TOWN OF BRISTOL, RHODE ISLAND

PLANNING BOARD MEETING

Agenda
Thursday, March 5th, 2026 at 7:00 PM
Colt School Auditorium, 570 Hope Street, Bristol, RI 02809

A. Pledge of Allegiance

B. Minutes from February 12, 2026 meeting

C. Agenda Item

C1. **Public Hearing, Discuss and Possible Action on Master Plan phase for Major Land Development of the Comfort Inn and Suites** – continued from February 12th, 2026 - proposal to build an 80 room hotel. Property on south side of Gooding Avenue approximately 50 feet east of the intersection of **Gooding Avenue and Broadcommon Road**, near utility pole #218. Owner: D & M Boca Development, LLC Zoned: GB. Assessor's Plat 111 Lot 1

D. Adjournment

Date Posted: February 25, 2026

Posted By: mbw

KELLY, SOUZA, PARMENTER & RESNICK, P.C.
think TENACIOUS

Michael D. Resnick, Esq.
mresnick@ksprlaw.com

January 14, 2026

VIA EMAIL
Bristol Planning Board
c/o Diane M. Williamson, Director of Community Development
Bristol Planning Department
235 High Street, 1st Floor
Bristol, RI 02809
dwilliamson@bristolri.gov

Re: D&M Boca Development Comfort Inn & Suites

Dear Diane:

Please find this as a formal request to continue the review deadline, which is currently set for February 27, 2026, to March 27, 2026.

Sincerely,

Michael D. Resnick

MDR/rm

Cc: Amy Goins, Esq. (amygoins@utrlaw.com)

FUSS & O'NEILL
3 Davol Square, Suite C200
Providence, RI 02903
401.861.3070
www.fando.com

MEMORANDUM

TO: Diane Williamson, Director of Community Development

FROM: Amy Johnson, PE, Project Manager

Bree Sullivan, PE, Associate

DATE: March 4, 2026

RE: Gooding Ave Comfort Inn and Suites - Memo Regarding Abutter Concerns

---

Introduction

Fuss & O'Neill was requested by the Town of Bristol's Director of Community Development to review the assertions made in a drainage review/presentation provided by a project abutter, Ted Spinard, regarding the Comfort Inn & Suite Master Plan Application prepared by DiPrete Engineer, on behalf of D&M Boca Development, LLC.

Fuss & O'Neill's initial role in the project was to perform an assessment/review of the submitted application materials that are required during the Master Planning stage of the project. We will note that review of the proposed stormwater management infrastructure, including type, location, and configuration and design calculations, prepared by a Registered Professional Engineer, is not a requirement during the Master Plan submission for major land development projects and thus was not a part of our scope. It is not typical for applicants to have a fully designed stormwater management plan and state permits in-hand during the Master Plan submission stage. As such, the project was significantly further along in design and permitting than is typical of a Master Plan submission in the Town of Bristol.

Fuss & O'Neill reviewed the following documents:

1. Comfort Inn and Suites Letter from DiPrete Engineering, dated February 13, 2026
2. Master Plan Submission prepared by DiPrete Engineering for the July 10, 2025 Town of Bristol Planning Board Meeting
3. Documents Submitted by Mr. Spinard:
    a. Downstream Analysis – Wrong Method Completed by Applicant
    b. Downstream Analysis – Part A
    c. Downstream Analysis – Part B
    d. Errors with Hydrocad Stormwater system model
    e. Infiltration
    f. Proposed Gooding Avenue Hotel - Storm Chamber
    g. Silver Creek Drainage Study Appendix A
    h. Silver Creek Drainage Study Appendix B
    i. Silver Creek Drainage Intro
    j. Silver Creek Flood Examination
    k. Soil Textural Classification and Infiltration Rate

l. Supporting Materials
m. Technical Deficiencies

Assertion Review

The full assertions from Mr. Spinard and Fuss & O'Neill's evaluation of those assertions are provided below:

Spinard Comment 1:
The wrong soil textural classification was used. The soil is classified as Pittstown Silt Loam by NRCS. The sieve analysis show the soil to be silt loam.

Fuss & O'Neill Response 1:

i. The majority soil type within the developable area on the project site is Stissing Silt Loam (HSG D) according to NRCS Web Soil Survey. In their Master Plan Submission, DiPrete provided soil boundaries and classifications in accordance with the NRCS Web Soil Survey results. *Pittstown Silt Loam is the soil type within the neighborhood adjacent to the site based on NRCS Web Soil Survey maps.*
ii. Based on the sieve analysis provided for Test Pit 4 provided by DiPrete in response to the Town's request for more information regarding the soil classification, we agree that the soil textural classification is loam. Test Pit 4 is within the footprint of the underground infiltration system A, which is an infiltrating practice along with the Sand Filter B. No test pits were conducted within the proposed footprint of Sand Filter B. *We agree with DiPrete's statement in their response letter that Mr. Spinard's sample, collected at 20 Dixon Avenue, is not applicable to the design based on the location of the sample.*
iii. For the infiltration rate, the Rawl's Rate for loam should be used in the design calculations and the revised calculations should be resubmitted to the Town for the Preliminary Plan submission. A safety factor of 2 is recommended to be applied to the loam Rawl's Rate of 0.52 in/hr citing the same justification provided by DiPrete that the site being a former wetland, equating to a design infiltration rate of 0.26 in/hr. *We recommend that the Town adds this as a condition of Master Plan approval.*

Spinard Comment 2:
An incorrect infiltration rate was used. The infiltration rate should be silt loam, 0.27 inch/hr, not for Loam, 0.52 inch/hr.

Fuss & O'Neill Response 2:

i. We agree with Mr. Spinard that the incorrect infiltration rate was used in the design, but that the soil type has been confirmed as loam based on the sieve analysis results provided from DiPrete from Test Pit 4. A safety factor of 2 is recommended to be applied to the loam Rawl's Rate of 0.52 in/hr citing the same justification provided by DiPrete that the site being a former wetland, equating to a design infiltration rate of 0.26 in/hr. *Based on our response above, we recommend the applicant revises their calculations and submits them as part of the Preliminary Plan submission.*
ii. *Based on the information provided in DiPrete's response letter, reducing the rate of infiltration to 0.27in/hr will not increase flows off site in the post-development condition in comparison to the pre-development condition.*

Spinard Comment 3:
The wrong method of analysis was used. The effect of flooding within the Silver Creek must be analyzed with HEC RAS given the irregularity of the channel and resultant irregular channel capacity.

Fuss & O'Neill Response 3:

i. DiPrete's plans show no impact to the existing floodplain for Silver Creek, which has a 100-year floodplain elevation of 62'. Since the storage volume within the 100-year floodplain (Elevation 62') is not modified and, to go even further, the storage volume of the 100-year design storm (Elevation 67') from the 2007 BETA Silver Creek Drainage Study, the only impact potential to the flooding within Silver Creek would be an increase in peak flow rates and/or runoff volume in the post-development condition, which DiPrete's report and drainage calculations states is not occurring. However, *Fuss & O'Neill will review the downstream analysis in depth during the preliminary design stage of the project in accordance with Bristol Subdivision and Development Review Regulations Appendix F.2. Public Improvement and Design Standards Section I: Drainage.*

ii. RIDEM Office of Water Resources reviewed the concerns outlined of the 35 letters they received during the public notice period and found these letters do not constitute an objection of substantive nature, which would have triggered a public meeting as defined in 250-RCIR-150-15-1.10(D)(3). This regulation was amended in 2022 with the release of 250-RCIR-150-15-3 and the language of section 1.10(D)(3) has slightly changed to "…An objection of a substantive nature is any written comment offered in opposition to a project that: a. **Relates to the functions and values of the freshwater wetlands, buffers, floodplains, areas subject to flooding or areas subject to storm flowage**" (emphasis added), but the project was approved under 250-RCIR-150-15-1, which only stated in section 1.10(D)(3) "An objection of a substantive nature is any written comment offered in opposition to a project that: (1) **relates to the functions and values of the wetlands**;" (emphasis added).

iii. RIDEM also noted as a condition of their approval that an environmental consultant, experienced in site assessments and measures necessary to protect sensitive aquatic environments or sensitive ecosystems, must be employed prior to the start of site alterations to monitor the project and ensure compliance with the terms and conditions of the permit. RIDEM required the applicant to notify the program in written when the consultant is selected and provide monthly written reports regarding compliance with the permit until the project is complete.

iv. We do have concerns with systems infiltrating into HSG D soils and the potential of breakout from the slope or behind the retaining wall to contribute to offset flow, which is currently not accounted for in the model. *We recommend to the Town that they add a condition of approval that the applicant shows that they are controlling the potential horizontal movement of infiltrated stormwater so that it does not breakout and contribute to site runoff.*

v. Aside from our concerns regarding accounting for groundwater flow in the total volume discharged from the site, the applicant has correctly modeled the runoff from the site. HEC-RAS model is appropriate for modeling 1-D and 2-D flow within Silver Creek, but is necessary due to the reduced volume and peak flows discharged from the site. The total flow within the stream and velocity of flow cannot increase when there is a reduction in the contributing flow from the site compare to the pre-development discharged flows as the stream cross-section has not changed as a result of development.

Spinard Comment 4: There is existing flooding in the neighborhood. The proposed hotel development will make it worse.

Fuss & O'Neill Response 4:

i. We agree that there is existing flooding within the neighborhood that is a concern for abutters as well as the Town of Bristol. The 2007 BETA Silver Creek Drainage Study analyzed the crossing and projected flooding elevations during various design storms. However, the peak flow rates and volumes discharged from the site in the post-development model, provided by DiPrete, show a decrease in peak flow rate and volume, which would not exacerbate the current flooding issues downstream.
ii. We will review downstream impacts during the Preliminary Plan stage of the project in accordance with Bristol Subdivision and Development Review Regulations Appendix F.2. Public Improvement and Design Standards Section I: Drainage. Based on Master Plan submission results, the applicant complies with subdivision regulations Section I(2)(e) - any increase to stormwater runoff up to and including the 10-year storm must be retained on site and infiltrated.

Spinard Comment 5: Discontinued use of StormTech SC-740. The structure provided is not feasible.

Fuss & O'Neill Response 5:

i. It is standard practice for the contractor to submit construction products and materials to the engineer overseeing the project's construction to verify the proposed product and materials meet the specifications of the design in the approved plans. If a product is not available or has a long lead time that will conflict with the construction schedule, the contractor will provide a product or material that is an "approved equal" to the specified product or material. If an approved equal product or material cannot be sourced, an amendment may be made to the local and state permitting agencies submitting materials that show and justify the insignificant impact the different product will have on the design.

Spinard Comment 6: RIDEM OWR review had noted deficiencies.

Fuss & O'Neill Response 6:

i. There does not appear to be any outstanding concerns by RIDEM OWR regarding this application based on the permit received by the applicant.
ii. RIDEM issued a Permit to Alter Freshwater Wetlands (Wetlands Application No. 22-0264, RIPDES File No. RIR101247, Grounwater Discharge/UIC No. 001650) with a list of conditions of the permit approval, which are not all standard conditions. The applicant is required to abide by the permit conditions prior to the permit expiring.
iii. RIDEM Office of Water Resources reviewed the concerns outlined of the 35 letters they received during the public notice period and found these letters do not constitute an objection of substantive nature as defined in 250-RCIR-150-15-1.10(D)(3)(c). This regulation was amended in 2022 with the release of 250-RCIR-150-15-3(D)(3)(c) and the language has slightly changed, but the project was submitted while 250-RCIR-150-15-1 was in effect.

Summary of Findings

Based on our review of the documents provided by DiPrete, Mr. Spinard, and our own review of digitally available data, we concluded that infiltration rate for the two infiltrating systems was incorrect based on the loam soil classified identified through the sieve analysis provided by DiPrete. The Rawl's rate for loam with a safety factor of 2 applied, should be used as the exfiltration rate in the design calculations. Mr. Spinard's soil sample was not applicable to the site, but did lead to the request for more information from the design term regarding the soil classification used for the infiltration rate.

We have concerns with systems infiltrating into poorly draining native soils and the potential of breakout from the slope or behind the retaining wall to contribute to offset flow to Silver Creek, which is currently not accounted for in the model. *We recommend to the Town that they add a condition of approval that the applicant shows that they are controlling the potential horizontal movement of infiltrated stormwater so that it does not breakout and contribute to site runoff.*

We also recommend that the Town removes the condition of approval requiring the applicant to include porous pavements and/or porous pavers/concrete due to the high groundwater and poorly draining native soils on site.

Fuss & O'Neill does not agree, based on the information reviewed in the Master Plan submission, that the project will contribute to the existing flooding problem downstream. The proposed extents of grading are above the FEMA 100-yr floodplain elevation of 62' and above the 100-year design flood elevation of 67' estimated by BETA in the 2007 Silver Creek Drainage Study, so storage of the floodplains are not being reduced. The applicant has also shown in their Master Plan submission that they are decreasing the peak flow rates and volumes for all the design storm in the post-development condition. HydroCAD is appropriate and common engineering practice to be used for the model comparison of site runoff between the pre- and post-development site conditions.

Lastly, the applicant provided more information than required for the Master Plan Submission for the drainage calculations and drainage design. This information will be reviewed in depth by the Town and peer review engineer during the Preliminary Plan Submission in accordance with Bristol Subdivision and Development Review Regulations Appendix F.2. Public Improvement and Design Standards Section I: Drainage.

We recommend the Applicant revises their application prior to the Preliminary Plan Submission based on the comments provided in this memo and conditions of Master Plan approval from the Planning Board.

If you have any questions regarding our responses and information provided in this memo, please reach out to me at (401) 861-3073 or amy.johnson@fando.com.

/RZ

DiPrete Engineering

February 13, 2026

Diane M. Williamson, ALCP, CFM
Director, Community Development
Town of Bristol
9 Court Street
Bristol, Rhode Island 02809

RE: Comfort Inn and Suites
Gooding Avenue
AP 111 Lot 1
Bristol, Rhode Island
Project #: 2536-001-B01

Dear Ms. Williamson:

On behalf of the applicant, D & M Boca Development, LLC, DiPrete Engineering respectfully submits the following response to correspondence received January 23, 2026 from the Planning Department, the correspondence as presented to the planning board public hearing made by Mr. Spinard.

1. *The wrong soil textural classification was used. The soil is classified as Pittstown Silt Loam by NRCS. The sieve analysis show the soil to be silt loam.*

   The NRCS has identified soils as Pittstown Silt loam. The NRCS classifications are typically used for the purpose of ground cover to determine curve numbers.

   However, in order to determine the specific infiltration rates to be used for best management practice (BMP) analysis, the RIDEM Stormwater Design Manual (RIDISM) requires excavated soil evaluation (SEV) test pits within the area of actual stormwater control structure(s). The SEV's must be completed by a RIDEM licensed soil evaluator.

   Mr. Spinard has sampled and analyzed a soil sample at 20 Dixon Avenue, 1,000 feet from the proposed site. This data is not applicable and would not be allowed as a determinative evaluation by RIDEM for the proposed hotel site.

   Soil evaluation test holes were completed on site by SITEC, John Keegan, RIDEM Soil Evaluator #D-4006. Mr. Keegan completed 7 soil evaluation test holes, all of which were determined to be sandy loam texture (1.02 inches/hour infiltration rate). As described within the Stormwater Management Report and approved by RIDEM, based on the presence of Hydrologic Group D soil and former wetlands within the site footprint we effectively provided an additional factor of safety of 2 with a conservative infiltration rate of approximately one-half (0.52 inches/hour), equating to a "Loam" soil texture type.

   DiPrete Engineering obtained a soil sample within the area of the proposed sand filter, TP#4. The sieve analysis categorized the soil texture as loam. As such, we confirmed the conservative infiltration rate applied and the "Loam" soil type was found to be a valid basis of infiltration design.

2. *An Incorrect Infiltration Rate was used. The infiltration rate should be silt loam, 0.27 inch/hr, not for Loam, 0.52 inch/hr.*

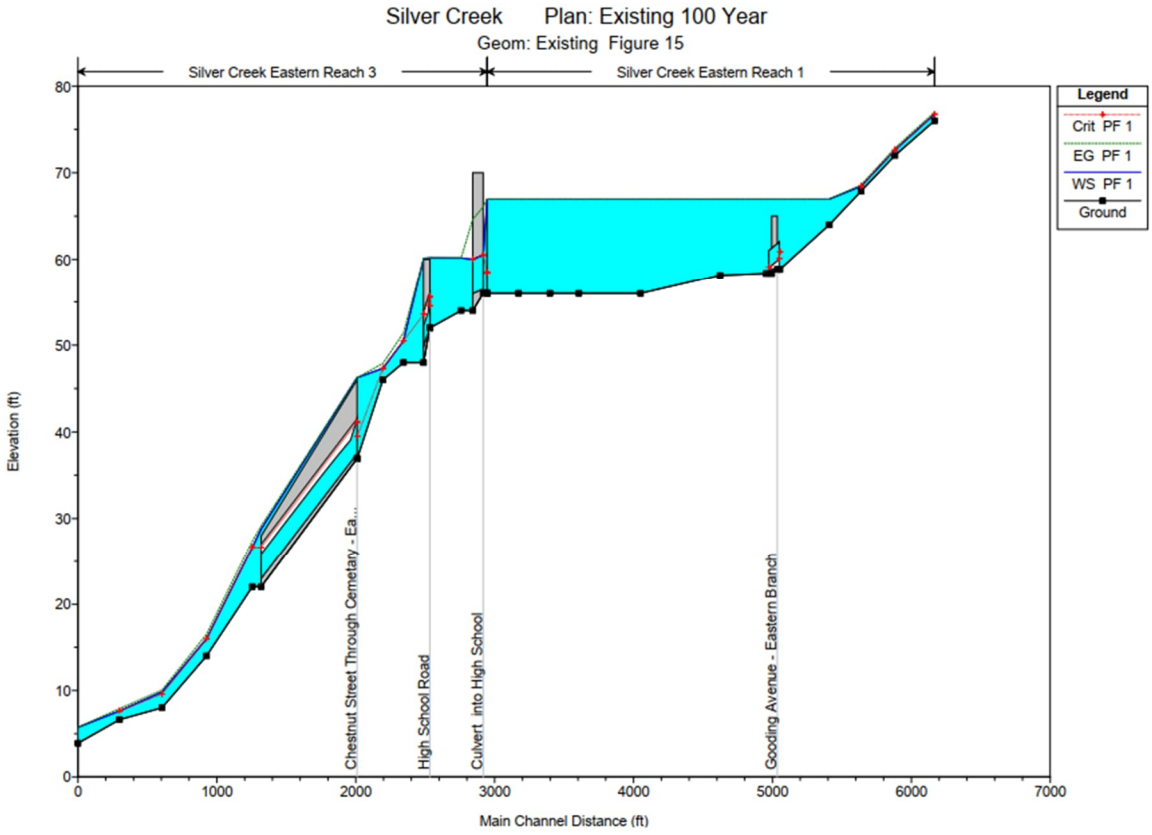
   As noted above DiPrete Engineering had utilized the soil texture to reflect the soils within the area of the sand filter. This is classified as "Loam" with an infiltration rate pf 0.52 inches/hr . The watershed analysis demonstrated a reduction of stormwater discharge rate and a reduction of stormwater discharge volume.

   Subsequent analysis of the stormwater management system has been completed with an assumed soil texture of "Silt Loam" with an infiltration rate of 0.27 inch/hr. The result has demonstrated a continued reduction in stormwater discharge rate and a reduction in stormwater discharge volume from pre to post-development conditions.

   The stormwater management system analysis achieves the attenuation of stormwater in either case.

3. *The wrong method of analysis was used. The effect of flooding within the Silver Creek must be analyzed with HEC RAS given the irregularity of the channel and resultant irregular channel capacity.*

   The flooding from the 100-year storm has been quantified with the HEC RAS analysis. A HEC RAS model has been analyzed by FEMA (2014) and by BETA Engineering (2007). Both methods had determined that the floodplain was caused as a continuous tail water elevation from the Mount Hope High School culverts backed up to the Gooding Avenue roadway. See following figure from this BETA watershed study:



The floodplain between the high school and Gooding Avenue behaves like a pond with constant elevation for the 100-year storm event. DiPrete Engineering considered the highest tail water elevation retained (elevation 67.0). A reduction of stormwater runoff rate and volume was designed to discharge to the Silver Creek tail water elevation. No alteration or filling of the Silver Creek tail water elevation is proposed; the minimum existing elevation onsite to be filled occurs near Sand Filter B and Headwall-19 between elevation 67.5 to 68.0.

Mr. Spinard's recommended modeling of the Silver Creek channel capacity would have no effect as the channel is under the tail water of the Mt Hope High School culverts. Mr. Spinard's opinion to model with HEC-RAS was not supported by the RIDEM staff engineers during permitting.

4. *There is existing flooding in the neighborhood. The proposed hotel development will make it worse.*

The location of the Silver Creek floodplain is mapped. The proposed hotel development stormwater management system will result in a reduction of stormwater discharge rate and stormwater discharge volume. The result will be no adverse effect on the existing flooding in the neighborhood.

Mr. Spinard's opinion of increased flooding was not supported by the RIDEM during permitting.

5. *Discontinued use of StormTech SC-740. The structure provided is not feasible.*

The underground sand filter has been approved with the ADS StormTech SC-740 is 85.4" L x 51"W x 30"H. This structure can be found online and is available by First Supply, Atlantic Plumbing Supply.

Alternatives with similar dimensions are the Triton S-22 Stormwater Chamber 55" L x 35"W x 30" H, and the ADS SC-800 with the same height and width as the SC-740 but 3 inches taller.

In any case, the contractor will need design engineer approval of the specifications prior to construction. We are also amenable to add a condition to future approvals requiring Public Works review and concurrence with drainage shop drawings prior to construction.

6. *RIDEM OWR review had noted deficiencies.*

A Letter of concern was submitted to the RIDEM by the Bristol Town Council dated December 8, 2023, with the request for careful review of flooding concerns within the subject site area and down gradient from the subject site area. The Bristol Conservation Commission has submitted a letter of concern dated December 7, 2023, with regards to the effectiveness of the wetlands. A letter of objection was submitted dated December 6, 2023, by Emily Spinard with reference to flooding, wetland alteration, and potential adverse downgradient effects.

The RIDEM staff engineers had raised the questions received during the application review. There are currently no outstanding comments and everything has been addressed to meet RIDEM's rules and regulations. The questions were addressed by our firm to the satisfaction of the RIDEM whereby approval was received under Freshwater Wetlands Permit No. 22-0264.

The above review is provided for the conceptual Master Plan submission. Additional engineering data and analysis will be submitted for Preliminary plan review as required.

If you have any further questions on this matter, please feel free to contact me at your earliest convenience.

Sincerely,
DiPrete Engineering Associates, Inc.

Christopher Duhamel, PE, PLS
Principal
cduhamel@diprete-eng.com

THIELSCH ENGINEERING

195 Frances Avenue
Cranston RI, 02910
Phone: (401)-467-6454
Fax: (401)-467-2398
thielsch.com
Let's Build a Solid Foundation

Client Information:
DiPrete Engineering
Cranston, RI
PM: Chris Duhamel
Assigned By: Allison Drake
Collected By: Client

Project Information:
AP 111 Lot 1, Gooding Ave
Bristol, RI
DiPrete Project Number: 2536-001-B01
Summary Page: 1 of 1
Report Date: 12.23.21

LABORATORY TESTING DATA SHEET, Report No.: 7421-M-142

Source	Sample No.	Depth (Ft)	Laboratory No.	Identification Tests								Proctor / CBR / Permeability Tests								Laboratory Log and Soil Description
				As Received Moisture Content %	LL %	PL %	Gravel %	Sand %	Fines %	Org. %	G_s	Dry unit wt. pcf	Test Moisture Content %	γ_d MAX (pcf) / W_{opt} (%)	γ_d MAX (pcf) / W_{opt} (%) (Corr.)	Target Test Setup as % of Proctor	CBR @ 0.1"	CBR @ 0.2"	Permeability cm/sec	
				D2216	D4318		D6913			D2974	D854			D1557						
Test Pit	TP-4		21-S-4822				12.2	32.6	55.2											Brown sandy silt

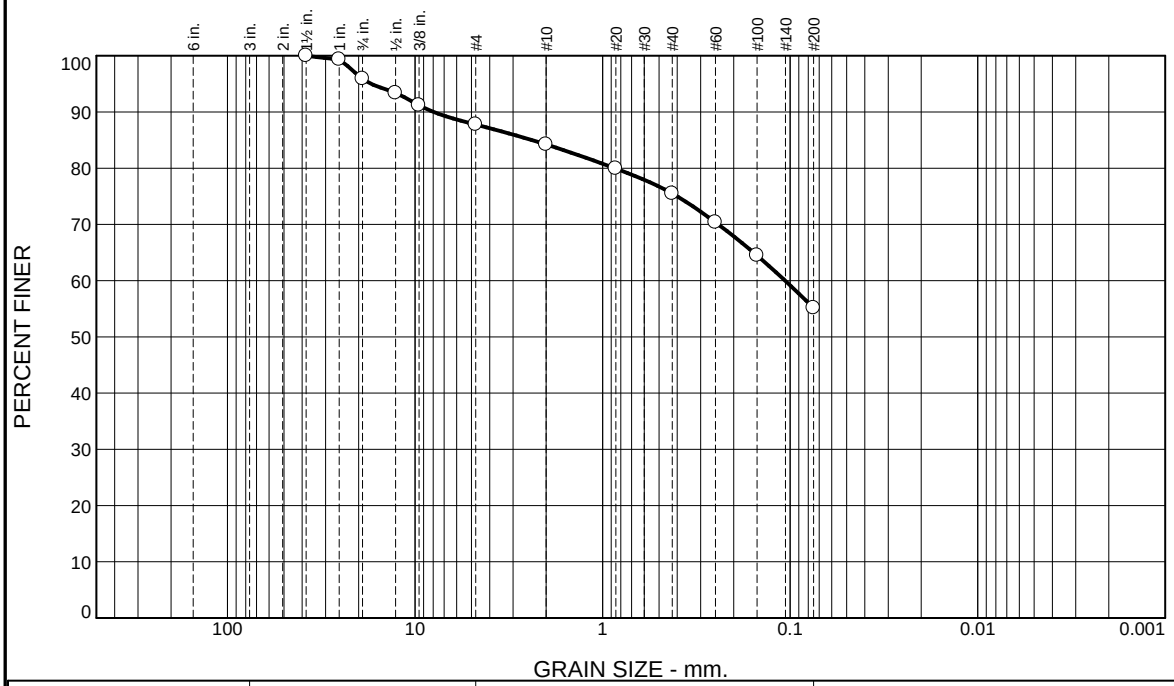
Date Received: *12.15.21*

Reviewed By:

Date Reviewed: *12.23.21*

This report only relates to items inspect and/or tested. No warranty, expressed or implied, is made.
This report shall not be reproduced, except in full, without prior written approval from the Agency, as defined in ASTM E329.

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	4.1	8.1	3.6	8.7	20.3	55.2	

Test Results (D6913 & ASTM D 1140)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1.5"	100.0		
1"	99.3		
0.75"	95.9		
0.5"	93.4		
0.375"	91.2		
#4	87.8		
#10	84.2		
#20	79.9		
#40	75.5		
#60	70.4		
#100	64.5		
#200	55.2		

* (no specification provided)

Material Description

Brown sandy silt

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=** NP

Classification

USCS (D 2487)= ML **AASHTO (M 145)=** A-4(0)

Coefficients

D_{90}= 7.9359 D_{85}= 2.3817 D_{60}= 0.1065
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Remarks

Sample visually classified as non-plastic.

Date Received: 12.15.21 **Date Tested:** 12.18.21

Tested By: AV / SF

Checked By: Rebecca Roth

Title: Laboratory Supervisor

Source of Sample: TP-4 **Date Sampled:**
Sample Number: TP-4

Thielsch Engineering Inc.

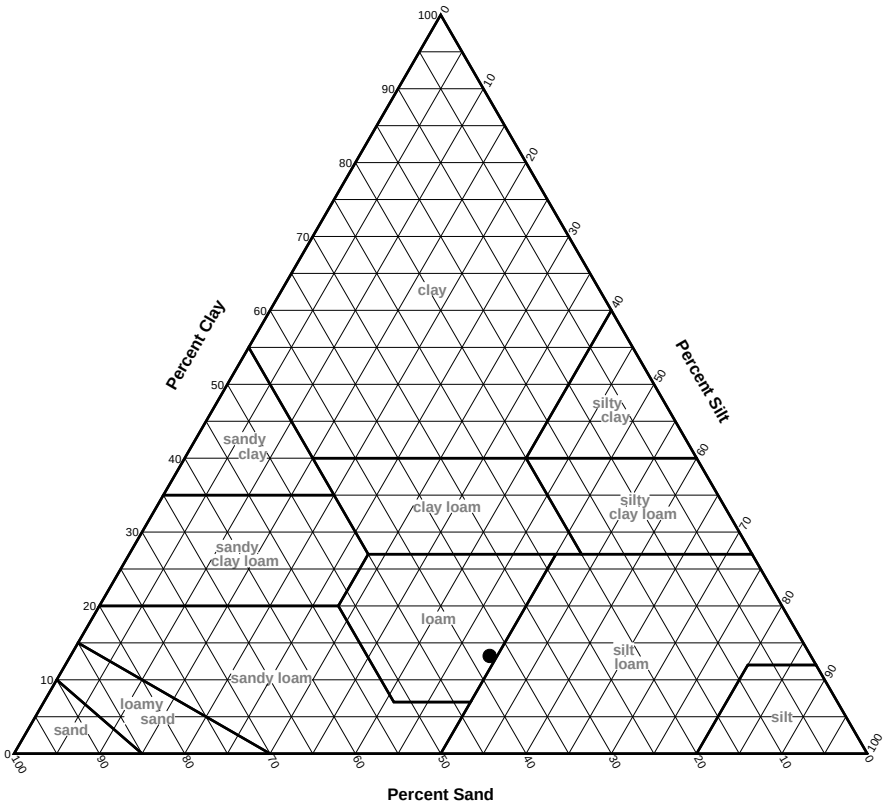
Cranston, RI

Client:

Project: AP 111 Lot 1, Gooding Ave
Bristol, RI

Project No: 2536-001-B01 Soil **Figure** 21-S-4822

USDA Soil Classification



SOIL DATA

	Source	Sample No.	Depth	Percentages From Material Passing a #10 Sieve			Classification
				Sand	Silt	Clay	
●	TP-4	TP-4		37.6	49.2	13.1	Loam

Thielsch Engineering Inc.

Cranston, RI

Client:

Project: AP 111 Lot 1, Gooding Ave
Bristol, RI

Project No.: 2536-001-B01 Soil Eval

Figure

Checked By: RR

From Executive Summary of Stormwater Report last modified and approved by RIDEM on July 10, 2025. Comparison between 0.52 in/hr and 0.27 in/hr rates shown in red.

Item C1.

Executive Summary

On behalf of the Client, we are submitting drainage calculations for the proposed development on Gooding Avenue in Bristol, Rhode Island. The site is located on Assessors' Plat 111 Lot 1. The site is currently undeveloped and exists today as almost entirely wooded. The client proposes to construct a new 80 room hotel building with associated parking and access driveways.

The post development stormwater will be treated for water quality using Best Management Practices (BMPs). The Site has been designed to meet the Rhode Island Stormwater Design and Installation Standards Manual (RISDISM). The site is largely made up of wetland and perimeter wetland areas and almost entirely Hydrologic Group D soils. Groundwater tables in the development area range from 24" to 36" below existing grade. Based on this information, low infiltration rates have been used in modeling the proposed BMPs to treat the water quality storm event. Also, the eastern end of the underground infiltration system A (UIS-A) will be located entirely above grade to maintain groundwater separation. Wherever this occurs, sand material will be installed between the bottom of stone and native soil below loam layer.

To mitigate post development flows on site, a sand filter and an underground infiltration/detention system will be utilized. The detention system has been designed to control runoff for the 1 through 100 year storm events. The sand filter and underground infiltration system have been designed as water quality BMPs. These will remove 85% or more of TSS (total suspended solids) generated by the proposed parking areas and access roads.

This report details how the site will show no net increase in stormwater runoff from pre development to post development conditions, and how the proposed BMPs will provide water quality treatment for stormwater runoff. The proposed improvements will not increase the rate of stormwater runoff onto the State Highway.

Pre development Conditions versus Post Development Conditions for each watershed are summarized below:

Subwatershed (design point)	1-yr Peak Flow		10-yr Peak Flow		25-yr Peak Flow		100-yr Peak Flow	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
DP-1:	2.34	0.99	6.50	4.99	9.08	6.75	14.58	10.39
All flows in cubic feet per second (cfs)		0.99		5.00		6.76		10.40

0.52 in/hr infiltration

0.27 in/hr infiltration

Sub-watershed (design point)	1-yr Volume		10-yr Volume		25-yr Volume		100-yr Volume	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
DP-1:	0.228	0.131	0.605	0.421	0.845	0.639	1.371	1.182
All flows in acre feet per second (af)		0.134		0.424		0.675		1.221

0.52 in/hr infiltration

0.27 in/hr infiltration

100-year peak storm elevations

UIS A Isolator Row (Node 104): Elevation @ 0.52 in/hr = 75.90
Elevation @ 0.27 in/hr = 75.90

UIS A (Node 105): Elevation @ 0.52 in/hr = 75.88
Elevation @ 0.27 in/hr = 75.88

UDS A (Node 106): Elevation @ 0.52 in/hr = 72.84
Elevation @ 0.27 in/hr = 72.98

Public Comment
Bristol RI Planning Board Meeting
Jan. 8, 2026

Re: Proposed hotel Gooding Avenue

The argument could be made that Bristol needs a hotel. But it is helpful to note that a hotel is one of the most intensive uses of undeveloped land.

And this location is not appropriate for many reasons.

First is safety. The listing for the topic tonight actually notes that the hotel is only 50 only feet from Broadcommon Road. Yet there is absolutely no mention of this intersection in either of the two traffic studies, and the word safety is never even mentioned in the latest study.

Both of these studies noted "no adverse effect from a hotel".

But Broadcommon and Gooding is a busy intersection used by many residents, including those of Bristol Woods. It's also heavily used by the many industries located in this area. **But it was totally ignored in the traffic studies.** Even the sidewalks on Narrows Road received more scrutiny. The sight lines at this intersection are limited, and its proximity to the crest of the Gooding Avenue hill makes it even more dangerous. Hotel traffic, because it's 24/7, and very intensive at times, would make this area even worse.

Both of the traffic studies were done in the off season, during limited times from January to April 5th, so their relevance in support of a tourist-related facility is further compromised.

Second, one has to question the utility of designating areas as wetlands if a developer is allowed to fill them in. What is the purpose of such designations if they are so casually dismissed?

Lastly, a review of the comp plan highlights one of the most frequent topics across all areas of the plan: that topic is the Silver Creek watershed.

References to the watershed appear in the following topics: Land Use; Open Space, Conservation and Recreation; Natural Historic and Cultural; Snapshot of Bristol Services and Facilities; and Natural Hazard Mitigation Plan.

One comment even refers to the need for minimizing the amount of new impervious paving. But at the August TRC meeting, when asked about making the parking lot permeable, the developer's representative said "that would cost money".

Our comp plan represents the very best effort by many to promote the common good for Bristol. Approving this project would defeat the whole purpose of these efforts.

As the comp plan notes, Bristol is, without a doubt, a “model seaside community”, with appeal based on its natural beauty, the very impressive tree canopy, a walkable town center, etc.

Of what use is a comp plan if so much of it can be cast aside?

Thank you for listening.

Judith A. Byrnes
62 Seabreeze Lane
Bristol, RI 02809
401 378 6811
judy.byrnes@yahoo.com

TOWN OF BRISTOL
COMMUNITY DEV.

2026 FEB -9 AM 8:35

Attn: Planning Board
10 Court Street
Bristol RI 02809

January 31st 2026

To the Members of the Bristol Planning Board,

I am a concerned resident writing to ask you to please make every effort possible to include RIDEM in the next public hearing regarding the proposed Gooding Avenue hotel.

While I do not live in a neighborhood directly impacted by the proposed development either by flooding or decreased property value, I am nevertheless extremely concerned about this potential project for all of the reasons bravely raised by my fellow residents at the January 8th meeting. I attempted to attend and was turned away at the door due to capacity being met, but I watched the full recording of the meeting posted online. Please make every effort possible to have the responsible parties from DEM attend the next meeting so the incredibly important discrepancies in the soil testing can be addressed. It is simply unacceptable to continue deliberations when such a foundational piece of the puzzle is in question. As is clear from the attendance and testimony from that meeting, the people of Bristol have made their voices heard but most importantly raised salient issues beyond opinion that cannot be ignored.

I humbly ask you to please consider the great responsibility you hold in your roles on the planning board and the irrevocable impact your decisions have on all residents. Thank you for your time.

Sincerely,

Audrey Cabral
Hopeworth Ave.

From: Brenda Cardullo

Sent: Wednesday, January 21, 2026 9:38 AM
To: Diane Williamson <dwilliamson@bristolri.gov>
Subject: Hotel on Gooding

Good morning,

I am writing to ask that the DEM come to the next meeting about the proposed hotel on Gooding. I was in attendance at the last meeting and found there to be only opposition to this hotel being built. What struck me most was the discrepancy in the soil test. In listening to Mr. and Mrs. Spinard it is obvious they did extensive homework on the soil. Would soil itself change over time? If the soil is anything like is being described, I know first hand. Though I live on Addy Drive, the soil is clay and does not absorb water. Our backyard does not dry up till June! I can't even imagine what it would mean with the runoff if a hotel were to be built on those wetlands for the people in the flood area. Why would the town be willing to put these people through more angst and hardship? It just doesn't make sense. There were many other reasons stated not to build this hotel and every one of them is valid right down to disturbing the wildlife and ecosystem. I am hoping the town will do the right thing and vote this down and am looking forward to the DEM being at the next meeting. Thank you.

Brenda Cardullo

22 Addy Drive

Begin forwarded message:

From: Date: December 19, 2023 at 9:10:15 PM EST
Subject: Wetlands Application No 22-0264

Mainstay/Sleep Inn Hotel
Gooding Ave. Bristol RI

Attached are pictures showing the water flooding we encounter whenever there is a significant rain fall. The perimeter of our property gets flooded and we feel it's gotten worse since the applicant cleared some of the hotel site in 2021.

We have invested much money to try to elevate our flooding problems with underground pipes and landscaping swirls.

We do not think the soil in our yard infiltrates water and the result is surface ponding of water after rainstorms.

Our grandchildren's playground was never flooded with water until the last few years. There is an underground stream across our road between our house and our neighbors. Water accumulates along the entire front of our house and pools at the end of our property making it impassable and dangerous when it freezes over in the winter.

The town has tried on numerous occasions to correct this water problem but it seems good for a short period and then returns.

We believe that the land they want to build this hotel on is predominantly made up of wetlands and filling it in and changing the land will cause our homeland even more flooding problems!

Please deny this application!

Thank you

Patti and Arthur Cirillo
37 Dartmouth Street
Bristol, RI 02809
Tel 401-225-8170
Sent from my iPhone

From: Denise Duarte
Sent: Tuesday, January 20, 2026 11:58 AM
To: Diane Williamson <dwilliamson@bristolri.gov>
Subject: Hotel

Good morning Ms. Williamson,

I am writing to voice my objection and concern with regards to the proposed hotel on Gooding Avenue. I attended the meeting at the town hall, and was frankly shocked when it came to light that the soil samples used by DEM to grant the permit were inaccurate. While I understand that the zoning is allowed under general use, nothing that was presented to the town that night from the developer was accurate. The soil samples, the traffic study (not done in the summer) and not taking into account the increase in traffic from the Robin Rug complex which will add over 120 units when complete. There was not one Bristol resident that was speaking in favour of the hotel; that should tell you something.

While I understand Bristol needs businesses to offset the residential tax burden, this does not align with the comprehensive plan.

"Bristol shall become a model seaside community for the 21st century. It shall become “the gem of the East Bay.” Bristol will be exceptional in the degree to which it will offer a small town, historic character blended with varied living and working environments, all closely connected with the water". Our community will certainly be more closely connected with the water if this goes through; we will be up to our knees in it.

Thank you for your consideration; please vote this down.

Denise Duarte

30 Valley Drive

401-835-1237

January 27, 2026

Dianne Williamson
Director, Community Development
10 Court Street
Bristol, RI 02809

Dear Dianne and members of the Planning Board for Bristol, RI

I am writing out to you regarding the proposal of the hotel that is in place.

I am extremely concerned about this, especially right behind the High School which will be a cause for trouble. Please take our/your children/grandchildren into consideration about this. This is not a good fit for Bristol, or anywhere in the East Bay area.

I am also encouraging that you all demand that the original DEM inspector who disapproved the request in 2016 and then approved on 2025 to be present at the next meeting (unfortunately, he is not listed under any staff listing at the DEM website). I am appalled as to how this was managed and what changed in the testing of this lot. If anything, it would be worse with all the rain and snow that would make it even wetter than before.

In all retrospect, I am genuine against this and let me explain why:

- My daughter who played soccer for BYSA had a tournament in Meriden Connecticut. While we were waiting for everyone to get together to go to the field, there was a junkie with a wad of money and was showing off to the girls that they can also make that kind of money. Not only were we all appalled, but angry that this hotel could allow this kind of behavior to exist amongst children

- Trafficking of all kinds. Humans, sex, illegals, and drugs on this type of facility will take a dramatic consequence if building this hotel will be allowed.

- Neighbors: their lives will be destroyed by this. Not only by the building, but the noises that it will be in their backyard. They won't be able to have natural light into their homes by keeping their windows cleared from curtains/blinds.

- I have witnessed a friend who had to live in a hotel due to a house fire several years ago and here is what we have encountered:

    a) drug dealings

b) overdoses that took time from emergency services such as Police, Firefighters and EMS ~~ does Bristol have these types of resources to attend these problems constantly? I don't believe so

c) CORONERS wagon outside the front door.

d) illegals was all over the place

- One night while they were sleeping someone tried to break into her room, and for that reason she and her family will never stay at a COMFORT INN again.

- Since this building will require a dumpster for trash which will also consist of leftover food scraps, those neighbors will have some unpleasant visitors in their back yard and into their homes. Its not deer, raccoons, coyotes or foxes, but RATS. How do I know this, I know of an individual who works for Hospitality Group and was asked to wire money to a pest control company to have them clear out the infestation of RATS at a hotel.

- Has anyone read that the Blithewold also is having issues (see attached article)

My other concern is their engineering individual who, would not attend to our request by speaking into the mic, had a slurring speech and couldn't pronounce some of the words of equipment/materials. How can this company be a good fit for this project.

Another point that I am concerned about is the Realtor who sold this property. I am pretty sure that he/she knew about the land being considered WET LAND, but their consideration to our neighbors, residents and future generation wasn't there. What was in it for this realtor? I am hoping it wasn't one of you.

If this is what you want for your residents who helped you get here, then go ahead and accept the request, but I am pleading with you not to.

Respectfully,

Maria G. Ferreira

Maria G. Ferreira
401-954-5921

Cc: Dianne Williamson
Town Councilman

Planning Committee

-----Original Message-----
From: Karyn Harper

Sent: Tuesday, January 20, 2026 10:32 AM
To: Diane Williamson <dwilliamson@bristolri.gov>
Subject: DEM presence at hotel meeting

Caution: This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe. When in doubt, contact your IT Department

Hello Diane
I am writing to voice my concern about the proposed hotel on Gooding Avenue. The meeting I attended had a big discrepancy in soil samples than what DEM presented. I would like to have DEM be present at the next meeting in February to explain why.

The fact this hotel has been giving this much power is a shame and and it doesn't belong in Bristol Please give this consideration when not one Bristolian wants this.

Thank you,
Karyn Harper

Paul Sousa
31 Dixon Avenue
Bristol, RI 02809

TOWN OF BRISTOL
COMMUNITY DEV.
2026 FEB 26 PM 12:44

February 18, 2026

Bristol Planning Board
c/o Diane Williamson
Director of Community Development
Bristol Planning Dept.
235 High Street, 1st Floor
Bristol, RI 02809

Subject: Rejection of the Comfort Inn Hotel and Suites Application on Gooding Avenue, Bristol, Rhode Island

Dear Members of the Planning Board,

I am writing in response to the proposed building of a Comfort Inn Hotel and Suites submitted by D&M Boca LLC.

As the owner of a directly abutting property located south of the proposed site at a lower elevation, I feel compelled to clearly express my serious concerns regarding the long-term consequences of this project.

Since purchasing our home in the spring of 2012, we have experienced repeated and significant flooding episodes, particularly at the base of Dixon Avenue. During heavy or sustained rainfall, water filters into the wetlands east of my property. When the ground becomes saturated, the water rises to levels that block my driveway and threaten our home. All homes in this area rely on multiple sump pumps to maintain dry basements. In my case, the sump pumps run constantly throughout the rainy season and especially during prolonged storm events, such as the devastating floods of 2010 and again in the fall of 2021 (as shown in photos). Beyond the constant anxiety of potential water damage, my property itself physically degrades due to the elevated water table. Because of ongoing erosion and soil displacement from saturation and runoff, I am forced to re-grade my property approximately every five to six years just to maintain stability and functionality.

This ongoing expense has a direct and measurable impact on the fragile environmental conditions in this area.

The proposed construction of a hotel and large parking lot will inevitably reduce the surface area available to absorb rainfall. Even with engineered drainage systems and retention ponds, impervious surfaces increase runoff. This will almost certainly exacerbate the already severe flooding conditions that affect my home and neighboring properties.

After reviewing the site plans, my concerns have only intensified. The inclusion of drainage ponds will likely attract increased mosquito populations, exposing families in the area to heightened risks of disease transmission. While mosquito mitigation measures may be proposed, long-term enforcement and maintenance are uncertain at best.

Additionally, the site plan shows the main building eliminating one swamp entirely, with utilities and stormwater features weaving in and out of other wetlands. It is deeply troubling that a proposal with this level of direct wetland disturbance has progressed this far. Over time, runoff from salt, gasoline, oil, and snow maintenance operations could severely impact the surrounding ecosystem. Wetlands exist for a reason—they are natural buffers and filtration systems. Once compromised, their recovery is uncertain.

There is also what appears to be a potentially historic stone wall along the west side of the property. Although plans indicate it will remain, experience shows that what is drawn on paper does not always reflect what ultimately happens on site.

Beyond the environmental concerns, there are serious quality-of-life and safety considerations. This is a quiet residential neighborhood with families and children who play outside daily. Introducing a three-story, 80-room commercial hotel directly adjacent to homes raises legitimate concerns about privacy, increased traffic, and general safety. A hotel by its nature brings a constant flow of short-term visitors. While many visitors may be well-intentioned, the reality is that residents would have no familiarity with who is coming and going at all hours. Increased foot traffic, vehicle activity, lighting, and proximity to backyards and homes diminish the sense of security and privacy that homeowners reasonably expect in a residential area.

Bristol is often celebrated for its historic charm, commercial vitality, and walkability. But one of its greatest treasures is the remaining natural forest and open space—the wetlands, wildlife corridors, and ecosystems that still survive here. These areas support deer, coyote, fox, turkey, rabbits, and countless other species. Even the clearing that has already occurred on the proposed lot has displaced wildlife, increasing the presence of rabbits on our property. Habitat loss continues to shrink the natural spaces these animals rely on.

At what point do we say enough is enough?

The flooding issues remain paramount for me and my family, but they are only one aspect of a broader environmental and community concern. Who will bear the consequences if flooding worsens? Who will be responsible if mosquito populations increase, if ecosystems are damaged, or if the character and safety of this neighborhood is altered? It will not be the developer—it will be the families who live here, who have quietly coexisted with this fragile environment for years, managing flooding, insects, bats, and wildlife as part of the natural balance of our neighborhood.

Poor decisions made today will surely affect many generations to come.

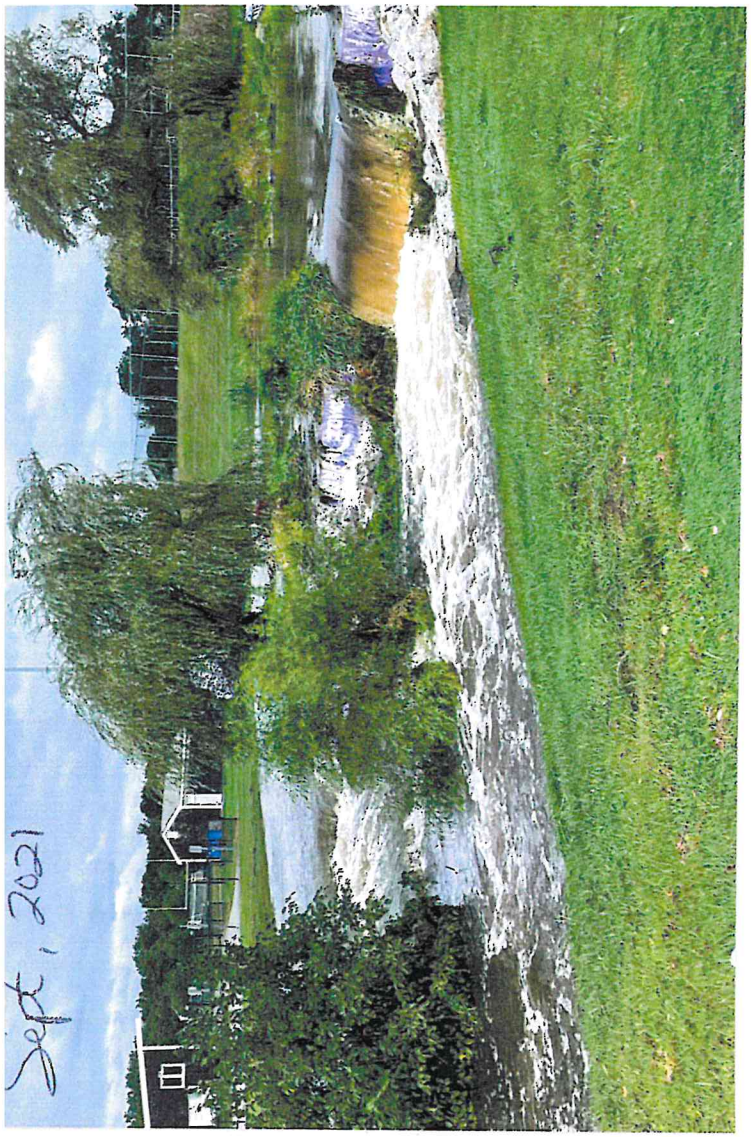
I respectfully urge you, the members of the planning board, to consider my objections and the cumulative environmental, financial, and community impacts this project may cause. This area is already environmentally sensitive and residential in nature. Further alteration of these wetlands risks intensifying flooding, degrading ecosystems, and permanently changing the character of this neighborhood.

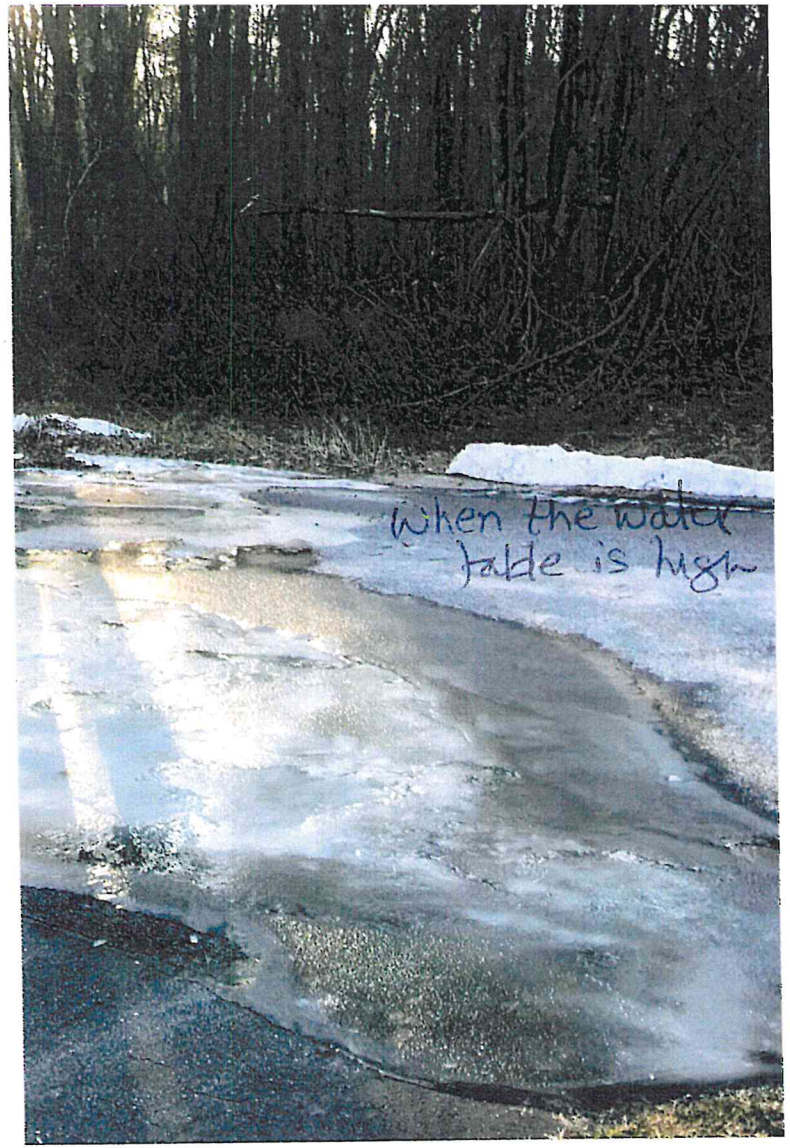
Please make the right decision and allow these wetlands to remain intact.

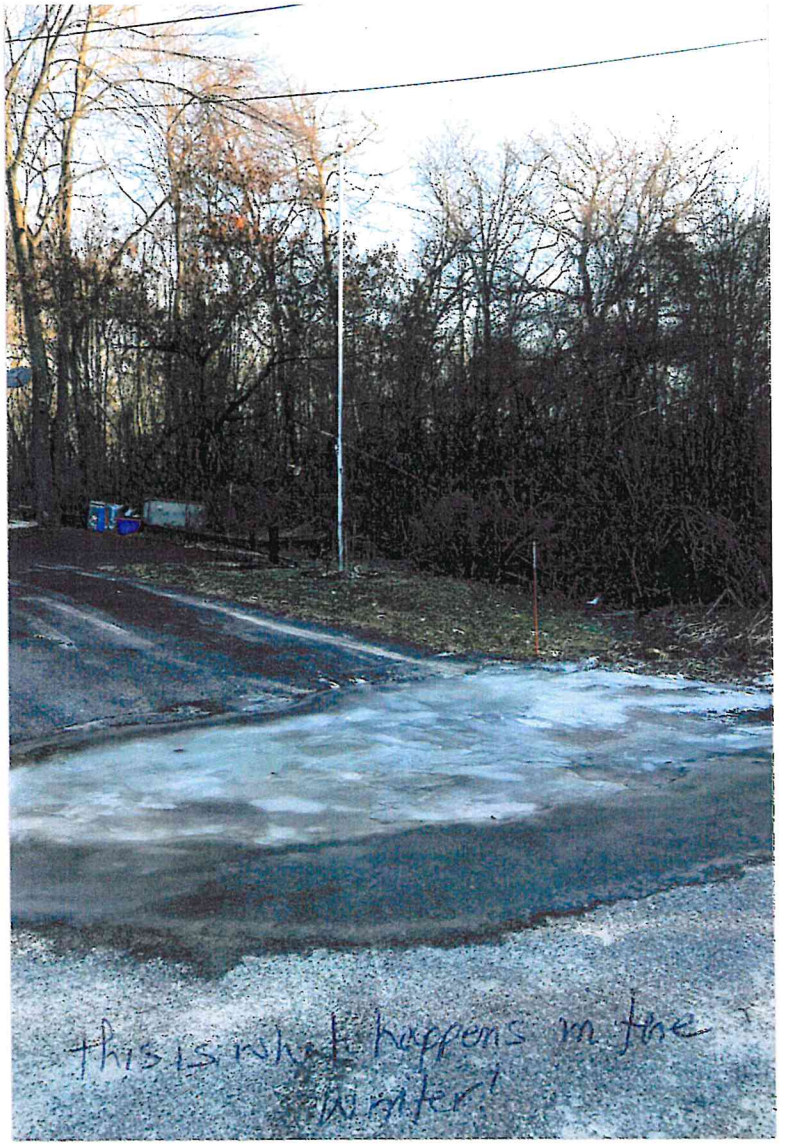
Thank you for your time and thoughtful consideration of the serious consequences this wetlands alteration could bring.

Sincerely,

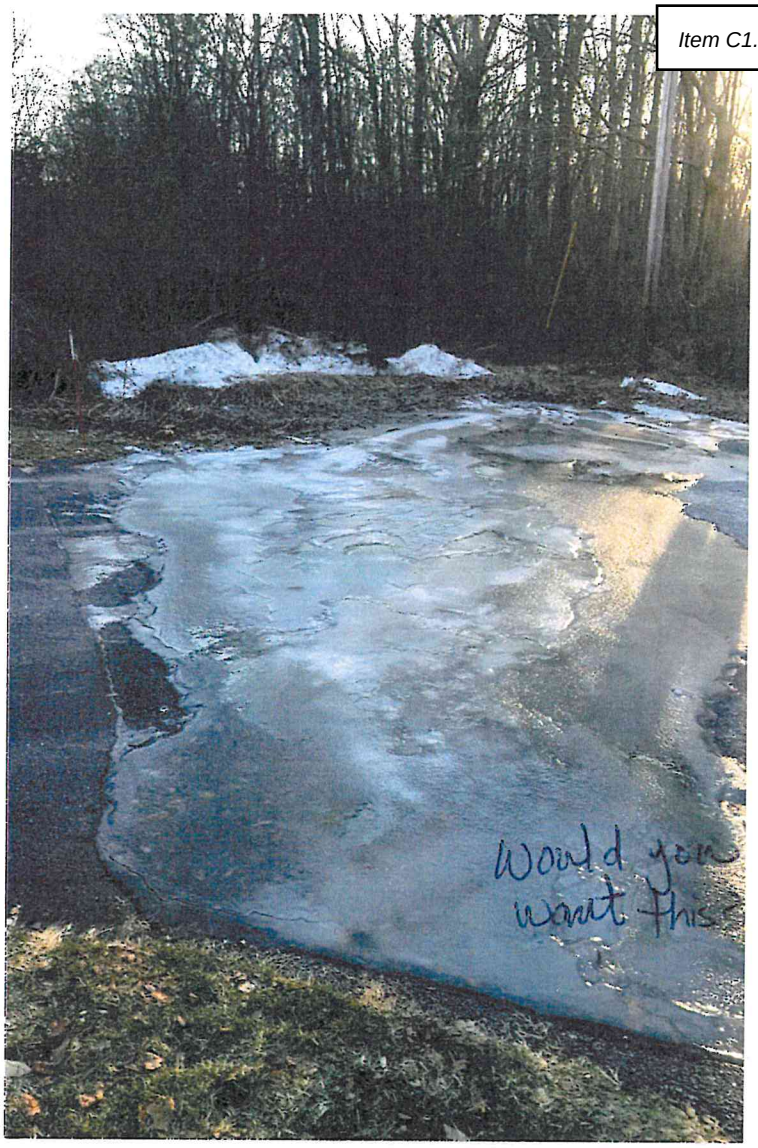
Paul Sousa


Sept, 2021


When the water
table is high


this is what happens in the
winter!

not Fair!


Would you
want this

Driveway

From: Carol F
Sent: Thursday, January 22, 2026 2:03 PM
To: Diane Williamson <dwilliamson@bristolri.gov>
Subject: potential hotel

Dear Ms. Williamson,

My mother and I are both taxpayers in the town of Bristol. We have lived here since 1971. We are against the building of this hotel for many reasons. We do not want this hotel to be built in our town, especially in that area on Gooding Avenue. Those woods belong to the wildlife. Those are wetlands.

We need your support and help. Please consider coming to the next meeting. There are so many reasons NOT to build it.

Sincerely,

Carol S. Talbot

Downstream Analysis

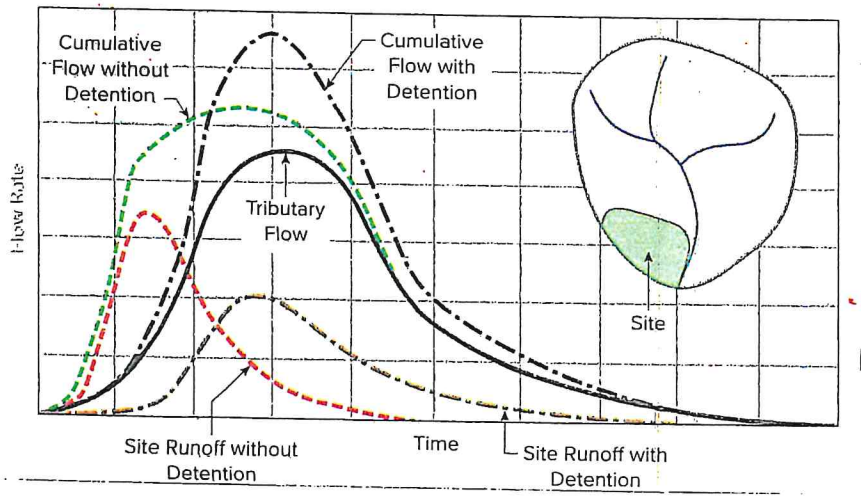
Table of Contents

- **Slide - Known Flooding Problems and Coincident Peaks requiring a Downstream Analysis**
- **Slide – Possible Coincident Peaks**
- **Pertinent sections of the *RI Stormwater Design Manual and Installation Manual* related to Downstream Analysis**

Proposed Gooding Avenue Hotel

Downstream Analysis Coincident Peaks

RAISE THE RED FLAG

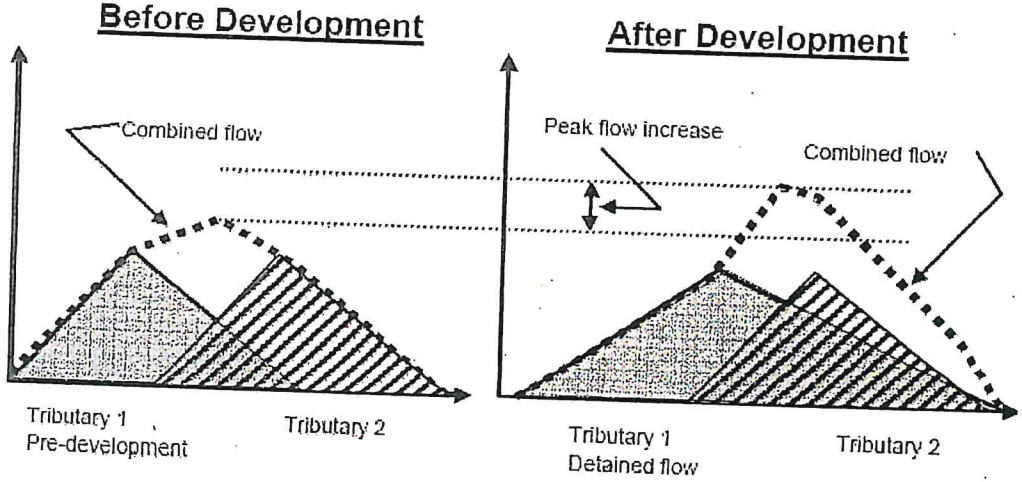


3.3.6 Downstream Analysis (RISDIM)
A downstream analysis is required for projects ...when existing conditions are already causing a problem (e.g. known drainage or flooding conditions)

Figure 3-1 Graphical Representation of Coincident Peaks (Ogden, 2000)

The figure above shows a case resulting from delaying the peak and extending the recession limb of the hydrograph; the peak flow rate in the main channel increases.

Two Downstream Combining Hydrographs



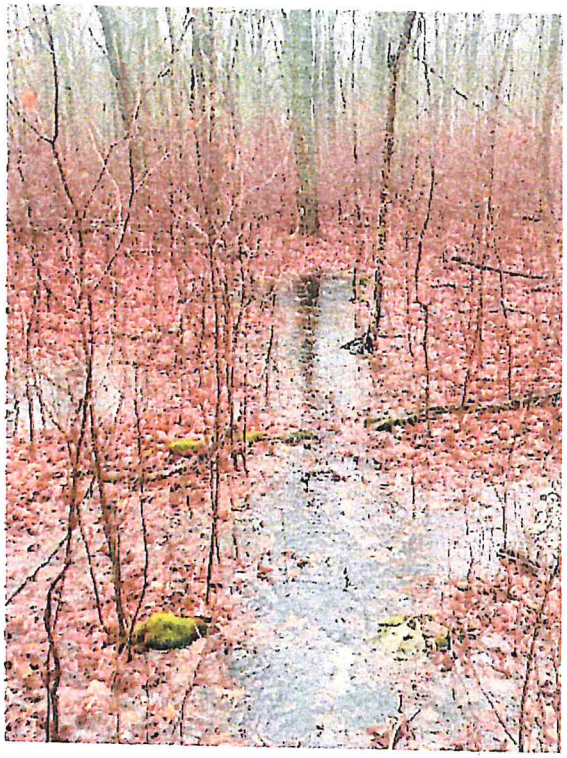
Item C1.

Downstream Analysis

Coincident Peaks

RAISE THE RED FLAG

Possible Coincident Peaks



Downstream Neighborhoods
late time peak discharge

Stormwater Management System
New High School

Downstream Analysis

The Applicant has contended during the RIDEM wetland review process that a Downstream Analysis was not required since they reduced the peak runoff rate. I have attached the pertinent sections of the RI Stormwater Design and Installation Standards Manual, which specifically explains and uses a graph to illustrate why a downstream analysis is required, even though there is a reduction in the pre and post runoff rates.

The Applicant attempted to satisfy the Downstream Analysis by modeling the section of Silver Creek as a 'Reach' using *HydroCAD* Stormwater modeling software. **This assessment is categorically wrong.**

I have attached sections from the HydroCAD Owner's Manual that describes a Reach as a "A uniform stream..." Silver Creek is not a uniform stream. That is why the HEC RAS model requires a series of cross-sections to reflect the non-uniform nature of natural streams. The Beta Silver Creek drainage model uses seven different cross sections in the Applicant's reference section.

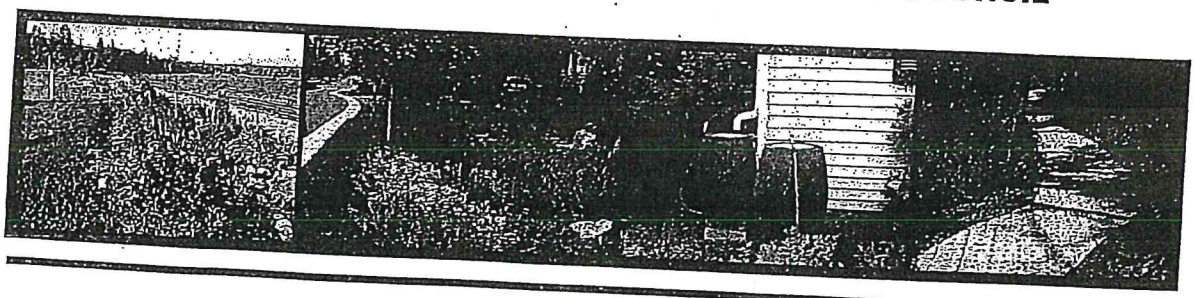
There is a section in the HydroCAD Owner's Manual dealing with Reach Routing Limitations. It states that "If a detailed water surface profile is required for a channel, you should use a program specifically designed for that purpose." Footnote 25 states "Water surface profiles are usually calculated under constant flow conditions, rather than with a hydrograph (time-varying flow)"

RHODE ISLAND STORMWATER DESIGN AND INSTALLATION STANDARDS MANUAL

AMENDED MARCH 2015

RHODE ISLAND DEPARTMENT OF ENVIRONMENTAL MANAGEMENT AND

COASTAL RESOURCES MANAGEMENT COUNCIL



For facility sizing criteria, the basis for hydrologic and hydraulic evaluation of development sites are as follows:

- The models TR-55 and TR-20 (or approved equivalent) will be used for determining the required storage and outlet structures for attenuating the peak flows from the 10-year and 100-year, 24-hour Type III design storms.
- The standard for characterizing pre-development land use for on-site areas shall be woods, meadow, or rangeland. For agricultural land, use a CN representing rangeland.
- For purposes of computing runoff, all pervious lands prior to development shall be assumed to be in good condition regardless of conditions existing at the time of computation.
- Off-site areas that drain to a proposed facility should be modeled as "present condition" for peak-flow attenuation requirements.
- If an off-site area drains to a facility, an applicant must also demonstrate safe passage of the 100-year event, based on actual conditions upstream.
- The length of sheet flow used in t_c calculations is limited to no more than 150 feet for pre-development conditions and 100 feet for post-development conditions.
- An applicant must demonstrate that flows from the 100-year event will be safely conveyed to a practice designed to manage the 100-year event.

The Q_p criterion can be waived for sites that:

- Direct discharge to a large river (i.e., 4th-order stream or larger. See Appendix I for State-wide list and map of stream order), bodies of water > 50.0 acres in surface area (i.e., lakes, ponds, reservoirs), or tidal waters.
- A Downstream Analysis indicates that peak discharge control would not be beneficial or would exacerbate peak flows in a downstream tributary of a particular site (i.e., through coincident peaks).

3.3.6 Downstream Analysis

A downstream analysis is required for projects meeting the project size and impervious cover characteristics in the table below, or when deemed appropriate by the approving agency when existing conditions are already causing a problem (e.g., known drainage or flooding conditions or existing channel erosion is evident), to determine whether peak flow impacts are fully attenuated by controlling the 10- and 100-year events. The criterion used for the limit of the downstream analysis is referred to as the "10% rule." Under the 10% rule, a hydrologic and hydraulic analysis is extended downstream to the point where the site represents 10% of the total drainage area. For example, a 10-acre disturbed area within the same subwatershed would be analyzed to the point downstream with a drainage area of 100 acres.

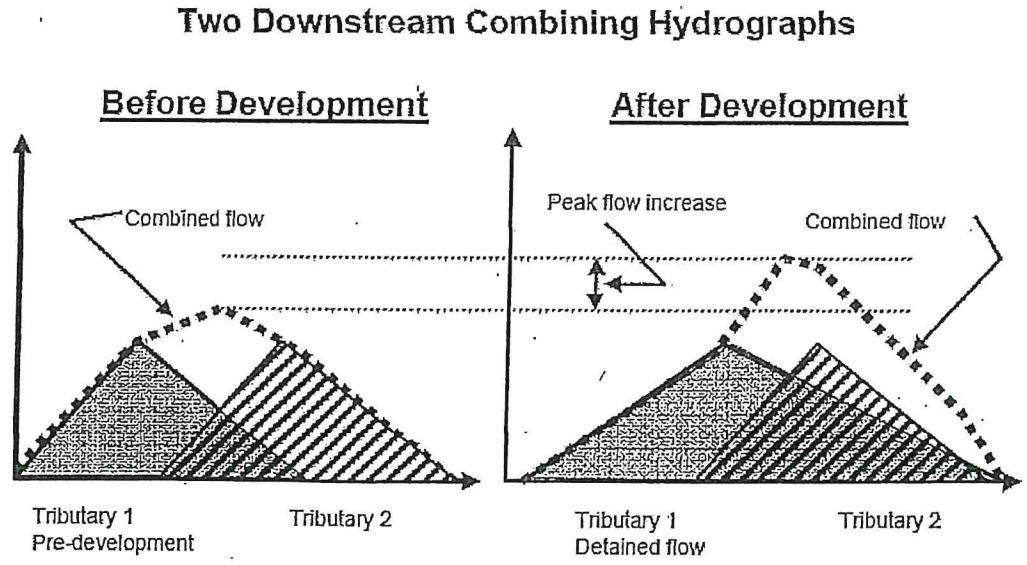
5 x 10 = 50 ACRES

Table 3-7 Projects for which a Downstream Analysis is required

Area of Disturbance Within the Subwatershed (acres)	Impervious Cover (%)[1]
>5 to10	>75
>10 to 25	>50
>25 to 50	>25
>50	all projects

A number of hydrologists have noted that overbank and extreme flood control approaches do not always provide full downstream control from the out-of-bank events, due to differences in timing of individual peak discharges in the downstream portion of the watershed. Depending on the shape and land use of a watershed, it is possible that upstream peak discharge may arrive at the same time a downstream structure is releasing its peak discharge, thus increasing the total discharge (see Figure 3-1). As a result of this "coincident peaks" problem, it is often necessary to evaluate conditions downstream from a site to ensure that effective out-of-bank control is being provided.

Figure 3-1 Graphical Representation of Coincident Peaks (Ogden, 2000)



[1] Percent Impervious Cover = I / disturbed area contributing to discharge locations

As a minimum, the analysis should include the hydrologic and hydraulic effects of all culverts and/or obstructions within the downstream channel and assess whether an increase in water surface elevations will impact existing buildings or other structures. The analysis should compute flow rates and velocities (for the overbank flood control storms) downstream to the location of the 10% rule for pre-developed conditions and proposed conditions both with and without detention facility(ies). If flow rates and velocities (for Q_p) with the proposed detention facility increase by less than 5% from the pre-developed condition, and no existing structures are impacted, then no additional analysis is necessary. If the flow rates and velocities increase by more than 5%, then the designer must redesign the detention structure, evaluate the effects of no detention structure, or propose corrective actions to the impacted downstream areas. Additional investigations may be required by the approving agency on a case-by-case basis depending on the magnitude of the project, the sensitivity of the receiving water resource, or other issues such as past drainage or flooding complaints.

Special caution should be employed where the analysis shows that no detention structure is required. Stormwater designers must be able to demonstrate that runoff will not cause downstream flooding within the stream reach to the location of the 10% rule. The absence of on-site detention shall not be perceived to waive or eliminate groundwater recharge (Re_v), water quality control (WQ_v), or stream channel protection requirements (CP_v).

A typical downstream analysis will require a hydrologic investigation of the disturbed area draining to a proposed detention facility and of the contributory watershed to the location of the 10% rule for the 10- and 100-year, 24-hour Type III storms. The approving agency may also request analysis of the 1-year, 24-hour Type III storm on a case-by-case basis. A hydraulic analysis of the stream channel below the facility to the location of the 10% rule will also be necessary (e.g., a HECRAS water surface profile analysis). Depending on the magnitude of the impact and the specific conditions of the analysis, additional information and data may be necessary such as collecting field run topography, establishing building elevations and culvert sizes or investigating specific drainage concerns or complaints.

Table 3-8 Summary of Stormwater Treatment Practice Criteria

Criteria	Description	Post-Development Storm Magnitude

Downstream Analysis

- Downstream Analysis – HEC RAS
- Slide HEC RAS (River Analysis)
- Slide – Natural Streams Characteristics
- Slide – HEC RAS Silver Creek Cross Section
- Slide – HEC RAS Silver Creek Cross Section
- The Standard Step Procedure in HEC RAS
- HEC RAS Abbreviations
- Sample HEC RAS analysis printout
- Slide Silver Creek Flood Examination (Spinard)
- Silver Creek Flood Examination Report

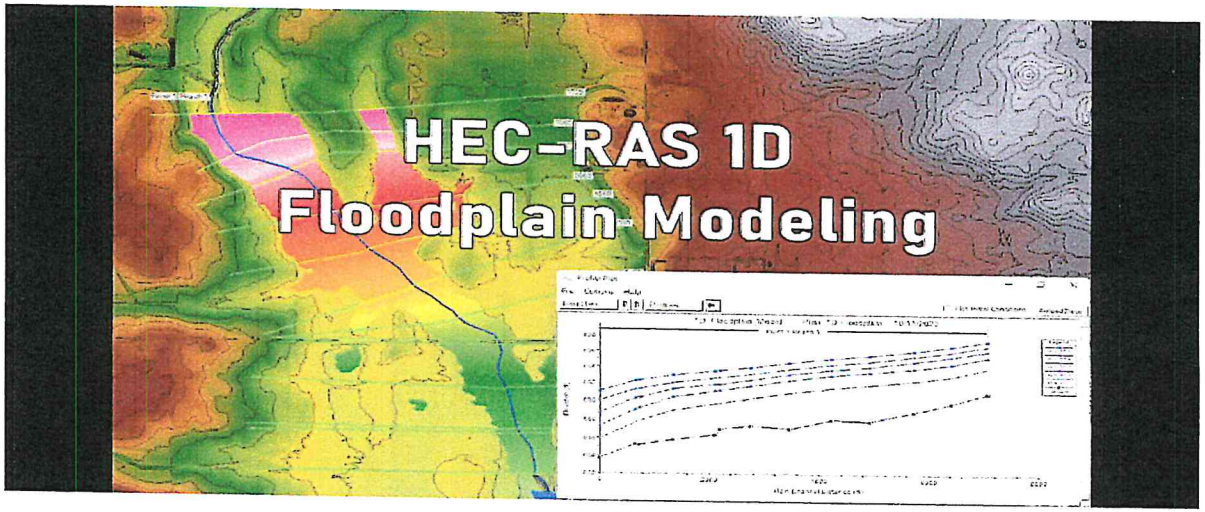
Slide Storm Chamber SC-740 is being discontinued

Proposed Gooding Avenue Hotel

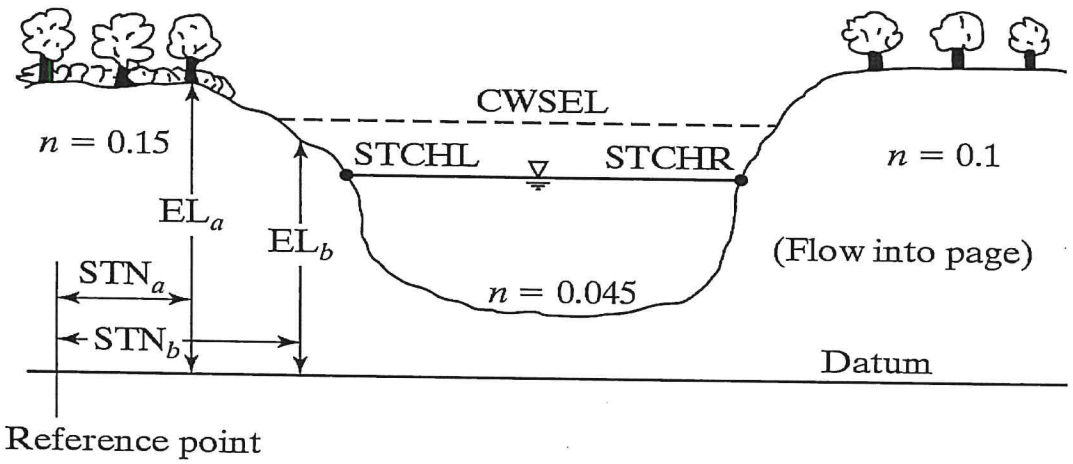
Downstream Analysis – HEC RAS

RAISE THE RED FLAG

Stormwater designers must be able to demonstrate that runoff will not cause downstream flooding within the stream reach. A typical downstream will require a hydrologic investigation of the disturbed area ...and the contributory watershed... for the 10 and 100-year, 24-hour, Type III storms. Depending on the magnitude of the impact and the specific conditions of the analysis, additional information may be necessary such as collecting field run topography, establishing building elevations and culvert sizes or investigating specific drainage.



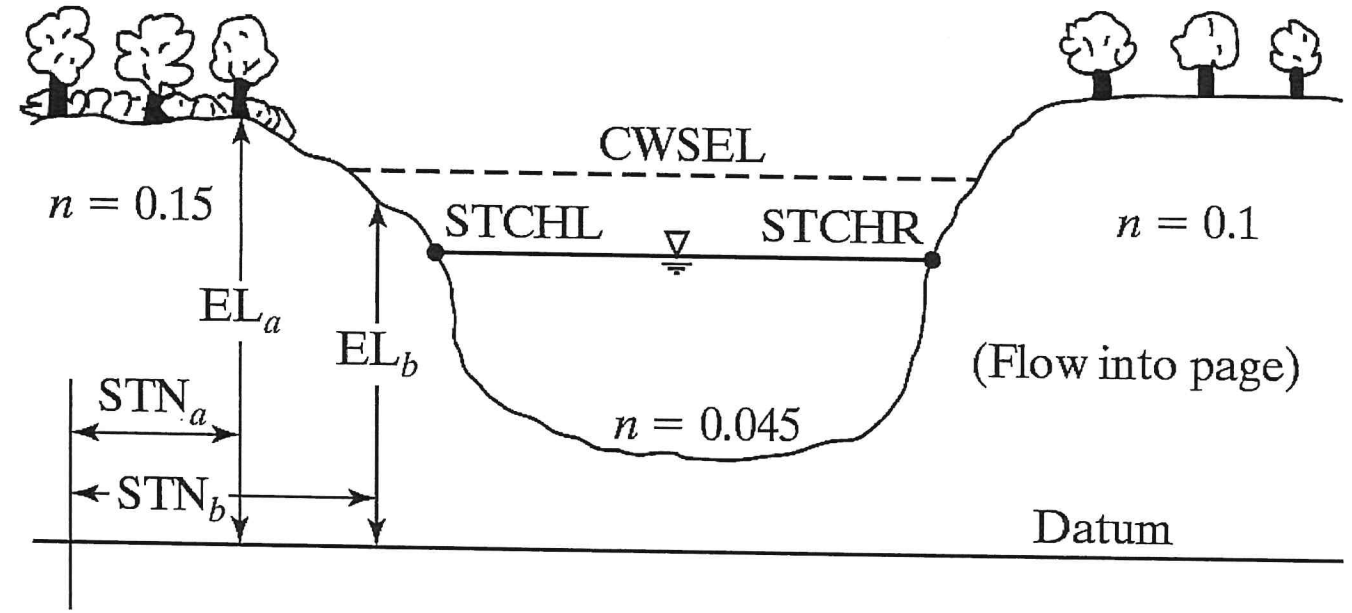
HEC RAS (River Analysis System, 1995)



HEC RAS or (HEC-2)is a computer model designed for natural cross sections in natural rivers. It solves the governing equations for the standard step method, generally in a downstream to upstream direction. It can Also handle the presence of bridges, culverts, and variable roughness, flow rate, depth, and velocity.

© 2002 Prentice Hall, Inc.

Item C1.



EL_a, EL_b = Ground elevation above datum for points a and b, respectively
STN_a, STN_b = Distance from reference point for points a and b, respectively
STCHL = Left channel bank station (when looking downstream)
STCHR = Right channel bank station (when looking downstream)
Note: Up to 100 points (EL, STN) may be defined for each section.

Figure 7.11

Typical cross section.

© 2002 Prentice Hall, Inc.
Philip B. Bedient
Hydrology and Floodplain Analysis

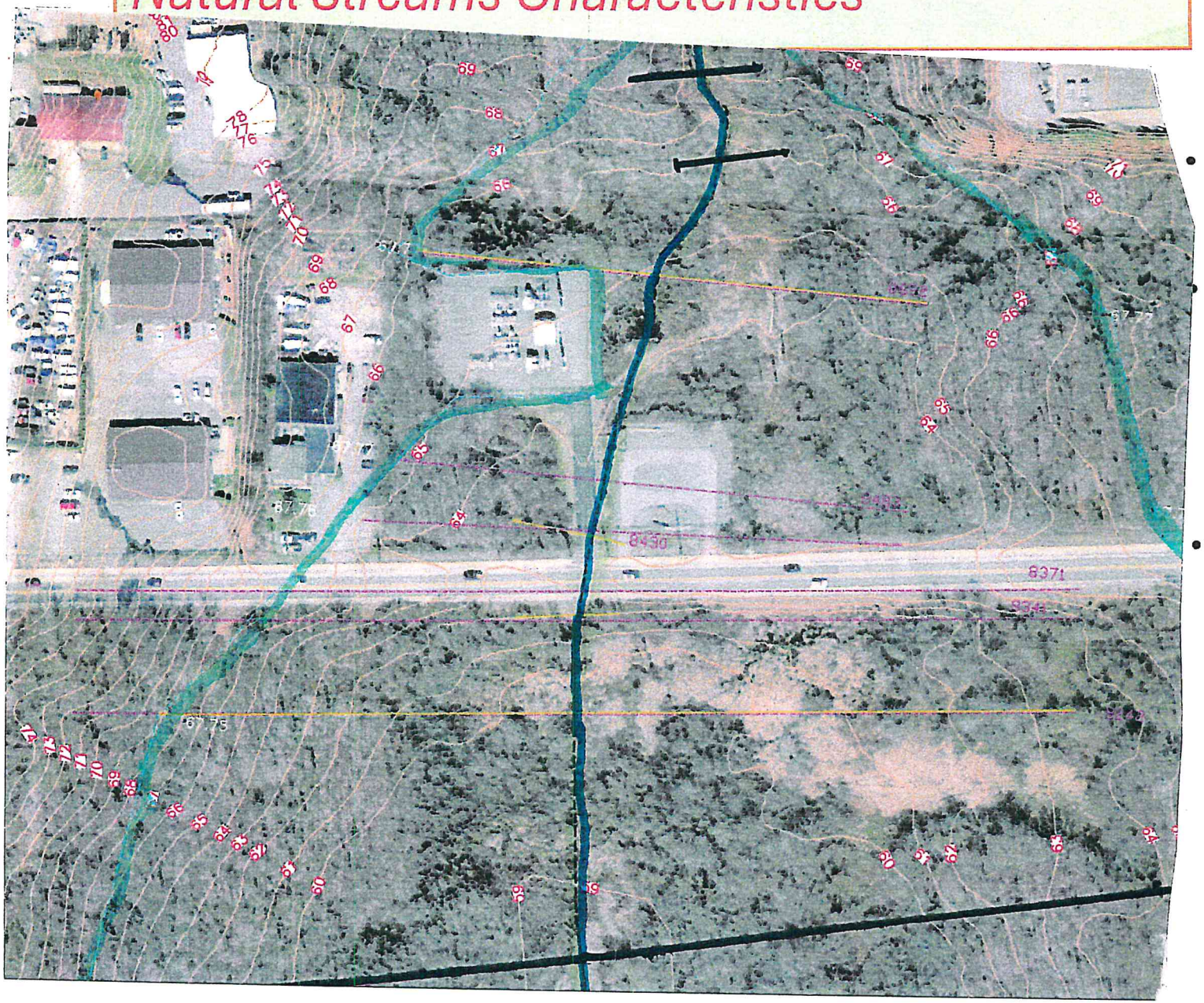
Item C1.

