☐ ☐ ☐ | Existing ground. |
| | | ☐ ☐ ☐ | Inlet, level (control) and outlet sections per SCS. |
| | | ☐ ☐ ☐ | Spillway and crest elevations. |
| ☐ | ☐ | ☑ | *PRETREATMENT DEVICES* of adequate depth and properly designed using required pretreatment volumes for the selected County BMP facility type. Including, but not limited to: sediment forebays, sediment basins, sumps, grass channels, gravel diaphragms, plunge pools, chamber separators, manufactured systems or other acceptable methods. |

| Yes | No | N/A | |
|---|---|---|---|
| ☑ | ☐ | ☐ | *CONSTRUCTION SPECIFICATIONS and NOTES* |
| ☐ | ☐ | ☑ | Anticipated sequence of construction for BMP (consistent with erosion and sediment control plan). |
| ☐ | ☐ | ☑ | Provisions to control base stream or storm flow conditions encountered during construction. |
| ☑ | ☐ | ☐ | Site and subgrade preparation requirements. |
| ☐ | ☐ | ☑ | Embankment, fill and backfill material soil and placement (lift) thickness requirements. |
| ☐ | ☐ | ☑ | Compaction and soil moisture content requirements. |
| ☐ | ☐ | ☑ | Geosynthetics for drainage, filtration, moisture barrier, separation, and reinforcement purposes. |
| ☐ | ☐ | ☑ | Clay or synthetic (PVC or HDPE) pond liners. |
| ☐ | ☐ | ☑ | Storm drain, underdrain and pipe conduit requirements. |
| ☐ | ☐ | ☑ | Minimum depth of pipe cover for temporary (construction) and final cover conditions. |
| ☐ | ☐ | ☑ | Permanent shutoff valve and pond drain. |
| ☐ | ☐ | ☑ | Concrete requirements for structural components. |
| ☑ | ☐ | ☐ | Riprap and slope protection. |
| ☐ | ☐ | ☑ | Access or maintenance road surface, base, subbase. |
| ☑ | ☐ | ☐ | Temporary and permanent stabilization measures. |
| ☑ | ☐ | ☐ | Temporary or permanent safety fencing. |
| ☐ | ☐ | ☑ | BMP Landscaping (deep, shallow, fringe, perimeter,etc.) |
| ☐ | ☐ | ☑ | Dust and traffic control (if warranted). |
| ☐ | ☐ | ☑ | Construction monitoring and certification by professional. |
| ☐ | ☐ | ☐ | Other: _____ |
| ☐ | ☐ | ☐ | Other: _____. |
| ☐ | ☐ | ☑ | *MAINTENANCE PROVISIONS* |
| ☐ | ☐ | ☐ | Entity responsible for maintenance identified.. |
| ☐ | ☐ | ☐ | Maintenance Plan which outlines the long-term schedule for inspection/maintenance of the facility and forebays |
| ☐ | ☐ | ☐ | Maintenance access from public right-of-way or publicly traveled road. |
| ☐ | ☐ | ☐ | Maintenance easement provided encompassing high water pool and buffer, principal and emergency spillways, outlet structures, forebays, embankment area and possible sediment-removal stockpile areas. |
| ☐ | ☐ | ☐ | Minimum 6 foot wide public safety shelf (landing) or alternative fencing. |

## IV. *OUTLET PROTECTIONS:*

| Yes | No | N/A | |
|---|---|---|---|
| ☑ | ☐ | ☐ | Sized for maximum design release (generally ~~10-year~~ 100-year storm). |
| ☐ | ☐ | ☑ | Flared end section or endwall. |
| ☐ | ☐ | ☑ | Dimensions. |
| ☑ | ☐ | ☐ | Rock or riprap size, quantity and placement thickness. |
| ☐ | ☐ | ☑ | Slope at 0 percent (Level Grade). |
| ☑ | ☐ | ☐ | Geotextiles (nonwoven). |
| ☑ | ☐ | ☐ | Special energy dissipators are required for design discharge velocities that exceed eighteen (18) feet per second; or if use of standard outlet protection would result in velocities exceeding permissible channel velocities; or if space restricts or limits their use. |

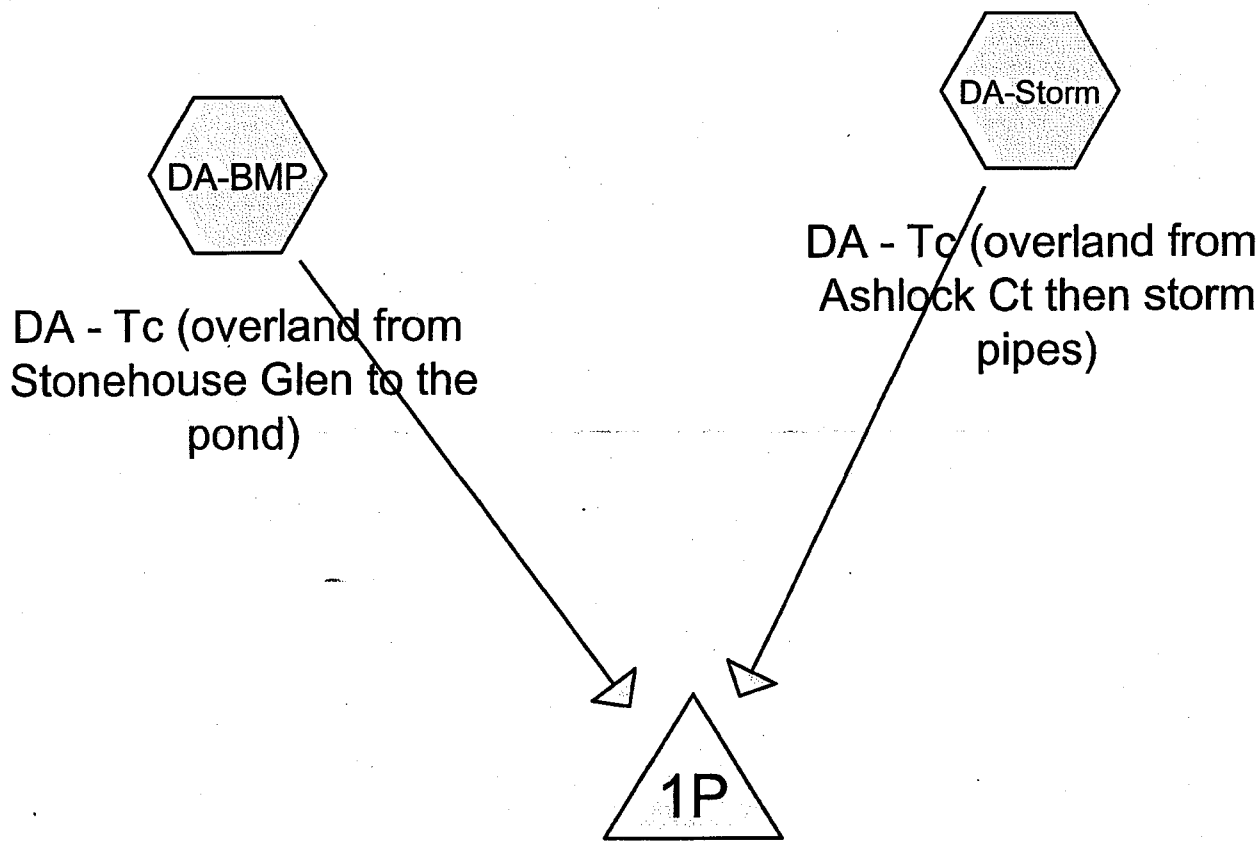
## V. *ADDITIONAL COMMENTS OR INFORMATION SPECIFIC TO THE PLAN:*

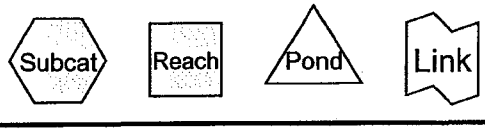
Plan Preparer: Piotr Swietuchowski, PE

Date: 06/22/12

SWMProg/BMP/Checklist/ChkList

# BMP WC-092 AS-BUILT CALCULATIONS – SCS METHOD




**Routing Diagram for BMP #1 - Record Info**
Prepared by {enter your company name here}, Printed 6/22/2012
HydroCAD® 10.00 s/n 01038 © 2012 HydroCAD Software Solutions LLC

## Summary for Pond 1P: Stonehouse Glen BMP #1 - Reocord Info

| | | | | | |
|---|---|---|---|---|---|
| Inflow Area = | 11.270 ac, | 24.58% Impervious, | Inflow Depth > | 1.37" | for 1-Year event |
| Inflow = | 22.80 cfs @ | 12.01 hrs, | Volume= | 1.283 af | |
| Outflow = | 0.72 cfs @ | 15.32 hrs, | Volume= | 0.760 af, | Atten= 97%, Lag= 198.7 min |
| Primary = | 0.72 cfs @ | 15.32 hrs, | Volume= | 0.760 af | |
| Secondary = | 0.00 cfs @ | 0.00 hrs, | Volume= | 0.000 af | |

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.03 hrs
Peak Elev= 79.88' @ 15.32 hrs Surf.Area= 9,026 sf Storage= 31,858 cf

Plug-Flow detention time= 327.5 min calculated for 0.760 af (59% of inflow)
[redacted]

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 72.10' | 78,353 cf | **Custom Stage Data (Prismatic)** Listed below (Recalc) |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 72.10 | 400 | 0 | 0 |
| 74.00 | 1,650 | 1,948 | 1,948 |
| 76.00 | 3,780 | 5,430 | 7,378 |
| 78.00 | 6,280 | 10,060 | 17,438 |
| 80.00 | 9,195 | 15,475 | 32,913 |
| 82.00 | 13,170 | 22,365 | 55,278 |
| 83.60 | 15,675 | 23,076 | 78,353 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 68.11' | **30.0" Round Culvert**<br>L= 78.0' RCP, rounded edge headwall, Ke= 0.100<br>Inlet / Outlet Invert= 68.11' / 67.21' S= 0.0115 '/' Cc= 0.900<br>n= 0.013, Flow Area= 4.91 sf |
| #2 | Device 1 | 80.53' | **60.0" Horiz. Orifice/Grate** C= 0.600<br>Limited to weir flow at low heads |
| [redacted] | | | |
| #4 | [redacted] | 83.60' | **36.0 deg x 50.0' long Sharp-Crested Vee/Trap Weir**<br>Cv= 2.58 (C= 3.23) |

**Primary OutFlow** Max=0.72 cfs @ 15.32 hrs HW=79.88' (Free Discharge)
└─**1=Culvert** (Passes 0.72 cfs of 93.09 cfs potential flow)
  ├─**2=Orifice/Grate** ( Controls 0.00 cfs)
  └─**3=Orifice/Grate** (Orifice Controls 0.72 cfs @ 14.75 fps)

**Secondary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=72.10' (Free Discharge)
└─**4=Sharp-Crested Vee/Trap Weir** ( Controls 0.00 cfs)

## Summary for Pond 1P: Stonehouse Glen BMP #1 - Reocord Info

| | | | | | |
|---|---|---|---|---|---|
| Inflow Area = | 11.270 ac, | 24.58% Impervious, | Inflow Depth > | 1.37" | for 1-Year event |
| Inflow = | 22.80 cfs @ | 12.01 hrs, | Volume= | 1.283 af | |
| Outflow = | 0.72 cfs @ | 15.32 hrs, | Volume= | 0.760 af, | Atten= 97%, Lag= 198.7 min |
| Primary = | 0.72 cfs @ | 15.32 hrs, | Volume= | 0.760 af | |
| Secondary = | 0.00 cfs @ | 0.00 hrs, | Volume= | 0.000 af | |

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.03 hrs
Peak Elev= 79.88' @ 15.32 hrs Surf.Area= 9,026 sf Storage= 31,858 cf

Plug-Flow detention time= 327.5 min calculated for 0.760 af (59% of inflow)
Center-of-Mass det. time= 209.6 min ( 1,047.1 - 837.5 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 72.10' | 78,353 cf | **Custom Stage Data (Prismatic)** Listed below (Recalc) |

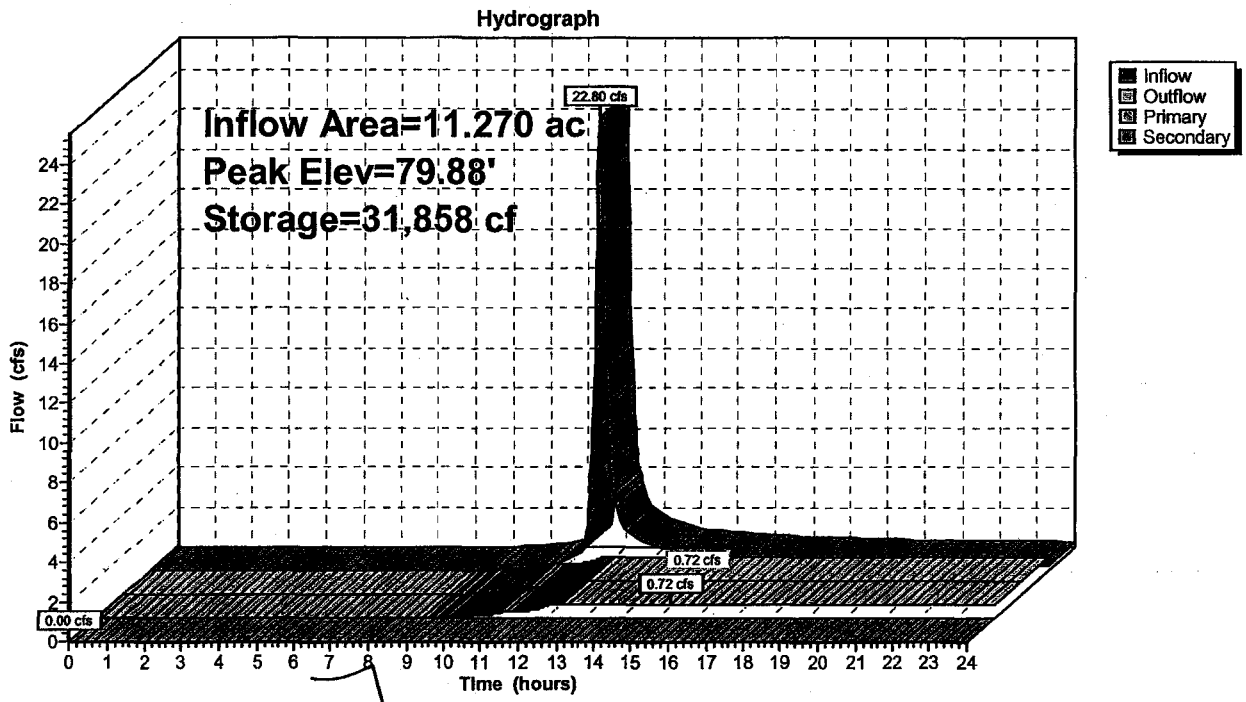
| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 72.10 | 400 | 0 | 0 |
| 74.00 | 1,650 | 1,948 | 1,948 |
| 76.00 | 3,780 | 5,430 | 7,378 |
| 78.00 | 6,280 | 10,060 | 17,438 |
| 80.00 | 9,195 | 15,475 | 32,913 |
| 82.00 | 13,170 | 22,365 | 55,278 |
| 83.60 | 15,675 | 23,076 | 78,353 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 68.11' | **30.0" Round Culvert**<br>L= 78.0' RCP, rounded edge headwall, Ke= 0.100<br>Inlet / Outlet Invert= 68.11' / 67.21' S= 0.0115 '/' Cc= 0.900<br>n= 0.013, Flow Area= 4.91 sf |
| #2 | Device 1 | 80.53' | **60.0" Horiz. Orifice/Grate** C= 0.600<br>Limited to weir flow at low heads |
| #3 | Device 1 | 70.38' | **3.0" Vert. Orifice/Grate** C= 0.600 |
| #4 | Secondary | 83.60' | **36.0 deg x 50.0' long Sharp-Crested Vee/Trap Weir**<br>Cv= 2.58 (C= 3.23) |

**Primary OutFlow** Max=0.72 cfs @ 15.32 hrs HW=79.88' (Free Discharge)
└─**1=Culvert** (Passes 0.72 cfs of 93.09 cfs potential flow)
  ├─**2=Orifice/Grate** ( Controls 0.00 cfs)
  └─**3=Orifice/Grate** (Orifice Controls 0.72 cfs @ 14.75 fps)

**Secondary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=72.10' (Free Discharge)
└─**4=Sharp-Crested Vee/Trap Weir** ( Controls 0.00 cfs)

## Pond 1P: Stonehouse Glen BMP #1 - Reocord Info




$$\frac{\left[(7.57)(84)\ (3.70)(77)\right]}{11.27} = 81.7$$

## Summary for Subcatchment DA-BMP: DA - Tc (overland from Stonehouse Glen to the pond)

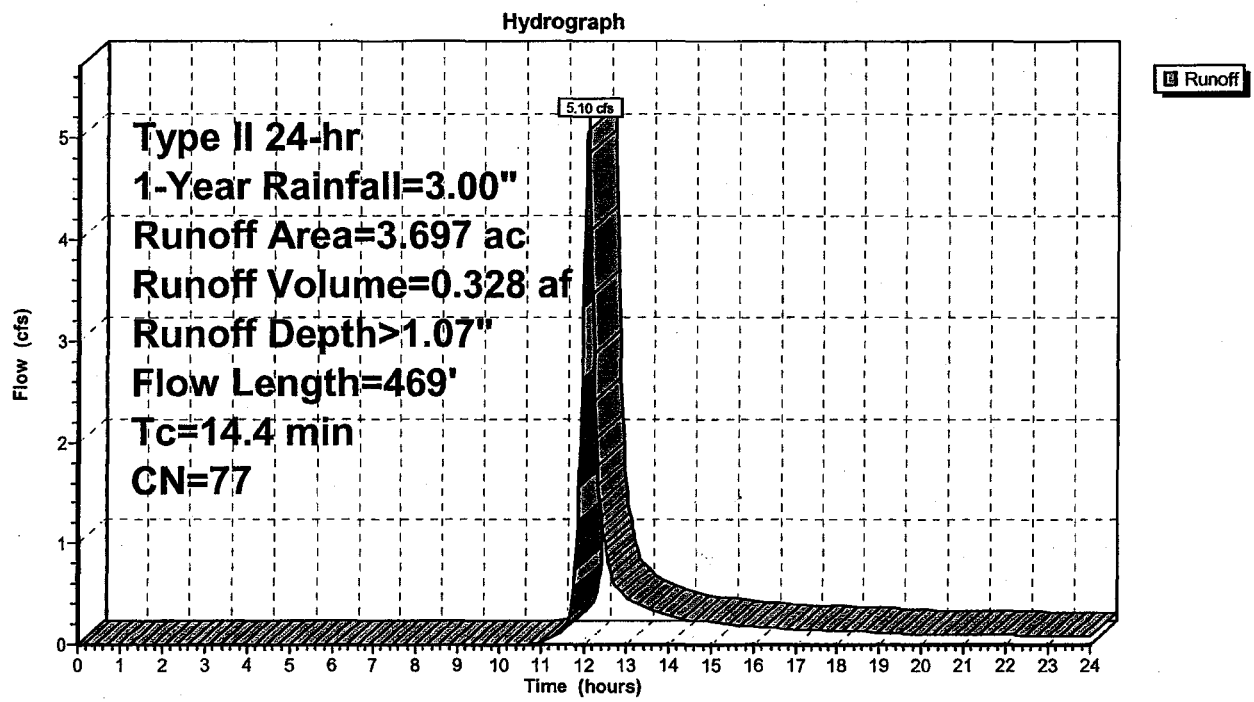
Runoff = 5.10 cfs @ 12.07 hrs, Volume= 0.328 af, Depth> 1.07"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.03 hrs
Type II 24-hr 1-Year Rainfall=3.00"

| | Area (ac) | CN | Description |
|---|---|---|---|
| * | 0.030 | 98 | Maintenance Road Impervious Area |
| * | 0.483 | 98 | Impervious Area on 5 Lots at 38% Impervious per Lot |
| | 3.184 | 74 | >75% Grass cover, Good, HSG C |
| | 3.697 | 77 | Weighted Average |
| | 3.184 | | 86.12% Pervious Area |
| | 0.513 | | 13.88% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 13.0 | 100 | 0.0600 | 0.13 | | **Sheet Flow, Sheet Flow**<br>Woods: Light underbrush n= 0.400 P2= 3.60" |
| 0.7 | 195 | 0.0974 | 4.68 | | **Shallow Concentrated Flow, Shallow Concentrated**<br>Grassed Waterway Kv= 15.0 fps |
| 0.7 | 174 | 0.0862 | 4.40 | | **Shallow Concentrated Flow, Shallow Concentrated**<br>Grassed Waterway Kv= 15.0 fps |
| 14.4 | 469 | Total | | | |

### Subcatchment DA-BMP: DA - Tc (overland from Stonehouse Glen to the pond)



## Summary for Subcatchment DA-Storm: DA - Tc (overland from Ashlock Ct then storm pipes)

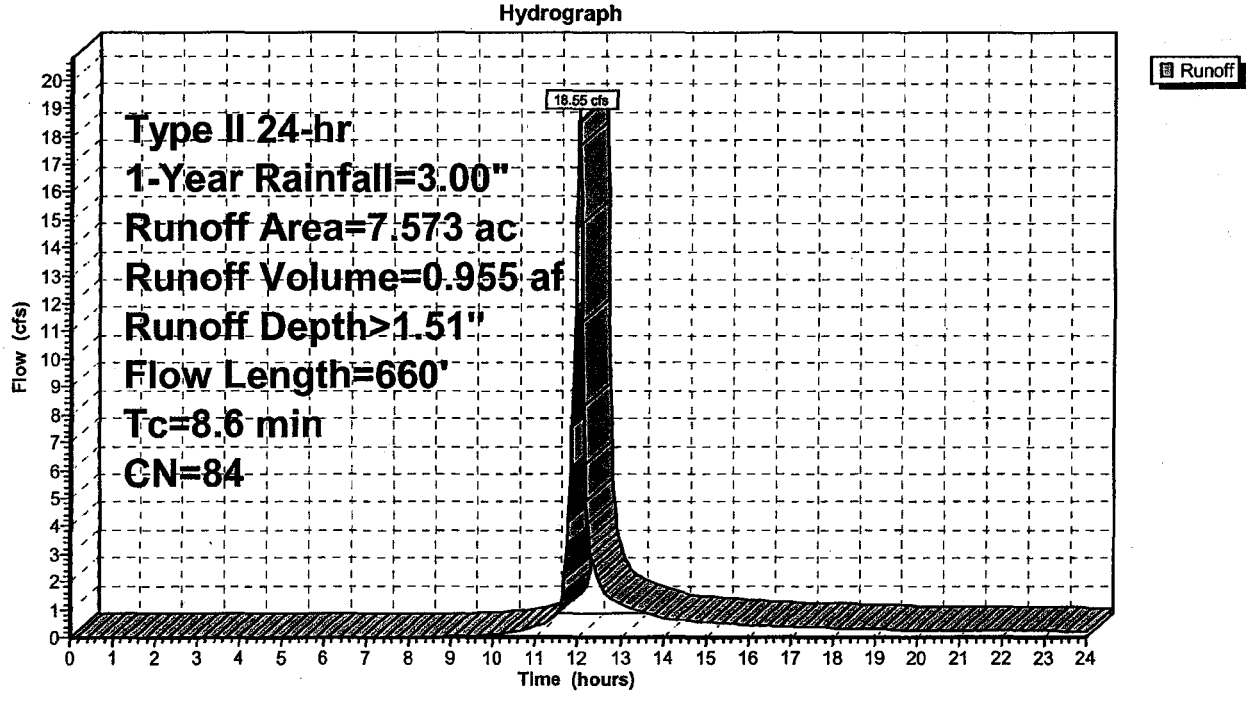
Runoff = 18.55 cfs @ 12.00 hrs, Volume= 0.955 af, Depth> 1.51"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.03 hrs
Type II 24-hr 1-Year Rainfall=3.00"

| | Area (ac) | CN | Description |
|---|---|---|---|
| * | 1.618 | 98 | Roads and Sidewalks Impervious Area |
| * | 1.683 | 98 | Impervious Area from 15 lots at 38% impervious per lot |
| | 4.272 | 74 | >75% Grass cover, Good, HSG C |
| | 7.573 | 84 | Weighted Average |
| | 5.315 | | 70.19% Pervious Area |
| | 2.258 | | 29.81% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 7.1 | 100 | 0.1000 | 0.24 | | **Sheet Flow,** Grass: Dense n= 0.240 P2= 3.60" |
| 1.0 | 152 | 0.0296 | 2.58 | | **Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps |
| 0.5 | 408 | 0.0334 | 13.16 | 41.34 | **Pipe Channel, Storm system** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013 |
| 8.6 | 660 | Total | | | |

### Subcatchment DA-Storm: DA - Tc (overland from Ashlock Ct then storm pipes)



## Summary for Pond 1P: Stonehouse Glen BMP #1 - Reocord Info

| | | | | | |
|---|---|---|---|---|---|
| Inflow Area = | 11.270 ac, | 24.58% Impervious, | Inflow Depth > | 1.85" | for 2-Year event |
| Inflow = | 30.77 cfs @ | 12.01 hrs, | Volume= | 1.736 af | |
| Outflow = | 2.57 cfs @ | 12.75 hrs, | Volume= | 1.016 af, | Atten= 92%, Lag= 44.6 min |
| Primary = | 2.57 cfs @ | 12.75 hrs, | Volume= | 1.016 af | |
| Secondary = | 0.00 cfs @ | 0.00 hrs, | Volume= | 0.000 af | |

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.03 hrs
Peak Elev= 80.63' @ 12.75 hrs Surf.Area= 10,453 sf Storage= 39,132 cf

Plug-Flow detention time= 277.3 min calculated for 1.015 af (58% of inflow)
Center-of-Mass det. time= 163.1 min ( 992.2 - 829.1 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 72.10' | 78,353 cf | **Custom Stage Data (Prismatic)** Listed below (Recalc) |

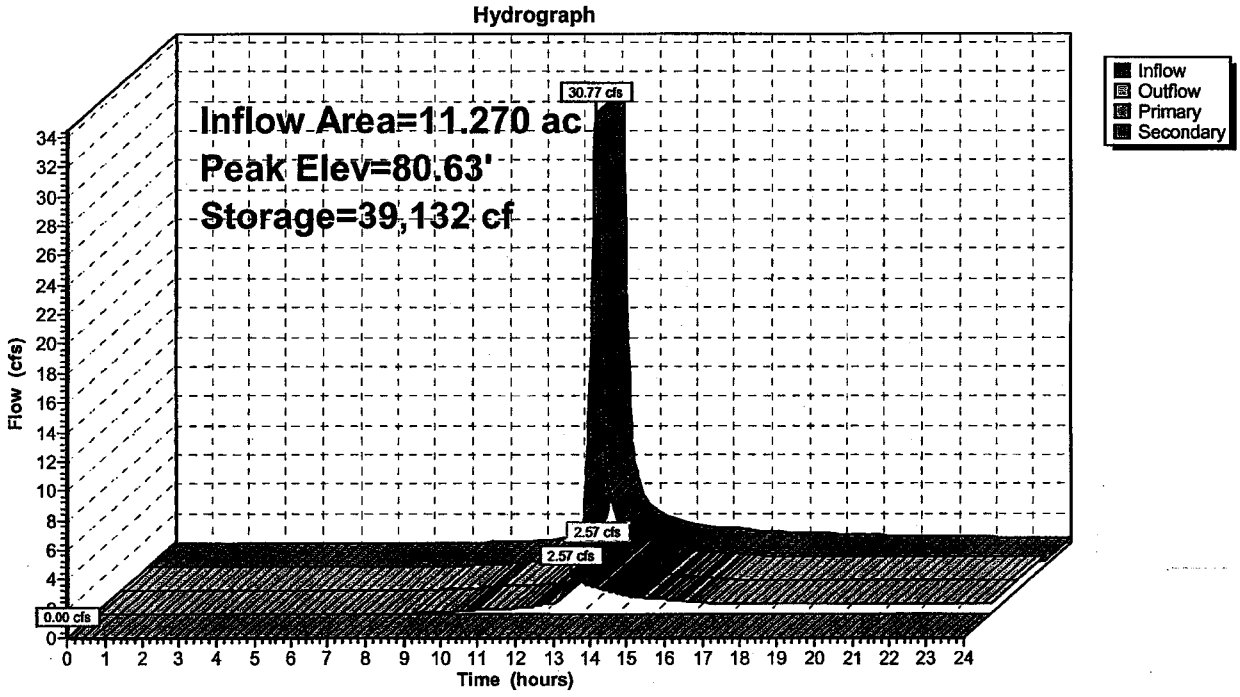
| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 72.10 | 400 | 0 | 0 |
| 74.00 | 1,650 | 1,948 | 1,948 |
| 76.00 | 3,780 | 5,430 | 7,378 |
| 78.00 | 6,280 | 10,060 | 17,438 |
| 80.00 | 9,195 | 15,475 | 32,913 |
| 82.00 | 13,170 | 22,365 | 55,278 |
| 83.60 | 15,675 | 23,076 | 78,353 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 68.11' | **30.0" Round Culvert**<br>L= 78.0' RCP, rounded edge headwall, Ke= 0.100<br>Inlet / Outlet Invert= 68.11' / 67.21' S= 0.0115 '/' Cc= 0.900<br>n= 0.013, Flow Area= 4.91 sf |
| #2 | Device 1 | 80.53' | **60.0" Horiz. Orifice/Grate** C= 0.600<br>Limited to weir flow at low heads |
| #3 | Device 1 | 70.38' | **3.0" Vert. Orifice/Grate** C= 0.600 |
| #4 | Secondary | 83.60' | **36.0 deg x 50.0' long Sharp-Crested Vee/Trap Weir**<br>Cv= 2.58 (C= 3.23) |

**Primary OutFlow** Max=2.45 cfs @ 12.75 hrs HW=80.63' (Free Discharge)
└─**1=Culvert** (Passes 2.45 cfs of 96.45 cfs potential flow)
  ├─**2=Orifice/Grate** (Weir Controls 1.70 cfs @ 1.05 fps)
  └─**3=Orifice/Grate** (Orifice Controls 0.75 cfs @ 15.32 fps)

**Secondary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=72.10' (Free Discharge)
└─**4=Sharp-Crested Vee/Trap Weir** ( Controls 0.00 cfs)

## Pond 1P: Stonehouse Glen BMP #1 - Reocord Info



## Summary for Subcatchment DA-BMP: DA - Tc (overland from Stonehouse Glen to the pond)

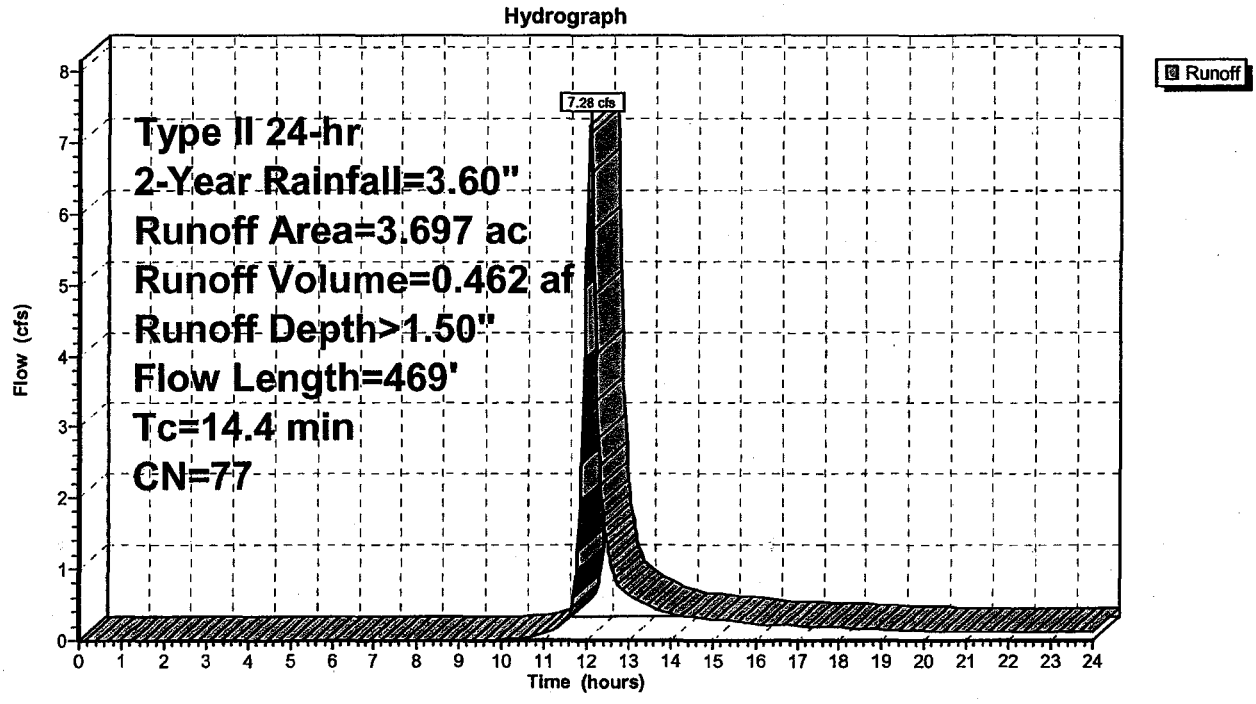
Runoff = 7.28 cfs @ 12.07 hrs, Volume= 0.462 af, Depth> 1.50"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.03 hrs
Type II 24-hr 2-Year Rainfall=3.60"

| | Area (ac) | CN | Description |
|---|---|---|---|
| * | 0.030 | 98 | Maintenance Road Impervious Area |
| * | 0.483 | 98 | Impervious Area on 5 Lots at 38% Impervious per Lot |
| | 3.184 | 74 | >75% Grass cover, Good, HSG C |
| | 3.697 | 77 | Weighted Average |
| | 3.184 | | 86.12% Pervious Area |
| | 0.513 | | 13.88% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 13.0 | 100 | 0.0600 | 0.13 | | **Sheet Flow, Sheet Flow**<br>Woods: Light underbrush n= 0.400 P2= 3.60" |
| 0.7 | 195 | 0.0974 | 4.68 | | **Shallow Concentrated Flow, Shallow Concentrated**<br>Grassed Waterway Kv= 15.0 fps |
| 0.7 | 174 | 0.0862 | 4.40 | | **Shallow Concentrated Flow, Shallow Concentrated**<br>Grassed Waterway Kv= 15.0 fps |
| 14.4 | 469 | Total | | | |

### Subcatchment DA-BMP: DA - Tc (overland from Stonehouse Glen to the pond)



## Summary for Subcatchment DA-Storm: DA - Tc (overland from Ashlock Ct then storm pipes)

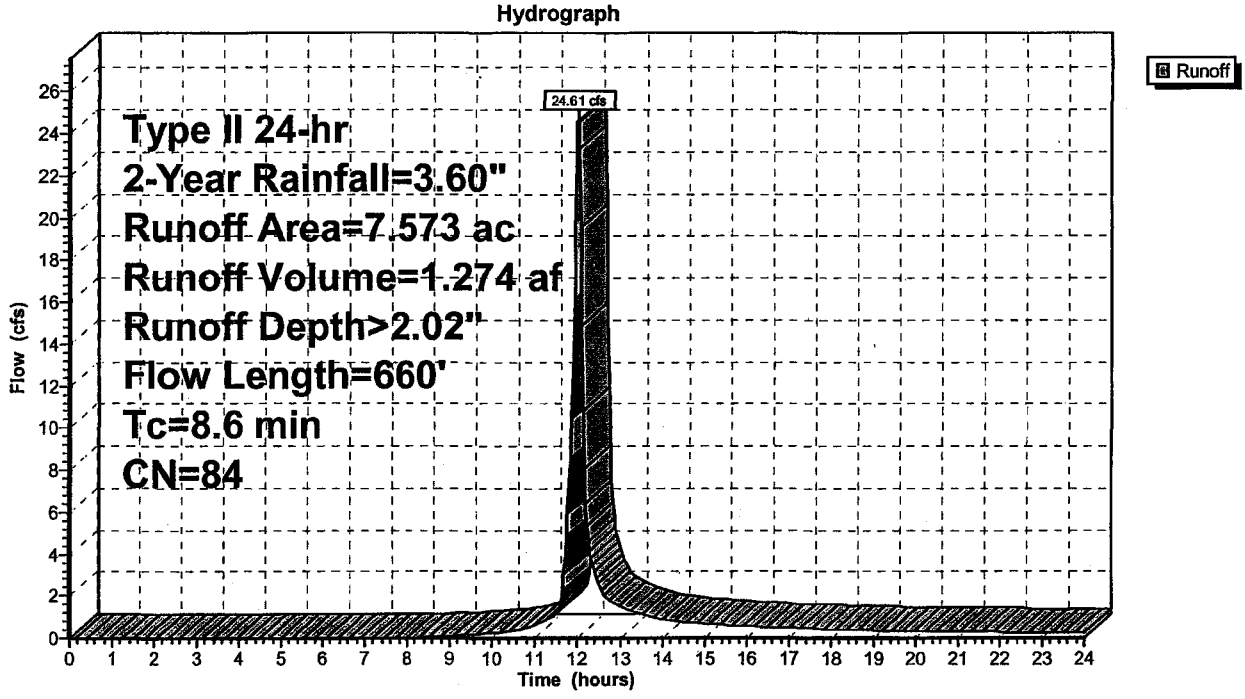
Runoff = 24.61 cfs @ 12.00 hrs, Volume= 1.274 af, Depth> 2.02"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.03 hrs
Type II 24-hr 2-Year Rainfall=3.60"

| | Area (ac) | CN | Description |
|---|---|---|---|
| * | 1.618 | 98 | Roads and Sidewalks Impervious Area |
| * | 1.683 | 98 | Impervious Area from 15 lots at 38% impervious per lot |
| | 4.272 | 74 | >75% Grass cover, Good, HSG C |
| | 7.573 | 84 | Weighted Average |
| | 5.315 | | 70.19% Pervious Area |
| | 2.258 | | 29.81% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 7.1 | 100 | 0.1000 | 0.24 | | **Sheet Flow,** Grass: Dense n= 0.240 P2= 3.60" |
| 1.0 | 152 | 0.0296 | 2.58 | | **Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps |
| 0.5 | 408 | 0.0334 | 13.16 | 41.34 | **Pipe Channel, Storm system** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013 |
| 8.6 | 660 | Total | | | |