Proposed Gooding Avenue Hotel

Downstream Analysis

Natural Streams Characteristics

RAISE THE RED FLAG



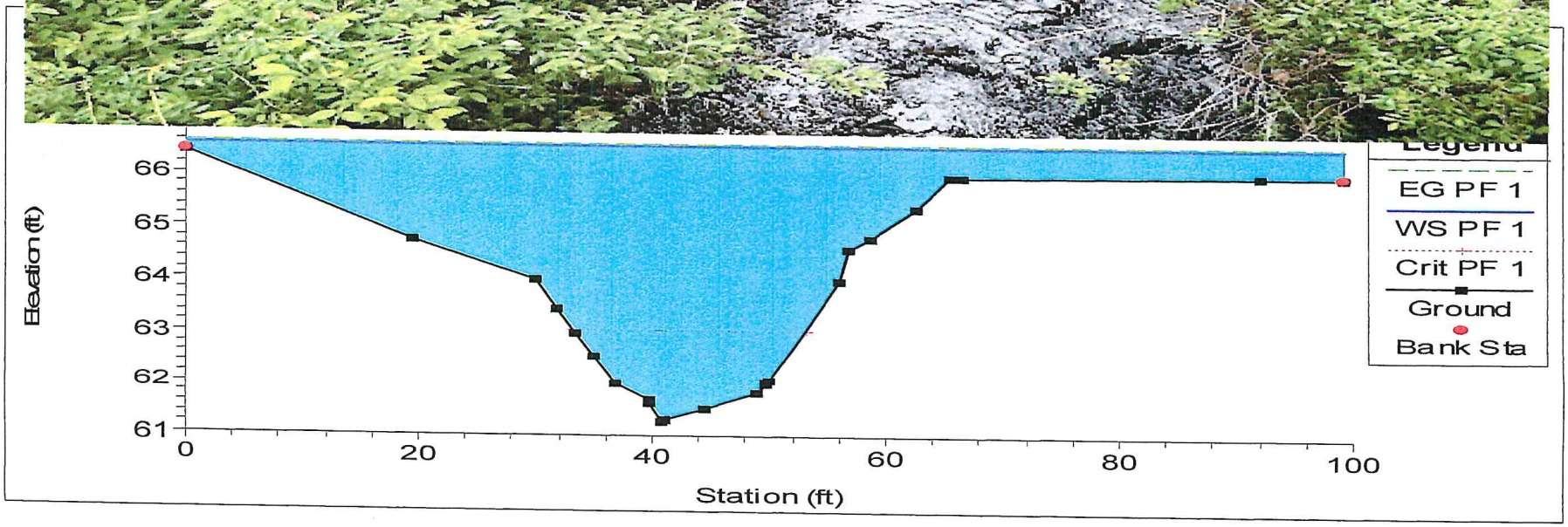
- Natural streams are **NOT Uniform**
- They have varying shapes, depths, slopes, velocities, and surface conditions.
- ~~Areal~~ AERIAL photograph shows two different Silver Creek cross-sections: 250 feet north and 250 feet south of Gooding Ave.

Item C1.

HEC RAS Silver Creek Cross Sections

North of Gooding Ave

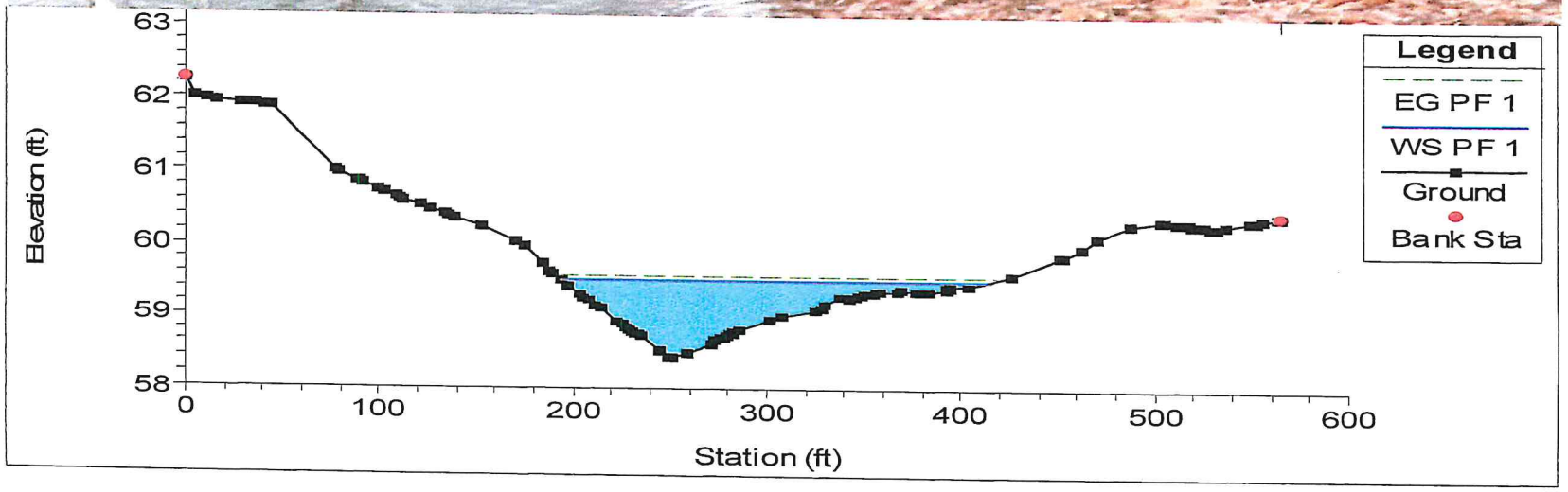
RAISE THE RED FLAG



Item C1.

HEC RAS Silver Creek Cross-Section

South of Gooding Ave.



Item C1.

Item C1.

The Standard Step Procedure in HEC-RAS

The HEC-RAS algorithm uses the following steps to compute water surface elevations using the standard step method:

1. Establish the downstream boundary condition for subcritical flow or the upstream boundary condition for supercritical flow. The boundary conditions include the starting water surface elevation or depth, the discharge, and the initial cross-section geometry. The starting water surface elevation could be obtained from a measured value at a gage, by assuming critical depth, by assuming normal depth, or by estimating. The conveyance and discharge in the left and right overbanks and in the channel are computed for the specified starting water surface elevation. The discharge-weighted velocity head and the friction slope at the boundary are calculated. In addition, the cross-section geometry for all locations at which computations are required must be known, along with Manning's *n* values, reach lengths, obstruction data, and discharges throughout the river system.
2. The water surface elevation is estimated, with the assumption of subcritical flow, at the next cross section (Section 2) upstream from the boundary (Section 1). HEC-RAS projects the depth from Section 1 onto Section 2 for an initial estimate of the water surface elevation.
3. For the assumed water surface elevation at Section 2, the incremental conveyance is computed for the left and right overbanks and for the channel at Section 2, using Equation 2.47. The conveyance is summed to obtain the total conveyance at Section 2.
4. The total discharge at Section 2 is distributed to the left and right overbank areas and to the channel in proportion to the incremental conveyance. An average discharge is computed for each of the three flow paths (channel and left and right overbank distance) between the two sections.
5. The friction slope at Section 2 is computed with Equation 2.51 from the total discharge and total conveyance at Section 2.
6. The average velocities in the left and right overbank, the channel, and the entire cross section are computed. The mean velocity head is computed with a modification of Equation 2.48 for the velocity and discharge terms for each channel subsegment (left and right overbank areas and the channel) and the total section discharge and average velocity. Although HEC-RAS does not use α for the computations, it is computed and displayed for inspection by the user. The program sets the discharge-weighted velocity head (including α) equal to the right-hand side of the following equation:

$$\alpha\frac{V_{ave}^2}{2g} = \frac{1}{2g}\left(\frac{V_{lob}^2 Q_{lob} + V_{ch}^2 Q_{ch} + V_{rob}^2 Q_{rob}}{Q_{TOT}}\right)$$

7. The initial estimate of the energy grade line elevation is obtained by adding the mean velocity head found from step 6 to the estimated water surface elevation of step 2.
8. A discharge-weighted reach length (L_Q) is found from the discharge and the reach length for each of the three flow paths between the two sections. Equation 2.53 is used for this computation in HEC-RAS.
9. The average friction slope is found between the two sections. Four different equations for average friction slope are available in HEC-RAS. The friction loss between the two sections is computed with Equation 2.44.
10. The mean velocity head at section 2 is subtracted from the mean velocity head at section 1. If the difference is negative, the flow area is contracting and the coefficient of contraction is used in Equation 2.45 to compute the contraction loss. If the difference is positive, the flow area is expanding and the coefficient of expansion is used in Equation 2.45 to compute an expansion loss.
11. Equation 2.46 is used to compute the water surface elevation at Section 2 and the value is compared to the assumed value from step 2. If the difference is within a predefined tolerance, the elevation is accepted as correct and computations move on to the next section upstream (Section 3), with steps 2–11 repeated for computations between Sections 2 and 3. If the difference is outside the required tolerance, a revised $WSEL_2$ is estimated and steps 3–11 are repeated until the tolerance is met.

HEC RAS Abbreviations

Profile Number	Profile Number	
Q Total	Total Flow in Cross-Section	cfs
Min CL El	Minimum Main Channel Elevation	feet
W.S. El	Calculated water surface from Energy equation	feet
Crit W S.	Critical Water Surface elevation. Water surface Corresponding to the minimum energy on the energy versus depth curve	feet
E G Elev	Energy grade line for calculated WS elevation	feet
E G Slope	Slope of Energy Grade line	ft/ft
Vel Chan	Average velocity of flow in main channel	ft/s
Flow Area	Total area of cross section total flow	sqft
Top Width	Total width of wetted cross section	ft
Froude # Chi number	Froude number for main channel	

Proposed Gooding Avenue Hotel

HEC RAS Model Silver Creek (East) and Elbow Tributary - Results

Showing the hydraulic parameters for each cross-section used to determine flood elevations

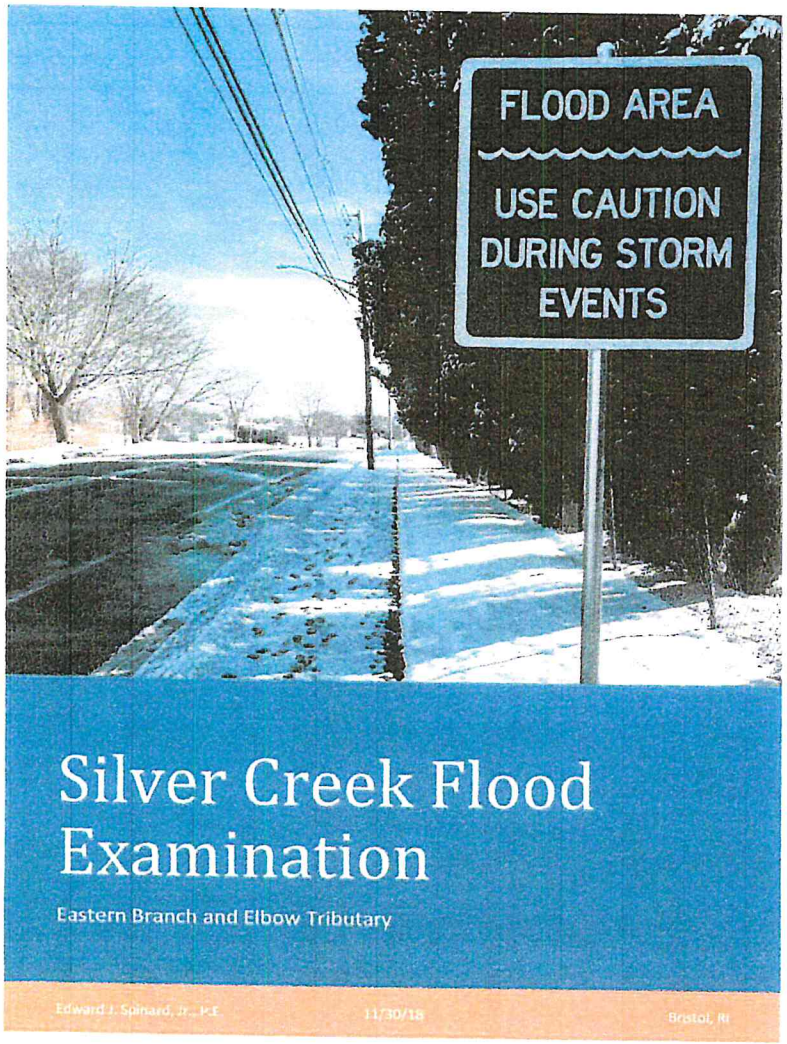
HEC-RAS Plan: Plan 08 River: Silver Creek Reach: Silver Creek Upp Profile: PF 1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Silver Creek Upp	9611	PF 1	88.64	78.00	79.21	78.74	79.28	0.013668	2.12	41.85	52.63	0.42
Silver Creek Upp	9386	PF 1	88.64	72.00	72.62	72.62	72.85	0.092268	3.88	22.87	49.01	1.00
Silver Creek Upp	9098	PF 1	88.64	68.00	69.44	68.71	69.46	0.003189	1.00	89.04	117.43	0.20
Silver Creek Upp	8754	PF 1	149.10	64.00	64.53	64.53	64.68	0.109725	3.11	47.98	163.30	1.01
Silver Creek Upp	8483	PF 1	337.53	58.00	63.74	59.51	63.74	0.000098	0.53	689.95	198.47	0.05
Silver Creek Upp	8443		Culvert									
Silver Creek Upp	8410	PF 1	337.53	58.00	63.73		63.74	0.000099	0.53	688.45	198.40	0.05
Silver Creek Upp	8402	PF 1	337.53	58.00	63.73		63.73	0.000035	0.28	1035.96	250.00	0.03
Silver Creek Upp	8304	PF 1	361.40	57.00	63.73		63.73	0.000007	0.13	2747.49	788.61	0.01
Silver Creek Upp	8055	PF 1	373.98	57.00	63.73		63.73	0.000005	0.11	3460.45	952.02	0.01
Silver Creek Upp	7475	PF 1	373.98	57.00	63.73		63.73	0.000001	0.07	5241.41	982.78	0.01
Silver Creek Upp	6822	PF 1	382.86	56.00	63.73		63.73	0.000002	0.08	4710.17	1103.27	0.01
Silver Creek Upp	6602	PF 1	382.86	56.00	63.73		63.73	0.000004	0.12	3186.43	677.10	0.01
Silver Creek Upp	6406	PF 1	382.86	56.00	63.71		63.72	0.000140	0.84	456.42	60.56	0.05

Proposed Gooding Avenue Hotel

HEC RAS Model Silver Creek (East) and Elbow Tributary

RAISE THE RED FLAG



- Prepared to understand the dynamics of natural river flow better.
- Prepared to identify Silver Creek's unique characteristics and how they affect flood flow and flood elevations.
- Prepared to show the feasibility of creating a HEC RAS model of Silver Creek
- Note: This Report does not include recent changes to the High School stormwater management system

Downstream Analysis – Wrong Method completed by Applicant

Table of Contents

- **Summary of RIDEM request for DiPrete to perform a Downstream Analysis**
- **RIDEM review by Engineer dated 1/04/2016 requesting downstream analysis**
- **RIDEM review by Engineer dated 12/12/2017 requesting downstream analysis**
- **DiPrete's response to RIDEM review by the Engineer dated 01/23/2018, requesting downstream analysis**
- **RIDEM review by Engineer dated 3/12/2018 (missing from RIDEM Wetland File) requesting downstream analysis**
- **DiPrete's response to RIDEM review by the Engineer dated 04/10/2018, requesting downstream analysis**
- **RIDEM review by Engineer dated 7/12/2022 requesting downstream analysis**
- **DiPrete's response to RIDEM review by the Engineer dated 1/04/2023, requesting downstream analysis**
- **Reach analysis using HydoCAD for downstream analysis**
- **RIDEM review by Engineer dated 06/30/2023 accepted DiPrete's analysis**
- **Graphic representative of Uniform and Non-Uniform Flow**
- **Section of HydroCAD Stormwater Modeling System Manual indicating that the HydroCAD is not to be used for determining constant river flow and flood elevations**
- **Comment on DiPrete HydroCADreach model results**

Downstream Analysis- Wrong Method completed by Applicant does not address the potential for downstream flooding

- RIDEM requested the Applicant to perform a Downstream Analysis three different times during their review.
- RIDEM accepted a downstream analysis using HydroCAD to model downstream effects
- Applicant completed a "rough drainage analysis of Silver Creek," by modeling Silver Creek as a Reach using HydroCAD.
- A Reach is a uniform stream, channel, or pipe.
- It has a constant width, side slopes, depth, slope, and surface condition.
- The manual for HydroCAD states that it is not to be used for flood plain analysis.

3.3.6 *Downstream Analysis*

A downstream analysis is required for projects ...when existing conditions are already causing a problem (e.g. known drainage or flooding conditions

Item C1.

- **RIDEM has requested in numerous reviews that the Applicant perform a Downstream Analysis.**
  A RIDEM review dated December 12, 2017 recognized the downstream flooding and requested that the applicant perform a downstream analysis considering the existing limitation at the twin 48"culverts at the high school. The RIDEM review request is based the *R.I Stormwater Design and Installation Standards Manual* that states when there is a known flooding problem, regardless of whether the peak runoff rates from the proposed development are decreased, a downstream analysis is still required. DiPrete response was that the drainage system, at the proposed hotel site, not only reduced the peak flow rates but also resulted in a decrease in flood volumes from pre to post conditions. This did not represent a valid response to RIDEM request (DiPrete response dated January 23, 2018 p.3).

  Since the previous response to RIDEM request for a downstream analysis was inadequate. A RIDEM review on March 12, 2018, Item 2 requested the downstream analysis and even suggested that "a downstream analysis would be to revise the existing *Silver Creek Drainage Study.* DiPrete response was that there is no increase in peak runoff, however in order to verify that peaks do not create flood rate, "we completed a rough drainage analysis....**not having the raw watershed data from Beta study**..." (DiPrete response dated April 10, 2018 p.2).

  Again, on July 12, 2022, RIDEM requested on Engineering Review Comments No. 11 that you (the Applicant) submitted analysis indicates pre and post project drainage diagrams of flows to Bristol Harbor. No analysis was provided. DiPrete response was that they completed a rough drainage analysis for Silver Creek (using the wrong methodology) **because "not having the raw watershed data from the Beta Study"** (DiPrete response dated January 4, 2023.

  RIDEM complete their review on June 30, 2023 concluding that" the designer has addressed potential downstream flooding concerns by indicating that the submitted analysis shows that the total runoff volume of runoff to the receiving wetlands will be decreased in 1, 10, and 100-year 24 hour Type III storm events". This is not consistent with RIDEM regulations concerning the requirement for a Downstream Analysis if it there is a decrease in the peak runoff rates from the proposed development.

Conclusion A Downstream Analysis should be completed. It is my opinion, that after several RIDEM reviews of the Applicant's submittals and numerous requests to conduct the analysis, using the appropriate HEC-RAS method, RIDEM accepted a useless and erroneous assessment. RIDEM accepted the Applicant excuse of "Not having the raw watershed data from the BETA study, we model the following parameters. It is curious why RIDEM ignored their own requirements and accepted such a useless assessment of the flooding issues.

WETLANDS ENGINEERING FINAL REVIEW

Date 1/04/2016 **Reviewer** Nicholas A Pisani, P E

Nicholas A. Pisani P.E.

Application Number

FWW#	15-0033
WQC#	
GWD/UIC#	001650
RIPDES#	RIR101247
OTHER	

Applicant Name KenDan, LLC

Project Name Proposed Hotel Facility

Plans and Analysis Reviewed Revised Plans and Reports received by DEM on 9/02/2015

Engineering Review conducted with Checklist rev date 2/20/2014

Recommended Action Several issues have been identified which need to be addressed These are

1 Please note that this reviewer was made aware of an oversight in the designer's pre-project time of concentration value The use of the default 6 minute time of concentration value is unacceptable, given the length of the anticipated time of concentration flow path The use of a site specific time of concentration analysis results in smaller existing condition peak runoff discharge rates in the events modeled, such as the 10-year and 100-year 24-hour Type III rainfall events By using a smaller existing condition peak flow for comparison with proposed condition peak flows, the design has utilized a smaller volume of detention storage than what would otherwise be needed This reviewer therefore considers that additional detention storage volume would be needed to properly mitigate against any increases in peak runoff discharge rates to the immediate receiving wetland area If any permit is issued additional detention storage will need to be incorporated into the design so as to avoid any increases in peak runoff discharge rates from the site in the 10 and 100-year 24-hour Type III rainfall events

2 The submitted downstream analysis will need to be modified so as to utilize the updated rainfall depths associated with the 10- and 100-year storm events that are found in the 2010 Rhode Island Stormwater Design and Installation Standards Manual (2010 RISDISM) These rainfall depths are 4 9" for the 10-year 24-hour Type III event and 8 6" for the 100-year 24-hour Type III event

3 The downstream analysis will need to be extended downstream at least to take into account the twin 48" culvert located at the Mount Hope High School This is considered to be necessary because this represents the first major constriction point in the stream / river proceeding downstream from the subject site The applicant may wish to consider the possible effects of any bypass / weir flow which may exist around the culvert in the area located to the west of the school The relatively low grades in this area may tend to allow some component of large storm events to bypass around the culverts It is unclear as to whether or not such bypass flow was taken into account in the Silver Creek Drainage Study dated November 2007 by Beta Engineers-Scientists Please note that is evaluating any such overland bypass flow, be mindful of the fact that the Town of Bristol has a RI

DEM approval for some proposed grading in that area, as part of proposed athletic field improvements See RI DEM / Freshwater Wetlands Program File 10-0119)

4 In order to avoid any questions of any potential discrepancies in floodplain elevations owing to any differences in datum planes used, please address the elevation datum used on the site plan, in the Silver Creek Drainage Study, and on the latest FEMA Flood Insurance Rate Map for the site If different data are used, please provide a conversion to a common datum

5 The site plan needs to clearly depict the proposed connection to sanitary sewer line This connection will need to avoid and minimize any impacts to wetland areas to the maximum extent practicable

STORMWATER ENGINEERING REVIEW
REQUEST FOR ADDITIONAL INFORMATION

Item C1.

Date 12/12/2017 **Reviewer** Nicholas A Pisani, P E Nicholas A. Pisani P.E

Application Number

FWW#	15-0033
WQC#	
GWD/UIC#	001650
RIPDES#	RIR101247
OTHER	

Applicant Name KenDan, LLC

Project Name Gooding Avenue Development

Plans and Analysis Reviewed Plans and Reports received by DEM on 11/06/2017

Engineering Review conducted with Checklist rev date **2/20/2014**

Interim Review Findings

1) **Drainage Issues-** See comments below
2) **Floodplain Issues-** The site of the proposed work is located inland of the 100-year floodplain

Interim Technical Justification If the site plans for the proposed development include a BMP that does not fully comply with all the applicable design requirements of the RISDISM, then please note below

1) The design of the proposed underground infiltration practice will meet the 50' minimum setback to waters of the state assuming permission is granted to fill the area of wetland between A7 and A13, as depicted on the proposed grading plan

Review Comments

(1) The submitted analysis of the 1 2" storm event models the Isolator Row-TM as a separate storage and infiltration practice However, the submitted analysis ignores this Isolator Row-TM bypass and the Isolator Rows-TM Please include the Isolator Row-TM and the Isolator Row-TM by pass in the modeling of the 1, 10, and 100-yr larger storm events

(2) With respect to the proposed Qp / WQ ByPass structure, the submitted analysis indicates that the 18" outlet pipe to the detention practice will have an invert of 73 50', but the submitted plan shows this pipe at an invert of 73 0' Please revise the plans and/or analysis to ensure consistency on this matter

(3) The submitted channel protection volume analysis needs to also include the one-year flow from proposed Subcatchment 107 Please note that the one year discharge to the wetland includes the 0 11 cfs from proposed Pond 106 UDS plus the secondary / bypass discharge of 0 51 cfs from the proposed Pond 108 Forebay to the proposed sand filter This flow totals about 0 62 cfs, ignoring any time of peak differences Please revise the design to provide the required channel protection volume storage to attain a total peak one-year event release rate of 0 19 cfs or less from the total collected drainage that is being discharged to the wetland (This is calculated as follows total volume in one year storm equals 0 250 + 0 037 = 0 287 acft, from subcatchments 101 and 107, respectively This equals 12,502

cf Multiplying by the required 0 65 factor gives a total of 8126 cf Multiplying by 24 x 60 x 60 gives an average release rate over 24 hours of 0 094 cfs Doubling this amount to provides an approximate peak one -year release rate of 0 188 cfs, which round to 0 19 cfs)

(4) With respect to pre-development Subcatchment 10, please address whether the Tc flow path represents the path from the most hydraulically distant point in the subwatershed Please note that there are more distant areas to the west of the point chosen If a change is needed, please submit a revised analysis and a revised detention design if needed

(5) Please provide a narrative and a drainage diagram to accompany the submitted "Drainage network Hydraulic Calculations" The diagram needs to label each catch basin and manhole in a manner which will allow them to be identified on the submitted utilities plan Also, the in submitted "Drainage Network Hydraulic Calculations", the "Inlet Report" indicates that the pipe system uses the 100-year storm event Please confirm that the "Pipes" analysis table is also based on the 100-year storm event Please confirm that all runoff in the 100-year storm event will enter the proposed drainage system without bypass to the adjacent wetland area

(6) This office is aware of downstream flooding issues along the receiving watercourse One of the most significant concerns is at the Mount Hope High School located downstream of the site Section 3 3 6 of the Rhode Island Stormwater Design and Installation Standards Manual (RISDISM) states that a downstream analysis is required " when deemed appropriate by the approving agency when existing conditions are already causing a problem (e g , known drainage or flooding conditions or existing channel erosion is evident), to determine whether peak flow impacts are fully attenuated by controlling the 10- and 100-year events" The known drainage or flooding conditions are evidenced in the Silver Creek Drainage Study, Bristol, RI dated November 2007 by Beta Engineers-Scientists Therefore, as per Section 3 3 6 of the RISDISM, please provide a downstream analysis On page 11 of Silver Creek Drainage Study, Bristol, RI, it indicates that there is an existing limitation at the twin 48" culverts at the high school (Mount Hope High School) Please ensure that the downstream analysis extends at least to a point downstream of the twin 48" culverts at Mount Hope High School

(7) Please address any potential tailwater conditions in the 100-year storm event that may exist at each of the proposed outlets, including the pipe outfall and the weir outlet from the proposed sediment forebay Please note that the floodplain elevations in the FEMA Study and in the Silver Creek Drainage Study may be exceeded because neither study appears to use the latest available 100-year rainfall data

(8) Please add appropriate long-term pollution prevention items to the long-term Operation and Maintenance Plan

DiPrete Engineering

January 23, 2018

Nicholas A Pisani, P E
Office of Water Resources
235 Promenade Street
Providence, RI 02908-5767

Environmental Management
JAN 25 2018
Office of Water Resources

RE Gooding Avenue Department
Bristol, Rhode Island
FWW Application No 15-0033
Project # 2536 001

Response to Dec. 2017

Dear Mr Pisani

We respectfully resubmit the attached revised materials for DEM Office of Water Resources review and approval The plans and design intent have been modified to address the comment provided by RIDEM in the original denial letter The area of biological wetlands alternation has been reduced from 5,200 sq ft to approximately 4,700 sq ft, and the total perimeter wetlands alteration has been reduced from 61,215 sq ft to approximately 44,750 sq ft Additionally, the area of tree clearing and buffer impacts has been reduced significantly to contain disturbance to the northwest portion of the parcel and ensure the functions and values of the wetland are not impacted

DiPrete Engineering has received your comments dated December 12, 2017 We have reviewed these comments and offer the following in response The original comments are provided in italics with responses in bold

Review Comments

1 *The submitted analysis of the 1 2" storm event models the Isolator Row-TM as a separate storage and infiltration practice However, the submitted analysisignores this Isolator Row-TM bypass and the Isolator Rows-TM Please include the Isolator Row-TM and the Isolator Row-TM by pass in the modeling of the 1, 10, and 100-yr larger storm events*

The Isolator Row has now been shown in the model for all storm events Please refer to the revised HydroCad printouts in the Stormwater Report

2 *With respect to the proposed Qp / WQ ByPass structure, the submitted analysis indicates that the 18" outlet pipe to the detention practice will have an invert of 73 50', but the submitted plan shows this pipe at an invert of 73 0' Pleaserevise the plans and/or analysis to ensure consistency on this matter*

As part of the revised design for optimizing WQ flow, channel protection and isolator bypass, we made minor revisions to the UIS-A/UDS-A model The invert for the 18" outlet pipe for the proposed Qp/WQ ByPass structure is now 72 50 and labeled identically within the HydroCad analysis and Underground System details

3 *The submitted channel protection volume analysis needs to also include the one- year flow from proposed Subcatchment 107 Please note that the one year discharge to the wetland includes the 0 11 cfs from proposed Pond 106 UDS*

plus the secondary/ bypass discharge of 0 51 cfs from the proposed Pond 108 Forebay to the proposed sand filter This flow totals about 0 62 cfs, ignoring any time of peak differences Please revise the design to provide the required channel protection volume storage to attain a total peak one-year event release rate of0 19 cfs or less from the total collected drainage that is being discharged to the wetland (This is calculated as follows total volume in one year storm equals 0 250 + 0 037= 0 287 acft, from subcatchments 101 and 107, respectively This equals 12,502 cf Multiplying by the required 0 65 factor gives a total of 8126 cf Multiplying by 24 x 60 x 60 gives an average release rate over 24 hours of 0 094 cfs Doubling this amount to provides an approximate peak one -year release rate of 0 188cfs, which round to 0 19 cfs)

In combination with modifying the drainage system to address downstream flooding concerns (see response #6), the design has been modified to optimize the release rate for the 1-year storm event to arrive at a maximum of 0 19 cfs in the updated HydroCad model This was done for each contributing subcatchment by

1) Designing UIS-A with a larger footprint in order to infiltrate greater than the 1 2" storm event and minimizing flow reaching UDS-A for the 1-year storm event The UDS was able to be designed with a smaller WQ orifice and a smaller WQ flow
2) Adding an underground storage component (UDS-B) connected to the eastern Sand Filter Stormwater will flow into UDS-B through four 6" pipe openings in the retaining wall which connect to the UDS manifold The pipe openings will be protected from clogging by trash racks as detailed on Sheet 8

With these modifications, the revised 1-year storm peak flow combining the Forebay and UDS-A outflows is 0 02 cfs (UDS-A) + 0 17 cfs (Sediment Forebay Secondary Flow) = 0 19 cfs

4 *With respect to pre-development Subcatchment 10, please address whether the Tc flow path represents the path from the most hydraulically distant point in the subwatershed Please note that there are more distant areas to the west of the point chosen If a change is needed, please submit a revised analysis and a revised detention design if needed*

While the origin of the Tc flow path could have been modeled from a lengthier location, the flow path used for modeling pre-development Subcatchment 10 resulted in a longer time of concentration and was therefore the more conservative and ***hydraulically distant*** option for the purposes of post-development peak flow comparison We have included a map and summary of the alternate time of concentration for a separate path upgradient of the driveways The most distant point results in a sheet flow short of 100' (the flow path hits the first driveway at 57' from the high point) and the ground cover does not take advantage of a section of woods sheet flow as the original 1B-1C segment does

In summary, the alternate lengthier flow path of 1A-Alt to 1D-Alt will take a total of 14 1 minutes, or 0 5 minutes less than the originally chosen 1A-1E flow path

Note that if we start from the backyard, the sheet flow is also fully in grassed areas and the overall length of flow path is substantially reduced by reaching the southern subcatchment line quickly

5 *Please provide a narrative and a drainage diagram to accompany the submitted "Drainage network Hydraulic Calculations" The diagram needs to label each catch basin and manhole in a manner which will allow them to be identified on the submitted utilities plan Also, in the submitted "Drainage Network Hydraulic Calculations", the "Inlet Report" indicates that the pipe system uses the 100 year storm event Please confirm that the "Pipes" analysis table is also based on the 100-year storm event Please confirm that all runoff in the 100 year storm event will enter the proposed drainage system without bypass to the adjacent wetland area*

The proposed drainage capacity spreadsheets were originally placed in Appendix A3 4 2 which was not fully referenced from the accompanying narrative in Section 3 4 1 We have revised the report layout to include and reference the tables directly after this aforementioned section Also, a statement has been added to the end of Section 3 4 1 to confirm the drainage system will fully handle the 100-year storm flow without bypass

The "Line ID" numbers correlate to the structure numbers shown on the Utility Plan For example, Inlet Report Line No 1 with Inlet ID of 6 refers to CB-6 located in the south central portion of the parking area And Pipes Line No 1 for Line ID 6-7 refers to the 18" HDPE pipe segment located between CB 6 and 6' diameter DMH-7

6 *This office is aware of downstream flooding issues along the receiving watercourse One of the most significant concerns is at the Mount Hope High School located downstream of the site Section 3 3 6 of the Rhode Island Stormwater Design and Installation Standards Manual (RISDISM) states that a downstream analysis is required " when deemed appropriate by the approving agency when existing conditions are already causing a problem (e g , known drainage or flooding conditions or existing channel erosion is evident), to determine whether peak flow impacts are fully attenuated by controlling the 10- and 100 year events" The known drainage or flooding conditions are evidenced in the Silver Creek Drainage Study, Bristol RI dated November 2007 by Beta Engineers-Scientists Therefore, as per Section 3 3 6 of the RISDISM, please provide a downstream analysis On page 11 of Silver Creek Drainage Study, Bristol RI, it indicates that there is an existing limitation at the twin 48" culverts at the high school (Mount Hope High School) Please ensure that the downstream analysis extends at least to a point downstream of the twin 48" culverts at Mount Hope High School*

The applicant has revised the drainage system to not only reduce peak flow rates, but also results in a decrease in flow volume from pre to post-development conditions Therefore, there will be no change or slightly improved flood conditions due to this development See Section 3 5 6 for the pre to post-development volume summary

7 *Please address any potential tailwater conditions in the 100 year storm eventthat may exist at each of the proposed outlets, including the pipe outfall and the weir outlet from the proposed sediment forebay Please note that the floodplain elevations in the FEMA Study and in the Silver Creek Drainage Study may be exceeded because neither study appears to use the latest available 100 year rainfall data*

Based on the Silver Creek Drainage Study, the 100 year storm event tailwater behind the existing High School culverts extending past the subject site is elevation 67 0 Based on reviewing the downstream area and from online topographic information, it appears there

would be outlets at a lower elevation for the water to bypass the culverts to the downstream water body prior to reaching an elevation well above the low point of Gooding Avenue

That said, for the purposes of reviewing tailwater conditions, we conservatively estimated an additional 3' of floodwater to an elevation of 70 0 to account for the increase in 100-year storm events between the original analysis and the new Stormwater Regulations

As shown in Appendix A3 5 4 6 of the Stormwater Report, we modeled a Reach approximating the section of Silver Creek adjacent to the subject site As detailed in the previous Drainage Study, we modeled a 2,100'+/- reach with a starting bottom elevation of 59 and end elevation of 56, for a slope of 0 14% We estimated the side slopes of the stream, and set both the depth of reach and depth of constant flow at 11' to set a consistent water elevation of 70 0 Subcatchment 100, Pond 106 (UDS-A) and Pond 108 (Forebay) were connected to this reach to determine any impacts due to tailwater

As shown in our analysis, the tailwater will not negatively impact the drainage system and no flooding will result The minimum finish grade within the building, driveways and parking area portion of the site is proposed to be approximately 71 at the eastern-most curb cut along Gooding Avenue

8 *Please add appropriate long-term pollution prevention items to the long term Operation and Maintenance Plan*

The Operation and Maintenance Plan has been reviewed and a few notes added to ensure all items are covered

Please feel free to contact me if you have any further questions regarding this matter

Sincerely,
DiPrete Engineering Associates, Inc

Kevin DeMers, PE
Senior Project Engineer

cc *Kendan, LLC*
Jane Kelly, DEM OWR

DiPrete Engineering

April 10, 2018
Revised May 11, 2018

Nicholas A. Pisani, P.E.
Office of Water Resources
235 Promenade Street
Providence, RI 02908-5767

Environmental Management
MAY 14 2018
Office of Water Resources

RE: **Gooding Avenue Department**
Bristol, Rhode Island
FWW Application No. 15-0033
Project #: 2536-001

Dear Mr. Pisani:

DiPrete Engineering (DE) has received your comments dated 3/12/2018. We have reviewed these comments as well as the guidance and clarification from our meeting on 3/20/2018 and offer the following in response. The original comments are provided in italics with responses in bold.

Review Comments:

1. *The latest revision states that the proposed total runoff volume will not be increased in the 100-year event by utilization of infiltration. The concerned party has raised concern that the soil at the site may be able to accept this larger runoff volume. Therefore, as per RISDISM Section 5.3.1 b7, the design be revised to demonstrate a minimum 4' separation to the seasonal high groundwater table (SHGWT) from the proposed bottom of stone of proposed infiltration practice. Also, the designer should submit a groundwater mounding analysis to attempt to demonstrate that none of the infiltrated runoff volume will break out to the ground surface in storm events up to and including the 100-year event. This should also consider the possible outflow through any proposed weep holes in the proposed retaining wall to be located between the proposed underground infiltration practice and the receiving wetland.*

   The proposed infiltration practices are proposed as recharge (Rev) for the water quality volume (WQv) only. Channel Protection Volume (CPv) and Overbank Flood Protection (Qp) are both managed by an underground detention system (UDS). As per the RISDISM Section 7.4.1, a groundwater mounding analysis shall be done if the infiltration practice is designed for a *10-year storm event or greater*.

   To determine the likely location of breakout to the surface on the east/wetlands side of the development, DE reviewed the horizontal hydraulic conductivity. Based on a guidance document, *"Representative hydraulic conductivities in saturated groundwater flow", authors Xavier Sanchez-Villa, Alberto Guadagnini, and Jesus Carrera, published 23 September 2006*, the horizontal hydraulic conductivity may be estimated as approximately an order of magnitude (10 times) higher than the vertical conductivity. In order to perform the most conservative calculation, rather than use the RISDISM book value of 0.52 inches per hour the maximum value of the USDA.gov published range of 0.6-2 in/hr was used to arrive at a more conservative horizontal conductivity of 2 in/hr x 10 = 20 inches per hour. This will result in a rise:run gradient of 0.52 inches per hour / 20 inches per hour = 0.026 vertical feet per horizontal foot (2.6% slope).

   On the eastern side of the UIS, the applicant proposes an impermeable line to elevation 68.0 to eliminate sidewall infiltration and promote vertical flow of infiltrated stormwater. At the bottom

of impermeable barrier, the infiltrated column of water can be modeled to travel a 1 run 0 026 drop slope at 20 inches (1 67 feet) per hour in the horizontal direction The proposed distance of the retaining wall from the eastern edge of UIS is 32 feet As per the attached analysis, the time when the first infiltrated stormwater reaches the subsoil is at Hour 5 4

The first flush of infiltrated stormwater will reach the wall at time
5 4 hours + (50'/(1 67'/hr)) = 35 3 hours into the storm

The elevation of infiltrated stormwater at this point assuming unsaturated conditions is 68-(0 026 x 50 0) = Elevation 66 7 More likely, this infiltrated flow will join the gradient of saturated soil as it approaches the new wetlands line east of proposed retaining wall In any case, the infiltrated stormwater will be at or below the bottom ground surface of 67 8 at the base of wall

2 *If the increase in total runoff volume being discharged to the receiving wetland, then the designer should provide a downstream analysis Please note that one option in the preparation of such a downstream analysis would be to revise the existing Silver Creek Drainage Study, Bristol, RI (Beta Engineers-Scientists, 2007) to use the updated rainfall amounts and the existing and proposed conditions at the subject site*

There is no increase in total runoff volume discharged to the receiving wetland As shown above, the infiltration's daylighting within the new wetland edge will not begin until hour 35 8 at the earliest, and the sum from the two "discarded" flows from the UIS and Isolator Row is 0 13 cfs Even if directly adding in the infiltrated runoff back into the total volume reaching the proposed design point, the volume goes from 1 402 acre-feet for existing conditions to 1 058 (surface) + (1 7 hours x 3600 seconds x 0 13 cfs)/43,560 (infiltrated) = 1 076 acre-feet for proposed conditions at Hour 24 of the 100-year storm event

However, in order to verify that peaks do not combine to create a greater flow rate or volume from pre to post-development conditions, DE completed a rough drainage analysis for Silver Creek Not having the raw watershed data from the BETA study, we modeled the following parameters

Leading to onsite Wetland Design Point
Area = 352 93
Ground cover was broken into grassland, woods, 1/3 acre residential, and urban industrial uses based on aerial mapping
Majority C soils were observed on the USDA mapping and therefore C soils were entirely used for the HydroCad ground covers
Time of concentration = 42 7 minutes using slopes based on USGS topography

Downstream of onsite Wetland Design Point
Area = 897 07
Ground cover was broken into grassland, woods, 1/3 acre residential, and urban industrial uses based on aerial mapping
Majority C soils were observed on the USDA mapping and therefore C soils were entirely used for the HydroCad ground covers
Time of concentration = 57 8 minutes using slopes based on USGS topography

Modified Reach 11/111
Modified from summation point only to V channel reach
Length of channel to Bristol Harbor based on USGS = 7,022 feet and Slope = 0 0078'/'

Used 5' depth and approximate side slopes based on segment of stream through subject site Assumed Manning's n of 0 035 (earth, dense weeks)

The resulting runoff is not meant to be an accurate output for the Silver Creek watershed, only a representation of the overall watershed for the purposes of determining the development's effect on watershed flows
As shown on the attached supplemental HydroCad analysis, the resulting flows/volumes at the onsite and Bristol Harbor reaches are as follows

Subwatershed (design point)	100-yr Peak Flow (cfs)		100-yr Peak Volume (ac-ft)	
	Pre	Post	Pre	Post
DP-11/111 (Onsite DP)	1,270	1,266	194 10	193 86
DP-12/112 (Proposed DP)	3,555	3,551	656 81	656 55

Therefore we have confirmed there will be no adverse impacts on the overall Silver Creek watershed due to the proposed development

3 *Please also provide a calculation of the time from discharge of drainage into the groundwater to discharge to surface waters from the infiltration practices at the site Please clearly demonstrate that this flow component will not add to the surface component in a manner which would need to be considered in the surface water hydrograph analysis*

As described in response #1, the earliest estimated arrival of infiltrated runoff to the existing ground within the new wetlands edge (east of the retaining wall) will occur at 35 3 hours into the storm event Based on the proposed hydrograph for the upgradient watershed, the flow at that time will be roughly 1% or less of the peak flow occurring at 12 57 hours

Also as calculated in #2, even if the sum of infiltrated volume was directly added to the surface runoff, there will be a substantial decrease in water from the site reaching the Creek from pre to post development conditions at Hour 24 of the 100-year storm event

4 *Please provide a comparison of the existing condition hydrograph and the proposed condition hydrograph Please address whether there will be an increase in either the peak of any of the proposed condition hydrographs or whether there will be any change in the time of he peak of the proposed condition hydrograph Please perform this task for the 1, 10, and 100 year 24 hour Type III storm events*

A comparison of pre to post-development for each of the 1, 10 and 100-year storm events is provided For each of the 1 and 10-year storm events, the proposed hydrograph stays entirely under the proposed hydrograph as flows approach zero around Hour 24 of the respective storm events During the 100-year storm event, the proposed hydrograph stays entirely under the existing conditions hydrograph until approximately Hour 16 5, when both the existing and proposed flows are roughly 0 5 cfs As shown on the 100-year hydrograph table for the overall Silver Creek watershed to the site Design Point, the flow within the stream is approximately 8% of the peak flow occurring at 12 57 hours Therefore this minimal increase in peak flow between Hours 16 5 to 24 will not impact the overall flood issues of Silver Creek

Also of note is the proposed 100-year storm outflow to the wetland Design Point will reduce to below 0 29 cfs between Hour 24 and 25, which is the allowable channel protection release rate for the 1-year storm event

5 *The proposed underground infiltration practice UIS-A does not maintain the minimum standard 50' to waters of the state (the adjacent wetland to the east, just in front of the proposed retaining wall, in vicinity of Wetland Flag #13) Please provide a written technical justification for this design addressing any potential water quality issues*

The closed drainage system and UDS geometry have been revised in order to enable a shift of the UIS to a location 50' from the nearest wetland areas under proposed conditions The existing grades at each corner are shown for reference to confirm the average seasonal high groundwater table (SHGWT) does not change from what was previously provided The average groundwater will be 72 5 (average existing grade) – 2 5 (TP groundwater depth) = 70 0 Therefore no elevation changes need to be made to UIS A or connected UDS-A

DE respectfully encloses the revised plans for your review and approval The reports remain unchanged since the previous copies were submitted on 1/23/2018 (Soil Erosion & Sediment Control Reports and Operations and Maintenance Plans) and 4/11/2018 (Stormwater Management Reports), respectively Note that the response to comments letter submitted digitally dated March 9, 2018 is also attached for your use

Please feel free to contact me if you have any further questions regarding this matter, or if further copies are needed

Sincerely,
DiPrete Engineering Associates, Inc

Kevin DeMers, PE
Senior Project Engineer

cc *Kendan, LLC*
Jane Kelly, DEM OWR

DEPARTMENT OF ENVIRONMENTAL MANAGEME

OFFICE OF WATER RESOURCES

STORMWATER ENGINEERING REVIEW
REQUEST FOR ADDITIONAL INFORMATION

STW/WQC File copy

Date: 7/12/2022

Reviewer: Nicholas A. Pisani, P.E.

Nicholas A. Pisani P.E.

Application Number:

FWW#:	22-0264
WQC#:	22-114
GWD/UIC#:	UIC 001650
RIPDES#:	RIR101247
OTHER:	_____

Applicant Name: KenDan, LLC

Project Name: Gooding Avenue Development

Plans and Analysis Reviewed: Plans and Reports received by DEM on 6/27/2022.

Engineering Review conducted with Checklist rev. date: **2/20/2014.**

Interim Review Findings:

1) **Drainage Issues-** See comments below.
2) **Floodplain Issues-** The site of the proposed work is not located within a 100-year floodplain.

Interim Technical Justification: If the site plans for the proposed development include a BMP that does not fully comply with all the applicable design requirements of the RIDEM Stormwater Management Design and Installation Rules (250-RICR-150-10-8), then please note below:

1) NA

Review Comments:

(1) In Appendix A Please provide a waterbody name for the ultimate receiving waterbody. Please note that in Appendix A Table 4.1 Silver Creek is appropriately indicated.

(2) In Appendix A, with respect to the entry for the required recharge value, please provide a supporting calculation. Please note that the soils present are C and D hydrologic groups. Therefore an apportioning analysis is appropriate. In any case the recharge provide is sufficient.

(3) With respect to the proposed sand filter, the table on Sheet 9 indicates a bottom of pond elevation of 69.0'. However, the lowest contour on the submitted site plan for this sand filter shows a 68.0 contour at its bottom. Please revise the plan to provide consistency on this item.

(4) Please indicate the invert and diameter of the four (4) pipes from the sand filter to the proposed Underground Detention System B.

(5) With respect to proposed Underground Detention System B, the submitted analysis indicates the length of pipes to be 85'. However the length represented on the detail site plan on Sheet 9 appears to only be 78'. Therefore, please revise the plans and/or the analysis to provide consistency on this item.

(6) With respect to the proposed Pond 104: UIS (Isolator Row) please revise the detail of the proposed Isolator Rows-TM so as to provide an adequate access structure and adequate diameter of inlet pipe to allow for the efficient "hydro-jetting of sediments and vactoring (vacuuming)" as indicated in the submitted long-term operation and maintenance plan. The arrangement as is proposed, and the small diameter of inlet pipes proposed present concerns as to how the required maintenance will be successfully performed.

(7) With respect to proposed Pond 104: UIS A (Isolator Row) the submitted analysis indicates a 6" diameter outlet at invert elevation of 74.0' Please direct the reviewer to where on the plan this outlet is located.

(8) With respect to proposed large Underground Detention System, the submitted analysis indicates the length of the 13 interior pipes to be 75'. However the length represented on the detail site plan on Sheet 9 appears to only be 67'. Therefore, please revise the plans and/or the analysis to provide consistency on this item.

(9) With respect to proposed Pond 104 UIS A (Isolator Row) and Pond 105 (UIS A) please revise their labels to indicate that they contain underground sand filter layers and as such are considered as sand filters.

(10) Please revise the submitted "Written Narrative in Support of an Application to Alter a Freshwater Wetland for a Hotel Development, A.P. 111, Lot 1; Gooding Avenue, Bristol, Rhode Island". Please note that this document contains more than one instance of information that is not accurate with respect to the current submittal, including incorrect plan preparer information and incorrect proposed stormwater practice.

(11) With respect to the submitted analysis, the submitted drainage diagram indicates pre- and post- project drainage diagrams of flows to Bristol Harbor (Reaches 12 pre-project and Reach 112 post-project). However, no supporting analysis has been provided. Please provide this supporting

analysis.

(12) The submittal indicates that proposed total runoff volume will not be increased in the 100-year year event by utilization of infiltration. Please provide a groundwater mounding analysis to attempt to demonstrate that none of the infiltrated runoff volume will break out to the ground surface in storm events up to and including the 100-year event. This should also consider the possible outflow through any proposed weep holes in the proposed retaining wall to be located between the proposed underground infiltration practice and the receiving wetland. This should also consider the possible outflow through any proposed weep holes in the proposed retaining wall to be located between the proposed underground infiltration practice and the receiving wetland.

(13) Please also provide a calculation of the time from discharge of drainage into the groundwater to discharge to surface waters from the infiltration practices at the site. Please clearly demonstrate that this flow component will not add to the surface component in a manner which would need to be considered in the surface water hydrograph analysis. Please provide a comparison of hydrographs to demonstrate that the volume being discharged from the site over time will not increase the discharge to the river in comparison with the existing condition hydrograph discharge from the site.

(14) Please provide a comparison of the existing condition hydrograph and the proposed condition hydrograph. Please address whether there will be an increase in either the peak of any of the proposed condition hydrographs or whether there will be any change in the time of the peak of the proposed condition hydrograph. Please perform this task for the 1, 10, and 100-year 24-hour Type III storm events.

(15) Please also provide a calculation of the time from discharge of drainage into the groundwater to discharge to surface waters from the infiltration practices at the site. Please clearly demonstrate that this flow component will not add to the surface component in a manner which would need to be considered in the surface water hydrograph analysis.

DiPrete Engineering

January 4, 2023

Martin D. Wencek, Supervisor
RIDEM Office of Water Resources
Freshwater Wetlands Program
235 Promenade Street
Providence, RI 02908-5767

STW/WGC No.
22-114

RE: **Gooding Avenue Department**
Bristol, Rhode Island
FWW Application No. 22-0264
Owner: KenDan, LLC
Project #: 2536-001

Dear Mr. Wencek:

DiPrete Engineering (DE) has received your comments dated August 1, 2022. We have reviewed these comments and offer the following in response. The original comments are provided in italics with responses in bold.

Biological Review Comments:

1. *Please revise the site plans to depict a permanent buffer marker along the Limit of Disturbance (LOD) approximately 32 feet north of wetland flag A2, as shown on the previously approved plans dated August 22, 2018.*

   Awaiting copy of previously approved plans from Kev D.

2. *Please label the wetland as a "Swamp" on the site plans, as shown on the previously approved plans dated August 22, 2018.*

   Awaiting copy of previously approved plans from Kev D.

3. *Please note that the submitted "Written Narrative in Support of an Application to Alter a Freshwater Wetland for a Hotel Development, A.P. 111, Lot 1; Gooding Avenue, Bristol, Rhode Island", states that 5,000 square feet of alterations to swamp and 61,215 square feet of alterations to the 50-foot perimeter wetland are proposed. However, the application form states that approximately 4,717 square feet of swamp and approximately 45,200 square feet of the 50-foot perimeter wetland would be altered by your project. Please update the written narrative.* ***See comment 10 under Engineering Review Comments.***

   The narrative has been updated for consistency with the application form (see copies of report Revised December 22, 2022.

4. *Please provide an updated abutter's map drawn to scale of not less than one inch to one hundred feet (1" = 100') showing the properties, lot numbers, and corresponding owners within a radius of two hundred feet (200') of the outermost boundary of the area of the proposed wetland alteration(s) as required per Rule 250-RICR-150-15-1.10(B)(2)(e). Please provide an updated list of the current property owners whose properties lie within two hundred feet (200') of the outermost boundary of the area of the proposed wetland alteration(s).*

   An updated 200' radius abutters map and list has been provided.

Engineering Review Comments:

1. *In Appendix A Please provide a waterbody name for the ultimate receiving waterbody. Please note that in Appendix A Table 4.1 Silver Creek is appropriately indicated.*

   Silver Creek (RI0007026R-01) has been added to Appendix A as the ultimate receiving waterbody.

2. *In Appendix A, with respect to the entry for the required recharge value, please provide a supporting calculation. Please note that the soils present are C and D hydrologic groups. Therefore an apportioning analysis is appropriate. In any case the recharge provide is sufficient.*

   A calculation has been included in Table 2-1 of Appendix A. Note that the onsite impervious area is located entirely on soils in the D hydrologic group.

3. *With respect to the proposed sand filter, the table on sheet 9 indicates a bottom of pond elevation of 69.0'. However, the lowest contour on the submitted site plan for this sand filter shows a 68.0 contour at its bottom. Please revise the plan to provide consistency on this item.*

   The plan view has been revised to show the correct bottom of sand filter contour of 69.

4. *Please indicate the invert and diameter of the four (4) pipes from the sand filter to the proposed Underground Detention System B.*

   The invert and diameter of the four (4) pipes from the sand filter to the proposed Underground Detention System B have been shown on Sheet 9.

5. *With respect to the Underground Detention System B, the submitted analysis indicates the length of pipes to be 85'. However, the length represented on the detail site plan on Sheet 9 appears to only be 78'. Therefore, please revise the plans and/or the analysis to provide consistency on this item.*

   The detail site plan on Sheet 9 has been revised to be consistent with the submitted analysis indicated length of 85'.

6. *With respect to the proposed Pond 104: UIS (Isolator Row) please revise the detail of the proposed Isolator Rows-TM so as to provide an adequate access structure and adequate diameter of inlet pipe to allow for the efficient "hydro-jetting of sediments and vactoring (vacuuming)" as indicated in the submitted long-term operation and maintenance plan. The arrangement as is proposed, and the small diameter of inlet pipes proposed present concerns as to how the required maintenance will be sufficiently performed.*

   The proposed Pond 104: UIS (Isolator Row) and related details have been updated on Sheet 8 and Sheet 9.

7. *With respect to Pond 104: UIS-A (Isolator Row) the submitted analysis indicates a 6" diameter outlet at invert elevation 74.0'. Please direct the reviewer to where on the plan this outlet is located.*

   Based on new updates and revisions, we no longer need the 6" outlet connection and have removed it from the plans and the analysis.

8. *With respect to proposed large Underground Detention System, the submitted analysis indicates the length of the 13 interior pipes to be 75'. However, the length represented on the detail site plan on Sheet 9 appears to only be 67'. Therefore, please revise the plans and/or the analysis to provide consistency on this item.*

   The length of the interior pipes, for the large Underground Detention System shown on Sheet 9, has been revised to 75' to be consistent with the analysis.

9. *With respect to proposed Pond 104 UIS A (Isolator Row) and Pond 105 (UIS A) please revise their labels to indicate that they contain underground sand filter layers and as such are considered as sand filters.*

   The labels have been revised in the analysis and the plan set.

10. *Please revise the submitted "Written Narrative in Support of an Application to Alter a Freshwater Wetland for a Hotel Development, A.P. 111, Lot 1; Gooding Avenue, Bristol, Rhode Island". Please note that this document contains more than one instance of information that is not accurate with respect to the current submittal, including incorrect plan preparer information and incorrect stormwater practice.*

    The narrative has been updated for consistency with the application form (see copies of report Revised December 22, 2022.

11. *With respect to the submitted analysis, the submitted drainage diagram indicates pre- and post-drainage diagrams of flows to Bristol Harbor (Reaches 12 pre-project and Reach 112 post-project). However, no supporting analysis has been provided. Please provide this supporting analysis.*

    The supporting analysis has been provided in the attached printouts. In order to verify that peaks do not combine to create a greater flow rate or volume from pre to post-development conditions, DE completed a rough drainage analysis for Silver Creek. Not having the raw watershed data from the BETA study, we modeled the following parameters:

    Leading to onsite Wetland Design Point:
    Area = 352.93
    Ground cover was broken into grassland, woods, 1/3 acre residential, and urban industrial uses based on aerial mapping.
    Majority C soils were observed on the USDA mapping and therefore C soils were entirely used for the HydroCad ground covers.
    Time of concentration = 42.7 minutes using slopes based on USGS topography.

    Downstream of onsite Wetland Design Point:
    Area = 897.07
    Ground cover was broken into grassland, woods, 1/3 acre residential, and urban industrial uses based on aerial mapping.
    Majority C soils were observed on the USDA mapping and therefore C soils were entirely used for the HydroCad ground covers.
    Time of concentration = 57.8 minutes using slopes based on USGS topography.

    Modified Reach 11/111:

Modified from summation point only to V channel reach.
Length of channel to Bristol Harbor based on USGS = 7,022 feet and Slope = 0.0078'/'.
Used 5' depth and approximate side slopes based on segment of stream through subject site.
Assumed Manning's n of 0.035 (earth, dense weeks).

The resulting runoff is not meant to be an accurate output for the Silver Creek watershed, only a representation of the overall watershed for the purposes of determining the development's effect on watershed flows.

As shown on the attached supplemental HydroCad analysis, the resulting flows/volumes at the onsite and Bristol Harbor reaches are as follows:

Subwatershed (design point)	100-yr Peak Flow (cfs)		100-yr Peak Volume (ac-ft)	
	Pre	Post	Pre	Post
DP-11/111 (Onsite DP):	1,270	1,266	194.10	193.86
DP-12/112 (Proposed DP):	3,555	3,551	656.81	656.57

Therefore we have confirmed there will be no adverse impacts on the overall Silver Creek watershed due to the proposed development.

12. *The submittal indicates that proposed total runoff volume will not be increased in the 100-year event by utilization of infiltration. Please provide a groundwater mounding analysis to attempt to demonstrate that none of the infiltrated runoff volume will break out to the ground surface in storm events up to and including the 100-year event. This should also consider the possible outflow through any proposed weep holes in the proposed retaining wall to be located between the proposed underground infiltration practice and the receiving wetland.*

To determine the likely location of breakout to the surface on the east/wetlands side of the development, DE reviewed the horizontal hydraulic conductivity. Based on a guidance document, *"Representative hydraulic conductivities in saturated groundwater flow", authors Xavier Sanchez-Villa, Alberto Guadagnini, and Jesus Carrera, published 23 September 2006,* the horizontal hydraulic conductivity may be estimated as approximately an order of magnitude (10 times) higher than the vertical conductivity. In order to perform the most conservative calculation, rather than use the RISDISM book value of 0.52 inches per hour the maximum value of the USDA.gov published range of 0.6-2 in/hr was used to arrive at a more conservative horizontal conductivity of 2 in/hr x 10 = 20 inches per hour. This will result in a rise:run gradient of 0.52 inches per hour / 20 inches per hour = 0.026 vertical feet per horizontal foot (2.6% slope).

On the eastern side of the UIS, the applicant proposes an impermeable liner to elevation 68.0 to eliminate sidewall infiltration and promote vertical flow of infiltrated stormwater. At the bottom of impermeable barrier, the infiltrated column of water can be modeled to travel a 1 run: 0.026 drop slope at 20 inches (1.67 feet) per hour in the horizontal direction. The proposed distance of the retaining wall from the eastern edge of UIS is 32 feet. As per the attached analysis, the time when the first infiltrated stormwater reaches the subsoil is at Hour 5.4.

The first flush of infiltrated stormwater will reach the wall at time:
5.4 hours + (50'/(1.67'/hr)) = 35.3 hours into the storm.

The elevation of infiltrated stormwater at this point assuming unsaturated conditions is 68-(0.026 x 50.0) = Elevation 66.7. More likely, this infiltrated flow will join the gradient of saturated soil as it approaches the new wetlands line east of proposed retaining wall. In any case, the infiltrated stormwater will be at or below the bottom ground surface of 67.8 at the base of wall.

13. *Please also provide a calculation of the time from discharge of drainage into the groundwater to discharge to surface waters from the infiltration practices at the site. Please clearly demonstrate that this flow component will not add to the surface component in a manner which would need to be considered in the surface water hydrograph analysis. Please provide a comparison of hydrographs to demonstrate that the volume being discharged from the site over time will not increase the discharge to the river in comparison with the existing condition hydrograph discharge from the site.*

    Response above also summarizes timeline of infiltrated stormwater flowing towards the wetland area. See attachment for hydrograph table detail of potential arrival of infiltrated stormwater to the edge of wetlands, as well as the point where the post-development hydrograph flow will surpass the pre-development hydrograph flow.

14. *Please provide a comparison of the existing condition hydrograph and the proposed condition hydrograph. Please address whether there will be an increase in either the peak of any of the proposed condition hydrographs or whether there will be any change in the time of the peak of the proposed condition hydrograph. Please perform this task for the 1, 10, and 100-year 24-hour Type III storm events.*

    Comparison of the design points has been provided for each of these storms. The peak flows under proposed conditions will be at a lower magnitude for all storms, and occur approximately 0.1 hours earlier. As shown in these comparisons, the only occurrence of the proposed outflow surpassing existing outflow occurs at approximately hour 16.5, when both the existing and proposed flows are under 0.5 cfs. As marked on the hydrograph table provided in response to #13, this crossing of hydrographs will occur when the Silver Creek design point is discharging at 82.3 cfs, a fraction of the peak of 1,266 cfs occurring at Hour 12.57.

15. *Please also provide a calculation of the time from discharge of drainage into the groundwater to discharge to surface waters from the infiltration practices at the site. Please clearly demonstrate that this flow component will not add to the surface component in a manner which would need to be considered in the surface water hydrograph analysis.*

    This comment has been addressed under Comment 13.

Please feel free to contact me if you have any further questions regarding this matter, or if further copies are needed.

Sincerely,
DiPrete Engineering Associates, Inc.

Time span=0 00-72 00 hrs dt=0 01 hrs, 7201 points
Runoff by SCS TR-20 method UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment200 Upgradient Offsite Runoff Area=352 930 ac 38 27% Impervious Runoff Depth=6 55"
Flow Length=5 196' Tc=42 7 min CN=83 Runoff=1,264 25 cfs 192 697 af

Subcatchment200 Upgradient Offsite Runoff Area=352 930 ac 38 27% Impervious Runoff Depth=6 55"
Flow Length=5 196' Tc=42 7 min CN=83 Runoff=1 264 25 cfs 192 697 af

Subcatchment201 Downgradient Offsite Runoff Area=897 070 ac 28 39% Impervious Runoff Depth=6 19"
Flow Length=9 823 Tc=57 8 min CN=80 Runoff=2,598 31 cfs 462 710 af

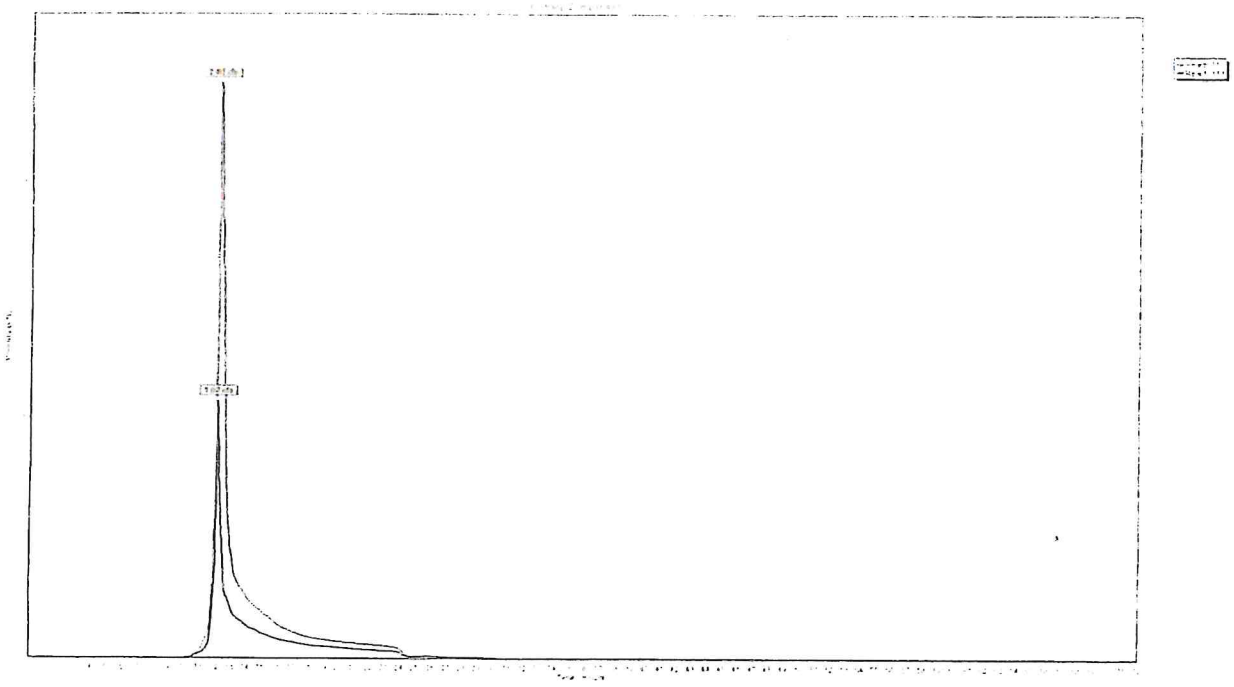
Subcatchment201 Downgradient Runoff Area=897 070 ac 28 39% Impervious Runoff Depth=6 19"
Flow Length=9 823 Tc=57 8 min CN=80 Runoff=2 598 31 cfs 462 710 af

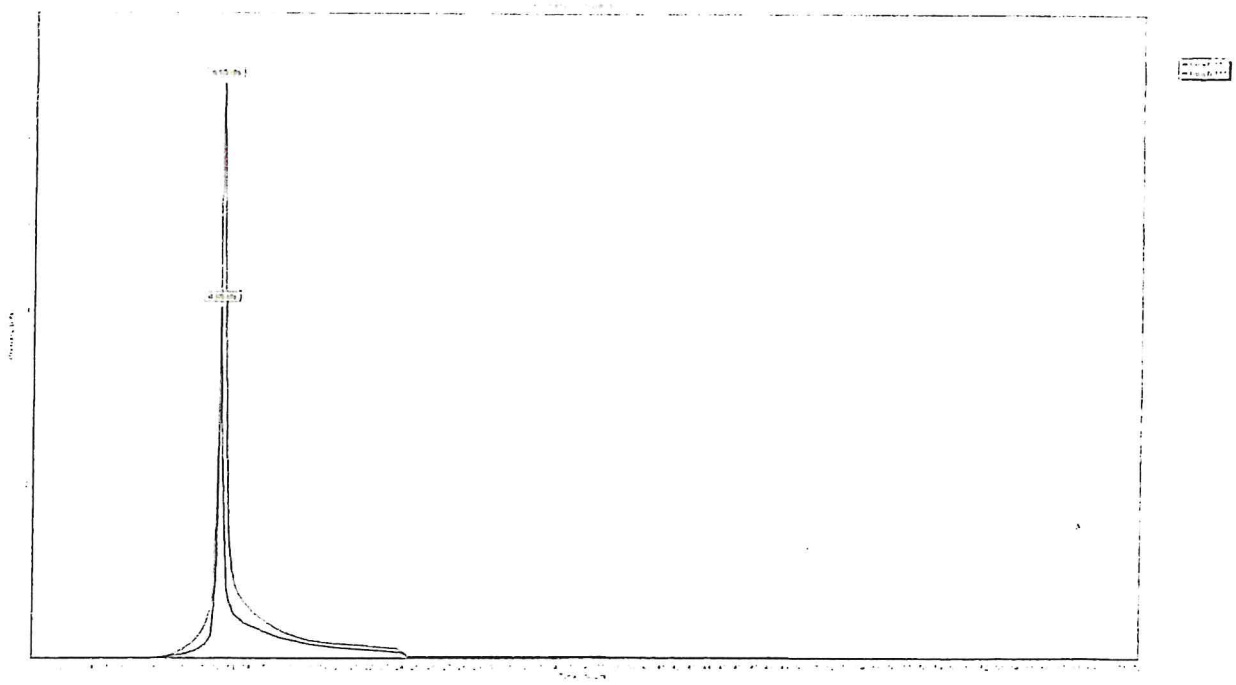
Reach 11 Silver Creek from site Avg Flow Depth=2 39' Max Vel=4 23 fps Inflow=1,269 86 cfs 194 099 af
n=0 035 L=7 022 0' S=0 0078 '/' Capacity=6 919 98 cfs Outflow=967 37 cfs 194 099 af

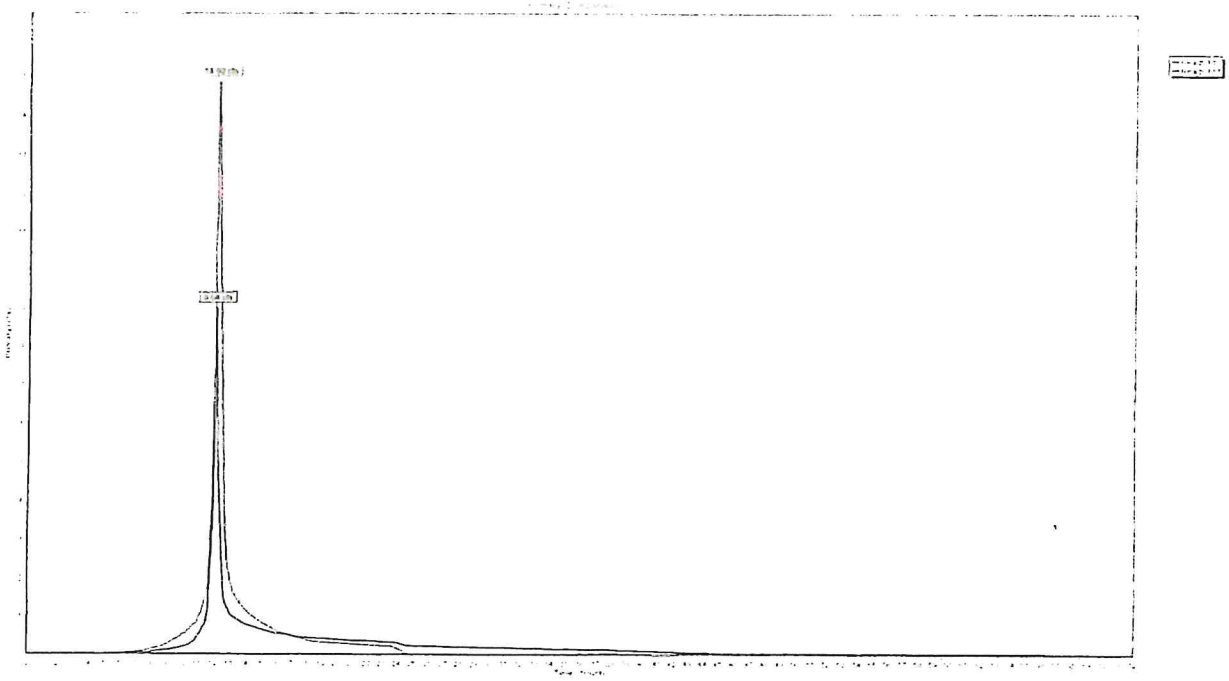
Reach 12 Bristol Harbor Inflow=3,555 02 cfs 656 809 af
Outflow=3 555 02 cfs 656 809 af

Reach 111 Silver Creek from site Avg Flow Depth=2 39' Max Vel=4 23 fps Inflow=1 266 08 cfs 193 864 af
n=0 035 L=7,022 0' S=0 0078 '/' Capacity=6 919 98 cfs Outflow=963 80 cfs 193 860 af

Reach 112 Bristol Harbor Inflow=3,551 01 cfs 656 570 af
Outflow=3 551 01 cfs 656 570 af



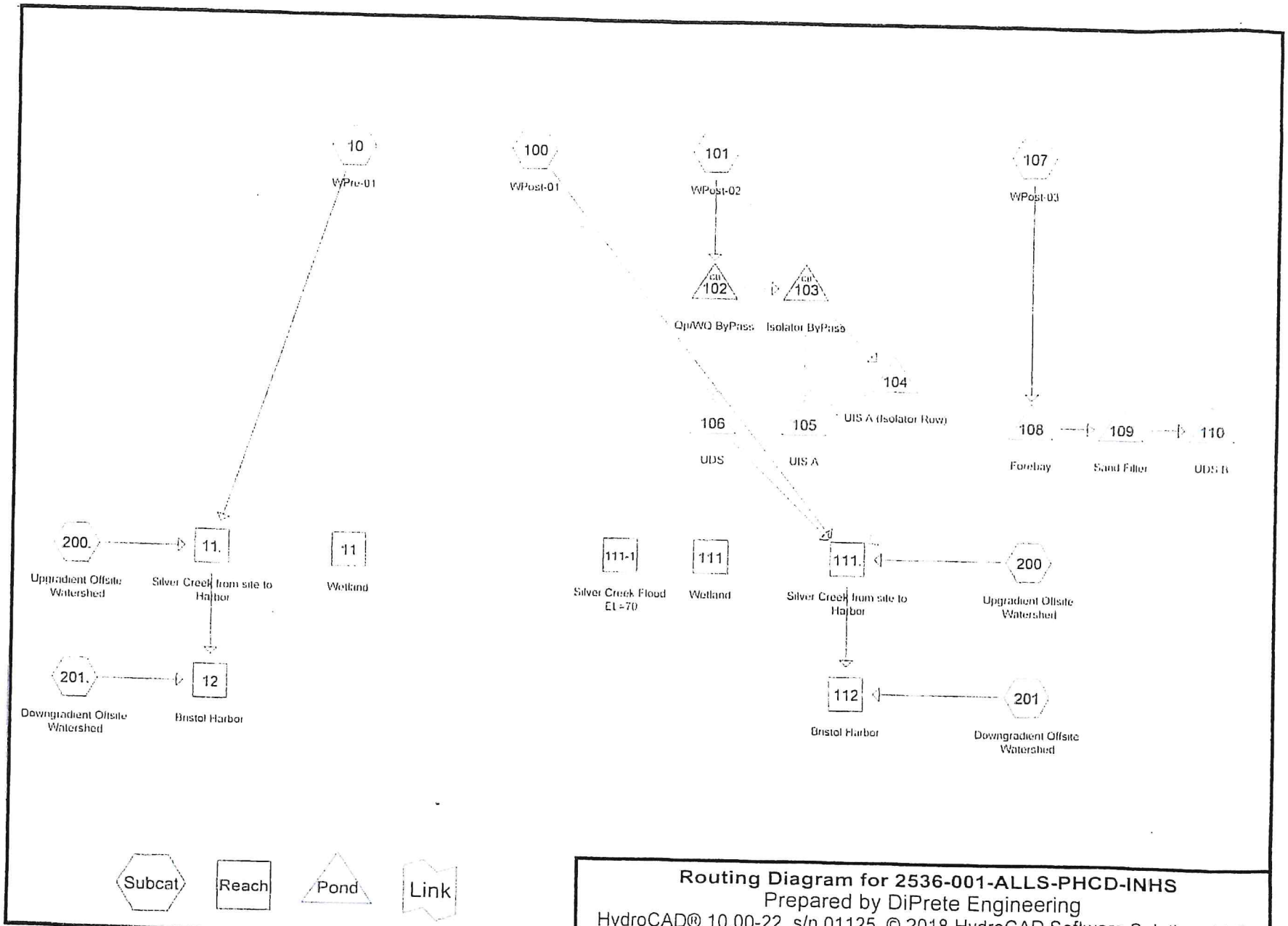




Hydrograph for Reach 111.: Silver Creek from site to Harbor

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Outflow (cfs)
0.00	0.00	0	55.00	0.00
0.50	0.00	0	55.00	0.00
1.00	0.00	0	55.00	0.00
1.50	0.00	0	55.00	0.00
2.00	0.00	0	55.00	0.00
2.50	0.00	0	55.00	0.00
3.00	0.00	0	55.00	0.00
3.50	0.00	0	55.00	0.00
4.00	0.00	0	55.00	0.00
4.50	0.00	0	55.00	0.00
5.00	0.55	272	55.02	0.01
5.50	2.52	2,753	55.10	0.20
6.00	5.05	8,612	55.17	0.92
6.50	7.91	17,376	55.25	2.32
7.00	11.72	28,800	55.32	4.57
7.50	16.57	43,159	55.39	7.81
8.00	22.34	60,242	55.46	12.18
8.50	29.27	79,673	55.53	17.67
9.00	39.64	103,161	55.61	24.91
9.50	53.00	132,806	55.69	34.90
10.00	68.52	167,949	55.77	47.73
10.50	86.79	207,445	55.86	63.23
11.00	114.09	255,741	55.95	83.56
11.50	154.98	318,986	56.07	112.21
12.00	339.84	457,285	56.28	181.37
12.50	**1,237.44**	**1,211,339**	**57.08**	**664.61**
13.00	**732.31**	**1,543,866**	**57.34**	**918.30**
13.50	325.19	1,081,528	56.96	571.37
14.00	206.01	739,175	56.62	344.01
14.50	156.64	552,559	56.40	233.36
15.00	132.37	447,441	56.26	176.16
15.50	114.90	384,097	56.17	143.74
16.00	98.18	338,158	56.10	121.25
16.50	82.33	298,855	56.03	102.88
17.00	71.93	265,845	55.97	88.02
17.50	64.18	240,233	55.92	76.90
18.00	56.79	218,929	55.88	67.95
18.50	49.92	199,667	55.84	60.08
19.00	46.06	183,541	55.81	53.70
19.50	43.61	171,783	55.78	49.18
20.00	41.34	162,837	55.76	45.79
20.50	39.18	155,447	55.74	43.03
21.00	37.39	149,021	55.73	40.70
21.50	35.73	143,404	55.71	38.66
22.00	34.05	138,290	55.70	36.81
22.50	32.40	133,404	55.69	35.11
23.00	30.78	128,577	55.68	33.44
23.50	29.12	123,779	55.66	31.78
24.00	27.45	118,989	55.65	30.12

Post-development passes pre-development hydrograph (both flows less than 0.5 cfs)



Routing Diagram for 2536-001-ALLS-PHCD-INHS
Prepared by DiPrete Engineering
HydroCAD® 10.00-22 s/n 01125 © 2018 HydroCAD Software Solutions LLC

Item C1.

FRESHWATER WETLANDS / STORMWATER ENGINEERING
CLEARANCE for NOTICE & FINAL REVIEW

Date: 6/30/2023

Reviewer: Nicholas A. Pisani, P.E.

Application Number:	**FWW#:**	22-0264
	WQC#:	22-114
	GWD/UIC#:	UIC--001650
	RIPDES#:	RIR101247
	OTHER:	_____

Applicant Name: KenDan, LLC

Project Name: Gooding Avenue Development

Plans and Analysis Reviewed: Plans and Reports received by DEM on 6/27/2022, with revised plans and analysis received on 5/25/2023.

Engineering Review conducted with Checklist rev. date: 2/20/2014.

Recommended Action: Adequate for Public Notice and Adequate for Approval with Condition.

Findings:

1) **Redevelopment Status:** The proposed project represents new development.

2) **Drainage and Water Quality Issues:** The submittal meets the pertinent requirements of the RIDEM Stormwater Management, Design and Installation Rule (250-RICR-150-10-8). Specifically:
   - **Re: Water Quality Standard:** The proposed design includes two (2) water quality treatment practices to provide water quality treatment for the proposed impervious area of proposed impervious areas proposed areas of rooftop and parking and access drives. These will consist of an infiltrating underground sand filter with proposed Isolator Row-TM pretreatment and an infiltrating surface sand filter with a sediment forebay as pretreatment. Together these will filter and infiltrate the water quality volume (one inch of runoff from contributing impervious areas) from the proposed project. The proposed design meets pertinent vertical separations to groundwater table and pertinent horizontal setbacks. Based on the above considerations the proposed design will meet the pertinent Water Quality Standard of the Stormwater Rules.
   - **Re: Recharge Standard:** The proposed design provides two (2) infiltrating sand filters. Together these infiltration practices will meet the pertinent Recharge Standard of the Stormwater Rules.
   - **Re: Channel Protection Standard:** The proposed project design includes an infiltrating subsurface sand filter, an infiltrating surface

sand filter, and two underground detention practices. Together these practices will provide a combination of infiltration and detention that will ensure that the discharge rate in the one-year storm event will be less than the allowable release rate required to ensure the 24-hour extended detention of the total runoff volume for the one-year storm event. Therefore, the submitted analysis shows that the proposed project design will meet Channel Protection Standard of the Stormwater Rules.

- **Re: Overbank Protection Standard:** The proposed design includes a proposed underground sand filter, a proposed surface sand filter, and two underground detention practices. The submitted analysis demonstrates that together these practices will serve to ensure that there will not be any increase in the peak runoff discharge rates in either the 10-year or the 100-year 24-hour Type III storm events. Therefor the proposed design meets the pertinent Overbank Protection Standard of the Stormwater Rules.
- The designer has addressed potential downstream flooding concerns by indicating that the submitted analysis shows that the total runoff volume of runoff to the receiving wetland will be decreased in the 1, 10 and 100-year 24-hour Type III storm events.

3) **Re: Soil Erosion and Sediment Control Issues:** The submittal includes an acceptable Soil Erosion and Sediment Control Plan.

4) **Floodplain and Floodway Issues:** The site of the proposed development is located inland of the FEMA-mapped 100-year floodplain.

Technical Justification(s): If the site plans for the proposed development include a BMP that does not fully comply with all the applicable design requirements of the RISDISM, then please note below:

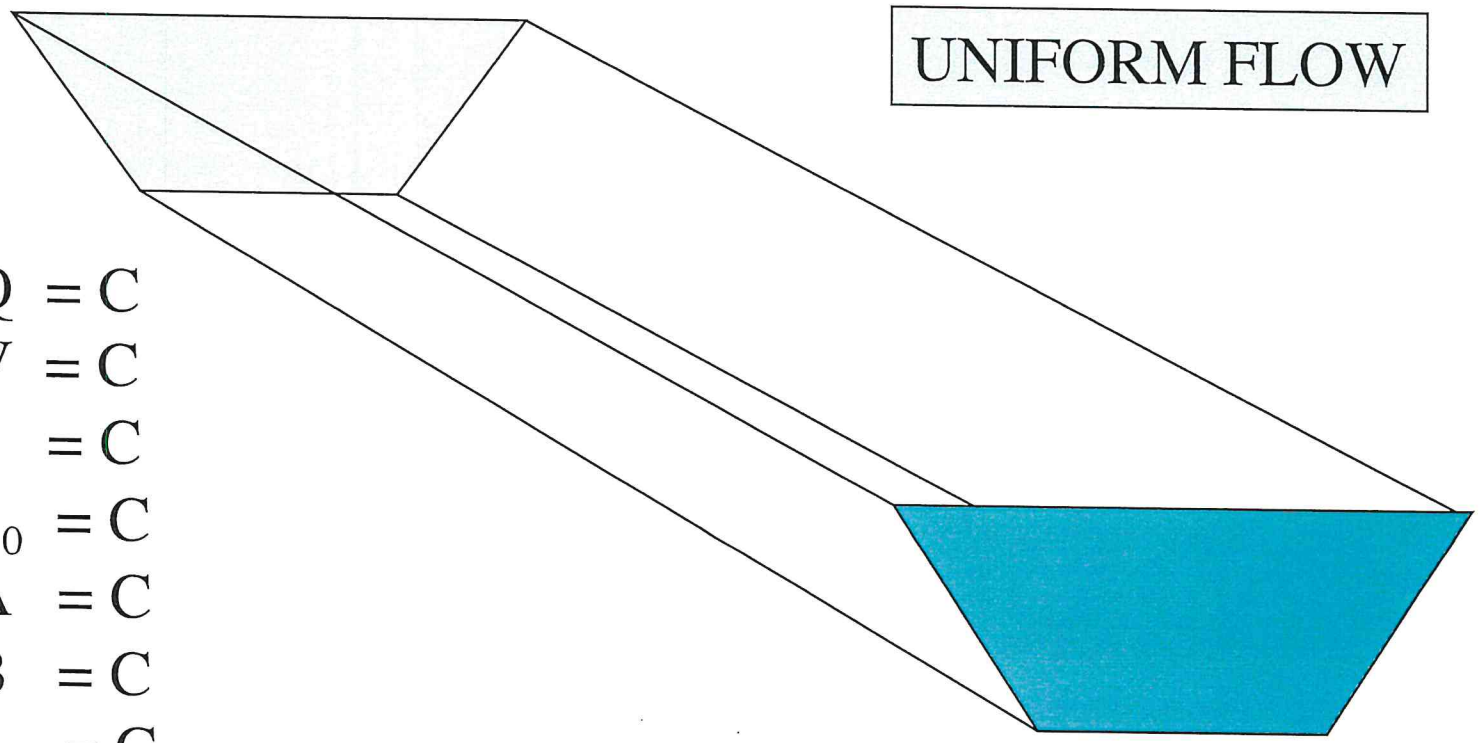
- NA

Permit Conditions:

1) The long-term operation and maintenance plan shall be strictly followed. The long-term operation and maintenance plan shall be that entitled "Operation & Maintenance Plan, Gooding Avenue Development, Located in Bristol, Rhode Island; Applicant: Kendan, LLC", dated 1-23-2018, Revised 4-06-2021, dated received 6/27/2022, prepared by DiPrete Engineering.

Graphic Representation Uniform and Non Uniform Flow

Normal depth implies that flow rate, velocity, depth, bottom slope, area, top width, and roughness remain constant within a **prismatic** channel as shown below



$Q = C$
$V = C$
$y = C$
$S_0 = C$
$A = C$
$B = C$
$n = C$

Item C1.