### Subcatchment DA-Storm: DA - Tc (overland from Ashlock Ct then storm pipes)



## Summary for Pond 1P: Stonehouse Glen BMP #1 - Reocord Info

| | | | | | |
|---|---|---|---|---|---|
| Inflow Area = | 11.270 ac, | 24.58% Impervious, | Inflow Depth > | 3.68" | for 10-Year event |
| Inflow = | 60.08 cfs @ | 12.01 hrs, | Volume= | 3.455 af | |
| Outflow = | 46.86 cfs @ | 12.08 hrs, | Volume= | 2.595 af, | Atten= 22%, Lag= 4.3 min |
| Primary = | 46.86 cfs @ | 12.08 hrs, | Volume= | 2.595 af | |
| Secondary = | 0.00 cfs @ | 0.00 hrs, | Volume= | 0.000 af | |

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.03 hrs
Peak Elev= 81.46' @ 12.08 hrs Surf.Area= 12,095 sf Storage= 48,448 cf

Plug-Flow detention time= 135.9 min calculated for 2.592 af (75% of inflow)
Center-of-Mass det. time= 45.8 min ( 855.9 - 810.1 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 72.10' | 78,353 cf | **Custom Stage Data (Prismatic)** Listed below (Recalc) |

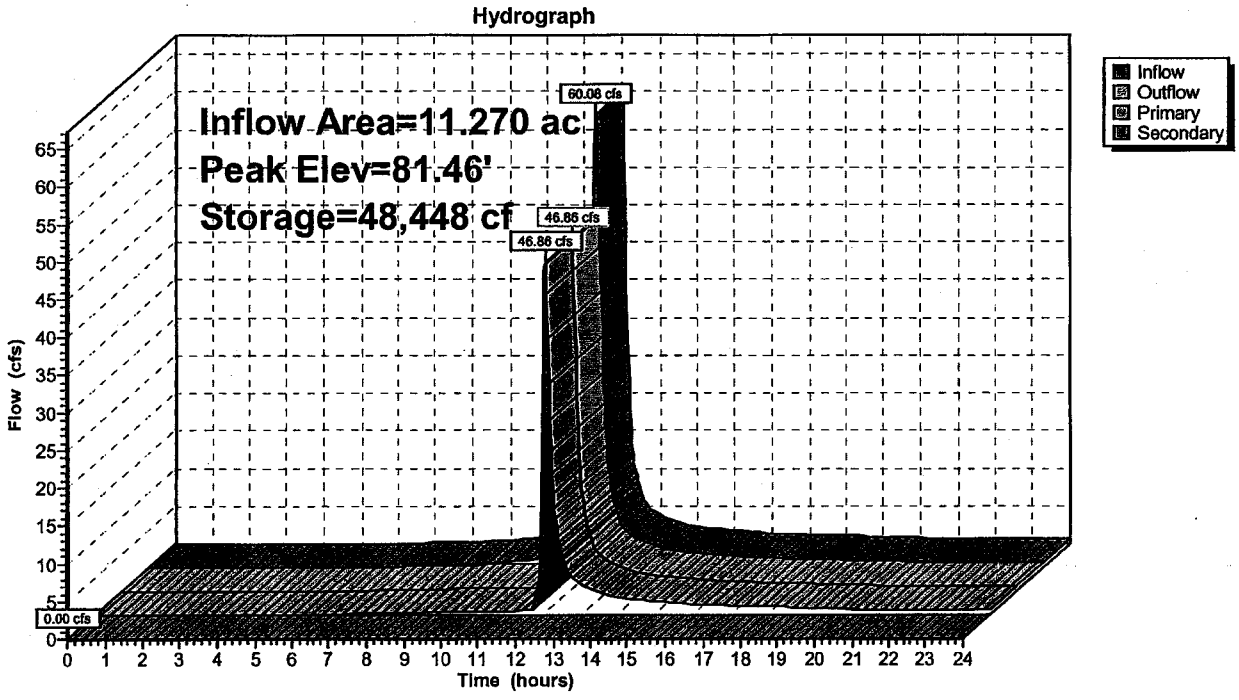
| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 72.10 | 400 | 0 | 0 |
| 74.00 | 1,650 | 1,948 | 1,948 |
| 76.00 | 3,780 | 5,430 | 7,378 |
| 78.00 | 6,280 | 10,060 | 17,438 |
| 80.00 | 9,195 | 15,475 | 32,913 |
| 82.00 | 13,170 | 22,365 | 55,278 |
| 83.60 | 15,675 | 23,076 | 78,353 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 68.11' | **30.0" Round Culvert**<br>L= 78.0' RCP, rounded edge headwall, Ke= 0.100<br>Inlet / Outlet Invert= 68.11' / 67.21' S= 0.0115 '/' Cc= 0.900<br>n= 0.013, Flow Area= 4.91 sf |
| #2 | Device 1 | 80.53' | **60.0" Horiz. Orifice/Grate** C= 0.600<br>Limited to weir flow at low heads |
| #3 | Device 1 | 70.38' | **3.0" Vert. Orifice/Grate** C= 0.600 |
| #4 | Secondary | 83.60' | **36.0 deg x 50.0' long Sharp-Crested Vee/Trap Weir**<br>Cv= 2.58 (C= 3.23) |

**Primary OutFlow** Max=46.25 cfs @ 12.08 hrs HW=81.45' (Free Discharge)
└─**1=Culvert** (Passes 46.25 cfs of 100.00 cfs potential flow)
  ├─**2=Orifice/Grate** (Weir Controls 45.47 cfs @ 3.14 fps)
  └─**3=Orifice/Grate** (Orifice Controls 0.78 cfs @ 15.93 fps)

**Secondary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=72.10' (Free Discharge)
└─**4=Sharp-Crested Vee/Trap Weir** ( Controls 0.00 cfs)

## Pond 1P: Stonehouse Glen BMP #1 - Reocord Info



## Summary for Subcatchment DA-BMP: DA - Tc (overland from Stonehouse Glen to the pond)

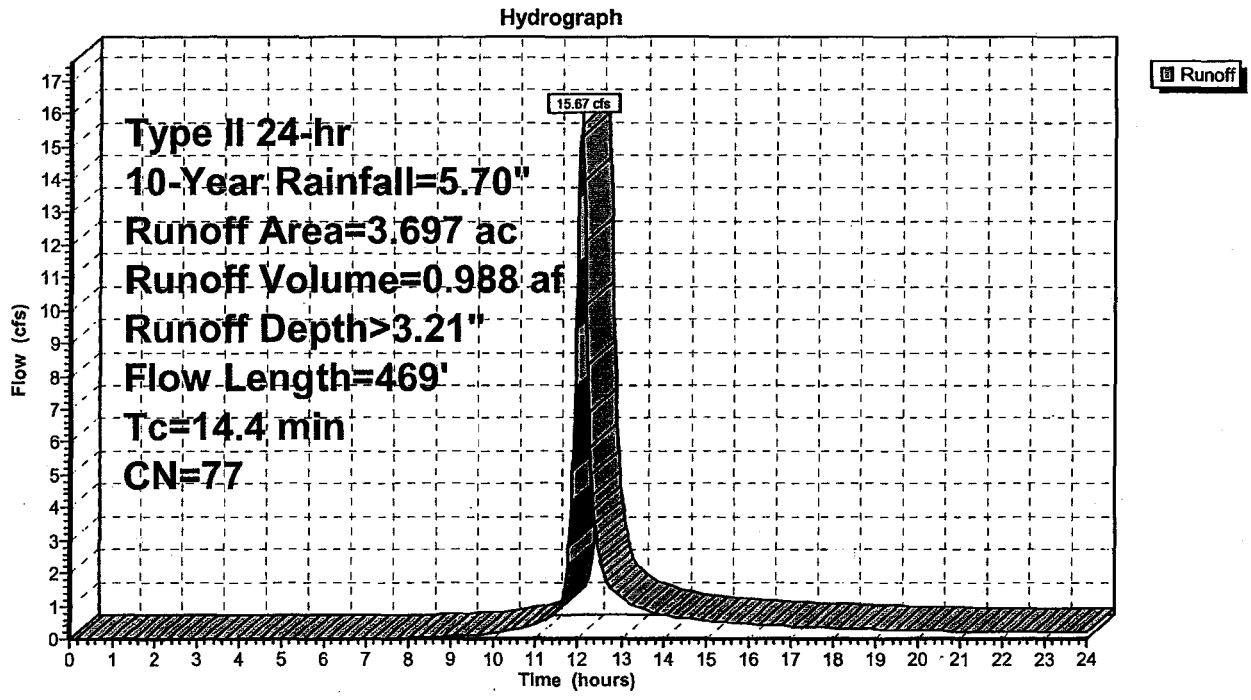
Runoff = 15.67 cfs @ 12.06 hrs, Volume= 0.988 af, Depth> 3.21"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.03 hrs
Type II 24-hr 10-Year Rainfall=5.70"

| | Area (ac) | CN | Description |
|---|---|---|---|
| * | 0.030 | 98 | Maintenance Road Impervious Area |
| * | 0.483 | 98 | Impervious Area on 5 Lots at 38% Impervious per Lot |
| | 3.184 | 74 | >75% Grass cover, Good, HSG C |
| | 3.697 | 77 | Weighted Average |
| | 3.184 | | 86.12% Pervious Area |
| | 0.513 | | 13.88% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 13.0 | 100 | 0.0600 | 0.13 | | **Sheet Flow, Sheet Flow**<br>Woods: Light underbrush n= 0.400 P2= 3.60" |
| 0.7 | 195 | 0.0974 | 4.68 | | **Shallow Concentrated Flow, Shallow Concentrated**<br>Grassed Waterway Kv= 15.0 fps |
| 0.7 | 174 | 0.0862 | 4.40 | | **Shallow Concentrated Flow, Shallow Concentrated**<br>Grassed Waterway Kv= 15.0 fps |
| 14.4 | 469 | Total | | | |

### Subcatchment DA-BMP: DA - Tc (overland from Stonehouse Glen to the pond)



## Summary for Subcatchment DA-Storm: DA - Tc (overland from Ashlock Ct then storm pipes)

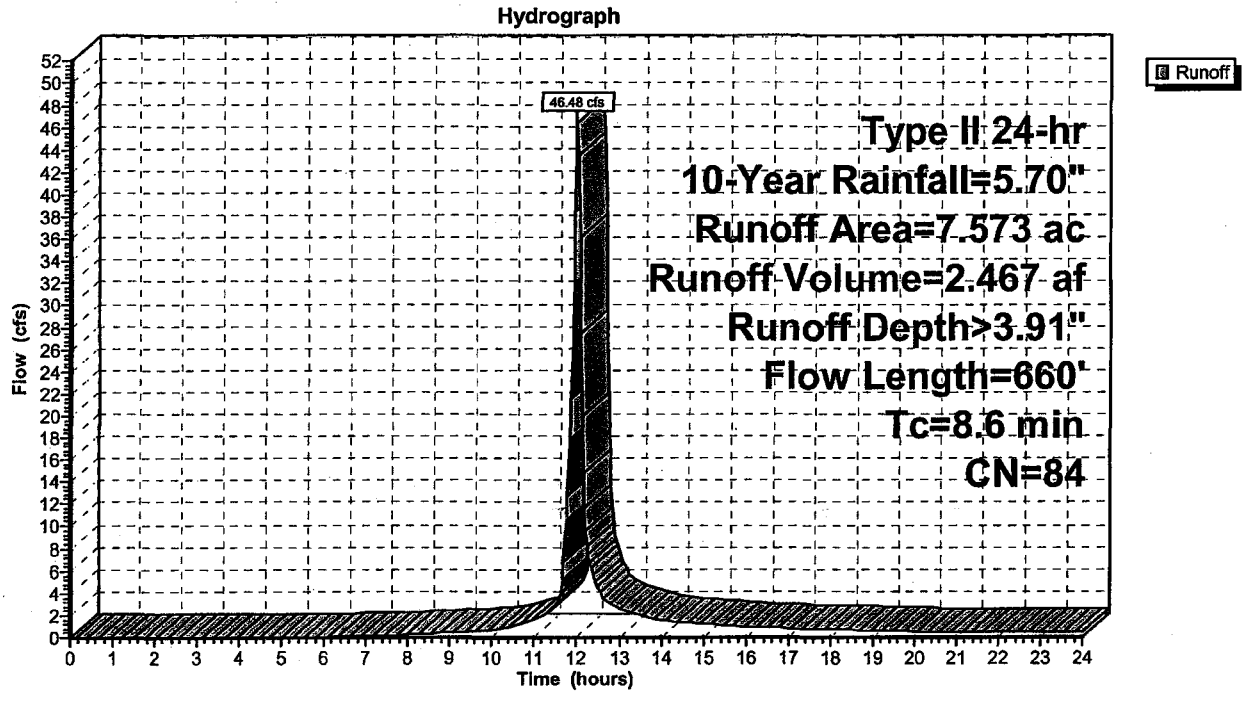
Runoff = 46.48 cfs @ 12.00 hrs, Volume= 2.467 af, Depth> 3.91"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.03 hrs
Type II 24-hr 10-Year Rainfall=5.70"

| | Area (ac) | CN | Description |
|---|---|---|---|
| * | 1.618 | 98 | Roads and Sidewalks Impervious Area |
| * | 1.683 | 98 | Impervious Area from 15 lots at 38% impervious per lot |
| | 4.272 | 74 | >75% Grass cover, Good, HSG C |
| | 7.573 | 84 | Weighted Average |
| | 5.315 | | 70.19% Pervious Area |
| | 2.258 | | 29.81% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 7.1 | 100 | 0.1000 | 0.24 | | **Sheet Flow,** Grass: Dense n= 0.240 P2= 3.60" |
| 1.0 | 152 | 0.0296 | 2.58 | | **Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps |
| 0.5 | 408 | 0.0334 | 13.16 | 41.34 | **Pipe Channel, Storm system** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013 |
| 8.6 | 660 | Total | | | |

### Subcatchment DA-Storm: DA - Tc (overland from Ashlock Ct then storm pipes)



## Summary for Pond 1P: Stonehouse Glen BMP #1 - Reocord Info

| | | | | | |
|---|---|---|---|---|---|
| Inflow Area = | 11.270 ac, | 24.58% Impervious, | Inflow Depth > | 5.81" | for 100-Year event |
| Inflow = | 92.88 cfs @ | 12.01 hrs, | Volume= | 5.460 af | |
| Outflow = | 86.74 cfs @ | 12.04 hrs, | Volume= | 4.583 af, | Atten= 7%, Lag= 2.2 min |
| Primary = | 86.74 cfs @ | 12.04 hrs, | Volume= | 4.583 af | |
| Secondary = | 0.00 cfs @ | 0.00 hrs, | Volume= | 0.000 af | |

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.03 hrs
Peak Elev= 81.94' @ 12.04 hrs Surf.Area= 13,049 sf Storage= 54,476 cf

Plug-Flow detention time= 100.5 min calculated for 4.583 af (84% of inflow)
Center-of-Mass det. time= 30.2 min ( 827.7 - 797.5 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 72.10' | 78,353 cf | **Custom Stage Data (Prismatic)** Listed below (Recalc) |

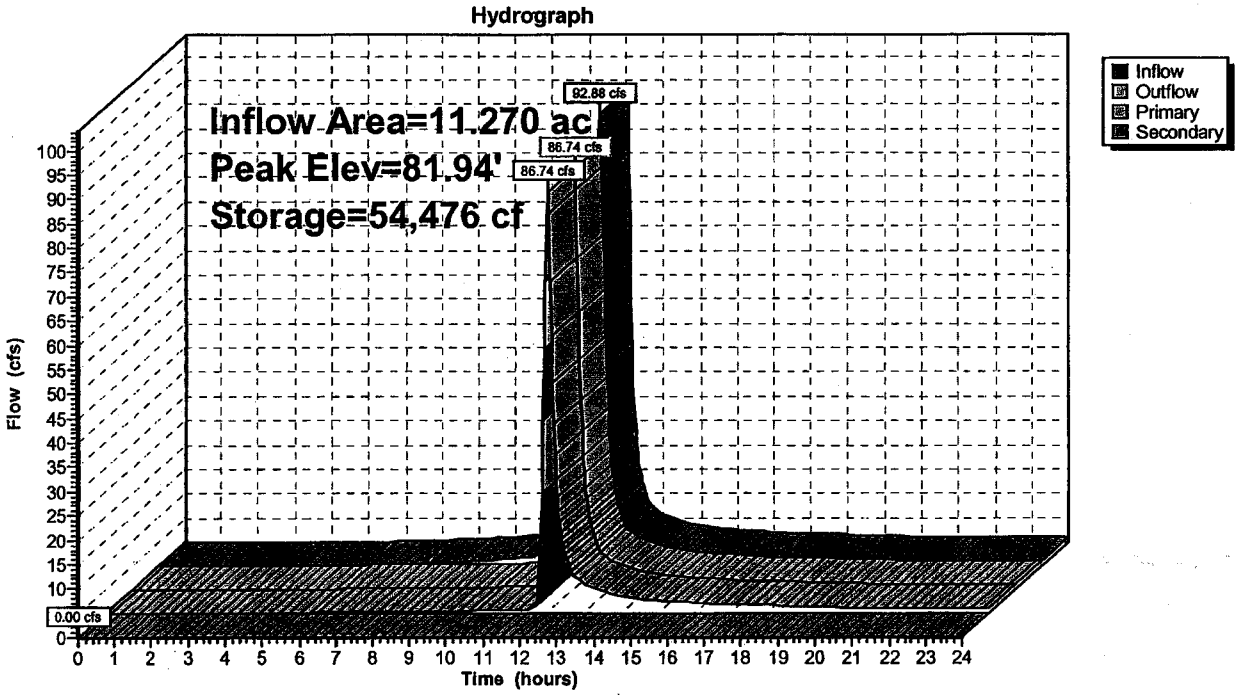
| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 72.10 | 400 | 0 | 0 |
| 74.00 | 1,650 | 1,948 | 1,948 |
| 76.00 | 3,780 | 5,430 | 7,378 |
| 78.00 | 6,280 | 10,060 | 17,438 |
| 80.00 | 9,195 | 15,475 | 32,913 |
| 82.00 | 13,170 | 22,365 | 55,278 |
| 83.60 | 15,675 | 23,076 | 78,353 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 68.11' | **30.0" Round Culvert**<br>L= 78.0' RCP, rounded edge headwall, Ke= 0.100<br>Inlet / Outlet Invert= 68.11' / 67.21' S= 0.0115 '/' Cc= 0.900<br>n= 0.013, Flow Area= 4.91 sf |
| #2 | Device 1 | 80.53' | **60.0" Horiz. Orifice/Grate** C= 0.600<br>Limited to weir flow at low heads |
| #3 | Device 1 | 70.38' | **3.0" Vert. Orifice/Grate** C= 0.600 |
| #4 | Secondary | 83.60' | **36.0 deg x 50.0' long Sharp-Crested Vee/Trap Weir**<br>Cv= 2.58 (C= 3.23) |

**Primary OutFlow** Max=85.84 cfs @ 12.04 hrs HW=81.93' (Free Discharge)
└─**1=Culvert** (Passes 85.84 cfs of 102.02 cfs potential flow)
  ├─**2=Orifice/Grate** (Weir Controls 85.04 cfs @ 3.87 fps)
  └─**3=Orifice/Grate** (Orifice Controls 0.80 cfs @ 16.27 fps)

**Secondary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=72.10' (Free Discharge)
└─**4=Sharp-Crested Vee/Trap Weir** ( Controls 0.00 cfs)

## Pond 1P: Stonehouse Glen BMP #1 - Reocord Info



## Summary for Subcatchment DA-BMP: DA - Tc (overland from Stonehouse Glen to the pond)

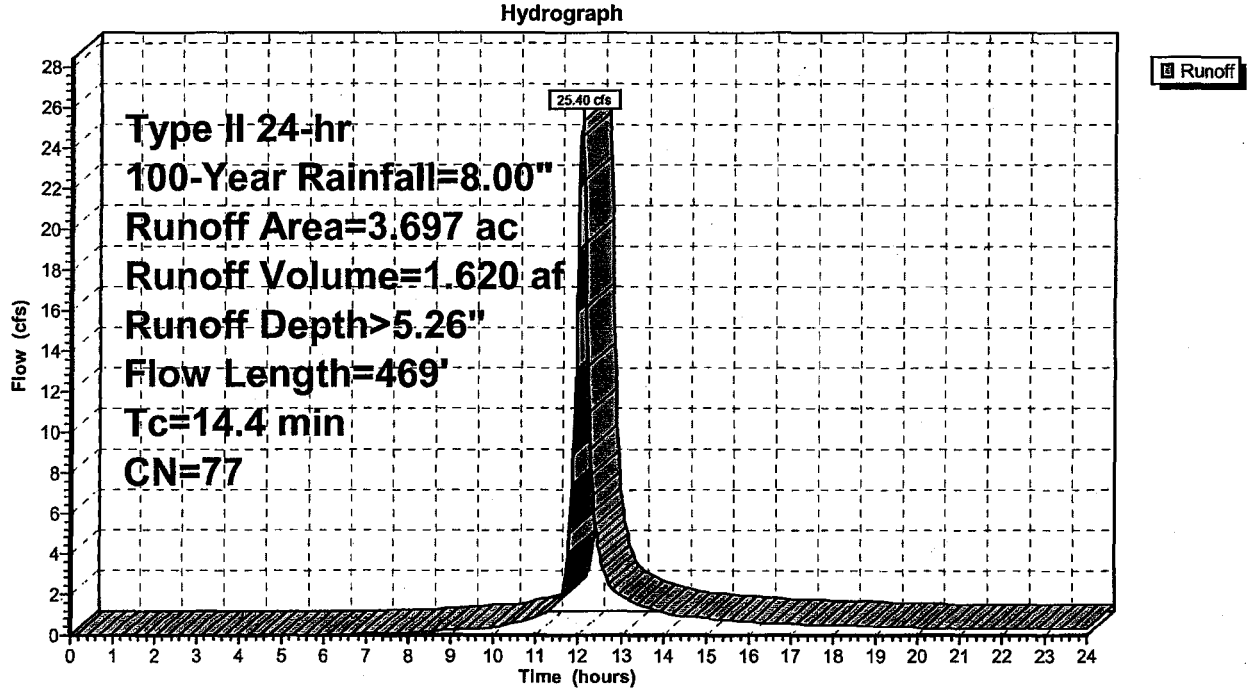
Runoff = 25.40 cfs @ 12.06 hrs, Volume= 1.620 af, Depth> 5.26"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.03 hrs
Type II 24-hr 100-Year Rainfall=8.00"

| | Area (ac) | CN | Description |
|---|---|---|---|
| * | 0.030 | 98 | Maintenance Road Impervious Area |
| * | 0.483 | 98 | Impervious Area on 5 Lots at 38% Impervious per Lot |
| | 3.184 | 74 | >75% Grass cover, Good, HSG C |
| | 3.697 | 77 | Weighted Average |
| | 3.184 | | 86.12% Pervious Area |
| | 0.513 | | 13.88% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 13.0 | 100 | 0.0600 | 0.13 | | **Sheet Flow, Sheet Flow** Woods: Light underbrush n= 0.400 P2= 3.60" |
| 0.7 | 195 | 0.0974 | 4.68 | | **Shallow Concentrated Flow, Shallow Concentrated** Grassed Waterway Kv= 15.0 fps |
| 0.7 | 174 | 0.0862 | 4.40 | | **Shallow Concentrated Flow, Shallow Concentrated** Grassed Waterway Kv= 15.0 fps |
| 14.4 | 469 | Total | | | |

### Subcatchment DA-BMP: DA - Tc (overland from Stonehouse Glen to the pond)



## Summary for Subcatchment DA-Storm: DA - Tc (overland from Ashlock Ct then storm pipes)

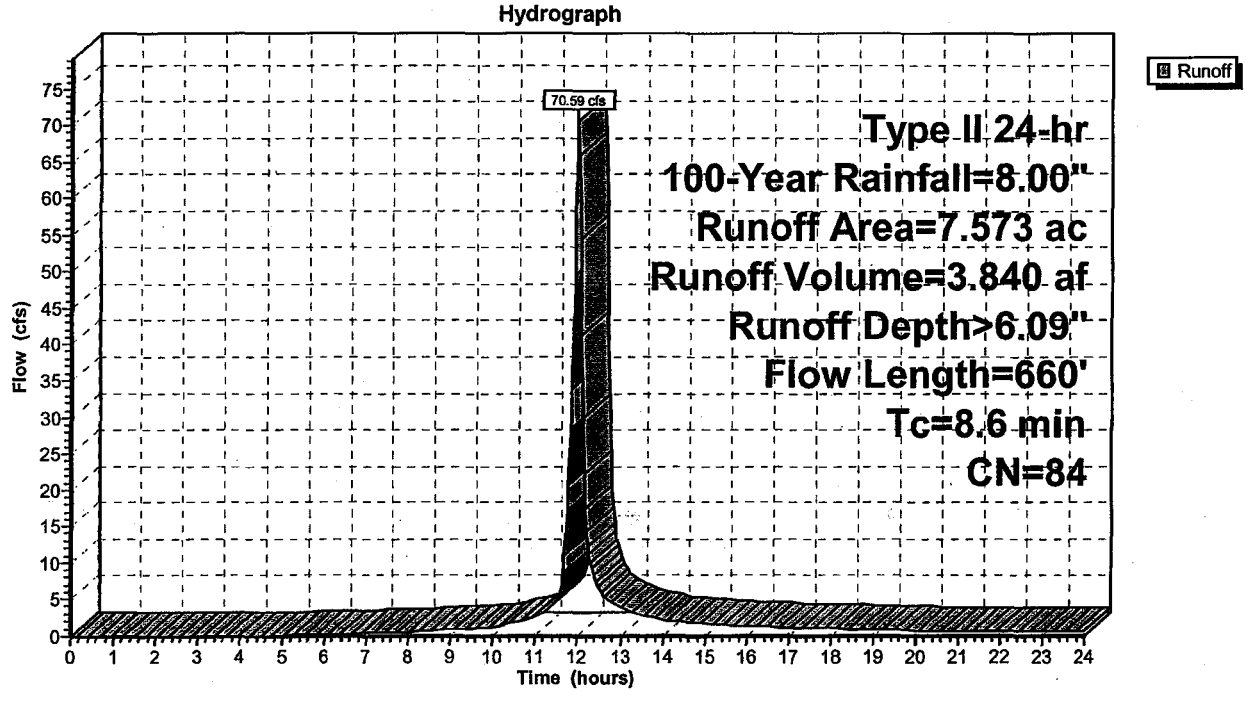
Runoff = 70.59 cfs @ 12.00 hrs, Volume= 3.840 af, Depth> 6.09"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.03 hrs
Type II 24-hr 100-Year Rainfall=8.00"

| | Area (ac) | CN | Description |
|---|---|---|---|
| * | 1.618 | 98 | Roads and Sidewalks Impervious Area |
| * | 1.683 | 98 | Impervious Area from 15 lots at 38% impervious per lot |
| | 4.272 | 74 | >75% Grass cover, Good, HSG C |
| | 7.573 | 84 | Weighted Average |
| | 5.315 | | 70.19% Pervious Area |
| | 2.258 | | 29.81% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 7.1 | 100 | 0.1000 | 0.24 | | **Sheet Flow,** Grass: Dense n= 0.240 P2= 3.60" |
| 1.0 | 152 | 0.0296 | 2.58 | | **Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps |
| 0.5 | 408 | 0.0334 | 13.16 | 41.34 | **Pipe Channel, Storm system** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013 |
| 8.6 | 660 | Total | | | |

## Subcatchment DA-Storm: DA - Tc (overland from Ashlock Ct then storm pipes)



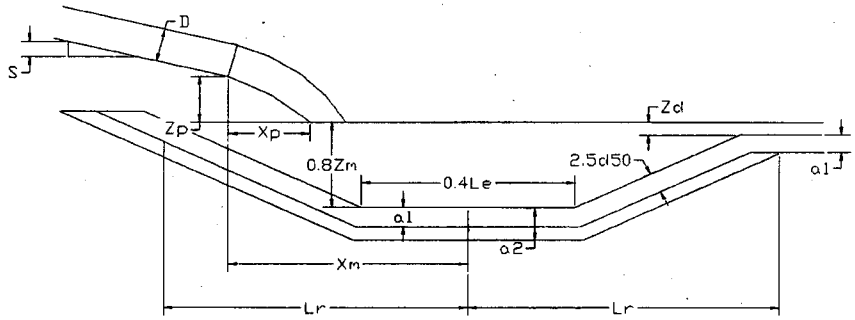
# STILLING BASIN SIZING CALCULATIONS

COMPUTATION SHEET
Design Note No. 6

U.S. DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| STATE | VA | PROJECT: | Stonehouse Glen BMP Outfall Repair | | | | | | |
| BY | PS | DATE: | 4/13/2012 | CHECKED BY | | DATE | | JOB NO. | 33315.01 |
| SUBJECT: | BMP Outfall | | | | | SHEET | 1 | of | 2 |

## Riprap Lined Plunge Pool




| GIVEN: | | | | | |
|---|---|---|---|---|---|
| Flow Rate "Q" | 86.74 | cfs | Riprap stone Density | 2.64 | |
| Pipe Diameter "D" | 2.5 | ft | Pipe slope | 0.012 | ft/ft |
| Drop from pipe to w.s. "Zp" | 1 | ft | Median Stone size "d50" | 1.5 | ft |
| Depth of Tail water "Zd" | 0 | ft | Filter Thickness | 1 | ft |

| Solution: | | | |
|---|---|---|---|
| Pipe Velocity "Vo" | 17.7 fps | Projection Velocity "Vp" | 21.4 fps |
| Horizontal Velocity "Vh" | 17.7 fps | Impact Distance "Xp" | 6.5 ft |
| Vertical Velocity "Vv" | 12.0 fps | Froude Number | 2.40 |

| | |
|---|---|
| Punge Pool Depth "Zm" | 4.23 ft |
| Distance from Outlet end of pipe to center of Pool "Xm" | 11.0 ft |

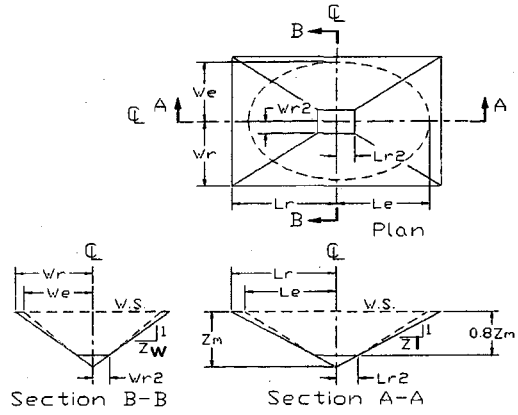
| Riprap Size Check | Adequate |
|---|---|

COMPUTATION SHEET
Design Note No. 6

U.S. DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

| | | | | | |
|---|---|---|---|---|---|
| STATE | | PROJECT | | | |
| BY | PS | DATE | CHECKED BY | DATE | JOB NO. 33315.01 |
| SUBJECT | | | | SHEET | 2 of 2 |

| PLUNGE POOL DIMENISONS: | |
|---|---|
| Depth at Center of Pool | 3.0 ft |
| Le = | 11.0 ft |
| We = | 7.2 ft |
| Lr2 = | 2.0 ft |
| Wr2 = | 1.5 ft |
| Zl = | 3.7:1 |
| Lr = | 11.3 ft |
| Zw = | 1.5 |
| Wr = | 8.0 ft |
| Check Lr | OK |




107.3-106.823

| AREAS: | |
|---|---|
| A1 = | 364.2006 sqft |
| A2 = | 9.1 sqft |
| A1a1 = | 1546.488 sqft |
| A2a1 = | 20.19588 sqft |
| A1a2 = | 2000.152 sqft |
| A2a2 = | 23.86985 sqft |

| VOLUMES: | |
|---|---|
| Va1 = | 150.0706 cyds |
| Va2 = | 220.7191 cyds |
| Vao= | 17.13512 cyds |
| **Riprap =** | **132.9355** cyds |
| **Filter =** | **70.6485** cyds |

# DRAINAGE AREA MAPS

**ECS Mid-Atlantic, LLC**
**108 Ingram Road**
**Suite 1**
**Williamsburg, VA 23188**
**(757) 229-6677 [Phone]**
**(757) 229-9978 [Fax]**

# LETTER OF TRANSMITTAL

| | |
|---|---|
| January 14, 2013 | RE: **Stonehouse Glen BMP Outfall Repair** |
| VHB, Inc.<br>351 McLaws Circle, Suite 3<br>Williamsburg, VA 23185 | ECS Job # **07:11716**<br>Permits: |
| ATTN: Mr. Piotr Swietuchowski, P.E. | Location: **9304 Stonehouse Glen**<br>**Toano, VA** |

We are enclosing:

X Materials Engineering Division Reports
X For your use
X As requested

ENCL:

| | | |
|---|---|---|
| Field Report # 1 | 01/09/2013 | undercut |

COMMONWEALTH OF VIRGINIA
W. LLOYD WARD
No. 0346
JAN 14 2013
PROFESSIONAL ENGINEER

W. Lloyd Ward
Branch Manager, Principal Engineer

Brent C. Williams
Project Engineer

**ECS Mid-Atlantic, LLC**
108 Ingram Road
Suite 1
Williamsburg, VA 23188
(757) 229-6677 [Phone]
(757) 229-9978 [Fax]

# FIELD REPORT

| | |
|---|---|
| Project No. | 07:11716 |
| Report No. | 1 |
| Day & Date | Wednesday 01/09/2013 |
| Weather | 65°/ Sunny |
| On-Site Time | 1.50 |
| Lab Time | 0.25 |
| Travel Time* | 1.00 |
| Total | 2.75 |
| Re Obs.Time | 0.00 |

| | |
|---|---|
| Project | Stonehouse Glen BMP Outfall Repair |
| Location | Toano, VA |
| Client | VHB, Inc. - Piotr Swietuchowski, P.E. |

Remarks **undercut**

Trip Charges* Tolls/Parking* Mileage* **40**

Chargeable Items

| Time of | Arrival | Departure |
|---|---|---|
| | 12:30P | 02:00P |

* Travel time and mileage will be billed in accordance with the contract.

**Summary of Services Performed (field test data, locations, elevations & depths are estimates) & Individuals Contacted.**

The undersigned arrived on site, as requested, to observe the undercutting of unsuitable material from the future BMP location. While on-site, the undersigned observed the undercut of soils from station number 9+73 to station number 10+00. The undersigned verified the depth of the undercut to be 2 feet below the design elevation.

Using a 1.75 inch steel probe, the undersigned probed the exposed material. The undersigned observed penetrations of approximately 3-4 inches and based on the proposed backfill this area was approved for continuing construction activities.

By **Brent C. Williams** 1300

189651

**ECS Mid-Atlantic, LLC**
**108 Ingram Road**
**Suite 1**
**Williamsburg, VA 23188**
**(757) 229-6677 [Phone]**
**(757) 229-9978 [Fax]**

# LETTER OF TRANSMITTAL

| | |
|---|---|
| January 16, 2013 | RE: **Stonehouse Glen BMP Outfall Repair** |
| VHB, Inc.<br>351 McLaws Circle, Suite 3<br>Williamsburg, VA 23185 | ECS Job # **07:11716**<br>Permits: |
| ATTN: Mr. Piotr Swietuchowski, P.E. | Location: **9304 Stonehouse Glen**<br>**Toano, VA** |

We are enclosing:

X Materials Engineering Division Reports
X For your use
X As requested

ENCL:

| | | |
|---|---|---|
| Field Report # 2 | 01/11/2013 | undercut |

COMMONWEALTH OF VIRGINIA
W. LLOYD WARD
No. 034613
JAN 16 2013
PROFESSIONAL ENGINEER

W. Lloyd Ward
Branch Manager, Principal Engineer

Brent C. Williams
Project Engineer

**ECS Mid-Atlantic, LLC**
108 Ingram Road
Suite 1
Williamsburg, VA 23188
(757) 229-6677 [Phone]
(757) 229-9978 [Fax]

# FIELD REPORT

| | |
|---|---|
| Project No. | 07:11716 |
| Report No. | 2 |
| Day & Date | Friday 01/11/2013 |
| Weather | 50°/ Cloudy |
| On-Site Time | 2.00 |
| Lab Time | 0.25 |
| Travel Time* | 1.25 |
| Total | 3.50 |
| Re Obs.Time | 0.00 |

| | |
|---|---|
| Project | Stonehouse Glen BMP Outfall Repair |
| Location | Toano, VA |
| Client | VHB, Inc. - Piotr Swietuchowski, P.E. |

Remarks **undercut**

Trip Charges* Tolls/Parking* Mileage* **40**

Chargeable Items

| Time of | Arrival | Departure |
|---|---|---|
| | 12:00P | 02:00P |

* Travel time and mileage will be billed in accordance with the contract.

**Summary of Services Performed (field test data, locations, elevations & depths are estimates) & Individuals Contacted.**

The undersigned arrived on site, as requested, to observe the continuation of undercutting and backfilling of material for the future BMP.

While on-site, the undersigned observed the contractor backfilling the first section (station number 10+00 to 9+73) of the BMP with #57 stone, #3 stone and fabric. Due to poor site conditions and impending rain, the contractor placed additional soil within this first section to assist with the stabilization of the work area. This area was built higher than required, and will be cut down to the designed elevation after the next section of work has been completed. ECS will continue to monitor the undercutting and backfilling per the recommendations made by ECS Williamsburg.

By **Brent C. Williams** 1300

189764

**ECS Mid-Atlantic, LLC**
**108 Ingram Road**
**Suite 1**
**Williamsburg, VA 23188**
**(757) 229-6677 [Phone]**
**(757) 229-9978 [Fax]**

# LETTER OF TRANSMITTAL

| | |
|---|---|
| January 25, 2013 | RE: **Stonehouse Glen BMP Outfall Repair** |
| VHB, Inc.<br>351 McLaws Circle, Suite 3<br>Williamsburg, VA 23185 | ECS Job # **07:11716**<br>Permits: |
| ATTN: Mr. Piotr Swietuchowski, P.E. | Location: **9304 Stonehouse Glen**<br>**Toano, VA** |

We are enclosing:

X Materials Engineering Division Reports
X For your use
X As requested

ENCL:

| | | |
|---|---|---|
| Field Report # 3 | 01/23/2013 | undercut |

COMMONWEALTH OF VIRGINIA
W. LLOYD WARD
JAN 25 2013
PROFESSIONAL ENGINEER

W. Lloyd Ward No. 034612
Branch Manager, Principal Engineer

Brent C. Williams
Project Engineer

**ECS Mid-Atlantic, LLC**
108 Ingram Road
Suite 1
Williamsburg, VA 23188
(757) 229-6677 [Phone]
(757) 229-9978 [Fax]

# FIELD REPORT

| | |
|---|---|
| Project No. | 07:11716 |
| Report No. | 3 |
| Day & Date | Wednesday 01/23/2013 |
| Weather | 30°/ Sunny |
| On-Site Time | 2.00 |
| Lab Time | 0.25 |
| Travel Time* | 1.50 |
| Total | 3.75 |
| Re Obs.Time | 0.00 |

| | |
|---|---|
| Project | Stonehouse Glen BMP Outfall Repair |
| Location | Toano, VA |
| Client | VHB, Inc. - Piotr Swietuchowski, P.E. |

Remarks **undercut**

Trip Charges* Tolls/Parking* Mileage* **80**

Chargeable Items

| Times of | Arrival | Departure |
|---|---|---|
| | 09:00A | 10:00A |
| | 01:00P | 02:00P |

* Travel time and mileage will be billed in accordance with the contract.

**Summary of Services Performed (field test data, locations, elevations & depths are estimates) & Individuals Contacted.**

The undersigned arrived on site, as requested, to observe the undercutting of unsuitable material from the future BMP location. While on-site, the undersigned observed the undercut of soils from station number 9+73 to station number 9+57. The undersigned verified the depth of the undercut to be approximately 2 feet below the design elevation.

Using a 1.75 inch steel probe, the undersigned probed the exposed material. The undersigned observed penetrations of approximately 2-3 inches and based on the proposed backfill this area was approved for continuing construction activities.

Later in the day, the undersigned returned to the site to observe coninued construction activitites. The undersigned observed the contractor attempt to stablize the previosly undercut area from this date by adding 18-24 inches of additional material to assist with the stabilization of soils to move to the next section. The contractor informed the udersigned that the operation will continue on 1/24/13 and that ECS will be contacted to observe the next 20-25 foot section.

By **Brent C. Williams** 1300

190538

**ECS MID-ATLANTIC, LLC** *"Setting the Standard for Service"*
Geotechnical • Construction Materials • Environmental • Facilities

January 29, 2013

Mr Ken McDermott c/o
Piotr Swietuchowski
VHB, Inc.
351 McLaws Circle, Suite 3
Williamsburg, Virginia 23185

ECS Project No. 07:11716

Reference: Step Pool Stream Slope Recommendations
Stonehouse Glen BMP Outfall Repair
Williamsburg, Virginia

Dear Mr. McDermott:

ECS Mid-Atlantic, LLC (ECS) was recently requested by you to observe and provide recommendations for the Step Pool Stream slopes that have experienced sloughing at the above referenced project site.

ECS personnel visited the site on January 28 and 29, 2013 and met with representatives of VHB, Barrs, and the County to observe the existing condition of the side slopes that have experienced sloughing. Portions of the existing slopes are at a slope of 1H:1V or less in areas and have experienced some sloughing. It was discussed that in the present condition and considering the steepness of the existing slope, a formal slope stability exploration including slope stability analysis would be required to provide additional recommendations. Alternatively, if the top of the slope could be extended beyond the limits of clearing approximately half way to the property line, this would allow for a flatter more stable slope that was closer to 1.5H:1V or greater. Therefore, based on our discussions it was decided to provide additional space within the property line to lay the slopes back. However, even with the slopes modified as discussed, due to water exiting the slope at approximately 6 feet above the structure locations, we recommend the slopes be armored with Class I or II Rip-Rap which should underlain by a non-woven fabric.

Therefore, we recommend that the slopes be flattened as much as possible with the revised project limits as discussed with the county. The side slopes in the areas between approximately Stations 9+57 and 8+98 will need to be stabilized with rip-rap to approximately 6 feet above the structure elevations. These elevations vary throughout the noted station locations. The wet sloughed soil material will need to be removed where necessary and the slope covered with a non-woven geotextile fabric. The surface of the fabric will be covered with rip-rap. The

purpose of a non-woven geotextile fabric is to allow water to freely pass through the rip-rap material, but not allow the fines to wash out through the rip-rap. The rip-rap will add surface pressure on the fabric to add stability. The rip-rap should be placed to the approximately 6 feet above the structure elevations along the slope and will range from an approximate thickness of 1 foot at the top to approximately 3 feet at the very bottom of the sloughed area. The initial thicker layer at the bottom of the slope is recommended to be larger Class II Rip-Rap and the additional rip rap tapering up the slope can be a Class I Rip-Rap. The thicker section at the bottom of the slope should help with constructability and overall slope stability.

This letter has been prepared in order to aid in the evaluation of this site and to assist the project team in determining the appropriate course of action. The letter report scope is limited to the specific project and location described, and the project description represents our understanding of the significant aspects relevant to earthwork construction.

We appreciate being of continued service to you during this project and look forward to its successful completion. If you should have any questions regarding the information and recommendations contained in this report or if we can be of any further assistance, please contact our office.

Respectfully,

ECS Mid-Atlantic, LLC

W. Lloyd Ward, P.E.
Principal Engineer

Michael J. Galli, P.E.
Principal Engineer

COMMONWEALTH OF VIRGINIA
W. LLOYD WARD
Lic. No. 034612
PROFESSIONAL ENGINEER

**ECS Mid-Atlantic, LLC**
**108 Ingram Road**
**Suite 1**
**Williamsburg, VA 23188**
**(757) 229-6677 [Phone]**
**(757) 229-9978 [Fax]**

# LETTER OF TRANSMITTAL

| | |
|---|---|
| January 30, 2013 | RE: **Stonehouse Glen BMP Outfall Repair** |
| VHB, Inc.<br>351 McLaws Circle, Suite 3<br>Williamsburg, VA 23185 | ECS Job # **07:11716**<br>Permits: |
| ATTN: Mr. Piotr Swietuchowski, P.E. | Location: **9304 Stonehouse Glen**<br>**Toano, VA** |

We are enclosing:

X Materials Engineering Division Reports
X For your use
X As requested

ENCL:

| | | |
|---|---|---|
| Field Report # 5 | 01/25/2013 | undercut |

COMMONWEALTH OF VIRGINIA
W. LLOYD WARD
No. 0346
PROFESSIONAL ENGINEER
JAN 30 2013

W. Lloyd Ward
Branch Manager, Principal Engineer

Brent C. Williams
Project Engineer

**ECS Mid-Atlantic, LLC**
108 Ingram Road
Suite 1
Williamsburg, VA 23188
(757) 229-6677 [Phone]
(757) 229-9978 [Fax]

# FIELD REPORT

| | |
|---|---|
| Project No. | 07:11716 |
| Report No. | 5 |
| Day & Date | Friday 01/25/2013 |
| Weather | 30°/ Cloudy |
| On-Site Time | 1.00 |
| Lab Time | 0.25 |
| Travel Time* | 1.25 |
| Total | 2.50 |
| Re Obs.Time | 0.00 |

| | |
|---|---|
| Project | Stonehouse Glen BMP Outfall Repair |
| Location | Toano, VA |
| Client | VHB, Inc. - Piotr Swietuchowski, P.E. |

Remarks **undercut**

Trip Charges* Tolls/Parking* Mileage* **40**

Chargeable Items

| Time of | Arrival | Departure |
|---|---|---|
| | 12:00P | 01:00P |

* Travel time and mileage will be billed in accordance with the contract.

**Summary of Services Performed (field test data, locations, elevations & depths are estimates) & Individuals Contacted.**

The undersigned arrived on site, as requested, to observe the undercutting of unsuitable material from the future BMP location. While on-site, the undersigned observed the undercut of soils from station number 9+27 to station number 9+10. The undersigned verified the depth of the undercut to be approximately 2 feet below the design elevation.

Using a 1.75 inch steel probe, the undersigned probed the exposed material. The undersigned observed penetrations of approximately 3-4 inches. The contractor will continue to undercut and backfill as timely as possible.

By **Brent C. Williams** 1300

190632

**ECS Mid-Atlantic, LLC**
**108 Ingram Road**
**Suite 1**
**Williamsburg, VA 23188**
**(757) 229-6677 [Phone]**
**(757) 229-9978 [Fax]**

# LETTER OF TRANSMITTAL

| | |
|---|---|
| February 7, 2013 | RE: **Stonehouse Glen BMP Outfall Repair** |
| VHB, Inc.<br>351 McLaws Circle, Suite 3<br>Williamsburg, VA 23185 | ECS Job # **07:11716**<br>Permits: |
| ATTN: Mr. Piotr Swietuchowski, P.E. | Location: **9304 Stonehouse Glen**<br>**Toano, VA** |

We are enclosing:

X Materials Engineering Division Reports
X For your use
X As requested

ENCL:

| | |
|---|---|
| Field Report # 6 | 01/30/2013 |
| Field Report # 7 | 02/04/2013 |

COMMONWEALTH OF VIRGINIA
W. LLOYD WARD
FEB 6 2013
PROFESSIONAL ENGINEER

W. Lloyd Ward No. 034612
Branch Manager, Principal Engineer

Brent C. Williams
Project Engineer

**ECS Mid-Atlantic, LLC**
108 Ingram Road
Suite 1
Williamsburg, VA 23188
(757) 229-6677 [Phone]
(757) 229-9978 [Fax]

# FIELD REPORT

| | |
|---|---|
| Project No. | 07:11716 |
| Report No. | 6 |
| Day & Date | Wednesday 01/30/2013 |
| Weather | 70°/ Cloudy |
| On-Site Time | 1.00 |
| Lab Time | 0.25 |
| Travel Time* | 1.25 |
| Total | 2.50 |
| Re Obs.Time | 0.00 |

| | |
|---|---|
| Project | Stonehouse Glen BMP Outfall Repair |
| Location | Toano, VA |
| Client | VHB, Inc. - Piotr Swietuchowski, P.E. |

Remarks

Trip Charges* Tolls/Parking* Mileage* 40

Chargeable Items

| Time of | Arrival | Departure |
|---|---|---|
| | 01:30P | 02:30P |

* Travel time and mileage will be billed in accordance with the contract.

**Summary of Services Performed (field test data, locations, elevations & depths are estimates) & Individuals Contacted.**

The undersigned arrived on site, as requested, to observe the undercutting of unsuitable material from the future step pool stream location. While on-site, the undersigned verified the total undercut of soils from station number 10+00 to station number 9+89. The undersigned verified the average depth of the undercut to be approximately 2 feet below the design elevation.

Due to failing slopes, the contractor needed to place additional soil material at the toe of the slope to assist with the stabilization of soils from station number 10+00 to station number 9+89. The contactor has completed the undercut and backfill process proposed by ECS, as well as the placement of #57 stone, #3 stone and the placement of the required non-woven fabric and geo-grid.

The contractor will begin the rough grading and placement of rip-rap stone during the next week of work.

By **Brent C. Williams** 1300

190904

**ECS Mid-Atlantic, LLC**
108 Ingram Road
Suite 1
Williamsburg, VA 23188
(757) 229-6677 [Phone]
(757) 229-9978 [Fax]

# FIELD REPORT

| | |
|---|---|
| Project No. | 07:11716 |
| Report No. | 7 |
| Day & Date | Monday 02/04/2013 |
| Weather | 35°/ Cloudy |
| On-Site Time | 1.00 |
| Lab Time | 0.25 |
| Travel Time* | 1.25 |
| Total | 2.50 |
| Re Obs.Time | 0.00 |

| | |
|---|---|
| Project | Stonehouse Glen BMP Outfall Repair |
| Location | Toano, VA |
| Client | VHB, Inc. - Piotr Swietuchowski, P.E. |

Remarks

Trip Charges* Tolls/Parking* Mileage* 40

Chargeable Items

| Time of | Arrival | Departure |
|---|---|---|
| | 12:30P | 01:30P |

* Travel time and mileage will be billed in accordance with the contract.

**Summary of Services Performed (field test data, locations, elevations & depths are estimates) & Individuals Contacted.**

The undersigned arrived on site, as requested, to observe continuing construction activities. While on-site, the undersigned observed the rough grading of the step pool from approximately station number 9+89 to 9+75. The undersigned observed the placement of Class II rip-rap on both sides of the step pool. While on-site, the undersigned observed the contractor placing rip-rap on the slopes on both sides of the step pool. The contractor informed the undersigned that this operation would continue for the remainder of this week. ECS will continue to monitor the construction of the step pool, as well as to monitor the conditions of the slopes on each side of the step poll.

By **Brent C. Williams** 1300

191040

**ECS Mid-Atlantic, LLC**
**108 Ingram Road**
**Suite 1**
**Williamsburg, VA 23188**
**(757) 229-6677 [Phone]**
**(757) 229-9978 [Fax]**

# LETTER OF TRANSMITTAL

February 15, 2013

VHB, Inc.
351 McLaws Circle, Suite 3
Williamsburg, VA 23185

ATTN: Mr. Piotr Swietuchowski, P.E.

RE: **Stonehouse Glen BMP Outfall Repair**

ECS Job # **07:11716**

Permits:

Location: **9304 Stonehouse Glen**
**Toano, VA**

We are enclosing:

X Materials Engineering Division Reports
X For your use
X As requested

ENCL:

Field Report # 8 02/12/2013

COMMONWEALTH OF VIRGINIA
C. B. SCOTT GRESHAM
No. 037785
FEB 15 2013
PROFESSIONAL ENGINEER

Scott Gresham, P.E.
Construction Services Manager

Brent C. Williams
Project Engineer

**ECS Mid-Atlantic, LLC**
108 Ingram Road
Suite 1
Williamsburg, VA 23188
(757) 229-6677 [Phone]
(757) 229-9978 [Fax]

# FIELD REPORT

| | |
|---|---|
| Project No. | 07:11716 |
| Report No. | 8 |
| Day & Date | Tuesday 02/12/2013 |
| Weather | 55°/ Sunny |
| On-Site Time | 1.50 |
| Lab Time | 0.25 |
| Travel Time* | 1.25 |
| Total | 3.00 |
| Re Obs.Time | 0.00 |

| | |
|---|---|
| Project | Stonehouse Glen BMP Outfall Repair |
| Location | Toano, VA |
| Client | VHB, Inc. - Piotr Swietuchowski, P.E. |

Remarks

Trip Charges* Tolls/Parking* Mileage* 40

Chargeable Items

| Time of | Arrival | Departure |
|---|---|---|
| | 10:00A | 11:30A |

* Travel time and mileage will be billed in accordance with the contract.

**Summary of Services Performed (field test data, locations, elevations & depths are estimates) & Individuals Contacted.**

The undersigned arrived on site, as requested, to observe continued construction activities at the BMP step pool.

While on-site, the undersigned observed the stabilization of slopes via the usage of class II rip-rap from station number 9+75 to 9+43. During the construction process, the undersigned observed the shearing away of material within the slope. The undersigned estimated the height of the rip-rap placed on this date to be between 4-5 feet higher than the designed finished elevations. This is an increase of the 3 foot completed rip-rap elevation that was recommended by ECS P.E. W. Lloyd Ward. The undersigned will continue to monitor the stabilization of the slopes on-site as needed by C.A. Barrs.

By **Brent C. Williams** 1300

191292

**ECS Mid-Atlantic, LLC**
**108 Ingram Road**
**Suite 1**
**Williamsburg, VA 23188**
**(757) 229-6677 [Phone]**
**(757) 229-9978 [Fax]**

# LETTER OF TRANSMITTAL

February 25, 2013

VHB, Inc.
351 McLaws Circle, Suite 3
Williamsburg, VA 23185

ATTN: Mr. Piotr Swietuchowski, P.E.

RE: **Stonehouse Glen BMP Outfall Repair**

ECS Job # **07:11716**

Permits:

Location: **9304 Stonehouse Glen**
**Toano, VA**

We are enclosing:

X Materials Engineering Division Reports
X For your use
X As requested

ENCL:

| | |
|---|---|
| Field Report # 9 | 02/15/2013 |
| Field Report # 11 | 02/18/2013 |
| Field Report # 12 | 02/21/2013 |

COMMONWEALTH OF VIRGINIA
W. LLOYD WARD
No. 03461
PROFESSIONAL ENGINEER
FEB 25 2013

W. Lloyd Ward
Branch Manager, Principal Engineer

Brent C. Williams
Project Engineer

**ECS Mid-Atlantic, LLC**
108 Ingram Road
Suite 1
Williamsburg, VA 23188
(757) 229-6677 [Phone]
(757) 229-9978 [Fax]

# FIELD REPORT

| | |
|---|---|
| Project No. | 07:11716 |
| Report No. | 9 |
| Day & Date | Friday 02/15/2013 |
| Weather | 40°/ Sunny |
| On-Site Time | 1.00 |
| Lab Time | 0.00 |
| Travel Time* | 1.25 |
| Total | 2.25 |
| Re Obs.Time | 0.00 |

| | |
|---|---|
| Project | Stonehouse Glen BMP Outfall Repair |
| Location | Toano, VA |
| Client | VHB, Inc. - Piotr Swietuchowski, P.E. |

Remarks

Trip Charges* Tolls/Parking* Mileage* 40

Chargeable Items

| Time of | Arrival | Departure |
|---|---|---|
| | 08:00A | 09:00A |

* Travel time and mileage will be billed in accordance with the contract.

**Summary of Services Performed (field test data, locations, elevations & depths are estimates) & Individuals Contacted.**

An engineering representative of ECS visited the site to observe a section of the step pool stream where the rip-rap needed to be extended up the slope. Additionally, we discussed that the rip-rap at the toe was having to be increased to 5 feet deep in order to stay stable during excavation of the step pool structure. The rip-rap that extends up the slope needs to be a combination of Class 2 and Class 1 due to the instability that is present from recent weather events. An ECS representative will be on-site to provide measurements for help in quantifying the rip-rap as additional construction takes place.

By **W. Lloyd Ward, — Branch Manager, Principal Engineer** 1100

191378

**ECS Mid-Atlantic, LLC**
108 Ingram Road
Suite 1
Williamsburg, VA 23188
(757) 229-6677 [Phone]
(757) 229-9978 [Fax]

# FIELD REPORT

| | |
|---|---|
| Project No. | 07:11716 |
| Report No. | 11 |
| Day & Date | Monday 02/18/2013 |
| Weather | 40°/ Sunny |
| On-Site Time | 0.50 |
| Lab Time | 0.25 |
| Travel Time* | 1.25 |
| Total | 2.00 |
| Re Obs.Time | 0.00 |

| | |
|---|---|
| Project | Stonehouse Glen BMP Outfall Repair |
| Location | Toano, VA |
| Client | VHB, Inc. - Piotr Swietuchowski, P.E. |

Remarks

Trip Charges* Tolls/Parking* Mileage* 40

Chargeable Items

| Time of | Arrival | Departure |
|---|---|---|
| | 01:00P | 01:30P |

* Travel time and mileage will be billed in accordance with the contract.

**Summary of Services Performed (field test data, locations, elevations & depths are estimates) & Individuals Contacted.**

The undersigned arrived on site, as requested, to observe continuing construction activities for the step pool. While on-site, the undersigned observed the placement of CLass II rip-rap from approximately station number 9+17 to 9+27. It was estimated that the height of the rip-rap placed on this date terminated approximately 12 feet above the final designed elevation of the structure. Site conditions were difficult due to rain from the previous day, therefore the contractor stopped the placement of rip-rap and began to remove saturated and unstable soils from the slope area. No measurements for the slope area were taken on this date.

By **Brent C. Williams** 1300

191519

**ECS Mid-Atlantic, LLC**
108 Ingram Road
Suite 1
Williamsburg, VA 23188
(757) 229-6677 [Phone]
(757) 229-9978 [Fax]

# FIELD REPORT

| | |
|---|---|
| Project No. | 07:11716 |
| Report No. | 12 |
| Day & Date | Thursday 02/21/2013 |
| Weather | 40°/ Sunny |
| On-Site Time | 1.00 |
| Lab Time | 0.25 |
| Travel Time* | 1.25 |
| Total | 2.50 |
| Re Obs.Time | 0.00 |

| | |
|---|---|
| Project | Stonehouse Glen BMP Outfall Repair |
| Location | Toano, VA |
| Client | VHB, Inc. - Piotr Swietuchowski, P.E. |

Remarks

Trip Charges* Tolls/Parking* Mileage* 40

Chargeable Items

| Time of | Arrival | Departure |
|---|---|---|
| | 02:30P | 03:30P |

* Travel time and mileage will be billed in accordance with the contract.

**Summary of Services Performed (field test data, locations, elevations & depths are estimates) & Individuals Contacted.**

The undersigned arrived on site, as requested, to observe continuing construction activities for the future step pool. While on-site, the undersigned observed the placement of Class II rip-rap from approximately station number 9+27 to 9+57. The undersigned continued observation of the removal of unstable soils from the slopes on both sides on the future step pool. Measurements were taken in an attempt to help quantify the material removed on this date. The dimensions recorded were as follows: approximately 30 feet in length, 15 feet in height and 3.5 feet in depth.

It was estimated that the height of the rip-rap placed on this date terminated approximately 10-14 feet above the final designed elevation of the structure.
The placement of rip-rap was completed on this date.

By **Brent C. Williams** 1300

191700

**ECS Mid-Atlantic, LLC**
**108 Ingram Road**
**Suite 1**
**Williamsburg, VA 23188**
**(757) 229-6677 [Phone]**
**(757) 229-9978 [Fax]**

# LETTER OF TRANSMITTAL

February 25, 2013

VHB, Inc.
351 McLaws Circle, Suite 3
Williamsburg, VA 23185

ATTN: Mr. Piotr Swietuchowski, P.E.

RE: **Stonehouse Glen BMP Outfall Repair**

ECS Job # **07:11716**

Permits:

Location: **9304 Stonehouse Glen**
**Toano, VA**

We are enclosing:

X Materials Engineering Division Reports
X For your use
X As requested

ENCL:

Field Report # 10 02/15/2013

COMMONWEALTH OF VIRGINIA
W. LLOYD WARD
No. 0346
FEB 25 2013
PROFESSIONAL ENGINEER

W. Lloyd Ward
Branch Manager, Principal Engineer

Brent C. Williams
Project Engineer

**ECS Mid-Atlantic, LLC**
108 Ingram Road
Suite 1
Williamsburg, VA 23188
(757) 229-6677 [Phone]
(757) 229-9978 [Fax]

# FIELD REPORT

| | |
|---|---|
| Project No. | 07:11716 |
| Report No. | 10 |
| Day & Date | Friday 02/15/2013 |
| Weather | 55°/ Sunny |
| On-Site Time | 1.50 |
| Lab Time | 0.25 |
| Travel Time* | 2.50 |
| Total | 4.25 |
| Re Obs.Time | 0.00 |

| | |
|---|---|
| Project | Stonehouse Glen BMP Outfall Repair |
| Location | Toano, VA |
| Client | VHB, Inc. - Piotr Swietuchowski, P.E. |

Remarks

Trip Charges* Tolls/Parking* Mileage* 80

Chargeable Items

| Times of | Arrival | Departure |
|---|---|---|
| | 09:00A | 09:30A |
| | 01:00P | 02:00P |

* Travel time and mileage will be billed in accordance with the contract.

**Summary of Services Performed (field test data, locations, elevations & depths are estimates) & Individuals Contacted.**

The undersigned arrived on site, as requested, to observe continuing construction activities. While on-site the undersigned observed the removal of unstable material from the slopes on both sides of the step pool.

While on-site the undersigned observed the excavation of soils from the slopes from approximately station number 8+87 to station number 9+27. The estimated dimensions of the undercut on this date were measured to be 40 feet long by 17.5 feet high by 3.5 feet in depth. Each of these measurements are to be applied on both slopes.

Later in the afternoon, the undersigned returned to the site to visually observe the placement of 2 layers of Class I and Class II rip-rap. There was approximately 20 tons of Class I and 60 tons of Class II rip-rap placed on this date.

By **Brent C. Williams** 1300

191379

**ECS Mid-Atlantic, LLC**
**108 Ingram Road**
**Suite 1**
**Williamsburg, VA 23188**
**(757) 229-6677 [Phone]**
**(757) 229-9978 [Fax]**

# LETTER OF TRANSMITTAL

| | |
|---|---|
| March 4, 2013 | RE: **Stonehouse Glen BMP Outfall Repair** |
| VHB, Inc.<br>351 McLaws Circle, Suite 3<br>Williamsburg, VA 23185 | ECS Job # **07:11716** |
| | Permits: |
| ATTN: Mr. Piotr Swietuchowski, P.E. | Location: **9304 Stonehouse Glen**<br>**Toano, VA** |

We are enclosing:

X Materials Engineering Division Reports
X For your use
X As requested

ENCL:

Field Report # 13 02/28/2013

COMMONWEALTH OF VIRGINIA
W. LLOYD WARD
No. 03461
PROFESSIONAL ENGINEER
MAR 4 2013

W. Lloyd Ward
Branch Manager, Principal Engineer

Brent C. Williams
Project Engineer

**ECS Mid-Atlantic, LLC**
108 Ingram Road
Suite 1
Williamsburg, VA 23188
(757) 229-6677 [Phone]
(757) 229-9978 [Fax]

# FIELD REPORT

| | |
|---|---|
| Project No. | 07:11716 |
| Report No. | 13 |
| Day & Date | Thursday 02/28/2013 |
| Weather | 40°/ Cloudy |
| On-Site Time | 2.00 |
| Lab Time | 0.25 |
| Travel Time* | 1.25 |
| Total | 3.50 |
| Re Obs.Time | 0.00 |

| | |
|---|---|
| Project | Stonehouse Glen BMP Outfall Repair |
| Location | Toano, VA |
| Client | VHB, Inc. - Piotr Swietuchowski, P.E. |

Remarks

Trip Charges* Tolls/Parking* Mileage* 40

Chargeable Items

| Time of | Arrival | Departure |
|---|---|---|
| | 01:00P | 03:00P |

* Travel time and mileage will be billed in accordance with the contract.

**Summary of Services Performed (field test data, locations, elevations & depths are estimates) & Individuals Contacted.**

The undersigned arrived on site, as requested, to observe continuing construction activities. While on-site, the undersigned observed the #57 stone from approximately station number 8+98 to 9+09, to aide and assist with the de-watering of the designed step pool trench. Approximately 8-10 inches of standing water was observed within the above stated area. The contractor informed the undersigned that the location being addressed on this date would be rough graded for the placement of the first structure on 3/1/13.

By **Brent C. Williams** 1300

192078

**Report of Subsurface Investigation and Geotechnical Engineering Services**
**Fieldstone Parkway Extended**
**James City County, Virginia**
**GET Project No: WM03-429G**
**October 31, 2003**
**Prepared For: LandMark Design Group**

SP-108-02
2ND SUB

Summary
- 6-12" Topsoil Removal.
- Muck 12-18" in Low Areas.
- Dewatering of excavations is expected.
- Onsite geotech recommended.

JAN 2004
RECEIVED
PLANNING DEPARTMENT

GET Solutions, Inc

Geotechnical
Environmental
Testing
Solutions, Inc.

October 31, 2003

TO: **LandMark Design Group**
4029 Ironbound Road
Suite 100
Williamsburg, Virginia 23188

Attn: Mr. Norman Mason, L.S.

RE: Report of Subsurface Investigation and Geotechnical Engineering Services
**Fieldstone Parkway Extended**
James City County, Virginia
**GET** Project No: WM03-429G

Dear Mr. Mason:

In compliance with your instructions, we have completed our Geotechnical Engineering Services for the referenced project. The results of this study, together with our recommendations, are presented in this report.

Often, because of design and construction details that occur on a project, questions arise concerning subsurface conditions. **G E T Solutions, Inc.** would be pleased to continue its role as Geotechnical Engineer during the project final design phase and implementation.

We trust that the information contained herein meets your immediate need, and we would ask that you call this office with any questions that you may have.

Respectfully Submitted,
**G E T Solutions, Inc.**

James R. Wheeler
Staff Geologist

Camille A. Kattan, P. E.
Principal Engineer
VA Lic. # 18045

COMMONWEALTH OF VIRGINIA
10/31/03
Camille A. Kattan
No.018045
PROFESSIONAL ENGINEER

Copies: (3) Client

1592 Penniman Road, Suite E • Williamsburg, VA 23185 • Phone: (757)-564-6452 • Fax: (757)-564-6453
info@getsolutionsinc.com

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## EXECUTIVE SUMMARY

The proposed development at this site is planned to consist of extending the existing Fieldstone Parkway alignment southeastward to intersect with Six Mount Zion Road. The proposed Fieldstone Parkway extension would begin at the current intersection with Mill Pond Run, generally continue southeastward, and terminate at the proposed intersection with Six Mount Zion Road. The proposed alignment will include the following:

- Approximately 6,000 linear feet of pavement
- Two lane road approximately 25 feet in width
- Fills of up to 30 feet within the ravines will be required to establish the design grades
- A minimum of one culvert crossing consisting of a single 8-foot by 10-foot concrete box
- Installation of drainage system on both sides of the proposed alignment and a proposed paved bike/pedestrian pathway along one side of the proposed alignment

Our field exploration program included five (5) SPT borings and four (4) hand auger borings to various depths within the proposed alignment. In addition, twelve (12) CBR samples were obtained from various subgrade elevations along the proposed alignment. A brief description of the subsurface soil conditions is noted below:

- CBR and Boring Locations - 5 to 11 inches of topsoil, underlain by the natural subsurface soils which generally consisted of SAND (SP-SM, SM, SC) with varying amounts of Clay and Silt and/or CLAY (CL, CH).
- Groundwater was encountered at some of the boring locations at depths ranging from approximately 4 to 20 feet below existing grades.

The results of the field exploration activities in conjunction with our laboratory testing program were used in determining various construction scenarios/ recommendations as listed below:

- Settlement associated with the fill at Station 83+50 (up to 30 feet) was considered the point of maximum fill height. Settlement at this location is estimated to be 2.25 inches with about 75% of the settlement occurring during construction.
- Stability of the proposed embankments constructed at a 2H:1V have a safety factor of at least 1.3.
- Some undercutting during construction should be anticipated due to the presence of clayey subgrade soils that could deteriorate during construction.
- Appears to be insufficient amount of on-site (cut) material available for reuse as fill for site balancing based on our subsurface investigation.

Based on the laboratory test results (12 CBRs) and our experience with similar soil conditions the following minimum flexible pavement sections are typically used in this area:

- Stable Subgrade - Compacted to 100% of the theoretical maximum dry density as determined by VTM-1
- 6.0 to 8.0 inches of Cement Treated Aggregate Base Material meeting 21-B gradation
- 3 inches of Asphalt Base – Type BM-25.0
- 1.5 inches of Surface Asphalt – Type SM-12.5

All materials and construction procedures should comply with the VDOT Road and Bridge Specifications. This summary briefly discusses some of the major topics mentioned in the attached report. Accordingly, this report should be read in its entirety to thoroughly evaluate the contents.

# 1.0 PROJECT INFORMATION

## 1.1 Project Authorization:

**G E T Solutions, Inc.** has completed our Geotechnical Engineering study for the Fieldstone Parkway Extended project in James City County, Virginia. Authorization to proceed with the services was obtained from Mr. Norman Mason, L.S. with LandMark Design Group.

## 1.2 Project Description:

The proposed development at this site is planned to consist of extending the existing Fieldstone Parkway alignment southeastward to intersect with Six Mount Zion Road. The existing Fieldstone Parkway begins at the intersection with Route 30, which is the entrance to the Stonehouse development and continues generally southeastward and currently terminates at the intersection with Mill Pond Run. The proposed Fieldstone Parkway extension would begin at the current intersection with Mill Pond Run and continue generally southeastward through the woods and terminate at the proposed intersection with Six Mount Zion Road.

The proposed Fieldstone Parkway extension upon completion will be approximately 6,000 linear feet, from Mill Pond Run to Six Mount Zion Road within the Stonehouse development in James City County, Virginia. The proposed alignment will be a two lane road approximately 25 feet in width, with at least one culvert crossing consisting of a single 8-foot by 10-foot concrete box. The box culvert will be located at Station 72+00. Substantial cut and fill operations will be required in establishing the design grades of the proposed roadway, with maximum fill heights on the order of 30 feet and maximum cut heights on the order of 15 feet. The proposed roadway design grades will range from 58 to 116 feet. The proposed development also includes the installation of a drainage system and a paved bike/pedestrian pathway.

If any of the noted information is incorrect or has changed, please inform **G E T Solutions, Inc.** so that we may amend the recommendations presented in this report, if appropriate.

## 1.3 Purpose and Scope of Services:

The purpose of this study was to obtain information of the general subsurface conditions at the proposed project site. The subsurface conditions encountered were then evaluated with respect to the available project characteristics. In this regard, engineering assessments for the following items were formulated:

1. General assessment of the soils revealed by the borings performed within the proposed roadway alignment.

2. General location and description of potentially deleterious material encountered in the borings that may interfere with construction progress, including existing fills or surficial/subsurface organics.

3. Soil subgrade preparation, including stripping, grading and compaction. Engineering criteria for placement and compaction of approved structural fill material.

4. Construction considerations for clearing, grading, fill placement and subgrade preparation.

5. Suitability of on-site (cut) material for reuse as select fill.

6. Pavement design recommendations based on our field and laboratory testing program (6 SPT borings, 6 hand auger borings and 12 CBR tests) and our experience with similar soil conditions.

7. Long-term and short-term embankment settlement analysis.

8. Embankment stability analysis.

The scope of services did not include an environmental assessment for determining the presence or absence of wetlands or hazardous or toxic material in the soil, bedrock, surface water, groundwater or air, on or below or around this site. Prior to development of this site, an environmental assessment is advisable.

# 2.0 FIELD AND LABORATORY PROCEDURES

## 2.1 Field Exploration:

In order to explore the general subsurface soil types and to aid in developing associated design parameters, six Standard Penetration Test (SPT) borings (designated as B-4 through B-7, B-9, and B-12) and six hand auger borings (designated as B-1 through B-3, B-8, B-10, and B-11) were drilled by **G E T Solutions, Inc.** within the proposed alignment areas. The SPT borings were performed with the use of a power drill rig using rotary wash "mud" drilling procedures. The soil samples were obtained with a Split-Spoon Sampler in general accordance with the Standard Penetration Test (SPT) ASTM D-1586. These samples were taken continuously from the ground surface to a depth of 10 feet, and at 5-foot intervals thereafter.

In addition and considering the uniformity of the shallow subsurface soils at each of the boring locations, one bulk soil sample was collected at each boring location (with the exception of Borings B-5, B-7, and B-12). The bulk subgrade soil samples were collected from the approximate subgrade elevations at depths ranging from 0.5 to 20 feet below existing grades. Bulk samples were collected for borings B-5, B-7, and B-12; however the sample locations were offset along the roadway alignment in order to obtain bulk samples that represent the subgrade soils. The bulk soil samples were returned to our laboratory and subjected to CBR testing in accordance with VTM standards.

The boring and CBR locations were established and staked in the field by a representative of **G E T Solutions, Inc** in compliance with the VDOT recommended frequencies. The approximate boring locations are shown on the "Boring Location Plan" (Figure 1) attached to this report (Appendix I). The table below lists the boring and CBR schedule, including boring type, boring depth, CBR sample depth and locations.

## Table I – Boring/CBR Schedule

| Boring | Boring Type | Boring Length | Boring Station Number | CBR Station Number | CBR Depth Below Grade (feet) |
|---|---|---|---|---|---|
| B-1 | Hand Auger | 10 | 52+60 | 52+60 | 2-3 |
| B-2 | Hand Auger | 10 | 57+00 | 57+00 | 1-2 |
| B-3 | Hand Auger | 10 | 62+00 | 62+00 | 0.5-1 |
| B-4 | SPT | 15 | 67+00 | 67+00 | 8-10 |
| B-5 | SPT | 60 | 72+00 | 73+75 | 0.5-2 |
| B-6 | SPT | 40 | 77+00 | 77+00 | 18-20 |
| B-7 | SPT | 50 | 83+50 | 82+50 | 0.5-2 |
| B-8 | Hand Auger | 10 | 88+00 | 88+00 | 2-4 |
| B-9 | SPT | 20 | 94+00 | 94+00 | 10-12 |
| B-10 | Hand Auger | 10 | 98+00 | 98+00 | 0.5-1 |
| B-11 | Hand Auger | 10 | 102+00 | 102+00 | 2-3 |
| B-12 | SPT | 40 | 107+25 | 106+25 | 0.5-2 |

The CBR soil samples were collected from the approximate subgrade level, as indicated on the provided plans.

## 2.2 Laboratory Testing:

Representative portions of all soil samples collected during drilling were sealed in glass jars, labeled and transferred to our laboratory for further analysis. The soil classification was performed by a Geotechnical Engineer in accordance with ASTM D2488.

A total of 7 representative split spoon soil samples were selected and subjected to natural moisture, #200 sieve wash, and Atterberg Limits testing and analysis in order to corroborate the visual classification and determine the characteristics of the plastic soils. These test results are presented in the following table, and are shown on the "Log of Boring" sheets (Appendix II), included with this report.

**Table II - Laboratory Test Results**

| Boring No. | Depth (Ft) | Natural Moisture Content (%) | -#200 Sieve (%) | Atterberg Limits (LL/PL/PI) | Classification |
|---|---|---|---|---|---|
| B-2 | 3-4 | 14.2 | 13.0 | Non Plastic | SM |
| B-4 | 4-6 | 14.5 | 17.4 | Non Plastic | SM |
| B-5 | 43-45 | 33.9 | 18.3 | Non Plastic | SM |
| B-6 | 8-10 | 18.7 | 58.0 | 57/20/37 | CH |
| B-7 | 18-20 | 25.7 | 9.7 | Non Plastic | SP-SM |
| B-9 | 8-10 | 21.7 | 74.5 | 40/22/18 | CL |
| B-11 | 2-3 | 16.2 | 67.5 | 32/17/15 | CL |

The bulk subgrade soil samples were subjected to natural moisture content, -#200 sieve, Atterberg Limits, Standard Proctor (VTM-1), and CBR (VTM-8) testing in accordance with VTM standards. The bulk samples were collected from the approximate subgrade elevations based on the plans provided. A summary of the CBR test results and the moisture density relationship curves (Proctors) are presented in Appendix IV.

## 3.0 SITE AND SUBSURFACE CONDITIONS

### 3.1 Site Location and Description:

The project site is located within the Stonehouse development in James City County, Virginia. In particular, the proposed new construction will extend from the southeast end of the existing Fieldstone Parkway in the southeasterly direction connecting to the existing Six Mount Zion Road.