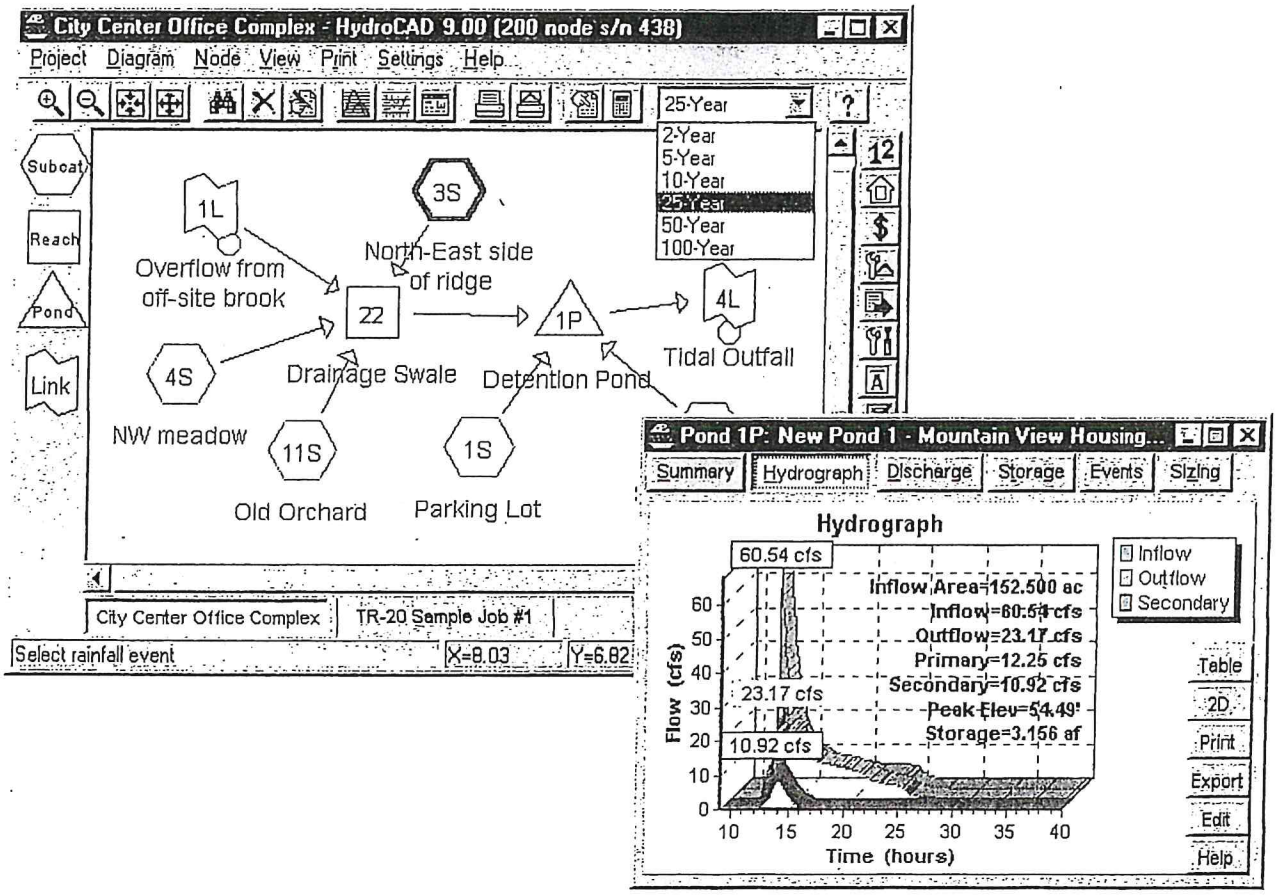
Non-Uniform Open Channel Flow

With natural or man-made channels, the shape, size, and slope may vary along the stream length, x. In addition, velocity and flow rate may also vary with x. Non-uniform flow can be best approximated using a numerical method called the Standard Step Method.

Item C1.

HydroCAD®

Stormwater Modeling System



Owner's Manual

Version 9

HydroCAD Software Solutions LLC

The Routing Diagram

The routing diagram shows the individual *nodes* that make up each project. The nodes are usually connected by arrows that indicate how their outflows are routed. Multiple inflows are summed automatically as required.[1]

Based on the routing diagram, HydroCAD is able to determine the correct sequence of calculations, and then calculate the flows throughout the project. Routing calculations are automatically updated as required. You can manipulate the diagram display with the main scroll bars, the tool bar, the main menu, the palette, and the mouse.

Watershed components

Each drainage system is represented by a network of the following types of *nodes*:

- **Subcatchment**: A relatively homogenous area of land that typically drains into a reach or pond. Each subcatchment generates a *runoff hydrograph*. A subcatchment may also be used to account for the rain falling directly on the surface of a pond. A subcatchment *cannot* be used to route an inflow hydrograph. Instead, use a subcatchment to calculate the runoff and a separate reach to perform the routing.

- **Pond**: A pond, swamp, dam, catch basin, manhole, drywell, or other impoundment that fills with water from one or more sources and empties in a manner determined by a weir, culvert, or other outlet device(s). The outflow of each pond is determined by a *hydrograph routing* calculation which attenuates and delays the peak flow. A pond may empty into a reach or into another pond. An optional *secondary* outflow may be used to *divert* the discharge from specific outlet devices and route them separately. A *discarded* outflow is also available for outflows that are not subject to further routing, such as exfiltration.

- **Catch Basin**: A special type of pond that provides an insignificant amount of storage, but otherwise has all the properties and capabilities of a pond. Since a catch basin has no storage capability, it cannot detain or attenuate its inflow. However, the routing calculations will determine the water surface level (headwater) at each point in time.

- **Reach**: A uniform stream, channel, or pipe that conveys water from one point to another and operates under *open channel flow*.[2] A reach may also be used to route an upstream hydrograph through a subcatchment.[3] The outflow of each reach is determined by a *hydrograph routing* calculation. This generally delays and attenuates the peak flow. A reach may be routed into a pond or into another reach.

- **Link**: A link may be used to 1) enter a hydrograph generated outside HydroCAD, 2) interconnect several routing diagrams, 3) scale a hydrograph, 4) split a hydrograph into two components for independent routing, or 5) define a fixed or tidal tailwater elevation.

---

[1] To sum multiple flows without performing a hydrograph routing, use an undescribed reach, pond, or link.

[2] To model a pipe under other flow conditions, including headwater and tailwater effects, use a *catch basin or pond with a culvert outlet.* This applies to most culverted road crossings, manholes, and other impoundments that feed a pipe.

[3] When a reach drains a subcatchment *along its length*, it may be best modeled as a component of the subcatchment's Tc calculation, rather than as an independent reach.

This technique is based on the assumption that the total flow is equal to the sum of the flows for the individual segments. If applied to a section with a constant Manning's value, the result is ***not*** the same as the original Manning's value.

Subdivision by Segment

$$Q = \sum Q_i \qquad \text{Eq. 27}$$

Q=Total flow for cross-section [ft³/sec] or [m³/sec]
Q_i=Flow for segment i (see Eq.23) [ft³/sec] or [m³/sec]

This technique produces exactly the same flow as the Lotter method, described above. It differs only in the calculation procedure, in which the total flow is the sum of the flows calculated separately for each segment, without the use of a composite Manning's value.

Subdivision by Manning's Value

$$Q = \sum Q_n \qquad \text{Eq. 28}$$

Q=Total flow for cross-section [ft³/sec] or [m³/sec]
Q_n=Flow for consecutive segments with same Manning's value

This technique subdivides the channel only when there is a change (break) in the Manning's value. This produces more consistent results than subdivision by segment, in that the resulting flow is independent of the number of points along the cross section. When all segments have the same Manning's value, the flow is identical to the traditional solution for a constant Manning's value. This technique is similar (although not identical) to the current procedure used in HEC-RAS.

Other Procedures

If another technique is used to calculate flow through a complex cross-section, the rating curve can be calculated separately and entered into HydroCAD using option 1, above. However, using a defined geometry or cross-section allows direct evaluation of the channel at any depth, without having to interpolate between a (smaller) number of user-defined stages.

Reach Routing Limitations

The preceding stage-discharge calculations are based solely on Manning's equation, and do *not* consider possible inlet, outlet, or tailwater effects. If a complete analysis is desired for a pipe, including entrance losses and possible tailwater effects, it should be modeled as a pond with a culvert outlet. If a detailed water surface profile is required for a channel, you should use a program specifically designed for that purpose.[25]

[25] Water surface profiles are usually calculated under constant flow conditions, rather than

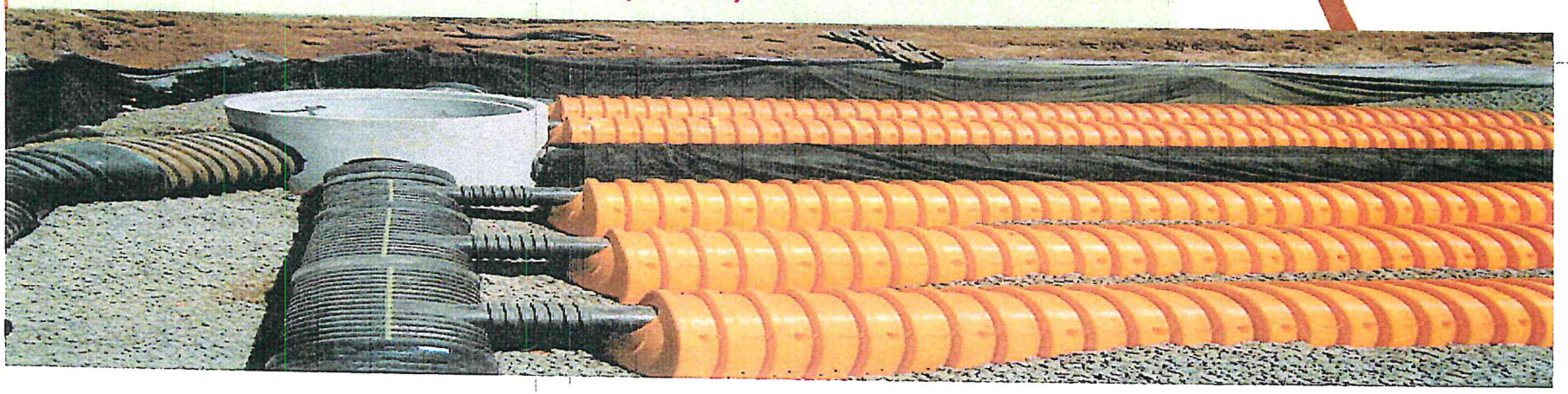
Primary Comparison

Time (hours)	Reach 11. (cfs)	Reach 111. (cfs)	Time (hours)	Reach 11. (cfs)	Reach 111. (cfs)	Time (hours)	Reach 11. (cfs)	Reach 111. (cfs)
0.00	0.00	0.00	27.00	3.51	3.67	54.00	0.00	0.02
0.50	0.00	0.00	27.50	2.49	2.66	54.50	0.00	0.02
1.00	0.00	0.00	28.00	1.83	1.99	55.00	0.00	0.02
1.50	0.00	0.00	28.50	1.36	1.52	55.50	0.00	0.02
2.00	0.00	0.00	29.00	1.05	1.19	56.00	0.00	0.02
2.50	0.00	0.00	29.50	0.81	0.96	56.50	0.00	0.02
3.00	0.00	0.00	30.00	0.63	0.78	57.00	0.00	0.02
3.50	0.00	0.00	30.50	0.51	0.65	57.50	0.00	0.02
4.00	0.00	0.00	31.00	0.42	0.55	58.00	0.00	0.02
4.50	0.00	0.00	31.50	0.34	0.48	58.50	0.00	0.02
5.00	0.01	0.01	32.00	0.28	0.42	59.00	0.00	0.02
5.50	0.20	0.20	32.50	0.23	0.37	59.50	0.00	0.02
6.00	0.92	0.92	33.00	0.19	0.33	60.00	0.00	0.02
6.50	2.32	2.32	33.50	0.16	0.29	60.50	0.00	0.02
7.00	4.57	4.57	34.00	0.14	0.26	61.00	0.00	0.02
7.50	7.83	7.80	34.50	0.12	0.24	61.50	0.00	0.02
8.00	12.22	12.17	35.00	0.11	0.22	62.00	0.00	0.02
8.50	17.74	17.67	35.50	0.09	0.20	62.50	0.00	0.02
9.00	25.02	24.91	36.00	0.08	0.19	63.00	0.00	0.02
9.50	35.06	34.89	36.50	0.07	0.18	63.50	0.00	0.02
10.00	47.96	47.72	37.00	0.06	0.17	64.00	0.00	0.02
10.50	63.55	63.26	37.50	0.05	0.16	64.50	0.00	0.02
11.00	83.97	83.68	38.00	0.04	0.15	65.00	0.00	0.02
11.50	112.72	112.36	38.50	0.04	0.14	65.50	0.00	0.02
12.00	182.30	181.75	39.00	0.03	0.13	66.00	0.00	0.02
12.50	**669.59**	**665.36**	39.50	0.03	0.13	66.50	0.00	0.02
13.00	**920.95**	**918.61**	40.00	0.03	0.12	67.00	0.00	0.02
13.50	572.45	571.50	40.50	0.03	0.11	67.50	0.00	0.02
14.00	344.61	344.09	41.00	0.02	0.11	68.00	0.00	0.02
14.50	233.75	233.41	41.50	0.02	0.10	68.50	0.00	0.02
15.00	176.45	176.20	42.00	0.02	0.09	69.00	0.00	0.02
15.50	143.95	143.77	42.50	0.02	0.08	69.50	0.00	0.01
16.00	121.40	121.27	43.00	0.02	0.08	70.00	0.00	0.01
16.50	102.96	102.89	43.50	0.02	0.07	70.50	0.00	0.01
17.00	88.06	88.03	44.00	0.01	0.07	71.00	0.00	0.01
17.50	76.91	76.91	44.50	0.01	0.06	71.50	0.00	0.01
18.00	67.93	67.95	45.00	0.01	0.06	72.00	0.00	0.01
18.50	60.04	60.08	45.50	0.01				
19.00	53.64	53.71	46.00	0.01				
19.50	49.11	49.18	46.50	0.01				
20.00	45.71	45.79	47.00	0.01				
20.50	42.95	43.03	47.50	0.01				
21.00	40.61	40.70	48.00	0.01				
21.50	38.56	38.66	48.50	0.01				
22.00	36.71	36.81	49.00	0.01				
22.50	35.00	35.11	49.50	0.01				
23.00	33.33	33.44	50.00	0.01				
23.50	31.67	31.78	50.50	0.00				
24.00	30.01	30.12	51.00	0.00				
24.50	27.20	27.33	51.50	0.00				
25.00	18.94	19.09	52.00	0.00				
25.50	11.96	12.12	52.50	0.00				
26.00	7.67	7.83	53.00	0.00	0.03			
26.50	5.10	5.26	53.50	0.00	0.03			

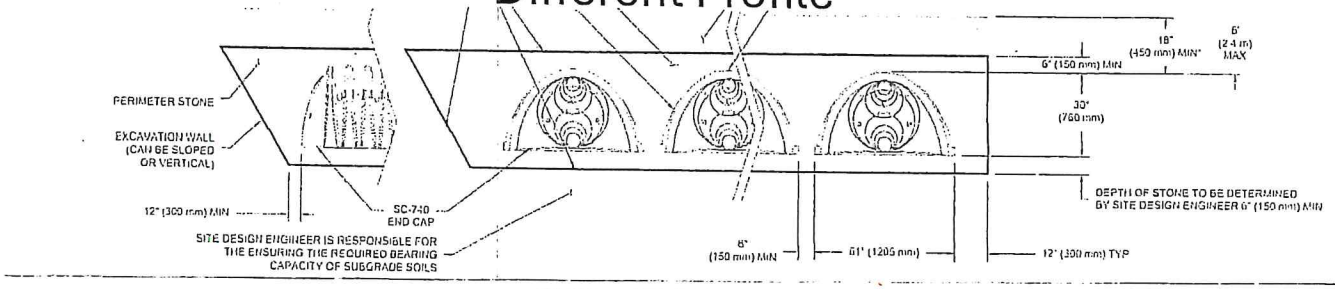
DiPrete using HydroCAD for 'Downstream Analys
NO water surface elevations
Flow Rate does not compare with HEC RAS anal
At high school culvert
Beta Study 337.53 cfs Elev. 66.96'
Spinard Study 358.46 cfs Elev. 67.22

Proposed Gooding Avenue Hotel

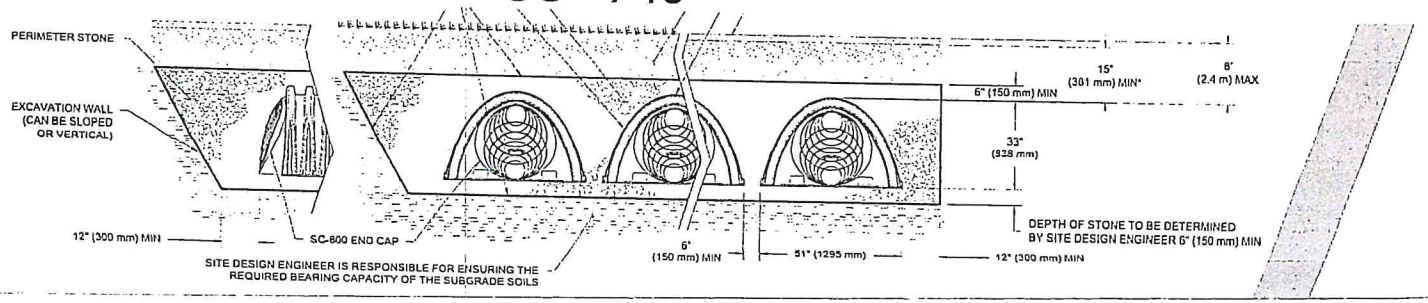
Storm Chamber SC – 740 is being discontinued – Recommend Use SC-800 (ADS)



Different Profile

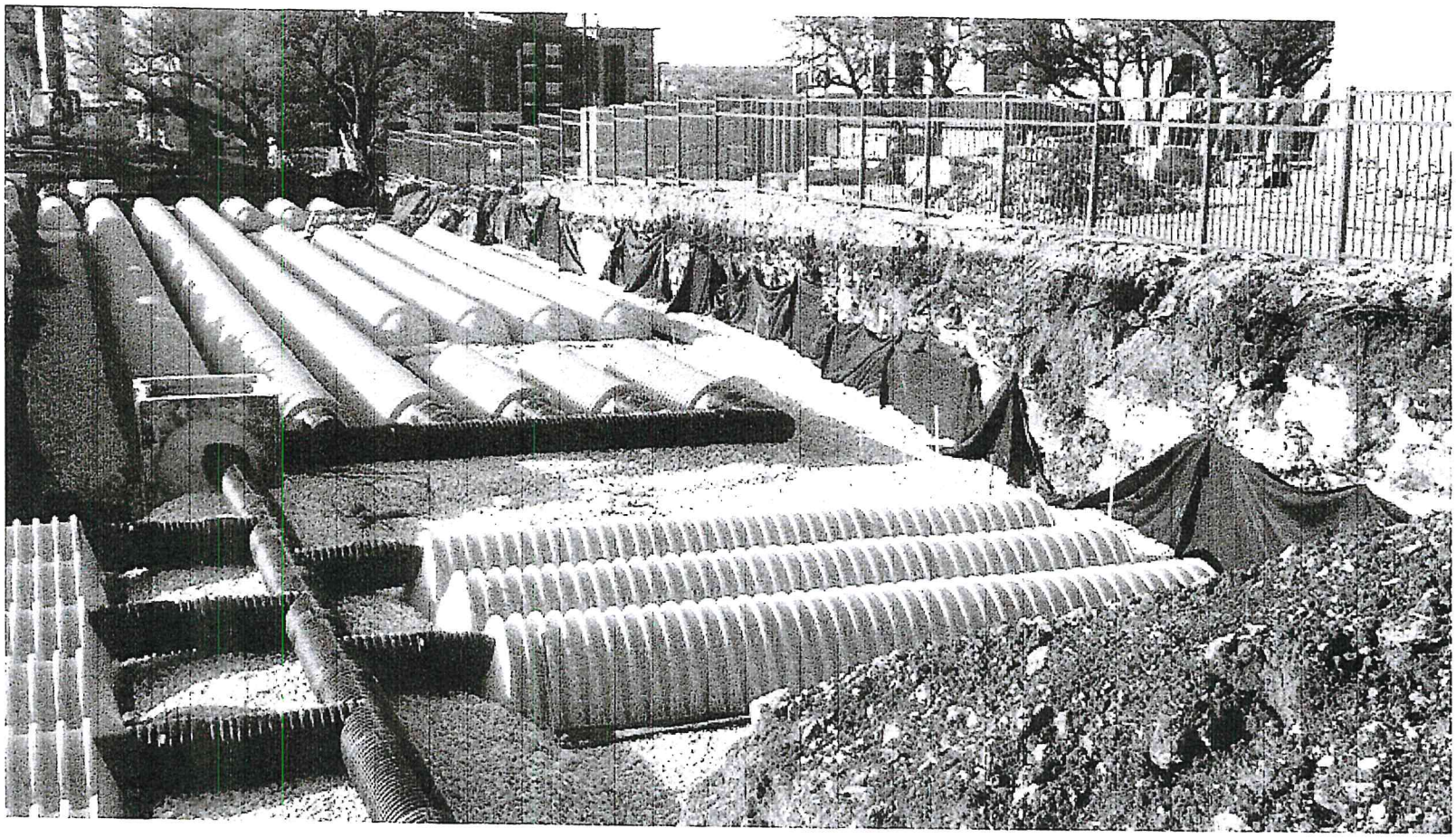


SC - 740



SC - 800

Item C1.



The SC-740 is in limited stock and will eventually be discontinued. Refer to the SC-800 for all of your design needs.

Learn More

Get new product info and more in advance.

Give Feedback

Proposed Gooding Avenue Hotel

Conclusion

In my opinion, the project does not comply with the following:

Town of Bristol Subdivision and Development Review Regulations
(Amended March 14, 2024)
Appendix F: Design and Construction Standards; I Drainage

(e)To the maximum extent practicable as agreed upon by the Planning Board Engineer and the applicant's engineer, any increase in storm runoff volume, up to and including the 10-year storm event, shall be retained and recharged on site as close as feasible to its place of origin by means of detention ponds or basins, seepage areas, subsurface drains, porous paving, or similar low impact design techniques. This shall be required within the Tanyard Brook and Silver Creek watersheds and encouraged to the extent practicable in other areas of Bristol.

(g)Proposals for disposal of surface run-off, downstream from the subdivision without damage to land and improvements or to the receiving water body. The drainage report shall specifically address the downstream impacts resulting from the proposed drainage system

Therefore, does not comply with:
Article 8.6 Required Findings

Infiltration

Infiltration used by the Applicant and agreed by RIDEM to reduce the volume of flood flow

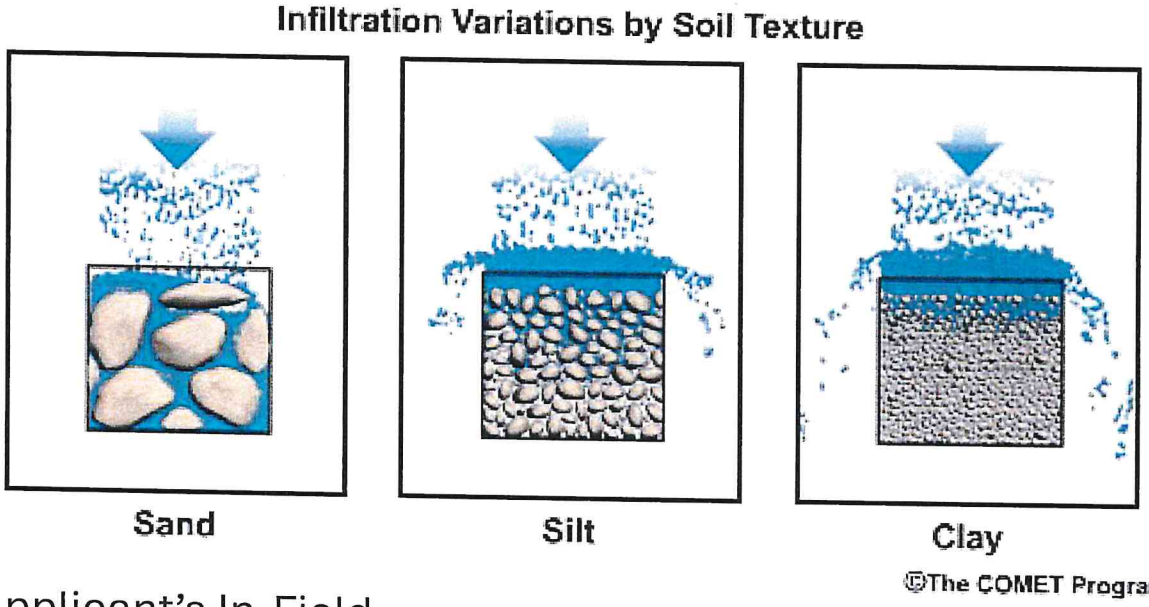
Table of Contents

- **Copy of infiltration statement by Applicant "Stormwater Management Report."**
- **Copy of RIDEM Engineer Review 6/30/2023**

Proposed Gooding Avenue Hotel

Infiltration by Soil Texture

The applicant used a higher infiltration rate than the soil can absorb for Pittstown soils. Stissing soils is a wetland soil.

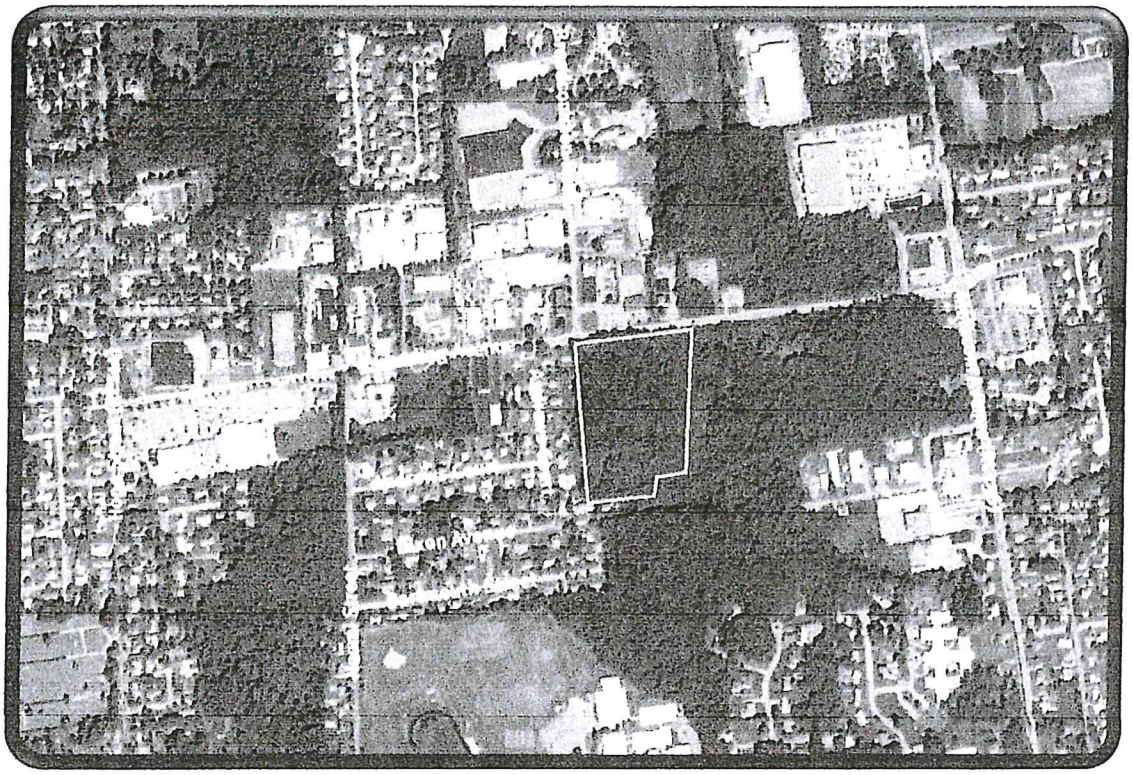


Applicant's In-Field Soil Observation classified soils as Sandy Loam

Soil Samples & Tests have classified the soils as Fine Sand, Silt, and Clay

DiPrete Engineering

Stormwater Management Report



KEVIN DEMERS
No. 8557
REGISTERED
PROFESSIONAL ENGINEER
CIVIL
4/7/2025

Gooding Avenue Development

Located in Bristol, Rhode Island

Applicant: Kendan, LLC.

1-19-2018

Revised: 3-27-2025

As shown in the tables above, no increase in stormwater runoff rate will occur following the proposed construction during the 1 through 100 year storm events.

Also note that, due to concerns within the overall Silver Creek watershed and constraints therein, the applicant is also demonstrating that the proposed stormwater system will result in a decrease in runoff volume.

Watershed #1: (DP-1)

Sub-watershed (design point)	1-yr Volume		10-yr Volume		25-yr Volume		100-yr Volume	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
DP-1:	0.228	0.131	0.605	0.421	0.845	0.639	1.371	1.182

All flows in acre feet per second (af)

As shown in the tables above, no increase in stormwater runoff volume will occur following the proposed construction during the 1 through 100 year storm events.

3.6 Minimum Standard 6: Redevelopment and Infill Projects.

The site is not classified as a redevelopment or infill project.

3.7 Minimum Standard 7: Pollution Prevention

A Soil Erosion and Sediment Control Plan (SESC) for this development can be found under a separate document. See the Soil Erosion and Sediment Control Plan for the development prepared by DiPrete Engineering. The SESC contains information for construction pollution prevention. For post construction pollution prevention see the Operations and Maintenance (O&M) document prepared for this development by DiPrete Engineering.

3.8 Minimum Standard 8: Land Uses with High Potential Pollutant Loads (LUHPPLs)

The site is not considered LUHHPL.

3.9 Minimum Standard 9: Illicit Discharges

There are no proposed Illicit Discharges on site. The site will be serviced by public water and sewer.

3.10 Minimum Standard 10: Construction Activity Soil Erosion, Runoff and Sedimentation and Pollution Prevention Control Measure Requirements

See the SESC for this development prepared by DiPrete Engineering.

3.11 Minimum Standard 11: Stormwater Management System Operation and Maintenance

See the O&M for this development prepared by DiPrete Engineering.

RHODE ISLAND DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
OFFICE OF WATER RESOURCES

FRESHWATER WETLANDS / STORMWATER ENGINEERING
CLEARANCE for NOTICE & FINAL REVIEW

Date: 6/30/2023

Reviewer: Nicholas A. Pisani, P.E.

Nicholas A. Pisani

Application Number:

FWW#:	22-0264
WQC#:	22-114
GWD/UIC#:	UIC--001650
RIPDES#:	RIR101247
OTHER:	_____

Applicant Name: KenDan, LLC

Project Name: Gooding Avenue Development

Plans and Analysis Reviewed: Plans and Reports received by DEM on 6/27/2022, with revised plans and analysis received on 5/25/2023.

Engineering Review conducted with Checklist rev. date: 2/20/2014.

Recommended Action: Adequate for Public Notice and Adequate for Approval with Condition.

Findings:

1) **Redevelopment Status:** The proposed project represents new development.

2) **Drainage and Water Quality Issues:** The submittal meets the pertinent requirements of the RIDEM Stormwater Management, Design and Installation Rule (250-RICR-150-10-8). Specifically:
   - **Re: Water Quality Standard:** The proposed design includes two (2) water quality treatment practices to provide water quality treatment for the proposed impervious area of proposed impervious areas proposed areas of rooftop and parking and access drives. These will consist of an infiltrating underground sand filter with proposed Isolator Row-TM pretreatment and an infiltrating surface sand filter with a sediment forebay as pretreatment. Together these will filter and infiltrate the water quality volume (one inch of runoff from contributing impervious areas) from the proposed project. The proposed design meets pertinent vertical separations to groundwater table and pertinent horizontal setbacks. Based on the above considerations the proposed design will meet the pertinent Water Quality Standard of the Stormwater Rules.
   - **Re: Recharge Standard:** The proposed design provides two (2) infiltrating sand filters. Together these infiltration practices will meet the pertinent Recharge Standard of the Stormwater Rules.
   - **Re: Channel Protection Standard:** The proposed project design includes an infiltrating subsurface sand filter, an infiltrating surface

sand filter, and two underground detention practices. Together these practices will provide a combination of infiltration and detention that will ensure that the discharge rate in the one-year storm event will be less than the allowable release rate required to ensure the 24-hour extended detention of the total runoff volume for the one-year storm event. Therefore, the submitted analysis shows that the proposed project design will meet Channel Protection Standard of the Stormwater Rules.

- **Re: Overbank Protection Standard:** The proposed design includes a proposed underground sand filter, a proposed surface sand filter, and two underground detention practices. The submitted analysis demonstrates that together these practices will serve to ensure that there will not be any increase in the peak runoff discharge rates in either the 10-year or the 100-year 24-hour Type III storm events. Therefor the proposed design meets the pertinent Overbank Protection Standard of the Stormwater Rules.
- The designer has addressed potential downstream flooding concerns by indicating that the submitted analysis shows that the total runoff volume of runoff to the receiving wetland will be decreased in the 1, 10 and 100-year 24-hour Type III storm events.

3) **Re: Soil Erosion and Sediment Control Issues:** The submittal includes an acceptable Soil Erosion and Sediment Control Plan.

4) **Floodplain and Floodway Issues:** The site of the proposed development is located inland of the FEMA-mapped 100-year floodplain.

Technical Justification(s): If the site plans for the proposed development include a BMP that does not fully comply with all the applicable design requirements of the RISDISM, then please note below:

- NA

Permit Conditions:

1) The long-term operation and maintenance plan shall be strictly followed. The long-term operation and maintenance plan shall be that entitled "Operation & Maintenance Plan, Gooding Avenue Development, Located in Bristol, Rhode Island; Applicant: Kendan, LLC", dated 1-23-2018, Revised 4-06-2021, dated received 6/27/2022, prepared by DiPrete Engineering.

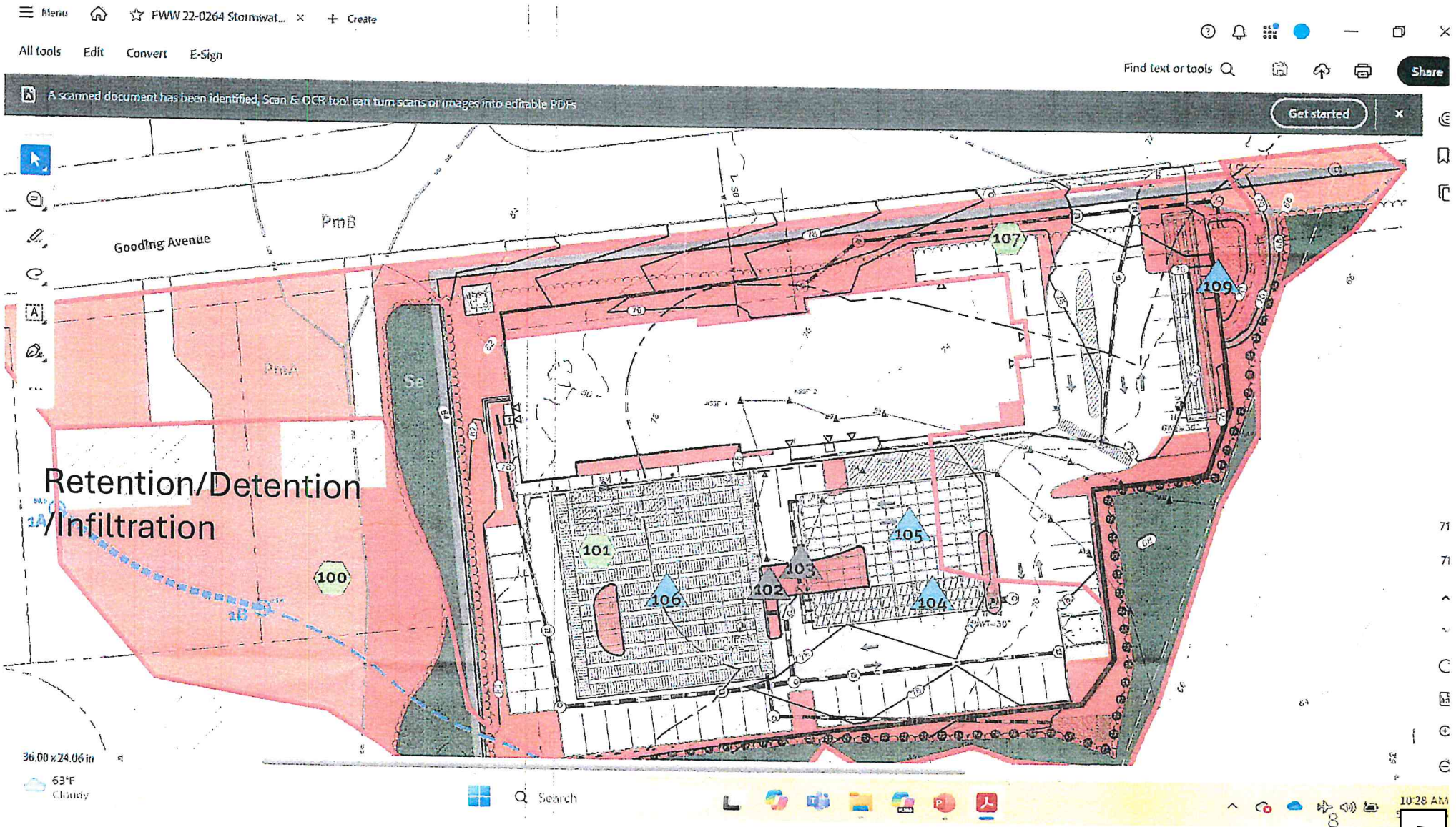
Errors within HydroCAD stormwater system model

Table of Contents

- **Slide Stormwater Model System**
- **Slide Modeling Stormwater Management System HydroCAD**
- **Slide Runoff Hydrographs**
- **HydroCAD Routing Diagram comparing DiPrete and Recreated Models**
- **Summary HydroCAD analysis DiPrete 100-year storm event**
- **Summary HydroCAD analysis Recreated100-year storm event**
- **Slide Model Shows Error Results when using the new infiltration rate of 0.27 in/hr**
- **Slide explanation of Error Messages**
- **Warning messages explained**
- **Detailed printout recreated HydroCAD analysis 100-year storm event with revised infiltration rate (0.27 in/hr)**

Stormwater Management System proposed by Applicant to improve water quality and reduce stormwater runoff rates into Silver Creek

RAISE THE RED FLAG



Item C1.

Proposed Gooding Avenue Hotel

Modeling Stormwater Management System

RAISE THE RED FLAG

HydroCAD® Stormwater Modeling

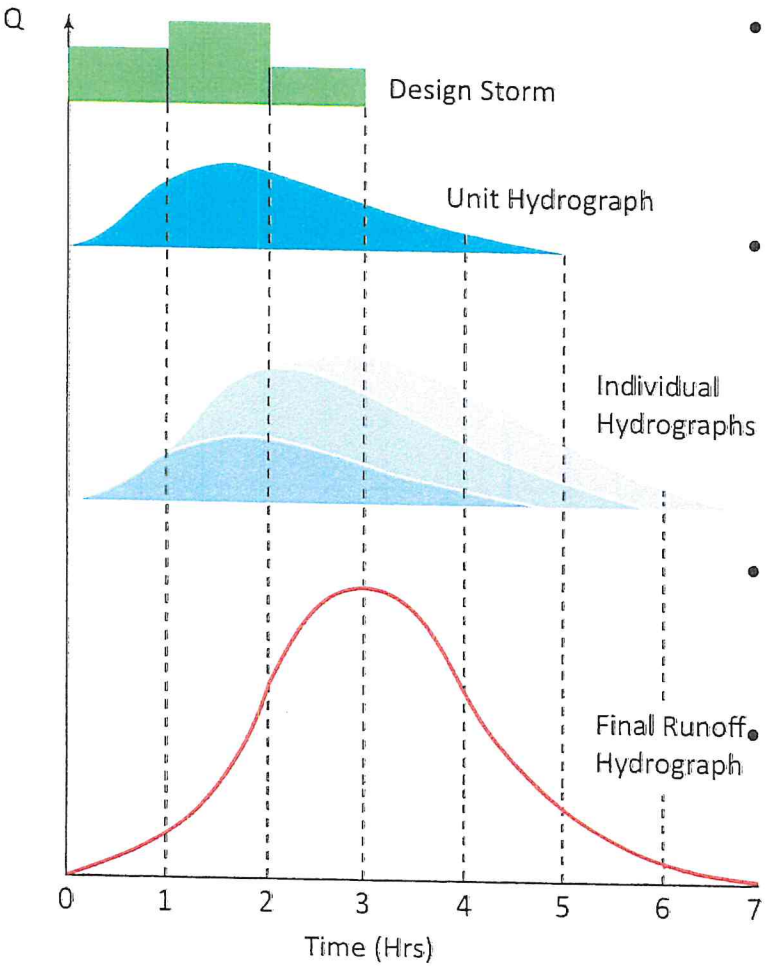
HydroCAD is a hydrology and hydraulics modeling system used for watershed analysis and design.

It provides runoff calculations, plus many techniques from TR-55, including CN lookup, CN weighting, and multiple procedures for calculating the time-of-concentration.

Runoff hydrographs can be routed through reaches and ponds, including a weir, culvert, orifice, or other device(s) that control the outflow.
Ponds can have compound outlets, such as a riser structure, as well as secondary outlets that are available for independent routing.

Proposed Gooding Avenue Hotel

Runoff Hydrographs



- A **design storm** refers to a specific rainfall event defined and described by the statistical likelihood of the event occurring in a given rainfall year.
- A **hydrograph** is a continuous plot of discharge (or flow rate versus time. Can be classified as rising limb, peak, and falling. A unit hydrograph, typically one inch, is developed to represent the watershed's response to runoff events
- **Individual Hydrographs** runoff from the areas closest to and furthest away from the discharge point within the watershed

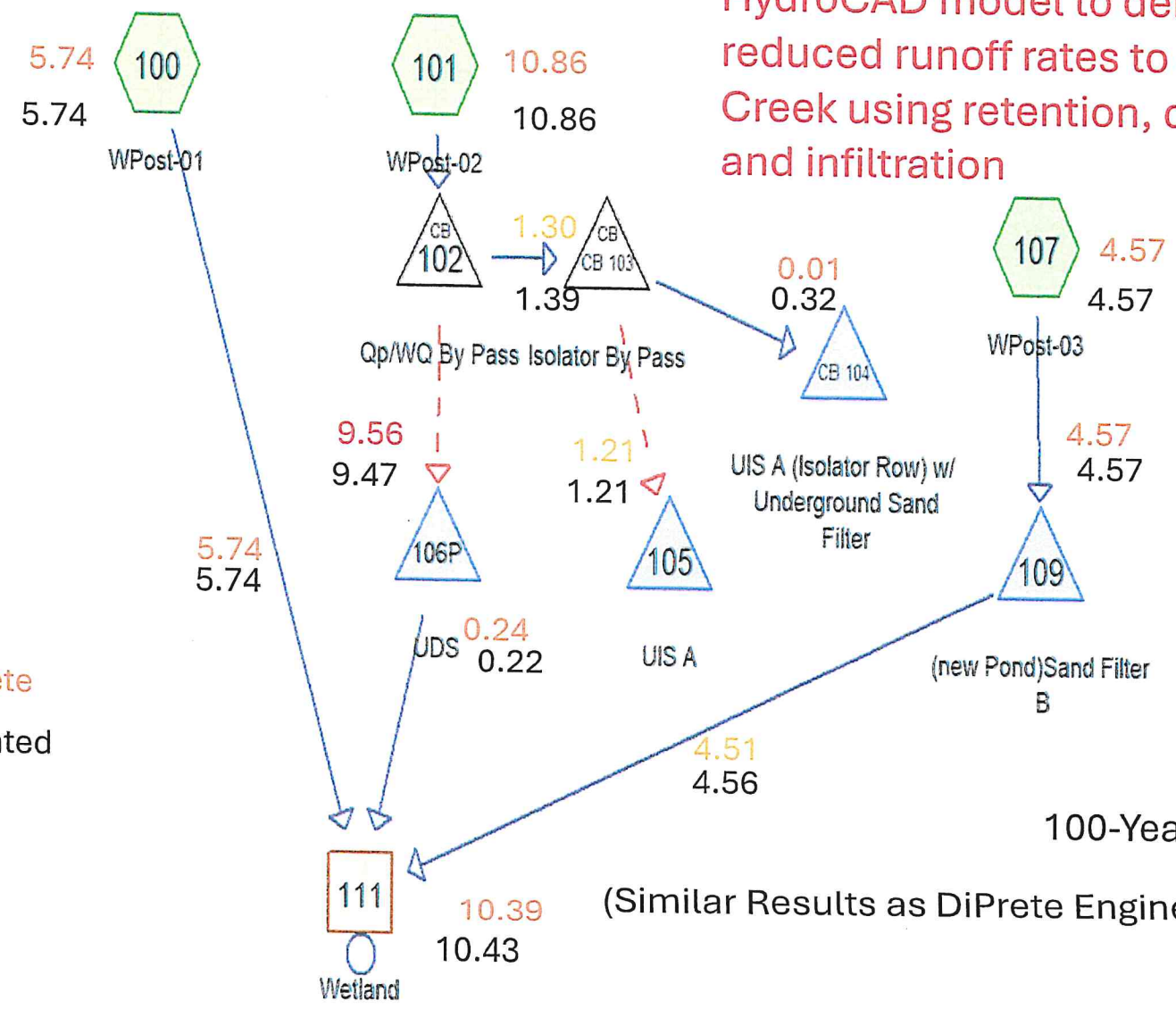
Final Runoff Hydrograph is the result of runoff from all areas contributing to the discharge location, creating the peak rate of runoff.

Item C1.

Bristol 2025 - HydroCAD 10.00-22 (40 node s/n 09085)

oject Diagram Node View Print Settings Help

100-year



DiPrete

Recreated

100-Year Storm Event

(Similar Results as DiPrete Engineering)

Item C1.

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 10: WPre-01 Runoff Area=2.765 ac 4.59% Impervious Runoff Depth=5.95"
Flow Length=409' Tc=14.6 min CN=78 Runoff=14.58 cfs 1.371 af

Subcatchment 100: WPost-01 Runoff Area=0.858 ac 10.02% Impervious Runoff Depth=6.07"
Flow Length=339' Tc=7.3 min CN=79 Runoff=5.74 cfs 0.434 af

Subcatchment 101: WPost-02 Runoff Area=1.334 ac 68.74% Impervious Runoff Depth=7.52"
Tc=6.0 min CN=91 Runoff=10.86 cfs 0.836 af

Subcatchment 107: WPost-03 Runoff Area=0.572 ac 48.25% Impervious Runoff Depth=7.28"
Tc=6.0 min CN=89 Runoff=4.57 cfs 0.347 af

Reach 11: Wetland Inflow=14.58 cfs 1.371 af
Outflow=14.58 cfs 1.371 af

Reach 111: Wetland Inflow=10.39 cfs 1.182 af
Outflow=10.39 cfs 1.182 af

Pond 102: Qp/WQ ByPass Peak Elev=76.38' Inflow=10.86 cfs 0.836 af
Primary=1.30 cfs 0.382 af Secondary=9.56 cfs 0.454 af Outflow=10.86 cfs 0.836 af

Pond 103: Isolator ByPass Peak Elev=76.23' Inflow=1.30 cfs 0.382 af
Primary=0.44 cfs 0.103 af Secondary=1.21 cfs 0.279 af Outflow=1.30 cfs 0.382 af

Pond 104: UIS A (Isolator Row) with Peak Elev=75.90' Storage=3,412 cf Inflow=0.44 cfs 0.103 af
Outflow=0.01 cfs 0.083 af

Pond 105: UIS A with Underground Sand Filter Peak Elev=75.88' Storage=9,947 cf Inflow=1.21 cfs 0.279 af
Outflow=0.04 cfs 0.222 af

Pond 106: UDS A Peak Elev=72.84' Storage=13,272 cf Inflow=9.56 cfs 0.454 af
Outflow=0.24 cfs 0.450 af

Pond 109: Sand Filter B Peak Elev=70.82' Storage=2,185 cf Inflow=4.57 cfs 0.347 af
Discarded=0.00 cfs 0.022 af Primary=4.50 cfs 0.298 af Outflow=4.51 cfs 0.321 af

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points x 2
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 10: WPre01 Runoff Area=2.765 ac 4.59% Impervious Runoff Depth=5.95"
Flow Length=409' Tc=14.6 min CN=78 Runoff=14.58 cfs 1.371 af

Subcatchment 100: WPost-01 Runoff Area=0.858 ac 10.02% Impervious Runoff Depth=6.07"
Flow Length=339' Tc=7.3 min CN=79 Runoff=5.74 cfs 0.434 af

Subcatchment 101: WPost-02 Runoff Area=1.334 ac 68.74% Impervious Runoff Depth=7.52"
Tc=6.0 min CN=91 Runoff=10.86 cfs 0.836 af

Subcatchment 107: WPost-03 Runoff Area=0.572 ac 48.25% Impervious Runoff Depth=7.28"
Tc=6.0 min CN=89 Runoff=4.57 cfs 0.347 af

Reach 11: (new Reach) Inflow=14.58 cfs 1.371 af
Outflow=14.58 cfs 1.371 af

Reach 111: Wetland Inflow=10.41 cfs 1.010 af
Outflow=10.41 cfs 1.010 af

Pond 102: Qp/WQ By Pass Peak Elev=76.37' Inflow=10.86 cfs 0.836 af
Primary=1.39 cfs 0.567 af Secondary=9.47 cfs 0.269 af Outflow=10.86 cfs 0.836 af

Pond 105: UIS A Peak Elev=75.43' Storage=9,953 cf Inflow=1.31 cfs 0.418 af
Outflow=0.25 cfs 0.418 af

Pond 106P: UDS Peak Elev=72.47' Storage=11,121 cf Inflow=9.47 cfs 0.269 af
Outflow=0.22 cfs 0.269 af

Pond 109: (new Pond)Sand Filter B Peak Elev=70.82' Storage=0.031 af Inflow=4.57 cfs 0.347 af
Discarded=0.01 cfs 0.039 af Primary=4.56 cfs 0.308 af Outflow=4.57 cfs 0.347 af

Pond CB 103: Isolator By Pass Peak Elev=75.44' Inflow=1.39 cfs 0.567 af
Primary=0.32 cfs 0.150 af Secondary=1.31 cfs 0.418 af Outflow=1.39 cfs 0.567 af

104

Pond Pond 103: UIS A (Isolator Row) w/ Peak Elev=75.44' Storage=3,202 cf Inflow=0.32 cfs 0.150 af
Outflow=0.08 cfs 0.150 af

Total Runoff Area = 5.529 ac Runoff Volume = 2.987 af Average Runoff Depth = 6.48"
74.57% Pervious = 4.123 ac 25.43% Impervious = 1.406 ac

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.292	74	> 75% grass HSG C (100)
0.192	74	> 75% grass cover HSG C (101)
0.286	80	> 75% grass cover HSG D (107)
0.146	80	> Grass cover HSG D (101)
0.488	74	>75% Grass cover, Good, HSG C (10, 107)
0.240	80	>75% Grass cover, Good, HSG D (10)
0.176	80	>75% grass HSG D (100)
1.152	98	Impervious (101, 107)
0.086	98	Off Site (100)
0.127	98	Off Site Impervious (10)
0.041	98	Offsite Impervious (101)
0.383	77	Woods HSG D (100, 101)
1.920	77	Woods/grass comb., Good, HSG D (10)
5.529	**82**	**TOTAL AREA**

Summary for Subcatchment 10: WPre01

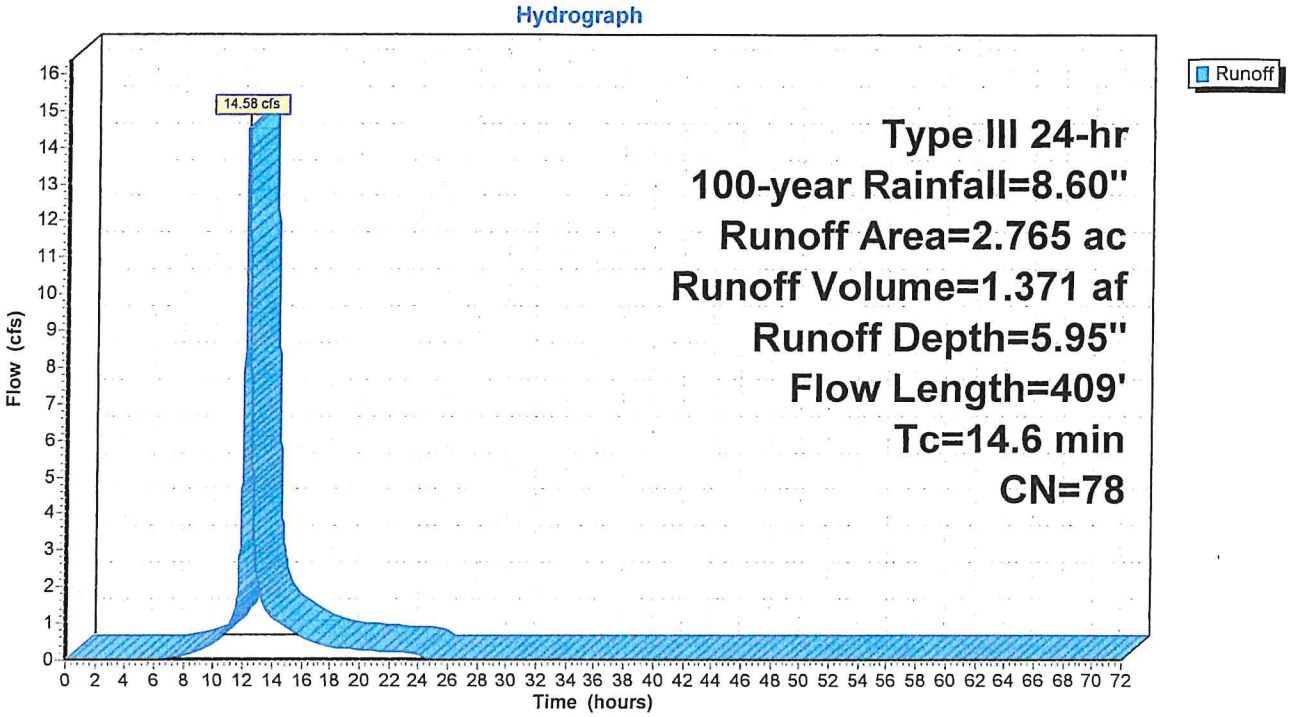
Runoff = 14.58 cfs @ 12.20 hrs, Volume= 1.371 af, Depth= 5.95"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year Rainfall=8.60"

	Area (ac)	CN	Description
*	0.127	98	Off Site Impervious
	0.478	74	>75% Grass cover, Good, HSG C
	0.240	80	>75% Grass cover, Good, HSG D
*	1.920	77	Woods/grass comb., Good, HSG D
	2.765	78	Weighted Average
	2.638		95.41% Pervious Area
	0.127		4.59% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.6	37	0.0450	0.13		**Sheet Flow, Sheet Flow 1A-1B** Grass: Dense n= 0.240 P2= 3.30"
8.5	63	0.0778	0.12		**Sheet Flow, Sheet Flow 1B-1C** Woods: Light underbrush n= 0.400 P2= 3.30"
0.2	41	0.0341	2.97		**Shallow Concentrated Flow, Shallow Concentrated Flow 1C-1D** Unpaved Kv= 16.1 fps
1.3	268	0.0451	3.42		**Shallow Concentrated Flow, Shallow Concentrated Flow** Unpaved Kv= 16.1 fps
14.6	409	Total			

Subcatchment 10: WPre01



Summary for Subcatchment 100: WPost-01

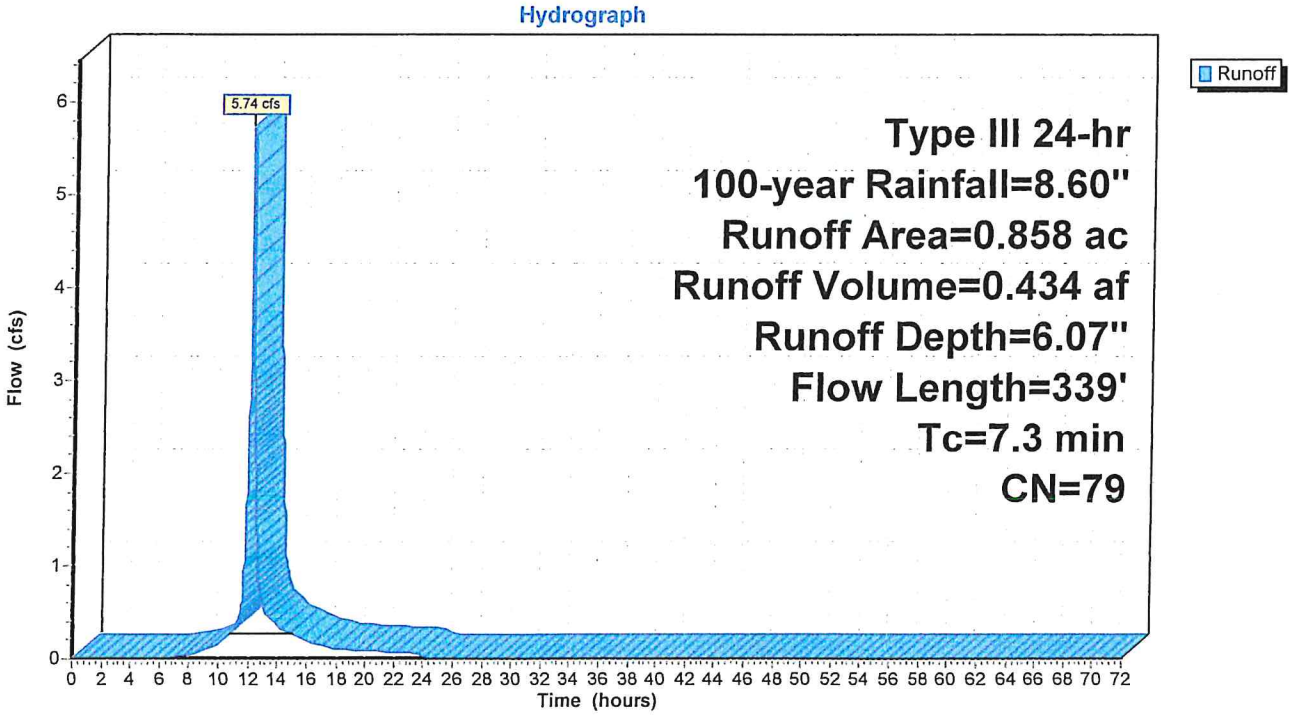
Runoff = 5.74 cfs @ 12.10 hrs, Volume= 0.434 af, Depth= 6.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year Rainfall=8.60"

	Area (ac)	CN	Description
*	0.086	98	Off Site
*	0.292	74	> 75% grass HSG C
*	0.176	80	>75% grass HSG D
*	0.304	77	Woods HSG D
	0.858	79	Weighted Average
	0.772		89.98% Pervious Area
	0.086		10.02% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.2	100	0.0610	0.27		**Sheet Flow, Sheet Flow 1A-1B** Grass: Short n= 0.150 P2= 3.30"
1.1	239	0.0468	3.48		**Shallow Concentrated Flow, Shalloe Concentrated Flow 1B-1C** Unpaved Kv= 16.1 fps
7.3	339	Total			

Subcatchment 100: WPost-01



Summary for Subcatchment 101: WPost-02

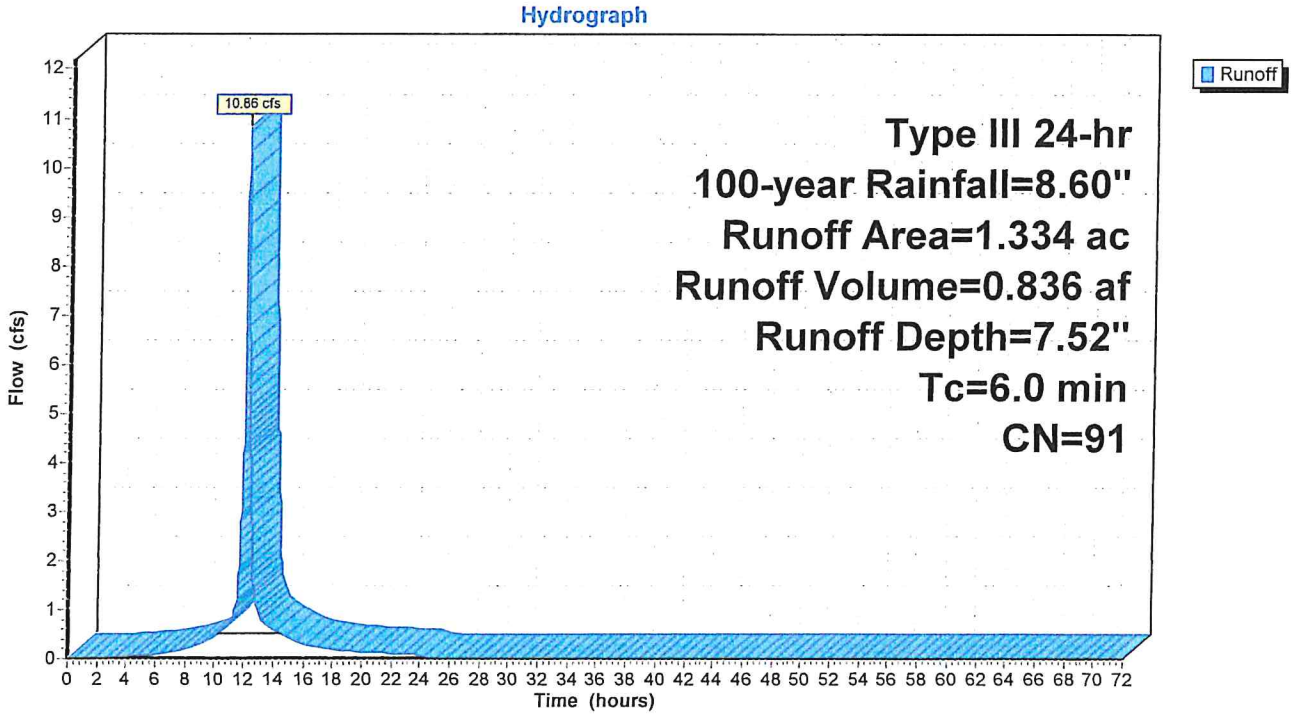
Runoff = 10.86 cfs @ 12.08 hrs, Volume= 0.836 af, Depth= 7.52"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year Rainfall=8.60"

	Area (ac)	CN	Description
*	0.876	98	Impervious
*	0.041	98	Offsite Impervious
*	0.192	74	> 75% grass cover HSG C
*	0.146	80	> Grass cover HSG D
*	0.079	77	Woods HSG D
	1.334	91	Weighted Average
	0.417		31.26% Pervious Area
	0.917		68.74% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment 101: WPost-02



Summary for Subcatchment 107: WPost-03

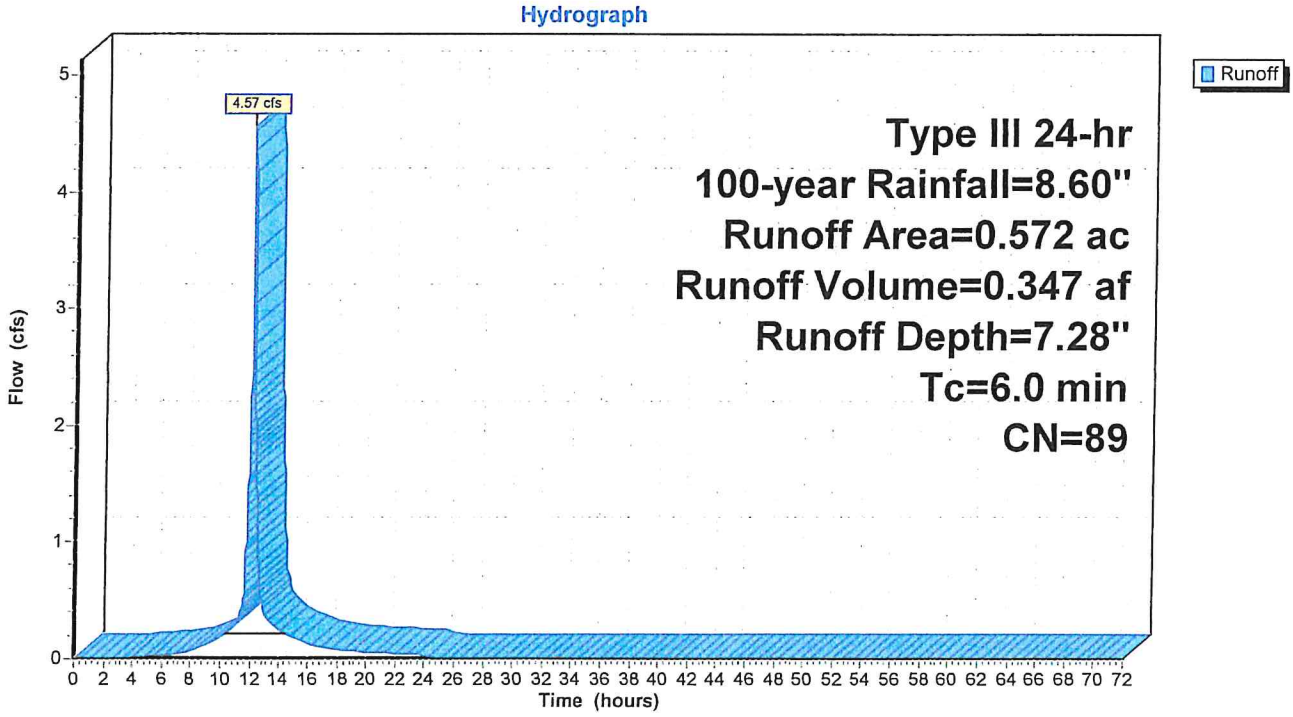
Runoff = 4.57 cfs @ 12.08 hrs, Volume= 0.347 af, Depth= 7.28"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year Rainfall=8.60"

	Area (ac)	CN	Description
*	0.276	98	Impervious
*	0.286	80	> 75% grass cover HSG D
	0.010	74	>75% Grass cover, Good, HSG C
	0.572	89	Weighted Average
	0.296		51.75% Pervious Area
	0.276		48.25% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment 107: WPost-03



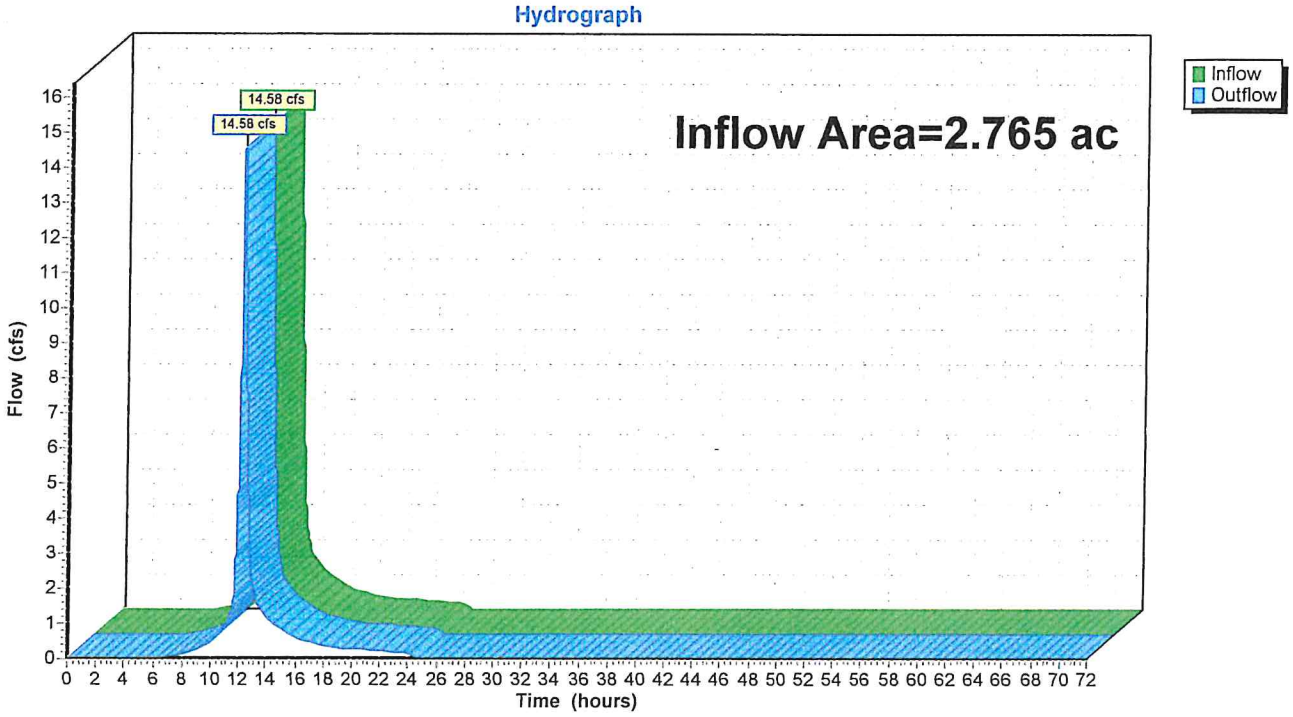
Summary for Reach 11: (new Reach)

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 2.765 ac, 4.59% Impervious, Inflow Depth = 5.95" for 100-year event
Inflow = 14.58 cfs @ 12.20 hrs, Volume= 1.371 af
Outflow = 14.58 cfs @ 12.20 hrs, Volume= 1.371 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2

Reach 11: (new Reach)



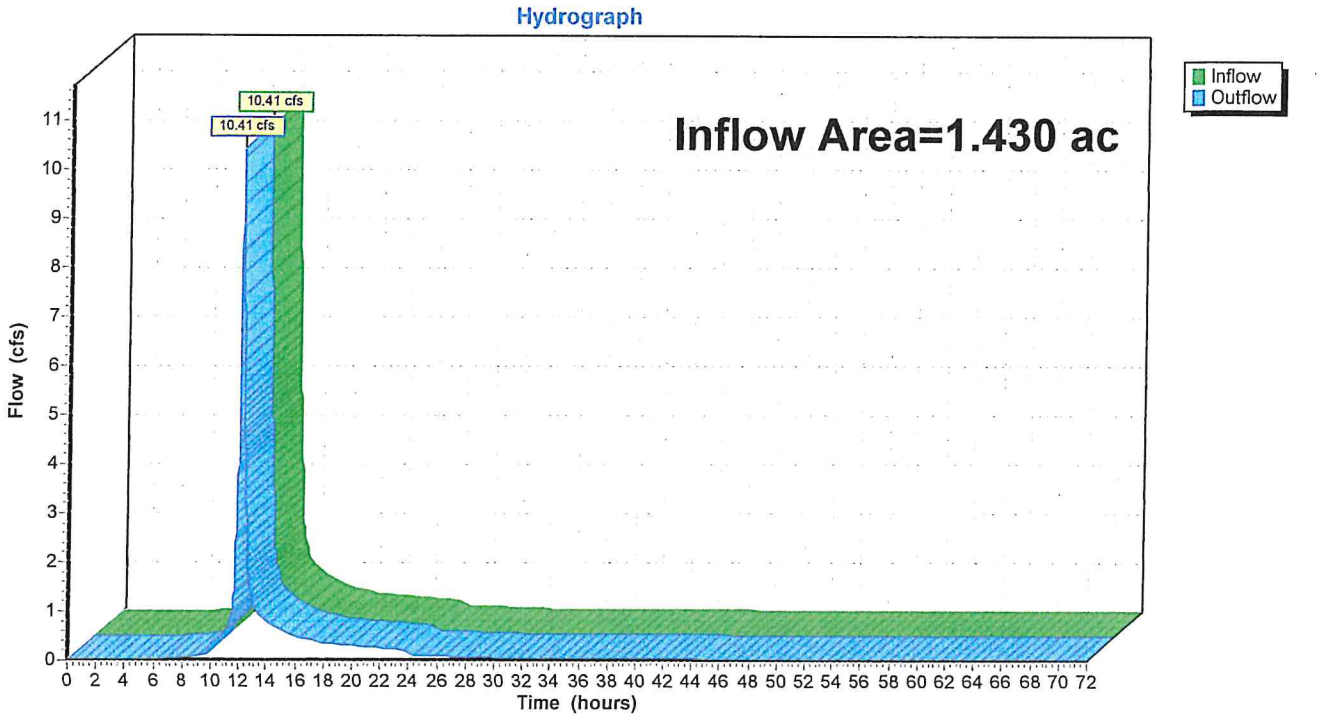
Summary for Reach 111: Wetland

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 1.430 ac, 25.31% Impervious, Inflow Depth = 8.48" for 100-year event
Inflow = 10.41 cfs @ 12.10 hrs, Volume= 1.010 af
Outflow = 10.41 cfs @ 12.10 hrs, Volume= 1.010 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2

Reach 111: Wetland



Summary for Pond 102: Qp/WQ By Pass

Inflow Area = 1.334 ac, 68.74% Impervious, Inflow Depth = 7.52" for 100-year event
Inflow = 10.86 cfs @ 12.08 hrs, Volume= 0.836 af
Outflow = 10.86 cfs @ 12.08 hrs, Volume= 0.836 af, Atten= 0%, Lag= 0.0 min
Primary = 1.39 cfs @ 12.08 hrs, Volume= 0.567 af
Secondary = 9.47 cfs @ 12.08 hrs, Volume= 0.269 af

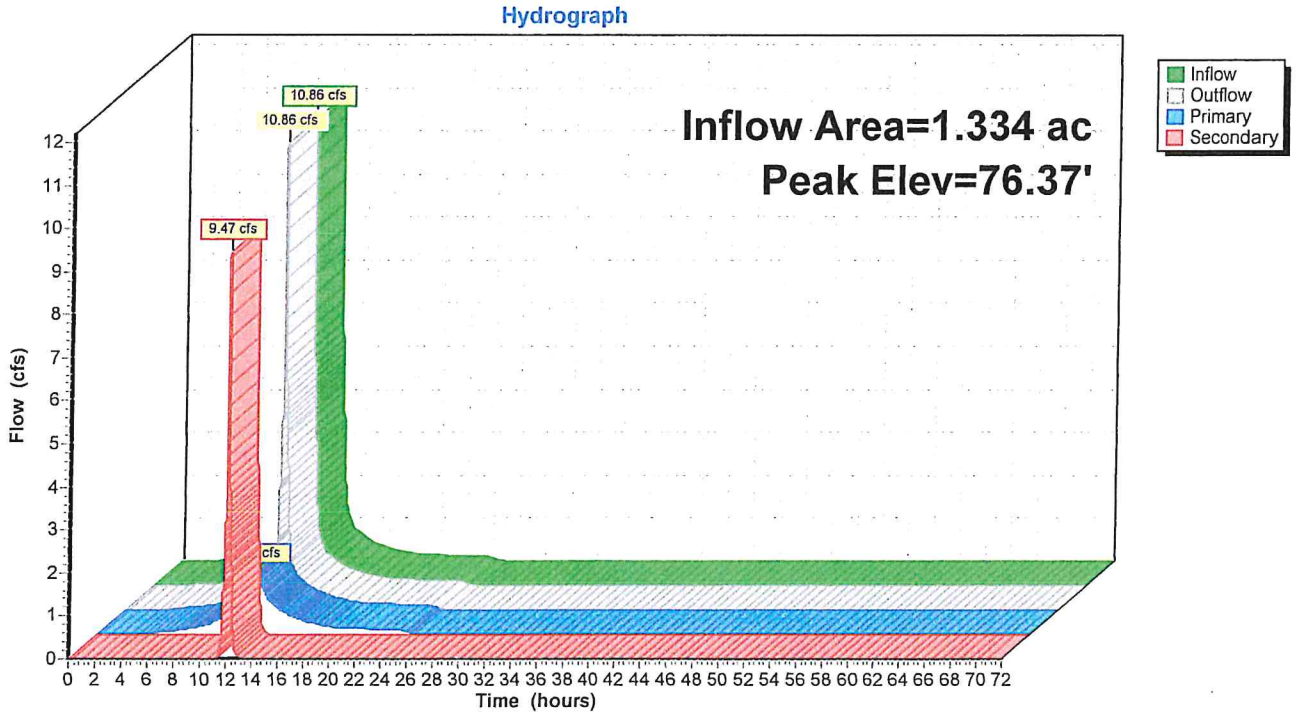
Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 76.37' @ 12.08 hrs
Flood Elev= 78.61'

Device	Routing	Invert	Outlet Devices
#1	Primary	73.50'	**6.0" Vert. 6.00" Vert WQ UIS** C= 0.600
#2	Device 3	75.75'	**6.0' long weir plate** 2 End Contraction(s)
#3	Secondary	72.50'	**18.0" Vert. 18" Vert. QP Pond** C= 0.600

Primary OutFlow Max=1.39 cfs @ 12.08 hrs HW=76.37' TW=74.22' (Dynamic Tailwater)
└─**1=6.00" Vert WQ UIS** (Orifice Controls 1.39 cfs @ 7.07 fps)

Secondary OutFlow Max=9.45 cfs @ 12.08 hrs HW=76.37' TW=71.43' (Dynamic Tailwater)
└─**3=18" Vert. QP Pond** (Passes 9.45 cfs of 15.04 cfs potential flow)
└─**2=weir plate** (Weir Controls 9.45 cfs @ 2.58 fps)

Pond 102: Qp/WQ By Pass



Summary for Pond 105: UIS A

[80] Warning: Exceeded Pond CB 103 by 1.17' @ 24.26 hrs (0.88 cfs 0.020 af)

Inflow	=	1.31 cfs @	12.11 hrs, Volume=	0.418 af
Outflow	=	0.25 cfs @	15.82 hrs, Volume=	0.418 af, Atten= 81%, Lag= 222.7 min
Discarded	=	0.25 cfs @	15.82 hrs, Volume=	0.418 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 75.43' @ 15.82 hrs Surf.Area= 7,849 sf Storage= 9,953 cf
Flood Elev= 76.00' Surf.Area= 7,849 sf Storage= 10,874 cf

Plug-Flow detention time= 519.4 min calculated for 0.418 af (100% of inflow)
Center-of-Mass det. time= 519.4 min (1,347.7 - 828.3)

Volume	Invert	Avail.Storage	Storage Description
#1	70.00'	4,278 cf	**Sand Filter (Prismatic)** Listed below (Recalc) 12,846 cf Overall x 33.3% Voids
#2A	73.00'	2,642 cf	**44.25'W x 80.60'L x 3.50'H Field A** 12,483 cf Overall - 4,548 cf Embedded = 7,935 cf x 33.3% Voids
#3A	73.50'	4,548 cf	**ADS_StormTech SC-740 +Cap** x 99 Inside #2 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 9 Rows of 11 Chambers
		11,468 cf	Total Available Storage

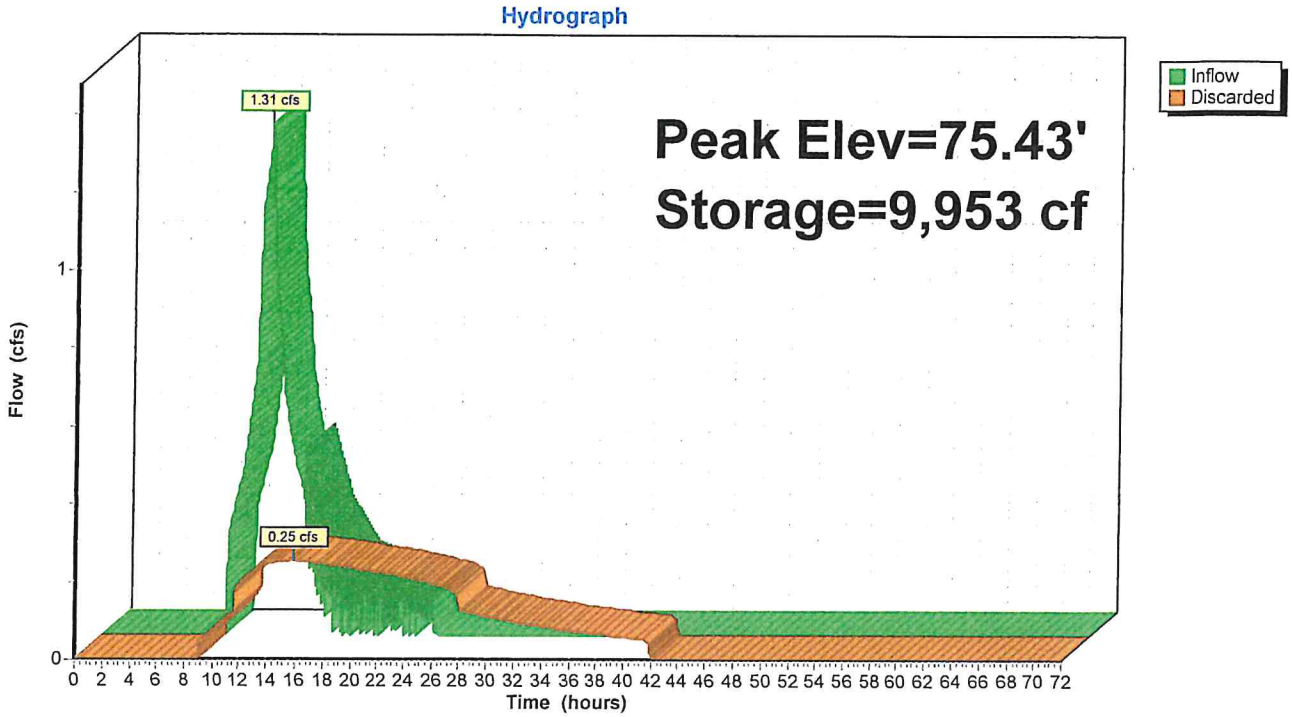
Storage Group A created with Chamber Wizard

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
70.00	4,282	0	0
73.00	4,282	12,846	12,846

Device	Routing	Invert	Outlet Devices
#1	Discarded	70.00'	**0.520 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 68.00' Phase-In= 0.01'

Discarded OutFlow Max=0.25 cfs @ 15.82 hrs HW=75.43' (Free Discharge)
↑—**1=Exfiltration** (Controls 0.25 cfs)

Pond 105: UIS A



Summary for Pond 106P: UDS

Inflow	=	9.47 cfs @	12.08 hrs, Volume=	0.269 af
Outflow	=	0.22 cfs @	12.66 hrs, Volume=	0.269 af, Atten= 98%, Lag= 34.6 min
Primary	=	0.22 cfs @	12.66 hrs, Volume=	0.269 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 72.47' @ 12.66 hrs Surf.Area= 5,764 sf Storage= 11,121 cf
Flood Elev= 75.00' Surf.Area= 0 sf Storage= 22,639 cf

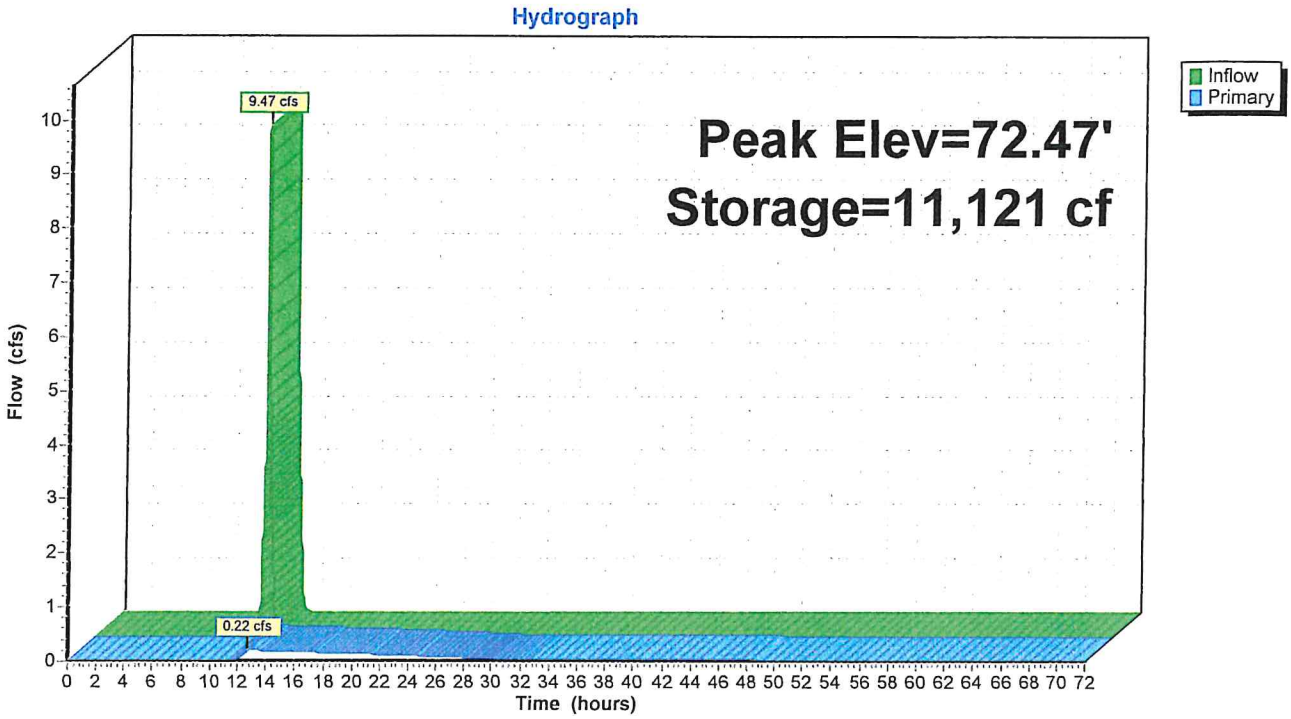
Plug-Flow detention time= 731.3 min calculated for 0.269 af (100% of inflow)
Center-of-Mass det. time= 731.3 min (1,457.7 - 726.4)

Volume	Invert	Avail.Storage	Storage Description
#1	70.00'	3,495 cf	**60.0" Round CMP_Round 60"** x 2 L= 89.0'
#2	70.00'	19,144 cf	**60.0" Round CMP_Round 60"** x 13 L= 75.0'
		22,639 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Device 4	70.00'	**1.0" Horiz. Low Flow CPv** C= 0.600 Limited to weir flow at low heads
#2	Device 4	70.65'	**2.0" W x 2.0" H Vert. Vert Orifice** C= 0.600
#3	Device 4	74.50'	**4.0' long x 0.5' breadth Broad-Crested Rectangular Outlet Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
#4	Primary	69.00'	**12.0" Round Culvert** L= 120.0' Ke= 0.500 Inlet / Outlet Invert= 69.00' / 68.00' S= 0.0083 '/' Cc= 0.900 n= 0.011 PVC, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.22 cfs @ 12.66 hrs HW=72.47' TW=0.00' (Dynamic Tailwater)
└**4=Culvert** (Passes 0.22 cfs of 5.73 cfs potential flow)
  ├**1=Low Flow CPv** (Orifice Controls 0.04 cfs @ 7.56 fps)
  ├**2=Vert Orifice** (Orifice Controls 0.18 cfs @ 6.34 fps)
  └**3=Broad-Crested Rectangular Outlet Weir** (Controls 0.00 cfs)

Pond 106P: UDS



Summary for Pond 109: (new Pond)Sand Filter B

Inflow Area = 0.572 ac, 48.25% Impervious, Inflow Depth = 7.28" for 100-year event
Inflow = 4.57 cfs @ 12.08 hrs, Volume= 0.347 af
Outflow = 4.57 cfs @ 12.09 hrs, Volume= 0.347 af, Atten= 0%, Lag= 0.3 min
Discarded = 0.01 cfs @ 39.11 hrs, Volume= 0.039 af
Primary = 4.56 cfs @ 12.09 hrs, Volume= 0.308 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 70.82' @ 12.09 hrs Surf.Area= 0.011 ac Storage= 0.031 af

Plug-Flow detention time= 157.7 min calculated for 0.347 af (100% of inflow)
Center-of-Mass det. time= 158.1 min (935.0 - 776.9)

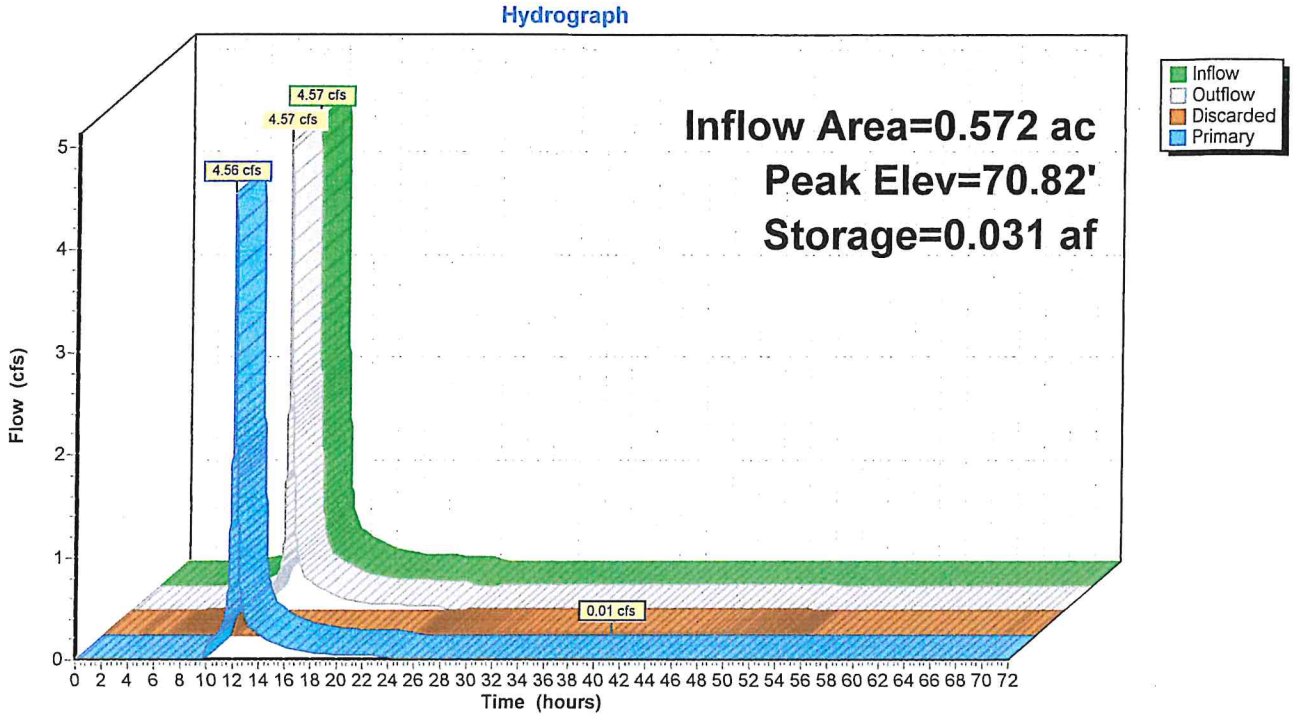
Volume	Invert	Avail.Storage	Storage Description
#1	69.00'	0.019 af	**32.60'W x 10.00'L x 2.50'H Prismatoid**
#2	67.00'	0.002 af	**10.00'W x 10.75'L x 2.00'H Prismatoid** 0.005 af Overall x 33.0% Voids
#3	69.00'	0.014 af	**18.0" Round Pipe Storage** x 4 L= 85.0'
#4	69.00'	0.002 af	**24.0" Round Pipe Storage** x 2 L= 12.0'
		0.036 af	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	67.00'	**0.520 in/hr Exfiltration over Surface area**
#2	Primary	70.50'	**10.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Discarded OutFlow Max=0.01 cfs @ 39.11 hrs HW=69.76' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.01 cfs)

Primary OutFlow Max=4.56 cfs @ 12.09 hrs HW=70.82' TW=0.00' (Dynamic Tailwater)
↑—**2=Broad-Crested Rectangular Weir** (Weir Controls 4.56 cfs @ 1.43 fps)

Pond 109: (new Pond)Sand Filter B



Summary for Pond CB 103: Isolator By Pass

[80] Warning: Exceeded Pond 102 by 1.63' @ 24.31 hrs (0.58 cfs 0.030 af)

Inflow Area =	1.334 ac, 68.74% Impervious,	Inflow Depth =	5.10"	for 100-year event
Inflow =	1.39 cfs @ 12.08 hrs,	Volume=	0.567 af	
Outflow =	1.39 cfs @ 12.08 hrs,	Volume=	0.567 af,	Atten= 0%, Lag= 0.0 min
Primary =	0.32 cfs @ 8.99 hrs,	Volume=	0.150 af	
Secondary =	1.31 cfs @ 12.11 hrs,	Volume=	0.418 af	

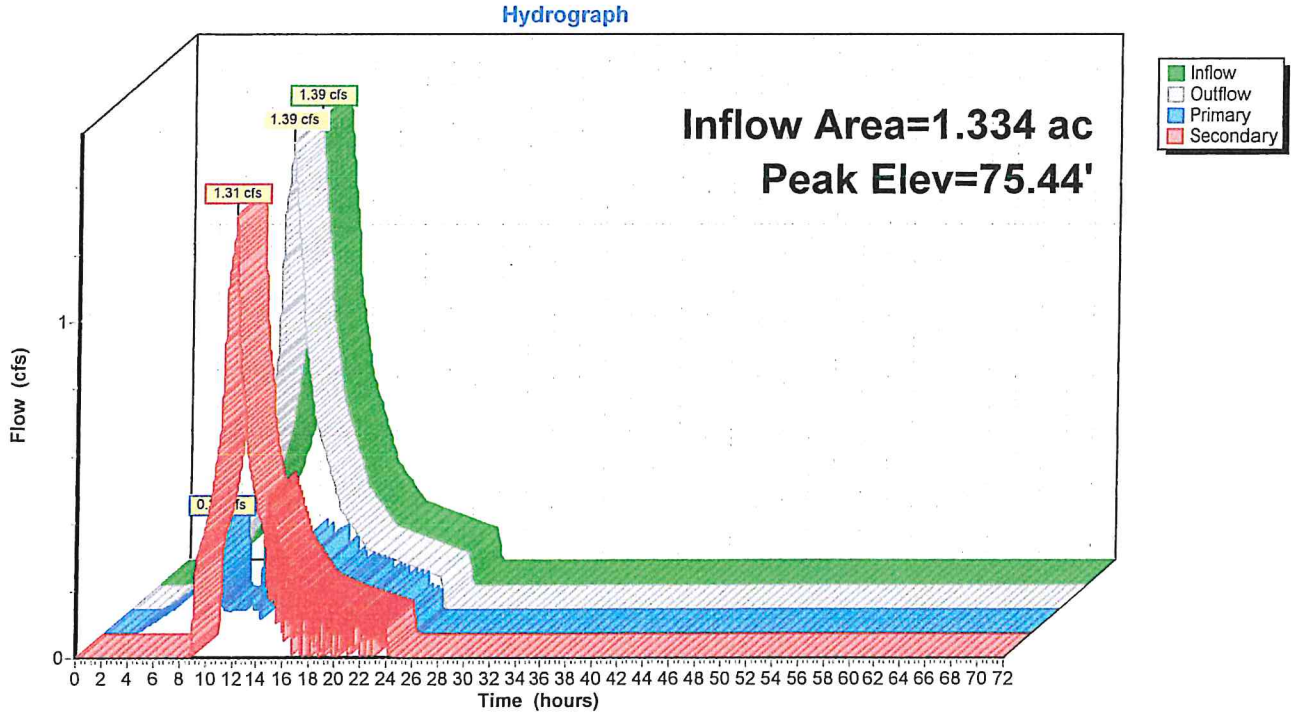
Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 75.44' @ 15.82 hrs
Flood Elev= 78.96'

Device	Routing	Invert	Outlet Devices
#1	Primary	73.00'	**15.0" Vert. Isolator Row** C= 0.600
#2	Device 3	74.00'	**4.0' long Weir PLate** 2 End Contraction(s)
#3	Secondary	73.55'	**15.0" Vert. CB 103 Isolator Bypass** C= 0.600

Primary OutFlow Max=0.32 cfs @ 8.99 hrs HW=73.99' TW=73.99' (Dynamic Tailwater)
└─**1=Isolator Row** (Orifice Controls 0.32 cfs @ 0.30 fps)

Secondary OutFlow Max=1.31 cfs @ 12.11 hrs HW=74.22' TW=73.87' (Dynamic Tailwater)
└─**3=CB 103 Isolator Bypass** (Passes 1.31 cfs of 1.86 cfs potential flow)
└─**2=Weir PLate** (Weir Controls 1.31 cfs @ 1.53 fps)

Pond CB 103: Isolator By Pass



Summary for Pond Pond 103: UIS A (Isolator Row) w/ Underground Sand Filter

[80] Warning: Exceeded Pond CB 103 by 1.17' @ 24.26 hrs (4.40 cfs 0.439 af)

Inflow Area = 1.334 ac, 68.74% Impervious, Inflow Depth = 1.35" for 100-year event
Inflow = 0.32 cfs @ 8.99 hrs, Volume= 0.150 af
Outflow = 0.08 cfs @ 15.84 hrs, Volume= 0.150 af, Atten= 76%, Lag= 411.0 min
Discarded = 0.08 cfs @ 15.84 hrs, Volume= 0.150 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 75.44' @ 15.84 hrs Surf.Area= 2,502 sf Storage= 3,202 cf
Flood Elev= 76.00' Surf.Area= 2,502 sf Storage= 3,526 cf

Plug-Flow detention time= 527.6 min calculated for 0.150 af (100% of inflow)
Center-of-Mass det. time= 527.7 min (1,221.2 - 693.5)

Volume	Invert	Avail.Storage	Storage Description
#1	70.00'	1,210 cf	**Sand Filter (Prismatic)** Listed below (Recalc) 3,633 cf Overall x 33.3% Voids
#2A	73.00'	999 cf	**15.75'W x 81.94'L x 3.50'H Field A** 4,517 cf Overall - 1,516 cf Embedded = 3,001 cf x 33.3% Voids
#3A	73.50'	1,516 cf	**ADS_StormTech SC-740 +Cap** x 33 Inside #2 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 3 Rows of 11 Chambers
#4	73.50'	34 cf	**4.00'D x 5.46'H Vertical Cone/Cylinder** x 0.5 -Impervious
		3,759 cf	Total Available Storage

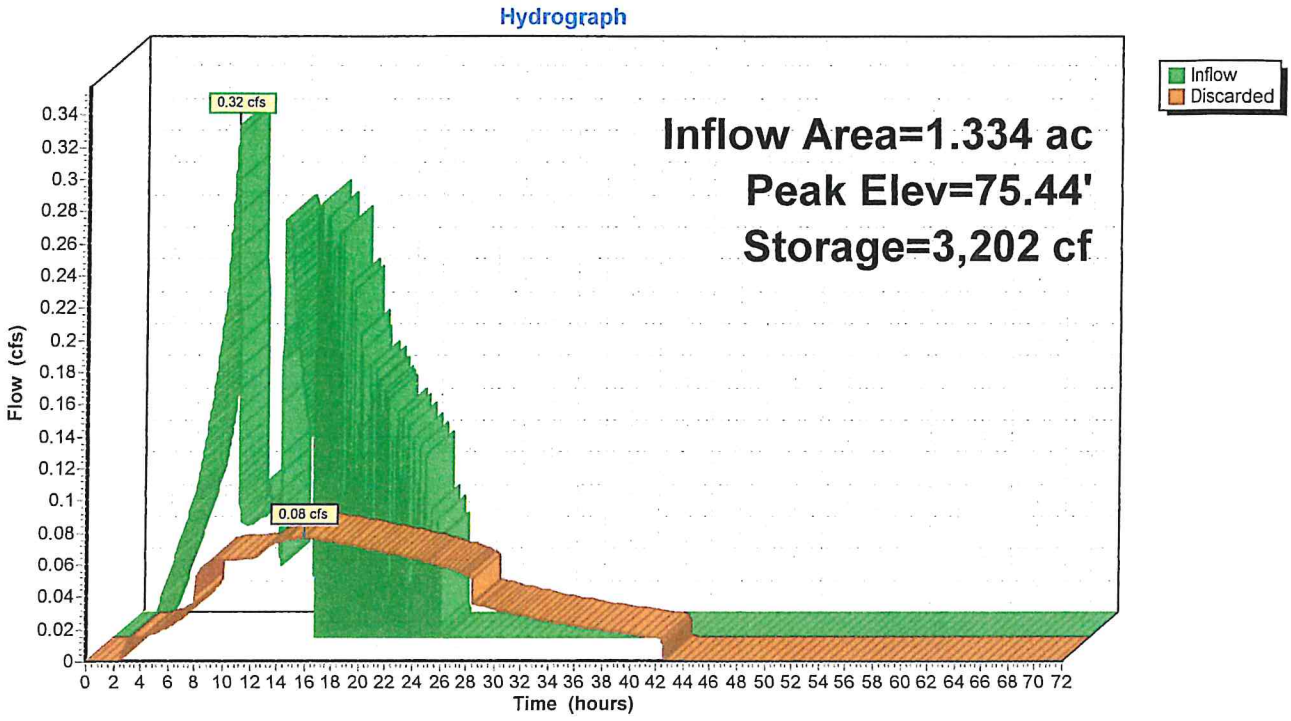
Storage Group A created with Chamber Wizard

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
70.00	1,211	0	0
73.00	1,211	3,633	3,633

Device	Routing	Invert	Outlet Devices
#1	Discarded	70.00'	**0.520 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 68.00' Phase-In= 0.01'

Discarded OutFlow Max=0.08 cfs @ 15.84 hrs HW=75.44' (Free Discharge)
↑**1=Exfiltration** (Controls 0.08 cfs)

Pond Pond 103: UIS A (Isolator Row) w/ Underground Sand Filter



What happens when one uses an infiltration rate of 0.27 for the proposed stormwater management system operations as modelled by HydroCAD

The model was slightly modified to allow the routing to continue, so that the specific problems can be identified. (See next slide)

Error 700: Unable to extend routing tables above xx'

While performing a pond routing, the water surface elevation has exceeded the expected range. HydroCAD attempted to extend the routing tables above the initial range, but failed because the storage and/or discharge curves are no longer increasing past the specified elevation.

This typically occurs because there is no additional storage or discharge capacity available. This makes it impossible to complete the routing operation.

- To correct the problem, you must provide additional storage and/or discharge information for higher elevations.

The system fails

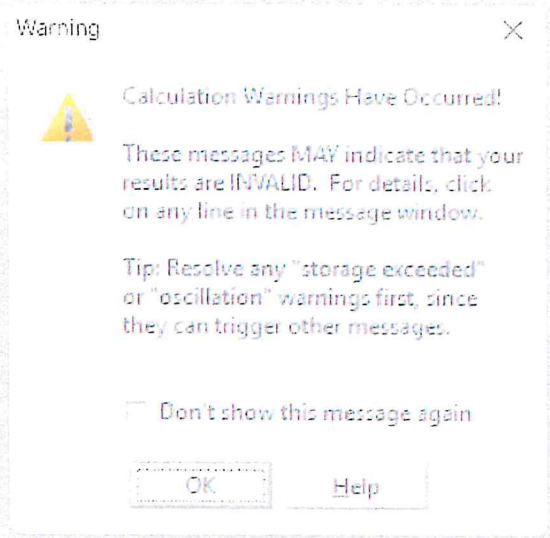
Item C1.

What happens when one uses an infiltration rate of 0.27 for the proposed stormwater management system operations as modelled by HydroCAD

Pass
By Pass
(Isolator Row) w/ Underground Sand Filter

Sand Filter B

w=Inflow)
y require smaller dt or Finer Routing (severity=3)



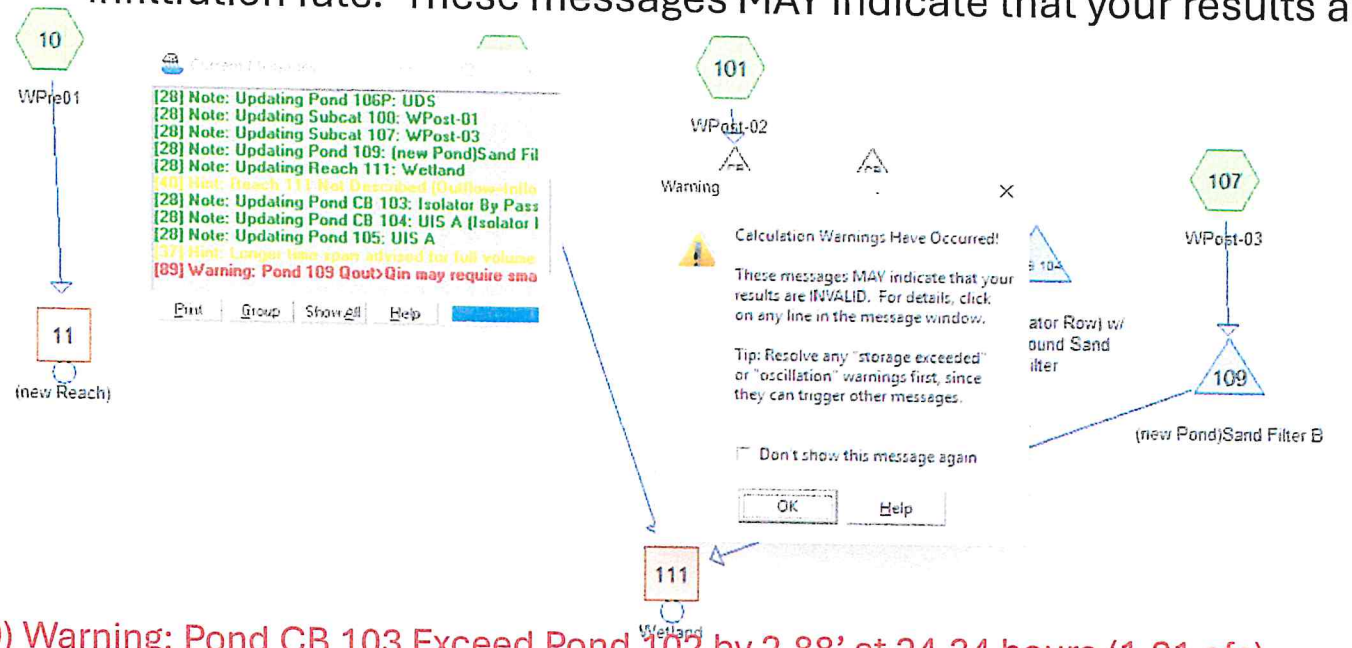
The system fails

Item C1.

Proposed Gooding Avenue Hotel

Model Shows *Error Messages*

HydroCAD Model shows Error Messages resulting from decreasing the infiltration rate. These messages MAY indicate that your results are INVALID



(80) Warning: Pond CB 103 Exceed Pond 102 by 2.88' at 24.34 hours (1.21 cfs)
(80) Warning: Pond CB 104 Exceed Pond 103 by 2.47' at 24.11 hours (8.03 cfs)
(80) Warning: Pond CB 105 Exceed Pond 103 by 2.47' at 24.11 hours (6.73 cfs)

Item C1.

Proposed Gooding Avenue Hotel

Explanation of *Error MessageS*

At some point during the routing, the node's water surface elevation has exceeded the water surface elevation of an inflowing pond, indicating a *possible reverse flow.* The message shows the maximum amount of reverse head, the time at which it occurred, and an estimate of the potential reverse flow.

Important: The pond routing is *not* altered by this situation, even though the higher tailwater may in reality cause a reverse flow. The routing continues to be performed as if a one-way valve were preventing the backflow.
The user is responsible for adjusting the model in any way that is deemed necessary to accommodate this situation.

Item C1.

Current Messages

[13] Note: Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points x 2
[16] Note: Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
[19] Note: Type III 24-hr 100-year Rainfall=8.60"
[22] Note: Reach routing by Dyn-Stor-Ind method
[25] Note: Pond routing by Dyn-Stor-Ind method
[28] Note: Updating Subcat 100: WPost-01
[28] Note: Updating Subcat 101: WPost-02
[28] Note: Updating Pond 102: Qp/WQ By Pass
[28] Note: Updating Pond CB 103: Isolator By Pass
[28] Note: Updating Pond Pond 104: UIS A (Isolator Row) w/ Underground Sand Filter
[28] Note: Updating Pond 105: UIS A
[28] Note: Updating Pond 106P: UDS
[28] Note: Updating Subcat 107: WPost-03
[28] Note: Updating Pond 109: (new Pond)Sand Filter B
[28] Note: Updating Reach 111: Wetland
[40] Hint: Reach 111 Not Described (Outflow=Inflow)
[87] Warning: Pond CB 103 Oscillations may require smaller dt or Finer Routing (severity=3)
[80] Warning: Pond CB 103 Exceeded Pond 102 by 2.88' @ 24.34 hrs (1.21 cfs 0.171 af)
[80] Warning: Pond Pond 104 Exceeded Pond CB 103 by 2.47' @ 24.11 hrs (8.03 cfs 2.305 af)
[80] Warning: Pond 105 Exceeded Pond CB 103 by 2.47' @ 24.11 hrs (6.72 cfs 0.690 af)
[37] Hint: Longer time span advised for full volumes

Item C1.

[80] Warning: {node} Exceeded Pond x by x.x' @ x.x hrs (x.x cfs x.x af)

At some point during the routing, the node's water surface elevation has exceeded the water surface elevation of an inflowing pond, indicating a *possible reverse flow.* The message shows the maximum amount of reverse head, the time at which it occurred, and an estimate of the potential reverse flow.

In some situations, the reverse head may be caused by an excessively large time increment. Reduce the dt or increase the finer routing increment to see if this reduces or eliminates the problem. Certain routing methods may require a finer routing increment when two adjacent nodes have very similar water surface elevations.

Important: The pond routing is *not* altered by this situation, even though the higher tailwater may in reality cause a reverse flow. The routing continues to be performed as if a one-way valve were preventing the backflow. The user is responsible for adjusting the model in any way that is deemed necessary to accommodate this situation. If the potential reverse flow volume is significant in proportion to the total outflow volume, you can consider modeling a reverse flow, which will also suppress this warning.

Note: This and other warning messages can be triggered by basic routing failures, such as oscillations. If any oscillation warnings are present, these must be resolved *first*.

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points x 2
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 10: WPre01 Runoff Area=2.765 ac 4.59% Impervious Runoff Depth=5.95"
Flow Length=409' Tc=14.6 min CN=78 Runoff=14.58 cfs 1.371 af

Subcatchment 100: WPost-01 Runoff Area=0.858 ac 10.02% Impervious Runoff Depth=6.07"
Flow Length=339' Tc=7.3 min CN=79 Runoff=5.74 cfs 0.434 af

Subcatchment 101: WPost-02 Runoff Area=1.334 ac 68.74% Impervious Runoff Depth=7.52"
Tc=6.0 min CN=91 Runoff=10.86 cfs 0.836 af

Subcatchment 107: WPost-03 Runoff Area=0.572 ac 48.25% Impervious Runoff Depth=7.28"
Tc=6.0 min CN=89 Runoff=4.57 cfs 0.347 af

Reach 11: (new Reach) Inflow=14.58 cfs 1.371 af
Outflow=14.58 cfs 1.371 af

Reach 111: Wetland Inflow=10.42 cfs 1.083 af
Outflow=10.42 cfs 1.083 af

Pond 102: Qp/WQ By Pass Peak Elev=76.37' Inflow=10.86 cfs 0.836 af
Primary=1.38 cfs 0.500 af Secondary=9.48 cfs 0.336 af Outflow=10.86 cfs 0.836 af

Pond 105: UIS A Peak Elev=75.78' Storage=10,579 cf Inflow=1.25 cfs 0.379 af
Outflow=0.14 cfs 0.379 af

Pond 106P: UDS Peak Elev=72.50' Storage=11,322 cf Inflow=9.48 cfs 0.336 af
Outflow=0.22 cfs 0.336 af

Pond 109: (new Pond)Sand Filter B Peak Elev=70.82' Storage=0.031 af Inflow=4.57 cfs 0.347 af
Discarded=0.01 cfs 0.028 af Primary=4.56 cfs 0.313 af Outflow=4.57 cfs 0.341 af

Pond CB 103: Isolator By Pass Peak Elev=75.78' Inflow=1.38 cfs 0.500 af
Primary=0.30 cfs 0.131 af Secondary=1.25 cfs 0.379 af Outflow=1.38 cfs 0.500 af

Pond Pond 104: UIS A (Isolator Row) w/ Peak Elev=75.78' Storage=3,422 cf Inflow=0.30 cfs 0.131 af
Outflow=0.04 cfs 0.131 af

Total Runoff Area = 5.529 ac Runoff Volume = 2.987 af Average Runoff Depth = 6.48"
74.57% Pervious = 4.123 ac 25.43% Impervious = 1.406 ac

Summary for Subcatchment 10: WPre01

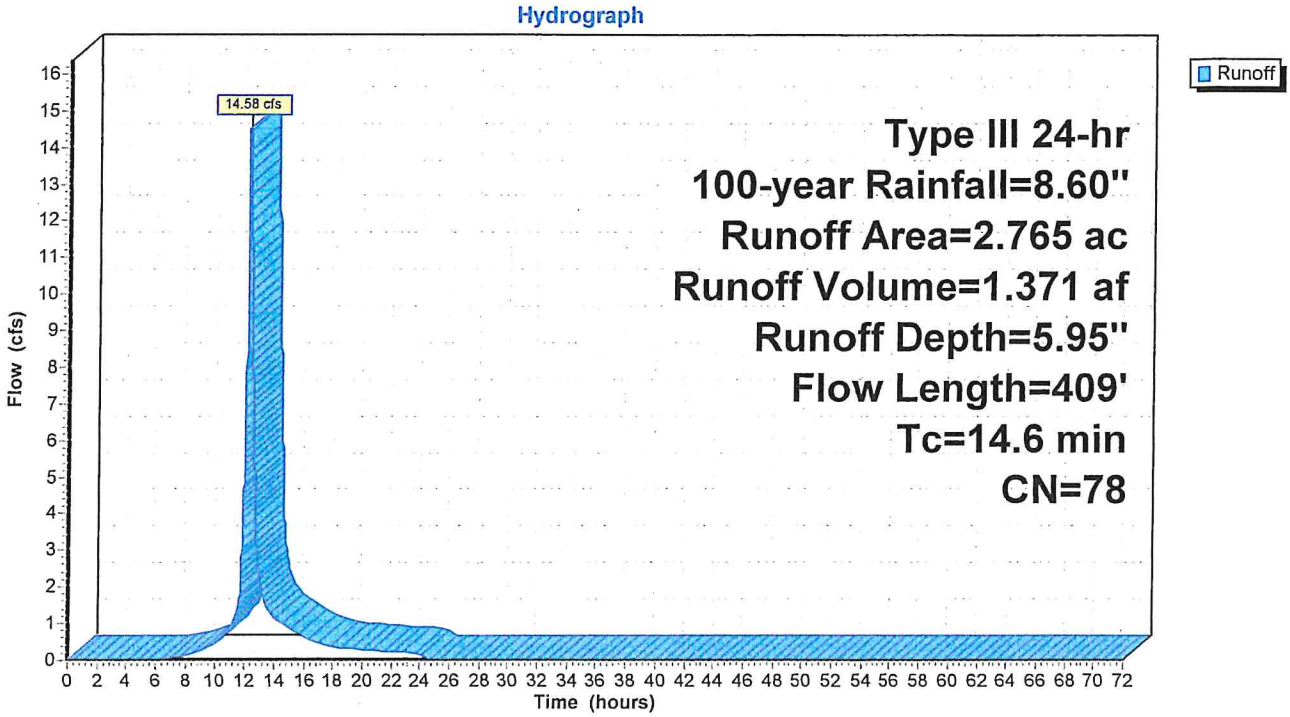
Runoff = 14.58 cfs @ 12.20 hrs, Volume= 1.371 af, Depth= 5.95"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year Rainfall=8.60"

	Area (ac)	CN	Description
*	0.127	98	Off Site Impervious
	0.478	74	>75% Grass cover, Good, HSG C
	0.240	80	>75% Grass cover, Good, HSG D
*	1.920	77	Woods/grass comb., Good, HSG D
	2.765	78	Weighted Average
	2.638		95.41% Pervious Area
	0.127		4.59% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.6	37	0.0450	0.13		**Sheet Flow, Sheet Flow 1A-1B** Grass: Dense n= 0.240 P2= 3.30"
8.5	63	0.0778	0.12		**Sheet Flow, Sheet Flow 1B-1C** Woods: Light underbrush n= 0.400 P2= 3.30"
0.2	41	0.0341	2.97		**Shallow Concentrated Flow, Shallow Concentrated Flow 1C-1D** Unpaved Kv= 16.1 fps
1.3	268	0.0451	3.42		**Shallow Concentrated Flow, Shallow Concentrated Flow** Unpaved Kv= 16.1 fps
14.6	409	Total			

Subcatchment 10: WPre01



Summary for Subcatchment 100: WPost-01

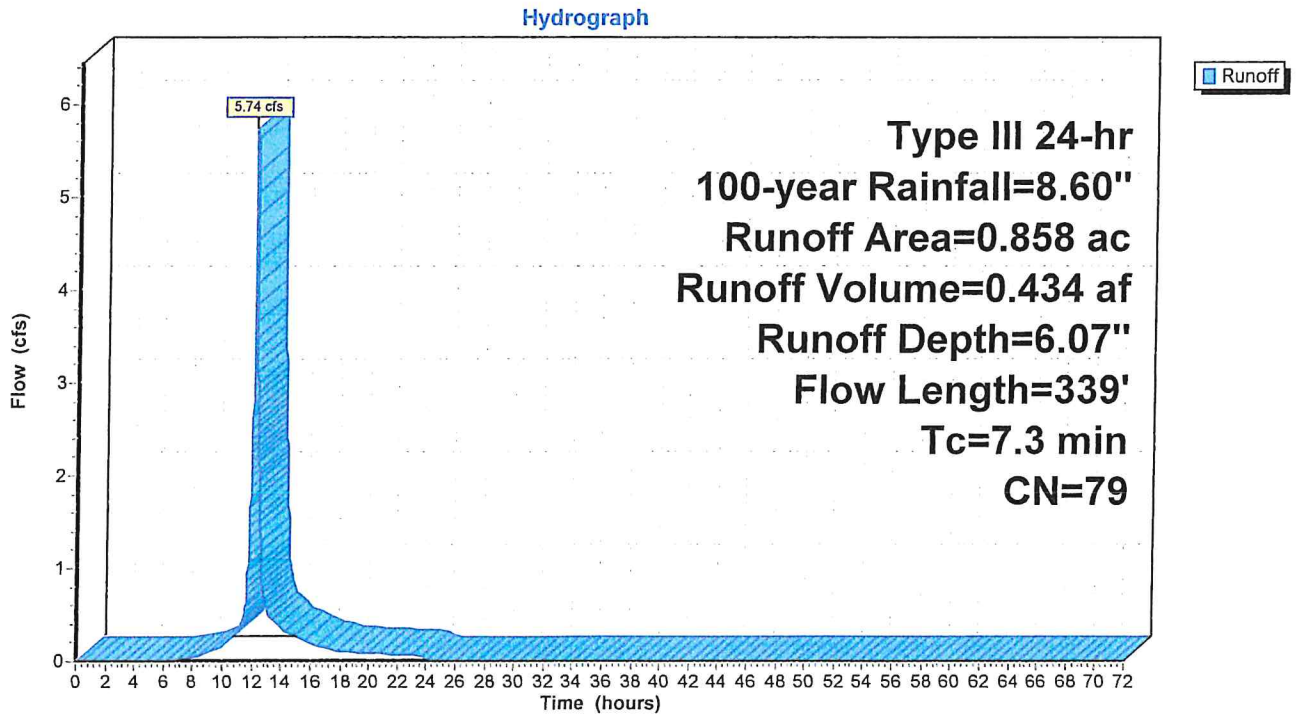
Runoff = 5.74 cfs @ 12.10 hrs, Volume= 0.434 af, Depth= 6.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year Rainfall=8.60"

	Area (ac)	CN	Description
*	0.086	98	Off Site
*	0.292	74	> 75% grass HSG C
*	0.176	80	>75% grass HSG D
*	0.304	77	Woods HSG D
	0.858	79	Weighted Average
	0.772		89.98% Pervious Area
	0.086		10.02% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.2	100	0.0610	0.27		**Sheet Flow, Sheet Flow 1A-1B** Grass: Short n= 0.150 P2= 3.30"
1.1	239	0.0468	3.48		**Shallow Concentrated Flow, Shalloe Concentrated Flow 1B-1C** Unpaved Kv= 16.1 fps
7.3	339	Total			

Subcatchment 100: WPost-01



Summary for Subcatchment 101: WPost-02

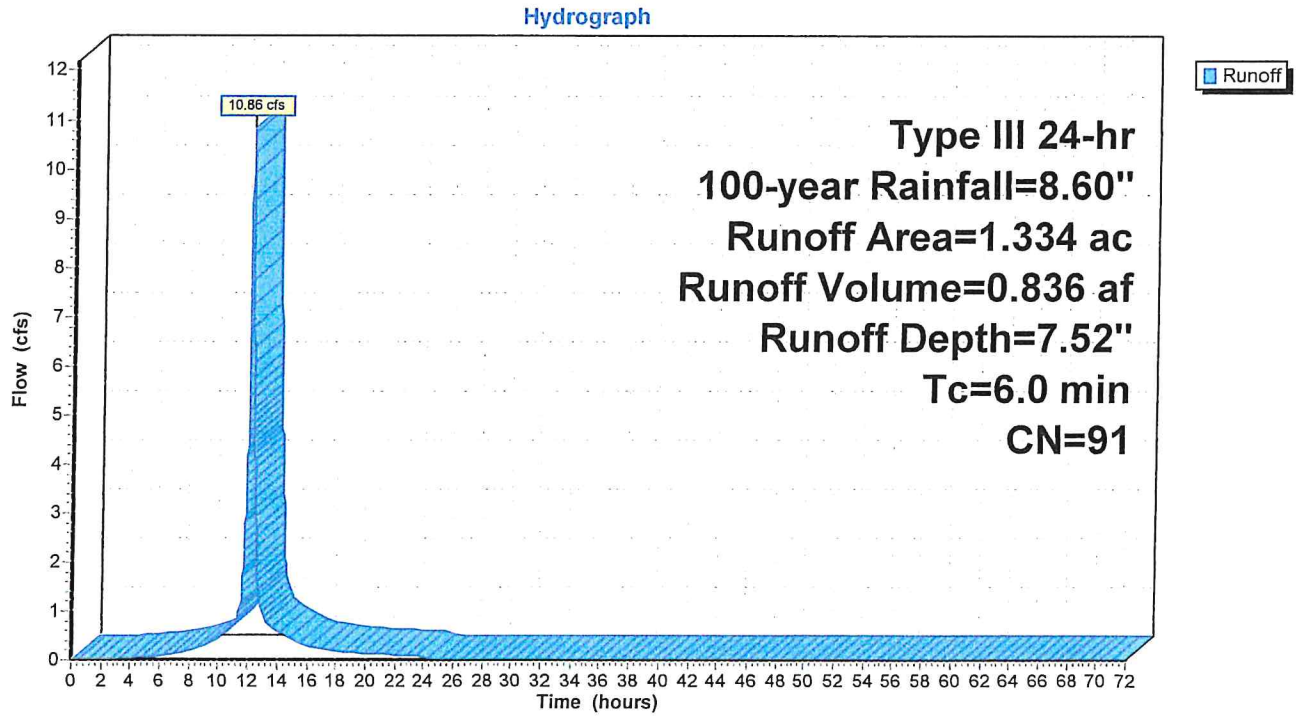
Runoff = 10.86 cfs @ 12.08 hrs, Volume= 0.836 af, Depth= 7.52"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year Rainfall=8.60"

	Area (ac)	CN	Description
*	0.876	98	Impervious
*	0.041	98	Offsite Impervious
*	0.192	74	> 75% grass cover HSG C
*	0.146	80	> Grass cover HSG D
*	0.079	77	Woods HSG D
	1.334	91	Weighted Average
	0.417		31.26% Pervious Area
	0.917		68.74% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment 101: WPost-02



Summary for Subcatchment 107: WPost-03

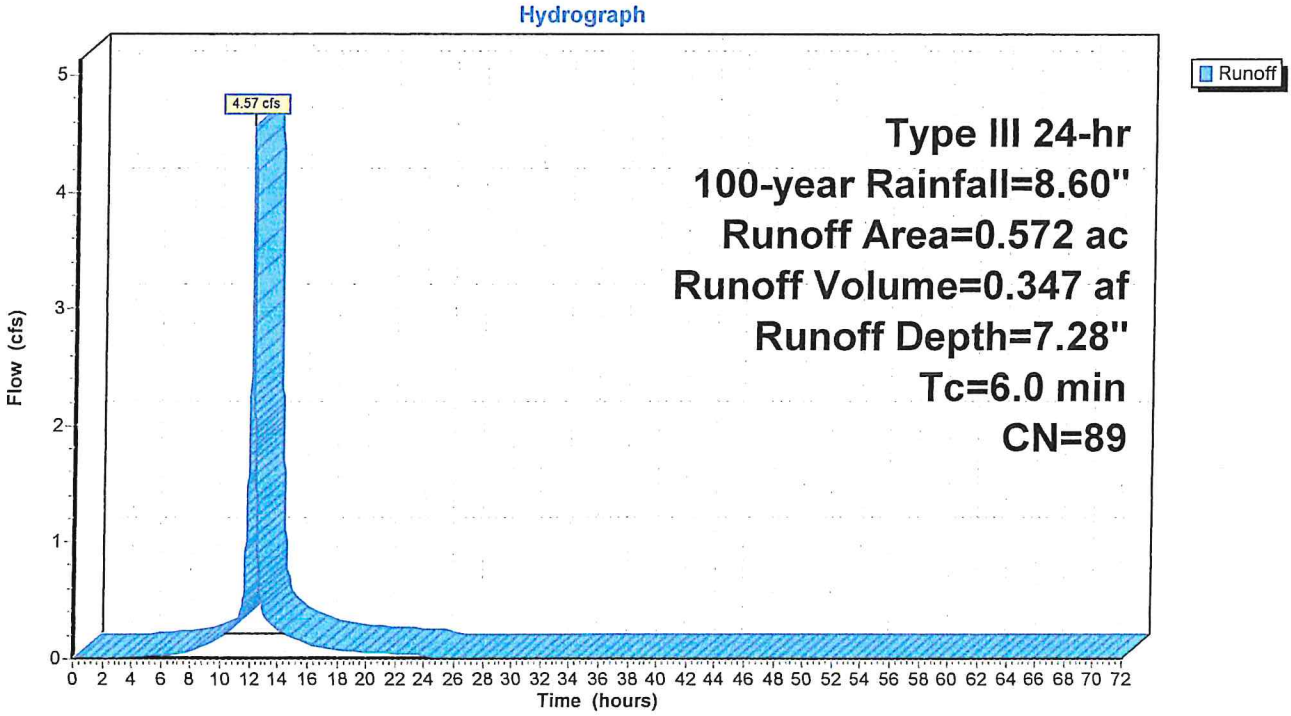
Runoff = 4.57 cfs @ 12.08 hrs, Volume= 0.347 af, Depth= 7.28"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year Rainfall=8.60"

	Area (ac)	CN	Description
*	0.276	98	Impervious
*	0.286	80	> 75% grass cover HSG D
	0.010	74	>75% Grass cover, Good, HSG C
	0.572	89	Weighted Average
	0.296		51.75% Pervious Area
	0.276		48.25% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment 107: WPost-03



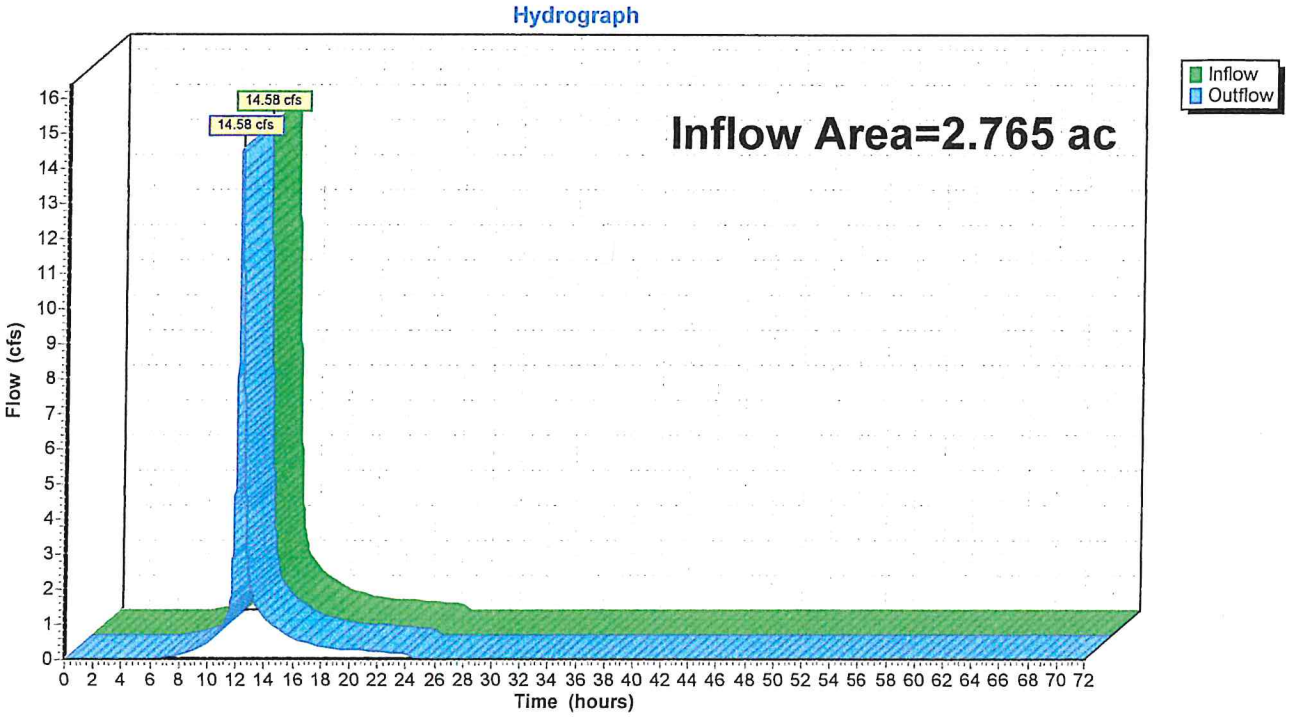
Summary for Reach 11: (new Reach)

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 2.765 ac, 4.59% Impervious, Inflow Depth = 5.95" for 100-year event
Inflow = 14.58 cfs @ 12.20 hrs, Volume= 1.371 af
Outflow = 14.58 cfs @ 12.20 hrs, Volume= 1.371 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2

Reach 11: (new Reach)



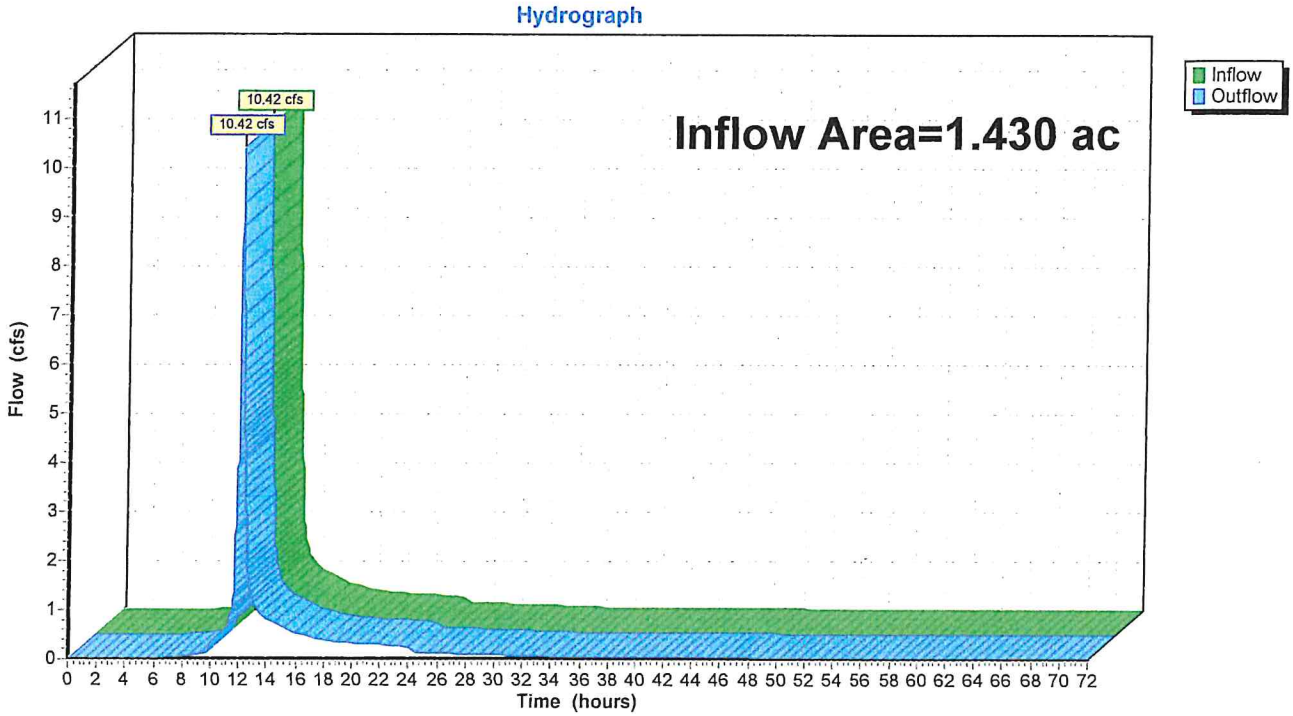
Summary for Reach 111: Wetland

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 1.430 ac, 25.31% Impervious, Inflow Depth > 9.08" for 100-year event
Inflow = 10.42 cfs @ 12.10 hrs, Volume= 1.083 af
Outflow = 10.42 cfs @ 12.10 hrs, Volume= 1.083 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2

Reach 111: Wetland



Summary for Pond 102: Qp/WQ By Pass

Inflow Area = 1.334 ac, 68.74% Impervious, Inflow Depth = 7.52" for 100-year event
Inflow = 10.86 cfs @ 12.08 hrs, Volume= 0.836 af
Outflow = 10.86 cfs @ 12.08 hrs, Volume= 0.836 af, Atten= 0%, Lag= 0.0 min
Primary = 1.38 cfs @ 12.07 hrs, Volume= 0.500 af
Secondary = 9.48 cfs @ 12.08 hrs, Volume= 0.336 af

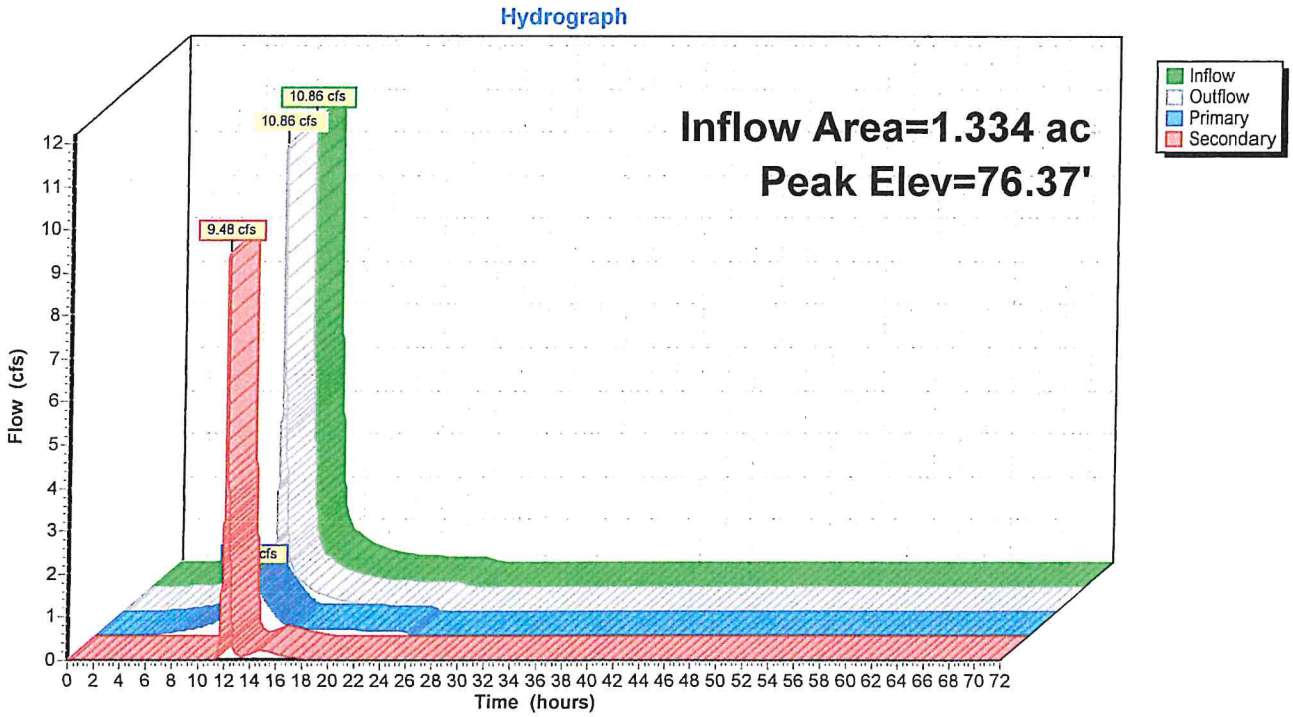
Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 76.37' @ 12.08 hrs
Flood Elev= 78.61'

Device	Routing	Invert	Outlet Devices
#1	Primary	73.50'	**6.0" Vert. 6.00" Vert WQ UIS** C= 0.600
#2	Device 3	75.75'	**6.0' long weir plate** 2 End Contraction(s)
#3	Secondary	72.50'	**18.0" Vert. 18" Vert. QP Pond** C= 0.600

Primary OutFlow Max=1.37 cfs @ 12.07 hrs HW=76.37' TW=74.26' (Dynamic Tailwater)
↑—**1=6.00" Vert WQ UIS** (Orifice Controls 1.37 cfs @ 7.00 fps)

Secondary OutFlow Max=9.46 cfs @ 12.08 hrs HW=76.37' TW=71.43' (Dynamic Tailwater)
↑—**3=18" Vert. QP Pond** (Passes 9.46 cfs of 15.04 cfs potential flow)
↑—**2=weir plate** (Weir Controls 9.46 cfs @ 2.58 fps)

Pond 102: Qp/WQ By Pass



Summary for Pond 105: UIS A

[80] Warning: Exceeded Pond CB 103 by 2.47' @ 24.11 hrs (6.72 cfs 0.690 af)

Inflow	=	1.25 cfs @	11.97 hrs, Volume=	0.379 af
Outflow	=	0.14 cfs @	15.34 hrs, Volume=	0.379 af, Atten= 89%, Lag= 202.3 min
Discarded	=	0.14 cfs @	15.34 hrs, Volume=	0.379 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 75.78' @ 15.34 hrs Surf.Area= 7,849 sf Storage= 10,579 cf
Flood Elev= 76.00' Surf.Area= 7,849 sf Storage= 10,874 cf

Plug-Flow detention time= 1,018.9 min calculated for 0.379 af (100% of inflow)
Center-of-Mass det. time= 1,018.8 min (1,833.8 - 814.9)

Volume	Invert	Avail.Storage	Storage Description
#1	70.00'	4,278 cf	**Sand Filter (Prismatic)** Listed below (Recalc) 12,846 cf Overall x 33.3% Voids
#2A	73.00'	2,642 cf	**44.25'W x 80.60'L x 3.50'H Field A** 12,483 cf Overall - 4,548 cf Embedded = 7,935 cf x 33.3% Voids
#3A	73.50'	4,548 cf	**ADS_StormTech SC-740 +Cap** x 99 Inside #2 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 9 Rows of 11 Chambers
		11,468 cf	Total Available Storage

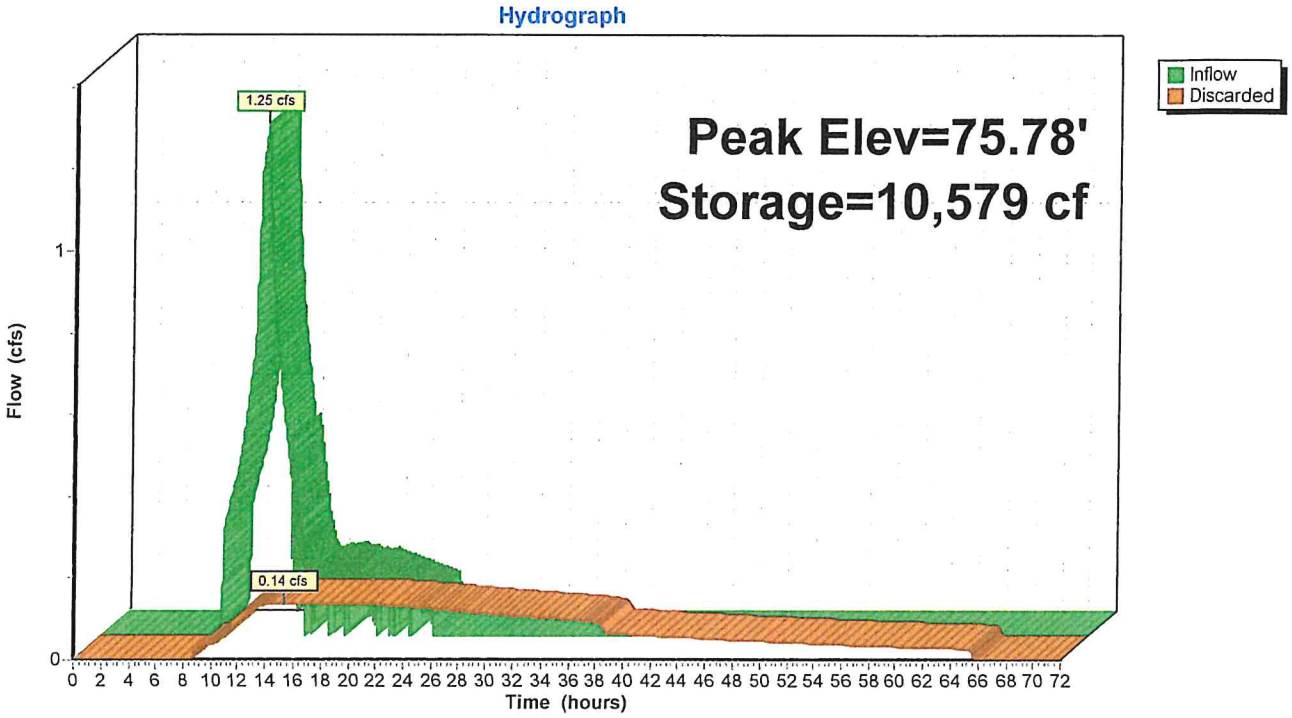
Storage Group A created with Chamber Wizard

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
70.00	4,282	0	0
73.00	4,282	12,846	12,846

Device	Routing	Invert	Outlet Devices
#1	Discarded	70.00'	**0.270 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 68.00' Phase-In= 0.01'

Discarded OutFlow Max=0.14 cfs @ 15.34 hrs HW=75.77' (Free Discharge)
↑**1=Exfiltration** (Controls 0.14 cfs)

Pond 105: UIS A



Summary for Pond 106P: UDS

Inflow	=	9.48 cfs @	12.08 hrs, Volume=	0.336 af
Outflow	=	0.22 cfs @	12.81 hrs, Volume=	0.336 af, Atten= 98%, Lag= 43.8 min
Primary	=	0.22 cfs @	12.81 hrs, Volume=	0.336 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 72.50' @ 12.81 hrs Surf.Area= 5,765 sf Storage= 11,322 cf
Flood Elev= 75.00' Surf.Area= 0 sf Storage= 22,639 cf

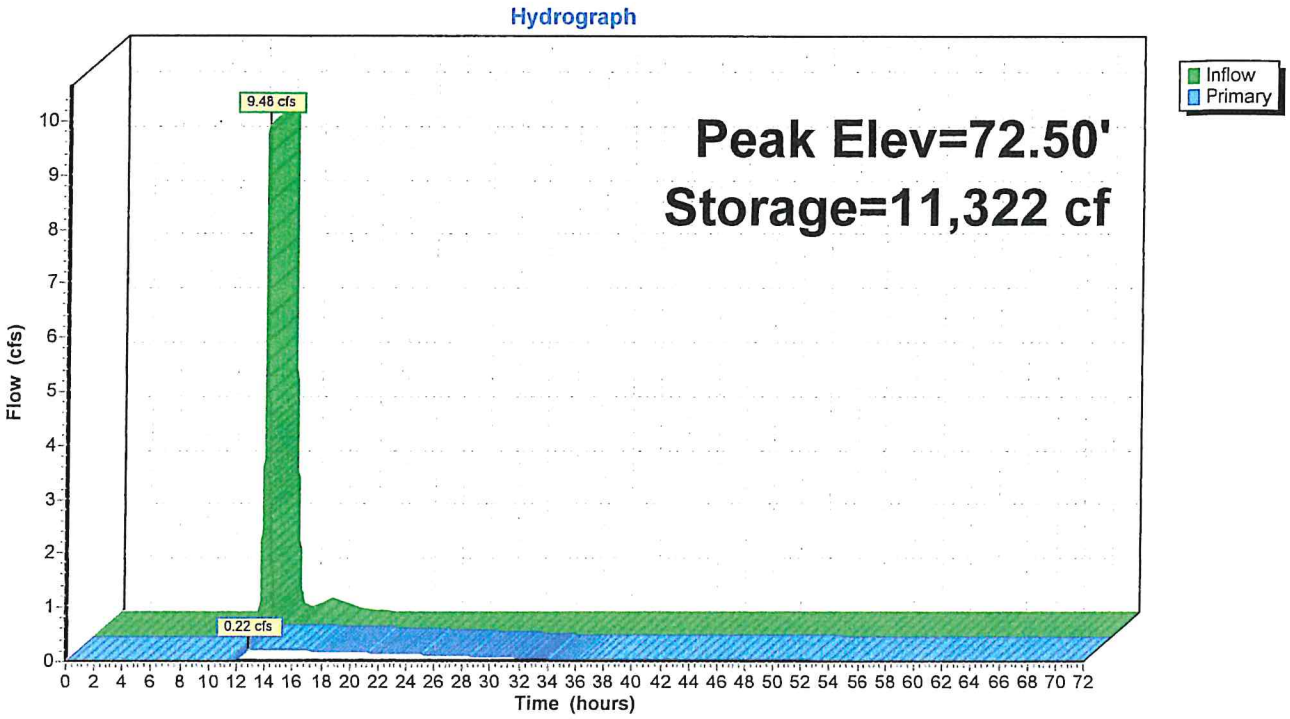
Plug-Flow detention time= 751.9 min calculated for 0.336 af (100% of inflow)
Center-of-Mass det. time= 751.6 min (1,512.7 - 761.1)

Volume	Invert	Avail.Storage	Storage Description
#1	70.00'	3,495 cf	**60.0" Round CMP_Round 60"** x 2 L= 89.0'
#2	70.00'	19,144 cf	**60.0" Round CMP_Round 60"** x 13 L= 75.0'
		22,639 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Device 4	70.00'	**1.0" Horiz. Low Flow CPv** C= 0.600 Limited to weir flow at low heads
#2	Device 4	70.65'	**2.0" W x 2.0" H Vert. Vert Orifice** C= 0.600
#3	Device 4	74.50'	**4.0' long x 0.5' breadth Broad-Crested Rectangular Outlet Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
#4	Primary	69.00'	**12.0" Round Culvert** L= 120.0' Ke= 0.500 Inlet / Outlet Invert= 69.00' / 68.00' S= 0.0083 '/' Cc= 0.900 n= 0.011 PVC, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.22 cfs @ 12.81 hrs HW=72.50' TW=0.00' (Dynamic Tailwater)
└**4=Culvert** (Passes 0.22 cfs of 5.76 cfs potential flow)
  ├**1=Low Flow CPv** (Orifice Controls 0.04 cfs @ 7.61 fps)
  ├**2=Vert Orifice** (Orifice Controls 0.18 cfs @ 6.40 fps)
  └**3=Broad-Crested Rectangular Outlet Weir** (Controls 0.00 cfs)

Pond 106P: UDS



Summary for Pond 109: (new Pond)Sand Filter B

Inflow Area = 0.572 ac, 48.25% Impervious, Inflow Depth = 7.28" for 100-year event
Inflow = 4.57 cfs @ 12.08 hrs, Volume= 0.347 af
Outflow = 4.57 cfs @ 12.09 hrs, Volume= 0.341 af, Atten= 0%, Lag= 0.3 min
Discarded = 0.01 cfs @ 52.93 hrs, Volume= 0.028 af
Primary = 4.56 cfs @ 12.09 hrs, Volume= 0.313 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 70.82' @ 12.09 hrs Surf.Area= 0.011 ac Storage= 0.031 af

Plug-Flow detention time= 177.3 min calculated for 0.341 af (98% of inflow)
Center-of-Mass det. time= 167.4 min (944.3 - 776.9)

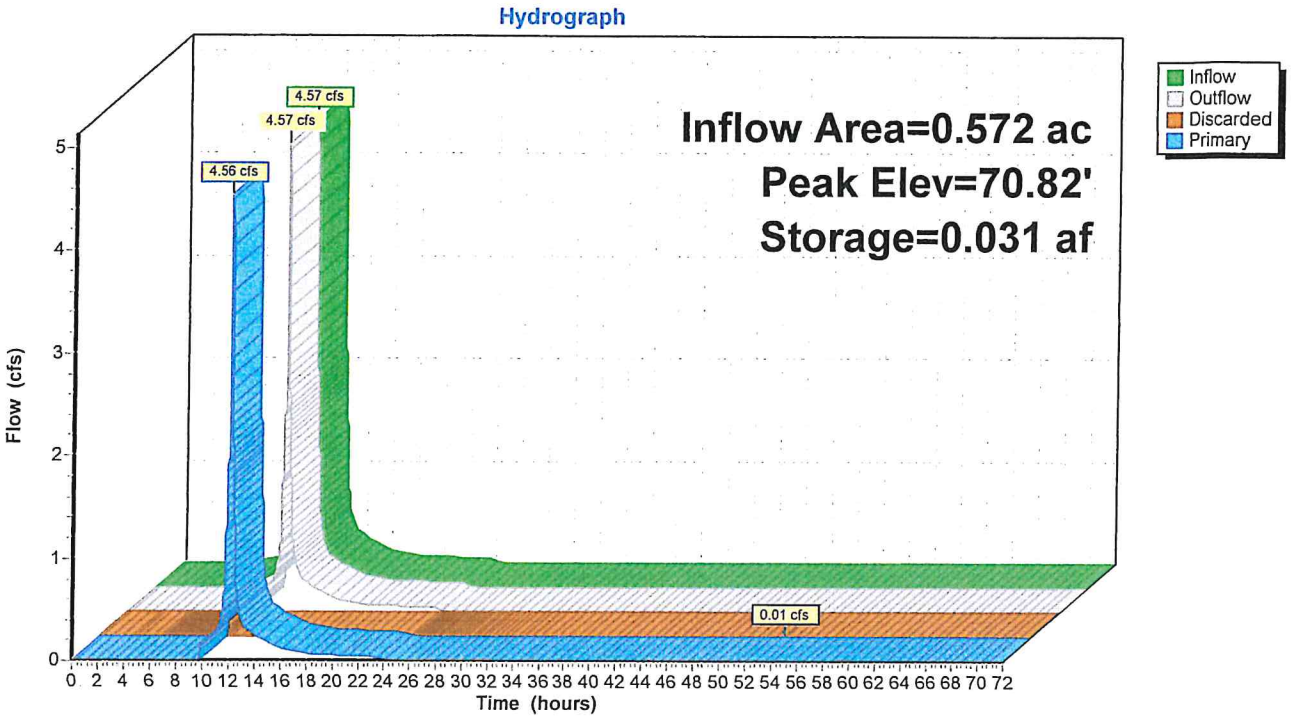
Volume	Invert	Avail.Storage	Storage Description
#1	69.00'	0.019 af	**32.60'W x 10.00'L x 2.50'H Prismatoid**
#2	67.00'	0.002 af	**10.00'W x 10.75'L x 2.00'H Prismatoid** 0.005 af Overall x 33.0% Voids
#3	69.00'	0.014 af	**18.0" Round Pipe Storage** x 4 L= 85.0'
#4	69.00'	0.002 af	**24.0" Round Pipe Storage** x 2 L= 12.0'
		0.036 af	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	67.00'	**0.270 in/hr Exfiltration over Surface area**
#2	Primary	70.50'	**10.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Discarded OutFlow Max=0.01 cfs @ 52.93 hrs HW=69.76' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.01 cfs)

Primary OutFlow Max=4.56 cfs @ 12.09 hrs HW=70.82' TW=0.00' (Dynamic Tailwater)
↑—**2=Broad-Crested Rectangular Weir** (Weir Controls 4.56 cfs @ 1.43 fps)

Pond 109: (new Pond)Sand Filter B



Summary for Pond CB 103: Isolator By Pass

[87] Warning: Oscillations may require smaller dt or Finer Routing (severity=3)
[80] Warning: Exceeded Pond 102 by 2.88' @ 24.34 hrs (1.21 cfs 0.171 af)

Inflow Area = 1.334 ac, 68.74% Impervious, Inflow Depth = 4.50" for 100-year event
Inflow = 1.38 cfs @ 12.07 hrs, Volume= 0.500 af
Outflow = 1.38 cfs @ 12.07 hrs, Volume= 0.500 af, Atten= 0%, Lag= 0.0 min
Primary = 0.30 cfs @ 14.12 hrs, Volume= 0.131 af
Secondary = 1.25 cfs @ 11.97 hrs, Volume= 0.379 af

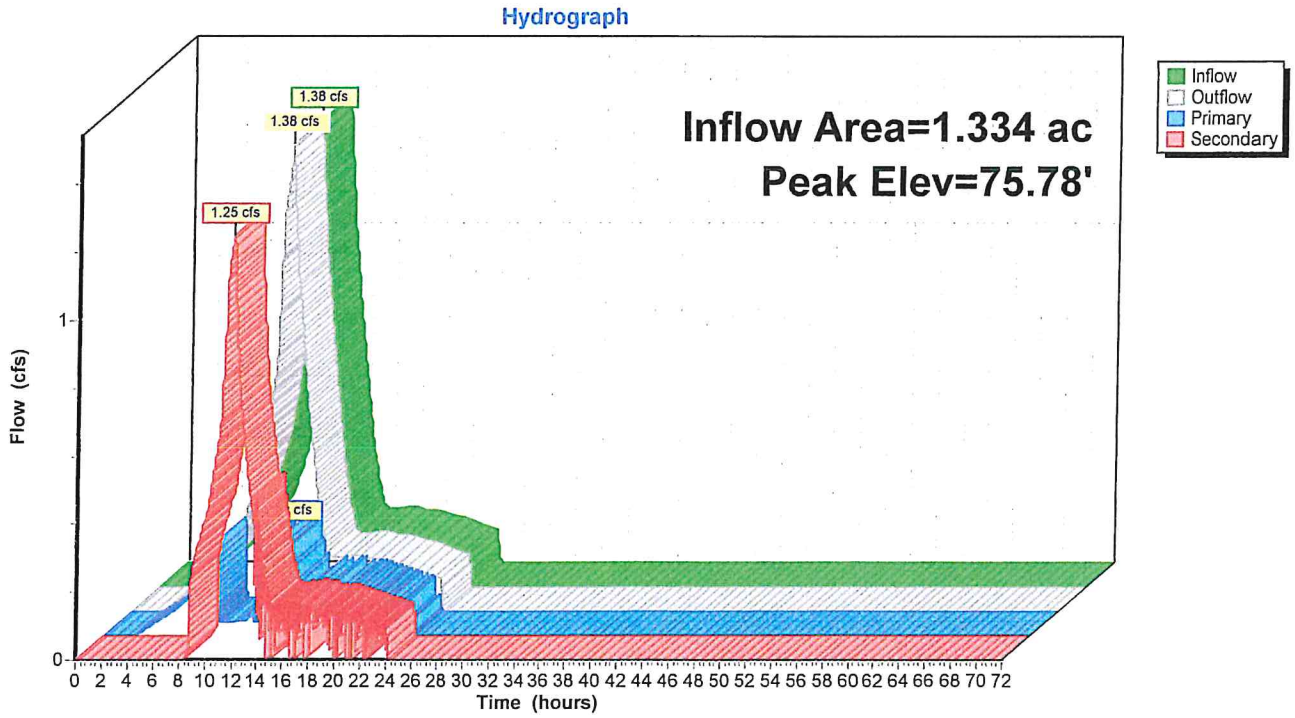
Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 75.78' @ 15.34 hrs
Flood Elev= 78.96'

Device	Routing	Invert	Outlet Devices
#1	Primary	73.00'	**15.0" Vert. Isolator Row** C= 0.600
#2	Device 3	74.00'	**4.0' long Weir PLate** 2 End Contraction(s)
#3	Secondary	73.55'	**15.0" Vert. CB 103 Isolator Bypass** C= 0.600

Primary OutFlow Max=0.00 cfs @ 14.12 hrs HW=75.63' TW=75.63' (Dynamic Tailwater)
└─**1=Isolator Row** (Controls 0.00 cfs)

Secondary OutFlow Max=1.25 cfs @ 11.97 hrs HW=74.21' TW=74.00' (Dynamic Tailwater)
└─**3=CB 103 Isolator Bypass** (Passes 1.25 cfs of 1.45 cfs potential flow)
└─**2=Weir PLate** (Weir Controls 1.25 cfs @ 1.50 fps)

Pond CB 103: Isolator By Pass



Summary for Pond Pond 104: UIS A (Isolator Row) w/ Underground Sand Filter

[80] Warning: Exceeded Pond CB 103 by 2.47' @ 24.11 hrs (8.03 cfs 2.305 af)

Inflow Area = 1.334 ac, 68.74% Impervious, Inflow Depth = 1.18" for 100-year event
Inflow = 0.30 cfs @ 14.12 hrs, Volume= 0.131 af
Outflow = 0.04 cfs @ 15.17 hrs, Volume= 0.131 af, Atten= 86%, Lag= 63.0 min
Discarded = 0.04 cfs @ 15.17 hrs, Volume= 0.131 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 75.78' @ 15.17 hrs Surf.Area= 2,502 sf Storage= 3,422 cf
Flood Elev= 76.00' Surf.Area= 2,502 sf Storage= 3,526 cf

Plug-Flow detention time= 1,050.1 min calculated for 0.131 af (100% of inflow)
Center-of-Mass det. time= 1,050.1 min (1,746.4 - 696.3)

Volume	Invert	Avail.Storage	Storage Description
#1	70.00'	1,210 cf	**Sand Filter (Prismatic)** Listed below (Recalc) 3,633 cf Overall x 33.3% Voids
#2A	73.00'	999 cf	**15.75'W x 81.94'L x 3.50'H Field A** 4,517 cf Overall - 1,516 cf Embedded = 3,001 cf x 33.3% Voids
#3A	73.50'	1,516 cf	**ADS_StormTech SC-740 +Cap** x 33 Inside #2 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 3 Rows of 11 Chambers
#4	73.50'	34 cf	**4.00'D x 5.46'H Vertical Cone/Cylinder** x 0.5 -Impervious
		3,759 cf	Total Available Storage

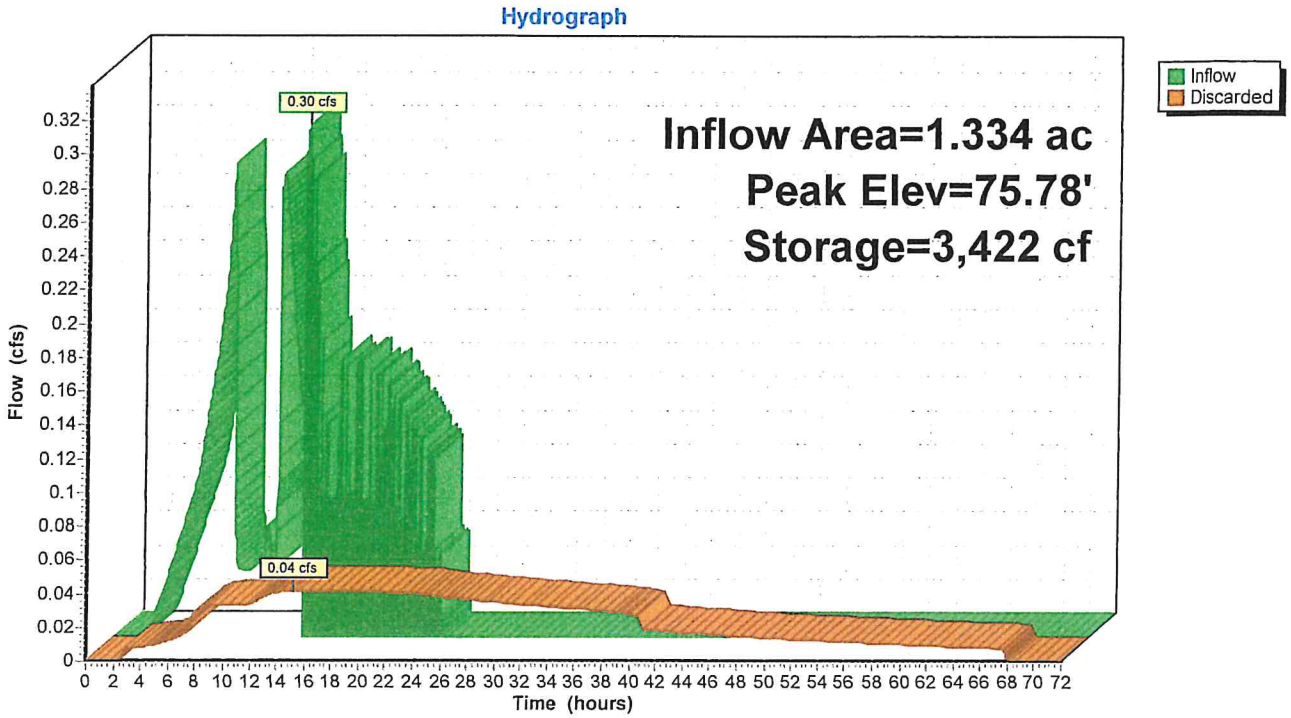
Storage Group A created with Chamber Wizard

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
70.00	1,211	0	0
73.00	1,211	3,633	3,633

Device	Routing	Invert	Outlet Devices
#1	Discarded	70.00'	**0.270 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 68.00' Phase-In= 0.01'

Discarded OutFlow Max=0.04 cfs @ 15.17 hrs HW=75.78' (Free Discharge)
1=Exfiltration (Controls 0.04 cfs)

Pond Pond 104: UIS A (Isolator Row) w/ Underground Sand Filter



Appendix B – Silver Creek Analysis

HydroCAD – 2, 10, and 100-year Storm Events

HEC-RAS

2-Year Storm

Legend

Silver Creek

Silver Creek Watersheds

Town of Bristol Rhode Island

Silver Creek

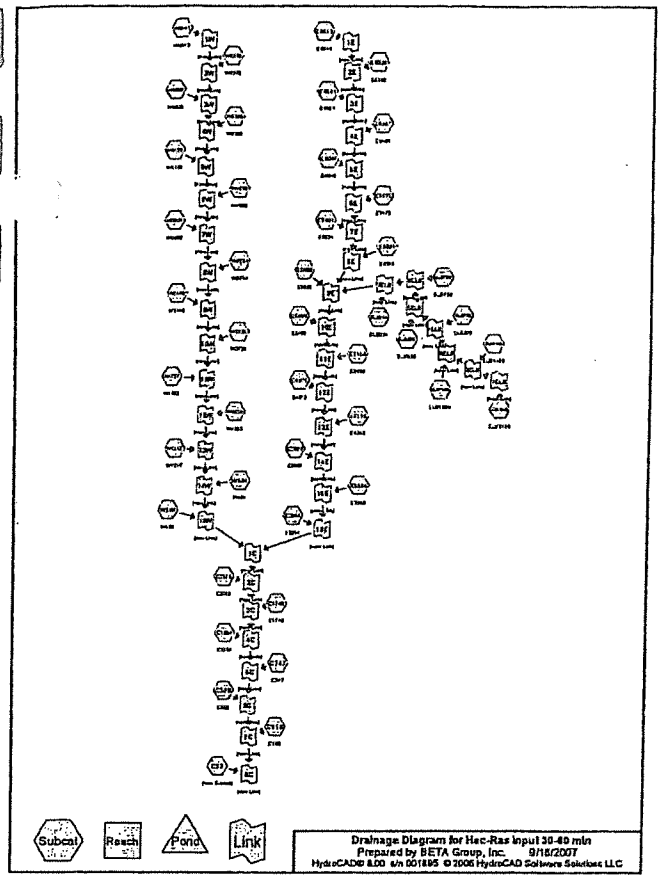
NOT TO SCALE

Appendix

Silver Creek Watersheds

Item C1.

HydroCAD – 2, 10, and 100-year Storm Events



Time span=0.00-30.00 hrs, dt=0.05 hrs, 601 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment C116: C116 Runoff Area=4.970 ac Runoff Depth=1.36"
Flow Length=450' Tc=25.8 min CN=77 Runoff=4.66 cfs 0.562 af

Subcatchment C1334: C1334 Runoff Area=35.190 ac Runoff Depth=1.77"
Flow Length=900' Slope=0.0200 '/' Tc=34.0 min CN=83 Runoff=38.94 cfs 5.205 af

Subcatchment C1748: C1748 Runoff Area=12.100 ac Runoff Depth=1.36"
Flow Length=850' Tc=33.5 min CN=77 Runoff=10.09 cfs 1.368 af

Subcatchment C2359: C2359 Runoff Area=32.610 ac Runoff Depth=1.70"
Flow Length=1,050' Slope=0.0400 '/' Tc=36.8 min CN=82 Runoff=33.21 cfs 4.621 af

Subcatchment C560: C560 Runoff Area=121.880 ac Runoff Depth=2.01"
Flow Length=4,800' Tc=73.9 min CN=86 Runoff=99.21 cfs 20.416 af

Subcatchment C62: (new Subcat) Runoff Area=12.170 ac Runoff Depth=1.77"
Flow Length=2,400' Tc=31.3 min CN=83 Runoff=13.99 cfs 1.800 af

Subcatchment C747: C747 Runoff Area=13.060 ac Runoff Depth=1.49"
Flow Length=700' Slope=0.0050 '/' Tc=58.8 min CN=79 Runoff=8.91 cfs 1.620 af

Subcatchment E2964: E2964 Runoff Area=25.840 ac Runoff Depth=1.36"
Flow Length=1,460' Slope=0.0400 '/' Tc=35.4 min CN=77 Runoff=21.05 cfs 2.933 af

Subcatchment E3568: E3568 Runoff Area=55.460 ac Runoff Depth=1.00"
Flow Length=2,790' Tc=55.8 min CN=71 Runoff=24.54 cfs 4.625 af

Subcatchment E3889: E3889 Runoff Area=6.520 ac Runoff Depth=1.36"
Flow Length=650' Tc=22.3 min CN=77 Runoff=6.51 cfs 0.737 af

Subcatchment E4219: E4219 Runoff Area=9.290 ac Runoff Depth=1.17"
Flow Length=800' Slope=0.0330 '/' Tc=24.2 min CN=74 Runoff=7.56 cfs 0.907 af

Subcatchment E4975: E4975 Runoff Area=17.350 ac Runoff Depth=1.42"
Flow Length=1,110' Slope=0.0250 '/' Tc=46.6 min CN=78 Runoff=12.87 cfs 2.056 af

Subcatchment E5158: E5158 Runoff Area=7.470 ac Runoff Depth=2.45"
Flow Length=500' Tc=17.1 min CN=91 Runoff=15.07 cfs 1.523 af

Subcatchment E5498: E5498 Runoff Area=6.670 ac Runoff Depth=1.77"
Flow Length=1,000' Tc=38.4 min CN=83 Runoff=6.95 cfs 0.986 af

Subcatchment E5909: E5909 Runoff Area=3.860 ac Runoff Depth=1.77"
Flow Length=450' Slope=0.0080 '/' Tc=52.8 min CN=83 Runoff=3.40 cfs 0.571 af

Subcatchment E6369: E6369 Runoff Area=17.580 ac Runoff Depth=1.36"
Flow Length=950' Tc=63.2 min CN=77 Runoff=10.36 cfs 1.988 af

Subcatchment E6821: E6821 Runoff Area=47.710 ac Runoff Depth=1.63"
Flow Length=2,042' Tc=62.2 min CN=81 Runoff=34.07 cfs 6.472 af

Subcatchment E7473: E7473 Runoff Area=56.050 ac Runoff Depth=1.56"
Flow Length=1,565' Tc=36.5 min CN=80 Runoff=52.19 cfs 7.274 af

Subcatchment E8046: E8046 Runoff Area=63.610 ac Runoff Depth=2.09"
Flow Length=3,435' Tc=57.2 min CN=87 Runoff=63.20 cfs 11.093 af

Subcatchment E8497: E8497 Runoff Area=161.630 ac Runoff Depth>1.42"
Flow Length=4,455' Tc=135.0 min CN=78 Runoff=60.02 cfs 19.150 af

Subcatchment E9081: E9081 Runoff Area=12.310 ac Runoff Depth=1.63"
Flow Length=575' Tc=22.5 min CN=81 Runoff=14.95 cfs 1.670 af

Subcatchment E9326: E9326 Runoff Area=24.170 ac Runoff Depth=1.17"
Flow Length=1,650' Tc=40.2 min CN=74 Runoff=16.55 cfs 2.359 af

Subcatchment E9611: E9611 Runoff Area=33.700 ac Runoff Depth=2.01"
Flow Length=1,650' Tc=53.6 min CN=86 Runoff=33.37 cfs 5.645 af

Subcatchment ELB1369: ELB1369 Runoff Area=19.910 ac Runoff Depth=1.56"
Flow Length=2,055' Tc=44.5 min CN=80 Runoff=16.75 cfs 2.584 af

Subcatchment ELB1483: ELB1483 Runoff Area=10.040 ac Runoff Depth=1.11"
Flow Length=1,125' Slope=0.0400 '/' Tc=38.1 min CN=73 Runoff=8.25 cfs 0.931 af

Subcatchment ELB2128: ELB2128 Runoff Area=36.550 ac Runoff Depth=1.49"
Flow Length=900' Tc=60.5 min CN=79 Runoff=24.61 cfs 4.534 af

Subcatchment ELB234: ELB234 Runoff Area=3.920 ac Runoff Depth=1.63"
Flow Length=400' Slope=0.0150 '/' Tc=26.4 min CN=81 Runoff=4.44 cfs 0.532 af

Subcatchment ELB729: ELB729 Runoff Area=53.530 ac Runoff Depth=1.49"
Flow Length=4,165' Tc=100.2 min CN=79 Runoff=25.77 cfs 5.641 af

Subcatchment ELB829: ELB829 Runoff Area=4.250 ac Runoff Depth=1.17"
Flow Length=750' Slope=0.0400 '/' Tc=31.8 min CN=74 Runoff=3.06 cfs 0.415 af

Subcatchment ELB972: ELB972 Runoff Area=7.430 ac Runoff Depth=1.17"
Flow Length=900' Slope=0.0400 '/' Tc=27.0 min CN=74 Runoff=5.77 cfs 0.725 af

Subcatchment W1217: W1217 Runoff Area=10.690 ac Runoff Depth=2.35"
Flow Length=650' Slope=0.0100 '/' Tc=17.0 min CN=90 Runoff=20.92 cfs 2.097 af

Subcatchment W1626: W1626 Runoff Area=60.580 ac Runoff Depth=1.29"
Flow Length=2,635' Tc=47.0 min CN=76 Runoff=40.23 cfs 6.529 af

Subcatchment W1737: W1737 Runoff Area=26.010 ac Runoff Depth=1.42"
Flow Length=1,150' Tc=47.9 min CN=78 Runoff=19.01 cfs 3.082 af

Subcatchment W2720: W2720 Runoff Area=27.950 ac Runoff Depth=1.70"
Flow Length=700' Tc=53.0 min CN=82 Runoff=23.28 cfs 3.960 af

Subcatchment W290: W290 Runoff Area=4.140 ac Runoff Depth=1.11"
Flow Length=650' Slope=0.0300 '/' Tc=28.3 min CN=73 Runoff=2.96 cfs 0.384 af

Subcatchment W3148: W3148 Runoff Area=9.510 ac Runoff Depth=1.23"
Flow Length=750' Tc=46.4 min CN=75 Runoff=6.01 cfs 0.976 af

Subcatchment W3774: W3774 Runoff Area=15.610 ac Runoff Depth=1.49"
Flow Length=1,200' Tc=31.3 min CN=79 Runoff=14.88 cfs 1.937 af

Subcatchment W3975: W3975 Runoff Area=9.970 ac Runoff Depth=2.45"
Flow Length=865' Tc=20.3 min CN=91 Runoff=18.85 cfs 2.033 af

Subcatchment W4529: W4529 Runoff Area=64.080 ac Runoff Depth=2.01"
Flow Length=3,200' Tc=51.2 min CN=86 Runoff=65.20 cfs 10.734 af

Subcatchment W5128: W5128 Runoff Area=11.350 ac Runoff Depth=2.18"
Flow Length=605' Slope=0.0200 '/' Tc=23.3 min CN=88 Runoff=18.24 cfs 2.060 af

Subcatchment W5300: W5300 Runoff Area=25.630 ac Runoff Depth=1.42"
Flow Length=925' Tc=30.7 min CN=78 Runoff=23.43 cfs 3.037 af

Subcatchment W6008: W6008 Runoff Area=12.660 ac Runoff Depth=1.42"
Flow Length=875' Tc=42.8 min CN=78 Runoff=9.78 cfs 1.491 af

Subcatchment W6278: W6278 Runoff Area=15.920 ac Runoff Depth=1.42"
Flow Length=1,350' Tc=25.8 min CN=78 Runoff=15.74 cfs 1.886 af

Subcatchment W6643: W6643 Runoff Area=25.890 ac Runoff Depth=1.93"
Flow Length=2,400' Tc=39.4 min CN=85 Runoff=29.05 cfs 4.163 af

Subcatchment WS84: WS84 Runoff Area=7.620 ac Runoff Depth=1.29"
Flow Length=650' Slope=0.0260 '/' Tc=36.2 min CN=76 Runoff=5.80 cfs 0.821 af

Link 1C: (new Link) Inflow=200.32 cfs 128.304 af
Primary=200.32 cfs 128.304 af

Link 1E: (new Link) Inflow=33.37 cfs 5.645 af
Primary=33.37 cfs 5.645 af

Link 1ELB: (new Link) Inflow=24.61 cfs 4.534 af
Primary=24.61 cfs 4.534 af

Link 1W: (new Link) Inflow=29.05 cfs 4.163 af
Primary=29.05 cfs 4.163 af

Link 2C: (new Link) delayed by 20.0 min Inflow=201.72 cfs 132.925 af
Primary=201.62 cfs 132.410 af

Link 2E: (new Link) delayed by 45.0 min Inflow=48.25 cfs 8.004 af
Primary=48.25 cfs 8.004 af

Link 2ELB: (new Link) delayed by 20.0 min Inflow=29.50 cfs 5.468 af
Primary=29.47 cfs 5.468 af

Link 2W: (new Link) delayed by 30.0 min Inflow=42.95 cfs 6.049 af
Primary=42.95 cfs 6.049 af

Link 3C: (new Link) delayed by 20.0 min Inflow=202.06 cfs 133.778 af
Primary=201.95 cfs 133.207 af

Link 3E: (new Link) delayed by 45.0 min Inflow=50.51 cfs 9.674 af
Primary=50.51 cfs 9.674 af

Link 3ELB: (new Link) delayed by 20.0 min Inflow=39.75 cfs 8.050 af
Primary=39.71 cfs 8.050 af

Link 3W: (new Link) delayed by 30.0 min Inflow=49.69 cfs 7.540 af
Primary=49.69 cfs 7.540 af

Link 4C: (new Link) delayed by 20.0 min Inflow=203.38 cfs 138.411 af
Primary=203.27 cfs 137.797 af

Link 4E: (new Link) delayed by 45.0 min Inflow=108.20 cfs 28.824 af
Primary=108.20 cfs 28.822 af

Link 4ELB: (new Link) delayed by 20.0 min Inflow=40.98 cfs 8.775 af
Primary=40.93 cfs 8.775 af

Link 4W: (new Link) delayed by 30.0 min Inflow=54.62 cfs 10.577 af
Primary=54.62 cfs 10.577 af

Link 5C: (new Link) Inflow=203.76 cfs 139.417 af
Primary=203.76 cfs 139.417 af

Link 5E: (new Link) delayed by 60.0 min Inflow=118.18 cfs 39.916 af
Primary=118.18 cfs 39.909 af

Link 5ELB: (new Link) delayed by 20.0 min Inflow=41.55 cfs 9.190 af
Primary=41.51 cfs 9.180 af

Link 5W: (new Link) delayed by 30.0 min Inflow=55.62 cfs 12.636 af
Primary=55.62 cfs 12.636 af

Link 6C: (new Link) Inflow=209.20 cfs 159.833 af
Primary=209.20 cfs 159.833 af

Item C1.