As indicated on the provided plan the existing elevations associated with the majority of the roadway ranged from 35 to 120 feet. The proposed roadway design grades will range from 58 to 116 feet. The project site is currently heavily wooded with three deep ravines, one with a creek, which significant amounts of fill will be required to establish design grades.

## 3.2 Subsurface Soil Conditions:

The results of our field exploration program indicated the presence of approximately 5 to 11 inches of topsoil material at the boring locations. The topsoil thickness could vary at other locations. Underlying the topsoil, the natural subsurface soils consisted mainly of SAND (SC, SM, SP-SM) with varying amounts of Clay and Silt and CLAY (CL,CH) deposits. The Standard Penetration Test (SPT) results, N-values, recorded within these soils indicated that the granular soils were of very loose to medium dense relative density, while the clayey soils were of soft to very stiff consistency.

The subsurface description is of a generalized nature provided to highlight the major soil strata encountered. The records of the subsurface exploration included in Appendix II (Log of Boring sheets) and the Generalized Soil Profile presented in Appendix III should be reviewed for specific information as to the individual borings. The stratifications shown on the records of the subsurface exploration represent the conditions only at the actual boring locations. Variations may occur and should be expected between boring locations. The stratifications represent the approximate boundary between subsurface materials and the transition may be gradual.

## 3.3 Groundwater Information:

| Boring | Station Number | Elevation (feet) | Groundwater (feet) |
|---|---|---|---|
| B-1 | 52+60 | 96 | Not Encountered |
| B-2 | 57+00 | 101 | Not Encountered |
| B-3 | 62+00 | 87 | Not Encountered |
| B-4 | 67+00 | 75 | 7 |
| B-5 | 72+50 | 36 | 4 |
| B-6 | 77+00 | 104 | 17 |
| B-7 | 83+50 | 61 | Not Encountered |
| B-8 | 88+00 | 94 | Not Encountered |
| B-9 | 94+00 | 114 | Not Encountered |
| B-10 | 98+00 | 97 | Not Encountered |
| B-11 | 102+00 | 120 | 20 |
| B-12 | 107+25 | 96 | Not Encountered |

The groundwater table was encountered at the location of Borings B-4 through B-7, and B-12 at depths ranging from 4 to 20 feet below the current site grades. The groundwater table was not encountered in the remaining borings to the depths explored. Groundwater conditions will vary with environmental variations and seasonal conditions, such as the frequency and magnitude of rainfall patterns, as well as man-made influences, such as existing swales, drainage ponds, underdrains and areas of covered soil (paved parking lots, side walks, etc.). It is estimated normal seasonal high groundwater level will fluctuate within 2 to 3 feet above the current levels. We recommend that the contractor determine the actual groundwater levels at the time of the construction to determine groundwater impact on this project.

## 4.0 EVALUATION AND RECOMMENDATIONS

Our recommendations are based on the previously discussed project information, our interpretation of the soil test borings and laboratory data, and our observations during our site reconnaissance. If the proposed construction should vary from what was described, we request the opportunity to review our recommendations and make any necessary changes. The following sections of the report describe the analyses conducted and provide recommendations based on the results of the analyses.

It is noted that cut/fill activities are anticipated for the majority of the proposed roadway project. Settlements associated with the minimal fill placement (<5 feet) are not expected to be an issue, and slope stability will be maintained with safety factors in excess of 1.5 provided cut and fill slopes are constructed on 2H:1V slopes or flatter. For the areas where larger fills are required (sloped embankments and ravines) we have performed embankment settlement and stability analyses as described in Section 4.1 of this report. Additionally, site drainage did appear to be adequate (although no rainfall occurred during site visit) and a low to moderate infiltration rate should be expected from the exposed shallow subsurface soils.

## 4.1 Embankment Settlement and Stability Analyses:

This project includes sloped embankment fill of up to 20 feet and fill for the ravines up to 30 feet as described in Section 1.2 of this report. The magnitude and duration of the settlement associated with these fills is important to planning the construction. We evaluated settlement at the point of maximum fill height (ravine at Station 83 + 50) to aid our assessment of the potential settlement. This section was considered representative of the conditions where the settlement would be the greatest and the time to substantial completion of settlement would be the longest. The magnitude and duration of the settlement at locations with lesser fill heights is expected to be less than the values calculated for this location. The soil parameters used in the settlement analysis were obtained based on the soils recovered at the location of Boring B-7, which was extended to a maximum depth of 50 feet below existing grades (Station 83 + 50).

Our evaluation did not include compression of the material that comprises the proposed embankments. Our past experience indicates that with materials such as those anticipated for the project fills a period of two weeks to two months is often required for internal settlement of the embankment fill to occur. The variation is a function of the material type used as fill, the degree of compaction achieved, and the moisture content at the time of placement. To account for this compression within the embankment fill, the construction schedule is generally arranged so that fine grading and pavement construction is delayed until after a suitable settlement period has expired.

The subsurface conditions at the analysis section were estimated by using the boring SPT boring data (Boring B-7) and the results of our laboratory classification tests. Based on our analysis, settlements of less than 2.25 inches are expected in the embankment fill areas (to within a depth of 16 feet below the existing base of the ravine). Since the recovered soils were generally granular in nature we estimate that most of the settlement (approximately 75%) will be elastic and will occur during construction.

In addition to the settlement analysis we also conducted stability analyses of the sloped embankment fill. The stability analysis was conducted using PCSTABL6 computer software. Circular potential failure surfaces were evaluated using the Modified Bishop method of analysis. The soil parameters used were estimated from SPT and hand auger borings and associated laboratory test data of the existing soils and from our experience with typical fill materials for other roadway projects. The results of the stability analyses indicate that fill slopes of 2:1 (H:V) have an acceptable safety factor (> 1.3). Flatter slopes of 2.5 or 3:1 are typically more easily maintained from an erosion and vegetation standpoint.

## 4.2 Clearing and Grading:

Prior to proceeding with construction, all vegetation, root mat, topsoil, debris, and other deleterious materials should be stripped from proposed construction areas. It is estimated that a cut ranging from 6 to 12 inches in depth will be required to remove the topsoil materials. This cut is expected to extend deeper in isolated areas to remove deeper deposits of organic soils, or unsuitable soils which become evident during the clearing, particularly in the wooded areas. Clean topsoil should be stockpiled for later use in landscaped areas. Furthermore, the construction areas, which encroach on the existing drainage ditches and ravines, should be "de-mucked" to remove very soft soils and alluvial deposits. Based on the results of probes performed in the ravines and our experience with similar soils conditions, the cut required to "de-muck" the soils in the base and sides of the ditches is estimated to range from 12 to 18 inches.

After clearing and stripping, areas intended to support pavements or new fill should be carefully inspected by a knowledgeable construction inspector. At that time the subgrade soils should be proofrolled with a loaded tandem axle dump truck, or other pneumatic-tire vehicle of similar size and weight. The purpose of the proofrolling is to locate weak, soft, or excessively wet soils. Any unsuitable materials observed during the inspection and proofrolling should be undercut and replaced with Select fill material (Type I, II, or III), or stabilized in place as directed by the construction inspector. These construction procedures should be performed in accordance with VDOT Road and Bridge Specifications (Sections 301.02 and 303.04).

The results of our field exploration program indicated that the soils below the topsoil material were typically granular in nature underlain by cohesive soils. Our laboratory testing program indicated that the soils at the anticipated subgrade elevations, which contained about 16 to 85% fines (silt and clay) and had in situ moisture contents ranging from 8 to 19% (up to 8% above optimum moisture content). The Clayey soils with these moisture contents relative to their optimum moisture contents could soften during the stripping and grading activities. Furthermore, combinations of excess surface moisture from precipitation ponding on the site and the construction traffic, including heavy compaction equipment, may create pumping and general deterioration of the bearing capabilities of the surface soils. Therefore, undercutting to remove soft soils in isolated areas may become necessary.

In this regard, and in order to reduce the potential for undercutting, care should be exercised during the grading and construction operations at the site. Furthermore, inherently wet subgrade soils combined with potential poor site drainage make this site particularly susceptible to subgrade deterioration. Thus, grading should be performed during a dry season if at all possible. This should minimize these potential problems, although they may not be eliminated.

Proofrolling should not be performed in areas where it could cause excessive damage to the subgrade such as areas with soft soils identified by inspection. Soft soils in such areas should be removed and replaced, or stabilized prior to placing fill (as previously described) so that the specified degree of compaction can be achieved.

Control of surface water is very important to the successful completion of the proposed construction. The contractor should plan his grading activities to control surface water and minimize erosion of exposed cut or fill material. This may include constructing temporary berms, ditches, flumes and/or slope drains to intercept runoff and discharge it in a controlled fashion.

## 4.3 Subgrade Preparation:

The pavement subgrade should be prepared and the suitability verified through the use of control strips and test sections as outlined in VDOT Road and Bridge Specifications Section 304 and verified in Section 305 (compaction requirements). Once cut and fill operations have been completed, the surface soils will be exposed to surface activities and weather conditions which may degrade the subgrade. A final inspection of the subgrade should be conducted by a qualified inspector and should be performed immediately prior to pavement construction. The prepared subgrade should be sloped to prevent the accumulation of surface water. If the exposed subgrade becomes wet or frozen, the inspector should be consulted.

## 4.4 Select Fill and Placement:

The following sections refer to select fill used on the project. We recommend that fill materials to replace undercut areas or achieve finish grades consist of VDOT Type I, II or III material. These soils are typically classified as SW, SP, SP-SM, SM, SM-SC, GW, or GP as defined by the Unified Soil Classification System (ASTM D2487). Select fill material within 2 feet of the finish soil subgrade elevation beneath pavements must conform to the classification and CBR requirements for the prepared subgrade used in the pavement design.

Based on the results of our field and laboratory testing program, some of the subsurface soils encountered beneath the topsoil consist of granular soils with varying amounts of silt and clay. Some of these granular soils do appear to meet VDOT Select I, II, or III criteria (% finer than #200 sieve). In order to verify the acceptance or rejection of the existing soils for use as VDOT Select I, II, or III the inspector should be notified who may recommend classification testing or will provide an opinion based on visual classification.

All select fill should be placed in maximum 8-inch loose lifts and compacted to the densities specified in the VDOT Road and Bridge Specifications Section 305, which should be determined by the laboratory compaction test, VTM-1. Soil moisture during placement should be maintained as specified in the VDOT Specifications (+/- 2% of the value of the optimum moisture content).

Where fill materials will be placed for the embankment fills, or placed up against sloping ground, the soil subgrade should be scarified and the new fill benched or keyed into the existing material in accordance with VDOT Road and Bridge Specification Section 303.04(h). All fill should be placed in horizontal lifts. In confined areas, such as utility trenches, portable compaction equipment and thin lifts of 4 to 5 inches may be required to achieve the specified degree of compaction.

We recommend that fill placement be monitored on a full-time basis to verify that the specified materials are used and the required degree of compaction is achieved. The monitoring should follow the guidelines in the VDOT Specifications.

Surface water control measures should be instituted to protect the new fill from erosion. A protective cover of grass or other vegetation should be established on permanent slopes as soon as possible during construction.

It is expected that dewatering will be required for excavations, which extend below the groundwater level. Dewatering at depths below the groundwater level may require well pointing or could possibly be accomplished by pumping from sumps.

Care should be used when operating the compactors near existing structures to avoid transmission of the vibrations that could cause settlement damage or disturb occupants. In this regard, it is recommended that the vibratory roller remain at least 25 feet away from existing structures; these areas should be compacted with small, hand-operated compaction equipment.

## 4.5 Proposed Pavements:

The California Bearing Ratio (CBR) test results indicated an average soaked CBR value of 13.3. In accordance with VDOT standards the highest and lowest CBR values were dropped and the average of the remaining CBR values was reported. In addition, the average soaked CBR value was multiplied by a factor of two-thirds to determine a pavement design CBR value. The two-thirds factor provides the necessary safety margins to compensate for some non-uniformity of the soil. Therefore, a CBR value of 8.9 was used in designing the pavement sections.

The Design Average Daily Traffic (ADT) Count was reported to be **6,500 Vehicles Per Day** (VPD), five percent of which were estimated to be trucks. The recommended pavement section presented in this report was calculated in accordance with the manual titled "2000 Pavement design Guide for Subdivision and Secondary Roads in Virginia" and based on our experience with similar projects.

## I. Flexible Pavement

| | |
|---|---|
| SUBGRADE: | Stable, compacted to at least 100% of the theoretical maximum dry density as determined by VTM-1 and approved by the VDOT inspector. |
| AGGREGATE BASE: | Minimum 6.0 inches of Cement Treated Aggregate (CTA). |
| ASPHALT BASE: | Minimum 3.0 inches of Asphalt Concrete, BM-25. |
| ASPHALT SURFACE: | Minimum 2.0 inches of Asphalt Concrete, SM-12.5. |

As an alternative and in order to provide a "heavier" section the designer may elect to increase the CTA thickness to 8.0 inches.

Actual pavement section thickness should be provided by the design civil engineer based on traffic loads, volume, and the owners design life requirements. The above sections represent minimum thickness representative of typical local construction practices and as such periodic maintenance should be anticipated. All pavement material and construction procedures should conform to Virginia Department of Transportation (VDOT) requirements. Specifically, Section 307 focuses on the construction of the Hydraulic Stabilization of the drainage layer and aggregate base materials, Section 309 focuses on the construction of the aggregate base layer and Section 315 focuses on the construction of the Asphalt Concrete Pavement.

In preparation for a stable subgrade support for the pavement section, the following construction steps are recommended:

1. Following pavement rough grading operations, the exposed subgrade should be observed under proofrolling. This proofrolling should be accomplished with a fully loaded dump truck or 7 to 10 ton drum roller to check for pockets of soft material hidden beneath a thin crust of better soil. Any unsuitable materials thus exposed should be removed and replaced with a well-compacted material. The inspection of these phases should be performed by the VDOT inspector.

2. Where unstable subgrade soils are encountered, different improvement alternates (such as undercutting and backfill with Select, use of Geotextiles, etc.) are to be addressed by the VDOT inspector during construction, if necessary, who will recommend the most economical approach at the time.

## 5.0 CONSTRUCTION CONSIDERATIONS

### 5.1 Drainage and Groundwater Concerns:

Dewatering is expected to be required for excavations, which extend beneath the groundwater level. We recommend that the contractor determine the actual groundwater levels at the time of the construction to determine groundwater impact on this project.

### 5.2 Site Utility Installation:

Based on the results of our field and laboratory testing program, the subsurface soils encountered beneath the topsoil consisted of various soil types. The cohesive soils encountered (CL, CH) and Clayey SAND (SC) do not appear to meet VDOT specifications for use as select fill. Some of the granular soils (SP-SM, SM) encountered at the boring locations appear to meet VDOT select fill requirements. It is recommended to perform additional classification test (natural moisture and -#200 sieve) during construction to verify their acceptance or rejection. Furthermore, the inspector should observe the base of the utility trenches prior to the pipe placement to verify that the bearing soils are suitable. Based on the cohesive nature of some of the soils recovered at the boring locations, some stabilization may be required to provide suitable pipe bedding. In addition depending on the depth of the utility trench

excavation, some means of dewatering may be required to facilitate the pipe installation and associated backfilling. The pipe materials and construction methods should conform to the VDOT Road and Bridge specifications.

## 5.3 Excavations:

In Federal Register, Volume 54, No. 209 (October, 1989), the United States Department of Labor, Occupational Safety and Health Administration (OSHA) amended its "Construction Standards for Excavations, 29 CFR, part 1926, Subpart P". This document was issued to better insure the safety of workmen entering trenches or excavations. It is mandated by this federal regulation that all excavations, whether they be utility trenches, basement excavation or footing excavations, be constructed in accordance with the new (OSHA) guidelines. It is our understanding that these regulations are being strictly enforced and if they are not closely followed, the owner and the contractor could be liable for substantial penalties.

The contractor is solely responsible for designing and constructing stable, temporary excavations and should shore, slope, or bench the sides of the excavations as required to maintain stability of both the excavation sides and bottom. The contractor's responsible person, as defined in 29 CFR Part 1926, should evaluate the soil exposed in the excavations as part of the contractor's safety procedures. In no case should slope height, slope inclination, or excavation depth, including utility trench excavation depth, exceed those specified in local, state, and federal safety regulations.

We are providing this information solely as a service to our client. **G E T Solutions, Inc.** is not assuming responsibility for construction site safety or the contractor's activities; such responsibility is not being implied and should not be inferred.

## 6.0 REPORT LIMITATIONS

The recommendations submitted are based on the available soil information obtained by **G E T Solutions, Inc.** and the information supplied by LandMark Design Group and their consultants for the proposed project. If there are any revisions to the plans for this project or if deviations from the subsurface conditions noted in this report are encountered during construction, **G E T Solutions, Inc.** should be notified immediately to determine if changes in the foundation recommendations are required. If **G E T Solutions, Inc.** is not retained to perform these functions, **G E T Solutions, Inc.** can not be responsible for the impact of those conditions on the geotechnical recommendations for the project.

The Geotechnical Engineer warrants that the findings, recommendations, specifications or professional advice contained herein have been made in accordance with generally accepted professional geotechnical engineering practices in the local area. No other warranties are implied or expressed.

After the plans and specifications are more complete the Geotechnical Engineer should be provided the opportunity to review the final design plans and specifications to assure our engineering recommendations have been properly incorporated into the design documents, in order that the earthwork and foundation recommendations may be properly interpreted and implemented. At that time, it may be necessary to submit supplementary recommendations. This report has been prepared for the exclusive use of LandMark Design Group and their consultants for the specific application to the Fieldstone Parkway Extended project within the Stonehouse development in James City County, Virginia.

## APPENDICES

I. BORING LOCATION PLAN

II. LOG OF BORINGS

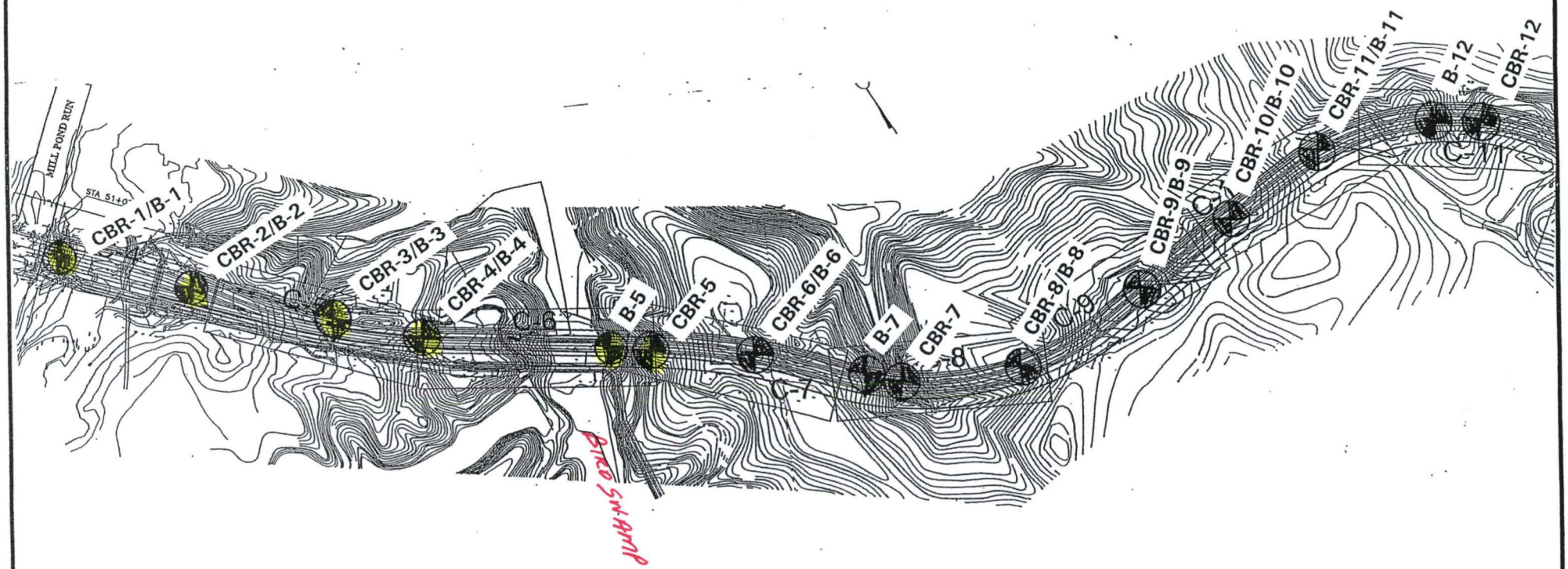
III. GENERALIZED SOIL PROFILE

IV. SUMMARY OF CBR TEST DATA

# APPENDIX I -

BORING LOCATION PLAN

Figure 1




Boring locations are approximate

## BORING LOCATION PLAN

| | | |
|---|---|---|
| PROJECT: | Fieldstone Parkway Road Extension for Stonehouse at Williamsburg LLC<br>James City County, Virginia | SCALE: NTS |
| PROJECT NO: | WM03-429G | DATE: 10/17/2003 |
| CLIENT: | LandMark Design Group | PLOT BY: JRW |

# APPENDIX II -

LOG OF BORINGS

Geotechnical Environmental Testing Solutions, Inc.

# LOG OF BORING No. B-1

**PROJECT:** Fieldstone Parkway Extended **PROJECT NO.:** WM03-429G
**CLIENT:** LandMark Design Group
**PROJECT LOCATION:** James City County, Virginia
**LOCATION:** Station 52+60 **ELEVATION:** 96 Feet
**DRILLER:** GET Solutions, Inc. **LOGGED BY:** J. Wheeler
**DRILLING METHOD:** Hand Auger **DATE:** 9-4-03
**DEPTH TO - WATER> INITIAL:** ▽ **AFTER 24 HOURS:** ▼ **CAVING>** C

| Depth (feet) | Description | Graphic | Sample No. | Blow Counts | % < #200 | TEST RESULTS (Plastic Limit ⊢—⊣ Liquid Limit; Water Content - ●; Penetration - ▨; 10 20 30 40 50 60 70) |
|---|---|---|---|---|---|---|
| 0 | | | | | | |
| | 6 Inches of Topsoil | | | | | |
| | 0.5 | | | | | |
| | Brown to orangish brown to tan, moist, Silty, fine to medium SAND (SM) | | | | | |
| 2 | | | | | | |
| 4 | | | | | | |
| 6 | | | | | | |
| 8 | | | | | | |
| 10 | | | | | | |
| | Boring terminated at 10 ft. | | | | | |
| 12 | | | | | | |
| 14 | | | | | | |

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Geotechnical Environmental Testing Solutions, Inc.

# LOG OF BORING No. B-2

**PROJECT:** Fieldstone Parkway Extended **PROJECT NO.:** WM03-429G
**CLIENT:** LandMark Design Group
**PROJECT LOCATION:** James City County, Virginia
**LOCATION:** Station 57+00 **ELEVATION:** 101 Feet
**DRILLER:** GET Solutions, Inc. **LOGGED BY:** J. Wheeler
**DRILLING METHOD:** Hand Auger **DATE:** 9-4-03
**DEPTH TO - WATER> INITIAL:** ▽ ____ **AFTER 24 HOURS:** ▽ ____ **CAVING>** ____

| Depth (feet) | Description | Graphic | Sample No. | Blow Counts | % < #200 | TEST RESULTS (Plastic Limit ⊢—⊣ Liquid Limit; Water Content - ●; Penetration - ▨; 10 20 30 40 50 60 70) |
|---|---|---|---|---|---|---|
| 0 | | | | | | |
| | 9 Inches of Topsoil | | | | | |
| | 0.75 | | | | | |
| | Brown, moist, Silty, fine to medium SAND (SM) with trace organics | | | | | |
| 2 | | | | | | |
| | 3 | | | | | |
| | Orangish brown and tan, moist, Silty, fine to medium SAND (SM) | | | | 13 | ● |
| 4 | Trace clay at 9-10 feet | | | | | |
| 6 | | | | | | |
| 8 | | | | | | |
| 10 | | | | | | |
| | Boring terminated at 10 ft. | | | | | |
| 12 | | | | | | |
| 14 | | | | | | |

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Geotechnical Environmental Testing Solutions, Inc.

# LOG OF BORING No. B-3

**PROJECT:** Fieldstone Parkway Extended **PROJECT NO.:** WM03-429G
**CLIENT:** LandMark Design Group
**PROJECT LOCATION:** James City County, Virginia
**LOCATION:** Station 62+00 **ELEVATION:** 87 Feet
**DRILLER:** GET Solutions, Inc. **LOGGED BY:** J. Wheeler
**DRILLING METHOD:** Hand Auger **DATE:** 9-4-03
**DEPTH TO - WATER> INITIAL:** ▽ **AFTER 24 HOURS:** ▽ **CAVING>** C

| Depth (feet) | Description | Graphic | Sample No. | Blow Counts | % < #200 | TEST RESULTS (Plastic Limit ⊢—⊣ Liquid Limit; Water Content - ●; Penetration - ▨; 10 20 30 40 50 60 70) |
|---|---|---|---|---|---|---|
| 0 | | | | | | |
| | 5 Inches of Topsoil | | | | | |
| | 0.42 | | | | | |
| | Light brown to orangish brown, moist, Silty, fine to medium SAND (SM) | | | | | |
| 2 | | | | | | |
| 4 | | | | | | |
| 6 | | | | | | |
| 8 | | | | | | |
| 10 | | | | | | |
| | Boring terminated at 10 ft. | | | | | |
| 12 | | | | | | |
| 14 | | | | | | |

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Geotechnical Environmental Testing Solutions, Inc.

# LOG OF BORING No. B-4

**PROJECT:** Fieldstone Parkway Extended **PROJECT NO.:** WM03-429G
**CLIENT:** LandMark Design Group
**PROJECT LOCATION:** James City County, Virginia
**LOCATION:** Station 67+00 **ELEVATION:** 75 Feet
**DRILLER:** GET Solutions, Inc. **LOGGED BY:** J. Wheeler
**DRILLING METHOD:** Rotary Wash "Mud" Drilling **DATE:** 9-9-03
**DEPTH TO - WATER> INITIAL:** ▽ 7 **AFTER 24 HOURS:** ▽ **CAVING>** ⊥

| Depth (feet) | Description | Graphic | Sample No. | Blow Counts | % < #200 | TEST RESULTS (Plastic Limit ⊢—⊣ Liquid Limit; Water Content - ●; Penetration - ▨; 10 20 30 40 50 60 70) |
|---|---|---|---|---|---|---|
| 0 | | | | | | |
| | Brown to orangish brown to tan to light gray, moist to wet, Silty, fine to medium SAND (SM), Very Loose to Medium Dense | | 1 | 2 2 2 | | |
| | | | 2 | 1 1 2 | | |
| 5 | | | 3 | 2 3 4 | 17 | ● |
| ▽ | | | 4 | 4 6 4 | | |
| | | | 5 | 5 6 7 | | |
| 10 | | | | | | |
| 15 | | | 6 | 4 4 5 | | |
| | Boring terminated at 15 ft. | | | | | |
| 20 | | | | | | |
| 25 | | | | | | |
| 30 | | | | | | |
| 35 | | | | | | |

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Geotechnical Environmental Testing Solutions, Inc.

# LOG OF BORING No. B-5

**PROJECT:** Fieldstone Parkway Extended **PROJECT NO.:** WM03-429G
**CLIENT:** LandMark Design Group
**PROJECT LOCATION:** James City County, Virginia
**LOCATION:** Station 72+50 **ELEVATION:** 36 Feet
**DRILLER:** GET Solutions, Inc. **LOGGED BY:** J. Wheeler
**DRILLING METHOD:** Rotary Wash "Mud" Drilling **DATE:** 9-9-03
**DEPTH TO - WATER> INITIAL:** ▽ 4 **AFTER 24 HOURS:** ▽ **CAVING>** C

| Depth (feet) | Description | Graphic | Sample No. | Blow Counts | % < #200 |
|---|---|---|---|---|---|
| 0 | | | | | |
| | Light brown and orangish brown, moist to wet, Silty, fine to medium SAND (SM), Very Loose to Loose | | 1 | 1 2 1 | |
| | | | 2 | 3 3 4 | |
| 5 | | | 3 | 4 5 4 | |
| | | | 4 | 4 4 3 | |
| 10 | | | 5 | 1 3 3 | |
| | BIRD SWAMP | | | | |
| 15 | | | 6 | 4 5 5 | |
| 20 | | | 7 | 4 5 4 | |
| 25 | | | 8 | 5 3 5 | |
| 30 | | | 9 | 5 5 5 | |
| | 33 | | | | |
| 35 | Gray, wet, Silty, fine to medium SAND (SM), Loose to Medium Dense | | 10 | 3 3 4 | |

TEST RESULTS
Plastic Limit ├──┤ Liquid Limit
Water Content - ●
Penetration - ▨
10 20 30 40 50 60 70

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Figure

Geotechnical Environmental Testing Solutions, Inc.

# LOG OF BORING No. B-5

**PROJECT:** Fieldstone Parkway Extended **PROJECT NO.:** WM03-429G
**CLIENT:** LandMark Design Group
**PROJECT LOCATION:** James City County, Virginia
**LOCATION:** Station 72+50 **ELEVATION:** 36 Feet
**DRILLER:** GET Solutions, Inc. **LOGGED BY:** J. Wheeler
**DRILLING METHOD:** Rotary Wash "Mud" Drilling **DATE:** 9-9-03
**DEPTH TO - WATER> INITIAL:** ▽ 4 **AFTER 24 HOURS:** ▽ **CAVING>** C

| Depth (feet) | Description | Graphic | Sample No. | Blow Counts | % < #200 | TEST RESULTS (Plastic Limit ⊢—⊣ Liquid Limit; Water Content - ●; Penetration - ▨; 10 20 30 40 50 60 70) |
|---|---|---|---|---|---|---|
| 40 | | | 11 | 5 5 6 | | |
| 45 | | | 12 | 5 5 6 | 18 | ● |
| 50 | | | 13 | 6 8 9 | | |
| 55 | | | 14 | 6 9 10 | | |
| 60 | | | 15 | 7 10 12 | | |
| | Boring terminated at 60 ft. | | | | | |
| 65 | | | | | | |
| 70 | | | | | | |

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Geotechnical Environmental Testing Solutions, Inc.

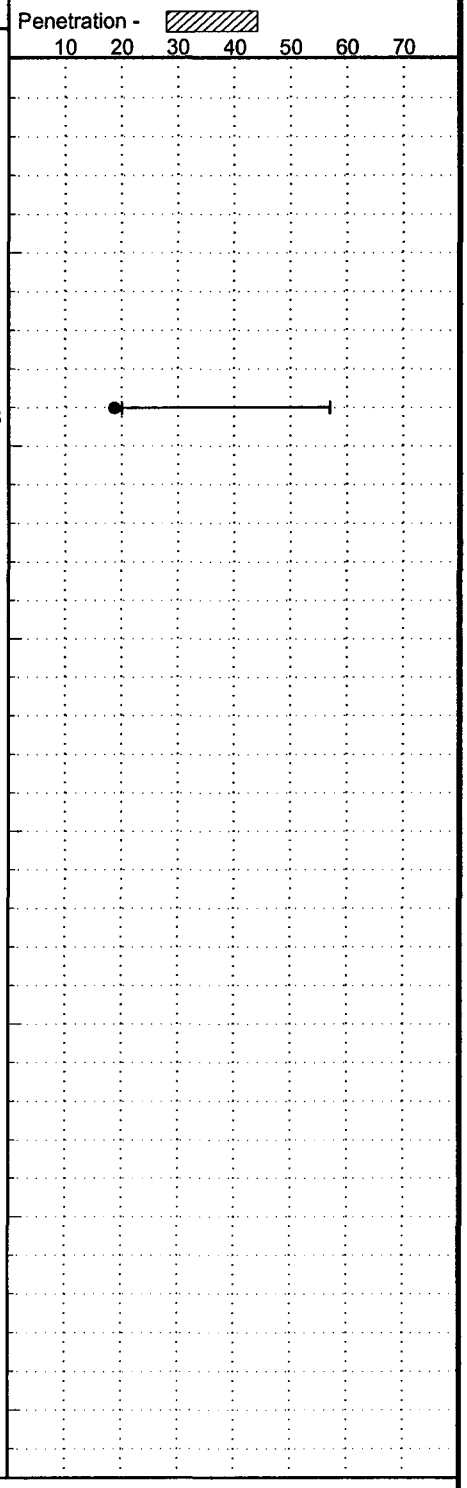
# LOG OF BORING No. B-6

**PROJECT:** Fieldstone Parkway Extended **PROJECT NO.:** WM03-429G
**CLIENT:** LandMark Design Group
**PROJECT LOCATION:** James City County, Virginia
**LOCATION:** Station 77+00 **ELEVATION:** 104 Feet
**DRILLER:** GET Solutions, Inc. **LOGGED BY:** J. Wheeler
**DRILLING METHOD:** Rotary Wash "Mud" Drilling **DATE:** 9-8-03
**DEPTH TO - WATER> INITIAL:** ▽ 17 **AFTER 24 HOURS:** ▽ **CAVING>** C

| Depth (feet) | Description | Sample No. | Blow Counts | % < #200 |
|---|---|---|---|---|
| 0 | | | | |
| | 6 Inches of Topsoil (0.5) | | | |
| | Light brown to orangish brown, moist, Silty, fine to medium SAND (SM) with trace Clay at 2-4 feet, Very Loose to Loose | 1 | 1 1 2 | |
| | | 2 | 2 2 3 | |
| 5 | | 3 | 2 3 4 | |
| | Brown, moist, Sandy CLAY (CL), Soft (6) | 4 | 3 2 3 | |
| | Mottled, brown-gray, Sandy CLAY (CH), Very Stiff (8) | 5 | 4 7 9 | 58 |
| 10 | | | | |
| | Gray, moist to wet, CLAY (CL) with some Sand and Silt and lenses of orangish brown, Silty SAND (SM), Very Stiff (13) | 6 | 7 8 12 | |
| 15 | ▽ | | | |
| | Orangish brown, wet, Clayey, fine SAND (SC), Medium Dense (18) | 7 | 8 8 9 | |
| 20 | | | | |
| | Orangish brown to tan, wet, poorly graded SAND (SP-SM) with trace Silt, Medium Dense (23) | 8 | 6 11 10 | |
| 25 | | | | |
| | | 9 | 8 8 10 | |
| 30 | Mottled, brown-gray, wet, Silty CLAY (CH) with trace Sand, Soft to Medium Stiff (30) | | | |
| | | 10 | 2 1 3 | |
| 35 | | | | |

TEST RESULTS

Plastic Limit ├──┤ Liquid Limit
Water Content - ●
Penetration - ▨




This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Geotechnical Environmental Testing Solutions, Inc.

# LOG OF BORING No. B-6

**PROJECT:** Fieldstone Parkway Extended **PROJECT NO.:** WM03-429G
**CLIENT:** LandMark Design Group
**PROJECT LOCATION:** James City County, Virginia
**LOCATION:** Station 77+00 **ELEVATION:** 104 Feet
**DRILLER:** GET Solutions, Inc. **LOGGED BY:** J. Wheeler
**DRILLING METHOD:** Rotary Wash "Mud" Drilling **DATE:** 9-8-03
**DEPTH TO - WATER> INITIAL:** ▽ 17 **AFTER 24 HOURS:** ▽ _____ **CAVING>** C _____

| Depth (feet) | Description | Graphic | Sample No. | Blow Counts | % < #200 | TEST RESULTS (Plastic Limit ⊢—⊣ Liquid Limit; Water Content - ●; Penetration - ▨; 10 20 30 40 50 60 70) |
|---|---|---|---|---|---|---|
| 40 | | | 11 | 2 3 4 | | |
| | Boring terminated at 40 ft. | | | | | |
| 45 | | | | | | |
| 50 | | | | | | |
| 55 | | | | | | |
| 60 | | | | | | |
| 65 | | | | | | |
| 70 | | | | | | |

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Geotechnical Environmental Testing Solutions, Inc.

# LOG OF BORING No. B-7

**PROJECT:** Fieldstone Parkway Extended **PROJECT NO.:** WM03-429G
**CLIENT:** LandMark Design Group
**PROJECT LOCATION:** James City County, Virginia
**LOCATION:** Station 83+50 **ELEVATION:** 61 Phase
**DRILLER:** GET Solutions, Inc. **LOGGED BY:** J. Wheeler
**DRILLING METHOD:** Rotary Wash "Mud" Drilling **DATE:** 9-8-03
**DEPTH TO - WATER> INITIAL:** ▽ 7 **AFTER 24 HOURS:** ▽ **CAVING>** C

| Depth (feet) | Description | Sample No. | Blow Counts | % < #200 |
|---|---|---|---|---|
| 0 | 5 Inches of Topsoil (0.42) | 1 | 2 2 3 | |
| | Orangish brown, moist, Sandy CLAY (CL), Soft | 2 | 5 5 5 | |
| 5 | Orangish brown to light brown, moist to wet Silty, fine to medium SAND (SM), Very Loose to Medium Dense (4) | 3 | 4 5 6 | |
| | | 4 | 5 4 2 | |
| 10 | | 5 | 2 1 1 | |
| 15 | | 6 | 6 7 7 | |
| | Brown, wet, poorly graded SAND (SP-SM) with trace Sand, Medium Dense (15) | 7 | 6 6 8 | 10 |
| 20 | | | | |
| 25 | | 8 | 7 7 8 | |
| | Brown to gray, wet, Silty, fine to medium SAND (SM), Medium Dense (28) | 9 | 9 12 15 | |
| 30 | | | | |
| 35 | | 10 | 7 10 9 | |

TEST RESULTS
Plastic Limit ├──┤ Liquid Limit
Water Content - ●
Penetration - ▨
10 20 30 40 50 60 70

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Geotechnical Environmental Testing Solutions, Inc.

# LOG OF BORING No. B-7

**PROJECT:** Fieldstone Parkway Extended **PROJECT NO.:** WM03-429G
**CLIENT:** LandMark Design Group
**PROJECT LOCATION:** James City County, Virginia
**LOCATION:** Station 83+50 **ELEVATION:** 61 Phase
**DRILLER:** GET Solutions, Inc. **LOGGED BY:** J. Wheeler
**DRILLING METHOD:** Rotary Wash "Mud" Drilling **DATE:** 9-8-03
**DEPTH TO - WATER> INITIAL:** ▽ 7 **AFTER 24 HOURS:** ▽ _____ **CAVING>** C _____

| Depth (feet) | Description | Graphic | Sample No. | Blow Counts | % < #200 |
|---|---|---|---|---|---|
| 40 | | | 11 | 9 7 8 | |
| 45 | | | 12 | 6 6 7 | |
| 50 | | | 13 | 7 7 8 | |
| | Boring terminated at 50 ft. | | | | |
| 55 | | | | | |
| 60 | | | | | |
| 65 | | | | | |
| 70 | | | | | |

TEST RESULTS
Plastic Limit ├──┤ Liquid Limit
Water Content - ●
Penetration - ▨
10 20 30 40 50 60 70

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Geotechnical Environmental Testing Solutions, Inc.