Link 6E: (new Link) delayed by 60.0 min Inflow=123.04 cfs 47.183 af
Primary=123.04 cfs 47.160 af

Link 6ELB: (new Link) delayed by 20.0 min Inflow=61.65 cfs 15.831 af
Primary=61.61 cfs 15.831 af

Link 6W: (new Link) delayed by 30.0 min Inflow=86.08 cfs 23.370 af
Primary=86.08 cfs 23.370 a'

Link 7C: (new Link) Inflow=209.37 cfs 160.395 a
Primary=209.37 cfs 160.395 af

Link 7E: (new Link) delayed by 45.0 min Inflow=126.55 cfs 53.633 af
Primary=126.55 cfs 53.583 af

Link 7ELB: (new Link) delayed by 20.0 min Inflow=62.14 cfs 16.362 af
Primary=62.10 cfs 16.362 af

Link 7W: (new Link) delayed by 30.0 min Inflow=88.59 cfs 25.403 af
Primary=88.59 cfs 25.403 af

Link 8C: (new Link) Inflow=209.84 cfs 162.195 af
Primary=209.84 cfs 162.195 af

Link 8E: (new Link) delayed by 45.0 min Inflow=127.52 cfs 55.571 af
Primary=127.52 cfs 55.425 af

Link 8W: (new Link) delayed by 30.0 min Inflow=91.10 cfs 27.339 af
Primary=91.10 cfs 27.339 af

Link 9E: (new Link) delayed by 30.0 min Inflow=137.07 cfs 72.358 af
Primary=137.07 cfs 72.183 af

Link 9W: (new Link) delayed by 30.0 min Inflow=92.36 cfs 28.315 af
Primary=92.36 cfs 28.315 af

Link 10E: (new Link) delayed by 30.0 min Inflow=137.36 cfs 73.170 af
Primary=137.36 cfs 72.943 af

Link 10W: (new Link) delayed by 30.0 min Inflow=96.29 cfs 32.278 af
Primary=96.29 cfs 32.278 af

Link 11E: (new Link) delayed by 30.0 min Inflow=137.71 cfs 74.466 af
Primary=137.71 cfs 74.199 af

Link 11W: (new Link) delayed by 30.0 min Inflow=98.96 cfs 35.357 af
Primary=98.96 cfs 35.356 af

Link 12E: (new Link) delayed by 30.0 min Inflow=138.33 cfs 76.255 af
Primary=138.33 cfs 75.944 af

Link 12W: (new Link) delayed by 30.0 min Inflow=104.08 cfs 41.885 af
Primary=104.08 cfs 41.876 af

Link 13E: (new Link) delayed by 30.0 min Inflow=138.61 cfs 76.851 af
Primary=138.61 cfs 76.489 af

Link 13W: (new Link) delayed by 30.0 min Inflow=104.95 cfs 43.974 af
Primary=104.95 cfs 43.935 af

Link 14E: (new Link) delayed by 30.0 min Inflow=138.81 cfs 77.227 af
Primary=138.81 cfs 76.823 af

Link 14W: (new Link) delayed by 30.0 min Inflow=105.39 cfs 44.756 af
Primary=105.39 cfs 44.695 af

Link 15E: (new Link) delayed by 30.0 min Inflow=140.25 cfs 81.448 af
Primary=140.25 cfs 80.960 af

Link 15W: (new Link) delayed by 30.0 min Inflow=105.59 cfs 45.079 af
Primary=105.59 cfs 44.991 af

Link 16E: (new Link) delayed by 30.0 min Inflow=141.34 cfs 83.893 af
Primary=141.34 cfs 83.313 af

Total Runoff Area = 1,244.460 ac Runoff Volume = 167.132 af Average Runoff Depth = 1.61"
68.71% Pervious Area = 855.023 ac 31.29% Impervious Area = 389.437 ac

Subcatchment C116: C116

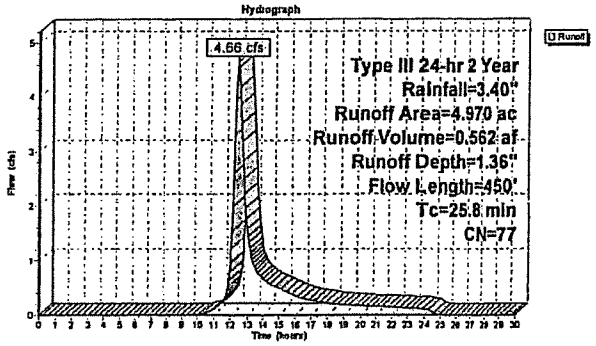
Runoff = 4.66 cfs @ 12.38 hrs, Volume= 0.562 af, Depth= 1.36"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Rainfall=3.40"

Area (ac)	CN	Description
4.970	77	Brush, Poor, HSG C
4.970		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.3	150	0.0100	0.14		Sheet Flow, Grass: Short n= 0.150 P2= 3.40"
8.5	300	0.0070	0.59		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
25.8	450	Total			

Subcatchment C116: C116



Subcatchment C1334: C1334

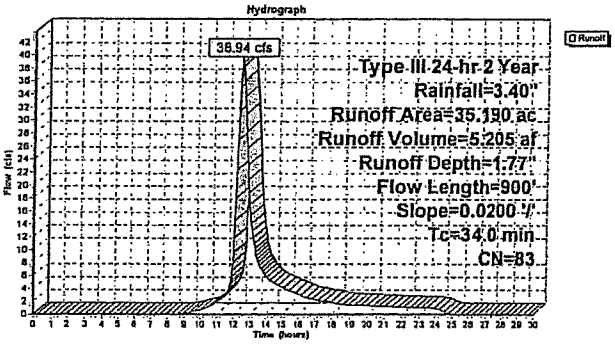
Runoff = 38.94 cfs @ 12.48 hrs, Volume= 5.205 af, Depth= 1.77"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Rainfall=3.40"

Area (ac)	CN	Description
2.520	94	Urban commercial, 85% Imp, HSG C
2.450	81	1/3 acre lots, 30% Imp, HSG C
2.510	74	>75% Grass cover, Good, HSG C
27.710	83	1/4 acre lots, 38% Imp, HSG C
35.190	83	Weighted Average
21.783		Pervious Area
13.407		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
19.1	150	0.0200	0.13		Sheet Flow, Grass: Dense n= 0.240 P2= 3.40"
6.7	400	0.0200	0.99		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
8.2	350	0.0200	0.71		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
34.0	900	Total			

Subcatchment C1334: C1334



Item C1.

Subcatchment C1748: C1748

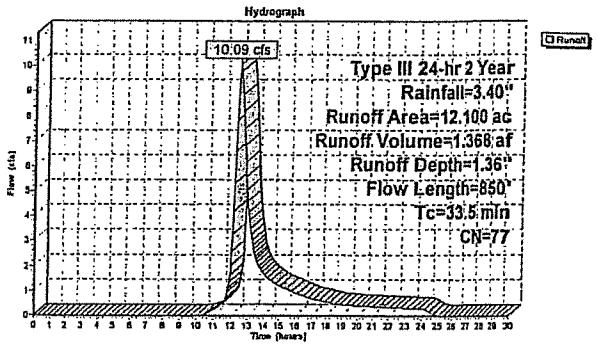
Runoff = 10.09 cfs @ 12.49 hrs, Volume= 1.368 af, Depth= 1.36"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Rainfall=3.40"

Area (ac)	CN	Description
1.420	94	Urban commercial, 85% Imp, HSG C
2.580	83	1/4 acre lots, 38% Imp, HSG C
2.020	74	>75% Grass cover, Good, HSG C
3.600	70	Brush, Fair, HSG C
2.500	74	>75% Grass cover, Good, HSG C
12.100	77	Weighted Average
9.920		Pervious Area
2.180		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.0	150	0.0270	0.15		Sheet Flow, Grass: Dense n= 0.240 P2= 3.40"
6.5	450	0.0270	1.15		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
10.0	250	0.0070	0.42		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
33.5	850	Total			

Subcatchment C1748: C1748



Subcatchment C2359: C2359

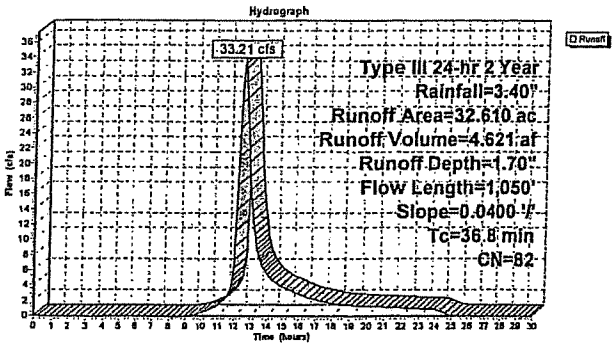
Runoff = 33.21 cfs @ 12.52 hrs, Volume= 4.621 af, Depth= 1.70"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Rainfall=3.40"

Area (ac)	CN	Description
8.300	91	Urban Industrial, 72% Imp, HSG C
2.000	77	Brush, Fair, HSG D
7.540	70	Brush, Fair, HSG C
14.770	83	1/4 acre lots, 38% Imp, HSG C
32.610	82	Weighted Average
21.021		Pervious Area
11.589		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
21.8	150	0.0400	0.11		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.40"
15.0	900	0.0400	1.00		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
36.8	1,050	Total			

Subcatchment C2359: C2359



Subcatchment C560: C560

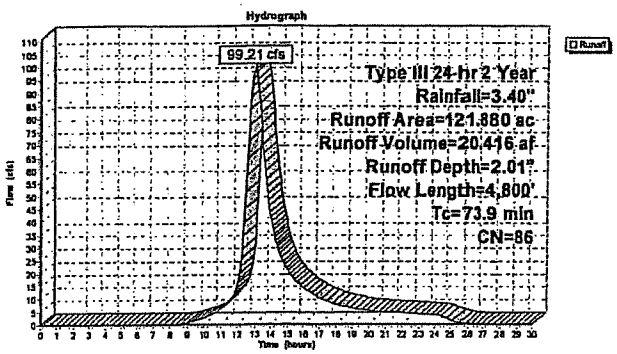
Runoff = 99.21 cfs @ 13.00 hrs, Volume= 20.416 af, Depth= 2.01"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Rainfall=3.40"

Area (ac)	CN	Description
19.710	94	Urban commercial, 85% Imp, HSG C
1.910	74	>75% Grass cover, Good, HSG C
1.250	73	Woods, Fair, HSG C
2.630	74	>75% Grass cover, Good, HSG C
7.880	70	1/2 acre lots, 25% Imp, HSG B
9.060	60	Woods, Fair, HSG B
79.440	90	1/8 acre lots, 65% Imp, HSG C
121.880	86	Weighted Average
51.520		Pervious Area
70.360		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
26.1	200	0.0380	0.12		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.40"
14.5	850	0.0380	0.97		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
2.9	225	0.0350	1.31		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
8.1	1,700	0.0300	3.52		Shallow Concentrated Flow, Paved Kv= 20.3 fps
6.7	1,100	0.0180	2.72		Shallow Concentrated Flow, Paved Kv= 20.3 fps
3.5	300	0.0050	1.44		Shallow Concentrated Flow, Paved Kv= 20.3 fps
10.1	425	0.0100	0.70		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
73.9	4,800	Total			

Subcatchment C560: C560



Item C1.

Subcatchment C62: (new Subcat)

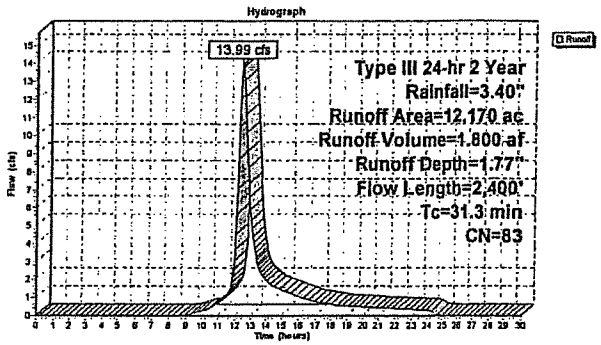
Runoff = 13.99 cfs @ 12.44 hrs, Volume= 1.800 af, Depth= 1.77"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Rainfall=3.40"

Area (ac)	CN	Description
12.170	83	1/4 acre lots, 38% Imp, HSG C
7.545		Pervious Area
4.625		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.5	200	0.0400	0.27		Sheet Flow, Grass: Short n= 0.150 P2= 3.40"
2.4	200	0.0400	1.40		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
16.4	2,000	0.0100	2.03		Shallow Concentrated Flow, Paved Kv= 20.3 fps
31.3	2,400	Total			

Subcatchment C62: (new Subcat)



Subcatchment C747: C747

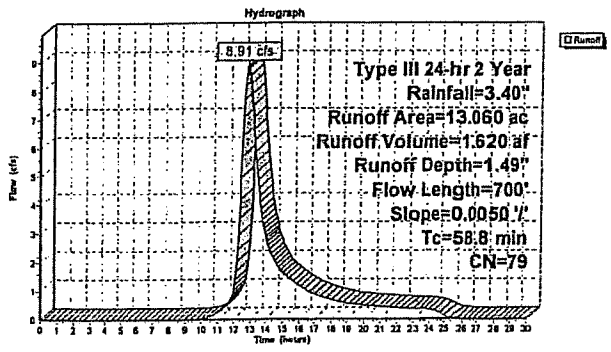
Runoff = 8.91 cfs @ 12.83 hrs, Volume= 1.620 af, Depth= 1.49"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Rainfall=3.40"

Area (ac)	CN	Description
2.870	90	1/8 acre lots, 65% Imp, HSG C
2.010	83	1/4 acre lots, 38% Imp, HSG C
4.720	74	>75% Grass cover, Good, HSG C
0.560	94	Urban commercial, 85% Imp, HSG C
2.900	70	Brush, Fair, HSG C
13.060	79	Weighted Average
9.955		Pervious Area
3.105		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
42.0	200	0.0050	0.08		Sheet Flow, Grass: Dense n= 0.240 P2= 3.40"
16.8	500	0.0050	0.49		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
58.8	700	Total			

Subcatchment C747: C747



Subcatchment E2964: E2964

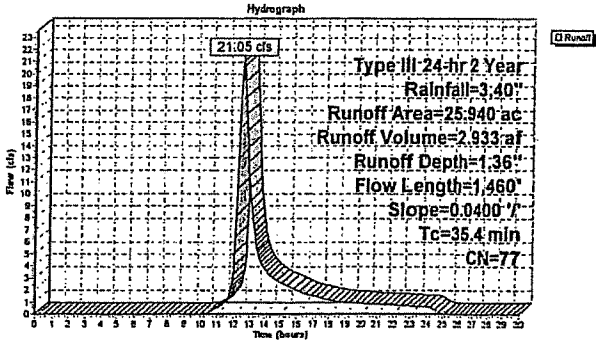
Runoff = 21.05 cfs @ 12.52 hrs, Volume= 2.933 af, Depth= 1.36"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Rainfall=3.40"

Area (ac)	CN	Description
12.450	81	1/3 acre lots, 30% Imp, HSG C
13.490	73	Woods, Fair, HSG C
25.940	77	Weighted Average
22.205		Pervious Area
3.735		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.5	150	0.0400	0.17		Sheet Flow, Grass: Dense n= 0.240 P2= 3.40"
2.4	200	0.0400	1.40		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
18.5	1,110	0.0400	1.00		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
35.4	1,460	Total			

Subcatchment E2964: E2964



Subcatchment E3568: E3568

Runoff = 24.54 cfs @ 12.83 hrs, Volume= 4.625 af, Depth= 1.00"

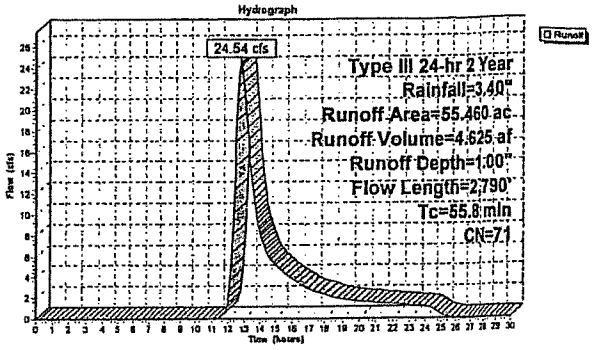
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Rainfall=3.40"

Area (ac)	CN	Description
1.850	74	>75% Grass cover, Good, HSG C
12.510	61	>75% Grass cover, Good, HSG B
20.920	83	1/4 acre lots, 38% imp, HSG C
13.320	60	Woods, Fair, HSG B
6.860	73	Woods, Fair, HSG C
55.460	71	Weighted Average
47.510		Pervious Area
7.950		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
21.8	150	0.0400	0.11		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.40"
9.8	590	0.0400	1.00		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
9.6	810	0.0400	1.40		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
5.1	440	0.0050	1.44		Shallow Concentrated Flow, Paved Kv= 20.3 fps
9.5	800	0.0400	1.40		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
55.8	2,790	Total			

Item C1.

Subcatchment E3568: E3568



Subcatchment E3889: E3889

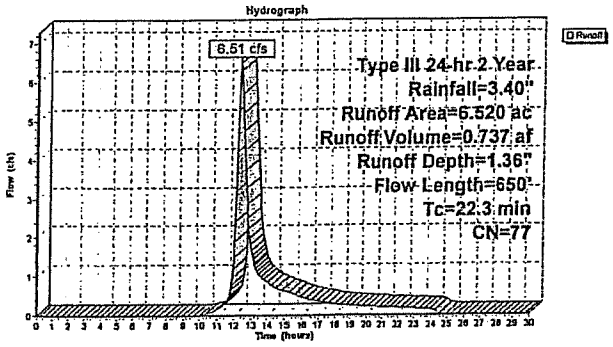
Runoff = 6.51 cfs @ 12.32 hrs, Volume= 0.737 af, Depth= 1.36"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Rainfall=3.40"

Area (ac)	CN	Description
2.290	83	1/4 acre lots, 38% Imp, HSG C
4.230	74	>75% Grass cover, Good, HSG C
6.520	77	Weighted Average
5.650		Pervious Area
0.870		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.3	150	0.0300	0.15		Sheet Flow, Grass: Dense n= 0.240 P2= 3.40"
6.0	500	0.0400	1.40		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
22.3	650	Total			

Subcatchment E3889: E3889



Subcatchment E4219: E4219

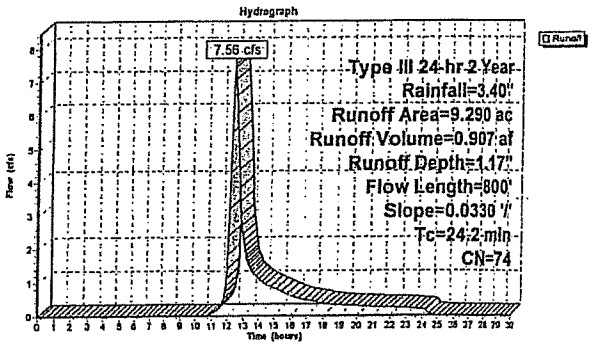
Runoff = 7.56 cfs @ 12.36 hrs, Volume= 0.907 af, Depth= 1.17"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Rainfall=3.40"

Area (ac)	CN	Description
9.290	74	>75% Grass cover, Good, HSG C
9.290		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.7	150	0.0330	0.16		Sheet Flow, Grass: Dense n= 0.240 P2= 3.40"
8.5	650	0.0330	1.27		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
24.2	800	Total			

Subcatchment E4219: E4219



Item C1.

Subcatchment E4975: E4975

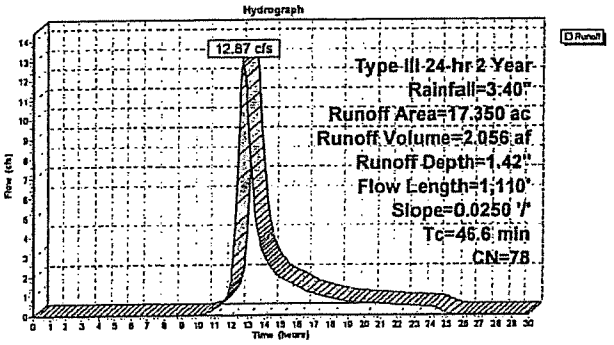
Runoff = 12.87 cfs @ 12.67 hrs, Volume= 2.056 af, Depth= 1.42"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Rainfall=3.40"

Area (ac)	CN	Description
4.910	91	Urban Industrial, 72% Imp, HSG C
12.440	73	Woods, Fair, HSG C
17.350	78	Weighted Average
13.815		Pervious Area
3.535		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
26.4	150	0.0250	0.09		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.40"
20.2	960	0.0250	0.79		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
46.6	1,110	Total			

Subcatchment E4975: E4975



Subcatchment E5158: E5158

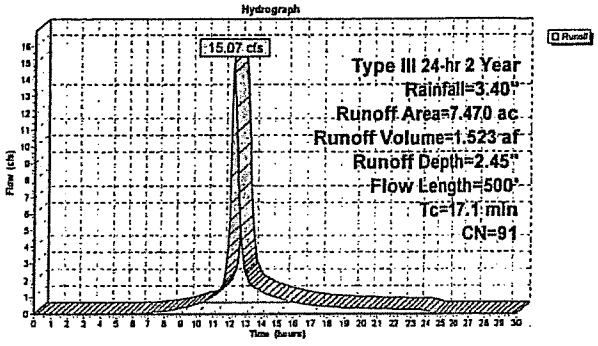
Runoff = 15.07 cfs @ 12.23 hrs, Volume= 1.523 af, Depth= 2.45"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Rainfall=3.40"

Area (ac)	CN	Description
1.900	82	Woods/grass comb., Poor, HSG C
5.570	94	Urban commercial, 85% Imp, HSG C
7.470	91	Weighted Average
2.736		Pervious Area
4.735		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.2	150	0.0300	0.22		Sheet Flow, Grass: Short n= 0.150 P2= 3.40"
5.9	350	0.0200	0.99		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
17.1	500	Total			

Subcatchment E5158: E5158



Subcatchment E5498: E5498

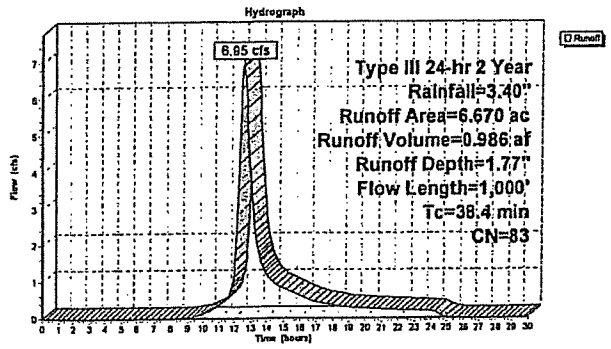
Runoff = 6.85 cfs @ 12.54 hrs, Volume= 0.986 af, Depth= 1.77"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Rainfall=3.40"

Area (ac)	CN	Description
2.620	94	Urban commercial, 85% Imp, HSG C
4.050	76	Woods/grass comb., Fair, HSG C
6.670	83	Weighted Average
4.443		Pervious Area
2.227		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.5	150	0.0400	0.17		Sheet Flow, Grass: Dense n= 0.240 P2= 3.40"
23.9	850	0.0140	0.59		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
38.4	1,000	Total			

Subcatchment E5498: E5498



Subcatchment E5909: E5909

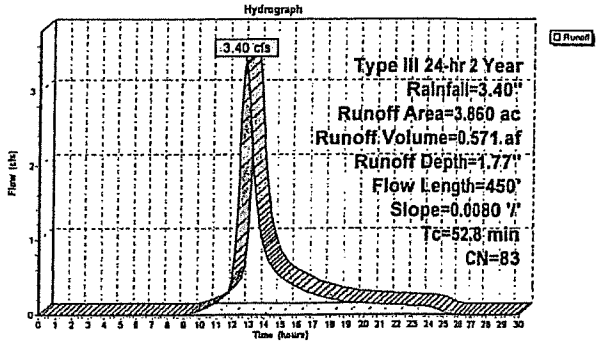
Runoff = 3.40 cfs @ 12.73 hrs, Volume= 0.571 af, Depth= 1.77"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Rainfall=3.40"

Area (ac)	CN	Description
1.480	94	Urban commercial, 85% Imp, HSG C
2.380	76	Woods/grass comb., Fair, HSG C
3.860	83	Weighted Average
2.602		Pervious Area
1.258		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
41.8	150	0.0080	0.06		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.40"
11.2	300	0.0080	0.45		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
52.8	450	Total			

Subcatchment E5909: E5909



Subcatchment E6369: E6369

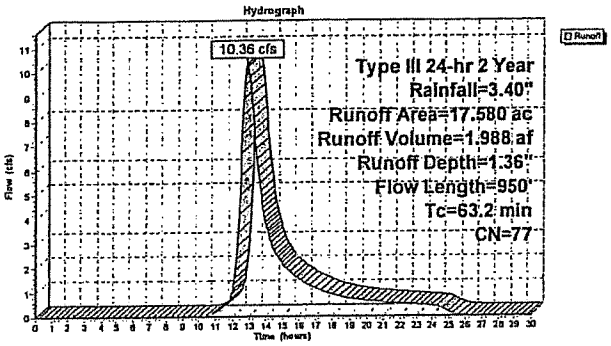
Runoff = 10.36 cfs @ 12.88 hrs, Volume= 1.988 af, Depth= 1.36"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Rainfall=3.40"

rea (ac)	CN	Description
8.290	73	Woods, Fair, HSG C
9.290	81	1/3 acre lots, 30% Imp, HSG C
17.580	77	Weighted Average
14.793		Pervious Area
2.787		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.5	150	0.0400	0.17		Sheet Flow, Grass: Dense n= 0.240 P2= 3.40"
48.7	800	0.0030	0.27		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
63.2	950	Total			

Subcatchment E6369: E6369



Item C1.

Subcatchment E6821: E6821

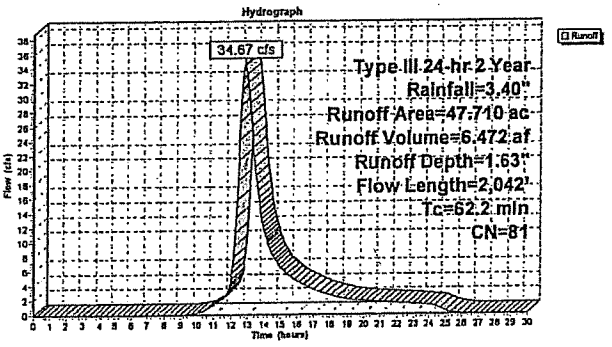
Runoff = 34.67 cfs @ 12.86 hrs, Volume= 6.472 af, Depth= 1.63"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Rainfall=3.40"

Area (ac)	CN	Description
8.430	83	1/4 acre lots, 38% Imp, HSG C
11.040	81	1/3 acre lots, 30% Imp, HSG C
4.790	83	1/4 acre lots, 38% Imp, HSG C
9.780	91	Urban Industrial, 72% Imp, HSG C
13.670	73	Woods, Fair, HSG C
47.710	81	Weighted Average
32.333		Pervious Area
15.377		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.1	150	0.1000	0.17		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.40"
1.1	100	0.1000	1.58		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
3.1	365	0.0800	1.98		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
5.0	430	0.0090	1.42		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
20.0					Direct Entry, Small Detention Pond
2.4	200	0.0400	1.40		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
2.7	325	0.0180	2.01		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
12.8	472	0.0150	0.61		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
62.2	2,042	Total			

Subcatchment E6821: E6821



Subcatchment E7473: E7473

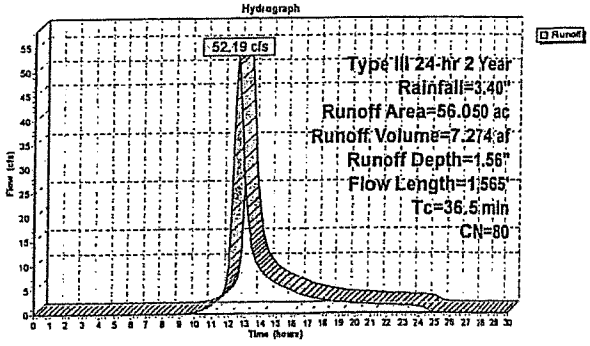
Runoff = 52.19 cfs @ 12.52 hrs, Volume= 7.274 af, Depth= 1.56"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Rainfall=3.40"

Area (ac)	CN	Description
5.660	83	1/4 acre lots, 38% Imp, HSG C
9.690	91	Urban Industrial, 72% Imp, HSG C
18.120	83	1/4 acre lots, 38% Imp, HSG C
22.580	73	Woods, Fair, HSG C
56.050	80	Weighted Average
40.037		Pervious Area
16.013		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.7	200	0.0500	0.31		Sheet Flow, Grass: Short n= 0.150 P2= 3.40"
2.9	300	0.0600	1.71		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
22.9	1,065	0.0240	0.77		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
36.5	1,565	Total			

Subcatchment E7473: E7473



Subcatchment E8046: E8046

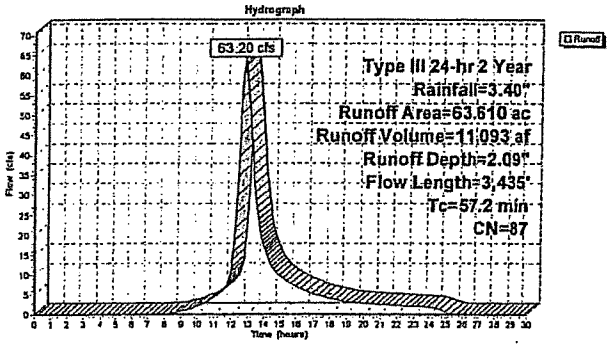
Runoff = 63.20 cfs @ 12.77 hrs, Volume= 11.093 af, Depth= 2.09"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Rainfall=3.40"

Area (ac)	CN	Description
36.960	91	Urban Industrial, 72% Imp, HSG C
2.300	83	1/4 acre lots, 38% Imp, HSG C
10.840	94	Urban commercial, 85% Imp, HSG C
13.510	70	Brush, Fair, HSG C
63.610	87	Weighted Average
26.911		Pervious Area
36.699		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.5	150	0.0250	0.14		Sheet Flow, Grass: Dense n= 0.240 P2= 3.40"
15.3	2,275	0.0150	2.49		Shallow Concentrated Flow, Paved Kv= 20.3 fps
24.4	1,010	0.0190	0.69		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
57.2	3,435	Total			

Subcatchment E8046: E8046



Item C1.

Subcatchment E8497: E8497

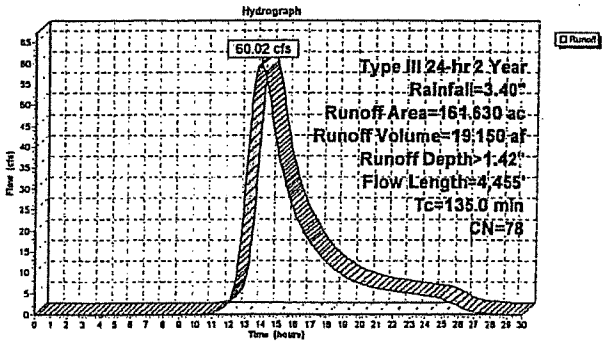
Runoff = 60.02 cfs @ 13.92 hrs, Volume= 19.150 af, Depth> 1.42"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Rainfall=3.40"

Area (ac)	CN	Description
15.850	83	1/4 acre lots, 38% Imp, HSG C
16.520	81	1/3 acre lots, 30% Imp, HSG C
13.150	94	Urban commercial, 85% Imp, HSG C
8.270	83	1/4 acre lots, 38% Imp, HSG C
7.790	94	Urban commercial, 85% Imp, HSG C
0.850	94	Urban commercial, 85% Imp, HSG C
5.500	91	Urban Industrial, 72% Imp, HSG C
93.700	72	Woods/grass comb., Good, HSG C
161.630	78	Weighted Average
125.027		Pervious Area
36.603		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
23.5	150	0.0120	0.11		Sheet Flow, Grass: Dense n= 0.240 P2= 3.40"
9.4	650	0.0270	1.15		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
14.1	700	0.0140	0.83		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
30.0					Direct Entry, Detention Pond
28.8	1,430	0.0140	0.83		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
3.6	400	0.0150	1.84		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
15.0					Direct Entry, Small Pond
10.6	1,125	0.0140	1.77		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
135.0	4,455	Total			

Subcatchment E8497: E8497



Subcatchment E9081: E9081

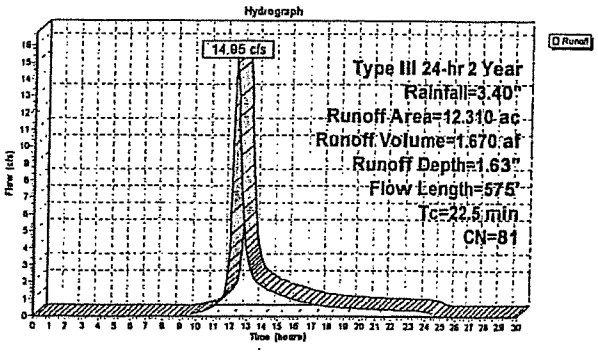
Runoff = 14.95 cfs @ 12.32 hrs, Volume= 1.670 af, Depth= 1.63"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Rainfall=3.40"

Area (ac)	CN	Description
6.640	70	Brush, Fair, HSG C
5.670	94	Urban commercial, 85% Imp, HSG C
12.310	81	Weighted Average
7.491		Pervious Area
4.819		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.5	150	0.0350	0.24		Sheet Flow, Grass: Short n= 0.150 P2= 3.40"
12.0	425	0.0140	0.59		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
22.5	575	Total			

Subcatchment E9081: E9081



Subcatchment E9326: E9326

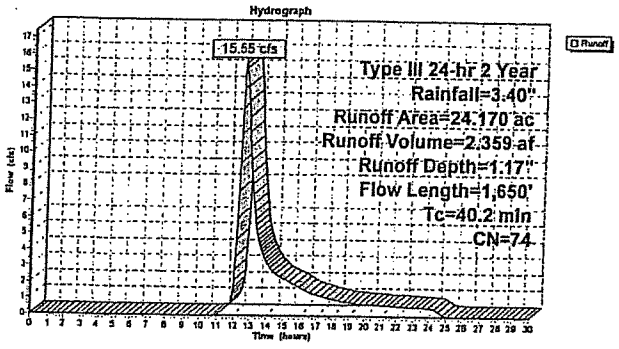
Runoff = 15.55 cfs @ 12.60 hrs, Volume= 2.359 af, Depth= 1.17"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Rainfall=3.40"

Area (ac)	CN	Description
4.140	94	Urban commercial, 85% Imp, HSG C
20.030	70	Brush, Fair, HSG C
24.170	74	Weighted Average
20.651		Pervious Area
3.519		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
26.8	150	0.0240	0.09		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.40"
3.4	200	0.0200	0.99		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
10.0	1,300	0.0210	2.17		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
40.2	1,650	Total			

Subcatchment E9326: E9326



Subcatchment E9611: E9611

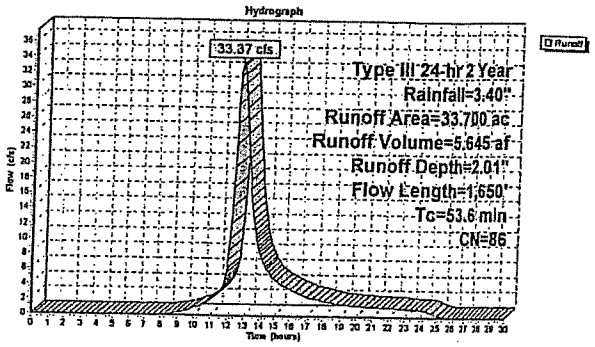
Runoff = 33.37 cfs @ 12.72 hrs, Volume= 5.645 af, Depth= 2.01"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Rainfall=3.40"

Area (ac)	CN	Description
12.370	72	Woods/grass comb., Good, HSG C
21.330	94	Urban commercial, 85% Imp, HSG C
33.700	86	Weighted Average
15.569		Pervious Area
18.131		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.3	150	0.0300	0.15		Sheet Flow, Grass: Dense n= 0.240 P2= 3.40"
37.3	1,500	0.0180	0.67		Shallow Concentrated Flow, Two ponds add some time Woodland Kv= 5.0 fps
53.6	1,650	Total			

Subcatchment E9611: E9611



Subcatchment ELB1369: ELB1369

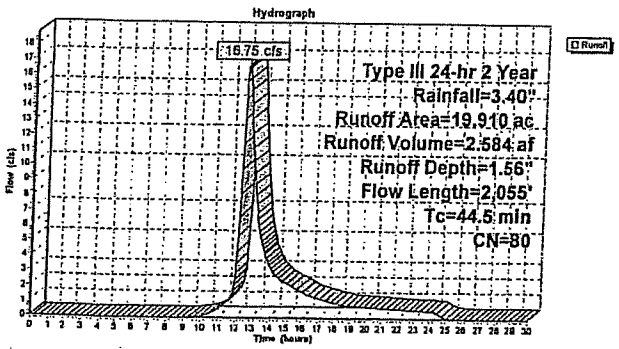
Runoff = 16.75 cfs @ 12.63 hrs, Volume= 2.584 af, Depth= 1.56"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Rainfall=3.40"

Area (ac)	CN	Description
17.390	81	1/3 acre lots, 30% Imp, HSG C
2.520	70	Brush, Fair, HSG C
19.910	80	Weighted Average
14.693		Pervious Area
5.217		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.6	150	0.0130	0.16		Sheet Flow, Grass: Short n= 0.150 P2= 3.40"
12.0	575	0.0130	0.80		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
16.9	1,330	0.0350	1.31		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
44.5	2,055	Total			

Subcatchment ELB1369: ELB1369



Subcatchment ELB1483: ELB1483

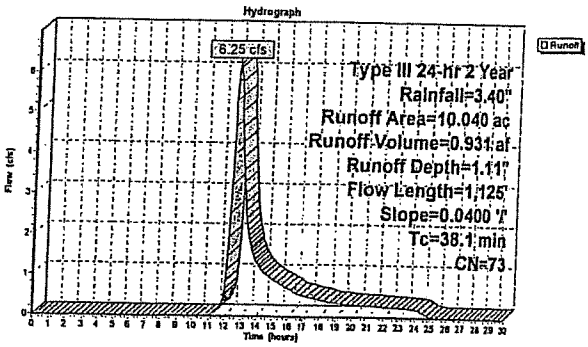
Runoff = 6.25 cfs @ 12.57 hrs, Volume= 0.931 af, Depth= 1.11"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Rainfall=3.40"

Area (ac)	CN	Description
7.570	70	Brush, Fair, HSG C
2.470	81	1/3 acre lots, 30% Imp, HSG C
10.040	73	Weighted Average
9.299		Pervious Area
0.741		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
21.8	150	0.0400	0.11		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.40"
16.3	975	0.0400	1.00		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
38.1	1,125	Total			

Subcatchment ELB1483: ELB1483



Subcatchment ELB2128: ELB2128

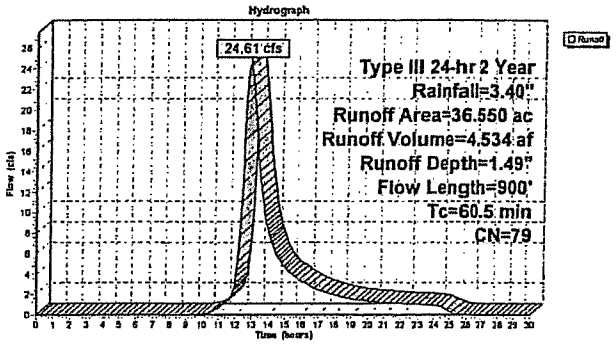
Runoff = 24.61 cfs @ 12.85 hrs, Volume= 4.534 af, Depth= 1.49"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Rainfall=3.40"

Area (ac)	CN	Description
6.980	90	1/8 acre lots, 65% Imp, HSG C
4.870	60	Woods, Fair, HSG B
4.870	73	Woods, Fair, HSG C
19.850	81	1/3 acre lots, 30% Imp, HSG C
36.550	79	Weighted Average
26.071		Pervious Area
10.479		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
50.2	150	0.0200	0.05		Sheet Flow, Woods: Dense underbrush n= 0.800 P2= 3.40"
10.3	750	0.0590	1.21		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
60.5	900	Total			

Subcatchment ELB2128: ELB2128



Subcatchment ELB234: ELB234

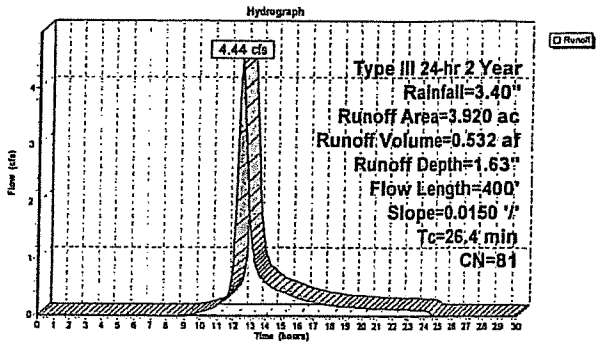
Runoff = 4.44 cfs @ 12.38 hrs, Volume= 0.532 af, Depth= 1.63"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Rainfall=3.40"

Area (ac)	CN	Description
3.920	81	1/3 acre lots, 30% Imp, HSG C
2.744		Pervious Area
1.176		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
21.5	150	0.0150	0.12		Sheet Flow, Grass: Dense n= 0.240 P2= 3.40"
4.9	250	0.0150	0.86		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
26.4	400	Total			

Subcatchment ELB234: ELB234



Subcatchment ELB729: ELB729

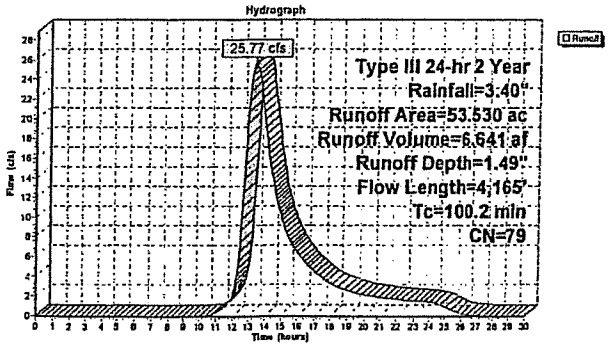
Runoff = 25.77 cfs @ 13.37 hrs, Volume= 6.641 af, Depth= 1.49"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Rainfall=3.40"

Area (ac)	CN	Description
11.760	94	Urban commercial, 85% Imp, HSG C
26.080	71	Meadow, non-grazed, HSG C
15.690	81	1/3 acre lots, 30% Imp, HSG C
53.530	79	Weighted Average
38.827		Pervious Area
14.703		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
33.0	150	0.0020	0.08		Sheet Flow, Grass: Short n= 0.150 P2= 3.40"
41.8	1,010	0.0020	0.40		Shallow Concentrated Flow, Cultivated Straight Rows Kv= 9.0 fps
18.9	1,455	0.0040	1.28		Shallow Concentrated Flow, Paved Kv= 20.3 fps
6.5	1,550	0.0380	3.95		Shallow Concentrated Flow, Paved Kv= 20.3 fps
100.2	4,165	Total			

Subcatchment ELB729: ELB729



Subcatchment ELB829: ELB829

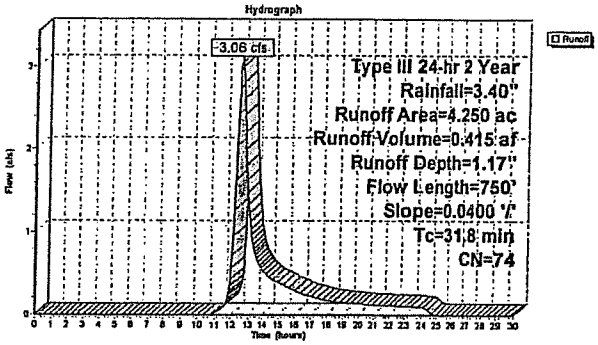
Runoff = 3.06 cfs @ 12.46 hrs, Volume= 0.415 af, Depth= 1.17"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Rainfall=3.40"

Area (ac)	CN	Description
0.750	81	1/3 acre lots, 30% Imp, HSG C
3.500	73	Woods, Fair, HSG C
4.250	74	Weighted Average
4.025		Pervious Area
0.225		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
21.8	150	0.0400	0.11		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.40"
10.0	600	0.0400	1.00		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
31.8	750	Total			

Subcatchment ELB829: ELB829



Subcatchment ELB972: ELB972

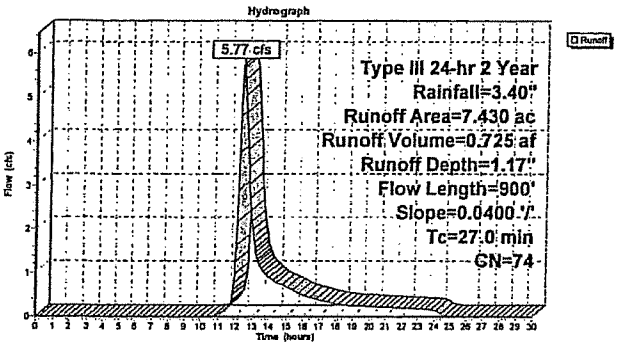
Runoff = 5.77 cfs @ 12.41 hrs, Volume= 0.725 af, Depth= 1.17"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Rainfall=3.40"

rea (ac)	CN	Description
1.000	81	1/3 acre lots, 30% Imp, HSG C
6.430	73	Woods, Fair, HSG C
7.430	74	Weighted Average
7.130		Pervious Area
0.300		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.5	150	0.0400	0.17		Sheet Flow, Grass: Dense n= 0.240 P2= 3.40"
12.5	750	0.0400	1.00		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
27.0	900	Total			

Subcatchment ELB972: ELB972



Subcatchment W1217: W1217

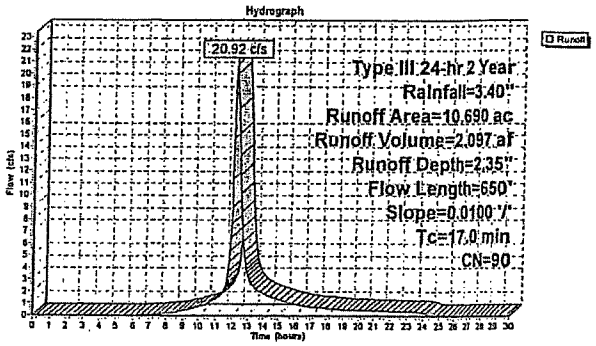
Runoff = 20.92 cfs @ 12.23 hrs, Volume= 2.097 af, Depth= 2.35"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Rainfall=3.40"

Area (ac)	CN	Description
10.690	90	1/8 acre lots, 65% Imp, HSG C
3.742		Pervious Area
6.949		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.5	100	0.0100	0.13		Sheet Flow, Grass: Short n= 0.150 P2= 3.40"
4.5	550	0.0100	2.03		Shallow Concentrated Flow, Paved Kv= 20.3 fps
17.0	650	Total			

Subcatchment W1217: W1217



Subcatchment W1626: W1626

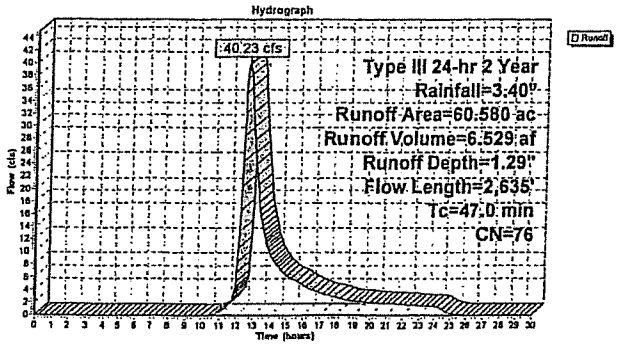
Runoff = 40.23 cfs @ 12.68 hrs, Volume= 6.529 af, Depth= 1.29"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Rainfall=3.40"

Area (ac)	CN	Description
20.360	81	1/3 acre lots, 30% Imp, HSG C
40.220	74	>75% Grass cover, Good, HSG C
60.580	78	Weighted Average
54.472		Pervious Area
6.108		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
22.8	200	0.0230	0.15		Sheet Flow, Grass: Dense n= 0.240 P2= 3.40"
14.9	950	0.0230	1.06		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
5.4	810	0.0150	2.49		Shallow Concentrated Flow, Paved Kv= 20.3 fps
3.9	675	0.0200	2.87		Shallow Concentrated Flow, Paved Kv= 20.3 fps
47.0	2,635	Total			

Subcatchment W1626: W1626



Subcatchment W1737: W1737

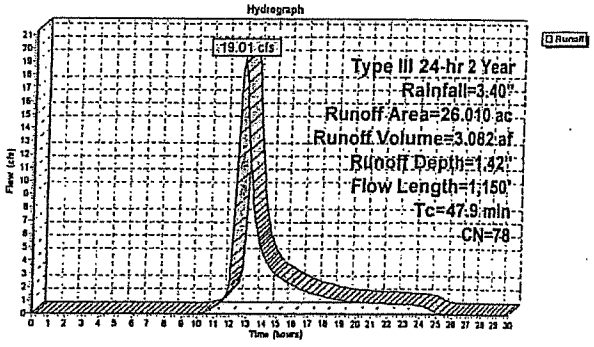
Runoff = 19.01 cfs @ 12.68 hrs, Volume= 3.082 af, Depth= 1.42"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Rainfall=3.40"

Area (ac)	CN	Description
18.140	78	Woods/grass comb., Fair, HSG C
7.870	83	1/4 acre lots, 38% Imp, HSG C
26.010	78	Weighted Average
23.019		Pervious Area
2.991		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
26.4	150	0.0250	0.09		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.40"
21.5	1,000	0.0240	0.77		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
47.9	1,150	Total			

Subcatchment W1737: W1737



Subcatchment W2720: W2720

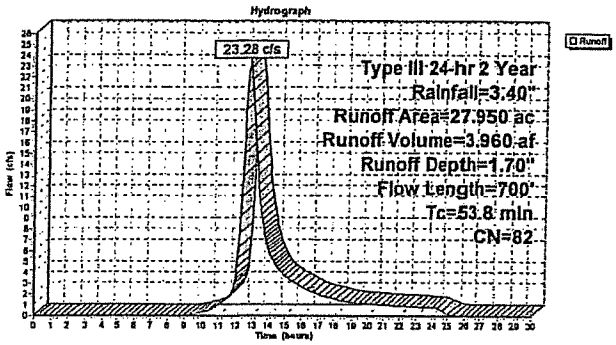
Runoff = 23.28 cfs @ 12.75 hrs, Volume= 3.960 af, Depth= 1.70"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Rainfall=3.40"

Area (ac)	CN	Description
3.790	73	Woods, Fair, HSG C
24.160	83	1/4 acre lots, 38% Imp, HSG C
27.950	82	Weighted Average
18.769		Pervious Area
9.181		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
36.3	100	0.0050	0.05		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.40"
17.5	600	0.0130	0.57		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
53.8	700	Total			

Subcatchment W2720: W2720



Subcatchment W290: W290

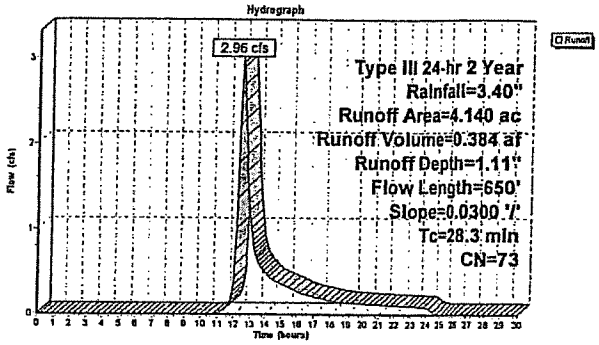
Runoff = 2.96 cfs @ 12.43 hrs, Volume= 0.384 af, Depth= 1.11"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Rainfall=3.40"

Area (ac)	CN	Description
4.140	73	Woods, Fair, HSG C
4.140		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.7	100	0.0300	0.09		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.40"
10.6	550	0.0300	0.87		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
28.3	650	Total			

Subcatchment W290: W290



Subcatchment W3148: W3148

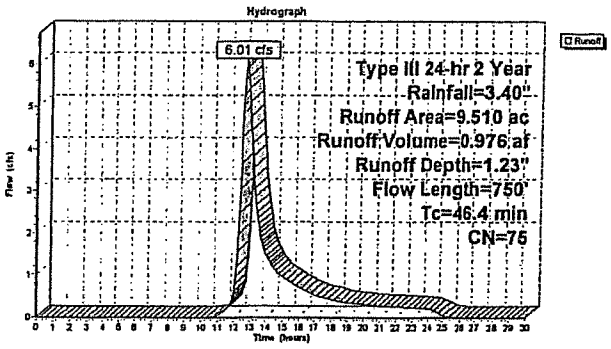
Runoff = 6.01 cfs @ 12.67 hrs, Volume= 0.976 af, Depth= 1.23"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Rainfall=3.40"

Area (ac)	CN	Description
2.120	83	1/4 acre lots, 38% Imp, HSG C
7.390	73	Woods, Fair, HSG C
9.510	75	Weighted Average
8.704		Pervious Area
0.806		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
26.4	150	0.0250	0.09		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.40"
20.0	600	0.0100	0.50		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
46.4	750	Total			

Subcatchment W3148: W3148



Subcatchment W3774: W3774

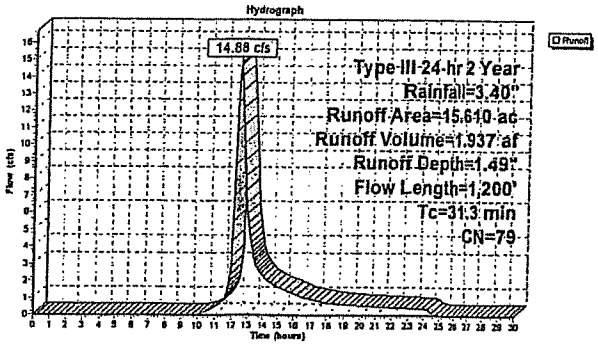
Runoff = 14.88 cfs @ 12.45 hrs, Volume= 1.937 af, Depth= 1.49"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Rainfall=3.40"

Area (ac)	CN	Description
1.990	94	Urban commercial, 85% Imp, HSG C
8.790	81	1/3 acre lots, 30% Imp, HSG C
4.830	70	Brush, Fair, HSG C
15.610	79	Weighted Average
11.282		Pervious Area
4.329		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.3	150	0.0300	0.15		Sheet Flow, Grass: Dense n= 0.240 P2= 3.40"
8.2	600	0.0300	1.21		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
6.8	450	0.0250	1.11		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
31.3	1,200	Total			

Subcatchment W3774: W3774



Subcatchment W3975: W3975

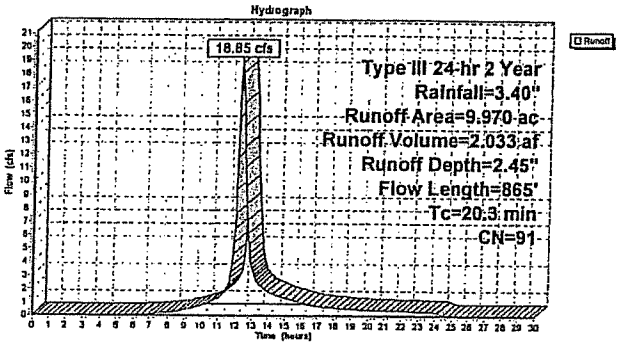
Runoff = 18.85 cfs @ 12.27 hrs, Volume= 2.033 af, Depth= 2.45"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Rainfall=3.40"

Area (ac)	CN	Description
9.970	91	Urban industrial, 72% Imp, HSG C
2.792		Pervious Area
7.178		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.0	150	0.0250	0.21		Sheet Flow, Grass: Short n= 0.150 P2= 3.40"
8.3	715	0.0080	1.44		Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
20.3	865	Total			

Subcatchment W3975: W3975



Subcatchment W4529: W4529

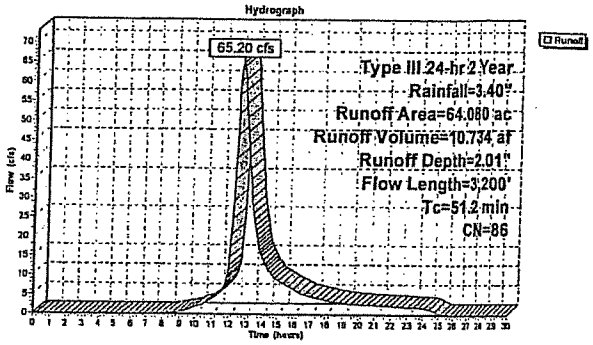
Runoff = 65.20 cfs @ 12.70 hrs, Volume= 10.734 af, Depth= 2.01"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Rainfall=3.40"

Area (ac)	CN	Description
25.860	94	Urban commercial, 85% Imp, HSG C
38.220	81	1/3 acre lots, 30% Imp, HSG C
64.080	86	Weighted Average
30.633		Pervious Area
33.447		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
28.8	200	0.0050	0.12		Sheet Flow, Grass: Short n= 0.150 P2= 3.40"
16.2	2,250	0.0130	2.31		Shallow Concentrated Flow, Paved Kv= 20.3 fps
6.2	750	0.0100	2.03		Shallow Concentrated Flow, Paved Kv= 20.3 fps
51.2	3,200	Total			

Subcatchment W4529: W4529



Subcatchment W5128: W5128

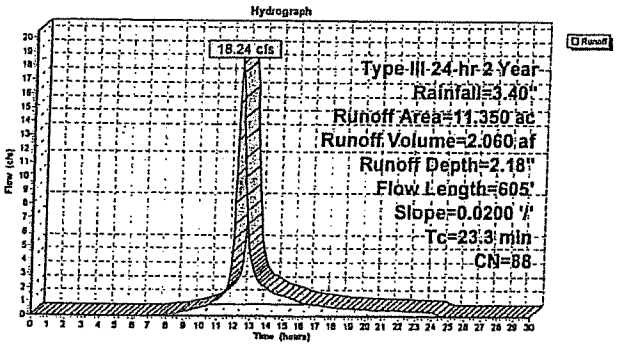
Runoff = 18.24 cfs @ 12.32 hrs, Volume= 2.060 af, Depth= 2.18"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Rainfall=3.40"

Area (ac)	CN	Description
4.320	83	1/4 acre lots, 38% Imp, HSG C
7.030	91	Urban industrial, 72% Imp, HSG C
11.350	88	Weighted Average
4.647		Pervious Area
6.703		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.5	200	0.0200	0.20		Sheet Flow, Grass: Short n= 0.150 P2= 3.40"
6.8	405	0.0200	0.99		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
23.3	605	Total			

Subcatchment W5128: W5128



Subcatchment W5300: W5300

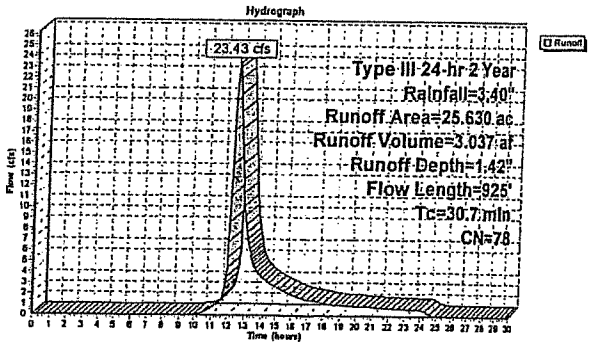
Runoff = 23.43 cfs @ 12.45 hrs, Volume= 3.037 af, Depth= 1.42"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Rainfall=3.40"

Area (ac)	CN	Description
14.570	73	Woods, Fair, HSG C
9.660	83	1/4 acre lots, 38% Imp, HSG C
1.400	94	Urban commercial, 85% Imp, HSG C
25.630	78	Weighted Average
20.769		Pervious Area
4.861		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.6	150	0.0130	0.16		Sheet Flow, Grass: Short n= 0.150 P2= 3.40"
15.1	775	0.0150	0.86		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
30.7	925	Total			

Subcatchment W5300: W5300



Subcatchment W6008: W6008

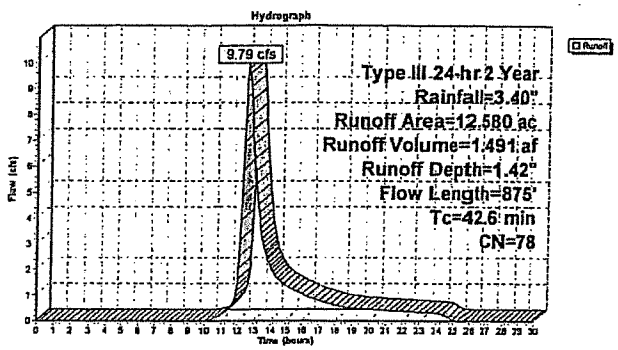
Runoff = 9.79 cfs @ 12.61 hrs, Volume= 1.491 af, Depth= 1.42"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Rainfall=3.40"

Area (ac)	CN	Description
6.890	73	Woods, Fair, HSG C
5.690	83	1/4 acre lots, 38% Imp, HSG C
12.580	78	Weighted Average
10.418		Pervious Area
2.162		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
22.9	150	0.0050	0.11		Sheet Flow, Grass: Short n= 0.150 P2= 3.40"
19.7	725	0.0150	0.61		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
42.6	875	Total			

Subcatchment W6008: W6008



Item C1.

Subcatchment W6278: W6278

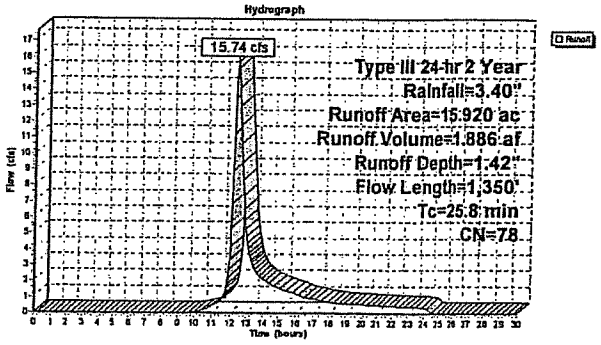
Runoff = 15.74 cfs @ 12.37 hrs, Volume= 1.886 af, Depth= 1.42"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Rainfall=3.40"

Area (ac)	CN	Description
7.730	73	Woods, Fair, HSG C
8.190	83	1/4 acre lots, 38% Imp, HSG C
15.920	78	Weighted Average
12.808		Pervious Area
3.112		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.0	150	0.0250	0.21		Sheet Flow, Grass: Short n= 0.150 P2= 3.40"
4.9	600	0.0100	2.03		Shallow Concentrated Flow, Paved Kv= 20.3 fps
8.9	600	0.0500	1.12		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
25.8	1,350	Total			

Subcatchment W6278: W6278



Subcatchment W6643: W6643

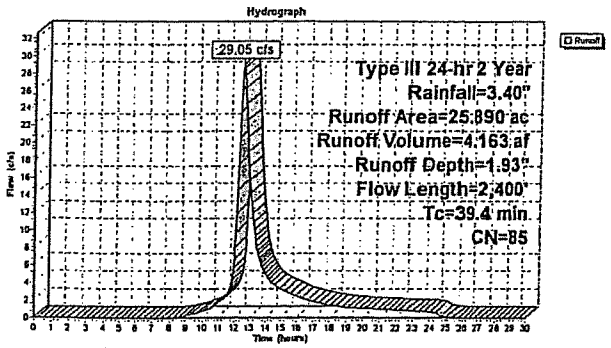
Runoff = 29.05 cfs @ 12.55 hrs, Volume= 4.163 af, Depth= 1.93"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Rainfall=3.40"

Area (ac)	CN	Description
14.500	86	Pasture/grassland/range, Poor, HSG C
11.390	83	1/4 acre lots, 38% Imp, HSG C
25.890	85	Weighted Average
21.562		Pervious Area
4.328		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.6	150	0.0130	0.16		Sheet Flow, Grass: Short n= 0.150 P2= 3.40"
11.2	1,500	0.0120	2.22		Shallow Concentrated Flow, Paved Kv= 20.3 fps
12.6	750	0.0200	0.99		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
39.4	2,400	Total			

Subcatchment W6643: W6643



Subcatchment W684: W684

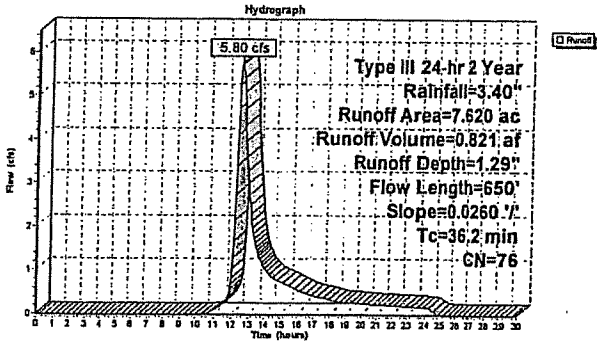
Runoff = 5.80 cfs @ 12.53 hrs, Volume= 0.821 af, Depth= 1.29"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Rainfall=3.40"

Area (ac)	CN	Description
2.420	83	1/4 acre lots, 38% Imp, HSG C
5.200	73	Woods, Fair, HSG C
7.620	76	Weighted Average
6.700		Pervious Area
0.920		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
25.9	150	0.0260	0.10		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.40"
10.3	500	0.0260	0.81		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
36.2	650	Total			

Subcatchment W684: W684

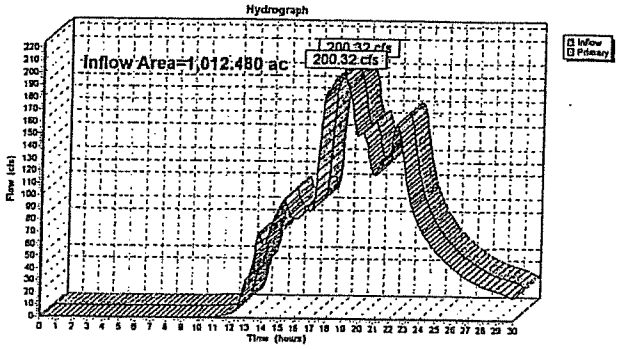


Link 1C: (new Link)

Inflow Area = 1,012.480 ac, Inflow Depth > 1.52" for 2 Year event
Inflow = 200.32 cfs @ 18.92 hrs, Volume= 128.304 af
Primary = 200.32 cfs @ 18.92 hrs, Volume= 128.304 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Link 1C: (new Link)



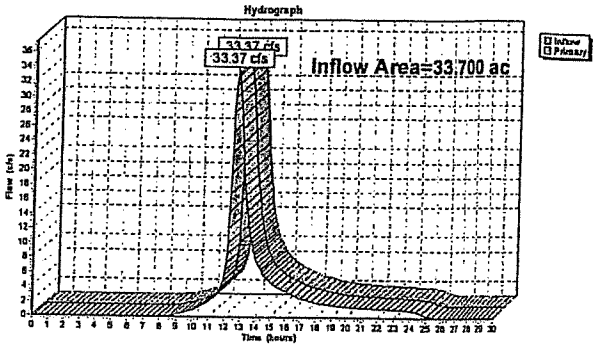
Item C1.

Link 1E: (new Link)

Inflow Area = 33.700 ac, Inflow Depth = 2.01" for 2 Year event
Inflow = 33.37 cfs @ 12.72 hrs, Volume= 5.645 af
Primary = 33.37 cfs @ 12.72 hrs, Volume= 5.645 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Link 1E: (new Link)

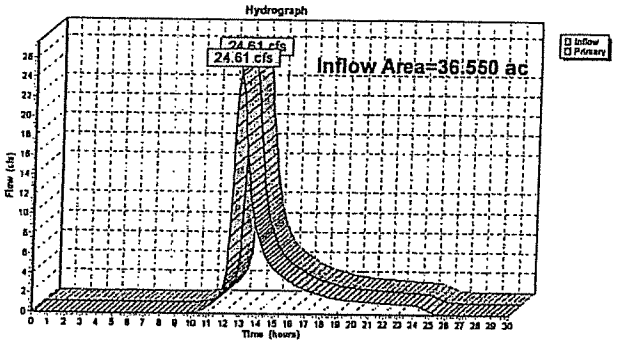


Link 1ELB: (new Link)

Inflow Area = 36.550 ac, Inflow Depth = 1.49" for 2 Year event
Inflow = 24.61 cfs @ 12.85 hrs, Volume= 4.534 af
Primary = 24.61 cfs @ 12.85 hrs, Volume= 4.534 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Link 1ELB: (new Link)

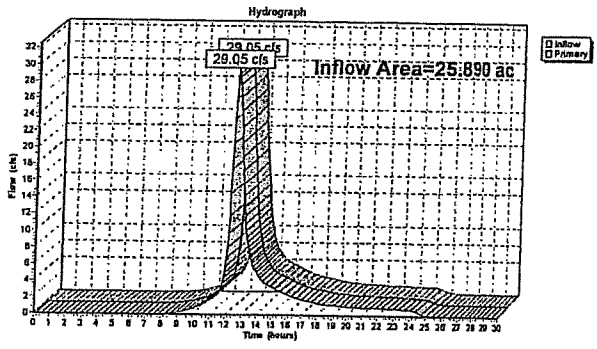


Link 1W: (new Link)

Inflow Area = 25.890 ac, Inflow Depth = 1.93" for 2 Year event
Inflow = 29.05 cfs @ 12.55 hrs, Volume= 4.163 af
Primary = 29.05 cfs @ 12.55 hrs, Volume= 4.163 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Link 1W: (new Link)

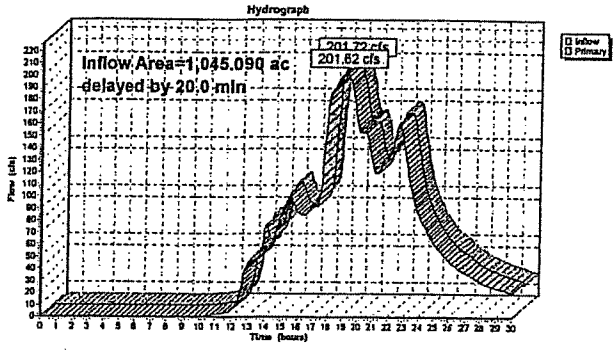


Link 2C: (new Link)

Inflow Area = 1,045.090 ac, Inflow Depth > 1.53" for 2 Year event
Inflow = 201.72 cfs @ 18.92 hrs, Volume= 132.925 af
Primary = 201.62 cfs @ 19.25 hrs, Volume= 132.410 af, Atten= 0%, Lag= 19.8 min

Primary outflow = Inflow delayed by 20.0 min, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Link 2C: (new Link)



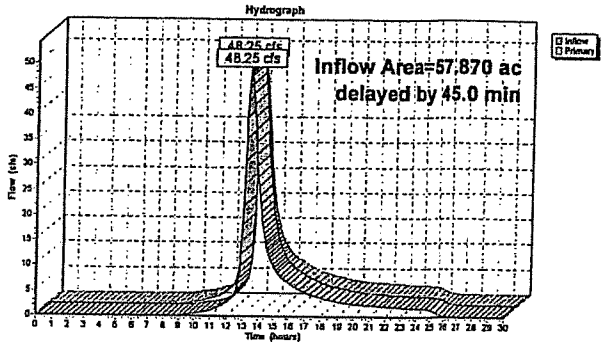
Item C1.

Link 2E: (new Link)

Inflow Area = 57.870 ac, Inflow Depth = 1.66" for 2 Year event
Inflow = 48.25 cfs @ 12.68 hrs, Volume= 8.004 af
Primary = 48.25 cfs @ 13.43 hrs, Volume= 8.004 af, Atten= 0%, Lag= 45.0 min

Primary outflow = Inflow delayed by 45.0 min, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Link 2E: (new Link)

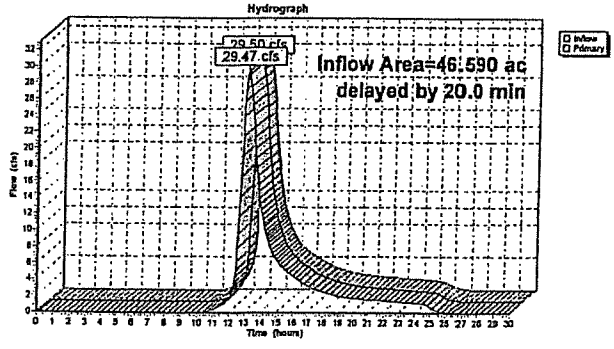


Link 2ELB: (new Link)

Inflow Area = 46.590 ac, Inflow Depth = 1.41" for 2 Year event
Inflow = 29.50 cfs @ 12.79 hrs, Volume= 5.466 af
Primary = 29.47 cfs @ 13.12 hrs, Volume= 5.466 af, Atten= 0%, Lag= 20.0 min

Primary outflow = Inflow delayed by 20.0 min, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Link 2ELB: (new Link)

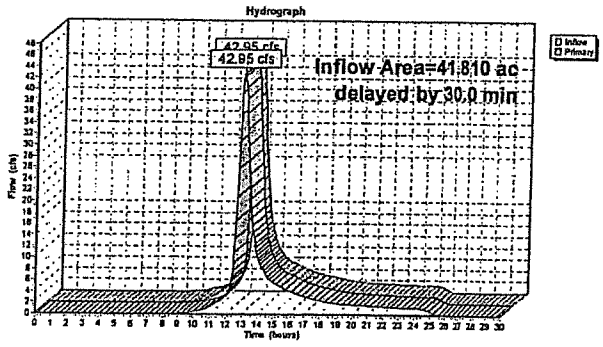


Link 2W: (new Link)

Inflow Area = 41.810 ac, Inflow Depth = 1.74" for 2 Year event
Inflow = 42.95 cfs @ 12.48 hrs, Volume= 6.049 af
Primary = 42.95 cfs @ 12.98 hrs, Volume= 6.048 af, Atten= 0%, Lag= 30.0 min

Primary outflow = Inflow delayed by 30.0 min, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Link 2W: (new Link)

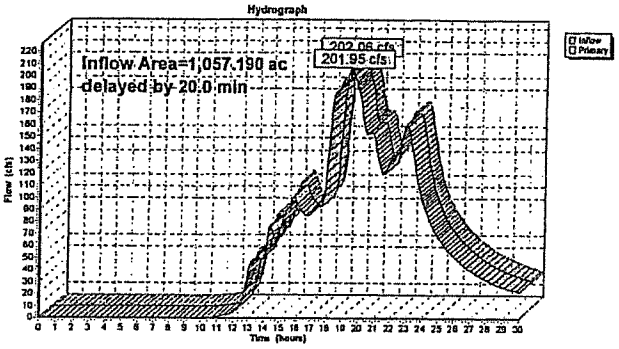


Link 3C: (new Link)

Inflow Area = 1,057.190 ac, Inflow Depth > 1.52" for 2 Year event
Inflow = 202.06 cfs @ 19.25 hrs, Volume= 133.778 af
Primary = 201.95 cfs @ 19.58 hrs, Volume= 133.207 af, Atten= 0%, Lag= 20.0 min

ary outflow = Inflow delayed by 20.0 min, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Link 3C: (new Link)



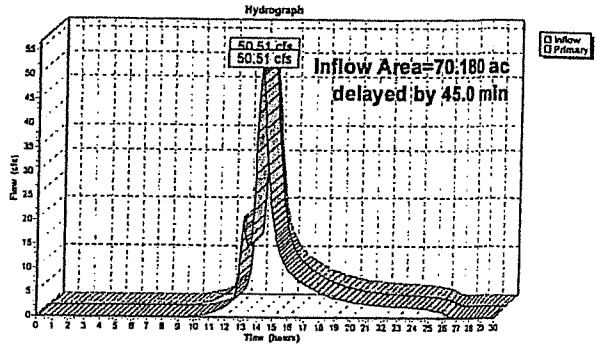
Item C1.

Link 3E: (new Link)

Inflow Area = 70.180 ac, Inflow Depth = 1.65" for 2 Year event
Inflow = 50.51 cfs @ 13.43 hrs, Volume= 9.674 af
Primary = 50.51 cfs @ 14.18 hrs, Volume= 9.674 af, Atten= 0%, Lag= 45.0 min

Primary outflow = Inflow delayed by 45.0 min, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Link 3E: (new Link)

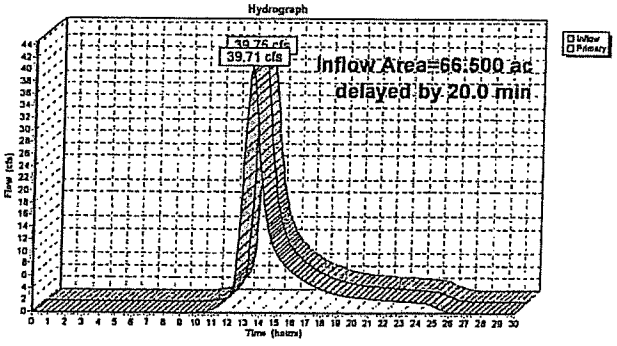


Link 3ELB: (new Link)

Inflow Area = 66.500 ac, Inflow Depth = 1.45" for 2 Year event
Inflow = 39.75 cfs @ 13.00 hrs, Volume= 8.050 af
Primary = 39.71 cfs @ 13.34 hrs, Volume= 8.050 af, Atten= 0%, Lag= 20.0 min

Primary outflow = Inflow delayed by 20.0 min, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Link 3ELB: (new Link)

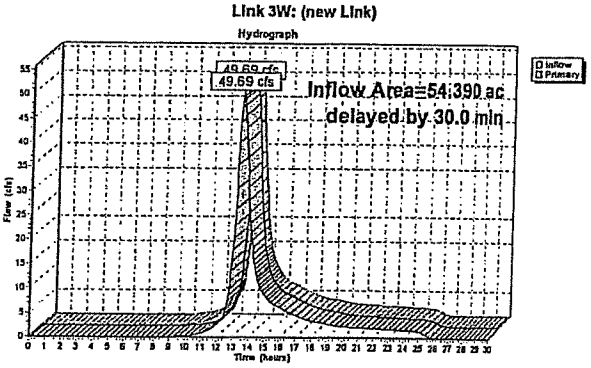


Link 3W: (new Link)

Inflow Area = 54.390 ac, Inflow Depth = 1.66" for 2 Year event
Inflow = 49.69 cfs @ 12.95 hrs, Volume= 7.540 af
Primary = 49.59 cfs @ 13.45 hrs, Volume= 7.540 af, Atten= 0%, Lag= 30.0 min

Primary outflow = Inflow delayed by 30.0 min, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Link 3W: (new Link)

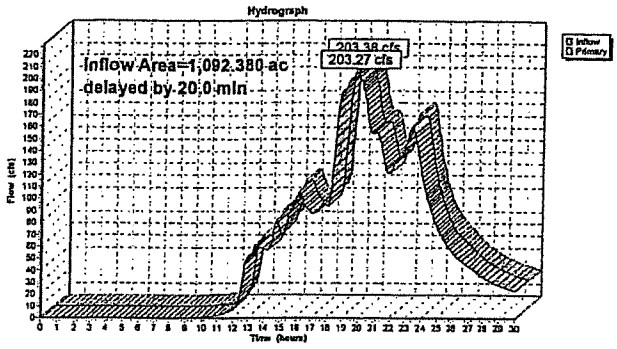


Link 4C: (new Link)

Inflow Area = 1,092.380 ac, Inflow Depth > 1.52" for 2 Year event
Inflow = 203.38 cfs @ 19.58 hrs, Volume= 138.411 af
Primary = 203.27 cfs @ 19.91 hrs, Volume= 137.797 af, Atten= 0%, Lag= 20.0 min

Primary outflow = Inflow delayed by 20.0 min, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Link 4C: (new Link)

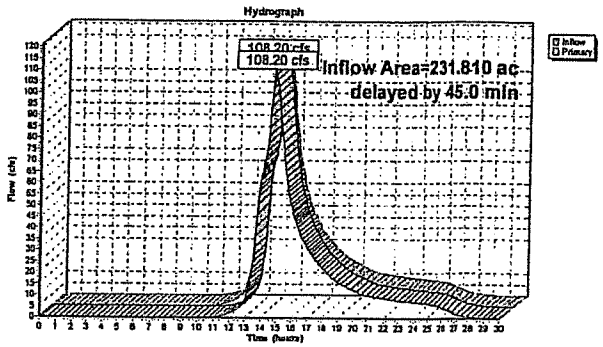


Link 4E: (new Link)

Inflow Area = 231.810 ac, Inflow Depth > 1.49" for 2 Year event
Inflow = 108.20 cfs @ 14.13 hrs, Volume= 28.824 af
Primary = 108.20 cfs @ 14.88 hrs, Volume= 28.822 af, Atten= 0%, Lag= 45.0 min

Primary outflow = Inflow delayed by 45.0 min, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Link 4E: (new Link)

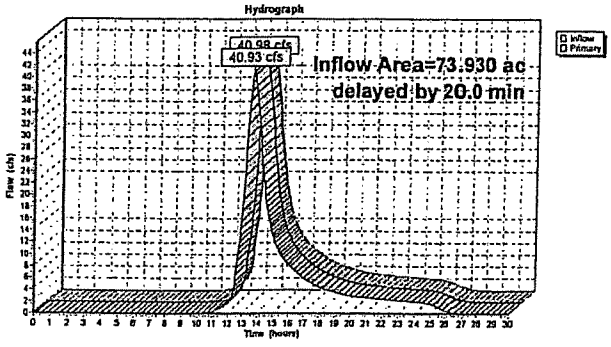


Link 4ELB: (new Link)

Inflow Area = 73.930 ac, Inflow Depth = 1.42" for 2 Year event
Inflow = 40.98 cfs @ 13.33 hrs, Volume= 8.775 af
Primary = 40.93 cfs @ 13.66 hrs, Volume= 8.775 af, Atten= 0%, Lag= 20.0 min

Primary outflow = Inflow delayed by 20.0 min, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Link 4ELB: (new Link)

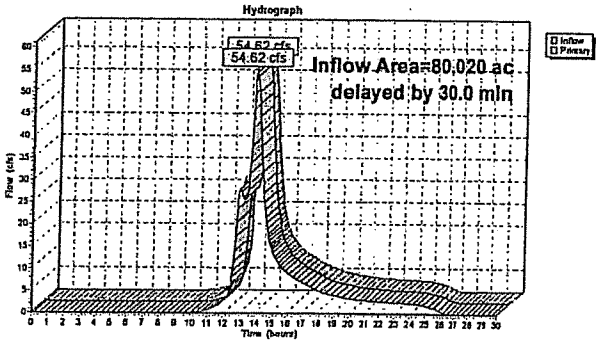


Link 4W: (new Link)

Inflow Area = 80.020 ac, Inflow Depth = 1.59" for 2 Year event
Inflow = 54.62 cfs @ 13.44 hrs, Volume= 10.577 af
Primary = 54.62 cfs @ 13.94 hrs, Volume= 10.577 af, Atten= 0%, Lag= 30.0 min

Primary outflow = Inflow delayed by 30.0 min, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Link 4W: (new Link)

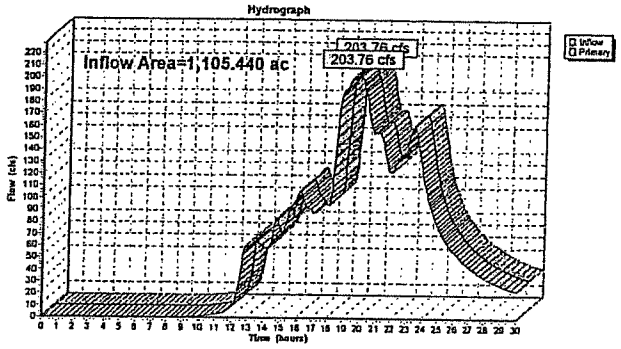


Link 5C: (new Link)

Inflow Area = 1,105.440 ac, Inflow Depth > 1.51" for 2 Year event
Inflow = 203.76 cfs @ 19.91 hrs, Volume= 139.417 af
Primary = 203.76 cfs @ 19.91 hrs, Volume= 139.417 af, Atten= 0%, Lag= 0.0 min

nary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Link 5C: (new Link)



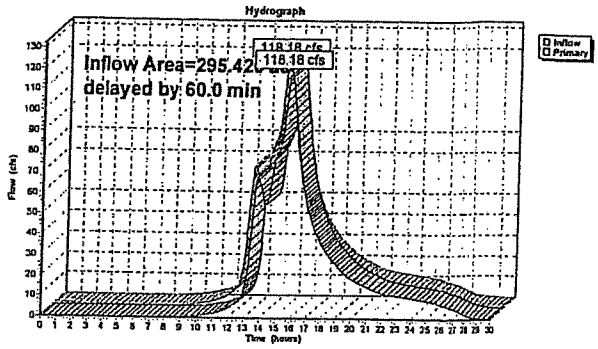
Item C1.

Link 5E: (new Link)

Inflow Area = 295.420 ac, Inflow Depth > 1.62" for 2 Year event
Inflow = 118.18 cfs @ 14.67 hrs, Volume= 39.916 af
Primary = 118.18 cfs @ 15.67 hrs, Volume= 39.909 af, Atten= 0%, Lag= 60.0 min

Primary outflow = Inflow delayed by 60.0 min, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Link 5E: (new Link)

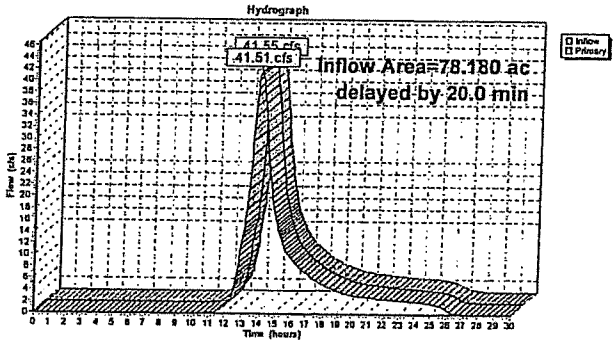


Link 5ELB: (new Link)

Inflow Area = 78.180 ac, Inflow Depth = 1.41" for 2 Year event
Inflow = 41.55 cfs @ 13.66 hrs, Volume= 9.190 af
Primary = 41.51 cfs @ 13.99 hrs, Volume= 9.180 af, Atten= 0%, Lag= 20.0 min

Primary outflow = Inflow delayed by 20.0 min, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Link 5ELB: (new Link)

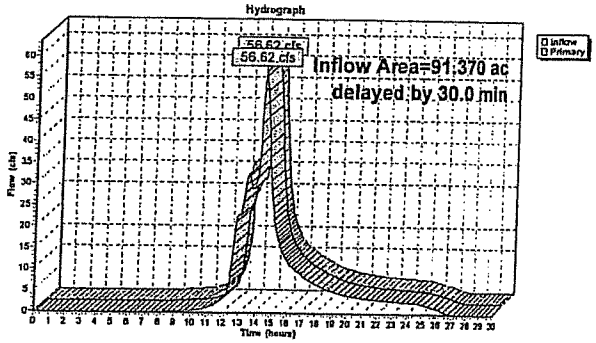


Link 5W: (new Link)

Inflow Area = 91.370 ac, Inflow Depth = 1.66" for 2 Year event
Inflow = 56.62 cfs @ 13.94 hrs, Volume= 12.635 af
Primary = 56.62 cfs @ 14.44 hrs, Volume= 12.636 af, Atten= 0%, Lag= 30.0 min

Primary outflow = Inflow delayed by 30.0 min, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Link 5W: (new Link)

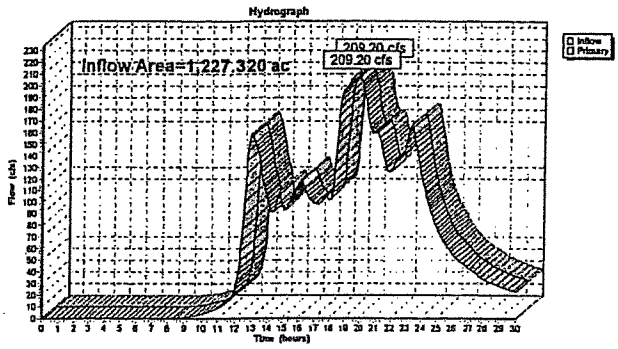


Link 6C: (new Link)

Inflow Area = 1,227.320 ac, Inflow Depth > 1.56" for 2 Year event
Inflow = 209.20 cfs @ 19.91 hrs, Volume= 159.833 af
Primary = 209.20 cfs @ 19.91 hrs, Volume= 159.833 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Link 6C: (new Link)

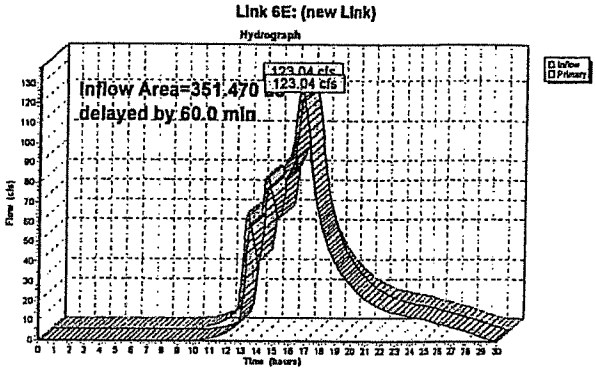


Link 6E: (new Link)

Inflow Area = 351.470 ac, Inflow Depth > 1.61" for 2 Year event
Inflow = 123.04 cfs @ 15.86 hrs, Volume= 47.183 af
Primary = 123.04 cfs @ 16.86 hrs, Volume= 47.160 af, Atten= 0%, Lag= 60.0 min

Primary outflow = Inflow delayed by 60.0 min, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Link 6E: (new Link)

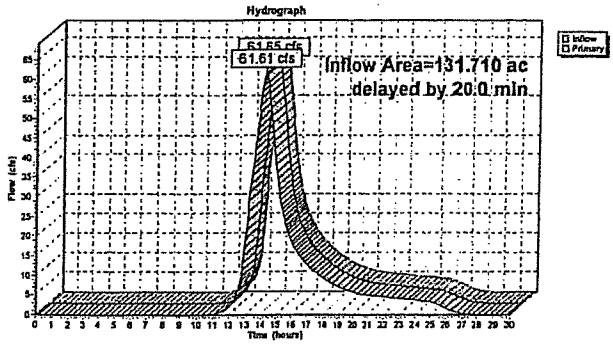


Link 6ELB: (new Link)

Inflow Area = 131.710 ac, Inflow Depth = 1.44" for 2 Year event
Inflow = 61.65 cfs @ 13.89 hrs, Volume= 15.831 af
Primary = 61.61 cfs @ 14.22 hrs, Volume= 15.831 af, Atten= 0%, Lag= 20.0 min

Primary outflow = Inflow delayed by 20.0 min, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Link 6ELB: (new Link)

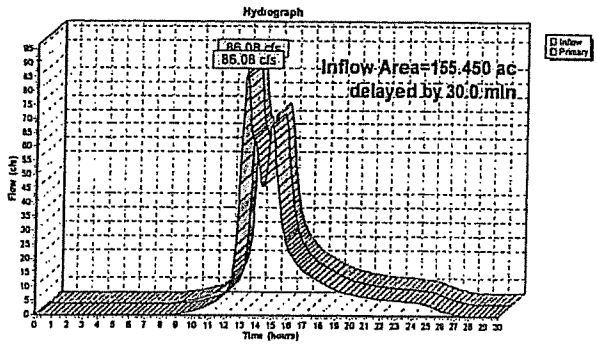


Link 6W: (new Link)

Inflow Area = 155.450 ac, Inflow Depth = 1.80" for 2 Year event
Inflow = 86.08 cfs @ 12.77 hrs, Volume= 23.370 af
Primary = 86.08 cfs @ 13.27 hrs, Volume= 23.370 af, Atten= 0%, Lag= 30.0 min

Primary outflow = Inflow delayed by 30.0 min, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Link 6W: (new Link)

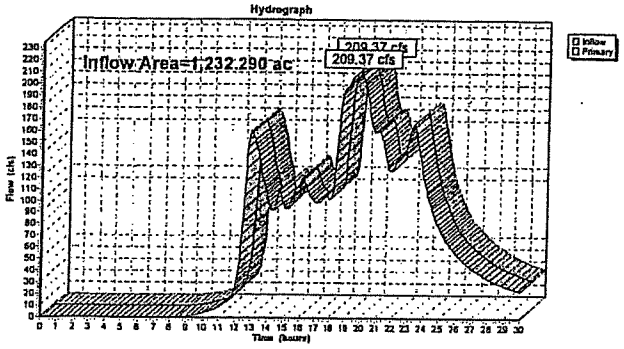


Link 7C: (new Link)

Inflow Area = 1,232.290 ac, Inflow Depth > 1.56" for 2 Year event
Inflow = 209.37 cfs @ 19.91 hrs, Volume= 160.395 af
Primary = 209.37 cfs @ 19.91 hrs, Volume= 160.395 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Link 7C: (new Link)



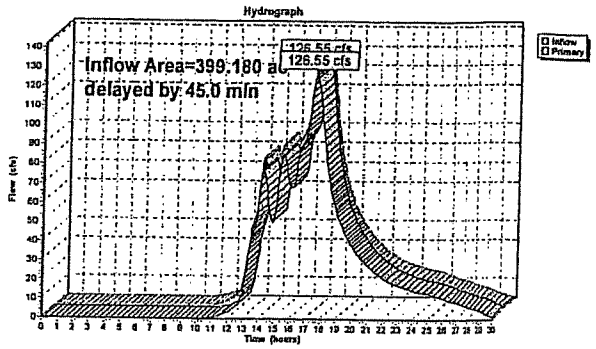
Item C1.

Link 7E: (new Link)

Inflow Area = 399.180 ac, Inflow Depth > 1.61" for 2 Year event
Inflow = 126.55 cfs @ 16.66 hrs, Volume= 53.633 af
Primary = 126.55 cfs @ 17.61 hrs, Volume= 53.583 af, Atten= 0%, Lag= 45.0 min

Primary outflow = Inflow delayed by 45.0 min, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Link 7E: (new Link)

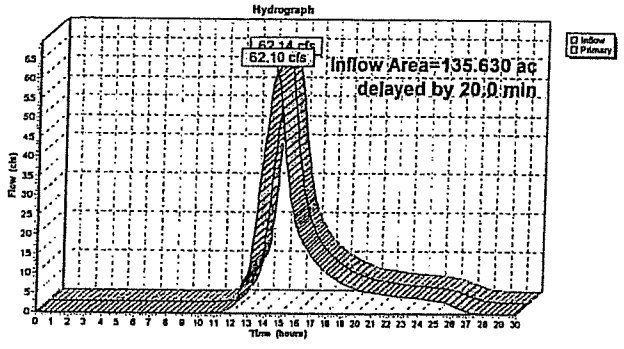


Link 7ELB: (new Link)

Inflow Area = 135.630 ac, Inflow Depth = 1.45" for 2 Year event
Inflow = 62.14 cfs @ 14.22 hrs, Volume= 16.362 af
Primary = 62.10 cfs @ 14.55 hrs, Volume= 16.362 af, Atten= 0%, Lag= 20.0 min

Primary outflow = Inflow delayed by 20.0 min, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Link 7ELB: (new Link)

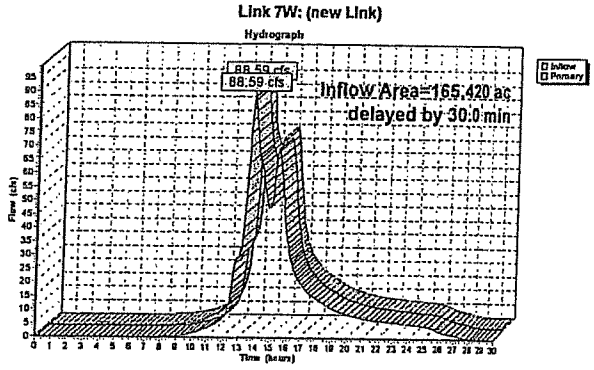


Link 7W: (new Link)

Inflow Area = 165.420 ac, Inflow Depth = 1.84" for 2 Year event
Inflow = 88.59 cfs @ 13.27 hrs, Volume= 25.403 af
Primary = 88.59 cfs @ 13.77 hrs, Volume= 25.403 af, Atten= 0%, Lag= 30.0 min

Primary outflow = Inflow delayed by 30.0 min, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Link 7W: (new Link)

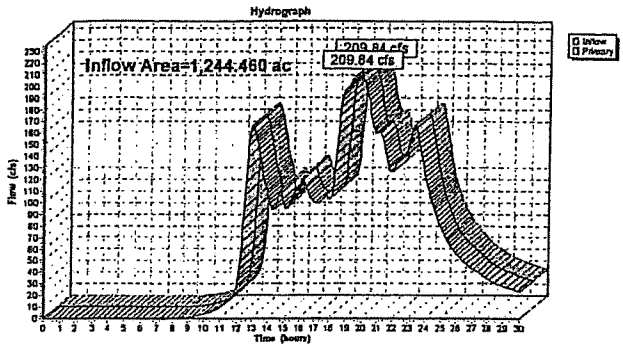


Link 8C: (new Link)

Inflow Area = 1,244.460 ac, Inflow Depth > 1.56" for 2 Year event
Inflow = 209.84 cfs @ 19.91 hrs, Volume= 162.195 af
Primary = 209.84 cfs @ 19.91 hrs, Volume= 162.195 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Link 8C: (new Link)

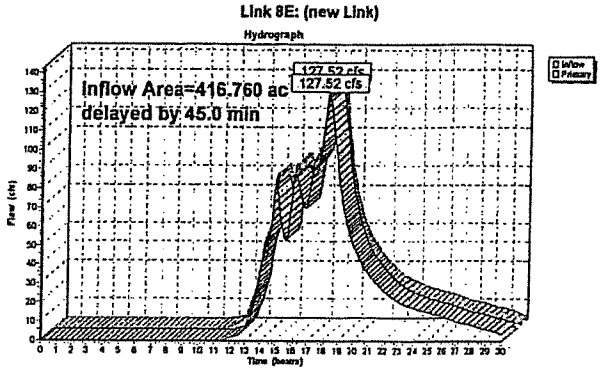


Link 8E: (new Link)

Inflow Area = 416.760 ac, Inflow Depth > 1.60" for 2 Year event
Inflow = 127.52 cfs @ 17.61 hrs, Volume= 55.571 af
Primary = 127.52 cfs @ 18.36 hrs, Volume= 55.425 af, Atten= 0%, Lag= 45.0 min

Primary outflow = Inflow delayed by 45.0 min, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Link 8E: (new Link)

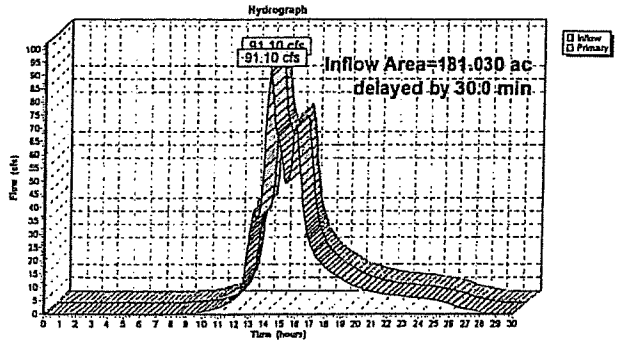


Link 8W: (new Link)

Inflow Area = 181.030 ac, Inflow Depth = 1.81" for 2 Year event
Inflow = 91.10 cfs @ 13.77 hrs, Volume= 27.338 af
Primary = 91.10 cfs @ 14.27 hrs, Volume= 27.339 af, Atten= 0%, Lag= 30.0 min

Primary outflow = Inflow delayed by 30.0 min, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Link 8W: (new Link)

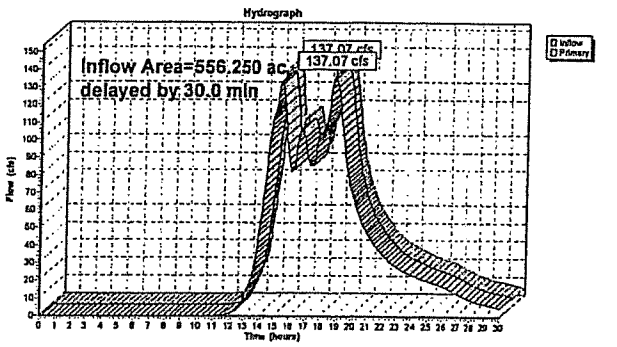


Link 9E: (new Link)

Inflow Area = 556.250 ac, Inflow Depth > 1.56" for 2 Year event
Inflow = 137.07 cfs @ 18.35 hrs, Volume= 72.358 af
Primary = 137.07 cfs @ 18.85 hrs, Volume= 72.183 af, Atten= 0%, Lag= 30.0 min

Primary outflow = Inflow delayed by 30.0 min, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Link 9E: (new Link)

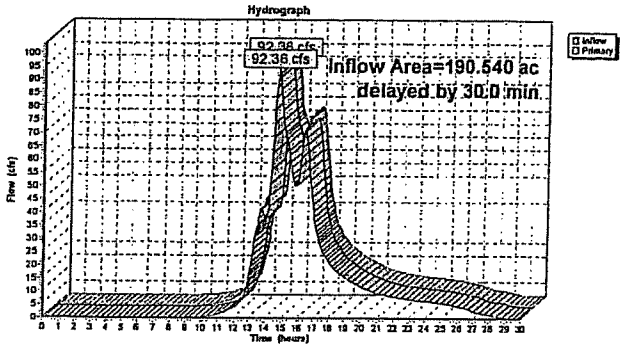


Link 9W: (new Link)

Inflow Area = 190.540 ac, Inflow Depth = 1.78" for 2 Year event
Inflow = 92.36 cfs @ 14.27 hrs, Volume= 28.315 af
Primary = 92.36 cfs @ 14.77 hrs, Volume= 28.315 af, Atten= 0%, Lag= 30.0 min

nary outflow = Inflow delayed by 30.0 min, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Link 9W: (new Link)

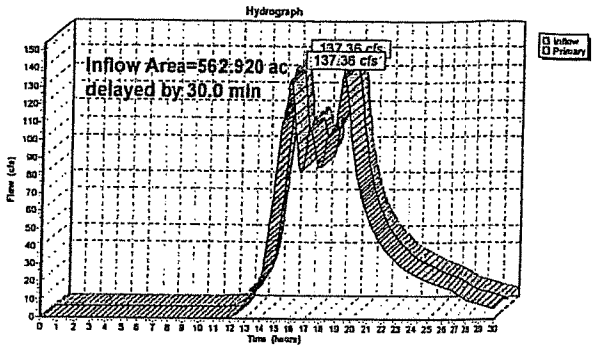


Link 10E: (new Link)

Inflow Area = 562.920 ac, Inflow Depth > 1.56" for 2 Year event
Inflow = 137.36 cfs @ 18.85 hrs, Volume= 73.170 af
Primary = 137.36 cfs @ 19.35 hrs, Volume= 72.943 af, Atten= 0%, Lag= 30.0 min

Primary outflow = Inflow delayed by 30.0 min, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Link 10E: (new Link)

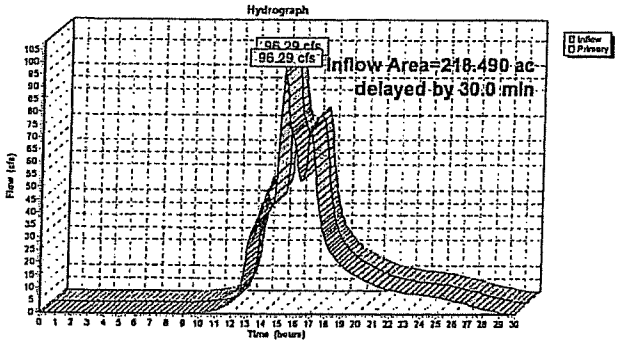


Link 10W: (new Link)

Inflow Area = 218.490 ac, Inflow Depth = 1.77" for 2 Year event
Inflow = 96.29 cfs @ 14.76 hrs, Volume= 32.276 af
Primary = 96.29 cfs @ 15.26 hrs, Volume= 32.276 af, Atten= 0%, Lag= 30.0 min

Primary outflow = Inflow delayed by 30.0 min, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Link 10W: (new Link)

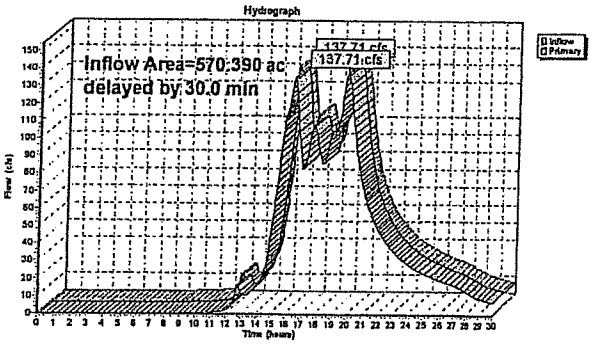


Link 11E: (new Link)

Inflow Area = 570.390 ac, Inflow Depth > 1.57" for 2 Year event
Inflow = 137.71 cfs @ 19.35 hrs, Volume= 74.466 af
Primary = 137.71 cfs @ 19.85 hrs, Volume= 74.199 af, Atten= 0%, Lag= 30.0 min

Primary outflow = Inflow delayed by 30.0 min, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Link 11E: (new Link)

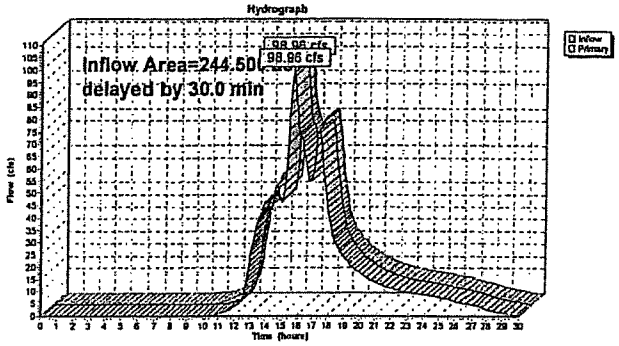


Link 11W: (new Link)

Inflow Area = 244.500 ac, Inflow Depth > 1.74" for 2 Year event
Inflow = 98.96 cfs @ 15.26 hrs, Volume= 35.357 af
Primary = 98.96 cfs @ 15.76 hrs, Volume= 35.356 af, Atten= 0%, Lag= 30.0 min

Primary outflow = Inflow delayed by 30.0 min, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Link 11W: (new Link)



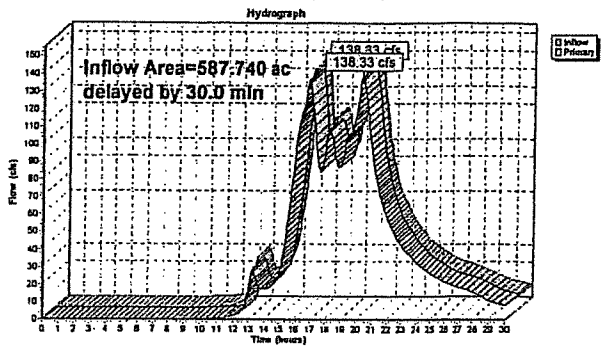
Item C1.

Link 12E: (new Link)

Inflow Area = 587.740 ac, Inflow Depth > 1.56" for 2 Year event
Inflow = 138.33 cfs @ 19.85 hrs, Volume= 76.255 af
Primary = 138.33 cfs @ 20.35 hrs, Volume= 75.944 af, Atten= 0%, Lag= 30.0 min

Primary outflow = Inflow delayed by 30.0 min, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Link 12E: (new Link)

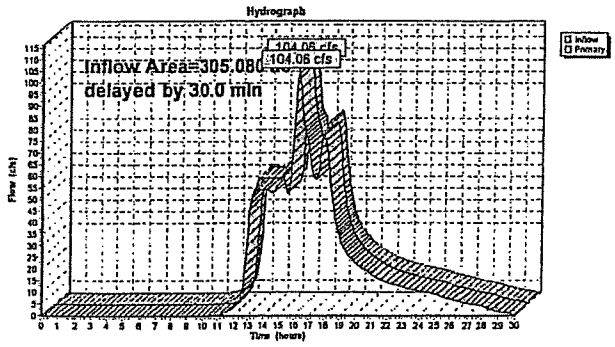


Link 12W: (new Link)

Inflow Area = 305.080 ac, Inflow Depth > 1.65" for 2 Year event
Inflow = 104.06 cfs @ 15.76 hrs, Volume= 41.885 af
Primary = 104.06 cfs @ 16.26 hrs, Volume= 41.876 af, Atten= 0%, Lag= 30.0 min

Primary outflow = Inflow delayed by 30.0 min, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Link 12W: (new Link)

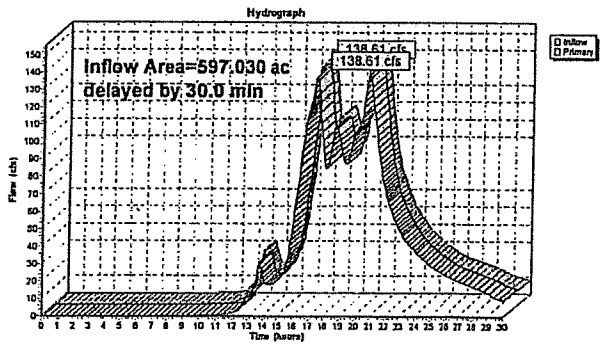


Link 13E: (new Link)

Inflow Area = 597.030 ac, Inflow Depth > 1.54" for 2 Year event
Inflow = 138.61 cfs @ 20.35 hrs, Volume= 76.851 af
Primary = 138.61 cfs @ 20.85 hrs, Volume= 76.459 af, Atten= 0%, Lag= 30.0 min

Primary outflow = Inflow delayed by 30.0 min, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Link 13E: (new Link)

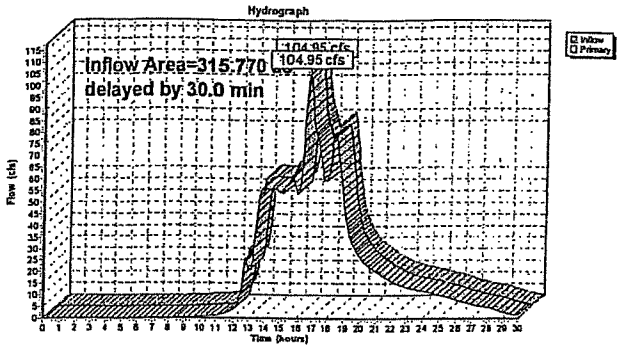


Link 13W: (new Link)

Inflow Area = 315.770 ac, Inflow Depth > 1.67" for 2 Year event
Inflow = 104.95 cfs @ 16.26 hrs, Volume= 43.974 af
Primary = 104.95 cfs @ 16.76 hrs, Volume= 43.935 af, Atten= 0%, Lag= 30.0 min

ry outflow = Inflow delayed by 30.0 min, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Link 13W: (new Link)



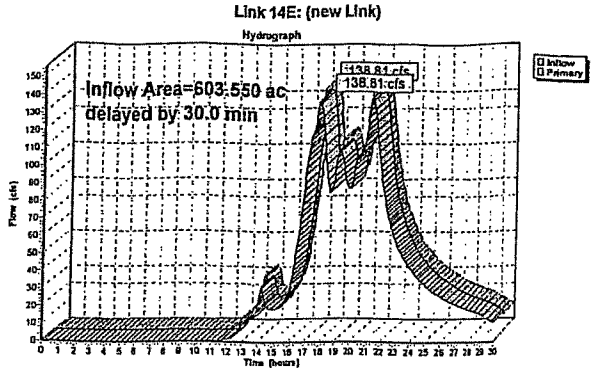
Item C1.

Link 14E: (new Link)

Inflow Area = 603.550 ac, Inflow Depth > 1.54" for 2 Year event
Inflow = 138.81 cfs @ 20.85 hrs, Volume= 77.227 af
Primary = 138.81 cfs @ 21.35 hrs, Volume= 76.823 af, Atten= 0%, Lag= 30.0 min

Primary outflow = Inflow delayed by 30.0 min, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Link 14E: (new Link)

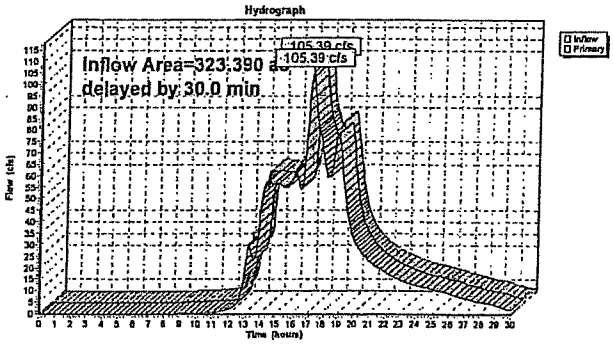


Link 14W: (new Link)

Inflow Area = 323.390 ac, Inflow Depth > 1.66" for 2 Year event
Inflow = 105.39 cfs @ 16.76 hrs, Volume= 44.756 af
Primary = 105.39 cfs @ 17.26 hrs, Volume= 44.695 af, Atten= 0%, Lag= 30.0 min

Primary outflow = Inflow delayed by 30.0 min, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Link 14W: (new Link)

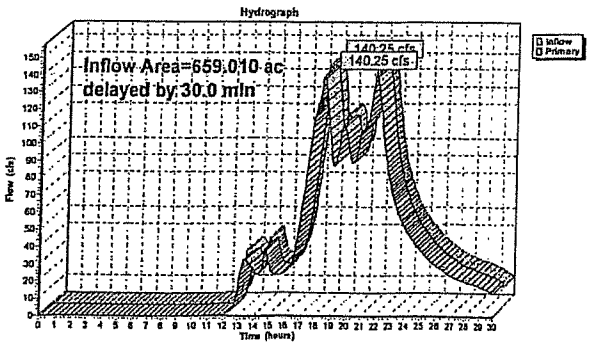


Link 15E: (new Link)

Inflow Area = 659.010 ac, Inflow Depth > 1.48" for 2 Year event
Inflow = 140.25 cfs @ 21.35 hrs, Volume= 81.448 af
Primary = 140.25 cfs @ 21.85 hrs, Volume= 80.960 af, Atten= 0%, Lag= 30.0 min

Primary outflow = Inflow delayed by 30.0 min, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Link 15E: (new Link)

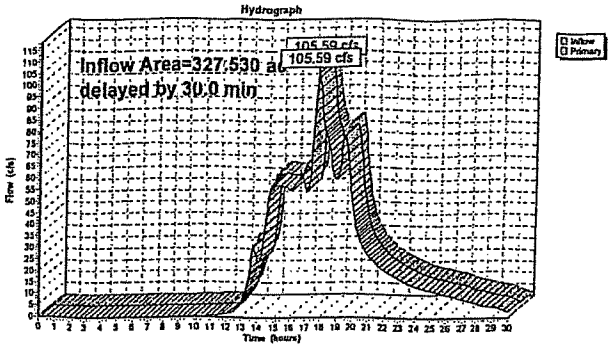


Link 15W: (new Link)

Inflow Area = 327.530 ac, Inflow Depth > 1.65" for 2 Year event
Inflow = 105.59 cfs @ 17.26 hrs, Volume= 45.079 af
Primary = 105.59 cfs @ 17.76 hrs, Volume= 44.991 af, Atten= 0%, Lag= 30.0 min

Primary outflow = Inflow delayed by 30.0 min, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Link 15W: (new Link)



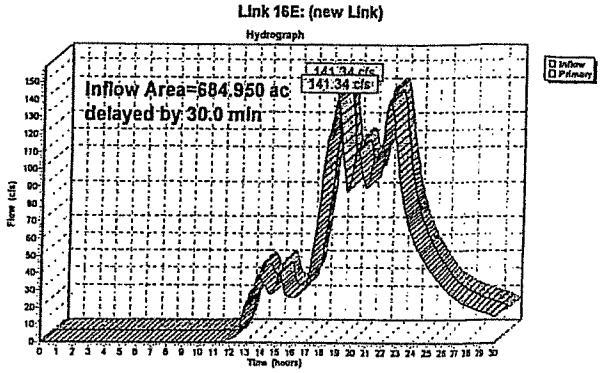
Item C1.

Link 16E: (new Link)

Inflow Area = 684.950 ac, Inflow Depth > 1.47" for 2 Year event
Inflow = 141.34 cfs @ 18.41 hrs, Volume= 83.893 af
Primary = 141.34 cfs @ 18.91 hrs, Volume= 83.313 af, Atten= 0%, Lag= 30.0 min

Primary outflow = Inflow delayed by 30.0 min, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Link 16E: (new Link)



10-Year Storm

Time span=0.00-30.00 hrs, dt=0.05 hrs, 601 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment C116: C116 Runoff Area=4.970 ac Runoff Depth=2.54"
Flow Length=450' Tc=25.8 min CN=77 Runoff=8.92 cfs 1.052 af

Subcatchment C1334: C1334 Runoff Area=35.190 ac Runoff Depth=3.08"
Flow Length=900' Slope=0.0200 '/' Tc=34.0 min CN=83 Runoff=67.65 cfs 9.043 af

Subcatchment C1748: C1748 Runoff Area=12.100 ac Runoff Depth=2.54"
Flow Length=850' Tc=33.5 min CN=77 Runoff=19.30 cfs 2.561 af

Subcatchment C2359: C2359 Runoff Area=32.610 ac Runoff Depth=2.99"
Flow Length=1,050' Slope=0.0400 '/' Tc=36.8 min CN=82 Runoff=58.54 cfs 8.125 af

Subcatchment C560: C560 Runoff Area=121.880 ac Runoff Depth=3.37"
Flow Length=4,800' Tc=73.9 min CN=86 Runoff=165.56 cfs 34.266 af

Subcatchment C62: (new Subcat) Runoff Area=12.170 ac Runoff Depth=3.08"
Flow Length=2,400' Tc=31.3 min CN=83 Runoff=24.30 cfs 3.127 af

Subcatchment C747: C747 Runoff Area=13.060 ac Runoff Depth=2.72"
Flow Length=700' Slope=0.0050 '/' Tc=58.8 min CN=79 Runoff=16.51 cfs 2.956 af

Subcatchment E2964: E2964 Runoff Area=25.940 ac Runoff Depth=2.54"
Flow Length=1,460' Slope=0.0400 '/' Tc=35.4 min CN=77 Runoff=40.26 cfs 5.490 af

Subcatchment E3565: E3565 Runoff Area=55.460 ac Runoff Depth=2.04"
Flow Length=2,790' Tc=55.8 min CN=71 Runoff=53.22 cfs 9.434 af

Subcatchment E3889: E3889 Runoff Area=6.520 ac Runoff Depth=2.54"
Flow Length=650' Tc=22.3 min CN=77 Runoff=12.46 cfs 1.380 af

Subcatchment E4219: E4219 Runoff Area=9.290 ac Runoff Depth=2.28"
Flow Length=800' Slope=0.0330 '/' Tc=24.2 min CN=74 Runoff=15.32 cfs 1.769 af

Subcatchment E4975: E4975 Runoff Area=17.350 ac Runoff Depth=2.63"
Flow Length=1,110' Slope=0.0250 '/' Tc=46.6 min CN=78 Runoff=24.22 cfs 3.798 af

Subcatchment E5158: E5158 Runoff Area=7.470 ac Runoff Depth=3.89"
Flow Length=500' Tc=17.1 min CN=91 Runoff=23.45 cfs 2.418 af

Subcatchment E5498: E5498 Runoff Area=6.670 ac Runoff Depth=3.08"
Flow Length=1,000' Tc=38.4 min CN=83 Runoff=12.09 cfs 1.714 af

Subcatchment E5909: E5909 Runoff Area=3.860 ac Runoff Depth=3.08"
Flow Length=450' Slope=0.0080 '/' Tc=52.8 min CN=83 Runoff=5.91 cfs 0.992 af

Subcatchment E6369: E6369 Runoff Area=17.580 ac Runoff Depth=2.54"
Flow Length=950' Tc=63.2 min CN=77 Runoff=19.94 cfs 3.720 af

Subcatchment E6821: E6821 Runoff Area=47.710 ac Runoff Depth=2.90"
Flow Length=2,042' Tc=62.2 min CN=81 Runoff=62.26 cfs 11.519 af

Subcatchment E7473: E7473 Runoff Area=56.050 ac Runoff Depth=2.81"
Flow Length=1,565' Tc=36.5 min CN=80 Runoff=94.89 cfs 13.105 af

Subcatchment E8046: E8046 Runoff Area=63.610 ac Runoff Depth=3.47"
Flow Length=3,435' Tc=57.2 min CN=87 Runoff=103.91 cfs 18.411 af

Subcatchment E8497: E8497 Runoff Area=161.630 ac Runoff Depth>2.63"
Flow Length=4,455' Tc=135.0 min CN=78 Runoff=113.68 cfs 35.383 af

Subcatchment E9081: E9081 Runoff Area=12.310 ac Runoff Depth=2.90"
Flow Length=575' Tc=22.5 min CN=81 Runoff=26.76 cfs 2.972 af

Subcatchment E9326: E9326 Runoff Area=24.170 ac Runoff Depth=2.28"
Flow Length=1,650' Tc=40.2 min CN=74 Runoff=31.53 cfs 4.602 af

Subcatchment E9611: E9611 Runoff Area=33.700 ac Runoff Depth=3.37"
Flow Length=1,650' Tc=53.6 min CN=86 Runoff=55.63 cfs 9.475 af

Subcatchment ELB1369: ELB1369 Runoff Area=19.910 ac Runoff Depth=2.81"
Flow Length=2,055' Tc=44.5 min CN=80 Runoff=30.52 cfs 4.655 af

Subcatchment ELB1483: ELB1483 Runoff Area=10.040 ac Runoff Depth=2.20"
Flow Length=1,125' Slope=0.0400 '/' Tc=38.1 min CN=73 Runoff=12.92 cfs 1.843 af

Subcatchment ELB2128: ELB2128 Runoff Area=36.550 ac Runoff Depth=2.72"
Flow Length=900' Tc=60.5 min CN=79 Runoff=45.59 cfs 8.272 af

Subcatchment ELB234: ELB234 Runoff Area=3.920 ac Runoff Depth=2.90"
Flow Length=400' Slope=0.0150 '/' Tc=26.4 min CN=81 Runoff=7.96 cfs 0.946 af

Subcatchment ELB729: ELB729 Runoff Area=53.530 ac Runoff Depth=2.72"
Flow Length=4,165' Tc=100.2 min CN=79 Runoff=47.98 cfs 12.115 af

Subcatchment ELB829: ELB829 Runoff Area=4.250 ac Runoff Depth=2.28"
Flow Length=750' Slope=0.0400 '/' Tc=31.8 min CN=74 Runoff=6.21 cfs 0.809 af

Subcatchment ELB972: ELB972 Runoff Area=7.430 ac Runoff Depth=2.28"
Flow Length=800' Slope=0.0400 '/' Tc=27.0 min CN=74 Runoff=11.68 cfs 1.415 af

Subcatchment W1217: W1217 Runoff Area=10.690 ac Runoff Depth=3.76"
Flow Length=650' Slope=0.0100 '/' Tc=17.0 min CN=90 Runoff=32.96 cfs 3.367 af

Subcatchment W1526: W1526 Runoff Area=60.580 ac Runoff Depth=2.45"
Flow Length=2,635' Tc=47.0 min CN=76 Runoff=78.36 cfs 12.385 af

Subcatchment W1737: W1737 Runoff Area=26.010 ac Runoff Depth=2.63"
Flow Length=1,150' Tc=47.9 min CN=78 Runoff=35.77 cfs 5.694 af

Subcatchment W2720: W2720 Runoff Area=27.950 ac Runoff Depth=2.89"
Flow Length=700' Tc=53.8 min CN=82 Runoff=41.11 cfs 6.964 af

Subcatchment W290: W290 Runoff Area=4.140 ac Runoff Depth=2.20"
Flow Length=650' Slope=0.0300 '/' Tc=28.3 min CN=73 Runoff=6.12 cfs 0.760 af

Subcatchment W3148: W3148 Runoff Area=9.510 ac Runoff Depth=2.37"
Flow Length=750' Tc=46.4 min CN=75 Runoff=11.96 cfs 1.877 af

Subcatchment W3774: W3774 Runoff Area=15.610 ac Runoff Depth=2.72"
Flow Length=1,200' Tc=31.3 min CN=79 Runoff=27.50 cfs 3.533 af

Subcatchment W3975: W3975 Runoff Area=9.970 ac Runoff Depth=3.89"
Flow Length=865' Tc=20.3 min CN=91 Runoff=29.34 cfs 3.228 af

Subcatchment W4529: W4529 Runoff Area=64.080 ac Runoff Depth=3.37"
Flow Length=3,200' Tc=51.2 min CN=86 Runoff=108.61 cfs 18.016 af

Subcatchment W5128: W5128 Runoff Area=11.350 ac Runoff Depth=3.57"
Flow Length=605' Slope=0.0200 '/' Tc=23.3 min CN=88 Runoff=29.61 cfs 3.380 af

Subcatchment W5300: W5300 Runoff Area=25.630 ac Runoff Depth=2.63"
Flow Length=925' Tc=30.7 min CN=78 Runoff=44.05 cfs 5.611 af

Subcatchment W6008: W6008 Runoff Area=12.580 ac Runoff Depth=2.63"
Flow Length=875' Tc=42.6 min CN=78 Runoff=18.42 cfs 2.754 af

Subcatchment W6278: W6278 Runoff Area=15.920 ac Runoff Depth=2.63"
Flow Length=1,350' Tc=25.8 min CN=78 Runoff=29.61 cfs 3.485 af

Subcatchment W6643: W6643 Runoff Area=25.890 ac Runoff Depth=3.28"
Flow Length=2,400' Tc=39.4 min CN=85 Runoff=49.03 cfs 7.067 af

Subcatchment W684: W684 Runoff Area=7.620 ac Runoff Depth=2.45"
Flow Length=650' Slope=0.0260 '/' Tc=36.2 min CN=76 Runoff=11.30 cfs 1.558 af

Link 1C: (new Link) Inflow=361.96 cfs 230.741 af
Primary=361.96 cfs 230.741 af

Link 1E: (new Link) Inflow=55.63 cfs 9.475 af
Primary=55.63 cfs 9.475 af

Link 1ELB: (new Link) Inflow=45.59 cfs 8.272 af
Primary=45.59 cfs 8.272 af

Link 1W: (new Link) Inflow=49.03 cfs 7.067 af
Primary=49.03 cfs 7.067 af

Link 2C: (new Link) delayed by 20.0 min Inflow=364.17 cfs 238.866 af
Primary=363.89 cfs 238.045 af

Link 2E: (new Link) delayed by 45.0 min Inflow=85.58 cfs 14.077 af
Primary=85.58 cfs 14.077 af

Link 2ELB: (new Link) delayed by 20.0 min Inflow=55.72 cfs 10.114 af
Primary=55.68 cfs 10.114 af

Link 2W: (new Link) delayed by 30.0 min Inflow=75.23 cfs 10.553 af
Primary=75.23 cfs 10.553 af

Link 3C: (new Link) delayed by 20.0 min Inflow=364.73 cfs 240.606 af
Primary=364.52 cfs 239.694 af

Link 3E: (new Link) delayed by 45.0 min Inflow=89.35 cfs 17.049 af
Primary=89.35 cfs 17.049 af

Link 3ELB: (new Link) delayed by 20.0 min Inflow=74.55 cfs 14.770 af
Primary=74.48 cfs 14.770 af

Link 3W: (new Link) delayed by 30.0 min Inflow=87.73 cfs 13.307 af
Primary=87.73 cfs 13.307 af

Link 4C: (new Link) delayed by 20.0 min Inflow=366.76 cfs 248.738 af
Primary=366.56 cfs 247.756 af

Link 4E: (new Link) delayed by 45.0 min Inflow=197.84 cfs 52.431 af
Primary=197.84 cfs 52.428 af

Link 4ELB: (new Link) delayed by 20.0 min Inflow=76.84 cfs 16.184 af
Primary=76.76 cfs 16.184 af

Link 4W: (new Link) delayed by 30.0 min Inflow=96.41 cfs 18.917 af
Primary=96.41 cfs 18.917 af

Link 5C: (new Link) Inflow=367.35 cfs 250.714 af
Primary=367.35 cfs 250.714 af

Link 5E: (new Link) delayed by 60.0 min Inflow=213.45 cfs 70.839 af
Primary=213.45 cfs 70.827 af

Link 5ELB: (new Link) delayed by 20.0 min Inflow=77.89 cfs 16.993 af
Primary=77.82 cfs 16.993 af

Link 5W: (new Link) delayed by 30.0 min Inflow=99.50 cfs 22.298 af
Primary=99.50 cfs 22.298 af

Link 6C: (new Link) Inflow=375.71 cfs 284.980 af
Primary=375.71 cfs 284.980 af

Subcatchment C1748: C1748

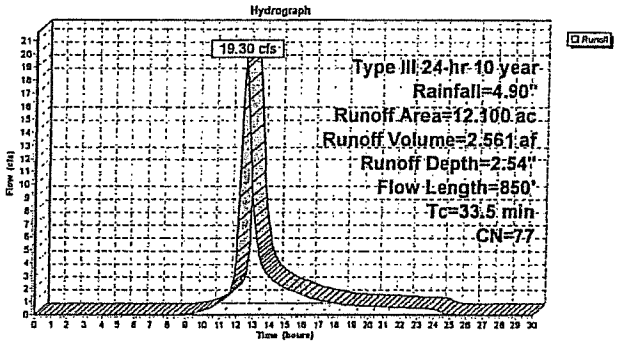
Runoff = 19.30 cfs @ 12.47 hrs, Volume= 2.561 af, Depth= 2.54"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 year Rainfall=4.90"

Area (ac)	CN	Description
1.420	94	Urban commercial, 85% imp, HSG C
2.560	83	1/4 acre lots, 38% imp, HSG C
2.020	74	>75% Grass cover, Good, HSG C
3.600	70	Brush, Fair, HSG C
2.500	74	>75% Grass cover, Good, HSG C
12.100	77	Weighted Average
9.920		Pervious Area
2.180		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.0	150	0.0270	0.15		Sheet Flow, Grass: Dense n= 0.240 P2= 3.40"
6.5	450	0.0270	1.15		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
10.0	250	0.0070	0.42		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
33.5	850	Total			

Subcatchment C1748: C1748



Subcatchment C2359: C2359

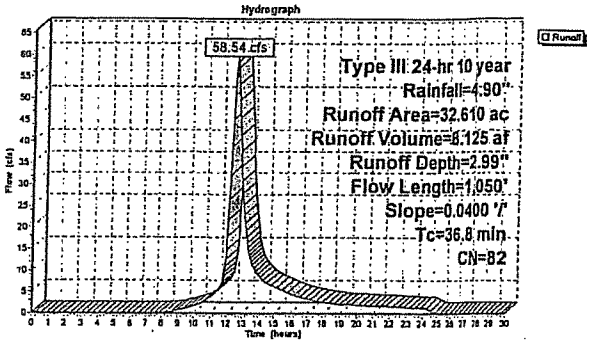
Runoff = 58.54 cfs @ 12.51 hrs, Volume= 8.125 af, Depth= 2.99"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 year Rainfall=4.90"

Area (ac)	CN	Description
8.300	91	Urban Industrial, 72% Imp, HSG C
2.000	77	Brush, Fair, HSG D
7.540	70	Brush, Fair, HSG C
14.770	83	1/4 acre lots, 38% Imp, HSG C
32.610	82	Weighted Average
21.021		Pervious Area
11.589		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
21.8	150	0.0400	0.11		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.40"
15.0	900	0.0400	1.00		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
36.8	1,050	Total			

Subcatchment C2359: C2359



Subcatchment C560: C560

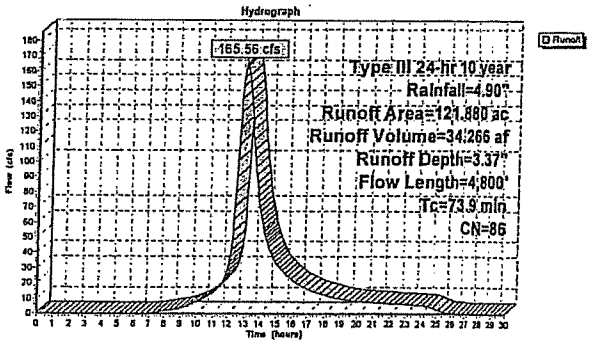
Runoff = 165.56 cfs @ 12.98 hrs, Volume= 34.266 af, Depth= 3.37"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 year Rainfall=4.90"

Area (ac)	CN	Description
19.710	94	Urban commercial, 85% Imp, HSG C
1.910	74	>75% Grass cover, Good, HSG C
1.250	73	Woods, Fair, HSG C
2.630	74	>75% Grass cover, Good, HSG C
7.880	70	1/2 acre lots, 25% Imp, HSG B
8.060	60	Woods, Fair, HSG B
79.440	90	1/8 acre lots, 65% Imp, HSG C
121.880	86	Weighted Average
51.520		Pervious Area
70.360		Impervious Area

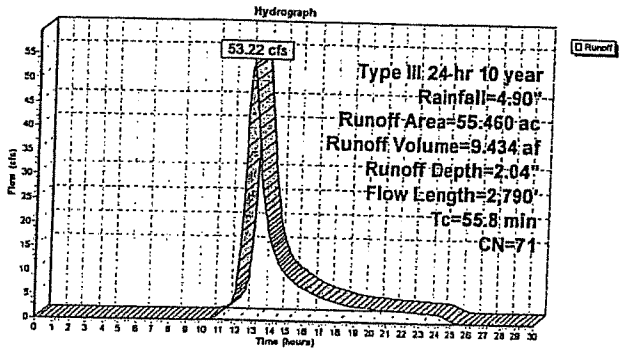
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
28.1	200	0.0380	0.12		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.40"
14.5	850	0.0380	0.97		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
2.9	225	0.0350	1.31		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
8.1	1,700	0.0300	3.52		Shallow Concentrated Flow, Paved Kv= 20.3 fps
6.7	1,100	0.0180	2.72		Shallow Concentrated Flow, Paved Kv= 20.3 fps
3.5	300	0.0050	1.44		Shallow Concentrated Flow, Paved Kv= 20.3 fps
10.1	425	0.0100	0.70		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
73.9	4,800	Total			

Subcatchment C560: C560



Item C1.

Subcatchment E3568: E3568



Subcatchment E3889: E3889

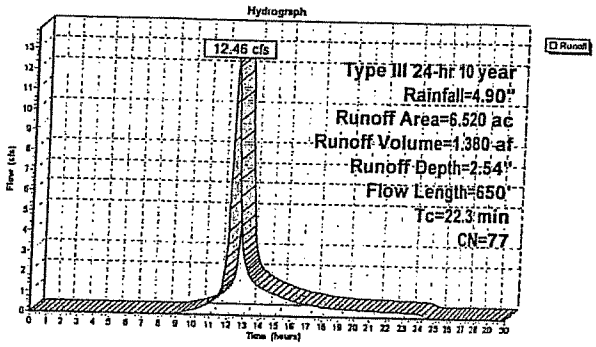
Runoff = 12.46 cfs @ 12.31 hrs, Volume= 1.380 af, Depth= 2.54"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 year Rainfall=4.90"

Area (ac)	CN	Description
2.290	83	1/4 acre lots, 38% Imp, HSG C
4.230	74	>75% Grass cover, Good, HSG C
6.520	77	Weighted Average
5.650		Pervious Area
0.870		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.3	150	0.0300	0.15		Sheet Flow, Grass: Dense n= 0.240 P2= 3.40"
6.0	500	0.0400	1.40		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
22.3	650	Total			

Subcatchment E3889: E3889



Subcatchment E4219: E4219

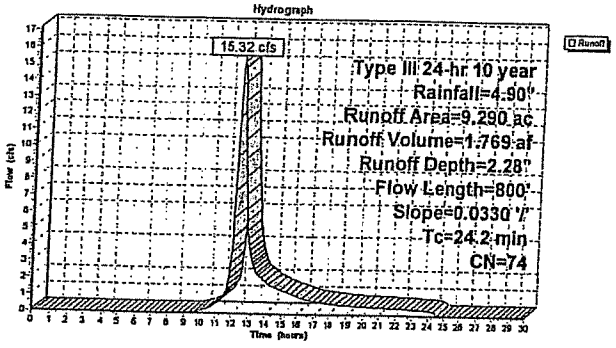
Runoff = 15.32 cfs @ 12.35 hrs, Volume= 1.769 af, Depth= 2.28"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 year Rainfall=4.90"

Area (ac)	CN	Description
9.290	74	>75% Grass cover, Good, HSG C
9.290		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.7	150	0.0330	0.16		Sheet Flow, Grass: Dense n= 0.240 P2= 3.40"
8.5	650	0.0330	1.27		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
24.2	800	Total			

Subcatchment E4219: E4219



Subcatchment E4975: E4975

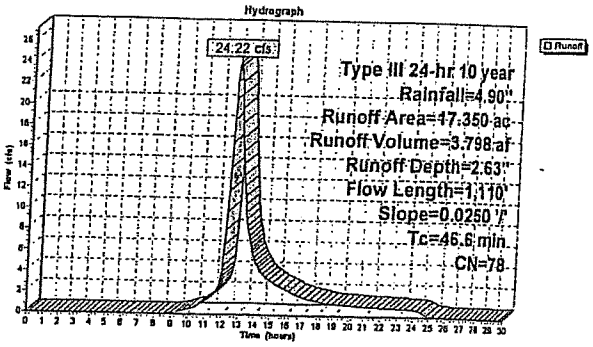
Runoff = 24.22 cfs @ 12.65 hrs, Volume= 3.798 af, Depth= 2.63"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 year Rainfall=4.90"

Area (ac)	CN	Description
4.910	91	Urban Industrial, 72% Imp, HSG C
12.440	73	Woods, Fair, HSG C
17.350	78	Weighted Average
13.815		Pervious Area
3.535		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
26.4	150	0.0250	0.09		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.40"
20.2	960	0.0250	0.79		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
46.6	1,110	Total			

Subcatchment E4975: E4975



Subcatchment E6821: E6821

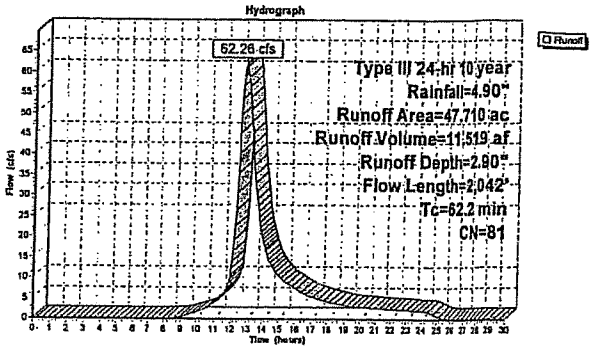
Runoff = 62.26 cfs @ 12.83 hrs, Volume= 11.519 af, Depth= 2.90"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 year Rainfall=4.90"

Area (ac)	CN	Description
8.430	83	1/4 acre lots, 38% Imp, HSG C
11.040	81	1/3 acre lots, 30% Imp, HSG C
4.780	83	1/4 acre lots, 38% Imp, HSG C
9.780	91	Urban Industrial, 72% Imp, HSG C
13.670	73	Woods, Fair, HSG C
47.710	81	Weighted Average
32.333		Pervious Area
15.377		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.1	150	0.1000	0.17		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.40"
1.1	100	0.1000	1.58		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
3.1	365	0.0800	1.98		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
5.0	430	0.0090	1.42		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
20.0					Direct Entry, Small Detention Pond
2.4	200	0.0400	1.40		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
2.7	325	0.0180	2.01		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
12.8	472	0.0150	0.61		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
62.2	2,042	Total			

Subcatchment E6821: E6821



Subcatchment E7473: E7473

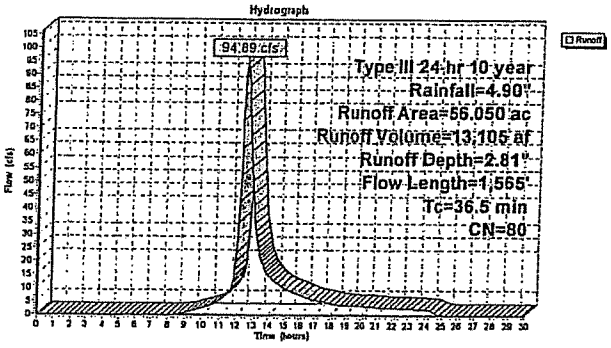
Runoff = 94.89 cfs @ 12.51 hrs, Volume= 13.105 af, Depth= 2.81"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 year Rainfall=4.90"

Area (ac)	CN	Description
5.660	83	1/4 acre lots, 38% Imp, HSG C
9.690	91	Urban Industrial, 72% Imp, HSG C
18.120	83	1/4 acre lots, 38% Imp, HSG C
22.580	73	Woods, Fair, HSG C
56.050	80	Weighted Average
40.037		Pervious Area
16.013		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.7	200	0.0600	0.31		Sheet Flow, Grass: Short n= 0.150 P2= 3.40"
2.9	300	0.0600	1.71		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
22.9	1,065	0.0240	0.77		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
36.5	1,565	Total			

Subcatchment E7473: E7473



Subcatchment E8046: E8046

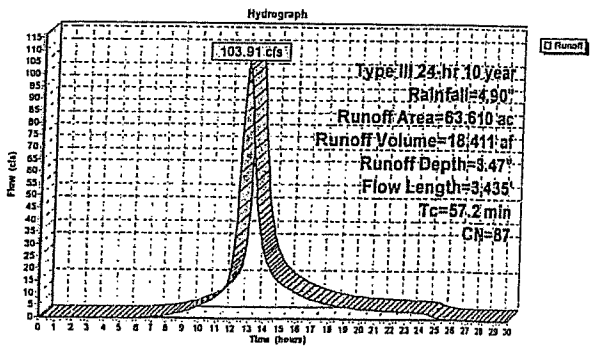
Runoff = 103.91 cfs @ 12.76 hrs, Volume= 18.411 af, Depth= 3.47"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 year Rainfall=4.90"

Area (ac)	CN	Description
36.960	91	Urban Industrial, 72% Imp, HSG C
2.300	83	1/4 acre lots, 38% Imp, HSG C
10.840	94	Urban commercial, 85% Imp, HSG C
13.510	70	Brush, Fair, HSG C
63.610	87	Weighted Average
26.911		Pervious Area
36.699		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.5	150	0.0250	0.14		Sheet Flow, Grass: Dense n= 0.240 P2= 3.40"
15.3	2,275	0.0150	2.49		Shallow Concentrated Flow, Paved Kv= 20.3 fps
24.4	1,010	0.0190	0.69		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
57.2	3,435	Total			

Subcatchment E8046: E8046



Subcatchment E9611: E9611

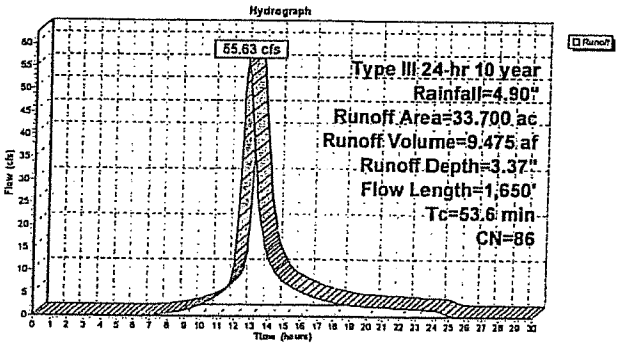
Runoff = 55.63 cfs @ 12.71 hrs, Volume= 9.475 af, Depth= 3.37"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 year Rainfall=4.90"

Area (ac)	CN	Description
12.370	72	Woods/grass comb., Good, HSG C
21.330	94	Urban commercial, 85% Imp, HSG C
33.700	86	Weighted Average
15.569		Pervious Area
18.131		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.3	150	0.0300	0.15		Sheet Flow, Grass: Dense n= 0.240 P2= 3.40"
37.3	1,500	0.0180	0.67		Shallow Concentrated Flow, Two ponds add some time Woodland Kv= 5.0 fps
53.6	1,650	Total			

Subcatchment E9611: E9611



Item C1.

Subcatchment ELB1369: ELB1369

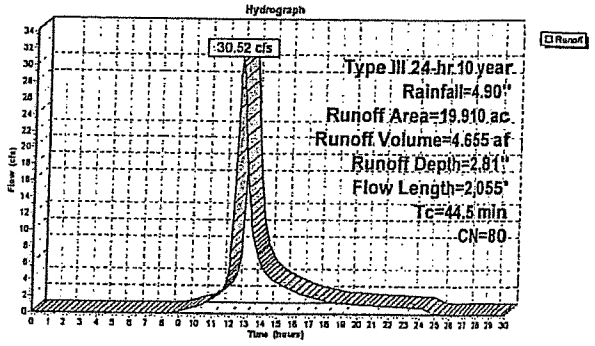
Runoff = 30.52 cfs @ 12.61 hrs, Volume= 4.655 af, Depth= 2.81"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 year Rainfall=4.90"

Area (ac)	CN	Description
17.390	81	1/3 acre lots, 30% Imp, HSG C
2.520	70	Brush, Fair, HSG C
19.910	80	Weighted Average
14.693		Pervious Area
5.217		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.6	150	0.0130	0.16		Sheet Flow, Grass: Short n= 0.150 P2= 3.40"
12.0	575	0.0130	0.80		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
16.9	1,330	0.0350	1.31		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
44.5	2,055	Total			

Subcatchment ELB1369: ELB1369



Subcatchment ELB1483: ELB1483

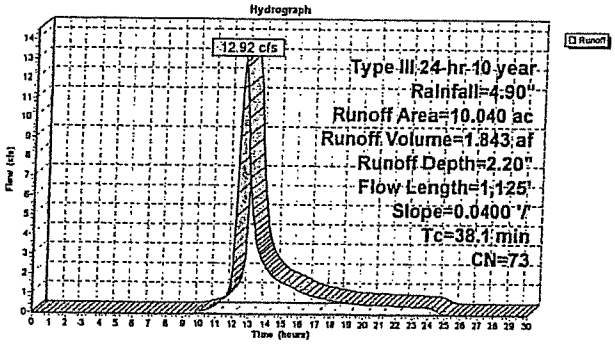
Runoff = 12.92 cfs @ 12.55 hrs, Volume= 1.843 af, Depth= 2.20"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 year Rainfall=4.90"

Area (ac)	CN	Description
7.570	70	Brush, Fair, HSG C
2.470	81	1/3 acre lots, 30% Imp, HSG C
10.040	73	Weighted Average
9.299		Pervious Area
0.741		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
21.8	150	0.0400	0.11		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.40"
16.3	975	0.0400	1.00		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
38.1	1,125	Total			

Subcatchment ELB1483: ELB1483



Subcatchment ELB2128: ELB2128

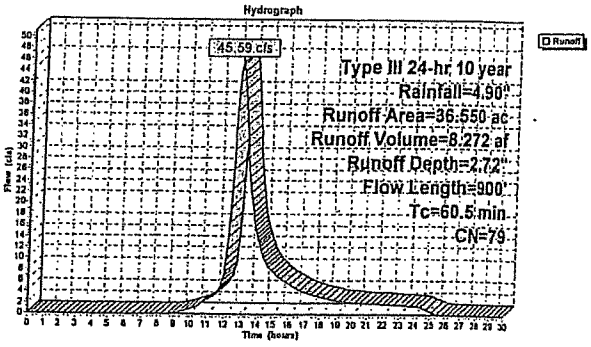
Runoff = 45.59 cfs @ 12.83 hrs, Volume= 8.272 af, Depth= 2.72"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 year Rainfall=4.90"

Area (ac)	CN	Description
6.960	90	1/8 acre lots, 65% Imp, HSG C
4.870	60	Woods, Fair, HSG B
4.870	73	Woods, Fair, HSG C
19.850	81	1/3 acre lots, 30% Imp, HSG C
36.550	79	Weighted Average
26.071		Pervious Area
10.479		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
50.2	150	0.0200	0.05		Sheet Flow, Woods: Dense underbrush n= 0.800 P2= 3.40"
10.3	750	0.0590	1.21		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
60.5	900	Total			

Subcatchment ELB2128: ELB2128



Subcatchment W1217: W1217

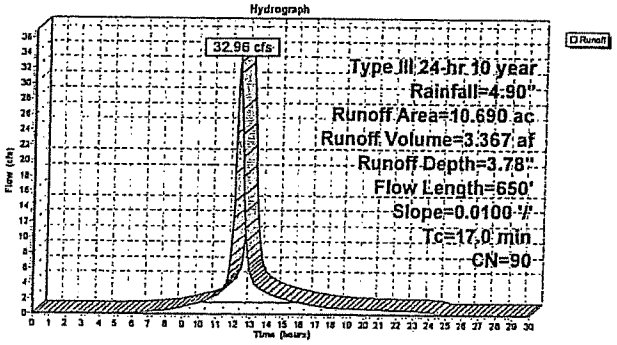
Runoff = 32.96 cfs @ 12.23 hrs, Volume= 3.367 af, Depth= 3.78"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 year Rainfall=4.90"

Area (ac)	CN	Description
10.690	90	1/8 acre lots, 65% Imp, HSG C
3.742		Pervious Area
6.949		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.5	100	0.0100	0.13		Sheet Flow, Grass: Short n= 0.150 P2= 3.40"
4.5	550	0.0100	2.03		Shallow Concentrated Flow, Paved Kv= 20.3 fps
17.0	650	Total			

Subcatchment W1217: W1217



Subcatchment W1626: W1626

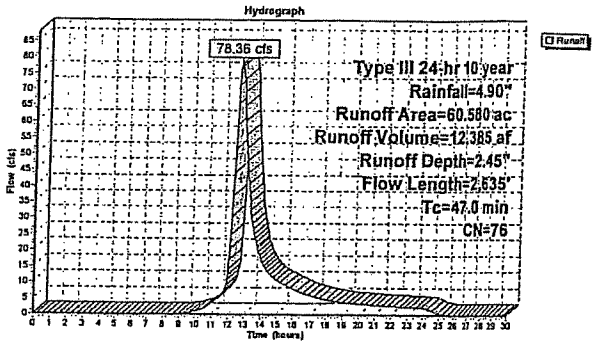
Runoff = 78.36 cfs @ 12.66 hrs, Volume= 12.385 af, Depth= 2.45"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 year Rainfall=4.90"

Area (ac)	CN	Description
20.360	81	1/3 acre lots, 30% Imp, HSG C
40.220	74	>75% Grass cover, Good, HSG C
60.580	76	Weighted Average
54.472		Pervious Area
6.108		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
22.8	200	0.0230	0.15		Sheet Flow, Grass: Dense n= 0.240 P2= 3.40"
14.9	950	0.0230	1.06		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
5.4	810	0.0150	2.49		Shallow Concentrated Flow, Paved Kv= 20.3 fps
3.9	675	0.0200	2.87		Shallow Concentrated Flow, Paved Kv= 20.3 fps
47.0	2,635	Total			

Subcatchment W1626: W1626



Subcatchment W1737: W1737

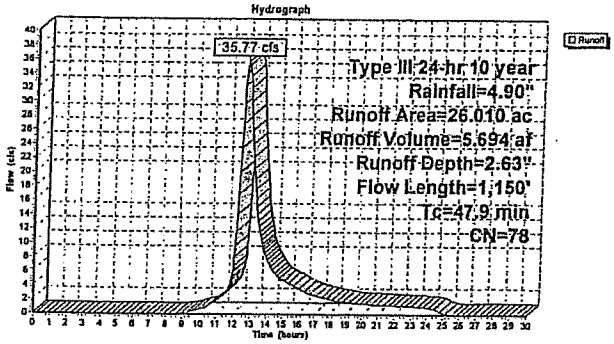
Runoff = 35.77 cfs @ 12.69 hrs, Volume= 5.694 af, Depth= 2.63"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 year Rainfall=4.90"

Area (ac)	CN	Description
18.140	76	Woods/grass comb., Fair, HSG C
7.870	83	1/4 acre lots, 38% Imp, HSG C
26.010	78	Weighted Average
23.018		Pervious Area
2.991		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
26.4	150	0.0250	0.09		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.40"
21.5	1,000	0.0240	0.77		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
47.9	1,150	Total			

Subcatchment W1737: W1737



Subcatchment W2720: W2720

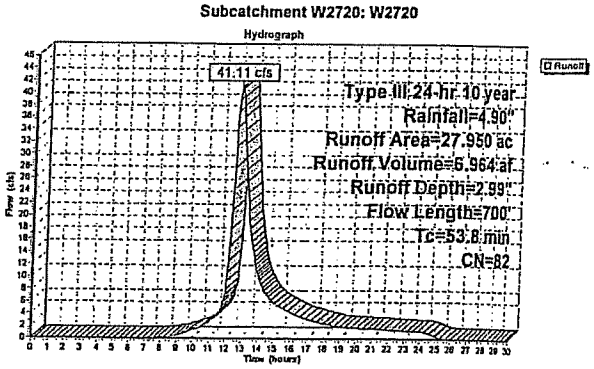
Runoff = 41.11 cfs @ 12.73 hrs, Volume= 6.964 af, Depth= 2.99"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 year Rainfall=4.90"

Area (ac)	CN	Description
3.790	73	Woods, Fair, HSG C
24.160	83	1/4 acre lots, 38% Imp, HSG C
27.950	82	Weighted Average
18.769		Pervious Area
9.181		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
36.3	100	0.0050	0.05		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.40"
17.5	600	0.0130	0.57		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
53.8	700	Total			

Subcatchment W2720: W2720



Subcatchment W4529: W4529

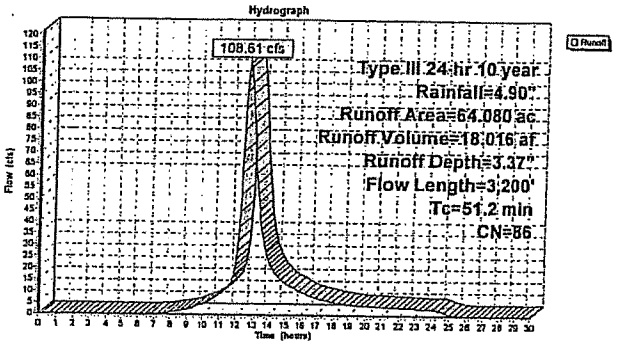
Runoff = 108.61 cfs @ 12.69 hrs, Volume= 18.016 af, Depth= 3.37"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 year Rainfall=4.90"

Area (ac)	CN	Description
25.860	94	Urban commercial, 85% Imp, HSG C
38.220	81	1/3 acre lots, 30% Imp, HSG C
64.080	86	Weighted Average
30.633		Pervious Area
33.447		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
28.8	200	0.0050	0.12		Sheet Flow, Grass: Short n= 0.150 P2= 3.40"
16.2	2,250	0.0130	2.31		Shallow Concentrated Flow, Paved Kv= 20.3 fps
6.2	750	0.0100	2.03		Shallow Concentrated Flow, Paved Kv= 20.3 fps
51.2	3,200	Total			

Subcatchment W4529: W4529



Subcatchment W5128: W5128

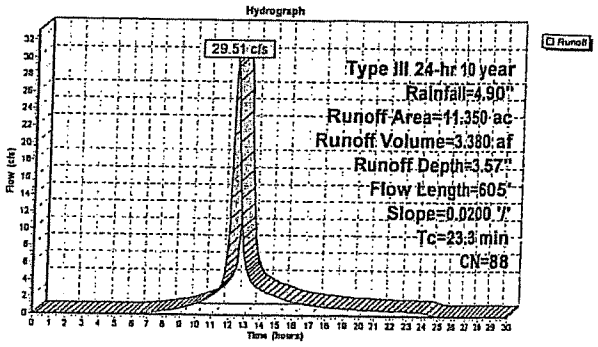
Runoff = 29.51 cfs @ 12.31 hrs, Volume= 3.380 af, Depth= 3.57"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 year Rainfall=4.90"

Area (ac)	CN	Description
4.320	83	1/4 acre lots, 38% Imp, HSG C
7.030	91	Urban Industrial, 72% Imp, HSG C
11.350	88	Weighted Average
4.647		Pervious Area
6.703		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.5	200	0.0200	0.20		Sheet Flow, Grass: Short n= 0.150 P2= 3.40"
6.8	405	0.0200	0.99		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
23.3	605	Total			

Subcatchment W5128: W5128



Subcatchment W5300: W5300

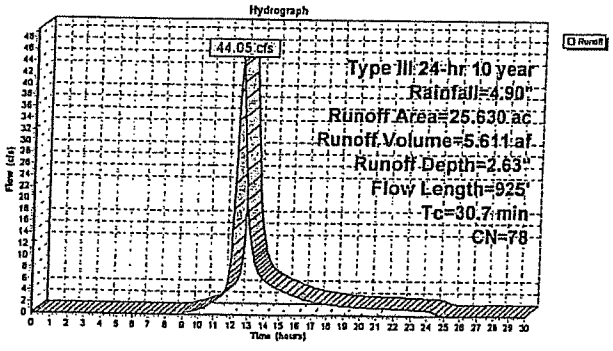
Runoff = 44.05 cfs @ 12.43 hrs, Volume= 5.611 af, Depth= 2.63"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 year Rainfall=4.90"

Area (ac)	CN	Description
14.570	73	Woods, Fair, HSG C
9.660	83	1/4 acre lots, 38% Imp, HSG C
1.400	94	Urban commercial, 85% Imp, HSG C
25.630	78	Weighted Average
20.769		Pervious Area
4.861		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.6	150	0.0130	0.16		Sheet Flow, Grass: Short n= 0.150 P2= 3.40"
15.1	775	0.0150	0.86		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
30.7	925	Total			

Subcatchment W5300: W5300



Subcatchment W6008: W6008

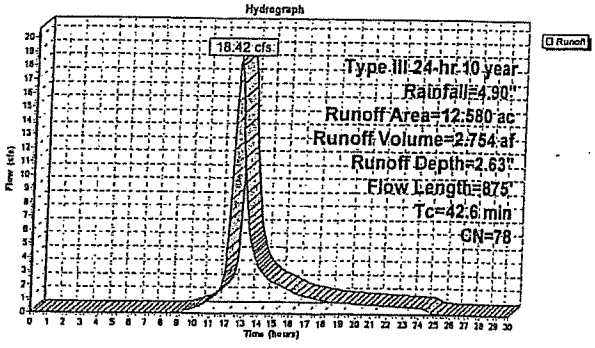
Runoff = 18.42 cfs @ 12.59 hrs, Volume= 2.754 af, Depth= 2.63"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 year Rainfall=4.90"

Area (ac)	CN	Description
6.890	73	Woods, Fair, HSG C
5.690	83	1/4 acre lots, 38% Imp, HSG C
12.580	78	Weighted Average
10.418		Pervious Area
2.162		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
22.9	150	0.0050	0.11		Sheet Flow, Grass: Short n= 0.150 P2= 3.40"
19.7	725	0.0150	0.61		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
42.6	875	Total			

Subcatchment W6008: W6008

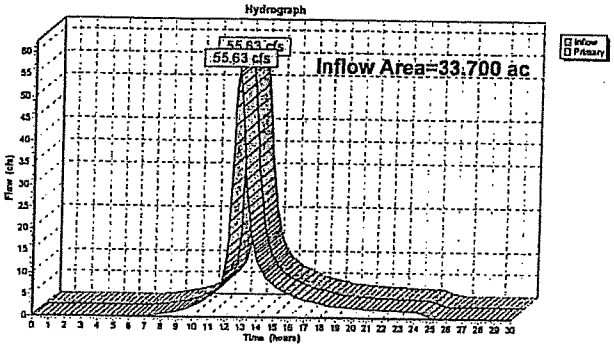


Link 1E: (new Link)

Inflow Area = 33.700 ac, Inflow Depth = 3.37" for 10 year event
Inflow = 55.63 cfs @ 12.71 hrs, Volume= 9.475 af
Primary = 55.63 cfs @ 12.71 hrs, Volume= 9.475 af, Atten= 0%, Lag= 0.0 min

ary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Link 1E: (new Link)

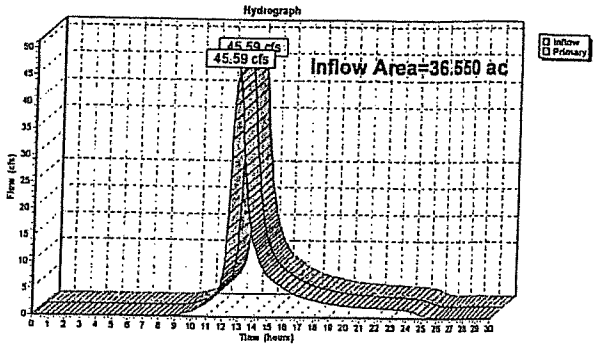


Link 1ELB: (new Link)

Inflow Area = 36.550 ac, Inflow Depth = 2.72" for 10 year event
Inflow = 45.59 cfs @ 12.83 hrs, Volume= 8.272 af
Primary = 45.59 cfs @ 12.83 hrs, Volume= 8.272 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Link 1ELB: (new Link)

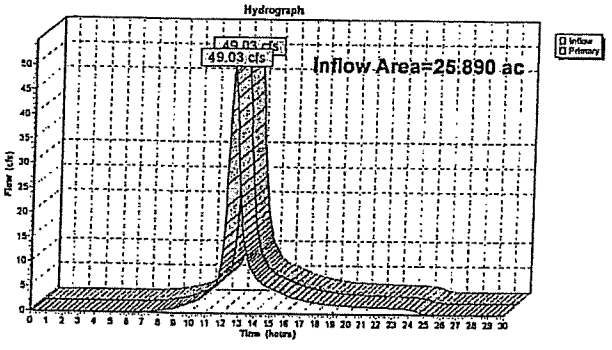


Link 1W: (new Link)

Inflow Area = 25.890 ac, Inflow Depth = 3.28" for 10 year event
Inflow = 49.03 cfs @ 12.54 hrs, Volume= 7.067 af
Primary = 49.03 cfs @ 12.54 hrs, Volume= 7.067 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Link 1W: (new Link)

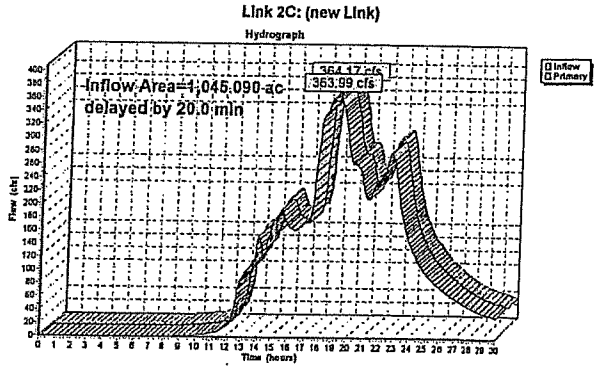


Link 2C: (new Link)

Inflow Area = 1,045.090 ac, Inflow Depth > 2.74" for 10 year event
Inflow = 364.17 cfs @ 18.89 hrs, Volume= 238.866 af
Primary = 363.99 cfs @ 19.23 hrs, Volume= 238.045 af, Atten= 0%, Lag= 20.0 min

Primary outflow = Inflow delayed by 20.0 min, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Link 2C: (new Link)

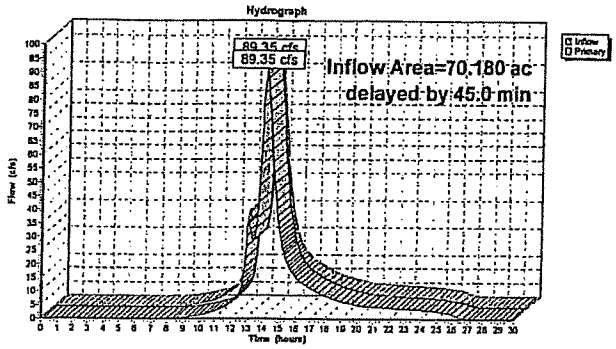


Link 3E: (new Link)

Inflow Area = 70.180 ac, Inflow Depth = 2.92" for 10 year event
Inflow = 89.35 cfs @ 13.40 hrs, Volume= 17.049 af
Primary = 89.35 cfs @ 14.15 hrs, Volume= 17.049 af, Atten= 0%, Lag= 45.0 min

Primary outflow = Inflow delayed by 45.0 min, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Link 3E: (new Link)

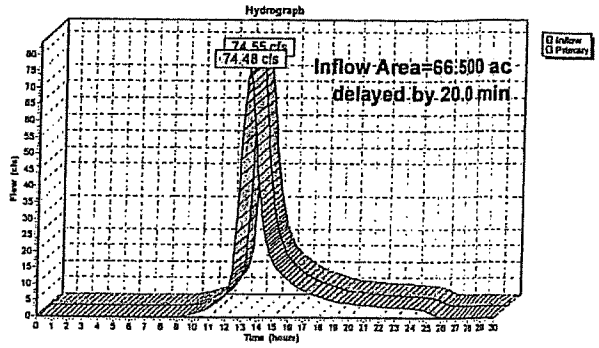


Link 3ELB: (new Link)

Inflow Area = 66.500 ac, Inflow Depth = 2.67" for 10 year event
Inflow = 74.55 cfs @ 12.97 hrs, Volume= 14.770 af
Primary = 74.48 cfs @ 13.31 hrs, Volume= 14.770 af, Atten= 0%, Lag= 19.9 min

Primary outflow = Inflow delayed by 20.0 min, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Link 3ELB: (new Link)

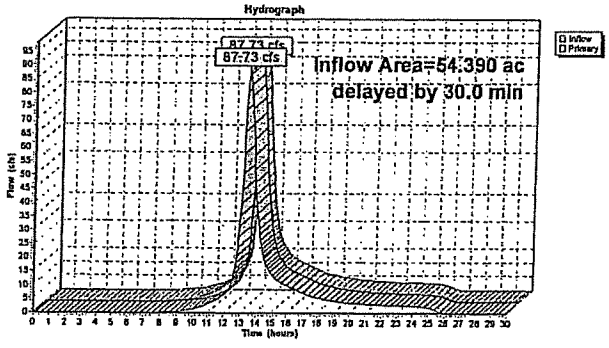


Link 3W: (new Link)

Inflow Area = 54.390 ac, Inflow Depth = 2.94" for 10 year event
Inflow = 87.73 cfs @ 12.93 hrs, Volume= 13.307 af
Primary = 87.73 cfs @ 13.43 hrs, Volume= 13.307 af, Atten= 0%, Lag= 30.0 min

Primary outflow = Inflow delayed by 30.0 min, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Link 3W: (new Link)

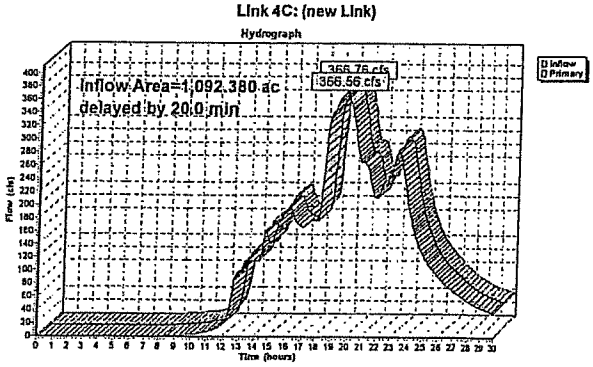


Link 4C: (new Link)

Inflow Area = 1,092.380 ac, Inflow Depth > 2.73" for 10 year event
Inflow = 366.76 cfs @ 19.56 hrs, Volume= 248.738 af
Primary = 366.56 cfs @ 19.69 hrs, Volume= 247.758 af, Atten= 0%, Lag= 20.0 min

Primary outflow = Inflow delayed by 20.0 min, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Link 4C: (new Link)

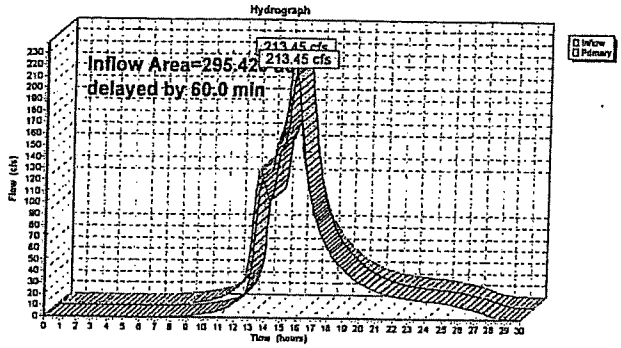


Link 5E: (new Link)

Inflow Area = 295.420 ac, Inflow Depth > 2.86" for 10 year event
Inflow = 213.45 cfs @ 14.84 hrs, Volume= 70.839 af
Primary = 213.45 cfs @ 15.84 hrs, Volume= 70.827 af, Atten= 0%, Lag= 60.0 min

Primary outflow = Inflow delayed by 60.0 min, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Link 5E: (new Link)

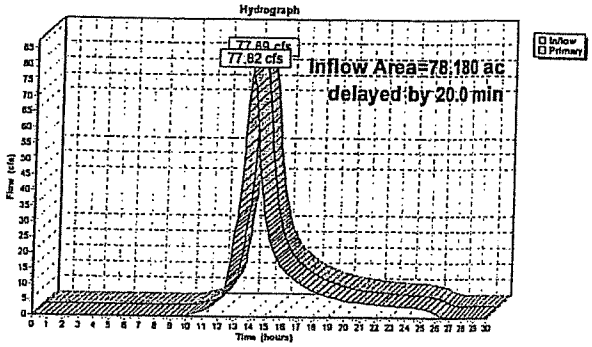


Link 5ELB: (new Link)

Inflow Area = 78.180 ac, Inflow Depth = 2.61" for 10 year event
Inflow = 77.89 cfs @ 13.63 hrs, Volume= 16.993 af
Primary = 77.82 cfs @ 13.98 hrs, Volume= 16.993 af, Atten= 0%, Lag= 20.0 min

Primary outflow = Inflow delayed by 20.0 min, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Link 5ELB: (new Link)

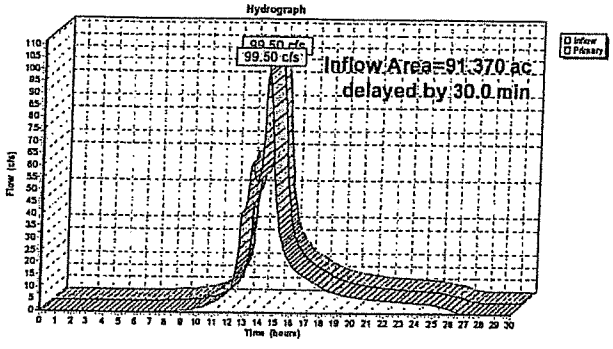


Link 5W: (new Link)

Inflow Area = 91.370 ac, Inflow Depth = 2.93" for 10 year event
Inflow = 99.50 cfs @ 13.92 hrs, Volume= 22.298 af
Primary = 99.50 cfs @ 14.42 hrs, Volume= 22.298 af, Atten= 0%, Lag= 30.0 min

Primary outflow = Inflow delayed by 30.0 min, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Link 5W: (new Link)

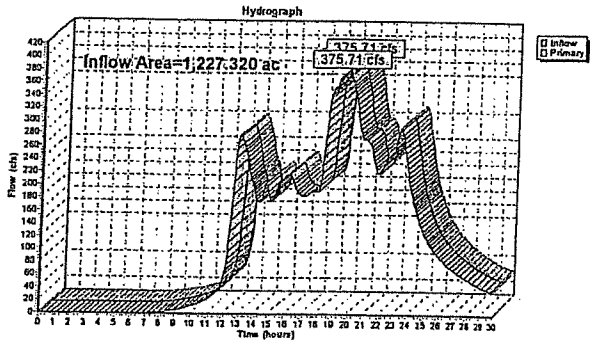


Link 6C: (new Link)

Inflow Area = 1,227.320 ac, Inflow Depth > 2.79" for 10 year event
Inflow = 375.71 cfs @ 19.89 hrs, Volume= 284.980 af
Primary = 375.71 cfs @ 19.89 hrs, Volume= 284.980 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Link 6C: (new Link)

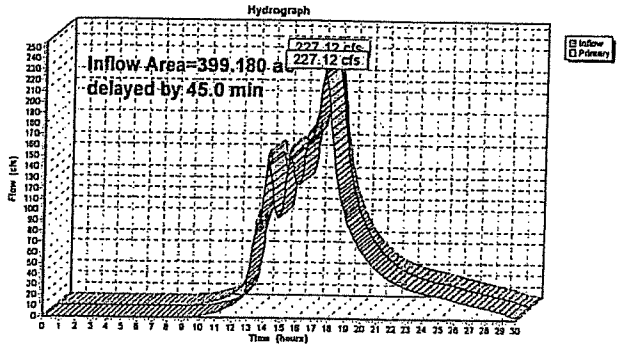


Link 7E: (new Link)

Inflow Area = 399.180 ac, Inflow Depth > 2.87" for 10 year event
Inflow = 227.12 cfs @ 16.83 hrs, Volume= 95.414 af
Primary = 227.12 cfs @ 17.58 hrs, Volume= 95.335 af, Atten= 0%, Lag= 45.0 min

Primary outflow = Inflow delayed by 45.0 min, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Link 7E: (new Link)

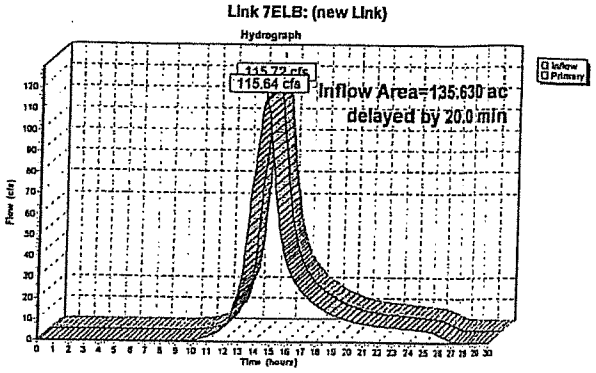


Link 7ELB: (new Link)

Inflow Area = 135.630 ac, Inflow Depth = 2.66" for 10 year event
Inflow = 115.72 cfs @ 14.19 hrs, Volume= 30.054 af
Primary = 115.64 cfs @ 14.52 hrs, Volume= 30.054 af, Atten= 0%, Lag= 20.0 min

Primary outflow = Inflow delayed by 20.0 min, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Link 7ELB: (new Link)

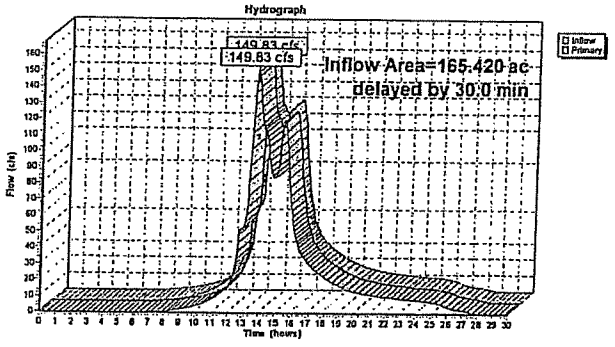


Link 7W: (new Link)

Inflow Area = 165.420 ac, Inflow Depth = 3.16" for 10 year event
Inflow = 149.83 cfs @ 13.26 hrs, Volume= 43.542 af
Primary = 149.83 cfs @ 13.76 hrs, Volume= 43.542 af, Atten= 0%, Lag= 30.0 min

Primary outflow = Inflow delayed by 30.0 min, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Link 7W: (new Link)

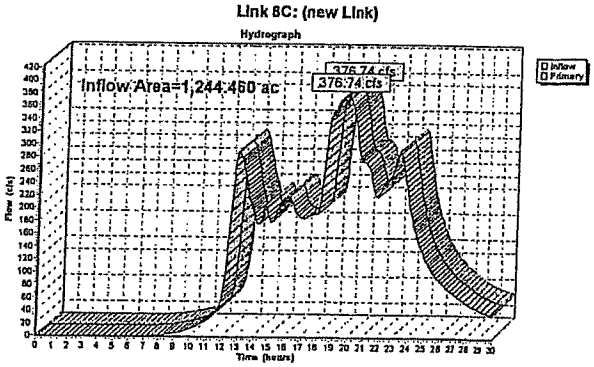


Link 8C: (new Link)

Inflow Area = 1,244.460 ac, Inflow Depth > 2.79" for 10 year event
Inflow = 376.74 cfs @ 19.89 hrs, Volume= 289.159 af
Primary = 376.74 cfs @ 19.89 hrs, Volume= 289.159 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Link 8C: (new Link)

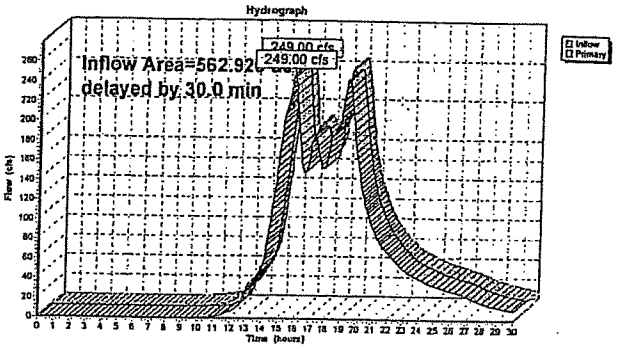


Link 10E: (new Link)

Inflow Area = 562.920 ac, Inflow Depth > 2.80" for 10 year event
Inflow = 249.00 cfs @ 15.39 hrs, Volume= 131.300 af
Primary = 249.00 cfs @ 15.89 hrs, Volume= 130.936 af, Atten= 0%, Lag= 30.0 min

Primary outflow = Inflow delayed by 30.0 min, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Link 10E: (new Link)



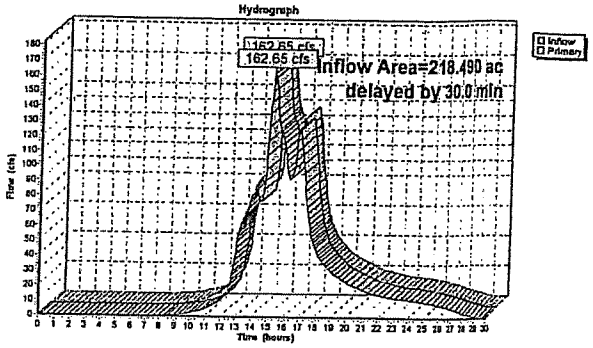
Item C1.