# LOG OF BORING No. B-8

**PROJECT:** Fieldstone Parkway Extended **PROJECT NO.:** WM03-429G
**CLIENT:** LandMark Design Group
**PROJECT LOCATION:** James City County, Virginia
**LOCATION:** Station 88+00 **ELEVATION:** 94 Feet
**DRILLER:** GET Solutions, Inc. **LOGGED BY:** J. Wheeler
**DRILLING METHOD:** Hand Auger **DATE:** 9-3-03
**DEPTH TO - WATER> INITIAL:** ▽ ____ **AFTER 24 HOURS:** ▼ ____ **CAVING>** C ____

| Depth (feet) | Description | Graphic | Sample No. | Blow Counts | % < #200 | TEST RESULTS (Plastic Limit ⊢—⊣ Liquid Limit; Water Content - ●; Penetration - ▨; 10 20 30 40 50 60 70) |
|---|---|---|---|---|---|---|
| 0 | | | | | | |
| | 6 Inches of Topsoil | | | | | |
| | 0.5 | | | | | |
| | Brown to reddish brown-gray, moist, Silty CLAY (CL/CH) with trace to little Sand | | | | | |
| | Mottled from 6 feet | | | | | |
| 2 | | | | | | |
| 4 | | | | | | |
| 6 | | | | | | |
| 8 | | | | | | |
| 10 | | | | | | |
| | Boring terminated at 10 ft. | | | | | |
| 12 | | | | | | |
| 14 | | | | | | |

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Geotechnical Environmental Testing Solutions, Inc.

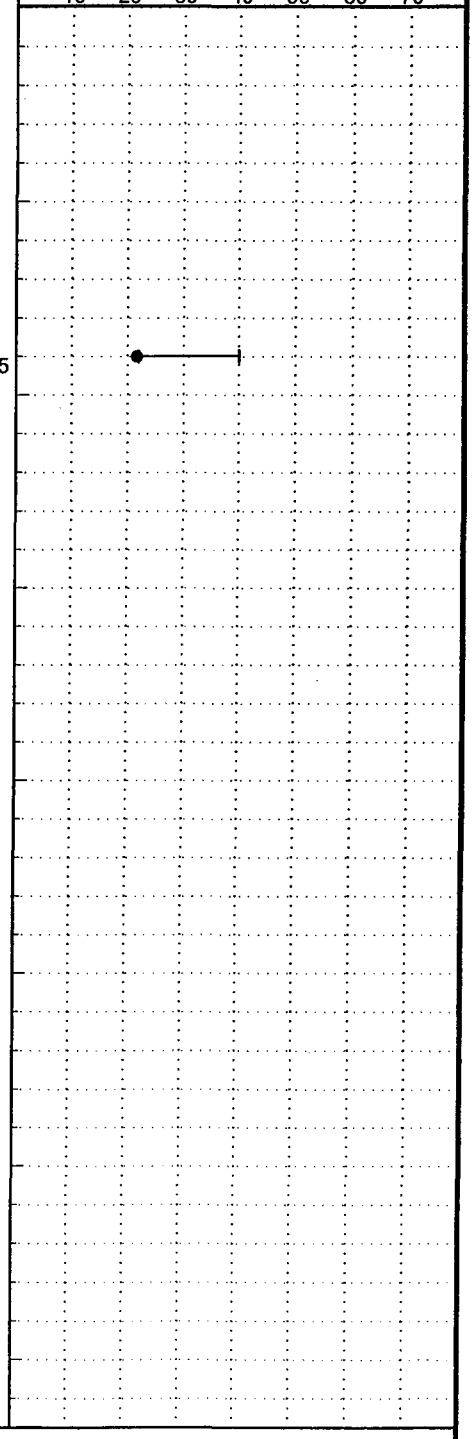
# LOG OF BORING No. B-9

**PROJECT:** Fieldstone Parkway Extended **PROJECT NO.:** WM03-429G
**CLIENT:** LandMark Design Group
**PROJECT LOCATION:** James City County, Virginia
**LOCATION:** Station 94+00 **ELEVATION:** 114 Feet
**DRILLER:** GET Solutions, Inc. **LOGGED BY:** J. Wheeler
**DRILLING METHOD:** Rotary Wash "Mud" Drilling **DATE:** 9-4-03
**DEPTH TO - WATER> INITIAL:** ▽ ____ **AFTER 24 HOURS:** ▽ ____ **CAVING>** ____

| Depth (feet) | Description | Graphic | Sample No. | Blow Counts | % < #200 |
|---|---|---|---|---|---|
| 0 | Orangish brown-gray, moist, Silty CLAY (CL/CH) with trace to little Sand, Medium Stiff to Very Stiff | | 1 | 5 6 10 | |
| | Mottled from 4 feet | | 2 | 6 12 14 | |
| 5 | | | 3 | 4 7 9 | |
| | | | 4 | 4 7 10 | |
| 10 | | | 5 | 3 9 10 | 75 |
| 15 | | | 6 | 4 8 10 | |
| 20 | | | 7 | 3 4 5 | |
| | Boring terminated at 20 ft. | | | | |
| 25 | | | | | |
| 30 | | | | | |
| 35 | | | | | |

TEST RESULTS

Plastic Limit ├──┤ Liquid Limit
Water Content - ●
Penetration - ▨




This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Figure

Geotechnical Environmental Testing Solutions, Inc.

# LOG OF BORING No. B-10

**PROJECT:** Fieldstone Parkway Extended **PROJECT NO.:** WM03-429G
**CLIENT:** LandMark Design Group
**PROJECT LOCATION:** James City County, Virginia
**LOCATION:** Station 98+00 **ELEVATION:** 97 Feet
**DRILLER:** GET Solutions, Inc. **LOGGED BY:** J. Wheeler
**DRILLING METHOD:** Hand Auger **DATE:** 9-3-03
**DEPTH TO - WATER> INITIAL:** ▽ ____ **AFTER 24 HOURS:** ▽ ____ **CAVING>** ____

| Depth (feet) | Description | Graphic | Sample No. | Blow Counts | % < #200 | TEST RESULTS (Plastic Limit ⊢—⊣ Liquid Limit; Water Content - ●; Penetration - ▨; 10 20 30 40 50 60 70) |
|---|---|---|---|---|---|---|
| 0 | | | | | | |
| | 8 Inches of Topsoil | | | | | |
| | 0.67 | | | | | |
| | Brown, moist, Silty, fine SAND (SM) | | | | | |
| 2 | | | | | | |
| | 2 | | | | | |
| | Brown, moist, Clayey SAND (SC) | | | | | |
| 4 | | | | | | |
| | 4 | | | | | |
| | Orangish brown, moist, Sandy CLAY (CL) | | | | | |
| 6 | | | | | | |
| 8 | | | | | | |
| 10 | | | | | | |
| | Boring terminated at 10 ft. | | | | | |
| 12 | | | | | | |
| 14 | | | | | | |

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Geotechnical Environmental Testing Solutions, Inc.

# LOG OF BORING No. B-11

**PROJECT:** Fieldstone Parkway Extended **PROJECT NO.:** WM03-429G
**CLIENT:** LandMark Design Group
**PROJECT LOCATION:** James City County, Virginia
**LOCATION:** Station 102+00 **ELEVATION:** 120 Feet
**DRILLER:** GET Solutions, Inc. **LOGGED BY:** J. Wheeler
**DRILLING METHOD:** Hand Auger **DATE:** 9-3-03
**DEPTH TO - WATER> INITIAL:** ▽ ____ **AFTER 24 HOURS:** ▽ ____ **CAVING>** ____

| Depth (feet) | Description | Graphic | Sample No. | Blow Counts | % < #200 | TEST RESULTS (Plastic Limit ⊢—⊣ Liquid Limit; Water Content - ●; Penetration - ▨; 10 20 30 40 50 60 70) |
|---|---|---|---|---|---|---|
| 0 | | | | | | |
| | 6 Inches of Topsoil | | | | | |
| 0.5 | Brown, moist, Silty, fine SAND (SM-ML) | | | | | |
| 2 | Brown to orangish brown, moist, Sandy CLAY (CL) with some Silt | | | | 68 | |
| 4 | | | | | | |
| 6 | | | | | | |
| 8 | | | | | | |
| 10 | Boring terminated at 10 ft. | | | | | |
| 12 | | | | | | |
| 14 | | | | | | |

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Geotechnical Environmental Testing Solutions, Inc.

# LOG OF BORING No. B-12

**PROJECT:** Fieldstone Parkway Extended **PROJECT NO.:** WM03-429G
**CLIENT:** LandMark Design Group
**PROJECT LOCATION:** James City County, Virginia
**LOCATION:** Station 107+25 **ELEVATION:** 96 Feet
**DRILLER:** GET Solutions, Inc. **LOGGED BY:** J. Wheeler
**DRILLING METHOD:** Rotary Wash "Mud" Drilling **DATE:** 9-3-03
**DEPTH TO - WATER> INITIAL:** ▽ 20 **AFTER 24 HOURS:** ▽ ____ **CAVING>** ____

| Depth (feet) | Description | Sample No. | Blow Counts | % < #200 |
|---|---|---|---|---|
| 0 | 11 Inches of Topsoil (0.67) | 1 | 2 3 2 | |
| | Brown, moist, Silty, fine to medium SAND (SM), Very Loose (2) | | | |
| | Brown to orangish brown-gray, moist, Sandy CLAY (CL), Soft to Stiff | 2 | 2 2 2 | |
| 5 | | 3 | 2 3 6 | |
| | | 4 | 4 6 8 | |
| | (8) Orangish brown, moist, Silty, fine to medium SAND (SM) with lenses of Sandy CLAY (CL), Medium Dense | 5 | 2 5 9 | |
| 10 | | | | |
| | (13) Mottled, orangish brown-gray, moist, Silty CLAY (CH/CL) with lenses of Sand, Medium Stiff | 6 | 2 3 3 | |
| 15 | | | | |
| | (18) Gray, moist to wet, Sandy CLAY (CL) with some Silt and trace Gravel, Soft to Medium Stiff | 7 | 2 2 2 | |
| 20 ▽ | | | | |
| 25 | | 8 | 2 3 3 | |
| | (28) Brown, wet, Silty CLAY (CH), Very Soft | 9 | 1 2 1 | |
| 30 | | | | |
| | (33) Brown, wet, Silty, fine to medium SAND (SM), Loose to Medium Dense | 10 | 3 3 5 | |
| 35 | | | | |

TEST RESULTS
Plastic Limit ├──┤ Liquid Limit
Water Content - ●
Penetration - ▨
10 20 30 40 50 60 70

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Geotechnical Environmental Testing Solutions, Inc.

# LOG OF BORING No. B-12

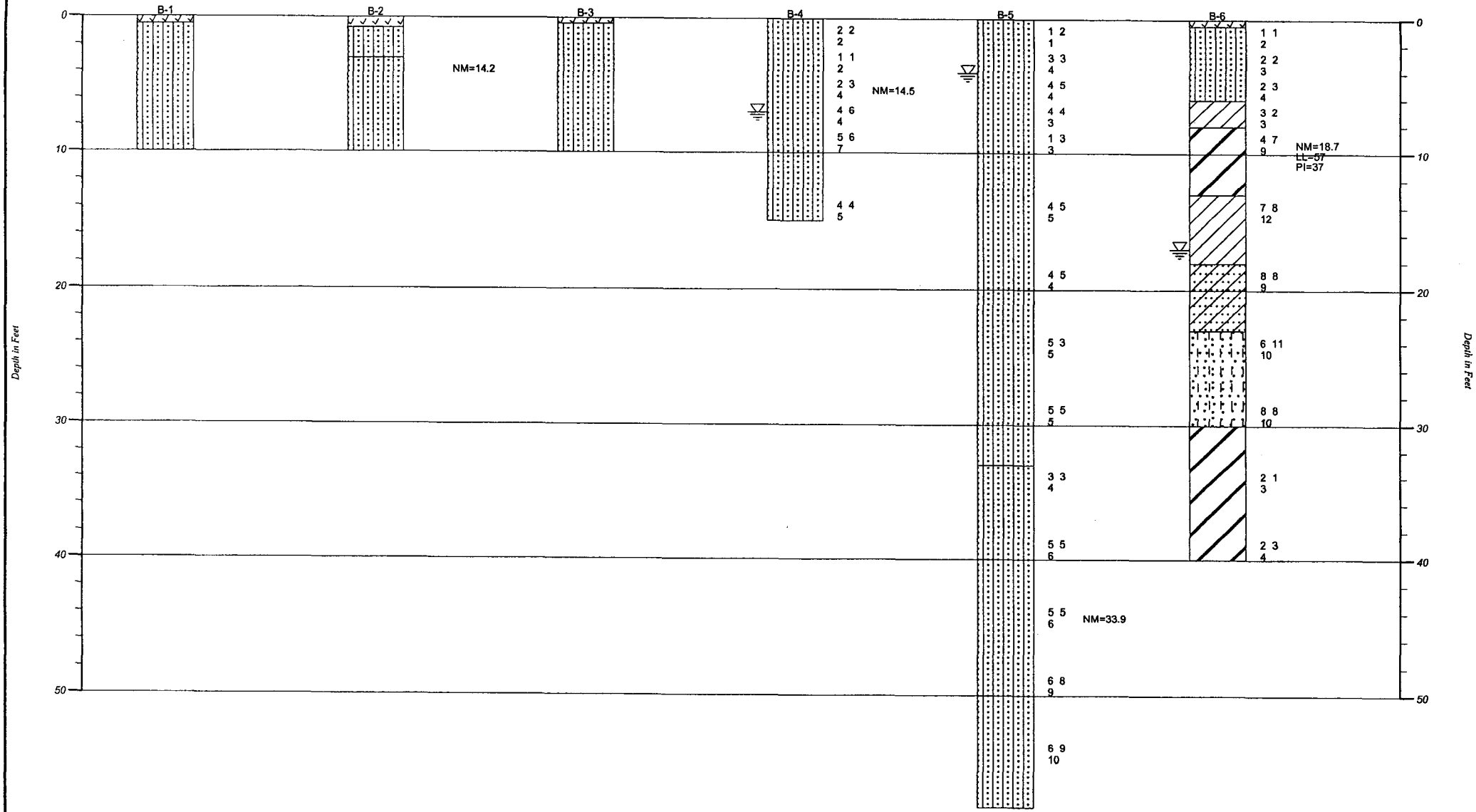
**PROJECT:** Fieldstone Parkway Extended **PROJECT NO.:** WM03-429G
**CLIENT:** LandMark Design Group
**PROJECT LOCATION:** James City County, Virginia
**LOCATION:** Station 107+25 **ELEVATION:** 96 Feet
**DRILLER:** GET Solutions, Inc. **LOGGED BY:** J. Wheeler
**DRILLING METHOD:** Rotary Wash "Mud" Drilling **DATE:** 9-3-03
**DEPTH TO - WATER> INITIAL:** ▽ 20 **AFTER 24 HOURS:** ▽ **CAVING>** ℄

| Depth (feet) | Description | Graphic | Sample No. | Blow Counts | % < #200 | TEST RESULTS (Plastic Limit ⊢—⊣ Liquid Limit; Water Content - ●; Penetration - ▨; 10 20 30 40 50 60 70) |
|---|---|---|---|---|---|---|
| 40 | | | 11 | 3 5 6 | | |
| | Boring terminated at 40 ft. | | | | | |
| 45 | | | | | | |
| 50 | | | | | | |
| 55 | | | | | | |
| 60 | | | | | | |
| 65 | | | | | | |
| 70 | | | | | | |

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

# APPENDIX III -

GENERALIZED SOIL PROFILE




Strata symbols

- Topsoil
- Silty sand
- Low plasticity clay
- High plasticity clay
- Clayey sand
- Poorly graded sand with silt

GET Solutions, Inc.

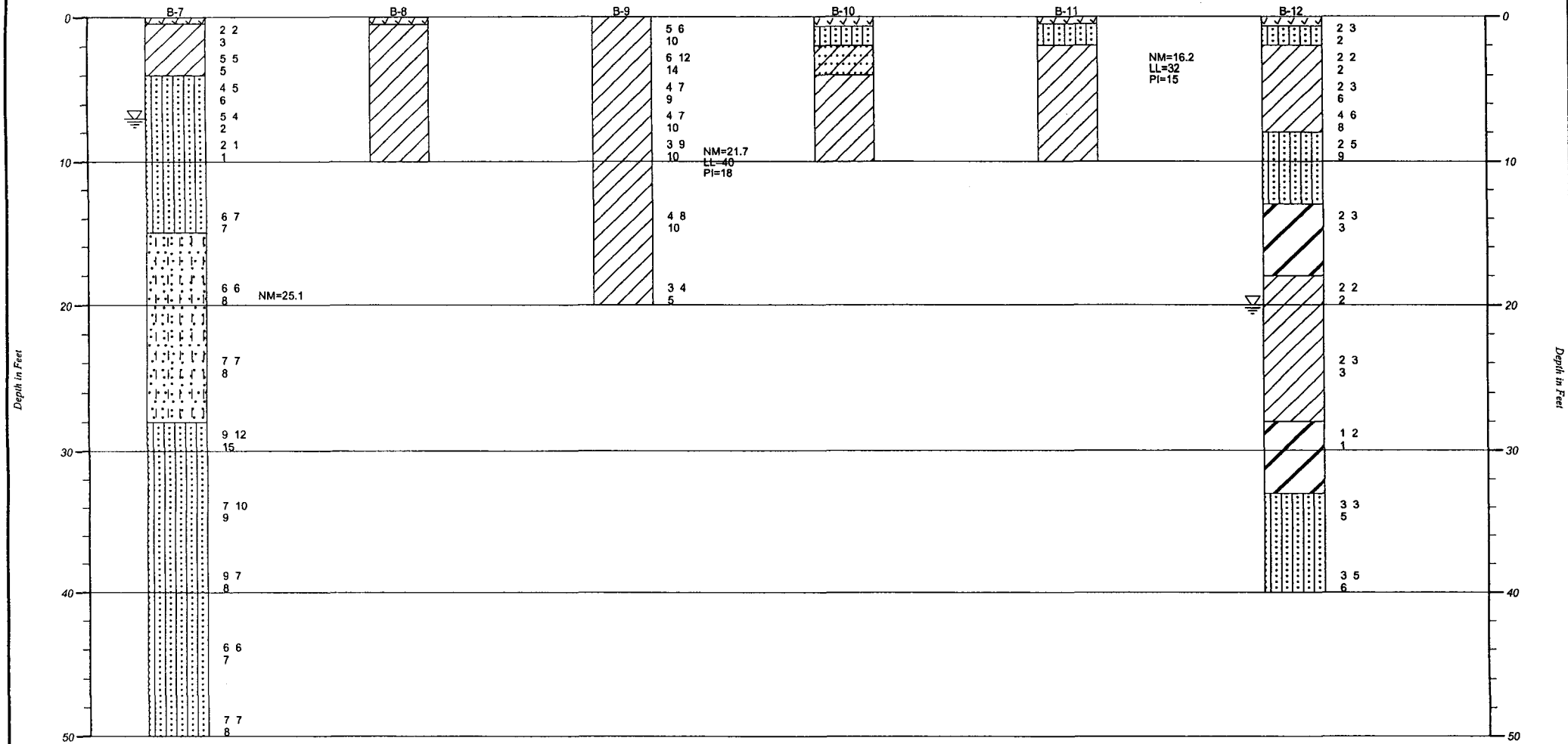
GENERALIZED SOIL PROFILE

| HORIZONTAL SCALE: | DRAWN BY/APPROVED BY | DATE DRAWN |
|---|---|---|
| VERTICAL SCALE: 1"=10' | JRW | 11/3/2003 |

Fieldstone Parkway Extended

James City County, Virginia

| PROJECT NO. WM03-429G | FIGURE NUMBER |
|---|---|
| | 1 |




Strata symbols

- Topsoil
- Silty sand
- Low plasticity clay
- High plasticity clay
- Clayey sand
- Poorly graded sand with silt

| GET Solutions, Inc. | | |
|---|---|---|
| GENERALIZED SOIL PROFILE | | |
| HORIZONTAL SCALE: | DRAWN BY/APPROVED BY | DATE DRAWN |
| VERTICAL SCALE: 1"=10' | JRW | 11/3/2003 |
| Fieldstone Parkway Extended<br>James City County, Virginia | | |
| PROJECT NO. WM03-429G | | FIGURE NUMBER<br>2 |

# APPENDIX IV -

## SUMMARY OF CBR TEST RESULTS

# SUMMARY OF CBR TEST DATA

| Sample Number | CBR-1 | CBR-2 | CBR-3 | CBR-4 | CBR-5 | CBR-6 | CBR-7 | CBR-8 | CBR-9 | CBR-10 | CBR-11 | CBR-12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample Depth (ft.) | 2-3 | 1-2 | 0.5-1 | 8-10 | 0.5-2 | 18-20 | 0.5-2 | 2-4 | 10-12 | 0.5-1 | 2-3 | 0.5-2 |
| Unified Soil Classification Symbol | SM | SM | SM | SM | SM | SC | SM | CL | CL | SM | SM | CL-ML |
| Natural Moisture Content (%) | 7.7 | 16.1 | 10.8 | 11.6 | 12.3 | 18.4 | 18.5 | 19.0 | 12.1 | 12.3 | 10.9 | 12.4 |
| Atterberg Limits LL/PL/PI | Non Plastic | Non Plastic | Non Plastic | Non Plastic | Non Plastic | 23/19/4 | Non Plastic | 34/22/12 | 45/20/25 | Non Plastic | Non Plastic | 27/21/6 |
| % Passing #200 Sieve | 16.0 | 33.0 | 16.2 | 25.7 | 18.7 | 40.9 | 49.1 | 85.1 | 77.3 | 45.9 | 49.6 | 61.1 |
| Maximum Dry Density, pcf | 112.7 | 125.1 | 117.7 | 119.4 | 116.5 | 121.7 | 115.9 | 108.7 | 109.8 | 117.2 | 112.0 | 104.1 |
| Optimum Moisture % | 15.0 | 8.0 | 8.5 | 10.9 | 13.0 | 10.2 | 12.8 | 15.0 | 17.5 | 10.5 | 11.9 | 18.4 |
| Unsoaked CBR Value | 20.5 | 14.9 | 17.9 | 15.9 | 17.2 | 15.1 | 16.9 | 9.4 | 10.9 | 14.8 | 16.1 | 12.0 |
| Soaked CBR Value | 18.6 | 13.8 | 17.1 | 14.4 | 16.7 | 13.1 | 14.0 | 6.8 | 7.7 | 13.2 | 13.1 | 10.8 |
| Resiliency Factor | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 2.5 | 2.5 | 2.0 | 2.0 | 2.5 | 2.5 | 2.0 |
| Swell % | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.9 | 0.2 | 1.7 | 1.5 | 0.4 | 0.9 | 0.5 |

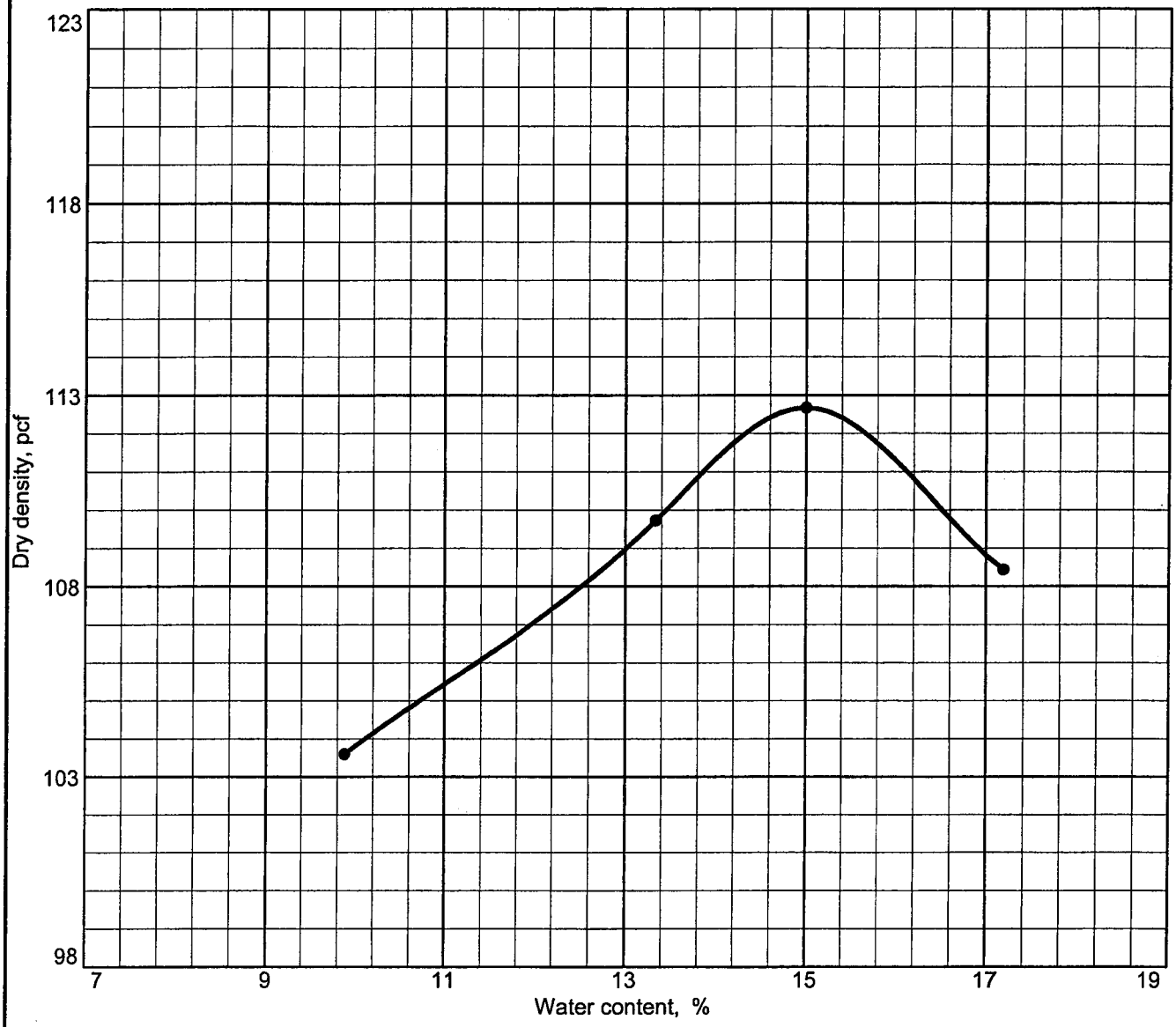
Project: Fieldstone Parkway Extended

Project No: WM03-429G

Client: LandMark Design Group

Date: 10/31/03

# MOISTURE DENSITY TEST REPORT (PROCTOR CURVE)




Test specification: ASTM D 698-91 Procedure A Standard

| Elev/ Depth | Classification | | Nat. Moist. | Sp.G. | LL | PI | % > No.4 | % < No.200 |
|---|---|---|---|---|---|---|---|---|
| | USCS | AASHTO | | | | | | |
| 2-3 Feet Below | SM | | 7.7 | | | | | 16.0 |

| TEST RESULTS | MATERIAL DESCRIPTION |
|---|---|
| Maximum dry density = 112.7 pcf<br>Optimum moisture = 15.0 % | Brown, moist, Silty, fine to medium SAND (SM) |

**Project No.** WM03-429G **Client:** LandMark Design Group

**Project:** Fieldstone Parkway Extended

● **Source:** **Sample No.:** CBR 1 **Elev./Depth:** 2-3 Feet Below

**Remarks:**

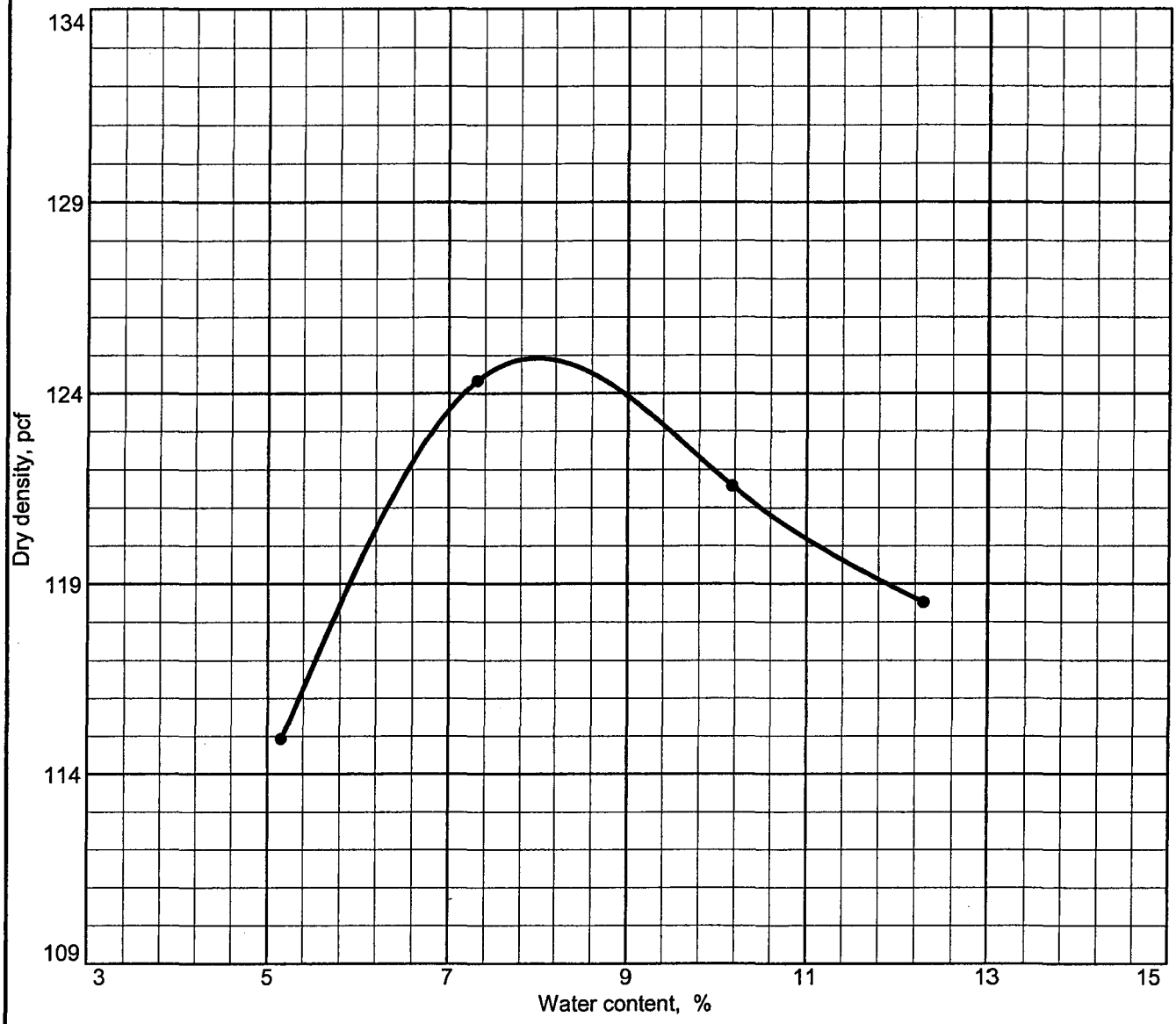
Soaked CBR Value = 18.6
Resiliency Factor = 3.0
CBR Sampled from Station 52+60

MOISTURE DENSITY TEST REPORT (PROCTOR CURVE)

**GET SOLUTIONS, INC.**

**Figure**

# MOISTURE DENSITY TEST REPORT (PROCTOR CURVE)




Test specification: ASTM D 698-91 Procedure A Standard

| Elev/ Depth | Classification | | Nat. Moist. | Sp.G. | LL | PI | % > No.4 | % < No.200 |
|---|---|---|---|---|---|---|---|---|
| | USCS | AASHTO | | | | | | |
| 1-2 Feet Below | SM | | 16.1 | | | | | 33.0 |

| TEST RESULTS | MATERIAL DESCRIPTION |
|---|---|
| Maximum dry density = 125.1 pcf<br>Optimum moisture = 8.0 % | Brown, moist, Silty, fine to medium SAND (SM) |

**Project No.** WM03-429G **Client:** LandMark Design Group

**Project:** Fieldstone Parkway Extended

● **Source:** **Sample No.:** CBR 2 **Elev./Depth:** 1-2 Feet Below

**Remarks:**

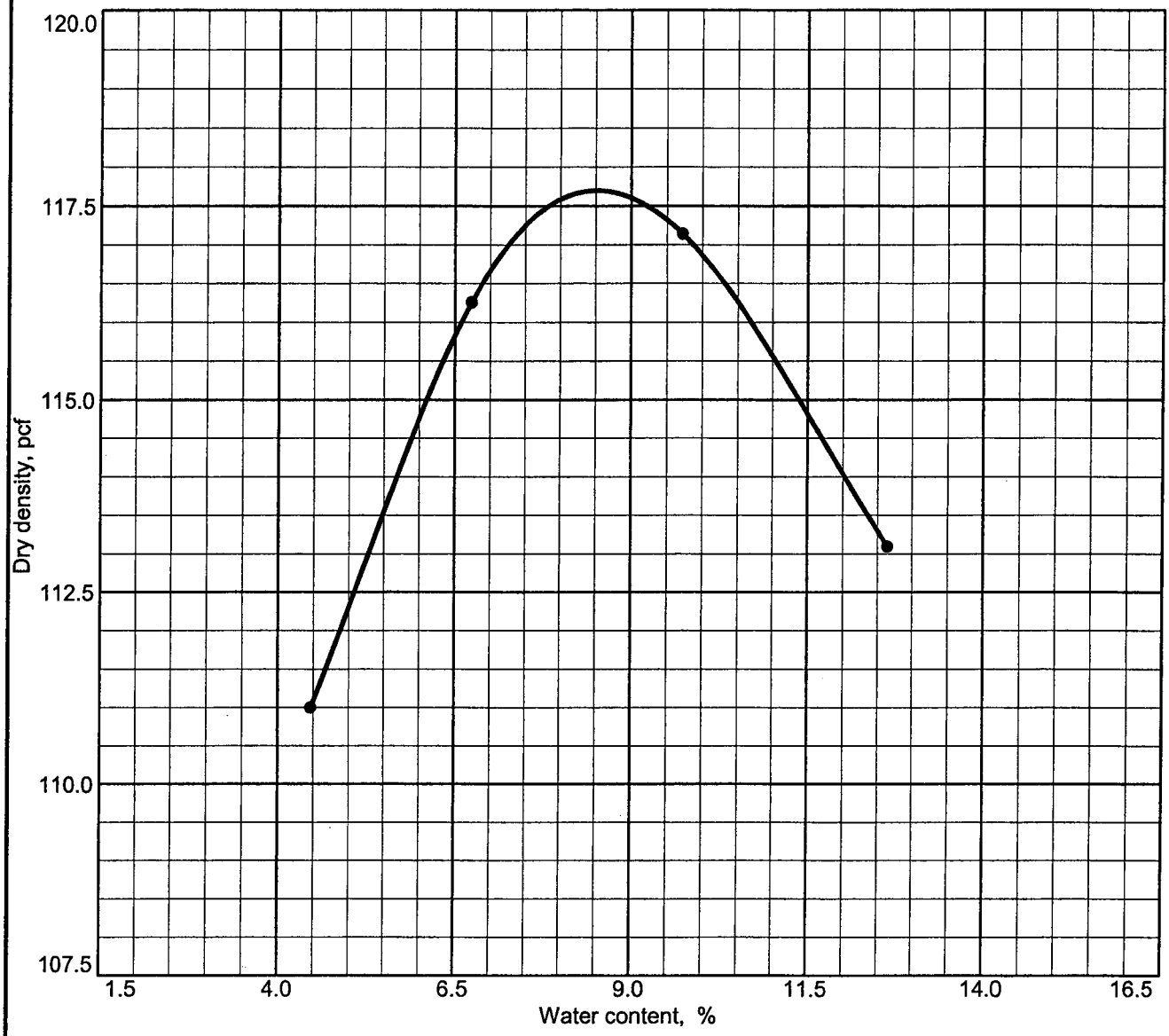
Soaked CBR Value = 13.8
Resiliency Factor = 3.0
CBR Sampled from Station 57+00

MOISTURE DENSITY TEST REPORT (PROCTOR CURVE)

**GET SOLUTIONS, INC.**

**Figure**

# MOISTURE DENSITY TEST REPORT (PROCTOR CURVE)




Test specification: ASTM D 698-91 Procedure A Standard

| Elev/ Depth | Classification | | Nat. Moist. | Sp.G. | LL | PI | % > No.4 | % < No.200 |
|---|---|---|---|---|---|---|---|---|
| | USCS | AASHTO | | | | | | |
| 0.5-1 Ft Below | SM | | 10.8 | | | | | 16.2 |

| TEST RESULTS | MATERIAL DESCRIPTION |
|---|---|
| Maximum dry density = 117.7 pcf<br>Optimum moisture = 8.5 % | Light brown, moist, Silty, fine to medium SAND (SM) |

**Project No.** WM03-429G **Client:** LandMark Design Group

**Project:** Fieldstone Parkway Extended

● **Source:** **Sample No.:** CBR 3 **Elev./Depth:** 0.5-1 Ft Below

**Remarks:**

Soaked CBR Value = 17.1
Resiliency Factor = 3.0
CBR Sampled from Station 62+00

MOISTURE DENSITY TEST REPORT (PROCTOR CURVE)

**GET SOLUTIONS, INC.**

**Figure**

# MOISTURE DENSITY TEST REPORT (PROCTOR CURVE)

Test specification: ASTM D 698-91 Procedure A Standard

| Elev/ Depth | Classification | | Nat. Moist. | Sp.G. | LL | PI | % > No.4 | % < No.200 |
|---|---|---|---|---|---|---|---|---|
| | USCS | AASHTO | | | | | | |
| 8-10 Ft Below | SM | | 11.6 | | | | | 25.7 |

| TEST RESULTS | MATERIAL DESCRIPTION |
|---|---|
| Maximum dry density = 119.4 pcf<br>Optimum moisture = 10.9 % | Brown, moist, Silty, fine to medium SAND (SM) |