Link 10W: (new Link)

Inflow Area = 218.490 ac, Inflow Depth = 3.07" for 10 year event
Inflow = 162.65 cfs @ 14.76 hrs, Volume= 55.915 af
Primary = 162.65 cfs @ 15.26 hrs, Volume= 55.915 af, Atten= 0%, Lag= 30.0 min

Primary outflow = Inflow delayed by 30.0 min, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Link 10W: (new Link)

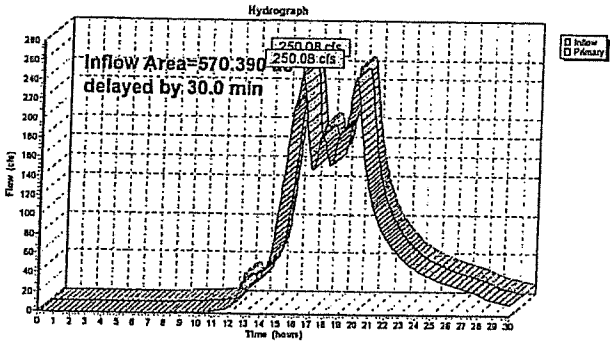


Link 11E: (new Link)

Inflow Area = 570.390 ac, Inflow Depth > 2.81" for 10 year event
Inflow = 250.08 cfs @ 15.89 hrs, Volume= 133.354 af
Primary = 250.08 cfs @ 16.39 hrs, Volume= 132.926 af, Atten= 0%, Lag= 30.0 min

Primary outflow = Inflow delayed by 30.0 min, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Link 11E: (new Link)

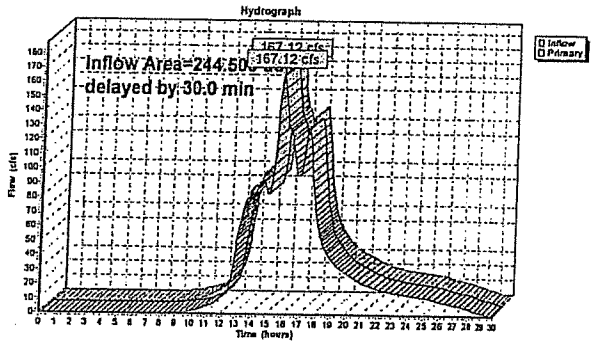


Link 11W: (new Link)

Inflow Area = 244.500 ac, Inflow Depth > 3.02" for 10 year event
Inflow = 167.12 cfs @ 15.26 hrs, Volume= 61.609 af
Primary = 167.12 cfs @ 15.76 hrs, Volume= 61.607 af, Atten= 0%, Lag= 30.0 min

Primary outflow = Inflow delayed by 30.0 min, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Link 11W: (new Link)

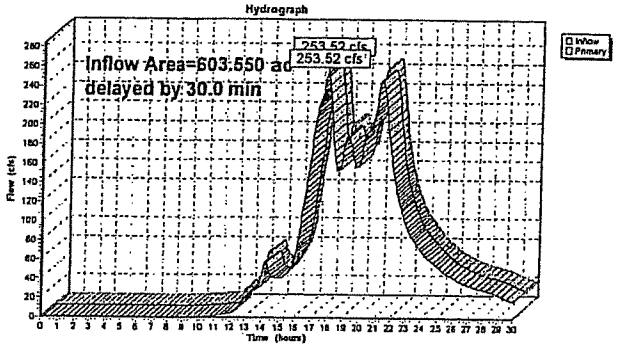


Link 14E: (new Link)

Inflow Area = 603.550 ac, Inflow Depth > 2.76" for 10 year event
Inflow = 253.52 cfs @ 17.39 hrs, Volume= 138.799 af
Primary = 253.52 cfs @ 17.89 hrs, Volume= 138.156 af, Atten= 0%, Lag= 30.0 min

Primary outflow = Inflow delayed by 30.0 min, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Link 14E: (new Link)

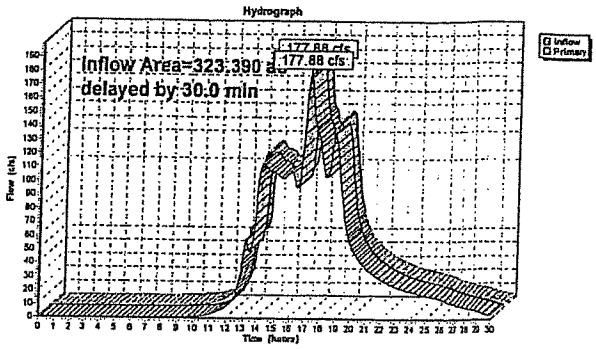


Link 14W: (new Link)

Inflow Area = 323.390 ac, Inflow Depth > 2.93" for 10 year event
Inflow = 177.88 cfs @ 16.75 hrs, Volume= 78.843 af
Primary = 177.88 cfs @ 17.25 hrs, Volume= 78.747 af, Atten= 0%, Lag= 30.0 min

Primary outflow = Inflow delayed by 30.0 min, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Link 14W: (new Link)

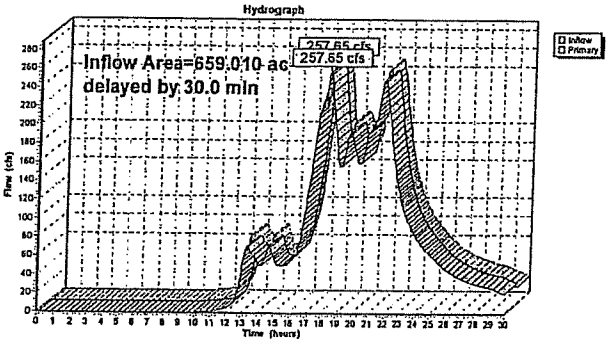


Link 15E: (new Link)

Inflow Area = 659.010 ac, Inflow Depth > 2.69" for 10 year event
Inflow = 257.65 cfs @ 17.89 hrs, Volume= 147.590 af
Primary = 257.65 cfs @ 18.39 hrs, Volume= 146.611 af, Atten= 0%, Lag= 30.0 min

Primary outflow = Inflow delayed by 30.0 min, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Link 15E: (new Link)

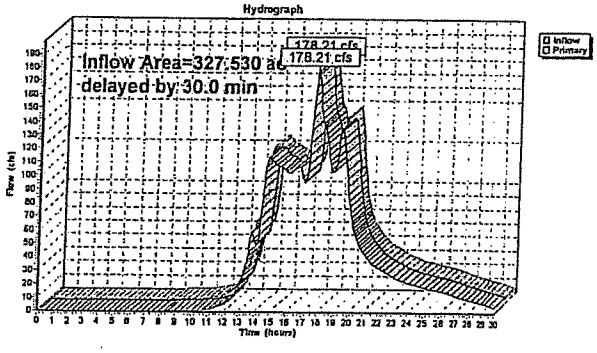


Link 15W: (new Link)

Inflow Area = 327.530 ac, Inflow Depth > 2.91" for 10 year event
Inflow = 178.21 cfs @ 17.25 hrs, Volume= 79.507 af
Primary = 178.21 cfs @ 17.75 hrs, Volume= 79.368 af, Atten= 0%, Lag= 30.0 min

Primary outflow = Inflow delayed by 30.0 min, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Link 15W: (new Link)



100-Year Storm

Time span=0.00-30.00 hrs, dt=0.05 hrs, 601 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

ubcatchment C116: C116 — Runoff Area=4.970 ac Runoff Depth=4.46"
Flow Length=450' Tc=25.8 min CN=77 Runoff=15.66 cfs 1.845 af

Subcatchment C1334: C1334 — Runoff Area=35.190 ac Runoff Depth=5.12"
Flow Length=900' Slope=0.0200 '/' Tc=34.0 min CN=83 Runoff=110.94 cfs 15.021 af

Subcatchment C1748: C1748 — Runoff Area=12.100 ac Runoff Depth=4.46"
Flow Length=850' Tc=33.5 min CN=77 Runoff=33.66 cfs 4.493 af

Subcatchment C2359: C2359 — Runoff Area=32.610 ac Runoff Depth=5.01"
Flow Length=1,050' Slope=0.0400 '/' Tc=36.8 min CN=82 Runoff=97.04 cfs 13.615 af

Subcatchment C560: C560 — Runoff Area=121.880 ac Runoff Depth=5.46"
Flow Length=4,800' Tc=73.9 min CN=86 Runoff=264.20 cfs 55.475 af

Subcatchment C62: (new Subcat) — Runoff Area=12.170 ac Runoff Depth=5.12"
Flow Length=2,400' Tc=31.3 min CN=83 Runoff=39.88 cfs 5.195 af

Subcatchment C747: C747 — Runoff Area=13.060 ac Runoff Depth=4.68"
Flow Length=700' Slope=0.0050 '/' Tc=58.8 min CN=79 Runoff=28.36 cfs 5.089 af

Subcatchment E2964: E2964 — Runoff Area=25.940 ac Runoff Depth=4.46"
Flow Length=1,460' Slope=0.0400 '/' Tc=35.4 min CN=77 Runoff=70.62 cfs 9.632 af

Subcatchment E3568: E3568 — Runoff Area=55.460 ac Runoff Depth=3.81"
Flow Length=2,790' Tc=55.8 min CN=71 Runoff=101.31 cfs 17.598 af

Subcatchment E3889: E3889 — Runoff Area=6.520 ac Runoff Depth=4.46"
Flow Length=650' Tc=22.3 min CN=77 Runoff=21.66 cfs 2.421 af

Subcatchment E4219: E4219 — Runoff Area=9.290 ac Runoff Depth=4.13"
Flow Length=600' Slope=0.0330 '/' Tc=24.2 min CN=74 Runoff=27.91 cfs 3.197 af

Subcatchment E4975: E4975 — Runoff Area=17.350 ac Runoff Depth=4.57"
Flow Length=1,110' Slope=0.0250 '/' Tc=46.6 min CN=78 Runoff=42.03 cfs 6.601 af

Subcatchment E5158: E5158 — Runoff Area=7.470 ac Runoff Depth=6.04"
Flow Length=500' Tc=17.1 min CN=91 Runoff=35.72 cfs 3.758 af

Subcatchment E5498: E5498 — Runoff Area=6.670 ac Runoff Depth=5.12"
Flow Length=1,000' Tc=38.4 min CN=83 Runoff=19.83 cfs 2.847 af

Subcatchment E5909: E5909 — Runoff Area=3.860 ac Runoff Depth=5.12"
Flow Length=450' Slope=0.0080 '/' Tc=52.8 min CN=83 Runoff=9.70 cfs 1.648 af

Subcatchment E6369: E6369 — Runoff Area=17.580 ac Runoff Depth=4.46"
Flow Length=950' Tc=53.2 min CN=77 Runoff=35.08 cfs 6.528 af

Subcatchment E6821: E6821 — Runoff Area=47.710 ac Runoff Depth=4.90"
Flow Length=2,042' Tc=62.2 min CN=81 Runoff=104.76 cfs 19.474 af

Subcatchment E7473: E7473 — Runoff Area=58.050 ac Runoff Depth=4.79"
Flow Length=1,565' Tc=36.5 min CN=80 Runoff=160.77 cfs 22.358 af

Subcatchment E8046: E8046 — Runoff Area=63.610 ac Runoff Depth=5.58"
Flow Length=3,435' Tc=57.2 min CN=87 Runoff=163.96 cfs 29.558 af

Subcatchment E8497: E8497 — Runoff Area=161.630 ac Runoff Depth>4.57"
Flow Length=4,455' Tc=135.0 min CN=78 Runoff=198.62 cfs 61.493 af

Subcatchment E9081: E9081 — Runoff Area=12.310 ac Runoff Depth=4.90"
Flow Length=575' Tc=22.5 min CN=81 Runoff=44.85 cfs 5.025 af

Subcatchment E9326: E9326 — Runoff Area=24.170 ac Runoff Depth=4.13"
Flow Length=1,650' Tc=40.2 min CN=74 Runoff=57.47 cfs 8.317 af

Subcatchment E9611: E9611 — Runoff Area=33.700 ac Runoff Depth=5.46"
Flow Length=1,650' Tc=53.6 min CN=86 Runoff=88.64 cfs 15.339 af

Subcatchment ELB1369: ELB1369 — Runoff Area=18.910 ac Runoff Depth=4.79"
Flow Length=2,055' Tc=44.5 min CN=80 Runoff=51.75 cfs 7.942 af

Subcatchment ELB1483: ELB1483 — Runoff Area=10.040 ac Runoff Depth=4.02"
Flow Length=1,125' Slope=0.0400 '/' Tc=38.1 min CN=73 Runoff=23.86 cfs 3.365 af

Subcatchment ELB2128: ELB2128 — Runoff Area=36.550 ac Runoff Depth=4.68"
Flow Length=900' Tc=50.5 min CN=79 Runoff=78.21 cfs 14.242 af

Subcatchment ELB234: ELB234 — Runoff Area=3.920 ac Runoff Depth=4.90"
Flow Length=400' Slope=0.0150 '/' Tc=26.4 min CN=81 Runoff=13.34 cfs 1.600 af

Subcatchment ELB729: ELB729 — Runoff Area=53.530 ac Runoff Depth=4.68"
Flow Length=4,165' Tc=100.2 min CN=79 Runoff=82.75 cfs 20.859 af

Subcatchment ELB829: ELB829 — Runoff Area=4.250 ac Runoff Depth=4.13"
Flow Length=750' Slope=0.0400 '/' Tc=31.8 min CN=74 Runoff=11.30 cfs 1.462 af

Subcatchment ELB972: ELB972 — Runoff Area=7.430 ac Runoff Depth=4.13"
Flow Length=900' Slope=0.0400 '/' Tc=27.0 min CN=74 Runoff=21.30 cfs 2.557 af

Subcatchment W1217: W1217 — Runoff Area=10.690 ac Runoff Depth=5.92"
Flow Length=650' Slope=0.0100 '/' Tc=17.0 min CN=90 Runoff=50.64 cfs 5.275 af

Subcatchment W1626: W1626 — Runoff Area=60.580 ac Runoff Depth=4.35"
Flow Length=2,635' Tc=47.0 min CN=76 Runoff=139.30 cfs 21.942 af

Subcatchment W1737: W1737 — Runoff Area=26.010 ac Runoff Depth=4.57"
Flow Length=1,150' Tc=47.9 min CN=78 Runoff=62.09 cfs 9.896 af

Subcatchment W2720: W2720 — Runoff Area=27.950 ac Runoff Depth=5.01"
Flow Length=700' Tc=53.8 min CN=82 Runoff=68.20 cfs 11.669 af

Subcatchment W290: W290 — Runoff Area=4.140 ac Runoff Depth=4.02"
Flow Length=650' Slope=0.0300 '/' Tc=28.3 min CN=73 Runoff=11.31 cfs 1.387 af

Subcatchment W3148: W3148 — Runoff Area=9.510 ac Runoff Depth=4.24"
Flow Length=750' Tc=46.4 min CN=75 Runoff=21.52 cfs 3.358 af

Subcatchment W3774: W3774 — Runoff Area=15.610 ac Runoff Depth=4.68"
Flow Length=1,200' Tc=31.3 min CN=79 Runoff=47.12 cfs 8.083 af

Subcatchment W3975: W3975 — Runoff Area=9.970 ac Runoff Depth=6.04"
Flow Length=865' Tc=20.3 min CN=91 Runoff=44.56 cfs 5.016 af

Subcatchment W4529: W4529 — Runoff Area=64.080 ac Runoff Depth=5.46"
Flow Length=3,200' Tc=51.2 min CN=86 Runoff=172.96 cfs 29.167 af

Subcatchment W5128: W5128 — Runoff Area=11.350 ac Runoff Depth=5.69"
Flow Length=605' Slope=0.0200 '/' Tc=23.3 min CN=88 Runoff=46.03 cfs 5.382 af

Subcatchment W5300: W5300 — Runoff Area=25.630 ac Runoff Depth=4.57"
Flow Length=925' Tc=30.7 min CN=78 Runoff=78.41 cfs 9.751 af

Subcatchment W6008: W6008 — Runoff Area=12.580 ac Runoff Depth=4.57"
Flow Length=875' Tc=42.6 min CN=78 Runoff=31.96 cfs 4.786 af

Subcatchment W6278: W6278 — Runoff Area=15.920 ac Runoff Depth=4.57"
Flow Length=1,350' Tc=25.8 min CN=78 Runoff=51.32 cfs 6.057 af

Subcatchment W6643: W6643 — Runoff Area=25.890 ac Runoff Depth=5.35"
Flow Length=2,400' Tc=39.4 min CN=85 Runoff=78.78 cfs 11.539 af

Subcatchment W684: W684 — Runoff Area=7.620 ac Runoff Depth=4.35"
Flow Length=650' Slope=0.0250 '/' Tc=36.2 min CN=76 Runoff=20.07 cfs 2.760 af

k 1C: (new Link) — Inflow=615.29 cfs 393.889 af
Primary=615.29 cfs 393.889 af

Link 1E: (new Link) — Inflow=88.64 cfs 15.339 af
Primary=88.64 cfs 15.339 af

Link 1ELB: (new Link) — Inflow=78.21 cfs 14.242 af
Primary=78.21 cfs 14.242 af

Link 1W: (new Link) — Inflow=78.78 cfs 11.539 af
Primary=78.78 cfs 11.539 af

Link 2C: (new Link) — delayed by 20.0 min Inflow=618.97 cfs 407.503 af
Primary=618.97 cfs 406.236 af

Link 2E: (new Link) — delayed by 45.0 min Inflow=143.08 cfs 23.656 af
Primary=143.08 cfs 23.656 af

Link 2ELB: (new Link) — delayed by 20.0 min Inflow=97.18 cfs 17.607 af
Primary=97.03 cfs 17.607 af

Link 2W: (new Link) — delayed by 30.0 min Inflow=124.27 cfs 17.596 af
Primary=124.27 cfs 17.596 af

Link 3C: (new Link) — delayed by 20.0 min Inflow=619.89 cfs 410.729 af
Primary=619.65 cfs 409.321 af

Link 3E: (new Link) — delayed by 45.0 min Inflow=149.10 cfs 28.681 af
Primary=149.10 cfs 28.681 af

Link 3ELB: (new Link) — delayed by 20.0 min Inflow=129.22 cfs 25.549 af
Primary=129.10 cfs 25.549 af

Link 3W: (new Link) — delayed by 30.0 min Inflow=145.94 cfs 22.382 af
Primary=145.94 cfs 22.382 af

Link 4C: (new Link) — delayed by 20.0 min Inflow=623.25 cfs 424.342 af
Primary=622.98 cfs 422.830 af

Link 4E: (new Link) — delayed by 45.0 min Inflow=337.53 cfs 90.174 af
Primary=337.53 cfs 90.170 af

Link 4ELB: (new Link) — delayed by 20.0 min Inflow=133.17 cfs 28.106 af
Primary=133.04 cfs 28.106 af

Link 4W: (new Link) — delayed by 30.0 min Inflow=160.14 cfs 32.134 af
Primary=160.14 cfs 32.134 af

Link 5C: (new Link) — Inflow=624.29 cfs 427.919 af
Primary=624.29 cfs 427.919 af

Link 5E: (new Link) — delayed by 60.0 min Inflow=361.40 cfs 119.727 af
Primary=361.40 cfs 119.709 af

Link 5ELB: (new Link) — delayed by 20.0 min Inflow=134.96 cfs 29.568 af
Primary=134.83 cfs 29.568 af

Link 5W: (new Link) — delayed by 30.0 min Inflow=164.82 cfs 37.516 af
Primary=164.82 cfs 37.516 af

Link 6C: (new Link) — Inflow=637.70 cfs 483.394 af
Primary=637.70 cfs 483.394 af

Link 6E: (new Link) — delayed by 60.0 min Inflow=373.98 cfs 142.068 af
Primary=373.98 cfs 142.010 af

Link 6ELB: (new Link) — delayed by 20.0 min Inflow=198.33 cfs 50.427 af
Primary=198.19 cfs 50.427 af

Link 6W: (new Link) — delayed by 30.0 min Inflow=238.39 cfs 66.683 af
Primary=238.39 cfs 66.683 af

Link 7C: (new Link) — Inflow=638.16 cfs 485.239 af
Primary=638.16 cfs 485.239 af

Link 7E: (new Link) — delayed by 45.0 min Inflow=382.86 cfs 161.484 af
Primary=382.86 cfs 161.361 af

Link 7ELB: (new Link) — delayed by 20.0 min Inflow=199.58 cfs 52.027 af
Primary=199.45 cfs 52.027 af

Link 7W: (new Link) — delayed by 30.0 min Inflow=242.05 cfs 71.698 af
Primary=242.05 cfs 71.698 af

Link 8C: (new Link) — Inflow=639.36 cfs 490.434 af
Primary=639.36 cfs 490.434 af

Link 8E: (new Link) — delayed by 45.0 min Inflow=385.46 cfs 167.889 af
Primary=385.46 cfs 167.526 af

Link 8W: (new Link) — delayed by 30.0 min Inflow=248.83 cfs 77.781 af
Primary=248.83 cfs 77.781 af

Link 9E: (new Link) — delayed by 30.0 min Inflow=427.56 cfs 221.200 af
Primary=427.56 cfs 220.763 af

Link 9W: (new Link) — delayed by 30.0 min Inflow=252.48 cfs 81.139 af
Primary=252.48 cfs 81.139 af

Link 10E: (new Link) — delayed by 30.0 min Inflow=429.34 cfs 223.611 af
Primary=429.34 cfs 223.045 af

Link 10W: (new Link) — delayed by 30.0 min Inflow=262.44 cfs 92.808 af
Primary=262.44 cfs 92.808 af

Link 11E: (new Link) — delayed by 30.0 min Inflow=430.93 cfs 226.803 af
Primary=430.93 cfs 226.138 af

Link 11W: (new Link) — delayed by 30.0 min Inflow=269.57 cfs 102.704 af
Primary=269.57 cfs 102.701 af

Link 12E: (new Link) — delayed by 30.0 min Inflow=434.24 cfs 232.739 af
Primary=434.24 cfs 231.969 af

Link 12W: (new Link) — delayed by 30.0 min Inflow=283.55 cfs 124.644 af
Primary=283.55 cfs 124.623 af

Link 13E: (new Link) — delayed by 30.0 min Inflow=435.58 cfs 235.166 af
Primary=435.58 cfs 234.277 af

Link 13W: (new Link) — delayed by 30.0 min Inflow=285.53 cfs 129.898 af
Primary=285.53 cfs 129.805 af

Link 14E: (new Link) — delayed by 30.0 min Inflow=436.44 cfs 236.698 af
Primary=436.44 cfs 235.704 af

Link 14W: (new Link) — delayed by 30.0 min Inflow=286.74 cfs 132.565 af
Primary=286.74 cfs 132.417 af

Link 15E: (new Link) — delayed by 30.0 min Inflow=443.30 cfs 253.303 af
Primary=443.30 cfs 252.099 af

Link 15W: (new Link) — delayed by 30.0 min Inflow=287.29 cfs 133.805 af
Primary=287.29 cfs 133.592 af

Link 16E: (new Link) — delayed by 30.0 min Inflow=446.09 cfs 261.731 af
Primary=446.09 cfs 260.297 af

Total Runoff Area = 1,244.460 ac Runoff Volume = 502.623 af Average Runoff Depth = 4.85"
68.71% Pervious Area = 855.023 ac 31.29% Impervious Area = 389.437 ac

Subcatchment C116: C116

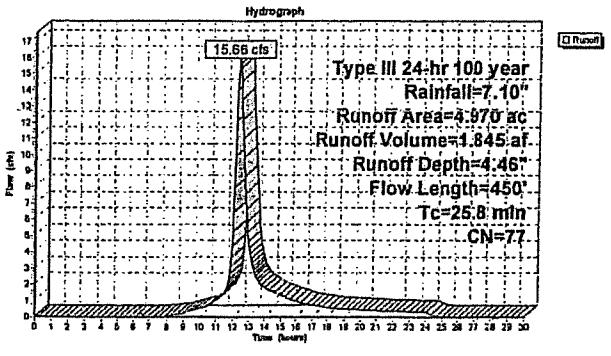
Runoff = 15.66 cfs @ 12.35 hrs, Volume= 1.845 af, Depth= 4.46"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 year Rainfall=7.10"

Area (ac)	CN	Description
4.970	77	Brush, Poor, HSG C
4.970		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.3	150	0.0100	0.14		Sheet Flow, Grass: Short n= 0.150 P2= 3.40"
8.5	300	0.0070	0.59		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
25.8	450	Total			

Subcatchment C116: C116



Subcatchment C1334: C1334

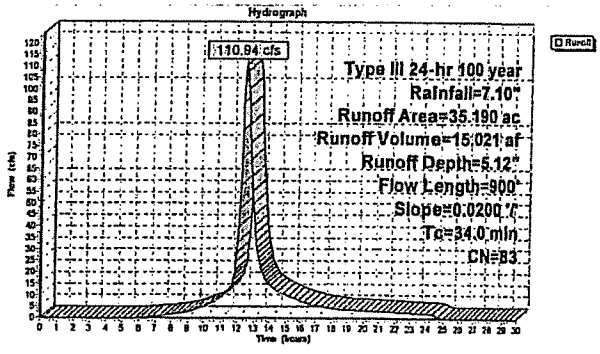
Runoff = 110.94 cfs @ 12.46 hrs, Volume= 15.021 af, Depth= 5.12"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 year Rainfall=7.10"

Area (ac)	CN	Description
2.520	94	Urban commercial, 85% Imp, HSG C
2.450	81	1/3 acre lots, 30% Imp, HSG C
2.510	74	>75% Grass cover, Good, HSG C
27.710	83	1/4 acre lots, 38% Imp, HSG C
35.190	83	Weighted Average
21.783		Pervious Area
13.407		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
19.1	150	0.0200	0.13		Sheet Flow, Grass: Dense n= 0.240 P2= 3.40"
6.7	400	0.0200	0.99		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
8.2	350	0.0200	0.71		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
34.0	900	Total			

Subcatchment C1334: C1334



Subcatchment C1748: C1748

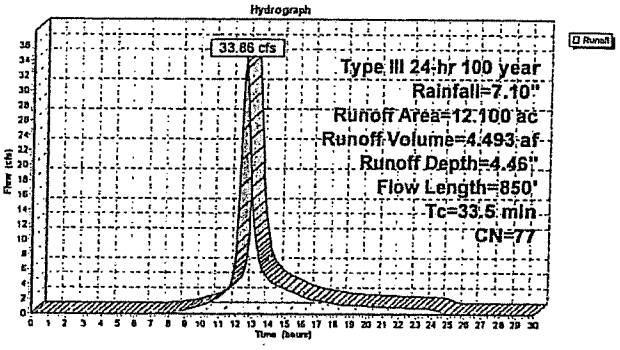
Runoff = 33.86 cfs @ 12.46 hrs, Volume= 4.493 af, Depth= 4.46"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 year Rainfall=7.10"

Area (ac)	CN	Description
1.420	94	Urban commercial, 85% Imp, HSG C
2.560	83	1/4 acre lots, 38% Imp, HSG C
2.020	74	>75% Grass cover, Good, HSG C
3.600	70	Brush, Fair, HSG C
2.500	74	>75% Grass cover, Good, HSG C
12.100	77	Weighted Average
9.920		Pervious Area
2.180		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.0	150	0.0270	0.15		Sheet Flow, Grass: Dense n= 0.240 P2= 3.40"
6.5	450	0.0270	1.15		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
10.0	250	0.0070	0.42		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
33.5	850	Total			

Subcatchment C1748: C1748



Subcatchment C2359: C2359

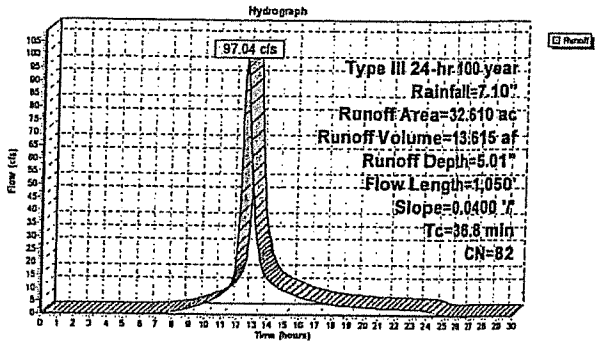
Runoff = 97.04 cfs @ 12.50 hrs, Volume= 13.615 af, Depth= 5.01"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 year Rainfall=7.10"

Area (ac)	CN	Description
8.300	91	Urban Industrial, 72% Imp, HSG C
2.000	77	Brush, Fair, HSG D
7.540	70	Brush, Fair, HSG C
14.770	83	1/4 acre lots, 38% Imp, HSG C
32.610	82	Weighted Average
21.021		Pervious Area
11.589		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
21.8	150	0.0400	0.11		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.40"
15.0	900	0.0400	1.00		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
36.8	1,050	Total			

Subcatchment C2359: C2359



Subcatchment C660: C660

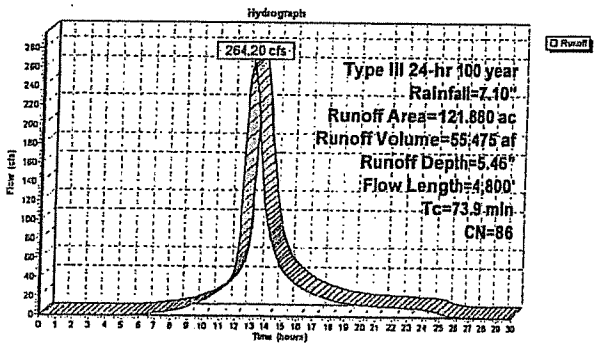
Runoff = 264.20 cfs @ 12.60 hrs, Volume= 55.475 af, Depth= 5.46"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 year Rainfall=7.10"

Area (ac)	CN	Description
19.710	94	Urban commercial, 85% Imp, HSG C
1.910	74	>75% Grass cover, Good, HSG C
1.250	73	Woods, Fair, HSG C
2.630	74	>75% Grass cover, Good, HSG C
7.880	70	1/2 acre lots, 25% Imp, HSG B
9.060	60	Woods, Fair, HSG B
79.440	90	1/8 acre lots, 65% Imp, HSG C
121.880	86	Weighted Average
51.520		Pervious Area
70.360		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
28.1	200	0.0380	0.12		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.40"
14.5	850	0.0380	0.97		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
2.9	225	0.0350	1.31		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
8.1	1,700	0.0300	3.52		Shallow Concentrated Flow, Paved Kv= 20.3 fps
6.7	1,100	0.0180	2.72		Shallow Concentrated Flow, Paved Kv= 20.3 fps
3.5	300	0.0050	1.44		Shallow Concentrated Flow, Paved Kv= 20.3 fps
10.1	425	0.0100	0.70		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
73.9	4,800	Total			

Subcatchment C660: C660



TOWN OF BRISTOL, RHODE ISLAND

PRELIMINARY ESTIMATE

CHESTNUT STREET AND CULVERT REPLACEMENT THRU CEMETERY

ITEM NO.	ITEM DESCRIPTION	UNIT	QUANTITY	UNIT COST ($/UNIT)	TOTAL COST ($)
201.0409	Remove and Dispose Flexible Pavement	SY	800	$6.00	$4,800.00
201.0414	Remove and Dispose Pipe	LF	900	$15.00	$13,500.00
202.0100	Earth Excavation	CY	1000	$15.00	$15,000.00
206.0201	Baled Hay Erosion Check, RI Std. 9.1.0	LF	500	$2.00	$1,000.00
206.0220	Silt Fence, RI Std. 9.2.0	LF	500	$3.00	$1,500.00
401.0100	Bituminous Base Course	TON	100	$60.00	$6,000.00
401.0200	Bituminous Surface Course, Type I-1	TON	100	$65.00	$6,500.00
701.0630	42 Inch RCP	LF	1100	$150.00	$165,000.00
701.7730	42 Inch FES	EA	1	$5,000.00	$5,000.00
702.0517	Frame and Grate, RI Std. 6.3.2	EA	12	$550.00	$6,600.00
702.0522	Frame and Cover, RI Std. 6.2.1	EA	1	$625.00	$625.00
702.0615	6' Precast Catch Basin w/hood and deep sump, RI Std. 4.4.0	EA	12	$3,600.00	$43,200.00
702.0640	6' Precast Manhole, RI Std. 4.2.2	EA	1	$4,000.00	$4,000.00
906.0602	4' x 6' Precast Box Culvert	LF	900	$500.00	$450,000.00
920.0090	Placed Stone Rip-rap R6, R7, R8	CY	25	$70.00	$1,750.00
920.0155	Bedding for Riprap FS-3, RI Std. 8.3.0	CY	25	$100.00	$2,500.00
920.0200	Filter Fabric for Riprap	SY	40	$3.25	$130.00
932.0200	Full-Depth Sawcut of Bituminous Pavement	LF	1100	$2.00	$2,200.00
L01.0102	Loam Borrow, 4 Inches Deep	SY	1000	$4.00	$4,000.00
L01.0102	Residential Seeding (Type 2)	SY	1000	$1.75	$1,750.00
	Unclassified Excavation	CY	500	$30.00	$15,000.00
	MPT	LS	1	$5,000.00	$5,000.00
	Dewatering	LS	1	$50,000.00	$50,000.00
	Landscaping	EA	1	$5,000.00	$5,000.00
				Subtotal	$810,055.00
				15% Eng. & Permitting	$121,508.25
				15% Contingency	$121,508.25
				TOTAL	$1,053,071.50
				SAY	$1,100,000.00

N:\3400s\3416 Silver Creek - Bristol RI\Engineering\Estimates\3416 System Upgrades.xls
9/18/2007, 8:17 AM

TOWN OF BRISTOL, RHODE ISLAND

PRELIMINARY ESTIMATE

ELBOW STREET

ITEM NO.	ITEM DESCRIPTION	UNIT	QUANTITY	UNIT COST ($/UNIT)	TOTAL COST ($)
201.0320	Clearing and Grubbing	A	0.5	$6,500.00	$3,250.00
202.0100	Earth Excavation	CY	80	$10.00	$800.00
206.0201	Baled Hay Erosion Check, RI Std. 9.1.0	LF	48	$2.00	$96.00
206.0220	Silt Fence, RI Std. 9.2.0	LF	200	$3.00	$600.00
401.0100	Bituminous Base Course	TON	60	$70.00	$4,200.00
401.0200	Bituminous Surface Course, Type I-1	TON	60	$70.00	$4,200.00
701.0630	30 Inch RCP - Class V	LF	40	$175.00	$7,000.00
701.7730	30 Inch FES	EA	2	$1,250.00	$2,500.00
702.0517	Frame and Grate, RI Std. 6.3.2	EA	4	$550.00	$2,200.00
702.0522	Frame and Cover, RI Std. 6.2.1	EA	1	$625.00	$625.00
702.0615	6' Precast Catch Basin w/hood and deep sump, RI Std. 4.4.0	EA	4	$3,600.00	$14,400.00
702.0640	6' Precast Manhole, RI Std. 4.2.2	EA	1	$4,000.00	$4,000.00
906.0602	Bituminous Berm, RI Std. 7.5.1	LF	400	$4.00	$1,600.00
920.0090	Placed Stone Rip-rap R6, R7, R8	CY	5	$70.00	$350.00
920.0155	Bedding for Riprap FS-3, RI Std. 8.3.0	CY	5	$100.00	$500.00
920.0200	Filter Fabric for Riprap	SY	10	$3.25	$32.50
932.0200	Full-Depth Sawcut of Bituminous Pavement	LF	60	$2.00	$120.00
L01.0102	Loam Borrow, 4 Inches Deep	SY	225	$4.00	$900.00
L01.0102	Residential Seeding (Type 2)	SY	225	$1.75	$393.75
	Unclassified Excavation	CY	100	$30.00	$3,000.00
	MPT	LS	1	$5,000.00	$5,000.00
	Landscaping	EA	1	$5,000.00	$5,000.00
				Subtotal	$60,767.25
				15% Eng. & Permitting	$9,115.09
				15% Contingency	$9,115.09
				TOTAL	$78,997.43
				SAY	$80,000.00

N:\3400s\3416 Silver Creek - Bristol RI\Engineering\Estimates\3416 System Upgrades.xls
9/18/2007, 8:17 AM

TOWN OF BRISTOL, RHODE ISLAND

PRELIMINARY ESTIMATE

SHERRY AVENUE

ITEM NO.	ITEM DESCRIPTION	UNIT	QUANTITY	UNIT COST ($/UNIT)	TOTAL COST ($)
201.0320	Clearing and Grubbing	A	0.25	$6,500.00	$1,625.00
202.0100	Earth Excavation	CY	0	$10.00	$0.00
206.0201	Baled Hay Erosion Check, RI Std. 9.1.0	LF	500	$2.00	$1,000.00
206.0220	Silt Fence, RI Std. 9.2.0	LF	1500	$3.00	$4,500.00
401.0100	Bituminous Base Course	TON	700	$70.00	$49,000.00
401.0200	Bituminous Surface Course, Type I-1	TON	700	$70.00	$49,000.00
701.0412	12 Inch RCP - Class III	LF	300	$60.00	$18,000.00
701.0418	18 Inch RCP - Class III	LF	1050	$75.00	$78,750.00
701.0424	24 Inch RCP - Class III	LF	570	$70.00	$39,900.00
701.0430	30 Inch RCP - Class III	LF	450	$100.00	$45,000.00
701.7730	30 Inch FES	EA	1	$1,250.00	$1,250.00
702.0517	Frame and Grate, RI Std. 6.3.2	EA	31	$550.00	$17,050.00
702.0522	Frame and Cover, RI Std. 6.2.1	EA	2	$625.00	$1,250.00
702.0615	6' Precast Catch Basin w/hood and deep sump, RI Std. 4.4.0	EA	31	$3,600.00	$111,600.00
702.0640	6' Precast Manhole, RI Std. 4.2.2	EA	2	$4,000.00	$8,000.00
906.0602	Bituminous Berm, RI Std. 7.5.1	LF	2000	$4.00	$8,000.00
920.0090	Placed Stone Rip-rap R6, R7, R8	CY	2.5	$70.00	$175.00
920.0155	Bedding for Riprap FS-3, RI Std. 8.3.0	CY	2.5	$100.00	$250.00
920.0200	Filter Fabric for Riprap	SY	5	$3.25	$16.25
932.0200	Full-Depth Sawcut of Bituminous Pavement	LF	240	$2.00	$480.00
L01.0102	Loam Borrow, 4 Inches Deep	SY	500	$4.00	$2,000.00
L01.0102	Residential Seeding (Type 2)	SY	500	$1.75	$875.00
	Unclassified Excavation	CY	200	$30.00	$6,000.00
	MPT	LS	1	$15,000.00	$15,000.00
	Landscaping	EA	1	$10,000.00	$10,000.00
				Subtotal	$468,721.25
				15% Eng. & Permitting	$70,308.19
				15% Contingency	$70,308.19
				TOTAL	$609,337.63
				SAY	$610,000.00

N:\3400s\3416 Silver Creek - Bristol RI\Engineering\Estimates\3416 System Upgrades.xls
9/18/2007, 8:17 AM

TOWN OF BRISTOL, RHODE ISLAND

PRELIMINARY ESTIMATE

PERRY STREET

ITEM NO.	ITEM DESCRIPTION	UNIT	QUANTITY	UNIT COST ($/UNIT)	TOTAL COST ($)
201.0320	Clearing and Grubbing	A	0.25	$6,500.00	$1,625.00
202.0100	Earth Excavation	CY	0	$10.00	$0.00
206.0201	Baled Hay Erosion Check, RI Std. 9.1.0	LF	440	$2.00	$880.00
206.0220	Silt Fence, RI Std. 9.2.0	LF	100	$3.00	$300.00
401.0100	Bituminous Base Course	TON	500	$70.00	$35,000.00
401.0200	Bituminous Surface Course, Type I-1	TON	500	$70.00	$35,000.00
701.0412	12 Inch RCP - Class III	LF	300	$60.00	$18,000.00
701.0418	18 Inch RCP - Class III	LF	1070	$75.00	$80,250.00
701.0424	24 Inch RCP - Class III	LF	820	$100.00	$82,000.00
701.0430	30 Inch RCP - Class III	LF	80	$120.00	$9,600.00
701.7730	30 Inch FES	EA	1	$1,250.00	$1,250.00
702.0517	Frame and Grate, RI Std. 6.3.2	EA	51	$550.00	$28,050.00
702.0522	Frame and Cover, RI Std. 6.2.1	EA	2	$625.00	$1,250.00
702.0615	6' Precast Catch Basin w/hood and deep sump, RI Std. 4.4.0	EA	11	$3,600.00	$39,600.00
702.0717	Double Grate Catch Basin, RI Std. 3.3.5	EA	20	$3,750.00	$75,000.00
702.0640	6' Precast Manhole, RI Std. 4.2.2	EA	2	$4,000.00	$8,000.00
906.0602	Bituminous Berm, RI Std. 7.5.1	LF	1050	$4.00	$4,200.00
920.0090	Placed Stone Rip-rap R6, R7, R8	CY	2.5	$70.00	$175.00
920.0155	Bedding for Riprap FS-3, RI Std. 8.3.0	CY	2.5	$100.00	$250.00
920.0200	Filter Fabric for Riprap	SY	5	$3.25	$16.25
932.0200	Full-Depth Sawcut of Bituminous Pavement	LF	300	$2.00	$600.00
L01.0102	Loam Borrow, 4 Inches Deep	SY	400	$4.00	$1,600.00
L01.0102	Residential Seeding (Type 2)	SY	400	$1.75	$700.00
	Unclassified Excavation	CY	200	$30.00	$6,000.00
	MPT	LS	1	$10,000.00	$10,000.00
	Landscaping	EA	1	$7,500.00	$7,500.00
				Subtotal	$446,846.25
				15% Eng. & Permitting	$67,026.94
				15% Contingency	$67,026.94
				TOTAL	$580,900.13
				SAY	$590,000.00

N:\3400s\3416 Silver Creek - Bristol RI\Engineering\Estimates\3416 System Upgrades.xls
9/18/2007, 8:17 AM

TOWN OF BRISTOL, RHODE ISLAND

PRELIMINARY ESTIMATE

HIGHVIEW DRIVE

ITEM NO.	ITEM DESCRIPTION	UNIT	QUANTITY	UNIT COST ($/UNIT)	TOTAL COST ($)
201.0320	Clearing and Grubbing	A	0	$6,500.00	$0.00
202.0100	Earth Excavation	CY	0	$10.00	$0.00
206.0201	Baled Hay Erosion Check, RI Std. 9.1.0	LF	80	$2.00	$160.00
206.0220	Silt Fence, RI Std. 9.2.0	LF	50	$3.00	$150.00
401.0100	Bituminous Base Course	TON	35	$70.00	$2,450.00
401.0200	Bituminous Surface Course, Type I-1	TON	35	$70.00	$2,450.00
701.0412	12 Inch RCP - Class III	LF	0	$60.00	$0.00
701.0418	18 Inch RCP - Class III	LF	296	$75.00	$22,200.00
701.0424	24 Inch RCP - Class III	LF	29	$100.00	$2,900.00
701.0430	30 Inch RCP - Class III	LF	0	$120.00	$0.00
701.4324	24 Inch Plastic Pipe	LF	20	$80.00	$1,600.00
701.7730	30 Inch FES	EA	0	$1,250.00	$0.00
702.0517	Frame and Grate, RI Std. 6.3.2	EA	0	$550.00	$0.00
702.0522	Frame and Cover, RI Std. 6.2.1	EA	0	$625.00	$0.00
702.0615	6' Precast Catch Basin w/hood and deep sump, RI Std. 4.4.0	EA	0	$3,600.00	$0.00
702.0717	Double Grate Catch Basin, RI Std. 3.3.5	EA	0	$3,750.00	$0.00
702.0640	6' Precast Manhole, RI Std. 4.2.2	EA	0	$4,000.00	$0.00
906.0602	Bituminous Berm, RI Std. 7.5.1	LF	0	$4.00	$0.00
920.0090	Placed Stone Rip-rap R6, R7, R8	CY	2.5	$70.00	$175.00
920.0155	Bedding for Riprap FS-3, RI Std. 8.3.0	CY	2.5	$100.00	$250.00
920.0200	Filter Fabric for Riprap	SY	5	$3.25	$16.25
932.0200	Full-Depth Sawcut of Bituminous Pavement	LF	370	$2.00	$740.00
L01.0102	Loam Borrow, 4 Inches Deep	SY	200	$4.00	$800.00
L01.0102	Residential Seeding (Type 2)	SY	200	$1.75	$350.00
	Unclassified Excavation	CY	50	$30.00	$1,500.00
	MPT	LS	1	$5,000.00	$5,000.00
	Landscaping	EA	1	$2,500.00	$2,500.00
				Subtotal	$43,241.25
				15% Eng. & Permitting	$6,486.19
				15% Contingency	$6,486.19
				TOTAL	$56,213.63
				SAY	$60,000.00

N:\3400s\3416 Silver Creek - Bristol RI\Engineering\Estimates\3416 System Upgrades.xls
9/18/2007, 8:17 AM

Item C1.

TOWN OF BRISTOL, RHODE ISLAND

PRELIMINARY ESTIMATE

JANE LANE

ITEM NO.	ITEM DESCRIPTION	UNIT	QUANTITY	UNIT COST ($/UNIT)	TOTAL COST ($)
201.0320	Clearing and Grubbing	A	0.25	$6,500.00	$1,625.00
202.0100	Earth Excavation	CY	0	$10.00	$0.00
206.0201	Baled Hay Erosion Check, RI Std. 9.1.0	LF	96	$2.00	$192.00
206.0220	Silt Fence, RI Std. 9.2.0	LF	50	$3.00	$150.00
401.0100	Bituminous Base Course	TON	35	$70.00	$2,450.00
401.0200	Bituminous Surface Course, Type I-1	TON	35	$70.00	$2,450.00
701.0412	12 Inch RCP - Class III	LF	0	$60.00	$0.00
701.0418	18 Inch RCP - Class III	LF	721	$75.00	$54,075.00
701.0424	24 Inch RCP - Class III	LF	136	$100.00	$13,600.00
701.0430	30 Inch RCP - Class III	LF	0	$120.00	$0.00
701.4324	24 Inch Plastic Pipe	LF	0	$80.00	$0.00
701.7724	24 Inch FES	EA	1	$900.00	$900.00
702.0517	Frame and Grate, RI Std. 6.3.2	EA	2	$550.00	$1,100.00
702.0522	Frame and Cover, RI Std. 6.2.1	EA	2	$625.00	$1,250.00
702.0615	6' Precast Catch Basin w/hood and deep sump, RI Std. 4.4.0	EA	2	$3,600.00	$7,200.00
702.0717	Double Grate Catch Basin, RI Std. 3.3.5	EA	0	$3,750.00	$0.00
702.0640	6' Precast Manhole, RI Std. 4.2.2	EA	2	$4,000.00	$8,000.00
906.0602	Bituminous Berm, RI Std. 7.5.1	LF	0	$4.00	$0.00
920.0090	Placed Stone Rip-rap R6, R7, R8	CY	2.5	$70.00	$175.00
920.0155	Bedding for Riprap FS-3, RI Std. 8.3.0	CY	2.5	$100.00	$250.00
920.0200	Filter Fabric for Riprap	SY	5	$3.25	$16.25
932.0200	Full-Depth Sawcut of Bituminous Pavement	LF	375	$2.00	$750.00
L01.0102	Loam Borrow, 4 Inches Deep	SY	775	$4.00	$3,100.00
L01.0102	Residential Seeding (Type 2)	SY	775	$1.75	$1,356.25
	Unclassified Excavation	CY	150	$30.00	$4,500.00
	MPT	LS	1	$2,500.00	$2,500.00
	Landscaping	EA	1	$5,000.00	$5,000.00
				Subtotal	$110,639.50
				15% Eng. & Permitting	$16,595.93
				15% Contingency	$16,595.93
				TOTAL	$143,831.35
				SAY	$150,000.00

N:\3400s\3416 Silver Creek - Bristol RI\Engineering\Estimates\3416 System Upgrades.xls
9/18/2007, 8:17 AM

TOWN OF BRISTOL, RHODE ISLAND

PRELIMINARY ESTIMATE

PAULL STREET/HILLSIDE ROAD

ITEM NO.	ITEM DESCRIPTION	UNIT	QUANTITY	UNIT COST ($/UNIT)	TOTAL COST ($)
201.0320	Clearing and Grubbing	A	0.25	$6,500.00	$1,625.00
202.0100	Earth Excavation	CY	25	$10.00	$250.00
206.0201	Baled Hay Erosion Check, RI Std. 9.1.0	LF	145	$2.00	$290.00
206.0220	Silt Fence, RI Std. 9.2.0	LF	50	$3.00	$150.00
401.0100	Bituminous Base Course	TON	50	$70.00	$3,500.00
401.0200	Bituminous Surface Course, Type I-1	TON	50	$70.00	$3,500.00
701.0412	12 Inch RCP - Class III	LF	139	$75.00	$10,425.00
701.0418	18 Inch RCP - Class III	LF	462	$90.00	$41,580.00
701.0424	24 Inch RCP - Class III	LF	0	$100.00	$0.00
701.0430	30 Inch RCP - Class III	LF	0	$100.00	$0.00
701.4324	24 Inch Plastic Pipe	LF	0	$80.00	$0.00
701.7718	18 Inch FES	EA	1	$1,000.00	$1,000.00
702.0517	Frame and Grate, RI Std. 6.3.2	EA	2	$550.00	$1,100.00
702.0522	Frame and Cover, RI Std. 6.2.1	EA	0	$625.00	$0.00
702.0615	6' Precast Catch Basin w/hood and deep sump, RI Std. 4.4.0	EA	2	$3,600.00	$7,200.00
702.0717	Double Grate Catch Basin, RI Std. 3.3.5	EA	0	$3,750.00	$0.00
702.0640	6' Precast Manhole, RI Std. 4.2.2	EA	0	$4,000.00	$0.00
906.0602	Bituminous Berm, RI Std. 7.5.1	LF	0	$4.00	$0.00
920.0090	Placed Stone Rip-rap R6, R7, R8	CY	2.5	$70.00	$175.00
920.0155	Bedding for Riprap FS-3, RI Std. 8.3.0	CY	2.5	$100.00	$250.00
920.0200	Filter Fabric for Riprap	SY	5	$3.25	$16.25
932.0200	Full-Depth Sawcut of Bituminous Pavement	LF	530	$2.00	$1,060.00
L01.0102	Loam Borrow, 4 Inches Deep	SY	400	$4.00	$1,600.00
L01.0102	Residential Seeding (Type 2)	SY	400	$1.75	$700.00
	Unclassified Excavation	CY	125	$30.00	$3,750.00
	MPT	LS	1	$5,000.00	$5,000.00
	Landscaping	EA	1	$2,500.00	$2,500.00
				Subtotal	$85,671.25
				15% Eng. & Permitting	$12,850.69
				15% Contingency	$12,850.69
				TOTAL	$111,372.63
				SAY	$120,000.00

N:\3400s\3416 Silver Creek - Bristol RI\Engineering\Estimates\3416 System Upgrades.xls
9/18/2007, 8:17 AM

Appendix E – Map of Study Area

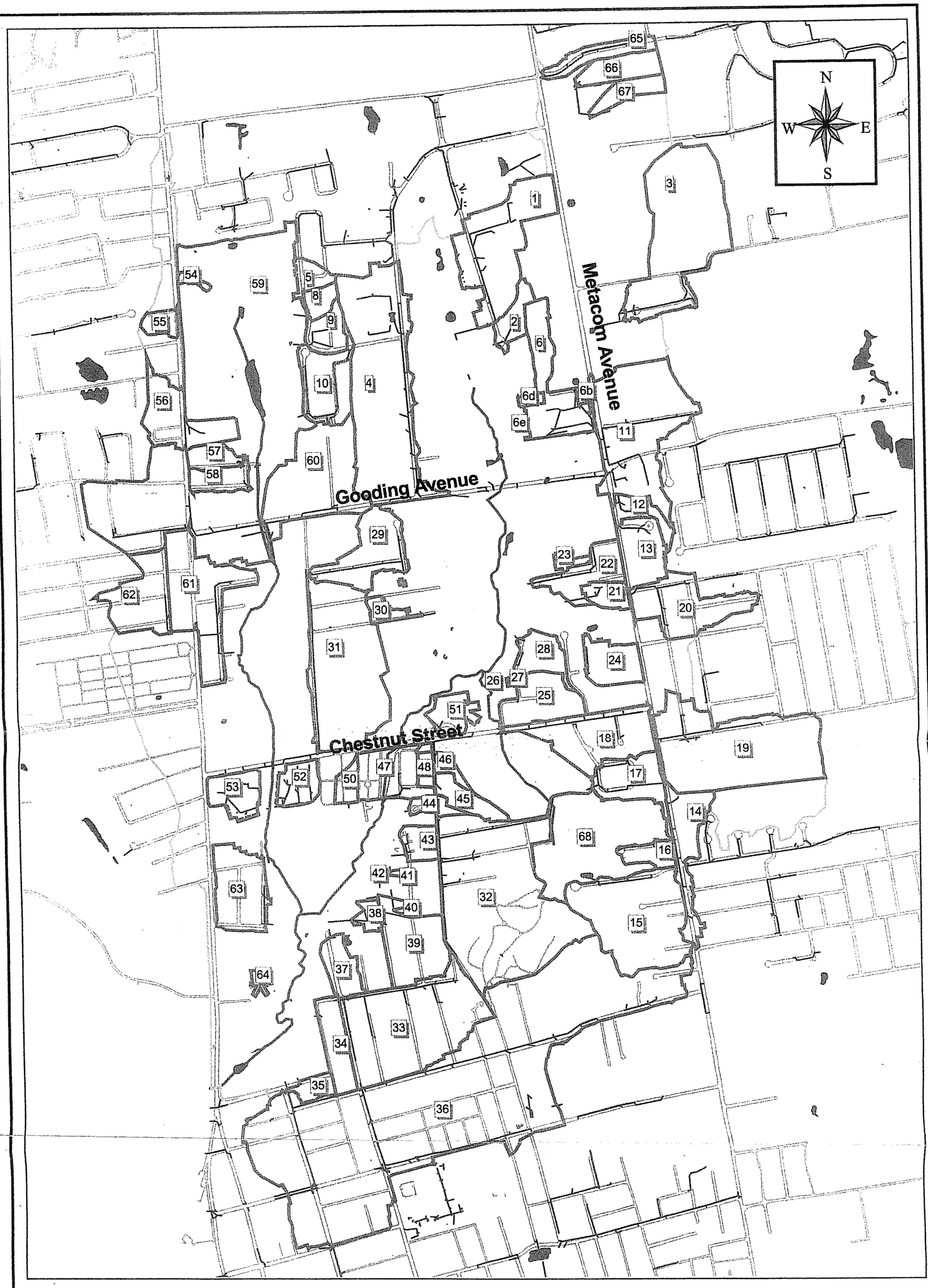
APPENDIX

Appendix A – Watershed Analysis
HydroCAD – 2, 10, 25, and 100-year Storm Events
Hydraflow – Pipe Capacity Analysis
Appendix B – Silver Creek Analysis
HydroCAD – 2, 10, and 100-year Storm Events
HEC-RAS
Appendix C – Problem Areas
Appendix D – Estimates
Appendix E – Map of Study Area

Appendix A – Watershed Analysis

HydroCAD – 2, 10, 25, and 100-year Storm Events

Hydraflow – Pipe Capacity Analysis



Legend

- Existing Drain Pipes
- Drainage System Watersheds
- Silver Creek Watershed

Town of Bristol Rhode Island

Silver Creek

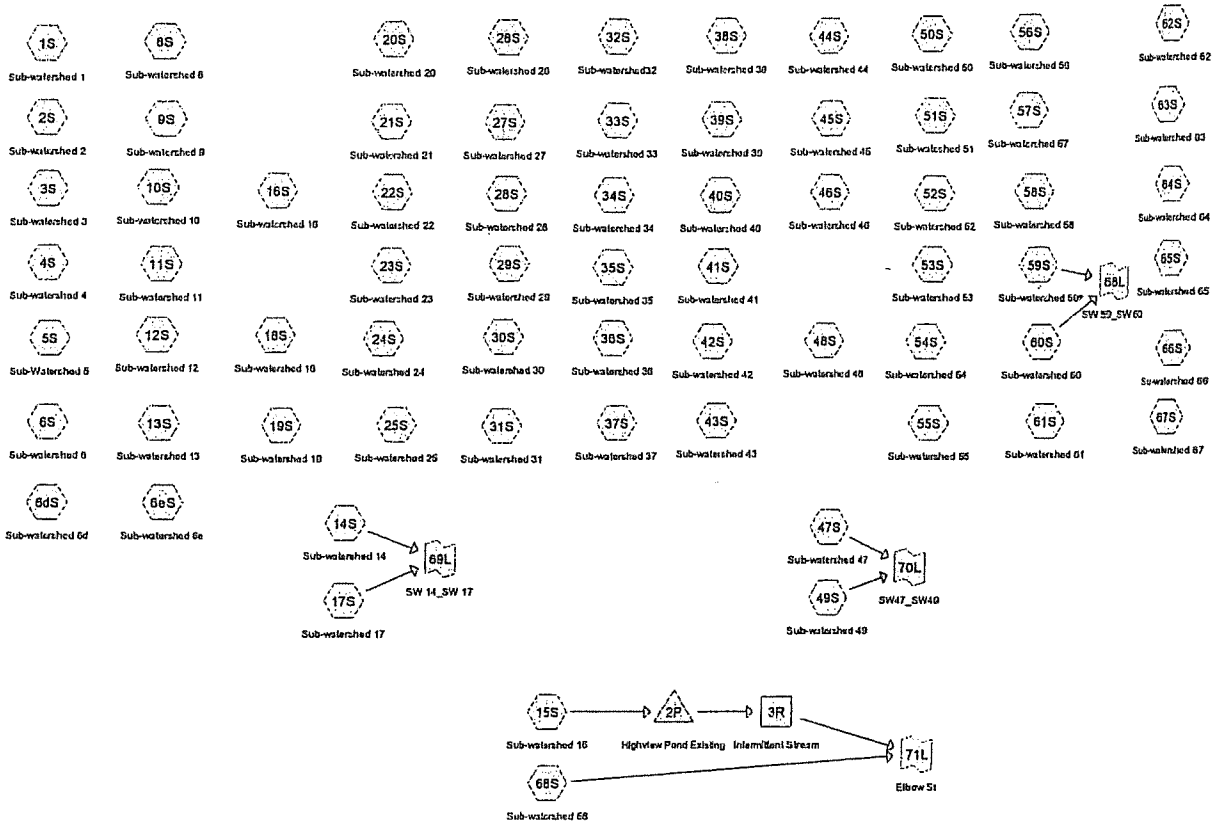
NOT TO SCALE

Appendix

Closed Drainage System Watersheds

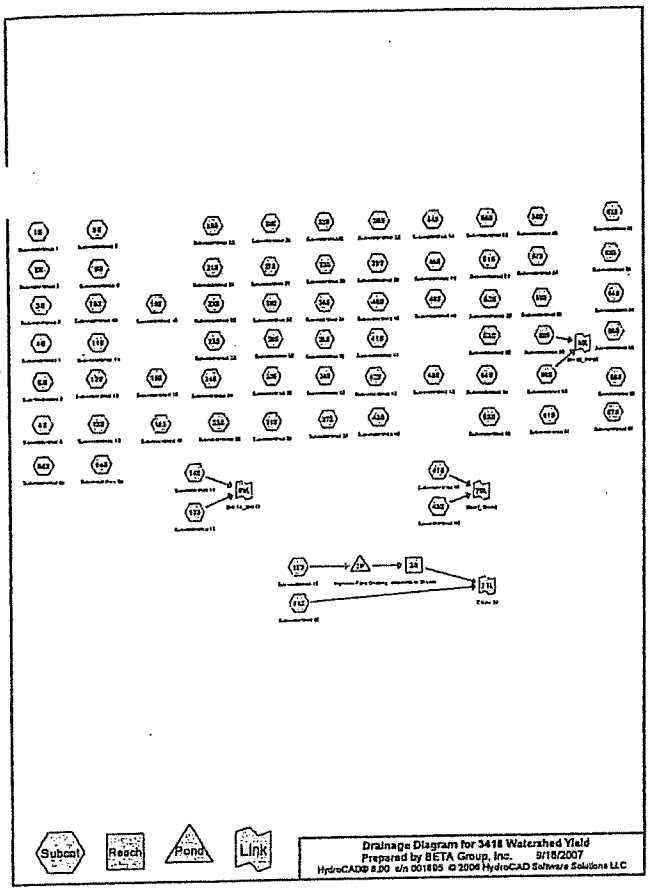
Item C1.

HydroCAD – 2, 10, 25, and 100-year Storm Events



Drainage Diagram for 3416 Watershed Yield
Prepared by BETA Group, Inc. 9/18/2007
HydroCAD® 8.00 s/n 001895 © 2006 HydroCAD Software Solutions LLC

2-Year Storm



Time span=0.00-24.00 hrs, dt=0.02 hrs, 1201 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Sub-watershed 1 Runoff Area=18.400 ac Runoff Depth>2.73"
Flow Length=1,460' Tc=20.1 min CN=94 Runoff=38.24 cfs 4.185 af

Subcatchment 2S: Sub-watershed 2 Runoff Area=3.220 ac Runoff Depth>2.73"
Flow Length=792' Tc=10.2 min CN=94 Runoff=8.58 cfs 0.734 af

Subcatchment 3S: Sub-watershed 3 Runoff Area=27.500 ac Runoff Depth>1.69"
Flow Length=2,500' Tc=39.3 min CN=82 Runoff=27.16 cfs 3.863 af

Subcatchment 4S: Sub-watershed 4 Runoff Area=35.010 ac Runoff Depth>2.24"
Flow Length=3,096' Tc=50.9 min CN=89 Runoff=40.02 cfs 6.544 af

Subcatchment 5S: Sub-Watershed 5 Runoff Area=2.340 ac Runoff Depth>1.56"
Tc=5.0 min CN=80 Runoff=4.39 cfs 0.303 af

Subcatchment 6dS: Sub-watershed 6d Runoff Area=0.630 ac Runoff Depth>2.74"
Tc=5.0 min CN=94 Runoff=1.99 cfs 0.144 af

Subcatchment 6eS: Sub-watershed 6e Runoff Area=0.500 ac Runoff Depth>2.74"
Tc=5.0 min CN=94 Runoff=1.58 cfs 0.114 af

Subcatchment 6S: Sub-watershed 6 Runoff Area=10.610 ac Runoff Depth>2.17"
Flow Length=1,536' Tc=11.4 min CN=88 Runoff=22.54 cfs 1.922 af

Subcatchment 8S: Sub-watershed 8 Runoff Area=2.070 ac Runoff Depth>1.55"
Flow Length=419' Tc=11.6 min CN=80 Runoff=3.11 cfs 0.268 af

Subcatchment 9S: Sub-watershed 9 Runoff Area=3.780 ac Runoff Depth>2.00"
Flow Length=633' Tc=16.8 min CN=86 Runoff=6.45 cfs 0.631 af

Subcatchment 10S: Sub-watershed 10 Runoff Area=8.740 ac Runoff Depth>1.77"
Flow Length=1,337' Tc=19.3 min CN=83 Runoff=12.41 cfs 1.287 af

Subcatchment 11S: Sub-watershed 11 Runoff Area=24.460 ac Runoff Depth>2.25"
Flow Length=1,757' Tc=26.1 min CN=89 Runoff=38.80 cfs 4.595 af

Subcatchment 12S: Sub-watershed 12 Runoff Area=3.040 ac Runoff Depth>2.44"
Flow Length=996' Tc=15.8 min CN=91 Runoff=6.37 cfs 0.618 af

Subcatchment 13S: Sub-watershed 13 Runoff Area=6.760 ac Runoff Depth>1.63"
Tc=5.0 min CN=81 Runoff=13.29 cfs 0.918 af

Subcatchment 14S: Sub-watershed 14 Runoff Area=8.050 ac Runoff Depth>1.48"
Flow Length=1,715' Tc=11.6 min CN=79 Runoff=11.47 cfs 0.997 af

Subcatchment 15S: Sub-watershed 15 Runoff Area=21.680 ac Runoff Depth>1.62"
Flow Length=1,259' Tc=22.2 min CN=81 Runoff=26.53 cfs 2.927 af

Subcatchment 16S: Sub-watershed 16 Runoff Area=2.740 ac Runoff Depth>1.70"
Flow Length=709' Tc=13.2 min CN=82 Runoff=4.32 cfs 0.387 af

Subcatchment 17S: Sub-watershed 17 Runoff Area=7.200 ac Runoff Depth>1.55"
Flow Length=1,430' Tc=21.6 min CN=80 Runoff=8.50 cfs 0.930 af

Subcatchment 18S: Sub-watershed 18 Runoff Area=13.850 ac Runoff Depth>1.55"
Flow Length=1,868' Tc=11.2 min CN=80 Runoff=21.07 cfs 1.793 af

Subcatchment 19S: Sub-watershed 19 Runoff Area=29.160 ac Runoff Depth>1.33"
Flow Length=2,101' Tc=63.7 min CN=77 Runoff=17.07 cfs 3.243 af

Subcatchment 20S: Sub-watershed 20 Runoff Area=11.220 ac Runoff Depth>1.62"
Flow Length=1,264' Tc=17.0 min CN=81 Runoff=15.31 cfs 1.517 af

Subcatchment 21S: Sub-watershed 21 Runoff Area=2.540 ac Runoff Depth>2.74"
Flow Length=496' Tc=5.5 min CN=94 Runoff=7.90 cfs 0.579 af

Subcatchment 22S: Sub-watershed 22 Runoff Area=6.280 ac Runoff Depth>2.74"
Flow Length=1,194' Tc=7.2 min CN=94 Runoff=18.43 cfs 1.432 af

Subcatchment 23S: Sub-watershed 23 Runoff Area=0.900 ac Runoff Depth>2.74"
Tc=5.0 min CN=94 Runoff=2.85 cfs 0.205 af

Subcatchment 24S: Sub-watershed 24 Runoff Area=5.430 ac Runoff Depth>2.44"
Flow Length=1,015' Tc=12.7 min CN=91 Runoff=12.33 cfs 1.105 af

Subcatchment 25S: Sub-watershed 25 Runoff Area=7.910 ac Runoff Depth>1.55"
Flow Length=943' Tc=13.6 min CN=80 Runoff=11.22 cfs 1.024 af

Subcatchment 26S: Sub-watershed 26 Runoff Area=0.040 ac Runoff Depth>3.16"
Tc=5.0 min CN=98 Runoff=0.14 cfs 0.011 af

Subcatchment 27S: Sub-watershed 27 Runoff Area=0.090 ac Runoff Depth>1.77"
Tc=5.0 min CN=83 Runoff=0.19 cfs 0.013 af

Subcatchment 28S: Sub-watershed 28 Runoff Area=4.430 ac Runoff Depth>1.55"
Flow Length=1,025' Tc=22.5 min CN=80 Runoff=5.14 cfs 0.572 af

Subcatchment 29S: Sub-watershed 29 Runoff Area=9.890 ac Runoff Depth>1.70"
Flow Length=1,194' Tc=11.1 min CN=82 Runoff=16.57 cfs 1.398 af

Subcatchment 30S: Sub-watershed 30 Runoff Area=1.680 ac Runoff Depth>1.62"
Flow Length=716' Tc=13.0 min CN=81 Runoff=2.54 cfs 0.227 af

Subcatchment 31S: Sub-watershed 31 Runoff Area=27.350 ac Runoff Depth>1.35"
Flow Length=1,762' Tc=27.7 min CN=77 Runoff=24.90 cfs 3.071 af

Subcatchment 32S: Sub-watershed32 Runoff Area=45.010 ac Runoff Depth>1.16"
Flow Length=1,805' Tc=26.8 min CN=74 Runoff=35.08 cfs 4.363 af

Subcatchment 33S: Sub-watershed 33 Runoff Area=27.500 ac Runoff Depth>1.62"
Flow Length=1,541' Tc=10.0 min CN=81 Runoff=44.26 cfs 3.722 af

Subcatchment 34S: Sub-watershed 34 Runoff Area=5.470 ac Runoff Depth>1.62"
Flow Length=867' Tc=16.4 min CN=81 Runoff=7.58 cfs 0.739 af

Subcatchment 35S: Sub-watershed 35 Runoff Area=2.020 ac Runoff Depth>2.17"
Flow Length=401' Tc=11.6 min CN=88 Runoff=4.27 cfs 0.366 af

Subcatchment 36S: Sub-watershed 36 Runoff Area=114.100 ac Runoff Depth>1.76"
Flow Length=4,314' Tc=29.2 min CN=83 Runoff=135.65 cfs 16.770 af

Subcatchment 37S: Sub-watershed 37 Runoff Area=4.120 ac Runoff Depth>2.01"
Flow Length=852' Tc=9.7 min CN=86 Runoff=8.55 cfs 0.689 af

Subcatchment 38S: Sub-watershed 38 Runoff Area=1.590 ac Runoff Depth>2.26"
Tc=5.0 min CN=89 Runoff=4.32 cfs 0.300 af

Subcatchment 39S: Sub-watershed 39 Runoff Area=10.460 ac Runoff Depth>1.62"
Flow Length=1,018' Tc=12.8 min CN=81 Runoff=15.95 cfs 1.418 af

Subcatchment 40S: Sub-watershed 40 Runoff Area=0.240 ac Runoff Depth>1.63"
Flow Length=189' Tc=6.6 min CN=81 Runoff=0.45 cfs 0.033 af

Subcatchment 41S: Sub-watershed 41 Runoff Area=0.290 ac Runoff Depth>2.01"
Flow Length=182' Tc=6.2 min CN=86 Runoff=0.68 cfs 0.049 af

Subcatchment 42S: Sub-watershed 42 Runoff Area=0.070 ac Runoff Depth>2.01"
Flow Length=178' Tc=6.9 min CN=86 Runoff=0.16 cfs 0.012 af

Subcatchment 43S: Sub-watershed 43 Runoff Area=2.850 ac Runoff Depth>1.62"
Flow Length=570' Tc=10.1 min CN=81 Runoff=4.71 cfs 0.386 af

Subcatchment 44S: Sub-watershed 44 Runoff Area=1.720 ac Runoff Depth>1.35"
Flow Length=760' Tc=20.2 min CN=77 Runoff=1.79 cfs 0.194 af

Subcatchment 45S: Sub-watershed 45 Runoff Area=3.670 ac Runoff Depth>1.17"
Flow Length=865' Tc=21.2 min CN=74 Runoff=3.16 cfs 0.356 af

Subcatchment 46S: Sub-watershed 46 Runoff Area=1.370 ac Runoff Depth>1.16"
Flow Length=727' Tc=25.0 min CN=74 Runoff=1.10 cfs 0.133 af

Subcatchment 47S: Sub-watershed 47 Runoff Area=7.620 ac Runoff Depth>1.49"
Flow Length=701' Tc=8.1 min CN=79 Runoff=12.21 cfs 0.944 af

Subcatchment 48S: Sub-watershed 48 Runoff Area=1.320 ac Runoff Depth>1.85"
Flow Length=449' Tc=8.7 min CN=84 Runoff=2.61 cfs 0.203 af

Subcatchment 49S: Sub-watershed 49 Runoff Area=0.300 ac Runoff Depth>1.49"
Flow Length=130' Tc=7.3 min CN=79 Runoff=0.49 cfs 0.037 af

Subcatchment 50S: Sub-watershed 50 Runoff Area=1.900 ac Runoff Depth>1.46"
Flow Length=555' Tc=11.3 min CN=79 Runoff=2.74 cfs 0.235 af

Subcatchment 51S: Sub-wateshed 51 Runoff Area=3.850 ac Runoff Depth>2.44"
Tc=5.0 min CN=91 Runoff=11.18 cfs 0.784 af

Subcatchment 52S: Sub-watershed 52 Runoff Area=3.900 ac Runoff Depth>2.26"
Flow Length=598' Tc=9.6 min CN=89 Runoff=9.08 cfs 0.735 af

Subcatchment 53S: Sub-watershed 53 Runoff Area=4.840 ac Runoff Depth>2.35"
Flow Length=584' Tc=9.2 min CN=90 Runoff=11.82 cfs 0.948 af

Subcatchment 54S: Sub-watershed 54 Runoff Area=0.590 ac Runoff Depth>1.77"
Tc=5.0 min CN=83 Runoff=1.27 cfs 0.087 af

Subcatchment 55S: Sub-watershed 55 Runoff Area=1.880 ac Runoff Depth>2.44"
Flow Length=592' Tc=17.0 min CN=91 Runoff=3.83 cfs 0.382 af

Subcatchment 56S: Sub-watershed 56 Runoff Area=9.220 ac Runoff Depth>1.62"
Flow Length=951' Tc=23.1 min CN=81 Runoff=11.08 cfs 1.244 af

Subcatchment 57S: Sub-watershed 57 Runoff Area=2.690 ac Runoff Depth>1.62"
Flow Length=659' Tc=16.2 min CN=81 Runoff=3.75 cfs 0.364 af

Subcatchment 58S: Sub-watershed 58 Runoff Area=3.420 ac Runoff Depth>1.62"
Flow Length=774' Tc=17.4 min CN=81 Runoff=4.63 cfs 0.462 af

Subcatchment 59S: Sub-watershed 59 Runoff Area=90.930 ac Runoff Depth>1.74"
Flow Length=3,726' Tc=74.5 min CN=83 Runoff=65.15 cfs 13.221 af

Subcatchment 60S: Sub-watershed 60 Runoff Area=18.370 ac Runoff Depth>2.63"
Flow Length=2,475' Tc=20.6 min CN=93 Runoff=36.61 cfs 4.025 af

Subcatchment 61S: Sub-watershed 61 Runoff Area=15.630 ac Runoff Depth>1.70"
Flow Length=1,028' Tc=9.6 min CN=82 Runoff=27.45 cfs 2.210 af

Subcatchment 62S: Sub-watershed 62 Runoff Area=9.320 ac Runoff Depth>1.62"
Flow Length=991' Tc=22.5 min CN=81 Runoff=11.34 cfs 1.258 af

Subcatchment 63S: Sub-watershed 63 Runoff Area=9.850 ac Runoff Depth>1.62"
Flow Length=1,245' Tc=12.1 min CN=81 Runoff=15.29 cfs 1.333 af

Subcatchment 64S: Sub-watershed 64 Runoff Area=0.720 ac Runoff Depth>2.44"
Flow Length=133' Tc=9.7 min CN=91 Runoff=1.79 cfs 0.147 af

Subcatchment 65S: Sub-watershed 65 Runoff Area=4.080 ac Runoff Depth>1.62"
Flow Length=1,220' Tc=15.0 min CN=81 Runoff=5.85 cfs 0.552 af

Subcatchment 66S: Su-watershed 66 Runoff Area=4.660 ac Runoff Depth>1.62"
Flow Length=863' Tc=22.0 min CN=81 Runoff=5.73 cfs 0.629 af

Subcatchment 67S: Sub-watershed 67 Runoff Area=3.140 ac Runoff Depth>1.84"
Flow Length=869' Tc=28.8 min CN=84 Runoff=3.93 cfs 0.482 af

Subcatchment 68S: Sub-watershed 68 Runoff Area=20.630 ac Runoff De
Flow Length=1,184' Tc=18.0 min CN=80 Runoff=26.25 cfs

Reach 3R: Intermittent Stream Avg. Depth=0.40' Max Vel=1.85 fps Inflow=15.60 cfs 2.891 af
n=0.070 L=725.0' S=0.0283 '/' Capacity=253.16 cfs Outflow=15.47 cfs 2.868 af

Pond 2P: Highview Pond Existing Peak Elev=119.11' Storage=24,195 cf Inflow=26.53 cfs 2.927 af
Outflow=15.60 cfs 2.891 af

Link 58L: SW 59_SW 60 Inflow=72.05 cfs 17.246 af
Primary=72.05 cfs 17.246 af

Link 69L: SW 14_SW 17 Inflow=18.31 cfs 1.927 af
Primary=18.31 cfs 1.927 af

Link 70L: SW47_SW49 Inflow=12.70 cfs 0.981 af
Primary=12.70 cfs 0.981 af

Link 71L: Elbow St Inflow=32.37 cfs 6.535 af
Primary=32.37 cfs 5.535 af

Total Runoff Area = 746.870 ac Runoff Volume = 110.032 af Average Runoff Depth = 1.77"
66.54% Pervious Area = 496.954 ac 33.46% Impervious Area = 249.916 ac

Subcatchment 1S: Sub-watershed 1

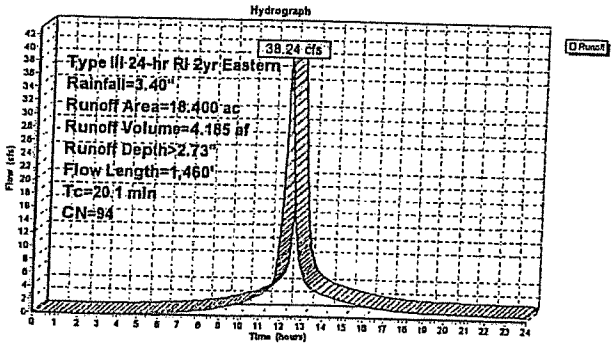
Runoff = 38.24 cfs @ 12.26 hrs, Volume= 4.185 af, Depth> 2.73"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 2yr Eastern Rainfall=3.40"

Area (ac)	CN	Description
18.400	94	Urban commercial, 85% Imp, HSG C
2.760		Pervious Area
15.640		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.7	100	0.0150	0.16		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
8.9	1,240	0.0210	2.33		Shallow Concentrated Flow, B-C Unpaved Kv= 16.1 fps
0.5	120	0.0330	3.69		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
20.1	1,460	Total			