**Project No.** WM03-429G **Client:** LandMark Design Group

**Project:** Fieldstone Parkway Extended

● **Source:** **Sample No.:** CBR 4 **Elev./Depth:** 8-10 Ft Below

**Remarks:**

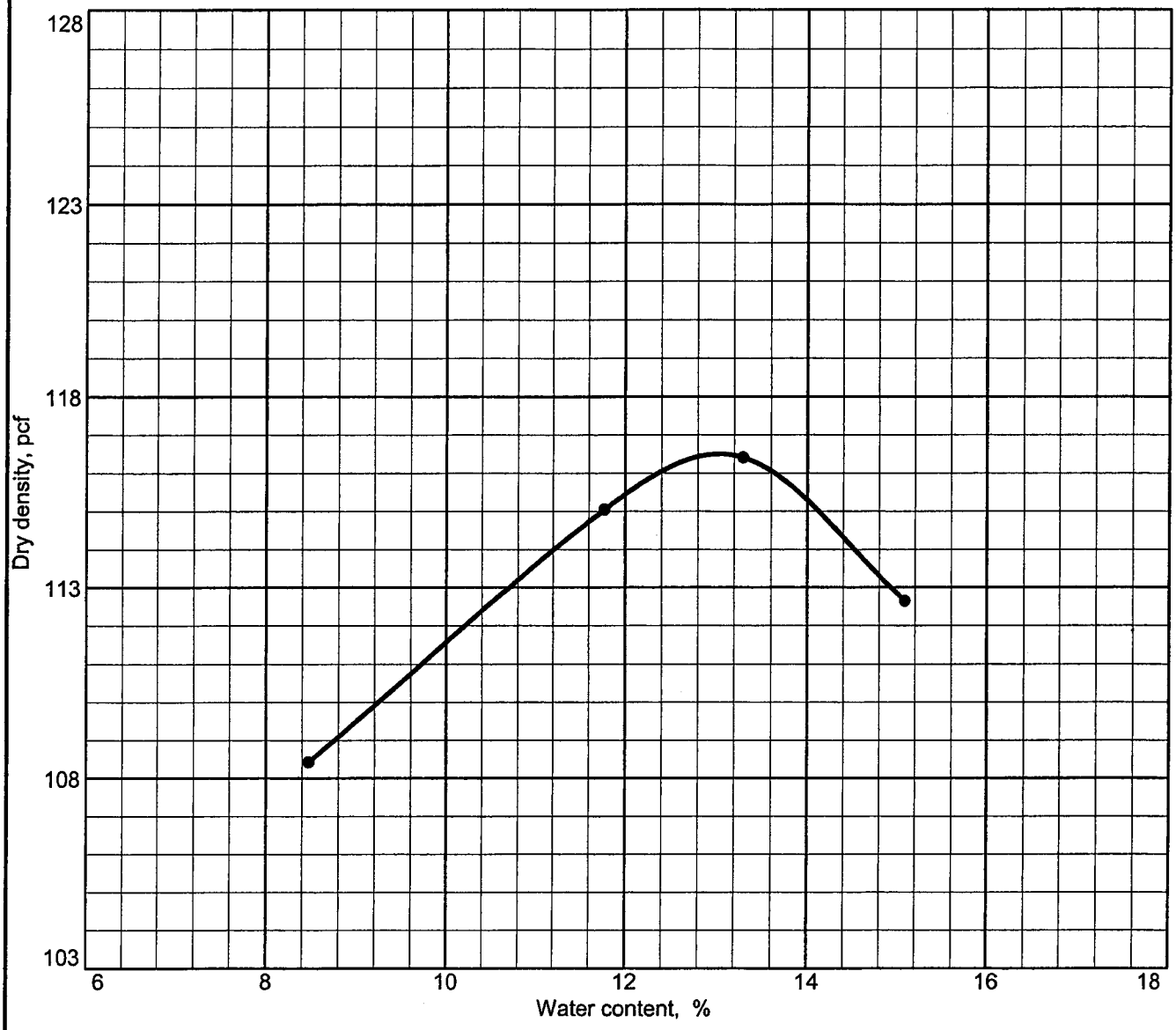
Soaked CBR Value = 14.4
Resiliency Factor = 3.0
CBR Sampled from Station 67+00

MOISTURE DENSITY TEST REPORT (PROCTOR CURVE)

**GET SOLUTIONS, INC.**

**Figure**

# MOISTURE DENSITY TEST REPORT (PROCTOR CURVE)




Test specification: ASTM D 698-91 Procedure A Standard

| Elev/ Depth | Classification | | Nat. Moist. | Sp.G. | LL | PI | % > No.4 | % < No.200 |
|---|---|---|---|---|---|---|---|---|
| | USCS | AASHTO | | | | | | |
| 0.5-2 Ft Below | SM | | 12.3 | | | | | 18.7 |

| TEST RESULTS | MATERIAL DESCRIPTION |
|---|---|
| Maximum dry density = 116.5 pcf<br>Optimum moisture = 13.0 % | Light brown, moist, Silty, fine to medium SAND (SM) |

**Project No.** WM03-429G **Client:** LandMark Design Group

**Project:** Fieldstone Parkway Extended

● **Source:** **Sample No.:** CBR 5 **Elev./Depth:** 0.5-2 Ft Below

**Remarks:**

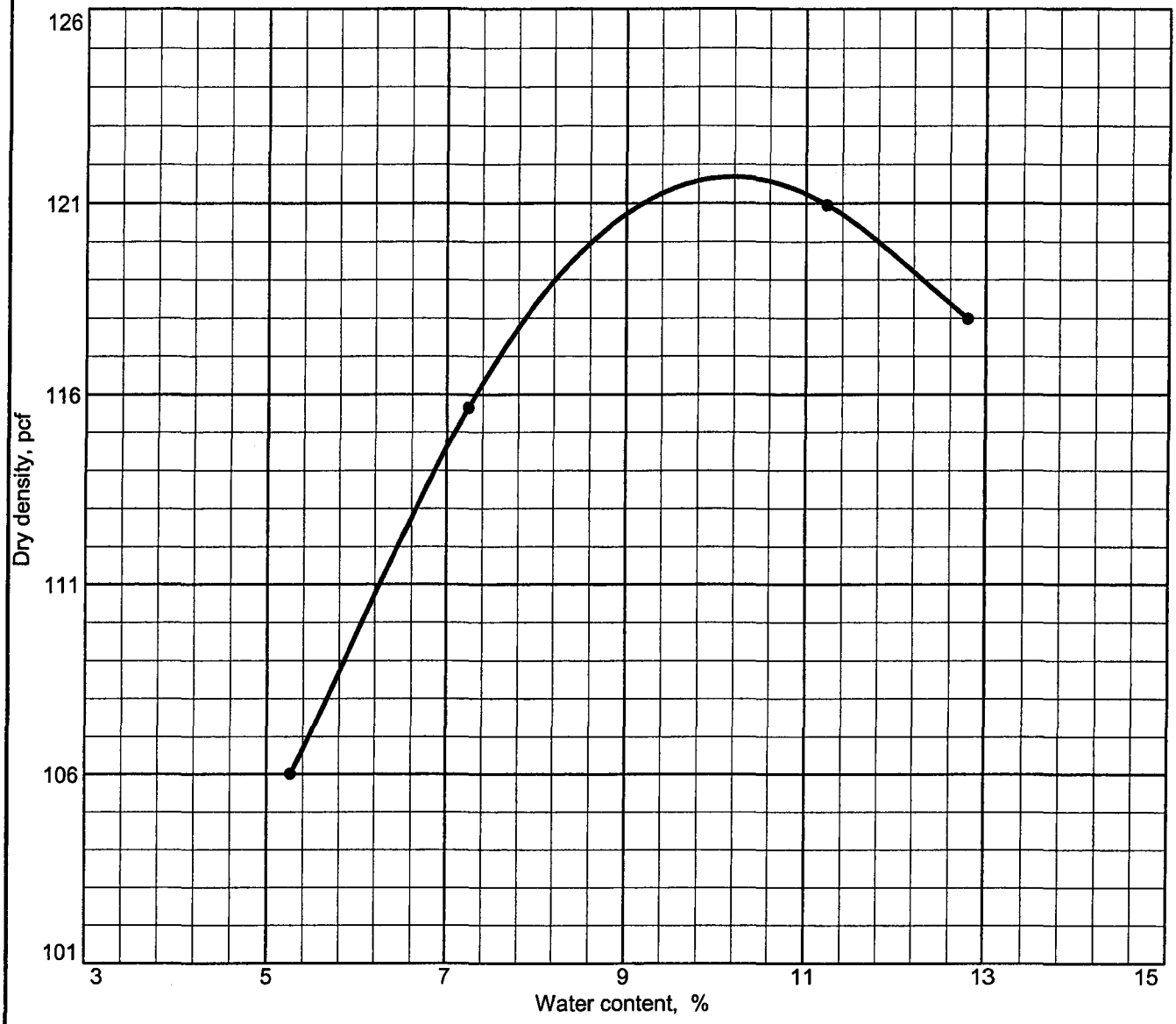
Soaked CBR Value = 16.7
Resiliency Factor = 3.0
CBR Sampled from Station 73+75

MOISTURE DENSITY TEST REPORT (PROCTOR CURVE)

**GET SOLUTIONS, INC.**

**Figure**

# MOISTURE DENSITY TEST REPORT (PROCTOR CURVE)




Test specification: ASTM D 698-91 Procedure A Standard

| Elev/ Depth | Classification | | Nat. Moist. | Sp.G. | LL | PI | % > No.4 | % < No.200 |
|---|---|---|---|---|---|---|---|---|
| | USCS | AASHTO | | | | | | |
| 18-20 Ft Below | SC | A-4(0) | 18.4 | | 23 | 4 | | 40.9 |

| TEST RESULTS | MATERIAL DESCRIPTION |
|---|---|
| Maximum dry density = 121.7 pcf<br>Optimum moisture = 10.2 % | Orangish brown, wet, Clayey, fine to medium SAND (SC) with some Silt |

**Project No.** WM03-429G **Client:** LandMark Design Group

**Project:** Fieldstone Parkway Extended

● **Source:** **Sample No.:** CBR 6 **Elev./Depth:** 18-20 Ft

**Remarks:**

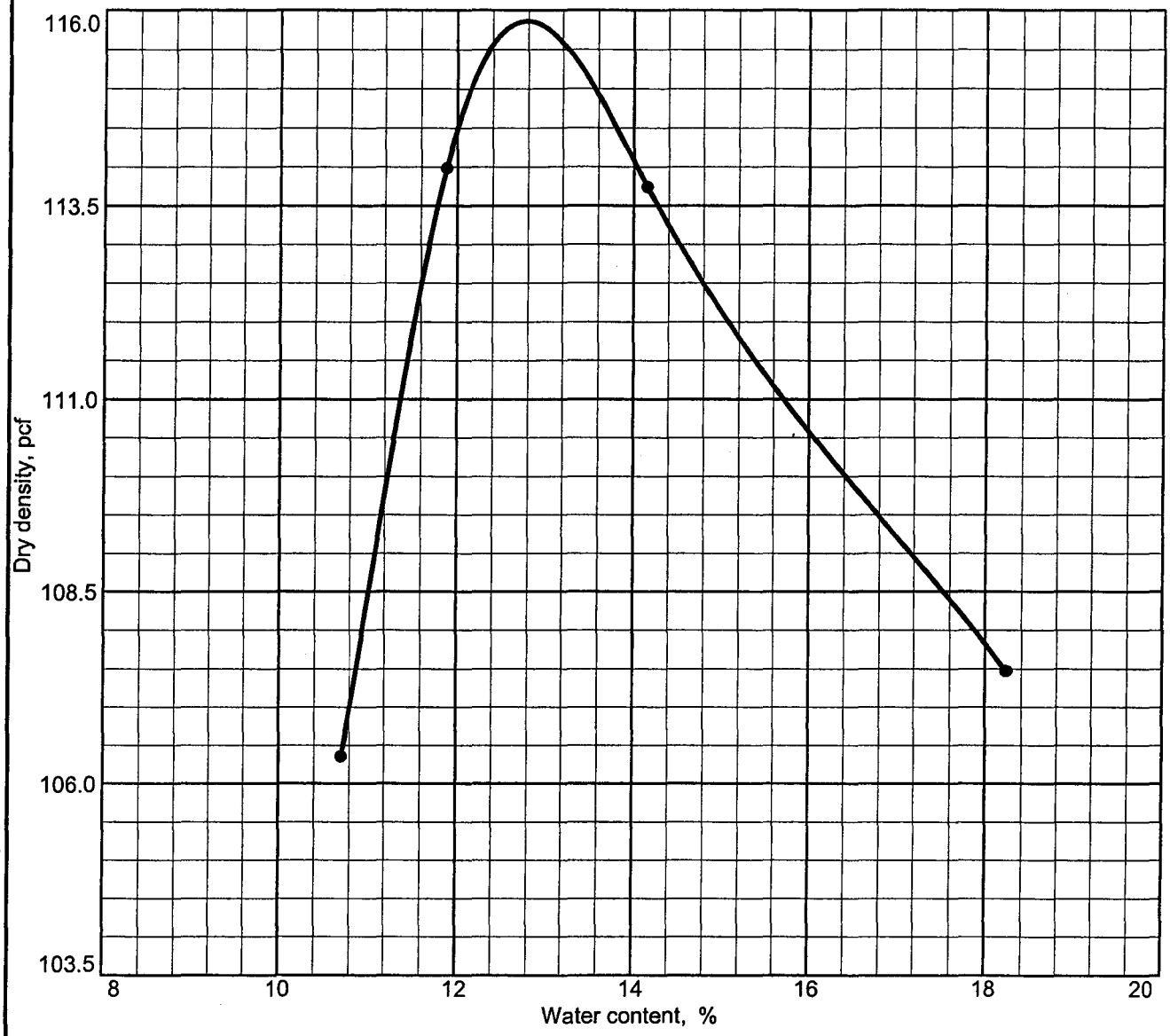
Soaked CBR Value = 13.1
Resiliency Factor = 2.5
CBR Sampled from Station 77+00

MOISTURE DENSITY TEST REPORT (PROCTOR CURVE)

**GET SOLUTIONS, INC.**

**Figure**

# MOISTURE DENSITY TEST REPORT (PROCTOR CURVE)




Test specification: ASTM D 698-91 Procedure A Standard

| Elev/ Depth | Classification | | Nat. Moist. | Sp.G. | LL | PI | % > No.4 | % < No.200 |
|---|---|---|---|---|---|---|---|---|
| | USCS | AASHTO | | | | | | |
| 0.5-2 Ft Below | SM | | 18.5 | | | | | 49.1 |

| TEST RESULTS | MATERIAL DESCRIPTION |
|---|---|
| Maximum dry density = 115.9 pcf<br>Optimum moisture = 12.8 % | Orangish brown, moist, Silty, fine to medium SAND (SM) |

**Project No.** WM03-429G **Client:** LandMark Design Group

**Project:** Fieldstone Parkway Extended

● **Source:** **Sample No.:** CBR 7 **Elev./Depth:** 0.5-2 Ft Below

**Remarks:**

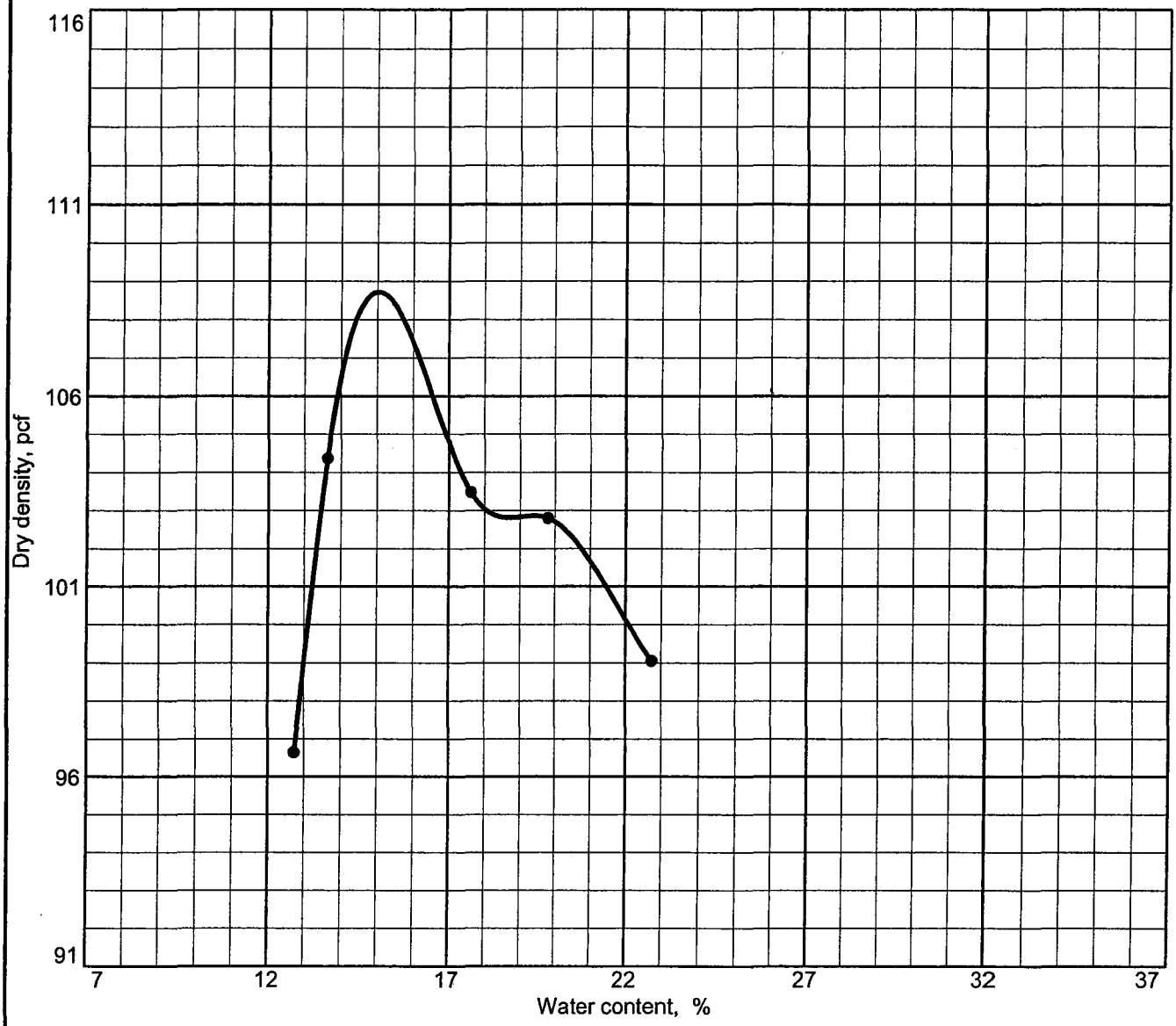
Soaked CBR Value = 14.0
Resiliency Factor = 2.5
CBR Sampled from Station 82+50

MOISTURE DENSITY TEST REPORT (PROCTOR CURVE)

**GET SOLUTIONS, INC.**

**Figure**

# MOISTURE DENSITY TEST REPORT (PROCTOR CURVE)




Test specification: ASTM D 698-91 Procedure A Standard

| Elev/ Depth | Classification | | Nat. Moist. | Sp.G. | LL | PI | % > No.4 | % < No.200 |
|---|---|---|---|---|---|---|---|---|
| | USCS | AASHTO | | | | | | |
| 2-4 Feet Below | CL | | 19.0 | | 34 | 12 | | 85.1 |

| TEST RESULTS | MATERIAL DESCRIPTION |
|---|---|
| Maximum dry density = 108.7 pcf<br>Optimum moisture = 15.0 % | Brown, moist, Silty CLAY (CL) with little Sand |

**Project No.** WM03-429G **Client:** LandMark Design Group

**Project:** Fieldstone Parkway Extended

● **Source:** **Sample No.:** CBR 8 **Elev./Depth:** 2-4 Feet Below

**Remarks:**

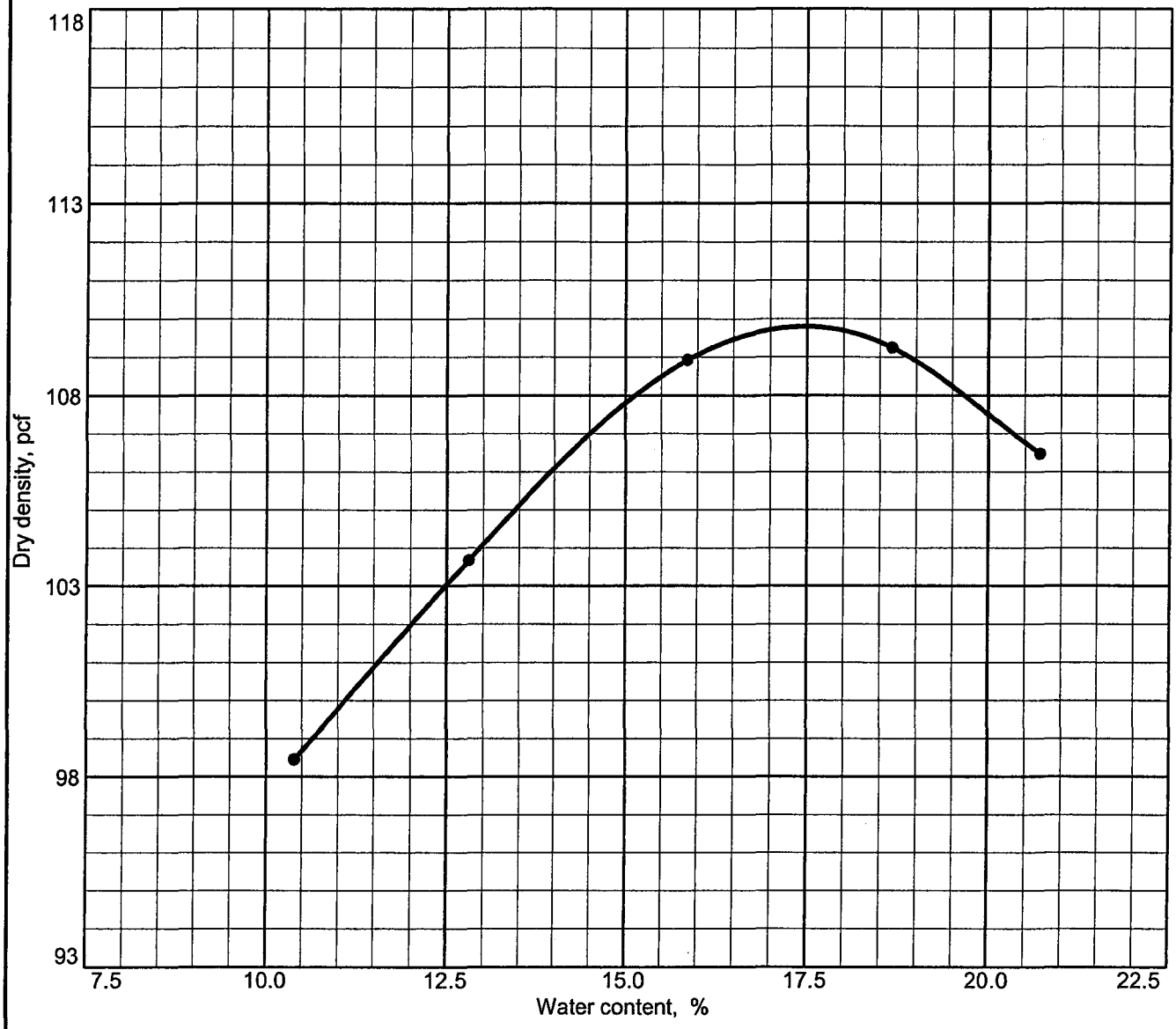
Soaked CBR Value = 6.8
Resiliency Factor = 2.0
CBR Sampled from Station 88+00

MOISTURE DENSITY TEST REPORT (PROCTOR CURVE)

**GET SOLUTIONS, INC.**

**Figure**

# MOISTURE DENSITY TEST REPORT (PROCTOR CURVE)




Test specification: ASTM D 698-91 Procedure A Standard

| Elev/ Depth | Classification | | Nat. Moist. | Sp.G. | LL | PI | % > No.4 | % < No.200 |
|---|---|---|---|---|---|---|---|---|
| | USCS | AASHTO | | | | | | |
| 10-12 Ft Below | CL | | 12.1 | | 45 | 25 | | 77.3 |

| TEST RESULTS | MATERIAL DESCRIPTION |
|---|---|
| Maximum dry density = 109.8 pcf<br>Optimum moisture = 17.5 % | Brown, moist, Silty CLAY (CL) with some Sand |

**Project No.** WM03-429G **Client:** LandMark Design Group

**Project:** Fieldstone Parkway Extended

● **Source:** **Sample No.:** CBR 9 **Elev./Depth:** 10-12 Ft

**Remarks:**

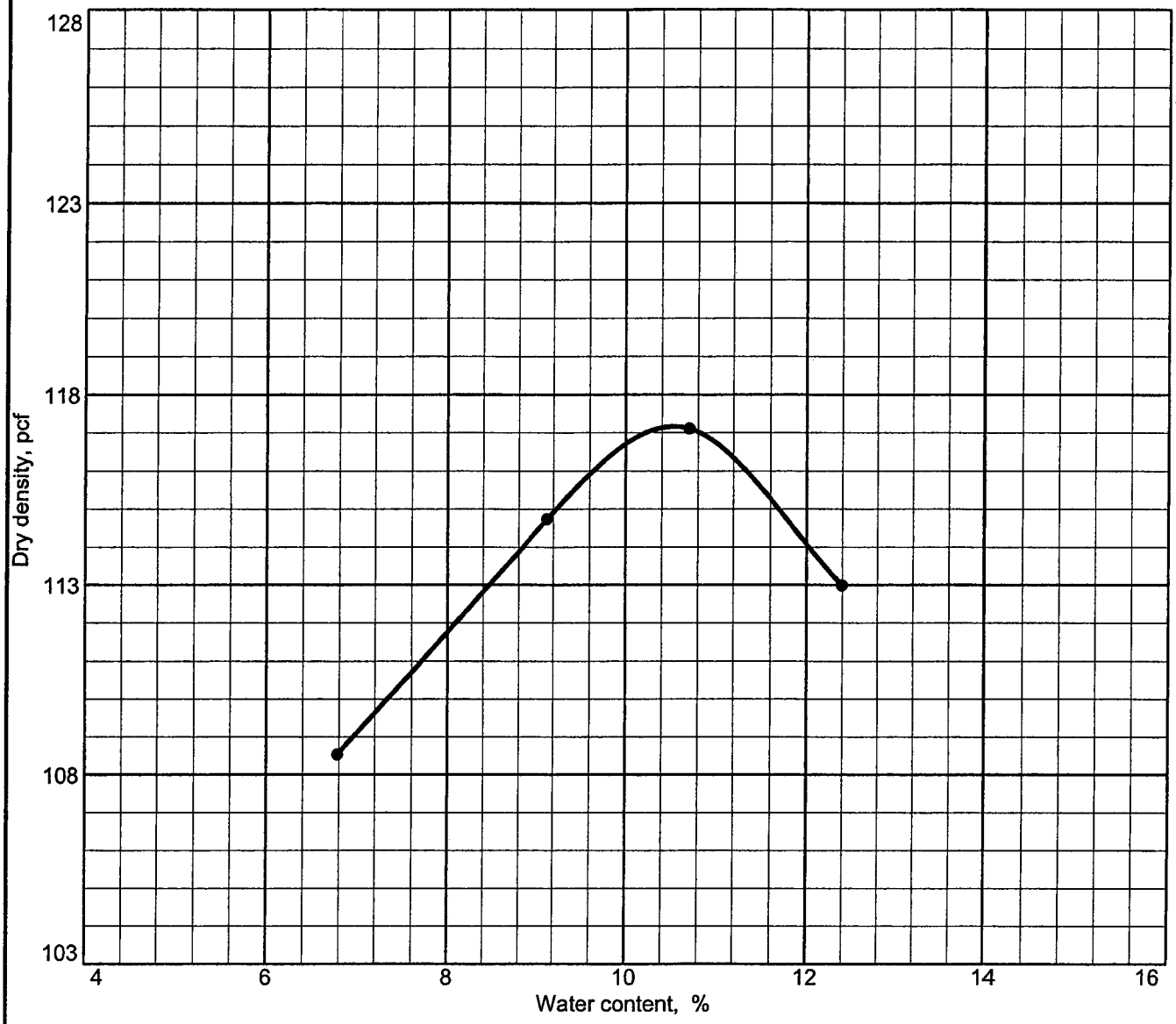
Soaked CBR Value = 7.7
Resiliency Factor = 2.0
CBR Sampled from Station 94+00

MOISTURE DENSITY TEST REPORT (PROCTOR CURVE)

**GET SOLUTIONS, INC.**

**Figure**

# MOISTURE DENSITY TEST REPORT (PROCTOR CURVE)




Test specification: ASTM D 698-91 Procedure A Standard

| Elev/ Depth | Classification | | Nat. Moist. | Sp.G. | LL | PI | % > No.4 | % < No.200 |
|---|---|---|---|---|---|---|---|---|
| | USCS | AASHTO | | | | | | |
| 0.5-1 Ft Below | SM | | 12.3 | | | | | 45.9 |

| TEST RESULTS | MATERIAL DESCRIPTION |
|---|---|
| Maximum dry density = 117.2 pcf<br>Optimum moisture = 10.5 % | Brown, moist, Silty, fine SAND (SM) |

**Project No.** WM03-429G **Client:** LandMark Design Group

**Project:** Fieldstone Parkway Extended

● **Source:** **Sample No.:** CBR 10 **Elev./Depth:** 0.5-1 Ft Below

**Remarks:**

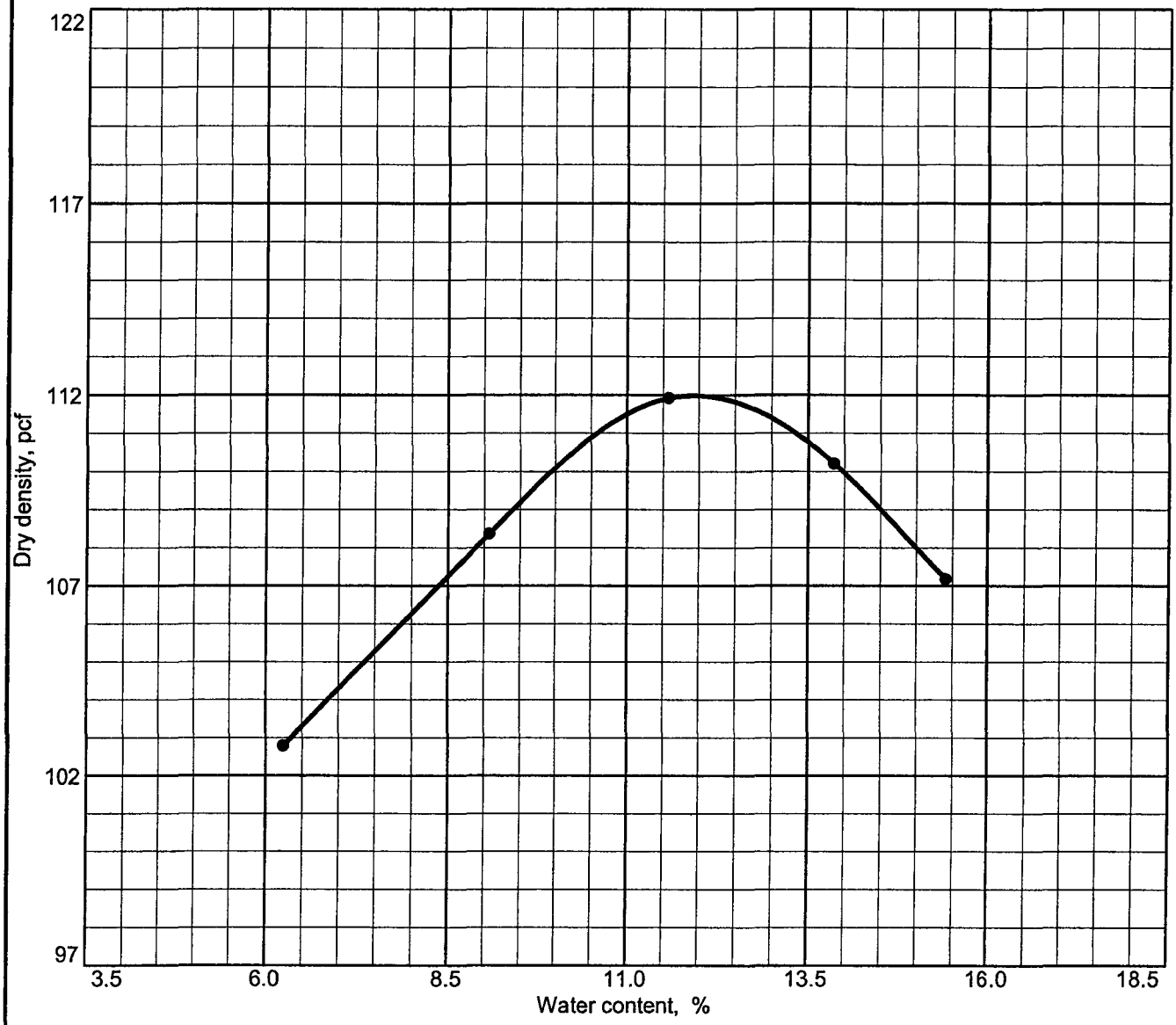
Soaked CBR Value = 13.2
Resiliency Factor = 2.5
CBR Sampled from Station 98+00

MOISTURE DENSITY TEST REPORT (PROCTOR CURVE)

**GET SOLUTIONS, INC.**

**Figure**

# MOISTURE DENSITY TEST REPORT (PROCTOR CURVE)




Test specification: ASTM D 698-91 Procedure A Standard

| Elev/ Depth | Classification | | Nat. Moist. | Sp.G. | LL | PI | % > No.4 | % < No.200 |
|---|---|---|---|---|---|---|---|---|
| | USCS | AASHTO | | | | | | |
| 2-3 Feet Below | SM | | 10.9 | | | | | 49.6 |

| TEST RESULTS | MATERIAL DESCRIPTION |
|---|---|
| Maximum dry density = 112.0 pcf<br>Optimum moisture = 11.9 % | Brown, moist, Silty, fine SAND (SM-ML) |

**Project No.** WM03-429G **Client:** LandMark Design Group
**Project:** Fieldstone Parkway Extended

● **Source:** **Sample No.:** CBR 11 **Elev./Depth:** 2-3 Feet Below

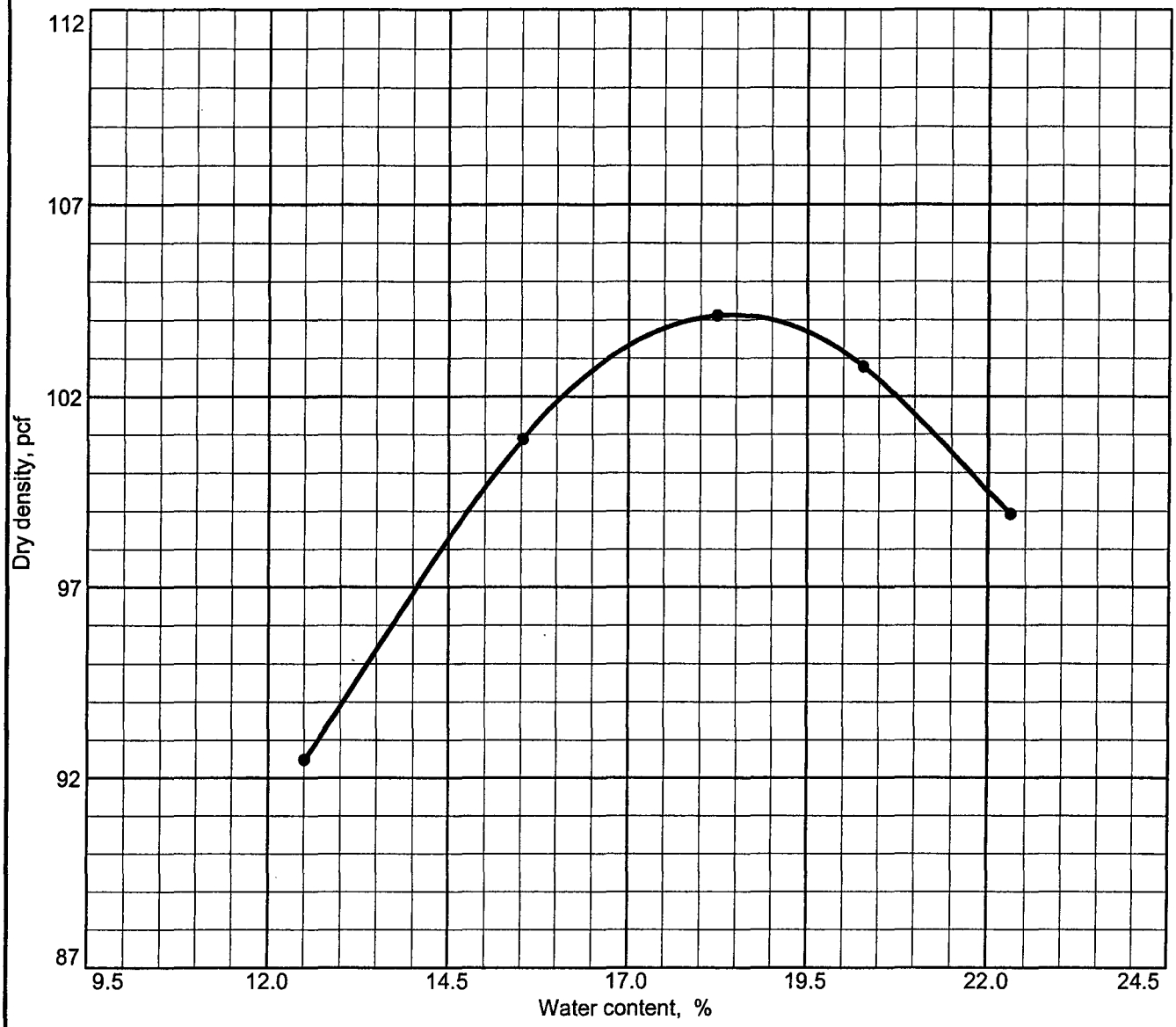
**Remarks:**
Soaked CBR Value = 13.1
Resiliency Factor = 2.5
CBR Sampled from Station 102+00

MOISTURE DENSITY TEST REPORT (PROCTOR CURVE)

**GET SOLUTIONS, INC.**

**Figure**

# MOISTURE DENSITY TEST REPORT (PROCTOR CURVE)




Test specification: ASTM D 698-91 Procedure A Standard

| Elev/ Depth | Classification | | Nat. Moist. | Sp.G. | LL | PI | % > No.4 | % < No.200 |
|---|---|---|---|---|---|---|---|---|
| | USCS | AASHTO | | | | | | |
| 0.5-2 Ft Below | CL-ML | | 12.4 | | 27 | 6 | | 61.1 |

| TEST RESULTS | MATERIAL DESCRIPTION |
|---|---|
| Maximum dry density = 104.1 pcf<br>Optimum moisture = 18.4 % | Orangish brown, moist, Sandy CLAY to Sandy SILT (CL-ML) |

**Project No.** WM03-429G **Client:** LandMark Design Group

**Project:** Fieldstone Parkway Extended

● **Source:** **Sample No.:** CBR 12 **Elev./Depth:** 0.5-2 Ft Below

**Remarks:**

Soaked CBR Value = 10.8
Resiliency Factor = 2.0
CBR Sampled from Station 106+25

MOISTURE DENSITY TEST REPORT (PROCTOR CURVE)

**GET SOLUTIONS, INC.**

**Figure**

**James City County, Virginia**
**Environmental Division**

# Erosion and Sediment Control and Stormwater Management Design Plan Checklists

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| V. | Additional Comments and Information | 14 |


GENERAL INFORMATION

Project Name: Fieldstone Parkway
Owner / Applicant: Stonehouse Development Company, LLC
Plan Preparer: AES Consulting Engineers Email:
Project Location: Intersection of Fieldstone Parkway & Mill Pond Run
Tax Map / Parcel: (04-4)(1-0-0025)
County Plan No. (if known):
County BMP Type: ( - )

Other information submitted in addition to this checklist (Check all that apply):

- ☑ Design or Construction Drawings (Plans, Profiles, Details, etc.).
- ☑ Erosion & Sediment Control Plan (Plans, Details, etc.).
- ☐ Erosion & Sediment Control Plan Design Report.
- ☐ Stormwater Management Design Plan (Plans, Profiles, Details, etc.).
- ☐ Stormwater Management Design Report.
- ☐ Other, List:

***Issue Date***
***March 1, 2001***

*JAMES CITY COUNTY, VIRGINIA*
*ENVIRONMENTAL DIVISION*

# *EROSION AND SEDIMENT CONTROL PLAN CHECKLIST*

## I. *GENERAL:*

| Yes | No | N/A | |
|---|---|---|---|
| ☑ | ☐ | ☐ | *FAMILIARITY* with current versions of Chapter 8, Erosion and Sedimentation Control and Chapter 23, Chesapeake Bay Preservation ordinances of the Code of James City County, Virginia and the Virginia Erosion and Sediment Control Handbook (VESCH). |
| ☑ | ☐ | ☐ | *LAND DISTURBING PERMIT AND SILTATION AGREEMENT* with surety are required for the project. |
| ☐ | ☑ | ☐ | *VARIANCE* if necessary, requested in writing, for the plan approving authority to waive or modify any of the minimum standards and specifications of the VESCH deemed inappropriate based on site conditions specific to this review case only. Variances which are approved shall be properly documented in the plan and become part of the approved erosion and sediment control plan for the site. |

## II. *SITE PLAN:*

| Yes | No | N/A | |
|---|---|---|---|
| ☑ | ☐ | ☐ | *VICINITY MAP* locating the site in relation to the surrounding area. Include any major landmarks which might assist in physically locating the site. |
| ☑ | ☐ | ☐ | *INDICATE NORTH* direction in relation to the site. |
| ☑ | ☐ | ☐ | *LIMITS OF CLEARING AND GRADING* for the site including that required for implementation of erosion and sediment controls, stockpile areas and utilities. |
| ☑ | ☐ | ☐ | *DISTURBED AREA ESTIMATES* in acres or square feet for the project. |
| ☑ | ☐ | ☐ | *EXISTING TOPOGRAPHY* or contours for the site at no more than 5 foot contour interval. |
| ☑ | ☐ | ☐ | *FINAL TOPOGRAPHY*, contours or proposed site grading in accordance with the design plan which indicates changes to existing topography and drainage patterns at no more than 2 foot contour interval (or 1 foot contours where required). |
| ☑ | ☐ | ☐ | *EXISTING AND PROPOSED SPOT ELEVATIONS* to supplement existing and proposed contours, topography or site grading information. Spot elevations may replace final contours in some instances, especially if terrain is in a low lying area or relatively flat. |
| ☑ | ☐ | ☐ | *EXISTING VEGETATION* including existing tree lines, grassed or unique vegetation areas. |

| Yes | No | N/A | |
|---|---|---|---|
| ☐ | ☑ | ☐ | *MAINTENANCE PLAN* or alternately, appropriate reference to current minimum standards and specifications of the VESCH, outlining the inspection frequency and maintenance requirements for all erosion and sediment control measures proposed for the project. |
| ☐ | ☑ | ☐ | *TRENCH DEWATERING* methods and erosion and sediment controls, if anticipated for the project. |
| ☑ | ☐ | ☐ | *CONSTRUCTION SEQUENCE* outlining the anticipated sequence for installation of erosion and sediment controls and site, grading and utility work to be performed for the project by the site contractor. |
| ☐ | ☐ | ☑ | *PHASING PLAN* if required for larger project sites that are to be developed in stages or phases. |
| ☑ | ☐ | ☐ | *STANDARD COUNTY NOTES* are required to be placed on the erosion and sediment control plan. Refer to the standard James City County Erosion and Sediment Control Notes dated May 5, 1999. |
| ☑ | ☐ | ☐ | *PROFESSIONAL SEAL AND SIGNATURE* required on final and complete approved plans, drawings, technical reports and specifications. |

## III. *NARRATIVE:*

| Yes | No | N/A | |
|---|---|---|---|
| ☑ | ☐ | ☐ | *PROJECT DESCRIPTION* briefly describing the nature and purpose of the land disturbing activity and the acreage to be disturbed. |
| ☑ | ☐ | ☐ | *EXISTING SITE CONDITIONS* description of existing topography, land use, cover and drainage patterns at the site. |
| ☐ | ☐ | ☑ | *ADJACENT AREA* descriptions of neighboring onsite or offsite areas such as streams, lakes, property, roads, etc. and potential impacts due to concentrated flow or runoff from the land disturbing activity. |
| ☐ | ☑ | ☐ | *OFFSITE DISTURBED AREA* descriptions of proposed borrow sites, waste or surplus areas, utility extensions and erosion and sediment controls to be implemented. |
| ☑ | ☐ | ☐ | *SOILS DESCRIPTION* briefly summarizing site, disturbed area and drainage basin soils including name, unit, hydrologic soil group (HSG) classification, surface runoff potential, erodibility, permeability, depth, texture, structure, erosion hazards, shrink-swell potential, limitations for use and anticipated depths to bedrock and the seasonal water table, as applicable. |
| ☑ | ☐ | ☐ | *CRITICAL AREAS* on the site which many have potentially serious erosion and sediment control problems and special considerations required (ie. steep slopes, hydric soils, channels, springs, sinkholes, water supply reservoirs, groundwater recharge areas, etc.) |

*JAMES CITY COUNTY, VIRGINIA*
*ENVIRONMENTAL DIVISION*

# *STORMWATER MANAGEMENT DESIGN PLAN CHECKLIST*

## I. *GENERAL:*

| Yes | No | N/A | |
|---|---|---|---|
| ☐ | ☐ | ☑ | *FAMILIARITY* with current versions of the James City County Guidelines for Design and Construction of Stormwater Management BMPs manual; Chapter 8, Erosion and Sediment Control and Chapter 23, Chesapeake Bay Preservation ordinances of the Code of James City County, Virginia; the Virginia Erosion and Sediment Control Handbook (VESCH); and the Virginia Stormwater Management Handbook (VSMH). |
| ☐ | ☐ | ☑ | *WAIVER OR EXCEPTION* if necessary, requested in writing, for the plan approving authority to waive or except the requirements of Chapter 23, Chesapeake Bay Preservation ordinance in accordance with procedure established in Sections 23-14 through 23-17 of the ordinance. Applies to this review case only. |
| ☐ | ☐ | ☑ | *VARIANCE REQUEST* if necessary, requested in writing for the plan approving authority to waive or modify any of the minimum standards and specifications of the VESCH deemed inappropriate based on site conditions specific to this review case only. Variances which are approved shall be properly documented in the plan and become part of the approved erosion and sediment control plan for the site. |
| ☐ | ☐ | ☑ | *PROFESSIONAL SEAL AND SIGNATURE* required on final and complete approved stormwater management plans, drawings, technical reports and specifications. |
| ☐ | ☐ | ☑ | *WORKSHEET FOR BMP POINT SYSTEM* to ensure the stormwater management plan for the project attains at least 10 BMP points (New Development) or traditional pollutant load reduction computations per the Chesapeake Bay Local Assistance Manual (Redevelopment Only). |
| ☐ | ☐ | ☑ | *PROPOSED CONSERVATION EASEMENT AREAS* for any natural open space points claimed in the BMP worksheet. |
| ☐ | ☐ | ☑ | *INSPECTION/MAINTENANCE AGREEMENT* is required to be prepared and executed with the County for the project. |
| ☐ | ☐ | ☑ | *FEMA FIRM PANEL* reference with designated special flood hazard areas or zone designations associated with the site, as applicable. |
| ☐ | ☐ | ☑ | *DRAINAGE AREA MAP* at a maximum scale of 1"=200' scale showing drainage area boundaries for pre- and postdevelopment conditions and associated time of concentration flow paths. Labels to include drainage area size, runoff coefficient or curve number and time of concentration for each subarea shown on the map. |

| Yes | No | N/A | |
|---|---|---|---|
| ☐ | ☐ | ☑ | Proposed site improvements and proposed impervious cover areas. |
| ☐ | ☐ | ☑ | Proposed stormwater conveyance, drainage and management facilities with appropriate labeled construction data and information. |
| ☐ | ☐ | ☑ | Proposed landscaping and seeding plans (disturbed areas, pond interior, etc.). |
| ☐ | ☐ | ☑ | Proposed slope stabilization areas (riprap, blankets, mattings, walls, etc.). |
| ☐ | ☐ | ☑ | Delineation of permanent pools and the 1-, 2-, 10- and 100-year Design Water Surface Elevations. |
| ☐ | ☐ | ☑ | Delineation of ponding, headwater, surcharge or backwater areas which may affect adjacent existing or proposed buildings, structures or upstream adjacent properties. |
| ☐ | ☐ | ☑ | Test boring locations with reference surface elevations (if known). |
| ☐ | ☐ | ☑ | Risers, barrels, underdrains, overflows and outlet protections. |
| ☐ | ☐ | ☑ | Emergency spillway level section and outlet channel. |
| ☐ | ☐ | ☑ | Existing and proposed site utilities and protection measures. |
| ☐ | ☐ | ☑ | Erosion and sediment control measures (for site or BMP). |
| ☐ | ☐ | ☑ | Maintenance or access corridors to permanent stormwater management, BMP or drainage facilities. |

## II. *STORMWATER CONVEYANCE SYSTEMS:*

| Yes | No | N/A | |
|---|---|---|---|
| ☐ | ☐ | ☑ | *PLAN VIEWS* |
| | ☐ | ☐ | ☑ Storm drain lengths, sizes, types, classes and slopes for all segments. Label directly on plan or use structure/pipe schedule. |
| | ☐ | ☐ | ☑ Access structure (inlets, manholes, junctions, etc.) rim elevations, inverts, type and required grate or top unit and lengths labeled. |
| | ☐ | ☐ | ☑ All structure numbers labeled. |
| | ☐ | ☐ | ☑ Adequate horizontal clearance from other site utilities or structures. |
| ☐ | ☐ | ☑ | *PROFILES* generally are not required but are encouraged to expedite review. If not provided, ensure all pipe segments have adequate minimum cover, do not exceed maximum depths of cover for the type/class of pipe specified and do not conflict with other site utilities or excavation areas. |
| ☐ | ☐ | ☑ | *DETAILS* |
| | ☐ | ☐ | ☑ Typical storm drain bedding details or reference note. |
| | ☐ | ☐ | ☑ Standard details or reference note for all proposed access structure types (inlets, manholes, junctions, etc.). |
| | ☐ | ☐ | ☑ Inlet shaping detail or applicable reference note. |
| | ☐ | ☐ | ☑ Step detail or applicable reference note (if depth 4 ft. or more). |
| | ☐ | ☐ | ☑ Typical open channel details with designation, location, shape, type, bottom width, top width, lining, slope, length, side slope, and installation depth required for construction. Channel design data as necessary may also be included. |
| | ☐ | ☐ | ☑ Outlet protections at all pipe outfalls. |

Yes No N/A

☐ ☐ ☑ Infiltration and filtering system facilities generally located at least 100 feet horizontally from any water supply well; 100 feet from any downslope building; and 25 feet from any upslope buildings, unless site specific investigation allows for reduced separation.

Yes No N/A

☐ ☐ ☑ *HYDRAULIC COMPUTATIONS*

- ☐ ☐ ☑ Elevation- or Stage- Storage curve and/or tabular data.
- ☐ ☐ ☑ Weir / Orifice Control - Extended Detention.
- ☐ ☐ ☑ Weir / Orifice Control - riser 1-year control for channel protection.
- ☐ ☐ ☑ Weir / Orifice Control - riser 2-year control for quantity (if required).
- ☐ ☐ ☑ Weir / Orifice Control - riser 10-year control for quantity (if required).
- ☐ ☐ ☑ Inlet / Outlet (barrel) control - (All Storms).
- ☐ ☐ ☑ Check for barrel control prior to riser orifice flow to prevent slug flow-water hammer conditions.
- ☐ ☐ ☑ Emergency spillway capacity and depth of flow.
- ☐ ☐ ☑ Elevation - Discharge (Outlet Rating) curve and/or table. Provide all supporting calculations and/or design assumptions.
- ☐ ☐ ☑ Adequate channel computations for receiving channel. May be waived if facility is designed based on current Stream Channel Protection criteria.

☐ ☐ ☑ *POND or RESERVOIR ROUTING*

- ☐ ☐ ☑ Storage-Indication Routing of postdeveloped inflow hydrographs for the 1-, 2-, 10-, and 100-year design storms. Preference is for structure to discharge up to the 10-year storm through the principal spillway and pass the 100-year storm with a minimum 1 foot of freeboard through a combination principal and emergency spillways. If no emergency spillway is provided, riser must be large enough to pass the design high water flow and trash without overtopping the facility, have 3 square feet or more of cross-sectional area, contain a hood type inlet and have a minimum freeboard of 2 feet. Token spillways with minimum 8 ft. width are also recommended at or above the design 100-year storm elevation.
- ☐ ☐ ☑ Downstream hydrographs at established study points, if conditions warrant (ie. facility discharge combined with uncontrolled bypass).

☐ ☐ ☑ *MISCELLANEOUS COMPUTATIONS*

- ☐ ☐ ☑ Water quality volume for permanent pool based on selected BMP treatment volume (WQv).
- ☐ ☐ ☑ Water quality volume for extended detention based on selected BMP treatment volume (WQv) with drawdown computations.
- ☐ ☐ ☑ Drawdown computations for the 1-year, 24 hour detention for stream channel protection criteria.
- ☐ ☐ ☑ Pond drain computations (within 24 hours).
- ☐ ☐ ☑ Anti-seep collar design (concrete preferred) or match material type.
- ☐ ☐ ☑ Filter diaphragm design (or alternative method of controlling seepage).

Yes No N/A

☐ ☐ ☑ *CORE TRENCH*

- ☐ ☐ ☑ Material (per plan or Geotechnical Report).
- ☐ ☐ ☑ Bottom width (4' minimum or greater as dictated by Geotechnical Report recommendations).
- ☐ ☐ ☑ Side slopes (1:1 maximum steepness)
- ☐ ☐ ☑ Depth (4' minimum or greater as dictated by Geotechnical Report).

☐ ☐ ☑ *PRINCIPAL CONTROL STRUCTURE. RISER OR SIMILAR STRUCTURE (DETAILS REQUIRED FOR ALL ITEMS)*

- ☐ ☐ ☑ Durable, watertight, resistant material (concrete preferred).
- ☐ ☐ ☑ Riser diameter is at least 1.25 times larger than barrel diameter.
- ☐ ☐ ☑ All pertinent dimensions and elevations shown.
- ☐ ☐ ☑ Control orifice or weir dimensions and elevations shown.
- ☐ ☐ ☑ Trash rack - removable - for each release.
- ☐ ☐ ☑ Anti-vortex device, baffle or plate.
- ☐ ☐ ☑ Riser base structure with dimensions and embedment specifications (concrete preferred).
- ☐ ☐ ☑ Interior access (steps, ladders, etc.) for maintenance for structures over 4 feet in height. Excessively high risers may need some form of exterior access on top portion.
- ☐ ☐ ☑ Low flow orifice with trash rack device.

☐ ☐ ☑ *PRINCIPAL CONTROL STRUCTURE OUTLET BARREL*

- ☐ ☐ ☑ Material (ASTM C-361 reinforced concrete pipe) with watertight joints. Prior approval required for all other pipe material (other RCP types, CMP, CPP, PVC, etc.).
- ☐ ☐ ☑ Support and bedding requirements for barrel - concrete cradles, etc. or as recommended by the Geotechnical Report.
- ☐ ☐ ☑ Pipe inverts, length, size, class and slope shown.
- ☐ ☐ ☑ Flared end section or endwall provided on barrel outlet.

☐ ☐ ☑ *SEEPAGE CONTROL*

- ☐ ☐ ☑ Phreatic line shown (4:1 slope measured from the intersection of the embankment and the principal spillway design high water).
- ☐ ☐ ☑ *ANTI-SEEP COLLARS*
  - ☐ ☐ ☑ Anti-seep collar, concrete preferred.
  - ☐ ☐ ☑ Size - 15 percent increase in length of saturation using outside pipe diameter.
  - ☐ ☐ ☑ Spacing and location on barrel (located at least 2 feet from a pipe joint).

Yes No N/A

☐ ☐ ☑ *CONSTRUCTION SPECIFICATIONS and NOTES*

- ☐ ☐ ☑ Anticipated sequence of construction for BMP (consistent with erosion and sediment control plan).
- ☐ ☐ ☑ Provisions to control base stream or storm flow conditions encountered during construction.
- ☐ ☐ ☑ Site and subgrade preparation requirements.
- ☐ ☐ ☑ Embankment, fill and backfill material soil and placement (lift) thickness requirements.
- ☐ ☐ ☑ Compaction and soil moisture content requirements.
- ☐ ☐ ☑ Geosynthetics for drainage, filtration, moisture barrier, separation, and reinforcement purposes.
- ☐ ☐ ☑ Clay or synthetic (PVC or HDPE) pond liners.
- ☐ ☐ ☑ Storm drain, underdrain and pipe conduit requirements.
- ☐ ☐ ☑ Minimum depth of pipe cover for temporary (construction) and final cover conditions.
- ☐ ☐ ☑ Permanent shutoff valve and pond drain.
- ☐ ☐ ☑ Concrete requirements for structural components.
- ☐ ☐ ☑ Riprap and slope protection.
- ☐ ☐ ☑ Access or maintenance road surface, base, subbase.
- ☐ ☐ ☑ Temporary and permanent stabilization measures.
- ☐ ☐ ☑ Temporary or permanent safety fencing.
- ☐ ☐ ☑ BMP Landscaping (deep, shallow, fringe, perimeter,etc.)
- ☐ ☐ ☑ Dust and traffic control (if warranted).
- ☐ ☐ ☑ Construction monitoring and certification by professional.
- ☐ ☐ ☐ Other: _____
- ☐ ☐ ☐ Other: _____.

☐ ☐ ☑ *MAINTENANCE PROVISIONS*

- ☐ ☐ ☑ Entity responsible for maintenance identified..
- ☐ ☐ ☑ Maintenance Plan which outlines the long-term schedule for inspection/maintenance of the facility and forebays
- ☐ ☐ ☑ Maintenance access from public right-of-way or publicly traveled road.
- ☐ ☐ ☑ Maintenance easement provided encompassing high water pool and buffer, principal and emergency spillways, outlet structures, forebays, embankment area and possible sediment-removal stockpile areas.
- ☐ ☐ ☑ Minimum 6 foot wide public safety shelf (landing) or alternative fencing.

**James City County, Virginia**
**Environmental Division**

# Erosion and Sediment Control and Stormwater Management Design Plan Checklists

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GENERAL INFORMATION

Project Name: FIELDSTONE PARKWAY ROAD EXTENSION
Owner / Applicant: STONEHOUSE AT WILLIAMSBURG LLC
Plan Preparer: ALISTAIR J. RAMSAY Email: ARAMSAY@LANDMARKDG.COM
Project Location: STONEHOUSE DISTRICT
Tax Map / Parcel: 06-4-1-1
County Plan No. (if known): SP-108-02
County BMP Type: _____ ( - )
Other information submitted in addition to this checklist (Check all that apply):

- ☒ Design or Construction Drawings (Plans, Profiles, Details, etc.).
- ☒ Erosion & Sediment Control Plan (Plans, Details, etc.).
- ☐ Erosion & Sediment Control Plan Design Report.
- ☐ Stormwater Management Design Plan (Plans, Profiles, Details, etc.).
- ☐ Stormwater Management Design Report.
- ☒ Other, List: DRAINAGE CALCULATIONS

***Issue Date***
***March 1, 2001***

*JAMES CITY COUNTY, VIRGINIA*
*ENVIRONMENTAL DIVISION*

# *EROSION AND SEDIMENT CONTROL PLAN CHECKLIST*

## I. *GENERAL:*

| Yes | No | N/A | |
|---|---|---|---|
| ☒ | ☐ | ☐ | *FAMILIARITY* with current versions of Chapter 8, Erosion and Sedimentation Control and Chapter 23, Chesapeake Bay Preservation ordinances of the Code of James City County, Virginia and the Virginia Erosion and Sediment Control Handbook (VESCH). |
| ☒ | ☐ | ☐ | *LAND DISTURBING PERMIT AND SILTATION AGREEMENT* with surety are required for the project. |
| ☐ | ☐ | ☐ | *VARIANCE* if necessary, requested in writing, for the plan approving authority to waive or modify any of the minimum standards and specifications of the VESCH deemed inappropriate based on site conditions specific to this review case only. Variances which are approved shall be properly documented in the plan and become part of the approved erosion and sediment control plan for the site. |

## II. *SITE PLAN:*

| Yes | No | N/A | |
|---|---|---|---|
| ☒ | ☐ | ☐ | *VICINITY MAP* locating the site in relation to the surrounding area. Include any major landmarks which might assist in physically locating the site. |
| ☒ | ☐ | ☐ | *INDICATE NORTH* direction in relation to the site. |
| ☒ | ☐ | ☐ | *LIMITS OF CLEARING AND GRADING* for the site including that required for implementation of erosion and sediment controls, stockpile areas and utilities. |
| ☒ | ☐ | ☐ | *DISTURBED AREA ESTIMATES* in acres or square feet for the project. |
| ☒ | ☐ | ☐ | *EXISTING TOPOGRAPHY* or contours for the site at no more than 5 foot contour interval. |
| ☒ | ☐ | ☐ | *FINAL TOPOGRAPHY*, contours or proposed site grading in accordance with the design plan which indicates changes to existing topography and drainage patterns at no more than 2 foot contour interval (or 1 foot contours where required). |
| ☒ | ☐ | ☐ | *EXISTING AND PROPOSED SPOT ELEVATIONS* to supplement existing and proposed contours, topography or site grading information. Spot elevations may replace final contours in some instances, especially if terrain is in a low lying area or relatively flat. |
| ☒ | ☐ | ☐ | *EXISTING VEGETATION* including existing tree lines, grassed or unique vegetation areas. |

| Yes | No | N/A | |
|---|---|---|---|
| ☒ | ☐ | ☐ | *EXISTING SITE FEATURES* including roads, buildings, homes, utilities, streams, fences, structures and other important surface features of the site. |
| ☒ | ☐ | ☐ | *SOILS MAP* with soil symbols, boundaries and legend in accordance with the current Soil Survey of James City and York Counties and the City of Williamsburg, Virginia. |
| ☒ | ☐ | ☐ | *ENVIRONMENTAL INVENTORY* in accordance with Section 23-10(2) of the Chesapeake Bay Preservation Ordinance of James City County. Inventory generally includes: tidal shores and wetlands, non-tidal wetlands, resource protection area, hydric soils and slopes steeper than 25 percent. For wetlands, provide a copy of issued permits or satisfactory evidence that appropriate permits are being pursued for the entire project. |
| ☐ | ☐ | ☒ | *100-YEAR FLOODPLAIN LIMITS* or any special flood hazard areas or flood zones based on appropriate Federal Management Agency Flood Insurance Rate Maps (FIRMs) or Flood Hazard Boundary Maps (FHBMs) of James City County, Virginia. |
| ☒ | ☐ | ☐ | *DRAINAGE AREAS* for offsite and onsite areas, existing or proposed as applicable. Include drainage divides and directional labels for all subareas at points of interest and size (in acres), weighted runoff coefficient or curve number and times of concentration for each subarea. |
| ☒ | ☐ | ☐ | *CRITICAL EROSION AREAS* which require special consideration or unique erosion and sediment control measures. Refer to the VESCH, Chapter 6 for criteria. NO. |
| ☒ | ☐ | ☐ | *DEVELOPMENT PLAN* for the site showing all improvements such as buildings, structures, parking areas, access roadways, above and below ground utilities, stormwater management and drainage facilities, trails or sidewalks, proposed vegetation and landscaping, amenities, etc. |
| ☒ | ☐ | ☐ | *LOCATION OF PRACTICES* proposed for erosion and sediment control, tree protection and temporary stormwater management due to land disturbance activities at the site. Use standard abbreviations, labels and symbols consistent for plan views based on minimum standards and specifications in Chapter 3 of the VESCH. |
| ☒ | ☐ | ☐ | *TEMPORARY STOCKPILE AREAS* or staging and equipment storage areas as required for onsite or offsite construction activities or indicate that none are anticipated for this project. |
| ☐ | ☐ | ☒ | *OFFSITE LAND DISTURBING AREAS* including borrow sites, waste areas, utility extensions, etc. and required erosion and sediment controls. If none are anticipated for the project, then indicate on the plans by general or erosion and sediment control notes. |
| ☒ | ☐ | ☐ | *DETAILS* or alternately, appropriate reference to current minimum standards and specifications of the VESCH for each measure proposed for the project. Non-modified, standard duplicated details (silt fence, diversion dikes, etc.) may be referenced to the current version of the VESCH. Specific dimensional or modified standards (basins, traps, outlet protections, check dams, etc.) require presentation on detail sheets. Schedules or tables may be used for multiple site measures such as sediment traps, basins, channels, slope drains, etc. Any modification to standard details should be clearly defined, explained and illustrated. |

Yes No N/A

☒ ☐ ☐ *MAINTENANCE PLAN* or alternately, appropriate reference to current minimum standards and specifications of the VESCH, outlining the inspection frequency and maintenance requirements for all erosion and sediment control measures proposed for the project.

☐ ☐ ☒ *TRENCH DEWATERING* methods and erosion and sediment controls, if anticipated for the project.

☒ ☐ ☐ *CONSTRUCTION SEQUENCE* outlining the anticipated sequence for installation of erosion and sediment controls and site, grading and utility work to be performed for the project by the site contractor.

☐ ☐ ☒ *PHASING PLAN* if required for larger project sites that are to be developed in stages or phases.

☒ ☐ ☐ *STANDARD COUNTY NOTES* are required to be placed on the erosion and sediment control plan. Refer to the standard James City County Erosion and Sediment Control Notes dated May 5, 1999.

☒ ☐ ☐ *PROFESSIONAL SEAL AND SIGNATURE* required on final and complete approved plans, drawings, technical reports and specifications.

## III. *NARRATIVE:*

Yes No N/A

☒ ☐ ☐ *PROJECT DESCRIPTION* briefly describing the nature and purpose of the land disturbing activity and the acreage to be disturbed.

☒ ☐ ☐ *EXISTING SITE CONDITIONS* description of existing topography, land use, cover and drainage patterns at the site.

☒ ☐ ☐ *ADJACENT AREA* descriptions of neighboring onsite or offsite areas such as streams, lakes, property, roads, etc. and potential impacts due to concentrated flow or runoff from the land disturbing activity.

☐ ☐ ☒ *OFFSITE DISTURBED AREA* descriptions of proposed borrow sites, waste or surplus areas, utility extensions and erosion and sediment controls to be implemented.

☒ ☐ ☐ ? *SOILS DESCRIPTION* briefly summarizing site, disturbed area and drainage basin soils including name, unit, hydrologic soil group (HSG) classification, surface runoff potential, erodibility, permeability, depth, texture, structure, erosion hazards, shrink-swell potential, limitations for use and anticipated depths to bedrock and the seasonal water table, as applicable.

☒ ☐ ☐ *CRITICAL AREAS* on the site which many have potentially serious erosion and sediment control problems and special considerations required (ie. steep slopes, hydric soils, channels, springs, sinkholes, water supply reservoirs, groundwater recharge areas, etc.)

Yes No N/A

☒ ☐ ☐ *PROPOSED EROSION & SEDIMENT CONTROL MEASURES* inclusive to the specific erosion and sediment control plan as proposed for the land disturbing activity. Measures should be consistent with those proposed on the site drawings. Address general use, installation, limitations, sequencing and maintenance requirements for each control measure.

☒ ☐ ☐ *STABILIZATION MEASURES* required for the site, either temporary or permanent, and during and following construction including temporary and permanent seeding and mulching, paving, stone, soil stabilization blankets and matting, sodding, landscaping or special stabilization techniques to be utilized at the site.

☒ ☐ ☐ *STORMWATER MANAGEMENT CONSIDERATIONS* for the site, either of temporary or permanent nature, and strategies, sequences and measures required for control. May reference the stormwater management plan for the site, if prepared, for permanent stormwater management facilities and control of drainage once the site is stabilized.

## IV. *CALCULATIONS:*

Yes No N/A

☒ ☐ ☐ *CALCULATIONS AND COMPUTATIONS* associated with hydrology, hydraulics and design of proposed temporary and permanent erosion and sediment control measures including: sediment traps and basins, diversions, stormwater conveyance channels, culverts, slope drains, outlet protections, etc. Computations are not required on the construction plan and may be attached in a supplemental erosion and sediment control plan design report, if presented in a clear and organized format.

☐ ☐ ☒ *TEMPORARY SEDIMENT BASIN DESIGN DATA SHEET* submitted for each basin along with schematic or sketch cross-section showing applicable design and construction data, storage volumes (wet-dry), dimensions and elevations. Peak design runoff to be based on the 2- or 25-year design storm event based on maximum disturbed site conditions (existing, interim or proposed conditions) in accordance with Minimum Standard 3.14 of the VESCH.

*JAMES CITY COUNTY, VIRGINIA*
*ENVIRONMENTAL DIVISION*

# *STORMWATER MANAGEMENT DESIGN PLAN CHECKLIST*

## I. *GENERAL:*

| Yes | No | N/A | |
|---|---|---|---|
| ☐ | ☐ | ☒ | *FAMILIARITY* with current versions of the James City County Guidelines for Design and Construction of Stormwater Management BMPs manual; Chapter 8, Erosion and Sediment Control and Chapter 23, Chesapeake Bay Preservation ordinances of the Code of James City County, Virginia; the Virginia Erosion and Sediment Control Handbook (VESCH); and the Virginia Stormwater Management Handbook (VSMH). |
| ☐ | ☐ | ☒ | *WAIVER OR EXCEPTION* if necessary, requested in writing, for the plan approving authority to waive or except the requirements of Chapter 23, Chesapeake Bay Preservation ordinance in accordance with procedure established in Sections 23-14 through 23-17 of the ordinance. Applies to this review case only. |
| ☐ | ☐ | ☒ | *VARIANCE REQUEST* if necessary, requested in writing for the plan approving authority to waive or modify any of the minimum standards and specifications of the VESCH deemed inappropriate based on site conditions specific to this review case only. Variances which are approved shall be properly documented in the plan and become part of the approved erosion and sediment control plan for the site. |
| ☐ | ☐ | ☒ | *PROFESSIONAL SEAL AND SIGNATURE* required on final and complete approved stormwater management plans, drawings, technical reports and specifications. |
| ☐ | ☐ | ☒ | *WORKSHEET FOR BMP POINT SYSTEM* to ensure the stormwater management plan for the project attains at least 10 BMP points (New Development) or traditional pollutant load reduction computations per the Chesapeake Bay Local Assistance Manual (Redevelopment Only). |
| ☐ | ☐ | ☒ | *PROPOSED CONSERVATION EASEMENT AREAS* for any natural open space points claimed in the BMP worksheet. |
| ☐ | ☐ | ☒ | *INSPECTION/MAINTENANCE AGREEMENT* is required to be prepared and executed with the County for the project. |
| ☐ | ☐ | ☒ | *FEMA FIRM PANEL* reference with designated special flood hazard areas or zone designations associated with the site, as applicable. |
| ☐ | ☐ | ☒ | *DRAINAGE AREA MAP* at a maximum scale of 1"=200' scale showing drainage area boundaries for pre- and postdevelopment conditions and associated time of concentration flow paths. Labels to include drainage area size, runoff coefficient or curve number and time of concentration for each subarea shown on the map. |

| Yes | No | N/A | |
|---|---|---|---|
| ☒ | ☐ | ☐ | *SOILS MAP* with soil symbols, boundaries and legend in accordance with the current Soil Survey of James City and York Counties and the City of Williamsburg, Virginia with approximate locations of the project site, BMPs and applicable drainage basins. |
| ☒ | ☐ | ☐ | *STORMWATER MANAGEMENT NARRATIVE* in a brief and simple format which describes the project; location; site and drainage basin soil characteristics; receiving water or drainage facility; existing site and drainage basin conditions (topography, land use, cover, slopes, etc.); proposed site development; proposed stormwater management and drainage plan including County BMP type selected; summary of hydrology and hydraulics; maintenance program; and any special assumptions utilized for development of the stormwater management and drainage design plan or computations. |
| ☒ | ☐ | ☐ | *TEMPORARY STORMWATER MANAGEMENT* (if applicable) for control of stormwater runoff encountered during construction activities in addition to measures provided in the erosion and sediment control plan or stormwater management/drainage plan for the site. Adequate protection measures or sequencing provided. |
| ☐ | ☐ | ☒ | *MODIFICATION PLAN* clearly defined for temporary sediment control structures which will be converted to permanent SWM/BMP structures. Includes appropriate hydrologic and hydraulic computations, conversions, sequencing and cleanout information or details. Normally related to primary control structures associated with dry detention or wet retention ponds. Normally not permitted for Group C or D categories such as bioretention, infiltration and filtering system facilities. |
| ☒ | ☐ | ☐ | *STORMWATER MANAGEMENT and DRAINAGE DESIGN REPORT* in a bound 8-1/2 x 11 inch size format. Report shall generally include a title sheet, date, project identification, owner and preparer information, table of contents, narrative, summaries and computations as required. Computations may include: backwater, closed conduit, headwater, hydraulic, hydraulic grade line, hydrology, inlet, open channel, storm sewer, water quality, extended detention or stream channel protection and muti-stage storm routing calculations, as applicable, for the project. Computation data may include hand or computer generated computations, maps or schematics. All information should be presented in a clear, easy to follow format and should closely match construction plan information. |
| ☒ | ☐ | ☐ | *PLAN VIEW* at 1 inch = 50 ft. scale or less (1" = 40', 1" = 30', etc.) |
| ☒ | ☐ | ☐ | North arrow and plan legend. |
| ☒ | ☐ | ☐ | Property lines. |
| ☒ | ☐ | ☐ | Adjacent property information. |
| ☒ | ☐ | ☐ | Existing site features and existing impervious cover areas. |
| ☒ | ☐ | ☐ | Impervious cover tabulations. |
| ☒ | ☐ | ☐ | Existing drainage facilities (natural or manmade). |
| ☒ | ☐ | ☐ | Existing environmentally sensitive areas (RPA, wetlands, floodplain, steep slopes, critical soils, buffers, etc.). |
| ☒ | ☐ | ☐ | Existing and proposed contours (1' or 2' contour interval) and spot elevations as necessary to define high and low topography. |
| ☒ | ☐ | ☐ | Existing and proposed easement locations. |

| Yes | No | N/A | |
|---|---|---|---|
| ☒ | ☐ | ☐ | Proposed site improvements and proposed impervious cover areas. |
| ☒ | ☐ | ☐ | Proposed stormwater conveyance, drainage and management facilities with appropriate labeled construction data and information. |
| ☐ | ☐ | ☒ | Proposed landscaping and seeding plans (disturbed areas, pond interior, etc.). |
| ☒ | ☐ | ☐ | Proposed slope stabilization areas (riprap, blankets, mattings, walls, etc.). |
| ☐ | ☐ | ☒ | Delineation of permanent pools and the 1-, 2-, 10- and 100-year Design Water Surface Elevations. |
| ☐ | ☐ | ☒ | Delineation of ponding, headwater, surcharge or backwater areas which may affect adjacent existing or proposed buildings, structures or upstream adjacent properties. |
| ☐ | ☐ | ☒ | Test boring locations with reference surface elevations (if known). |
| ☐ | ☐ | ☒ | Risers, barrels, underdrains, overflows and outlet protections. |
| ☐ | ☐ | ☒ | Emergency spillway level section and outlet channel. |
| ☒ | ☐ | ☐ | Existing and proposed site utilities and protection measures. |
| ☒ | ☐ | ☐ | Erosion and sediment control measures (for site or BMP). |
| ☐ | ☐ | ☒ | Maintenance or access corridors to permanent stormwater management, BMP or drainage facilities. |

## II. *STORMWATER CONVEYANCE SYSTEMS:*

| Yes | No | N/A | |
|---|---|---|---|
| ☐ | ☐ | ☐ | *PLAN VIEWS* |
| | | | ☒ ☐ ☐ Storm drain lengths, sizes, types, classes and slopes for all segments. Label directly on plan or use structure/pipe schedule. |
| | | | ☒ ☐ ☐ Access structure (inlets, manholes, junctions, etc.) rim elevations, inverts, type and required grate or top unit and lengths labeled. |
| | | | ☒ ☐ ☐ All structure numbers labeled. |
| | | | ☒ ☐ ☐ Adequate horizontal clearance from other site utilities or structures. |
| ☒ | ☐ | ☐ | *PROFILES* generally are not required but are encouraged to expedite review. If not provided, ensure all pipe segments have adequate minimum cover, do not exceed maximum depths of cover for the type/class of pipe specified and do not conflict with other site utilities or excavation areas. |
| ☐ | ☐ | ☐ | *DETAILS* |
| | | | ☒ ☐ ☐ Typical storm drain bedding details or reference note. |
| | | | ☒ ☐ ☐ Standard details or reference note for all proposed access structure types (inlets, manholes, junctions, etc.). |
| | | | ☒ ☐ ☐ Inlet shaping detail or applicable reference note. |
| | | | ☒ ☐ ☐ Step detail or applicable reference note (if depth 4 ft. or more). |
| | | | ☒ ☐ ☐ Typical open channel details with designation, location, shape, type, bottom width, top width, lining, slope, length, side slope, and installation depth required for construction. Channel design data as necessary may also be included. |
| | | | ☒ ☐ ☐ Outlet protections at all pipe outfalls. |

Yes No N/A

☐ ☐ ☐ *STORMWATER CONVEYANCE SYSTEM COMPUTATIONS*

- ☒ ☐ ☐ Storm Sewer Design computations based on 10-year design event.
- ☒ ☐ ☐ Hydraulic Grade Line computations based on 10-year design event.
- ☒ ☐ ☐ Inlet computations based on current VDOT procedure for spread, ponding depth and grate size required.
- ☒ ☐ ☐ Culvert Headwater computations. Design based on 10-year design storm event and check only for 100-year storm event.
- ☒ ☐ ☐ Open Channel computations based on 2-year design event for velocity and 10-year design event for capacity.
- ☒ ☐ ☐ Standard outlet protection or special energy dissipators.
- ☒ ☐ ☐ Pipe thickness design computations, as required, for selected pipe type (live load, minimum cover, maximum height of cover, etc.).
- ☒ ☐ ☐ Adequate channel computations for receiving channels (based on field measured channel section data).

## III. *STORMWATER MANAGEMENT / BMP FACILITIES*:

Yes No N/A

☐ ☐ ☒ *HYDROLOGY* - An SCS based methodology is required for the design of stormwater management/BMP facilities with watersheds exceeding 20 acres. Under 20 acres, other generally accepted methodologies such as the modified rational, critical storm are allowable. Refer to Chapter 5 of the VESCH or Chapter 5 of the VSMH.

- ☐ ☐ ☐ Runoff Curve Number or Coefficient determinations: predeveloped and ultimate development land use scenarios.
- ☐ ☐ ☐ Time of concentration: predeveloped and ultimate development indicating overland, shallow concentrated, and channel flow components (200 ft. maximum length for overland flow).
- ☐ ☐ ☐ Hydrograph generation (tabular or graphical): pre- and postdevelopment conditions for the 1-, 2-, 10-, and 100-year design storm events.

☐ ☐ ☒ *FACILITY CONFIGURATION and MINIMUM SEPARATIONS*

- ☐ ☐ ☐ Screening and layout consistent with Section 24-98(d) of the Chapter 24 Zoning ordinance (landscaping, screening, visibility, etc.).
- ☐ ☐ ☐ Basic considerations for safety and unauthorized entry.
- ☐ ☐ ☐ Proper length to width ratio (Typically 2H:1V).
- ☐ ☐ ☐ Facilities with deep pools (4 feet or more in depth) provided with two benches. Fifteen (15) ft. safety bench outward from normal pool at maximum 6 percent slope and aquatic bench inward from normal shoreline below normal pool. Narrower widths may be considered on a case-by-case basis.
- ☐ ☐ ☐ Pond buffer minimum 25 feet outward from maximum design WSEL. Additional setbacks may be required to permanent structures.
- ☐ ☐ ☐ No trees, shrubs or woody plants within 15 feet of embankment toe or 25 feet from principal spillway structure.

| Yes | No | N/A | |
|---|---|---|---|
| ☐ | ☐ | ☐ | Infiltration and filtering system facilities generally located at least 100 feet horizontally from any water supply well; 100 feet from any downslope building; and 25 feet from any upslope buildings, unless site specific investigation allows for reduced separation. |

| Yes | No | N/A | |
|---|---|---|---|
| ☐ | ☐ | ☒ | *HYDRAULIC COMPUTATIONS* |
| ☐ | ☐ | ☐ | Elevation- or Stage- Storage curve and/or tabular data. |
| ☐ | ☐ | ☐ | Weir / Orifice Control - Extended Detention. |
| ☐ | ☐ | ☐ | Weir / Orifice Control - riser 1-year control for channel protection. |
| ☐ | ☐ | ☐ | Weir / Orifice Control - riser 2-year control for quantity (if required). |
| ☐ | ☐ | ☐ | Weir / Orifice Control - riser 10-year control for quantity (if required). |
| ☐ | ☐ | ☐ | Inlet / Outlet (barrel) control - (All Storms). |
| ☐ | ☐ | ☐ | Check for barrel control prior to riser orifice flow to prevent slug flow-water hammer conditions. |
| ☐ | ☐ | ☐ | Emergency spillway capacity and depth of flow. |
| ☐ | ☐ | ☐ | Elevation - Discharge (Outlet Rating) curve and/or table. Provide all supporting calculations and/or design assumptions. |
| ☐ | ☐ | ☐ | Adequate channel computations for receiving channel. May be waived if facility is designed based on current Stream Channel Protection criteria. |
| ☐ | ☐ | ☒ | *POND or RESERVOIR ROUTING* |
| ☐ | ☐ | ☐ | Storage-Indication Routing of postdeveloped inflow hydrographs for the 1-, 2-, 10-, and 100-year design storms. Preference is for structure to discharge up to the 10-year storm through the principal spillway and pass the 100-year storm with a minimum 1 foot of freeboard through a combination principal and emergency spillways. If no emergency spillway is provided, riser must be large enough to pass the design high water flow and trash without overtopping the facility, have 3 square feet or more of cross-sectional area, contain a hood type inlet and have a minimum freeboard of 2 feet. Token spillways with minimum 8 ft. width are also recommended at or above the design 100-year storm elevation. |
| ☐ | ☐ | ☐ | Downstream hydrographs at established study points, if conditions warrant (ie. facility discharge combined with uncontrolled bypass). |
| ☐ | ☐ | ☒ | *MISCELLANEOUS COMPUTATIONS* |
| ☐ | ☐ | ☐ | Water quality volume for permanent pool based on selected BMP treatment volume (WQv). |
| ☐ | ☐ | ☐ | Water quality volume for extended detention based on selected BMP treatment volume (WQv) with drawdown computations. |
| ☐ | ☐ | ☐ | Drawdown computations for the 1-year, 24 hour detention for stream channel protection criteria. |
| ☐ | ☐ | ☐ | Pond drain computations (within 24 hours). |
| ☐ | ☐ | ☐ | Anti-seep collar design (concrete preferred) or match material type. |
| ☐ | ☐ | ☐ | Filter diaphragm design (or alternative method of controlling seepage). |

Yes No N/A

- ☐ ☐ ☐ Riser / base structure flotation analyses. FS = 1.25 minimum.
- ☐ ☐ ☐ Downstream danger reach study and/or emergency action plan (if conditions warrant).
- ☐ ☐ ☐ Upstream backwater analyses onto offsite adjacent property (if conditions warrant).
- ☐ ☐ ☐ 100 year floodplain impacts (if conditions warrant).

Yes No N/A

☐ ☐ ☒ *GEOTECHNICAL REQUIREMENTS*

- ☐ ☐ ☐ Geotechnical Report with recommendations specific to BMP facility type selected. Report prepared by a registered professional engineer. Requires submission, review and approval prior to issuance of Land Disturbance Permit.
- ☐ ☐ ☐ Initial Feasibility Testing requirements satisfied as per Appendix E of the James City County Guidelines for Design and Construction of Stormwater Management BMPs manual. (Infiltration, Bioretention and Filtering System BMP types only).
- ☐ ☐ ☐ Concept Design Testing requirements satisfied as per Appendix E of the James City County Guidelines for Design and Construction of Stormwater Management BMPs manual. (Infiltration, Bioretention and Filtering System BMP types only).
- ☐ ☐ ☐ Minimum Boring locations: borrow area, pool area, principal control structure, top of facility near one abutment and emergency spillway if provided.
- ☐ ☐ ☐ Boring logs with Unified Soil Classification (ASTM D2487), soils descriptions and depths to bedrock and the seasonal water table indicated.
- ☐ ☐ ☐ Standard County Record Drawing/Construction Certification note provided on plan. *Note: It is understood that preparation of record drawings and construction certifications as required for project facilities may not necessarily be performed by the plan preparer. These components may be performed by others.*

☐ ☐ ☒ *PRINCIPAL SPILLWAY PROFILE AND ASSOCIATED DETAILS*

- ☐ ☐ ☐ *EXISTING GROUND AND PROPOSED GRADE*
  - ☐ ☐ ☐ Embankment or excavation side slopes labeled (3H:1V maximum).
  - ☐ ☐ ☐ Minimum top width labeled (per VESCH or VSMH requirements).
  - ☐ ☐ ☐ Removal of unsuitable material under proposed facility (per Geotechnical Report requirements).

Yes No N/A

☐ ☐ ☒ *CORE TRENCH*

- ☐ ☐ ☐ Material (per plan or Geotechnical Report).
- ☐ ☐ ☐ Bottom width (4' minimum or greater as dictated by Geotechnical Report recommendations).
- ☐ ☐ ☐ Side slopes (1:1 maximum steepness)
- ☐ ☐ ☐ Depth (4' minimum or greater as dictated by Geotechnical Report).

☐ ☐ ☒ *PRINCIPAL CONTROL STRUCTURE. RISER OR SIMILAR STRUCTURE (DETAILS REQUIRED FOR ALL ITEMS)*

- ☐ ☐ ☐ Durable, watertight, resistant material (concrete preferred).
- ☐ ☐ ☐ Riser diameter is at least 1.25 times larger than barrel diameter.
- ☐ ☐ ☐ All pertinent dimensions and elevations shown.
- ☐ ☐ ☐ Control orifice or weir dimensions and elevations shown.
- ☐ ☐ ☐ Trash rack - removable - for each release.
- ☐ ☐ ☐ Anti-vortex device, baffle or plate.
- ☐ ☐ ☐ Riser base structure with dimensions and embedment specifications (concrete preferred).
- ☐ ☐ ☐ Interior access (steps, ladders, etc.) for maintenance for structures over 4 feet in height. Excessively high risers may need some form of exterior access on top portion.
- ☐ ☐ ☐ Low flow orifice with trash rack device.

☐ ☐ ☒ *PRINCIPAL CONTROL STRUCTURE OUTLET BARREL*

- ☐ ☐ ☐ Material (ASTM C-361 reinforced concrete pipe) with watertight joints. Prior approval required for all other pipe material (other RCP types, CMP, CPP, PVC, etc.).
- ☐ ☐ ☐ Support and bedding requirements for barrel - concrete cradles, etc. or as recommended by the Geotechnical Report.
- ☐ ☐ ☐ Pipe inverts, length, size, class and slope shown.
- ☐ ☐ ☐ Flared end section or endwall provided on barrel outlet.

☐ ☐ ☒ *SEEPAGE CONTROL*

- ☐ ☐ ☐ Phreatic line shown (4:1 slope measured from the intersection of the embankment and the principal spillway design high water).

- ☐ ☐ ☐ *ANTI-SEEP COLLARS*
  - ☐ ☐ ☐ Anti-seep collar, concrete preferred.
  - ☐ ☐ ☐ Size - 15 percent increase in length of saturation using outside pipe diameter.
  - ☐ ☐ ☐ Spacing and location on barrel (located at least 2 feet from a pipe joint).

## IV. *OUTLET PROTECTIONS:*

| Yes | No | N/A | |
|---|---|---|---|
| ☐ | ☐ | ☐ | Sized for maximum design release (generally 10-year storm). |
| ☐ | ☐ | ☐ | Flared end section or endwall. |
| ☐ | ☐ | ☐ | Dimensions. |
| ☐ | ☐ | ☐ | Rock or riprap size, quantity and placement thickness. |
| ☐ | ☐ | ☐ | Slope at 0 percent (Level Grade). |
| ☐ | ☐ | ☐ | Geotextiles (nonwoven). |
| ☐ | ☐ | ☐ | Special energy dissipators are required for design discharge velocities that exceed eighteen (18) feet per second; or if use of standard outlet protection would result in velocities exceeding permissible channel velocities; or if space restricts or limits their use. |

## V. *ADDITIONAL COMMENTS OR INFORMATION SPECIFIC TO THE PLAN:*

Plan Preparer: _____

Date: _____

SWMProg/BMP/Checklist/ChkList

ECS MID-ATLANTIC, LLC
"Setting the Standard for Service"
Geotechnical • Construction Materials • Environmental • Facilities

Environmental Division
November 13, 2012

MAY 16 2013

RECEIVED

Mr. Piotr (Peter) Swietuchowski, PE
Project Manager
VHB
351 McLaws Circle, Suite 3
Williamsburg, VA 23185-6316

ECS Project No. 07:11716

Reference: Stonehouse Glen BMP Outfall Repair
9304 Stonehouse Glen (Located South of Ashlock Court)
Stonehouse Glen Subdivision, Williamsburg, Virginia

Dear Mr. Swietuchowski,

Per your request, an engineering representative of ECS Mid-Atlantic, LLC visited the site on November 12, 2012 to attend a meeting with representatives of the contractor, VHB, and ACF Environmental to discuss subgrade issues encountered at the referenced project. The proposed project consists of modifications to the existing stilling basin and installation of a new step pool stream system. During the process of attempting to access the proposed construction area, the soils in the bottom of the existing swale were too soft to access with construction equipment. We were asked to attend the meeting to discuss options for providing a stable platform by which to access the proposed construction locations. The stable platform would be the basis for the construction of the new step pool stream system.

The contractor had begun clearing operations in the existing drainage swale before site conditions prevented them from continuing. The drainage swale was partially cleared of vegetation, but was extremely wet and saturated and would not support the weight of the construction equipment. Geostick penetrations extended at least 5 ft deep with little or no resistance. The contractor then excavated a 5 ft deep test pit under our observation. The soils throughout the depth of the test pit revealed dark gray, saturated, Silty Fine to Medium SAND (SM) intermixed with organic material. The soils encountered at the bottom of the test pit consisted of a blue-green, wet, Silty Fine to Medium SAND (SM) that was firm with geostick penetrations of an inch or less. A soil sample was obtained from this elevation and tested in our laboratory for No. 200 grain size analysis. Test results indicated 45% passing the No. 200 sieve hence verifying our classification of a Silty SAND.

We understand that the contractor will need to construct an access road to the back end of the existing swale to construct the step pool stream. The existing site grades are approximately 5 feet above the design subgrade elevation for the step pool stream. So in order to construct the access road, they will first need to excavate down approximately 5 ft below existing site grades to the design subgrade elevation for the new step pool. Once they are at the design subgrade

elevation for the step pool stream, based on our observations and discussions with ACF Environmental and Tensar, it is our opinion that the subgrade soils should be undercut a minimum of 2 feet to construct the access road. The subgrade should be lined with a geogrid material (Tensar-TX-160 Geogrid) and should be overlapped a minimum of 36 inches in all directions. The width of the undercut will be approximately the width of the bottom of the existing swale and will not continue into the existing side slopes. We then recommend backfilling the undercut area with 12 inches of a VDOT Size no. 57 stone with an additional 12 inches of VDOT Size no. 3 stone. The no. 3 stone material should be covered with a non-woven geotextile fabric prior to the placement of the materials (above the materials replacing the undercut) that will be used to construct the step pool stream. This fabric will be placed to help keep fines from migrating into the VDOT no. 3 stone. Due to the saturated condition of the soils, it is likely that the excavation will need to be made in short sections and backfilled immediately to avoid cave-in. Performing the work in short sections and the immediate backfilling of the excavations will also help to avoid de-stabilization of the adjacent slope.

The presence of water in the bottom of the existing swale will make it difficult to place the grid and stone material. The contractor will need to be prepared to control groundwater as necessary to complete the installation. Additionally, the depth of undercut and stone will likely vary across the area, therefore a representative of ECS will be on-site during the undercutting to provide recommendations to modify the depth of geogrid or stone as necessary depending on the actual conditions encountered.

We have appreciated being of service to you during the construction phase of this project and look forward to its successful construction. If you should have any questions regarding the information and recommendations contained in this report or if we can be of any further assistance, please contact our office.

Respectfully,
ECS Mid-Atlantic, LLC

COMMONWEALTH OF VIRGINIA
W. LLOYD WARD
Lic. No. 034612
PROFESSIONAL ENGINEER

W. Lloyd Ward, P.E.
Principal Engineer

Michael Galli, P.E.
Principal Engineer

# James City County Environmental Division
# Stormwater Management / BMP Inspection Report
# Detention and Retention Pond Facilities

County BMP ID Code (if known): WC092

Name of Facility: Stonehouse Glen Section 1 BMP No.: 1 of 3 Date: 06/21/11

Location: Adjacent to Ashlock Court

Name of Owner:

Name of Inspector: M. Majdeski

Type of Facility: Dry Pond

Weather Conditions: Sunny 65° Type: ☑ Final Inspection ☐ County BMP Inspection Program ☐ Owner Inspection

**If an inspection item is not applicable, mark NA, otherwise mark the appropriate column.**

**O.K. - The item checked is in adequate condition and the maintenance program is currently satisfactory. No action required.**
**Routine - The item checked requires attention, but does not present an immediate threat to the function/integrity of the BMP.**
**Urgent - The item checked requires immediate attention to keep the BMP operational and to prevent damage to the facility.**

**Provide an explanation and details in the comment column, if routine or urgent are marked.**

| Facility Item | O.K. | Routine | Urgent | Comments |
|---|---|---|---|---|
| **Embankments and Side Slopes:** | | | | |
| Grass Height | ✓ | | | |
| Vegetation Condition | ✓ | | | |
| Tree Growth | ✓ | | | |
| Erosion | | ✓ | | Repair erosion on north facing interior slopes; N end of pond |
| Trash & Debris | ✓ | | | |
| Seepage | ✓ | | | |
| Fencing or Benches | | | | N/A |
| **Interior Landscaping/Planted Areas:** ☑ None ☐ Constructed Wetland/Shallow Marsh ☐ Naturally Established Vegetation | | | | |
| Vegetated Conditions | | | | |
| Trash & Debris | | | | |
| Floating Material | | | | |
| Erosion | | | | |
| Sediment | | | | |
| Dead Plant | | | | |
| Aesthetics | | | | |
| Other | | | | |
| Notes: | | | | |

| Facility Item | O.K. | Routine | Urgent | Comments |
|---|---|---|---|---|
| **Water Pools:** ☐ Permanent Pool (Retention Basin) ☐ Shallow Marsh (Detention Basin) ☑ None, Dry (Detention Basin) | | | | |
| Shoreline Erosion | | | | |
| Algae | | | | |
| Trash & Debris | | | | |
| Sediment | | | | |
| Aesthetics | | | | |
| Other | | | | |
| **Inflows (Describe Types/Locations):** | | | | |
| Condition of Structure | ✓ | | | |
| Erosion | | ✓ | | See Below |
| Trash and Debris | | | | |
| Sediment | | ✓ | | Remove sediment from pond bottom (8-10") |
| Outlet Protection | | ✓ | | Repair inflow (6P) erosion |
| Other | | | | |
| **Principal Flow Control Structure - Riser, Intake, etc. (Describe Type):** | | | | |
| Condition of Structure | ✓ | | | |
| Corrosion | ✓ | | | |
| Trash and Debris | ✓ | | | |
| Sediment | ✓ | | | |
| Vegetation | ✓ | | | |
| Other | | | | |
| **Principal Outlet Structure - Barrel, Conduit, etc. :** | | | | |
| Condition of Structure | | | | |
| Settlement | | | | |
| Trash & Debris | | | | |
| Erosion/Sediment | | | | |
| Outlet Protection | | | ✓ | Repair erosion around (OR) + place rip rap |
| Other | | | | |
| **Emergency Spillway (Overflow):** N/A | | | | |
| Vegetation | | | | |
| Lining | | | | |
| Erosion | | | | |
| Trash & Debris | | | | |
| Other | | | | |
| Notes: | | | | |
| | | | | |

| Facility Item | O.K. | Routine | Urgent | Comments |
|---|---|---|---|---|
| **Nuisance Type Conditions:** | | | | |
| Mosquito Breeding | | | | |
| Animal Burrows | | | | |
| Graffiti | | | | |
| Other | | | | |
| **Surrounding Perimeter Conditions:** | | | | |
| Land Uses | ✓ | | | RESIDENTIAL |
| Vegetation | ✓ | | | |
| Trash & Debris | ✓ | | | |
| Aesthetics | ✓ | | | |
| Access /Maintenance Roads or Paths | ✓ | | | |
| Other | | | | |

**Remarks:**

**Overall Environmental Division Internal Rating:** ___ _____

**Signature:** _____ **Date:** _____

**Title:** _____

SWMProg\BMP\CoInspProg\InspForms\DetRet.wpd

# TRANSMITTAL SHEET

## ENGINEERING & RESOURCE PROTECTION → STORMWATER

Project: **Stonehouse Glen Sections 1 and 2**

County Plan No.: S-116-03 and S-98-03

Assigned BMP No.: ~~WC092~~, **WC095, WC094, WC091 and WC092**

BMP Type: Dry Ponds

Information Enclosed:

X Record Drawings (Asbuilts)

X Construction Certification

X Computations

X Other : Approved Plans

Name: **Tina Creech**

Date: 2/12/14

Signature: Tina Creech

# Stormwater Division

## MEMORANDUM

**DATE:** August 4, 2014
**TO:** Michael J. Gillis, Virginia Correctional Enterprises Document Management Services
**FROM:** Jacob Smith, Stormwater Intern
**PO:** 110426
**RE:** Files Approved for Scanning

| | | | |
|---|---|---|---|
| **NAME PDF/SCANNED FILE:** | STONEHOUSE GLEN SEC 1 DRY POND 1 | | |
| **BMP ID OR GEN FILE NUMBER:** | WC092 | **OWNER NAME:** | STONEHOUSE GLEN LLC |
| **PIN:** | CONTRADICTORY | **SITE ADDRESS:** | CONTRADICTORY |
| | | **LEGAL DESCRIPTION:** | CONTRADICTORY |

| | | | | | |
|---|---|---|---|---|---|
| **MAINTENANCE AGREEMENT IN FILE:** | YES | **BOOK/PAGE OR DOCUMENT NO.:** | CONTRADICTORY | **OTHER DESCRIPTION:** | N/A |

| | | | |
|---|---|---|---|
| **BOX NO.:** | 4 | **COMMENTS:** | DCELARATION INSPECTION MAINTENANCE |

# Vanasse Hangen Brustlin, Inc. TRANSMITTAL

Transportation
Land Development
Environmental Services

351 McLaws Circle, Suite 3
Williamsburg, VA 23185-6316
757 220 0500
FAX 757 220 8544

| | |
|---|---|
| **Date:** 11/20/13 | **VHB Project No.:** 33315.01 |
| **Re:** WC092 BMP Outfall Repair | |

Environmental Division
NOV 20 2013
RECEIVED

**To:** Bill Cain, Chief Engineer
Engineering and Resource Protection Division
101-E Mounts Bay Road
Williamsburg, VA 23185

**We are sending you:** ☐ Attached ☐ Under Separate cover via Regular Mail the following items:

☐ Shop drawings ☐ Prints ☐ Plans ☐ Diskettes ☐ Specifications ☐ Copy of Letter ☐ Change Order
☒ Other

| Copies | Date | No. | Description |
|---|---|---|---|
| 1 | 11/20/2013 | | Record Drawing |
| 1 | 11/20/2013 | | Record Drawing and Construction Certification Forms |
| | | | |
| | | | |
| | | | |
| | | | |

**These are transmitted as checked below:**

☐ For approval ☐ Approved as submitted ☐ Resubmit ____ Copies for approval
☐ For your use ☐ Approved as noted ☐ Submit ____ Copies for distribution
☒ As requested ☐ Return for corrections ☐ Return ____ Corrected prints
☐ For review and comment ☐ For bids due
☐ Returned prints on loan to VHB

**REMARKS:**

If VHB provides materials to the Client that are stored electronically, the Client recognizes that data, plans, specifications, reports, documents, or other information recorded on or transmitted as electronic media ("CADD Documents") are subject to undetectable alteration, either intentional or unintentional, due to, among other causes, transmission, conversion, media degradation, software error, or human alteration. Accordingly, the CADD Documents are provided to the Client for informational purposes only and not as an end product. VHB makes no warranties, either express or implied, regarding the fitness or suitability of the CADD Documents.

The CADD Documents are instruments of professional service, and shall not be used, in whole or in part, for any project other than that for which they were created, without the express written consent of VHB and without suitable compensation to VHB. Accordingly, the Client agrees to waive any and all claims against VHB resulting in any way from the unauthorized alternation, misuse or reuse of the CADD documents and to defend, indemnify, and hold VHB harmless for any claims, losses, damages, or costs, including attorneys fees, arising out of the alteration, misuse or reuse of any CADD Documents.

**Copy to:** Mr. Ken McDermott

**By:** Piotr Swietuchowski, PE
VHB, Inc.

# LANDMARK DESIGN GROUP
## TRANSMITTAL

RECEIVED
AUG 21 2006
ENVIRONMENTAL DIVISION

To: SCOTT THOMAS, PE

Company: JAMES CITY COUNTY, ENVIRONMENTAL

From: A. Scott Thompson, L.S. AS

Date: 0818/06

Subject: Stonehouse Glen Section I &II Bmp Interim Record Drawings

LMDG Job No.: 2002261-504.00

SP-98-03

Attached please find:
- [x] Prints
- [ ] Plans
- [ ] Specifications
- [ ] Drawings
- [ ] Report
- [ ] Letter

PH 2 SH GLEN SEC 1
PH 2 SH GLEN SEC 2
S-116-03

Transmitted as checked below:
- [ ] For your use
- [ ] As requested
- [x] For review and comment
- [ ] For approval
- [ ] Approved
- [ ]

| Copies | Date | Drawing No. | Description |
|---|---|---|---|
| 3ea. | 8/14/06 | 17300-17306W | RECORD DRAWING PRINT |
| 1ea. | 08/14/06 | | Stormwater Management/BMP Facilities Record Drawing and construction certification |

Notes:

Copies
1. File:
2.
3.

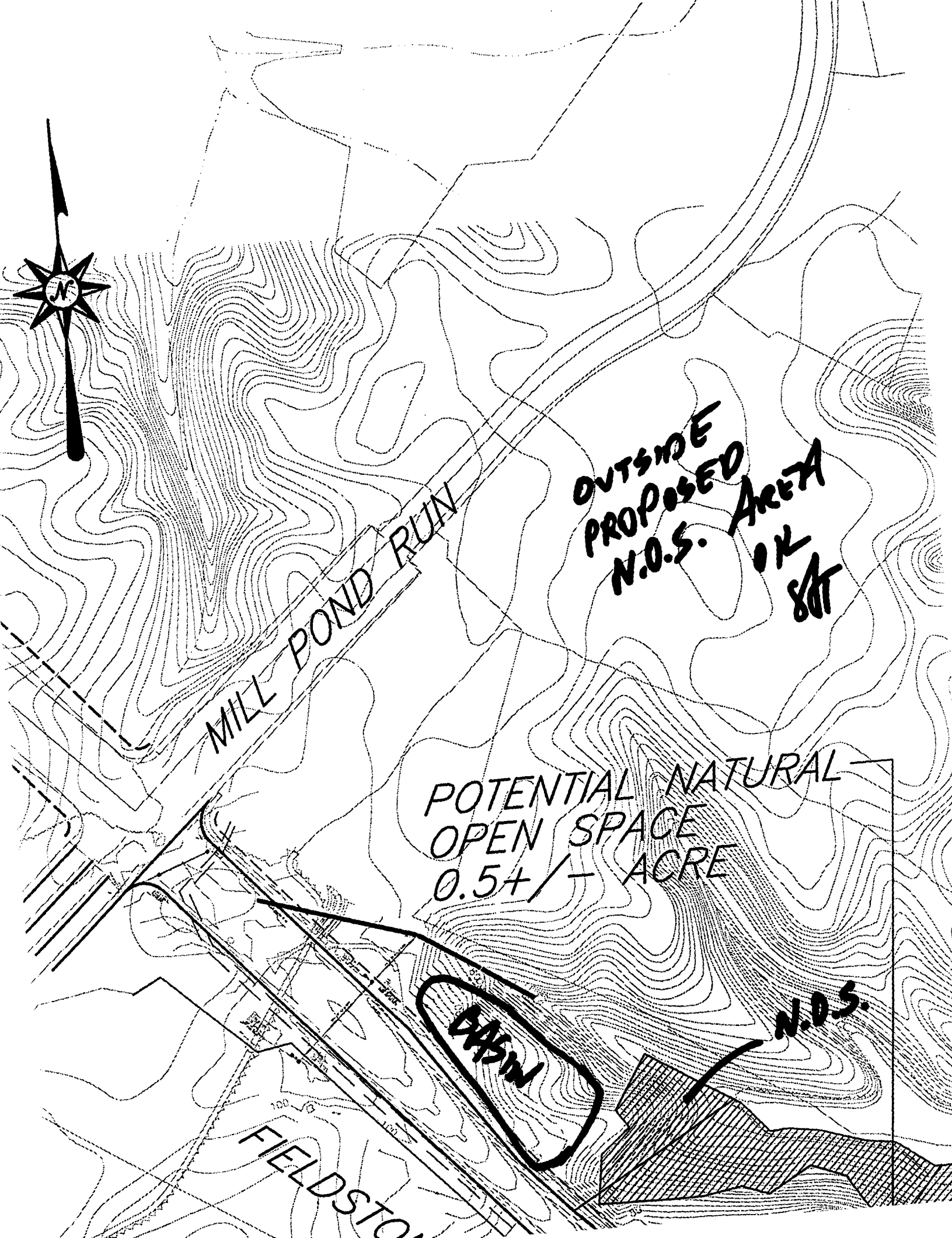
Enclosures
- [ ]
- [ ]
- [ ]

LandMark Design Group, Inc.

By: Ast

**Acknowledgment by Recipient: _____ _____
Name Date

Engineers • Planners • Surveyors • Landscape Architects • Environmental Consultants
4029 Ironbound Road, Suite 100, Williamsburg, VA 23188 (757) 253-2975 FAX: (757) 229-0049 lmdg@landmarkdgwb.com


MILL POND RUN
OUTSIDE PROPOSED N.O.S. AREA OK SDT
POTENTIAL NATURAL OPEN SPACE 0.5+/- ACRE
N.O.S.
FIELDSTO

# TRANSMITTAL

**DATE:** February 19, 2013

**TO:** Records Management
Engineering and Resource Protection

**FROM:** Leanne Reidenbach, Senior Planner II

**SUBJECT:** SP-0007-2013, Stonehouse Glen BMP Outfall Site Plan Amendment

**TAX ID:** 0540400001C

**ACTION:** For your files.

Environmental Division
FEB 20 2013
RECEIVED

# Vanasse Hangen Brustlin, Inc. TRANSMITTAL

Transportation
Land Development
Environmental Services

351 McLaws Circle, Suite 3
Williamsburg, VA 23185-6316
757 220 0500
FAX 757 220 8544

| | |
|---|---|
| **Date:** 05/15/13 | **VHB Project No.:** 33315.01 |
| **Re:** Stonehouse Glen | |

Environmental Division
MAY 16 2013
RECEIVED

**To:** Bill Cain, Chief Engineer
Engineering and Resource Protection Division
101-E Mounts Bay Road
Williamsburg, VA 23185

**We are sending you:** ☐ Attached ☐ Under Separate cover via Regular Mail the following items:

☐ Shop drawings ☐ Prints ☐ Plans ☐ Diskettes ☐ Specifications ☐ Copy of Letter ☐ Change Order
☒ Other

| Copies | Date | No. | Description |
|---|---|---|---|
| 1 | 05/15/2013 | | Record Drawing |
| 1 | 05/15/2013 | | Record Drawing and Construction Certification Forms |
| 1 | 05/15/2013 | | Comments Response Letter |
| 1 | 05/15/2013 | | 4 CD – BMP Photographs |
| 1 | | | Geotechnical Site Reports – WC092 BMP Outfall Repair |
| | | | |

**These are transmitted as checked below:**

☐ For approval ☐ Approved as submitted ☐ Resubmit ____ Copies for approval
☐ For your use ☐ Approved as noted ☐ Submit ____ Copies for distribution
☒ As requested ☐ Return for corrections ☐ Return ____ Corrected prints
☐ For review and comment ☐ For bids due
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The CADD Documents are instruments of professional service, and shall not be used, in whole or in part, for any project other than that for which they were created, without the express written consent of VHB and without suitable compensation to VHB. Accordingly, the Client agrees to waive any and all claims against VHB resulting in any way from the unauthorized alternation, misuse or reuse of the CADD documents and to defend, indemnify, and hold VHB harmless for any claims, losses, damages, or costs, including attorneys fees, arising out of the alteration, misuse or reuse of any CADD Documents.

**Copy to:** Mr. Ken McDermott

**By:** Piotr Swietuchowski, PE
VHB, Inc.

Transportation
Land Development
Environmental
Services

Vanasse Hangen Brustlin, Inc.

351 McLaws Circle, Suite 3
Williamsburg, Virginia 23185
757 220-0500
FAX 757 220-8994

Environmental Division
MAY 16 2013
RECEIVED

**Meeting Notes**

Attendees: Bill Cain
Mike Woolson
Scott StClair
Piotr Swietuchowski

Date/Time: 2013-04-22

Project No.: 33315.01

Place: Stonehouse Glen

Re: Final site observation

Notes taken by: Piotr Swietuchowski

---

We met at Stonehouse Glen on April 22nd to review repairs completed per the comments presented in James City County's letter received October 28. These comments are reproduced below with our responses based completed modifications and field decisions.

**BMP # 4**
**WC095-Adjacent to Newland Court**

***Construction - Related Items:***

14. Remove 12"-18" of sediment build-up from pond bottom and the area around the primary pond orifice and re-vegetate once complete.

*Cat tails and excess vegetation have been removed and then re-established positive drainage.*

15. Repair erosion along left side of the access roadway resulting from concentrated runoff and inert material being buried in the gravel section. Prior to close out of the project and the release of the posted bonds, any and all foreign materials are to be removed from the stone section and replaced with stone.

*The erosion along the left side of the access roadway was repaired. Earth berm was installed on the lover side of receiving DI-7 inlet to prevent overflow of runoff on the BMP slope. The erosion on the maintenance road was repaired and two stone diversion rills were added across the road to direct the water toward the swale and prevent future erosion.*

**WC094-Adjacent to Stonehouse Glen and Newland Court**
***Construction - Related Items:***

11. Remove 8"-10" of sediment from throughout the pond bottom and from the area surrounding the primary pond orifice and re-vegetate the area following the remediation work.

*The low flow orifice was adjusted to create positive drainage. The pond inflow areas have been regarded and stabilized. Additional outlet protection RipRap have been added and sealed with the mortar.*

12. Repair erosion along the BMP access roadway. Currently there is a rill that has formed along the centerline of the drive primarily due to inaccessibility of stormwater to the rip rap lined ditch along the side of the access. Prior to resubmittal, a smooth transition needs to be provided into the referenced channel to promote positive drainage into the measure.

*The erosion on the maintenance road was repaired and two stone diversion rills were added to prevent future erosion.*

13. Re-establish the access roadway at Newland Court per the approved plan. Currently a portion of the access has been covered with sod and is being maintained by the adjacent property owner and a utility box has been located in the centerline of the entrance. Prior to release of the project and associated bonds, the access must be relocated to the side of the utility and sod replaced with stone.

*It was confirmed that the access road easements to the BMPs is 30 feet wide, therefore existing maintenance roads is located within the access easement. The sod within the access road has been removed and replaced with stone base.*

***WC091 - Adjacent to Ottaway Court***
***Construction - Related Items:***

1. Remove sediment from inflows within the dry pond and ensure that the primary pond orifice is clear of debris and vegetation.

2. Remove all vegetation from within the pond's primary outlet protection.

3. Replace the cover on the manhole immediately upstream of the pond's outlet protection.

4. Repair erosion along the BMP access road at the bottom of the hill.

*Excessive vegetation has been removed from the bottom of the pond and positive drainage has been re-established. The erosion along the BMP access road have been repair and all disturbed areas have been stabilized.*

**WC092-Adjacent to Ashlock Court**
***Construction - Related Items:***

5. Repair and re-stabilize the eroded areas along the north facing interior slopes of the pond.

*The subject slopes have been stabilized as requested*

6. Remove 8"-10"sediment from the pond bottom and from the area surrounding the primary pond orifice and re-vegetate the area following the remediation work.

*The sediment has been removed from the bottom of the BMP and the positive drainage has been re-established.*

7. Repair erosion along the right side of the outlet protection as associated with the inflow pipe and ensure the area is properly re-stabilized following the remediation work.

*The erosion along right side of the outlet protection has been corrected and the outlet protection has been re-installed. Additional RipRap has been added.*

8. Repair erosion and replace rip-rap at the primary BMP outfall. Much of the outlet protection from the pond has been washed downstream into the adjacent streambed.

*The outfall protection has been redesign to implement natural channel design principles. The stilling basin and series of steep pool have been installed below the BMP outfall.*

9. It appears from information obtained from a recent site inspection that the referenced stormwater management facility is not operating as originally intended as the downstream channel section is experiencing severe erosion and rip rap from the associated stilling basin has migrated several yards downstream. Though information provided in the record drawings appears to indicate that the associated components of the facility have been installed generally in accordance with the approved plans, information is necessary to show that the required attenuation volume has been provided with basin limits. Should it be determined that the facility has the required volume, it may be necessary to reevaluate the facility to insure full compliance with State Minimum Standard 19.

*The outfall protection has been redesign to implement natural channel design principles. The stilling basin and series of steep pool have been installed below the BMP outfall.*

**WC093-Adjacent to Stonehouse Glen and Fieldstone Parkway**

10. James City County Engineering and Resource Protection Division has no comments to provide for this facility.

*Acknowledged.*