Subcatchment 1S: Sub-watershed 1



Subcatchment 2S: Sub-watershed 2

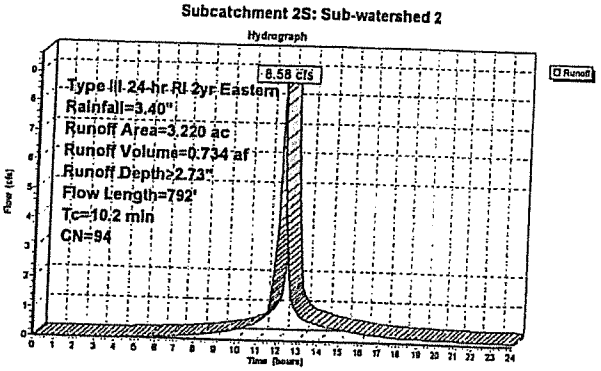
Runoff = 8.58 cfs @ 12.14 hrs, Volume= 0.734 af, Depth> 2.73"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 2yr Eastern Rainfall=3.40"

Area (ac)	CN	Description
3.220	94	Urban commercial, 85% Imp, HSG C
0.483		Pervious Area
2.737		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.1	100	0.0600	0.27		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
2.4	394	0.0280	2.69		Shallow Concentrated Flow, B-C Unpaved Kv= 16.1 fps
1.7	298	0.0200	2.87		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
10.2	792	Total			

Subcatchment 2S: Sub-watershed 2



Subcatchment 3S: Sub-watershed 3

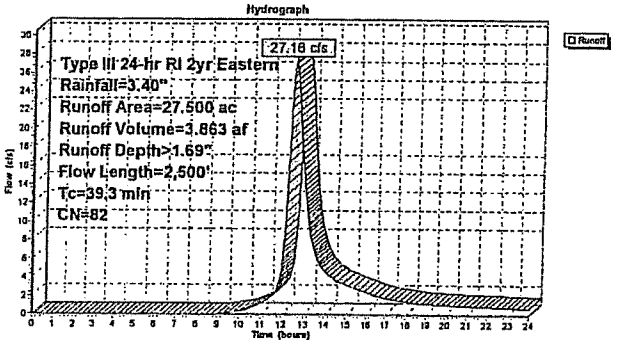
Runoff = 27.16 cfs @ 12.55 hrs, Volume= 3.863 af, Depth> 1.69"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 2yr Eastern Rainfall=3.40"

Area (ac)	CN	Description
13.750	86	Pasture/grassland/range, Poor, HSG C
10.750	80	1/2 acre lots, 25% Imp, HSG C
3.000	73	Woods, Fair, HSG C
27.500	82	Weighted Average
24.813		Pervious Area
2.688		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	100	0.0100	0.28		Sheet Flow, A-B Cultivated: Residue<=20% n= 0.060 P2= 3.40"
18.4	1,200	0.0217	1.03		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
13.9	1,200	0.0050	1.44		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
39.3	2,500	Total			

Subcatchment 3S: Sub-watershed 3



Subcatchment 4S: Sub-watershed 4

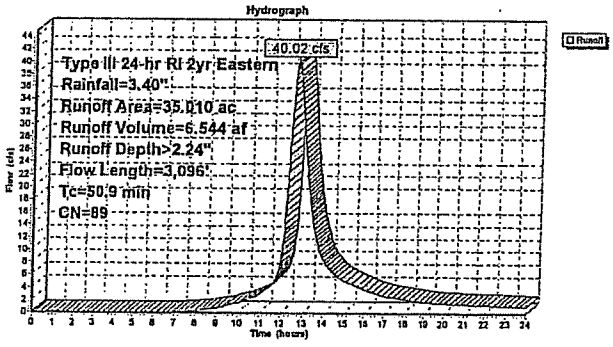
Runoff = 40.02 cfs @ 12.69 hrs, Volume= 6.544 af, Depth> 2.24"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 2yr Eastern Rainfall=3.40"

Area (ac)	CN	Description
5.901	90	Fallow, crop residue, Poor, HSG C
17.070	94	Urban commercial, 85% Imp, HSG C
5.647	79	Pasture/grassland/range, Fair, HSG C
3.680	79	1 acre lots, 20% Imp, HSG C
2.712	91	Urban Industrial, 72% Imp, HSG C
35.010	89	Weighted Average
17.812		Pervious Area
17.198		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.5	100	0.0200	0.18		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
1.8	106	0.0190	0.98		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
0.2	30	0.0170	2.65		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
0.6	70	0.0860	2.05		Shallow Concentrated Flow, D-E Short Grass Pasture Kv= 7.0 fps
0.7	82	0.0100	2.03		Shallow Concentrated Flow, E-F Paved Kv= 20.3 fps
24.2	322	0.0010	0.22		Shallow Concentrated Flow, F-G Short Grass Pasture Kv= 7.0 fps
13.9	2,386	0.0200	2.87		Shallow Concentrated Flow, G-H Paved Kv= 20.3 fps
50.9	3,096	Total			

Subcatchment 4S: Sub-watershed 4



Subcatchment 5S: Sub-Watershed 5

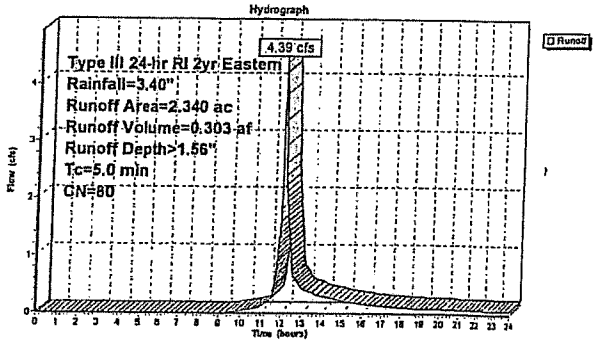
Runoff = 4.39 cfs @ 12.08 hrs, Volume= 0.303 af, Depth> 1.55"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 2yr Eastern Rainfall=3.40"

Area (ac)	CN	Description
2.340	80	1/2 acre lots, 25% Imp, HSG C
1.755		Pervious Area
0.585		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry, A-D

Subcatchment 5S: Sub-Watershed 5



Subcatchment 6dS: Sub-watershed 6d

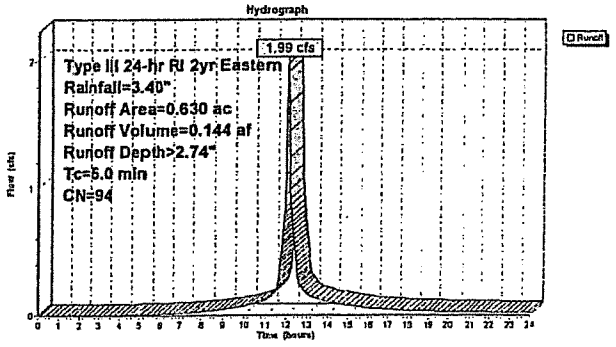
Runoff = 1.99 cfs @ 12.07 hrs, Volume= 0.144 af, Depth> 2.74"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 2yr Eastern Rainfall=3.40"

Area (ac)	CN	Description
0.630	94	Urban commercial, 85% imp, HSG C
0.095		Pervious Area
0.535		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry, A-C

Subcatchment 6dS: Sub-watershed 6d



Subcatchment 6eS: Sub-watershed 6e

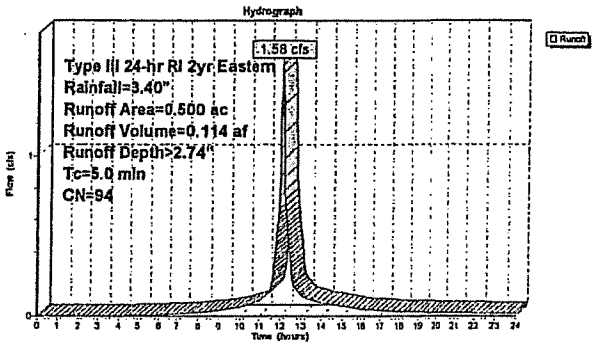
Runoff = 1.58 cfs @ 12.07 hrs, Volume= 0.114 af, Depth> 2.74"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 2yr Eastern Rainfall=3.40"

Area (ac)	CN	Description
0.500	94	Urban commercial, 85% imp, HSG C
0.075		Pervious Area
0.425		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry, A-C

Subcatchment 6eS: Sub-watershed 6e



Subcatchment 6S: Sub-watershed 6

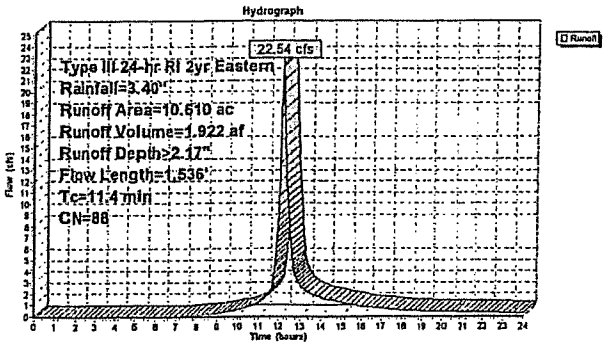
Runoff = 22.54 cfs @ 12.16 hrs, Volume= 1.922 af, Depth> 2.17"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 2yr Eastern Rainfall=3.40"

Area (ac)	CN	Description
8.380	87	Dirt roads, HSG C
2.230	94	Urban commercial, 85% imp, HSG C
10.610	88	Weighted Average
8.714		Pervious Area
1.895		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.6	100	0.0900	2.59		Sheet Flow, A-B Smooth surfaces n= 0.011 P2= 3.40"
10.8	1,436	0.0120	2.22		Shallow Concentrated Flow, B-C Paved Kv= 20.3 fps
11.4	1,536	Total			

Subcatchment 6S: Sub-watershed 6



Subcatchment 8S: Sub-watershed 8

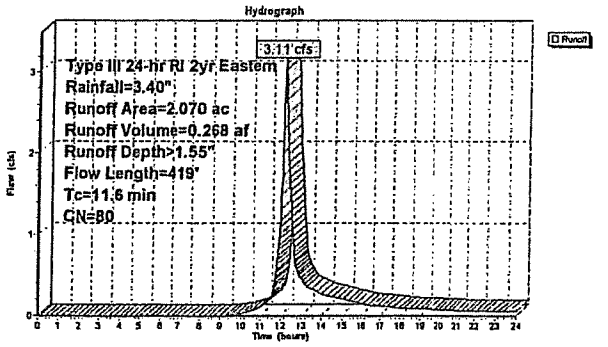
Runoff = 3.11 cfs @ 12.16 hrs, Volume= 0.268 af, Depth> 1.55"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 2yr Eastern Rainfall=3.40"

Area (ac)	CN	Description
2.070	80	1/2 acre lots, 25% imp, HSG C
1.552		Pervious Area
0.517		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.1	100	0.0300	0.21		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
3.1	228	0.0300	1.21		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
0.4	91	0.0400	4.06		Shallow Concentrated Flow, B-C Paved Kv= 20.3 fps
11.6	419	Total			

Subcatchment 8S: Sub-watershed 8



Subcatchment 9S: Sub-watershed 9

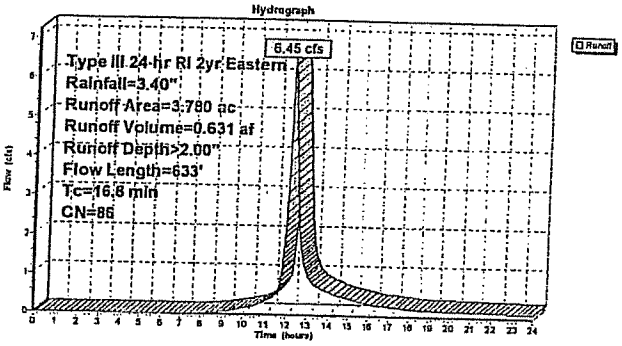
Runoff = 6.45 cfs @ 12.23 hrs, Volume= 0.631 af, Depth> 2.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 2yr Eastern Rainfall=3.40"

Area (ac)	CN	Description
2.990	90	1/8 acre lots, 65% Imp, HSG C
0.790	73	Woods, Fair, HSG C
3.780	86	Weighted Average
1.837		Pervious Area
1.944		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.5	100	0.0200	0.18		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
4.7	200	0.0200	0.71		Shallow Concentrated Flow, B-C Woodland Kv= 5.0 fps
1.7	160	0.0500	1.57		Shallow Concentrated Flow, B- C Short Grass Pasture Kv= 7.0 fps
0.9	173	0.0230	3.08		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
16.8	633	Total			

Subcatchment 9S: Sub-watershed 9



Subcatchment 10S: Sub-watershed 10

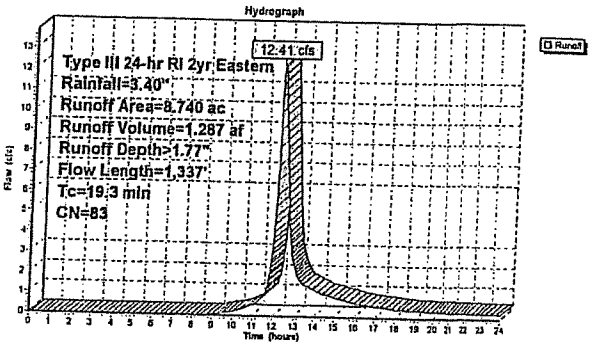
Runoff = 12.41 cfs @ 12.27 hrs, Volume= 1.287 af, Depth> 1.77"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 2yr Eastern Rainfall=3.40"

Area (ac)	CN	Description
8.740	83	1/4 acre lots, 38% Imp, HSG C
5.419		Pervious Area
3.321		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.5	100	0.0200	0.18		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
3.8	196	0.0150	0.86		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
6.0	1,041	0.0200	2.87		Shallow Concentrated Flow, B-C Paved Kv= 20.3 fps
19.3	1,337	Total			

Subcatchment 10S: Sub-watershed 10



Subcatchment 11S: Sub-watershed 11

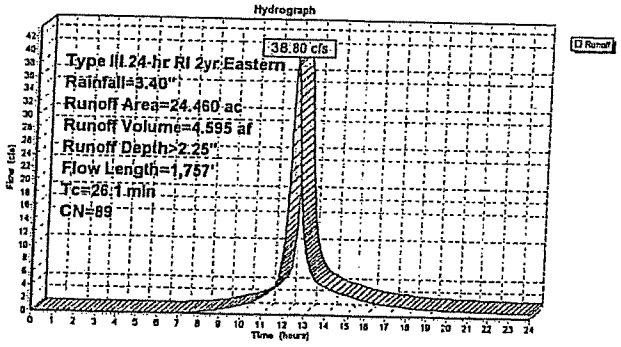
Runoff = 38.80 cfs @ 12.35 hrs, Volume= 4.595 af, Depth> 2.25"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 2yr Eastern Rainfall=3.40"

Area (ac)	CN	Description
5.370	90	Fallow, crop residue, Poor, HSG C
10.340	94	Urban commercial, 85% Imp, HSG C
8.750	83	1/4 acre lots, 38% Imp, HSG C
24.460	89	Weighted Average
12.346		Pervious Area
12.114		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.6	100	0.0200	0.36		Sheet Flow, A-B Cultivated: Residue<=20% n= 0.060 P2= 3.40"
12.0	504	0.0100	0.70		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
9.5	1,153	0.0100	2.03		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
26.1	1,757	Total			

Subcatchment 11S: Sub-watershed 11



Subcatchment 12S: Sub-watershed 12

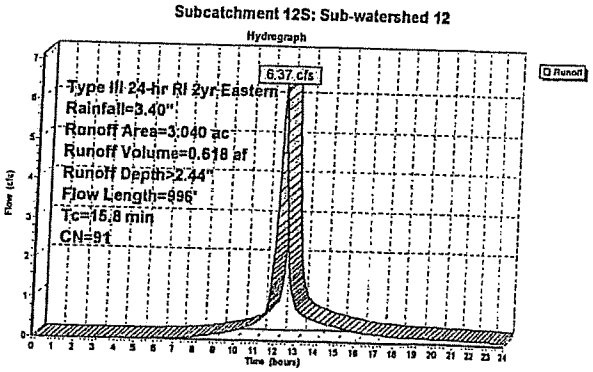
Runoff = 6.37 cfs @ 12.21 hrs, Volume= 0.618 af, Depth> 2.44"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 2yr Eastern Rainfall=3.40"

Area (ac)	CN	Description
2.130	94	Urban commercial, 85% Imp, HSG C
0.910	83	1/4 acre lots, 38% Imp, HSG C
3.040	91	Weighted Average
0.884		Pervious Area
2.156		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.1	100	0.0300	0.21		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
5.5	462	0.0400	1.40		Shallow Concentrated Flow, A-B Short Grass Pasture Kv= 7.0 fps
2.2	434	0.0270	3.34		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
15.8	996	Total			

Subcatchment 12S: Sub-watershed 12



Subcatchment 13S: Sub-watershed 13

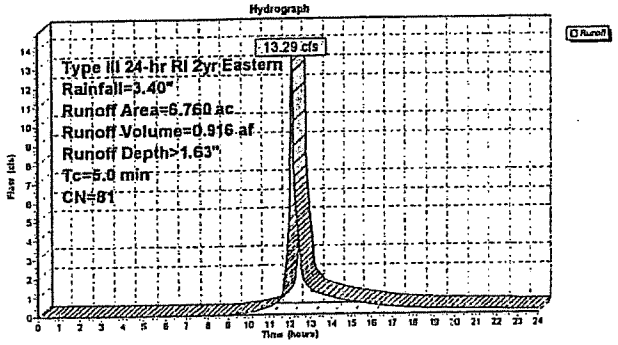
Runoff = 13.29 cfs @ 12.08 hrs, Volume= 0.916 af, Depth> 1.63"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 2yr Eastern Rainfall=3.40"

Area (ac)	CN	Description
6.760	81	1/3 acre lots, 30% Imp, HSG C
4.732		Pervious Area
2.028		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry, A-C

Subcatchment 13S: Sub-watershed 13



Subcatchment 14S: Sub-watershed 14

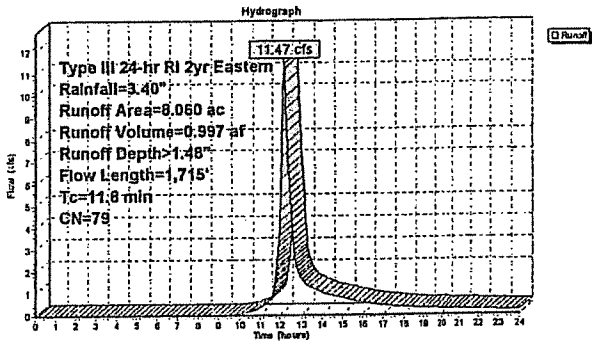
Runoff = 11.47 cfs @ 12.17 hrs, Volume= 0.997 af, Depth> 1.48"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 2yr Eastern Rainfall=3.40"

Area (ac)	CN	Description
0.240	94	Urban commercial, 85% Imp, HSG C
7.820	79	1 acre lots, 20% Imp, HSG C
8.060	79	Weighted Average
6.292		Pervious Area
1.768		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.6	100	0.0100	1.07		Sheet Flow, A-B Smooth surfaces n= 0.011 P2= 3.40"
10.2	1,615	0.0170	2.65		Shallow Concentrated Flow, B-C Paved Kv= 20.3 fps
11.8	1,715	Total			

Subcatchment 14S: Sub-watershed 14



Subcatchment 15S: Sub-watershed 15

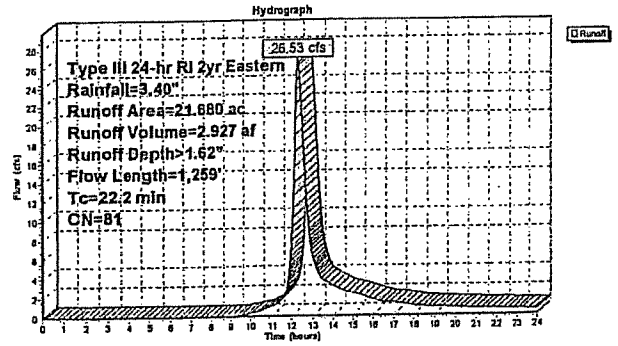
Runoff = 26.53 cfs @ 12.31 hrs, Volume= 2.927 af, Depth> 1.62"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 2yr Eastern Rainfall=3.40"

Area (ac)	CN	Description
15.390	79	1 acre lots, 20% Imp, HSG C
5.090	90	1/8 acre lots, 65% Imp, HSG C
1.200	76	Woods/grass comb., Fair, HSG C
21.680	81	Weighted Average
15.294		Pervious Area
6.387		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.1	100	0.0300	0.21		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
1.3	168	0.0120	2.22		Shallow Concentrated Flow, B-C Paved Kv= 20.3 fps
12.8	991	0.0340	1.29		Shallow Concentrated Flow, C-D Short Grass Pasture Kv= 7.0 fps
22.2	1,259	Total			

Subcatchment 15S: Sub-watershed 15



Subcatchment 16S: Sub-watershed 16

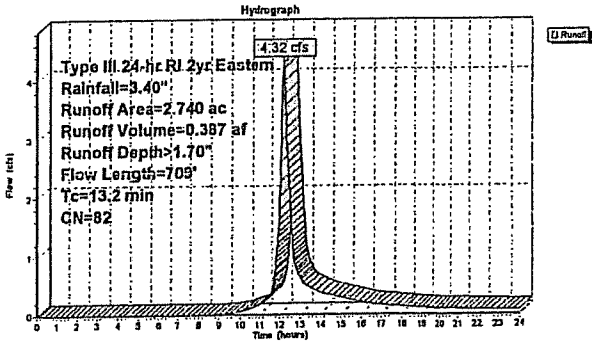
Runoff = 4.32 cfs @ 12.18 hrs, Volume= 0.387 af, Depth> 1.70"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 2yr Eastern Rainfall=3.40"

Area (ac)	CN	Description
2.330	81	1/3 acre lots, 30% Imp, HSG C
0.410	91	Fallow, bare soil, HSG C
2.740	82	Weighted Average
2.041		Pervious Area
0.699		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.5	100	0.0200	0.18		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
2.0	161	0.0370	1.35		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
1.7	448	0.0450	4.31		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
13.2	709	Total			

Subcatchment 16S: Sub-watershed 16



Subcatchment 17S: Sub-watershed 17

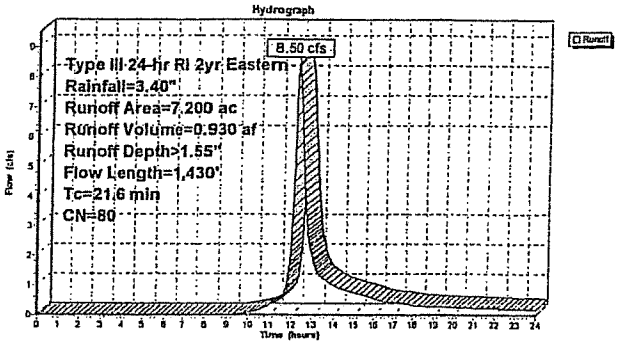
Runoff = 8.50 cfs @ 12.31 hrs, Volume= 0.930 af, Depth> 1.55"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 2yr Eastern Rainfall=3.40"

Area (ac)	CN	Description
7.200	80	1/2 acre lots, 25% imp, HSG C
5.400		Pervious Area
1.800		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.5	100	0.0100	0.13		Sheet Flow, A-C Grass: Short n= 0.150 P2= 3.40"
1.8	338	0.0240	3.14		Shallow Concentrated Flow, B-C Paved Kv= 20.3 fps
0.5	125	0.0400	4.06		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
2.9	260	0.0400	1.50		Shallow Concentrated Flow, D-E Short Grass Pasture Kv= 7.0 fps
3.9	607	0.0160	2.57		Shallow Concentrated Flow, E-F Paved Kv= 20.3 fps
21.6	1,430	Total			

Subcatchment 17S: Sub-watershed 17



Subcatchment 18S: Sub-watershed 18

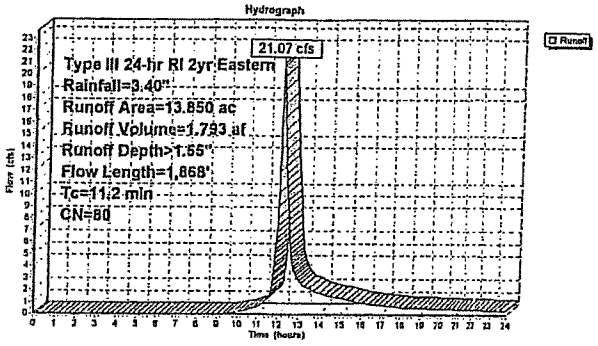
Runoff = 21.07 cfs @ 12.16 hrs, Volume= 1.793 af, Depth> 1.55"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 2yr Eastern Rainfall=3.40"

Area (ac)	CN	Description
13.160	80	1/2 acre lots, 25% imp, HSG C
0.690	73	Woods, Fair, HSG C
13.850	80	Weighted Average
10.560		Pervious Area
3.290		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.8	100	0.0500	2.05		Sheet Flow, A-B Smooth surfaces n= 0.011 P2= 3.40"
3.3	299	0.0470	1.52		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
7.1	1,469	0.0290	3.46		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
11.2	1,868	Total			

Subcatchment 18S: Sub-watershed 18



Subcatchment 19S: Sub-watershed 19

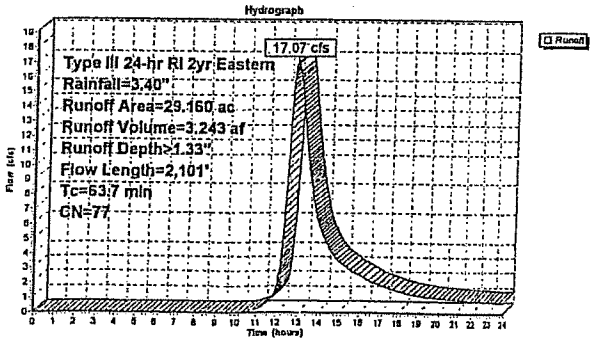
Runoff = 17.07 cfs @ 12.89 hrs, Volume= 3.243 af, Depth> 1.33"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 2yr Eastern Rainfall=3.40"

Area (ac)	CN	Description
1.460	94	Urban commercial, 85% imp, HSG C
1.460	80	1/2 acre lots, 25% imp, HSG C
26.240	76	Woods/grass comb., Fair, HSG C
29.160	77	Weighted Average
27.554		Pervious Area
1.606		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.1	100	0.0160	0.11		Sheet Flow, A-B Grass: Dense n= 0.240 P2= 3.40"
2.9	161	0.0170	0.91		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
0.1	17	0.0230	3.08		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
1.2	80	0.0250	1.11		Shallow Concentrated Flow, D-E Short Grass Pasture Kv= 7.0 fps
0.1	13	0.0200	2.87		Shallow Concentrated Flow, E-F Paved Kv= 20.3 fps
35.7	678	0.0040	0.32		Shallow Concentrated Flow, F-G Woodland Kv= 5.0 fps
8.6	1,052	0.0100	2.03		Shallow Concentrated Flow, G-H Paved Kv= 20.3 fps
63.7	2,101	Total			

Subcatchment 19S: Sub-watershed 19



Subcatchment 20S: Sub-watershed 20

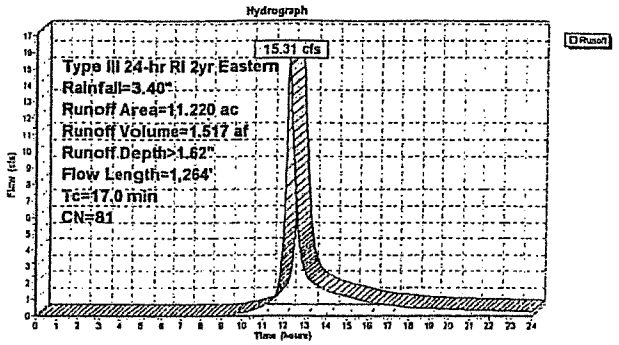
Runoff = 15.31 cfs @ 12.24 hrs, Volume= 1.517 af, Depth> 1.62"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 2yr Eastern Rainfall=3.40"

Area (ac)	CN	Description
11.220	81	1/3 acre lots, 30% Imp, HSG C
7.854		Pervious Area
3.366		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.1	100	0.0300	0.21		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
4.0	174	0.0110	0.73		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
4.9	990	0.0280	3.40		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
17.0	1,264	Total			

Subcatchment 20S: Sub-watershed 20



Subcatchment 21S: Sub-watershed 21

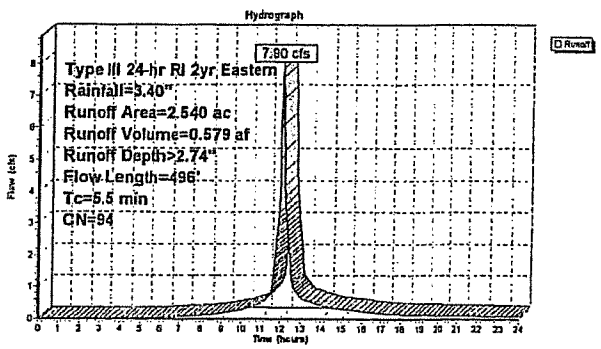
Runoff = 7.90 cfs @ 12.08 hrs, Volume= 0.579 af, Depth> 2.74"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 2yr Eastern Rainfall=3.40"

Area (ac)	CN	Description
2.540	94	Urban commercial, 85% Imp, HSG C
0.381		Pervious Area
2.159		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.8	70	0.1000	0.31		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
0.2	30	0.1200	2.28		Sheet Flow, B-C Smooth surfaces n= 0.011 P2= 3.40"
1.5	396	0.0450	4.31		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
5.5	496	Total			

Subcatchment 21S: Sub-watershed 21



Subcatchment 22S: Sub-watershed 22

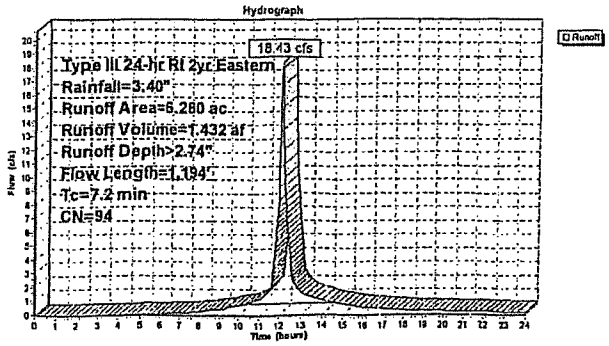
Runoff = 18.43 cfs @ 12.10 hrs, Volume= 1.432 af, Depth> 2.74"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 2yr Eastern Rainfall=3.40"

Area (ac)	CN	Description
6.280	94	Urban commercial, 85% Imp, HSG C
0.942		Pervious Area
5.338		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	100	0.0800	2.47		Sheet Flow, A-B Smooth surfaces n= 0.011 P2= 3.40"
6.5	1,094	0.0190	2.80		Shallow Concentrated Flow, B-C Paved Kv= 20.3 fps
7.2	1,194	Total			

Subcatchment 22S: Sub-watershed 22



Subcatchment 23S: Sub-watershed 23

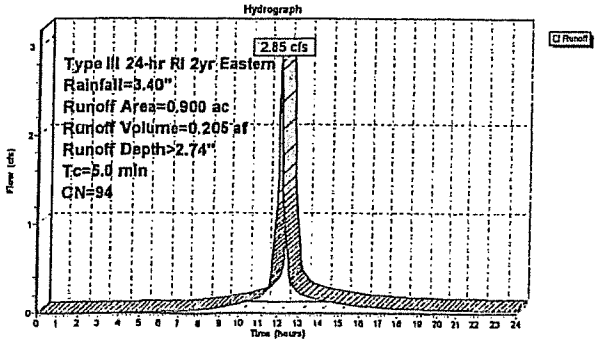
Runoff = 2.85 cfs @ 12.07 hrs, Volume= 0.205 af, Depth> 2.74"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 2yr Eastern Rainfall=3.40"

Area (ac)	CN	Description
0.900	94	Urban commercial, 85% Imp, HSG C
0.135		Pervious Area
0.765		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry, A-E

Subcatchment 23S: Sub-watershed 23



Subcatchment 24S: Sub-watershed 24

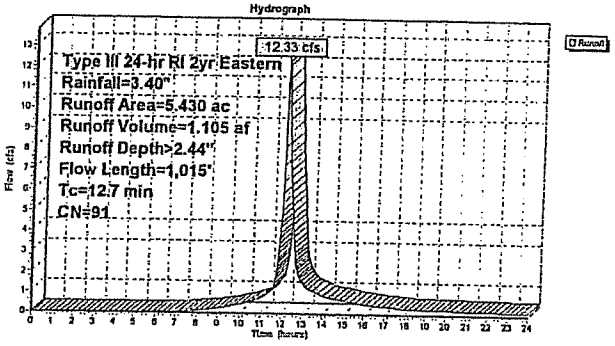
Runoff = 12.33 cfs @ 12.17 hrs, Volume= 1.105 af, Depth> 2.44"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 2yr Eastern Rainfall=3.40"

Area (ac)	CN	Description
4.340	94	Urban commercial, 85% Imp, HSG C
1.090	81	1/3 acre lots, 30% Imp, HSG C
5.430	91	Weighted Average
1.414		Pervious Area
4.016		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.5	100	0.0800	0.31		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
3.7	397	0.0650	1.78		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
3.5	518	0.0150	2.49		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
12.7	1,015	Total			

Subcatchment 24S: Sub-watershed 24



Subcatchment 25S: Sub-watershed 25

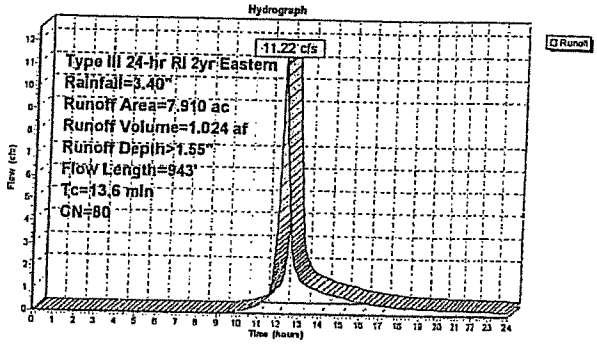
Runoff = 11.22 cfs @ 12.19 hrs, Volume= 1.024 af, Depth> 1.55"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 2yr Eastern Rainfall=3.40"

Area (ac)	CN	Description
7.120	81	1/3 acre lots, 30% Imp, HSG C
0.790	73	Woods, Fair, HSG C
7.910	80	Weighted Average
5.774		Pervious Area
2.136		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.2	100	0.0400	0.23		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
3.5	276	0.0360	1.33		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
2.9	567	0.0250	3.21		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
13.6	943	Total			

Subcatchment 25S: Sub-watershed 25



Subcatchment 26S: Sub-watershed 26

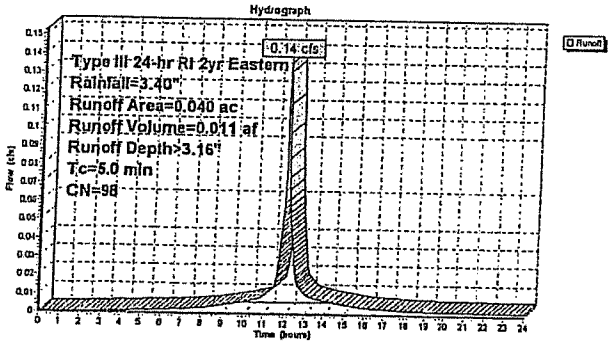
Runoff = 0.14 cfs @ 12.07 hrs, Volume= 0.011 af, Depth> 3.16"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 2yr Eastern Rainfall=3.40"

Area (ac)	CN	Description
0.040	98	Paved parking & roofs
0.040		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry, A-B

Subcatchment 26S: Sub-watershed 26



Subcatchment 27S: Sub-watershed 27

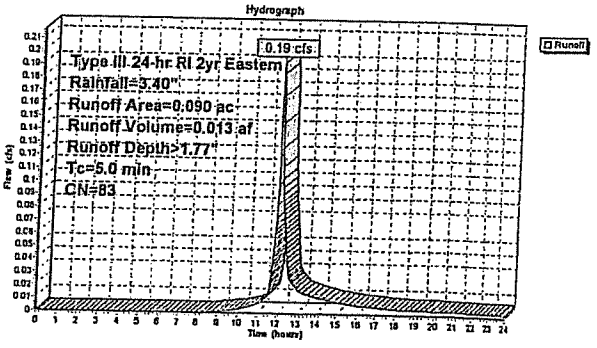
Runoff = 0.19 cfs @ 12.08 hrs, Volume= 0.013 af, Depth> 1.77"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 2yr Eastern Rainfall=3.40"

Area (ac)	CN	Description
0.090	83	1/4 acre lots, 38% Imp, HSG C
0.056		Pervious Area
0.034		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry, A-B

Subcatchment 27S: Sub-watershed 27



Subcatchment 28S: Sub-watershed 28

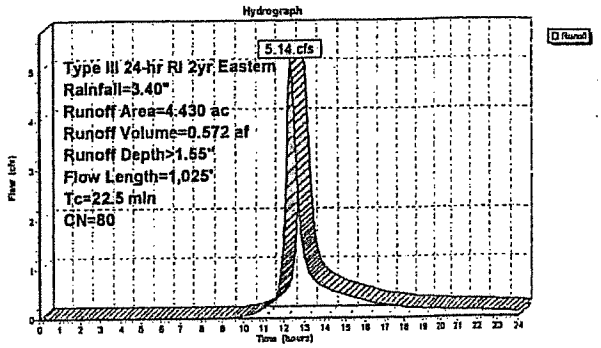
Runoff = 5.14 cfs @ 12.32 hrs, Volume= 0.572 af, Depth> 1.55"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 2yr Eastern Rainfall=3.40"

Area (ac)	CN	Description
3.990	81	1/3 acre lots, 30% Imp, HSG C
0.440	73	Woods, Fair, HSG C
4.430	80	Weighted Average
3.233		Pervious Area
1.197		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.5	100	0.0200	0.18		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
0.4	23	0.0220	1.04		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
0.1	19	0.0200	2.87		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
0.4	23	0.0200	0.99		Shallow Concentrated Flow, D-E Short Grass Pasture Kv= 7.0 fps
0.1	22	0.0200	2.87		Shallow Concentrated Flow, E-F Paved Kv= 20.3 fps
7.5	426	0.0360	0.95		Shallow Concentrated Flow, F-G Woodland Kv= 5.0 fps
1.2	100	0.0400	1.40		Shallow Concentrated Flow, G-H Short Grass Pasture Kv= 7.0 fps
3.3	312	0.0060	1.57		Shallow Concentrated Flow, H-I Paved Kv= 20.3 fps
22.5	1,025	Total			

Subcatchment 28S: Sub-watershed 28



Subcatchment 29S: Sub-watershed 29

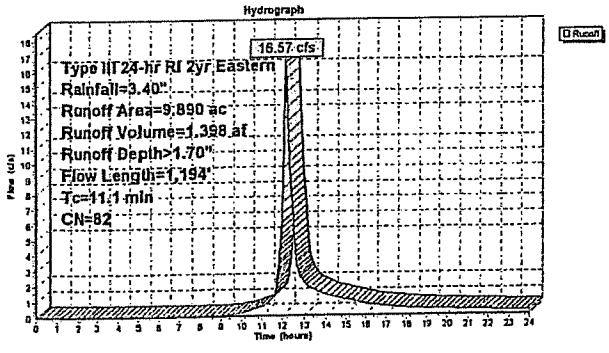
Runoff = 16.57 cfs @ 12.16 hrs, Volume= 1.398 af, Depth> 1.70"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 2yr Eastern Rainfall=3.40"

Area (ac)	CN	Description
0.490	74	>75% Grass cover, Good, HSG C
0.980	94	Urban commercial, 85% Imp, HSG C
8.420	81	1/3 acre lots, 30% Imp, HSG C
9.890	82	Weighted Average
6.531		Pervious Area
3.359		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.5	100	0.0110	1.12		Sheet Flow, A-B Smooth surfaces n= 0.011 P2= 3.40"
6.7	453	0.0260	1.13		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
2.9	641	0.0330	3.69		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
11.1	1,194	Total			

Subcatchment 29S: Sub-watershed 29



Subcatchment 30S: Sub-watershed 30

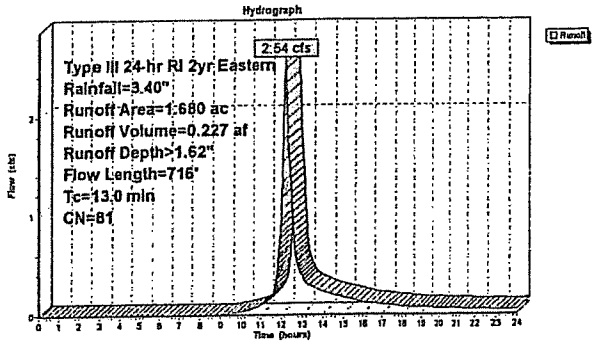
Runoff = 2.54 cfs @ 12.18 hrs, Volume= 0.227 af, Depth> 1.62"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 2yr Eastern Rainfall=3.40"

Area (ac)	CN	Description
1.680	81	1/3 acre lots, 30% Imp, HSG C
1.176		Pervious Area
0.504		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.5	100	0.0200	0.18		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
1.2	118	0.0510	1.58		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
2.3	498	0.0320	3.63		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
13.0	716	Total			

Subcatchment 30S: Sub-watershed 30



Subcatchment 31S: Sub-watershed 31

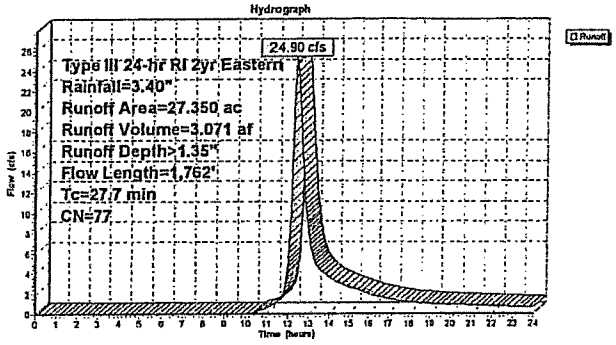
Runoff = 24.90 cfs @ 12.40 hrs, Volume= 3.071 af, Depth> 1.35"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 2yr Eastern Rainfall=3.40"

Area (ac)	CN	Description
12.350	81	1/3 acre lots, 30% Imp, HSG C
15.000	74	>75% Grass cover, Good, HSG C
27.350	77	Weighted Average
23.645		Pervious Area
3.705		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.6	100	0.0500	0.25		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
15.3	1,075	0.0280	1.17		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
5.8	587	0.0070	1.70		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
27.7	1,762	Total			

Subcatchment 31S: Sub-watershed 31



Subcatchment 32S: Sub-watershed32

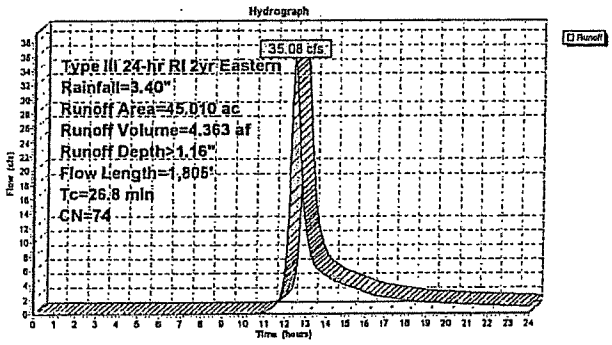
Runoff = 35.08 cfs @ 12.40 hrs, Volume= 4.363 af, Depth> 1.16"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 2yr Eastern Rainfall=3.40"

Area (ac)	CN	Description
14.440	81	1/3 acre lots, 30% Imp, HSG C
13.320	69	50-75% Grass cover, Fair, HSG B
15.110	73	Woods, Fair, HSG C
0.900	88	Fallow, crop residue, Good, HSG C
1.240	56	Brush, Fair, HSG B
45.010	74	Weighted Average
40.678		Pervious Area
4.332		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.0	100	0.0840	0.14		Sheet Flow, A-B Grass: Bermuda n= 0.410 P2= 3.40"
2.3	179	0.0698	1.32		Shallow Concentrated Flow, B-C Woodland Kv= 5.0 fps
2.9	654	0.0528	3.70		Shallow Concentrated Flow, C-D Unpaved Kv= 16.1 fps
5.8	474	0.0738	1.36		Shallow Concentrated Flow, D-E Woodland Kv= 5.0 fps
3.8	398	0.0075	1.76		Shallow Concentrated Flow, E-F Paved Kv= 20.3 fps
26.8	1,805	Total			

Subcatchment 32S: Sub-watershed32



Subcatchment 33S: Sub-watershed 33

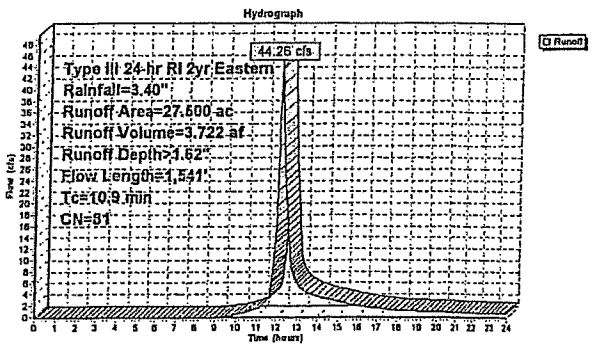
Runoff = 44.26 cfs @ 12.15 hrs, Volume= 3.722 af, Depth> 1.62"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 2yr Eastern Rainfall=3.40"

Area (ac)	CN	Description
0.960	94	Urban commercial, 85% Imp, HSG C
26.540	81	1/3 acre lots, 30% Imp, HSG C
27.500	81	Weighted Average
18.722		Pervious Area
8.778		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.6	100	0.1200	0.36		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
1.0	154	0.1400	2.62		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
5.3	1,287	0.0400	4.06		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
10.9	1,541	Total			

Subcatchment 33S: Sub-watershed 33



Subcatchment 34S: Sub-watershed 34

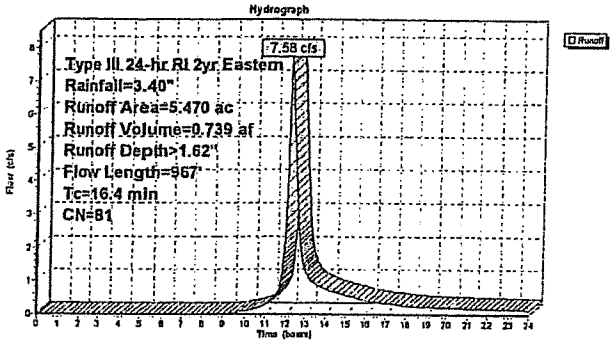
Runoff = 7.58 cfs @ 12.23 hrs, Volume= 0.739 af, Depth> 1.62"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 2yr Eastern Rainfall=3.40"

Area (ac)	CN	Description
5.470	81	1/3 acre lots, 30% Imp, HSG C
3.829		Pervious Area
1.641		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.5	100	0.0200	0.18		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
1.8	131	0.0300	1.21		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
5.1	736	0.0140	2.40		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
16.4	967	Total			

Subcatchment 34S: Sub-watershed 34



Subcatchment 35S: Sub-watershed 35

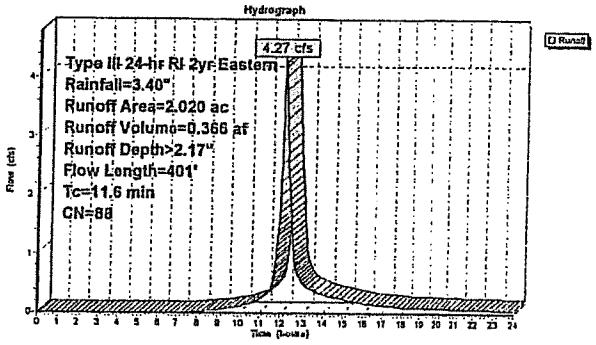
Runoff = 4.27 cfs @ 12.16 hrs, Volume= 0.366 af, Depth> 2.17"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 2yr Eastern Rainfall=3.40"

Area (ac)	CN	Description
1.010	94	Urban commercial, 85% Imp, HSG C
1.010	81	1/3 acre lots, 30% Imp, HSG C
2.020	88	Weighted Average
0.859		Pervious Area
1.161		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.1	100	0.0300	0.21		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
2.0	111	0.0180	0.94		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
1.5	190	0.0110	2.13		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
11.6	401	Total			

Subcatchment 35S: Sub-watershed 35



Subcatchment 36S: Sub-watershed 36

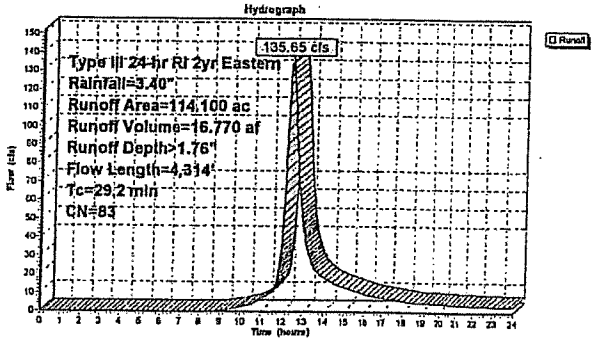
Runoff = 135.65 cfs @ 12.41 hrs, Volume= 16.770 af, Depth> 1.76"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 2yr Eastern Rainfall=3.40"

Area (ac)	CN	Description
81.170	83	1/4 acre lots, 38% Imp, HSG C
9.230	94	Urban commercial, 85% Imp, HSG C
6.090	60	Woods, Fair, HSG B
0.440	69	50-75% Grass cover, Fair, HSG B
4.180	56	Brush, Fair, HSG B
12.990	91	Urban Industrial, 72% Imp, HSG C
114.100	83	Weighted Average
66.057		Pervious Area
48.043		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.5	100	0.0200	0.18		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
1.4	172	0.0810	1.99		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
18.3	4,042	0.0330	3.69		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
29.2	4,314	Total			

Subcatchment 36S: Sub-watershed 36



Subcatchment 37S: Sub-watershed 37

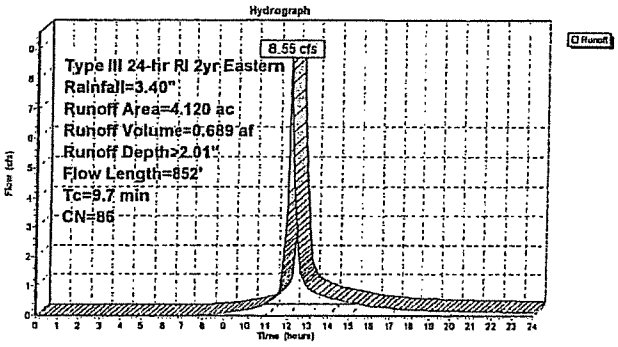
Runoff = 8.55 cfs @ 12.14 hrs, Volume= 0.689 af, Depth> 2.01"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 2yr Eastern Rainfall=3.40"

Area (ac)	CN	Description
1.240	81	1/3 acre lots, 30% Imp, HSG C
2.470	91	Urban Industrial, 72% Imp, HSG C
0.410	74	>75% Grass cover, Good, HSG C
4.120	86	Weighted Average
1.970		Pervious Area
2.150		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.0	100	0.0300	1.67		Sheet Flow, A-B Smooth surfaces n= 0.011 P2= 3.40"
8.7	752	0.0050	1.44		Shallow Concentrated Flow, B-C Paved Kv= 20.3 fps
9.7	852	Total			

Subcatchment 37S: Sub-watershed 37



Subcatchment 38S: Sub-watershed 38

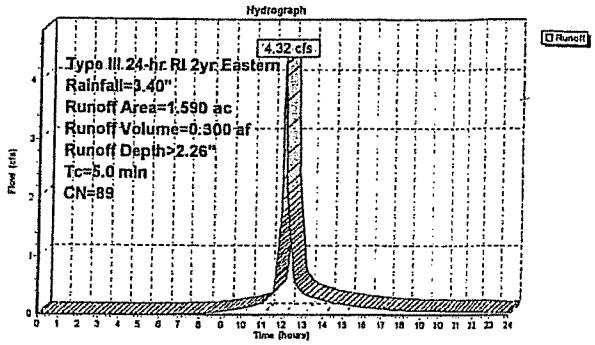
Runoff = 4.32 cfs @ 12.07 hrs, Volume= 0.300 af, Depth> 2.26"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 2yr Eastern Rainfall=3.40"

Area (ac)	CN	Description
0.160	91	Urban Industrial, 72% Imp, HSG C
0.320	79	Pasture/grassland/range, Fair, HSG C
1.110	91	Urban Industrial, 72% Imp, HSG C
1.590	89	Weighted Average
0.676		Pervious Area
0.914		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry, A-C

Subcatchment 38S: Sub-watershed 38



Subcatchment 39S: Sub-watershed 39

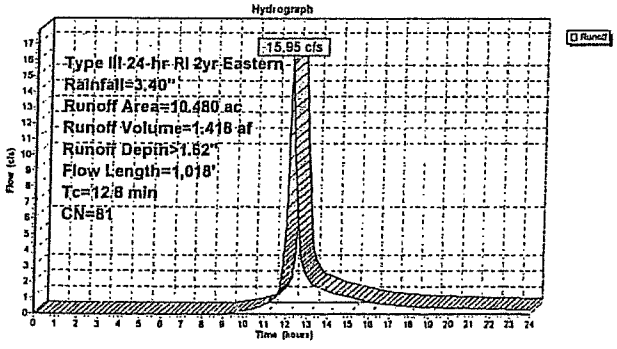
Runoff = 15.95 cfs @ 12.18 hrs, Volume= 1.418 af, Depth> 1.62"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 2yr Eastern Rainfall=3.40"

Area (ac)	CN	Description
0.520	79	Pasture/grassland/range, Fair, HSG C
9.960	81	1/3 acre lots, 30% Imp, HSG C
10.480	81	Weighted Average
7.492		Pervious Area
2.988		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.1	100	0.0500	0.27		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
1.8	212	0.0750	1.92		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
2.0	387	0.0260	3.27		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
2.9	319	0.0690	1.84		Shallow Concentrated Flow, D-E Short Grass Pasture Kv= 7.0 fps
12.8	1,018	Total			

Subcatchment 39S: Sub-watershed 39



Subcatchment 40S: Sub-watershed 40

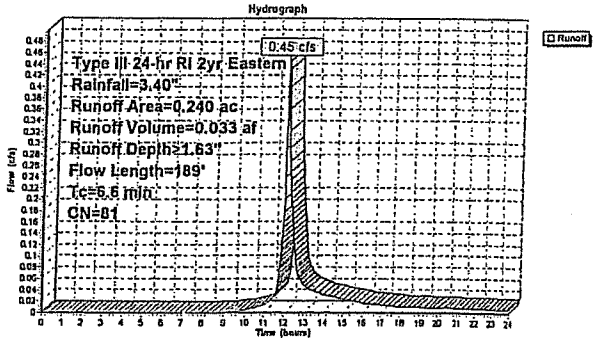
Runoff = 0.45 cfs @ 12.10 hrs, Volume= 0.033 af, Depth> 1.63"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 2yr Eastern Rainfall=3.40"

Area (ac)	CN	Description
0.240	81	1/3 acre lots, 30% Imp, HSG C
0.168		Pervious Area
0.072		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.1	100	0.0600	0.27		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
0.5	89	0.1500	2.71		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
6.6	189	Total			

Subcatchment 40S: Sub-watershed 40



Subcatchment 41S: Sub-watershed 41

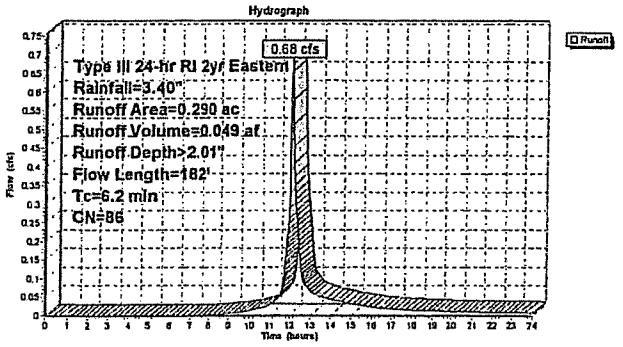
Runoff = 0.68 cfs @ 12.09 hrs, Volume= 0.049 af, Depth> 2.01"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 2yr Eastern Rainfall=3.40"

Area (ac)	CN	Description
0.290	86	Pasture/grassland/range, Poor, HSG C
0.290		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.5	100	0.0800	0.31		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
0.7	82	0.0730	1.89		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
6.2	182	Total			

Subcatchment 41S: Sub-watershed 41



Subcatchment 42S: Sub-watershed 42

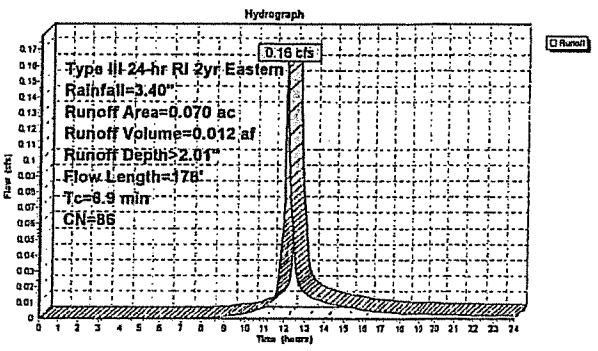
Runoff = 0.16 cfs @ 12.10 hrs, Volume= 0.012 af, Depth> 2.01"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 2yr Eastern Rainfall=3.40"

Area (ac)	CN	Description
0.070	86	Pasture/grassland/range, Poor, HSG C
0.070		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.1	100	0.0600	0.27		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
0.8	78	0.0510	1.58		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
6.9	178	Total			

Subcatchment 42S: Sub-watershed 42



Subcatchment 43S: Sub-watershed 43

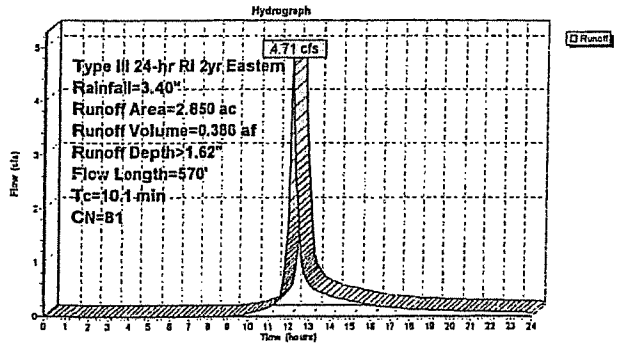
Runoff = 4.71 cfs @ 12.14 hrs, Volume= 0.386 af, Depth> 1.62"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 2yr Eastern Rainfall=3.40"

Area (ac)	CN	Description
2.850	81	1/3 acre lots, 30% Imp, HSG C
1.995		Pervious Area
0.855		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.1	100	0.0500	0.27		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
1.8	228	0.0880	2.08		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
1.7	206	0.0100	2.03		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
0.5	36	0.0280	1.17		Shallow Concentrated Flow, D-E Short Grass Pasture Kv= 7.0 fps
10.1	570	Total			

Subcatchment 43S: Sub-watershed 43



Subcatchment 44S: Sub-watershed 44

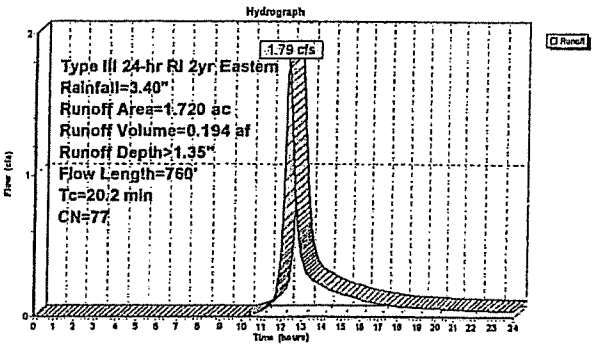
Runoff = 1.79 cfs @ 12.29 hrs, Volume= 0.194 af, Depth> 1.35"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 2yr Eastern Rainfall=3.40"

Area (ac)	CN	Description
0.860	81	1/3 acre lots, 30% imp, HSG C
0.880	73	Woods, Fair, HSG C
1.720	77	Weighted Average
1.462		Pervious Area
0.258		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.4	100	0.0500	0.12		Sheet Flow, A-B Woods: Light underbrush n= 0.400 P2= 3.40"
4.3	262	0.0420	1.02		Shallow Concentrated Flow, B-C Woodland Kv= 5.0 fps
1.5	398	0.0450	4.31		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
20.2	760	Total			

Subcatchment 44S: Sub-watershed 44



Subcatchment 45S: Sub-watershed 45

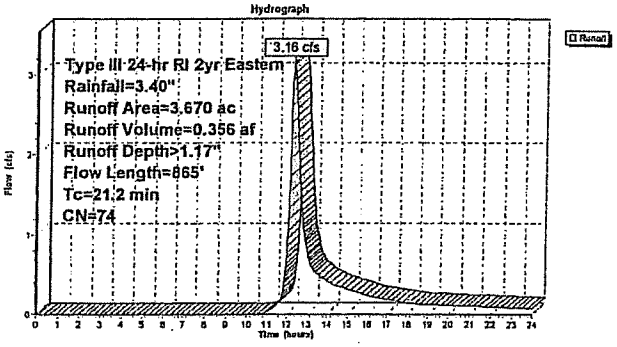
Runoff = 3.16 cfs @ 12.32 hrs, Volume= 0.356 af, Depth> 1.17"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 2yr Eastern Rainfall=3.40"

Area (ac)	CN	Description
3.120	73	Woods, Fair, HSG C
0.180	81	1/3 acre lots, 30% Imp, HSG C
0.370	82	Woods/grass comb., Poor, HSG C
3.670	74	Weighted Average
3.616		Pervious Area
0.054		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.1	100	0.0300	0.21		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
13.1	765	0.0380	0.97		Shallow Concentrated Flow, B-C Woodland Kv= 5.0 fps
21.2	865	Total			

Subcatchment 45S: Sub-watershed 45



Subcatchment 46S: Sub-watershed 46

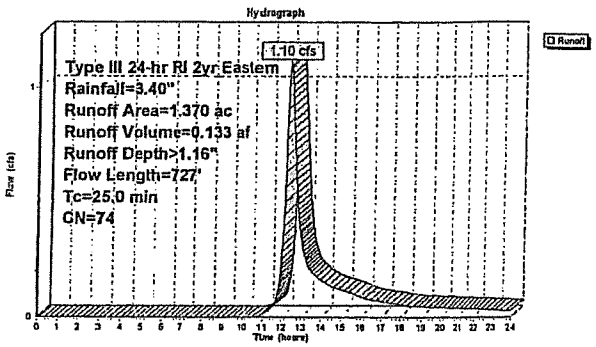
Runoff = 1.10 cfs @ 12.37 hrs, Volume= 0.133 af, Depth> 1.16"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 2yr Eastern Rainfall=3.40"

Area (ac)	CN	Description
1.230	73	Woods, Fair, HSG C
0.140	82	Woods/grass comb., Poor, HSG C
1.370	74	Weighted Average
1.370		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.8	100	0.0400	0.11		Sheet Flow, A-B Woods: Light underbrush n= 0.400 P2= 3.40"
7.6	373	0.0270	0.82		Shallow Concentrated Flow, B-C Woodland Kv= 5.0 fps
1.6	254	0.0160	2.57		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
25.0	727	Total			

Subcatchment 46S: Sub-watershed 46



Subcatchment 47S: Sub-watershed 47

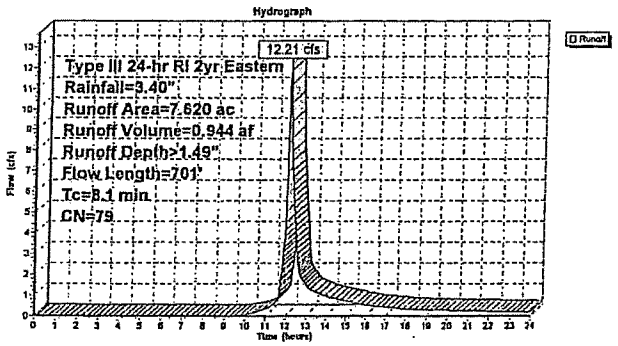
Runoff = 12.21 cfs @ 12.12 hrs, Volume= 0.944 af, Depth> 1.49"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 2yr Eastern Rainfall=3.40"

Area (ac)	CN	Description
7.620	79	50-75% Grass cover, Fair, HSG C
7.620		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0	100	0.1000	0.33		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
0.2	20	0.0500	1.57		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
2.9	581	0.0280	3.40		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
8.1	701	Total			

Subcatchment 47S: Sub-watershed 47



Subcatchment 48S: Sub-watershed 48

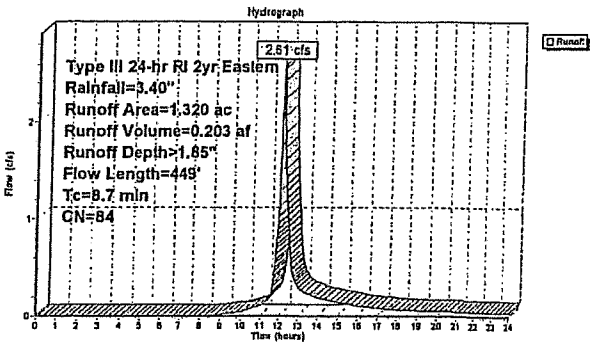
Runoff = 2.61 cfs @ 12.12 hrs, Volume= 0.203 af, Depth> 1.85"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 2yr Eastern Rainfall=3.40"

Area (ac)	CN	Description
1.320	84	50-75% Grass cover, Fair, HSG D
1.320		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.1	100	0.0600	0.27		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
0.4	39	0.0510	1.58		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
2.2	310	0.0130	2.31		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
8.7	449	Total			

Subcatchment 48S: Sub-watershed 48



Subcatchment 49S: Sub-watershed 49

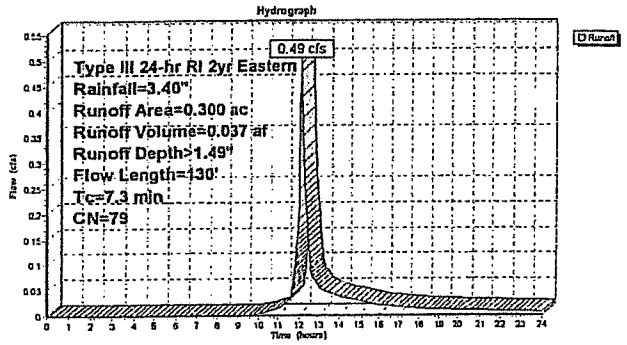
Runoff = 0.49 cfs @ 12.11 hrs, Volume= 0.037 af, Depth> 1.49"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 2yr Eastern Rainfall=3.40"

Area (ac)	CN	Description
0.300	79	50-75% Grass cover, Fair, HSG C
0.300		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.2	100	0.0400	0.23		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
0.1	11	0.1800	2.97		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
0.0	19	0.1100	6.73		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
7.3	130	Total			

Subcatchment 49S: Sub-watershed 49



Subcatchment 50S: Sub-watershed 50

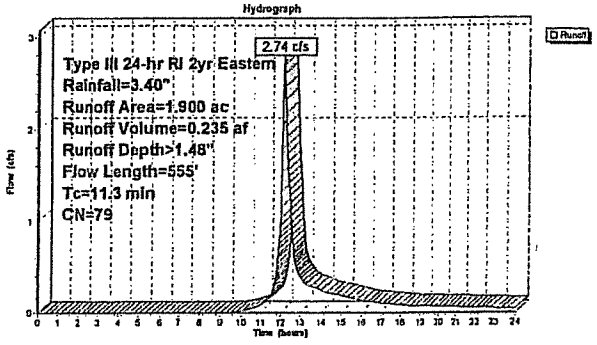
Runoff = 2.74 cfs @ 12.16 hrs, Volume= 0.235 af, Depth> 1.48"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 2yr Eastern Rainfall=3.40"

Area (ac)	CN	Description
1.900	79	50-75% Grass cover, Fair, HSG C
1.900		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.6	100	0.0500	0.25		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
4.5	419	0.0500	1.57		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
0.2	36	0.0170	2.65		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
11.3	555	Total			

Subcatchment 50S: Sub-watershed 50



Subcatchment 51S: Sub-wateshed 51

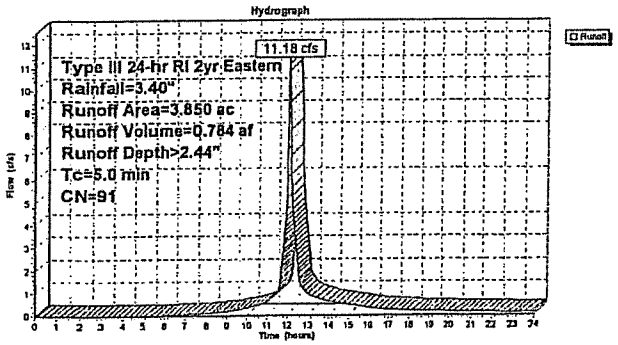
Runoff = 11.18 cfs @ 12.07 hrs, Volume= 0.784 af, Depth> 2.44"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 2yr Eastern Rainfall=3.40"

Area (ac)	CN	Description
3.850	91	Urban Industrial, 72% Imp, HSG C
1.078		Pervious Area
2.772		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry, A-C

Subcatchment 51S: Sub-wateshed 51



Subcatchment 52S: Sub-watershed 52

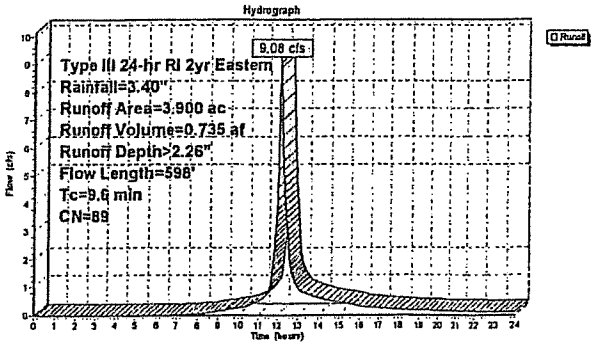
Runoff = 9.08 cfs @ 12.13 hrs, Volume= 0.735 af, Depth> 2.26"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 2yr Eastern Rainfall=3.40"

Area (ac)	CN	Description
3.510	90	1/8 acre lots, 65% Imp, HSG C
0.390	79	50-75% Grass cover, Fair, HSG C
3.900	89	Weighted Average
1.618		Pervious Area
2.282		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.6	100	0.1200	0.36		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
1.9	108	0.0190	0.86		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
2.8	361	0.0110	2.13		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
0.3	29	0.0690	1.84		Shallow Concentrated Flow, D-E Short Grass Pasture Kv= 7.0 fps
9.6	598	Total			

Subcatchment 52S: Sub-watershed 52



Subcatchment 53S: Sub-watershed 53

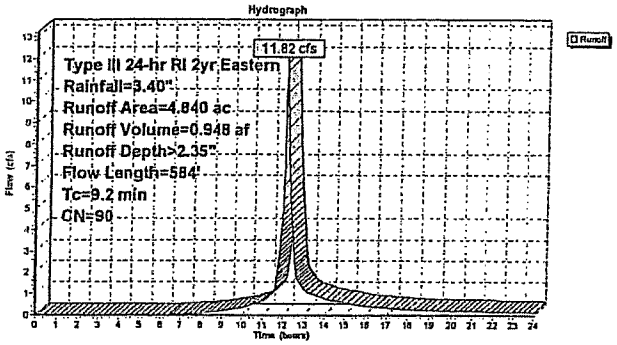
Runoff = 11.82 cfs @ 12.13 hrs, Volume= 0.948 af, Depth> 2.35"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 2yr Eastern Rainfall=3.40"

Area (ac)	CN	Description
4.840	90	1/8 acre lots, 65% Imp, HSG C
1.694		Pervious Area
3.146		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.6	100	0.0500	0.25		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
0.3	33	0.0610	1.73		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
2.3	451	0.0270	3.34		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
9.2	584	Total			

Subcatchment 53S: Sub-watershed 53



Subcatchment 54S: Sub-watershed 54

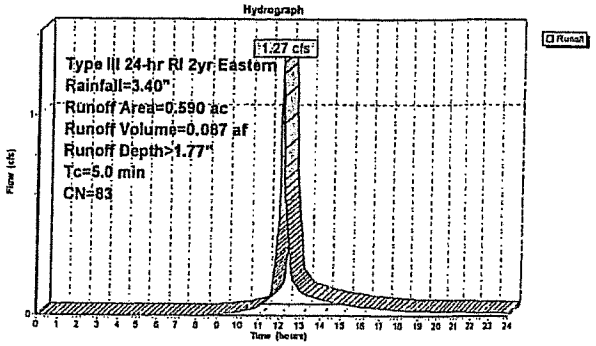
Runoff = 1.27 cfs @ 12.08 hrs, Volume= 0.087 af, Depth> 1.77"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 2yr Eastern Rainfall=3.40"

Area (ac)	CN	Description
0.590	83	1/4 acre lots, 38% Imp, HSG C
0.366		Pervious Area
0.224		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry, A-C

Subcatchment 54S: Sub-watershed 54



Subcatchment 55S: Sub-watershed 55

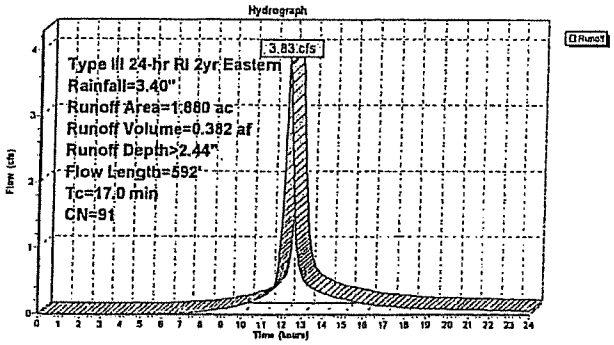
Runoff = 3.83 cfs @ 12.23 hrs, Volume= 0.382 af, Depth> 2.44"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 2yr Eastern Rainfall=3.40"

Area (ac)	CN	Description
1.880	91	Urban Industrial, 72% Imp, HSG C
0.526		Pervious Area
1.354		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.5	100	0.0100	0.13		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
4.5	492	0.0080	1.82		Shallow Concentrated Flow, B-C Paved Kv= 20.3 fps
17.0	592	Total			

Subcatchment 55S: Sub-watershed 55



Subcatchment 56S: Sub-watershed 56

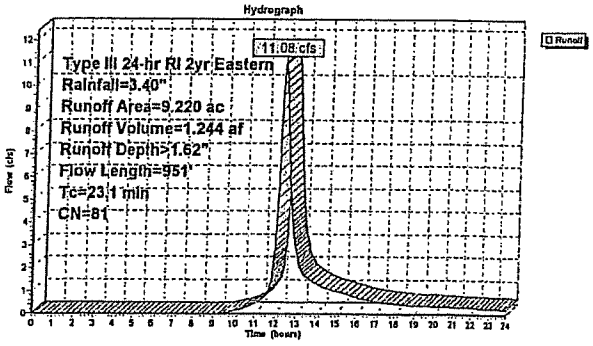
Runoff = 11.08 cfs @ 12.33 hrs, Volume= 1.244 af, Depth> 1.62"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 2yr Eastern Rainfall=3.40"

Area (ac)	CN	Description
9.220	81	1/3 acre lots, 30% Imp, HSG C
6.454		Pervious Area
2.766		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.5	100	0.0100	0.13		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
5.7	228	0.0090	0.66		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
4.9	623	0.0110	2.13		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
23.1	951	Total			

Subcatchment 56S: Sub-watershed 56



Subcatchment 57S: Sub-watershed 57

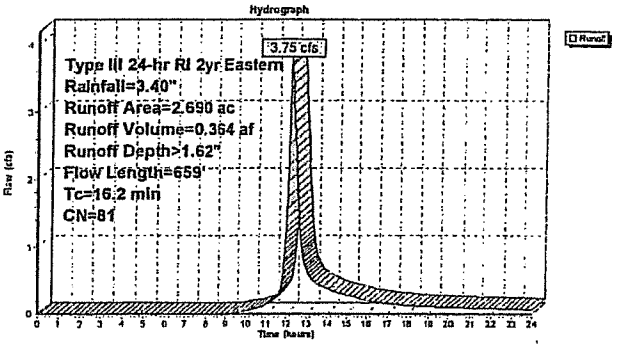
Runoff = 3.75 cfs @ 12.23 hrs, Volume= 0.364 af, Depth> 1.62"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 2yr Eastern Rainfall=3.40"

Area (ac)	CN	Description
2.690	81	1/3 acre lots, 30% imp, HSG C
1.883		Pervious Area
0.807		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.4	100	0.0370	0.22		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
6.4	190	0.0050	0.49		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
2.2	349	0.0170	2.65		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
0.2	20	0.0500	1.57		Shallow Concentrated Flow, D-E Short Grass Pasture Kv= 7.0 fps
16.2	659	Total			

Subcatchment 57S: Sub-watershed 57



Subcatchment 58S: Sub-watershed 58

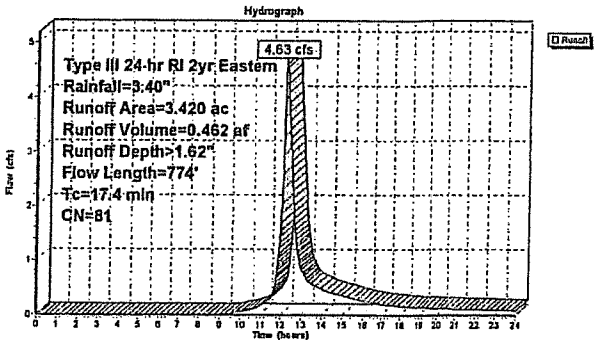
Runoff = 4.63 cfs @ 12.24 hrs, Volume= 0.462 af, Depth> 1.62"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 2yr Eastern Rainfall=3.40"

Area (ac)	CN	Description
3.420	81	1/3 acre lots, 30% imp, HSG C
2.394		Pervious Area
1.026		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.5	100	0.0100	0.13		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
1.1	74	0.0270	1.15		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
3.8	600	0.0170	2.65		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
17.4	774	Total			

Subcatchment 58S: Sub-watershed 58



Subcatchment 59S: Sub-watershed 59

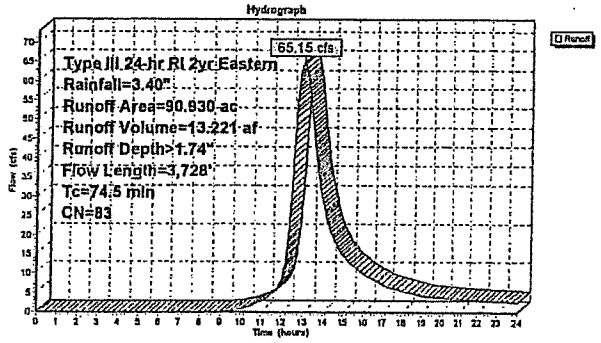
Runoff = 65.15 cfs @ 13.00 hrs, Volume= 13.221 af, Depth> 1.74"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 2yr Eastern Rainfall=3.40"

Area (ac)	CN	Description
35.570	83	1/4 acre lots, 38% imp, HSG C
15.400	79	Pasture/grassland/range, Fair, HSG C
13.820	94	Urban commercial, 85% imp, HSG C
2.410	91	Urban industrial, 72% imp, HSG C
0.840	86	Woods/grass comb., Poor, HSG D
12.190	73	Woods, Fair, HSG C
2.700	79	Pasture/grassland/range, Fair, HSG C
90.930	83	Weighted Average
63.931		Pervious Area
26.999		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.5	100	0.0050	0.10		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
49.4	2,858	0.0190	0.96		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
1.2	48	0.0010	0.64		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
2.9	164	0.0180	0.94		Shallow Concentrated Flow, D-E Short Grass Pasture Kv= 7.0 fps
3.5	377	0.0080	1.82		Shallow Concentrated Flow, E-F Paved Kv= 20.3 fps
1.0	181	0.0220	3.01		Shallow Concentrated Flow, F-G Paved Kv= 20.3 fps
74.5	3,728	Total			

Subcatchment 59S: Sub-watershed 59



Subcatchment 60S: Sub-watershed 60

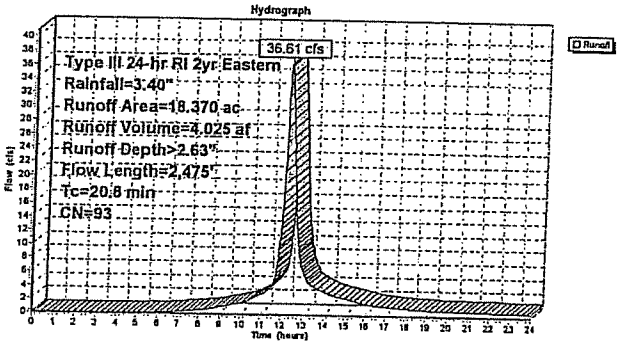
Runoff = 36.61 cfs @ 12.28 hrs, Volume= 4.025 af, Depth> 2.63"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 2yr Eastern Rainfall=3.40"

Area (ac)	CN	Description
5.510	91	Urban Industrial, 72% Imp, HSG C
12.860	94	Urban commercial, 85% Imp, HSG C
18.370	93	Weighted Average
3.472		Pervious Area
14.898		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.2	100	0.0400	0.23		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
0.6	83	0.1100	2.32		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
13.0	2,292	0.0210	2.94		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
20.8	2,475	Total			

Subcatchment 60S: Sub-watershed 60



Subcatchment 61S: Sub-watershed 61

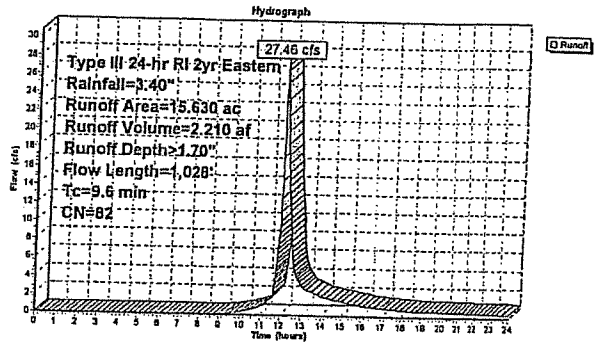
Runoff = 27.46 cfs @ 12.14 hrs, Volume= 2.210 af, Depth> 1.70"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 2yr Eastern Rainfall=3.40"

Area (ac)	CN	Description
14.070	81	1/3 acre lots, 30% Imp, HSG C
1.560	94	Urban commercial, 85% Imp, HSG C
15.630	82	Weighted Average
10.083		Pervious Area
5.547		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.8	100	0.0700	0.29		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
1.2	132	0.0700	1.85		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
2.6	796	0.0630	5.10		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
9.6	1,028	Total			

Subcatchment 61S: Sub-watershed 61



Subcatchment 62S: Sub-watershed 62

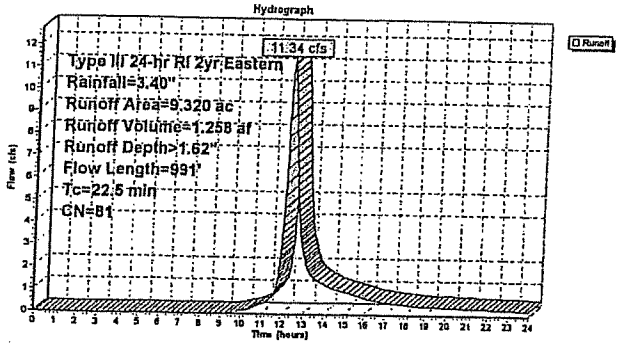
Runoff = 11.34 cfs @ 12.32 hrs, Volume= 1.258 af, Depth> 1.62"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 2yr Eastern Rainfall=3.40"

Area (ac)	CN	Description
9.320	81	1/3 acre lots, 30% Imp, HSG C
6.524		Pervious Area
2.796		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.5	100	0.0100	0.13		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
5.2	169	0.0060	0.54		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
4.8	722	0.0150	2.49		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
22.5	991	Total			

Subcatchment 62S: Sub-watershed 62



Subcatchment 63S: Sub-watershed 63

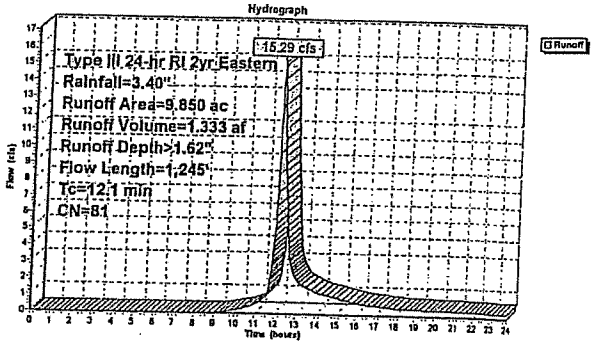
Runoff = 15.29 cfs @ 12.17 hrs, Volume= 1.333 af, Depth> 1.62"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 2yr Eastern Rainfall=3.40"

Area (ac)	CN	Description
9.850	81	1/3 acre lots, 30% Imp, HSG C
6.895		Pervious Area
2.955		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.9	37	0.0540	0.21		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
0.6	63	0.0480	1.83		Sheet Flow, B-C Smooth surfaces n= 0.011 P2= 3.40"
0.6	118	0.0250	3.21		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
2.0	188	0.0480	1.53		Shallow Concentrated Flow, D-E Short Grass Pasture Kv= 7.0 fps
6.0	839	0.0130	2.31		Shallow Concentrated Flow, E-F Paved Kv= 20.3 fps
12.1	1,245	Total			

Subcatchment 63S: Sub-watershed 63



Subcatchment 64S: Sub-watershed 64

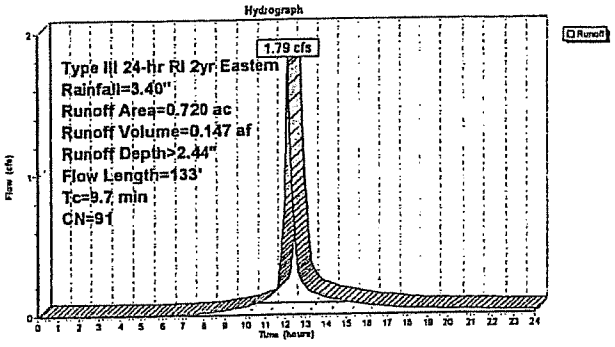
Runoff = 1.79 cfs @ 12.13 hrs, Volume= 0.147 af, Depth> 2.44"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 2yr Eastern Rainfall=3.40"

Area (ac)	CN	Description
0.720	91	Urban Industrial, 72% Imp, HSG C
0.202		Pervious Area
0.518		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.2	100	0.0400	0.23		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
2.5	33	0.0010	0.22		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
9.7	133	Total			

Subcatchment 64S: Sub-watershed 64



Subcatchment 65S: Sub-watershed 65

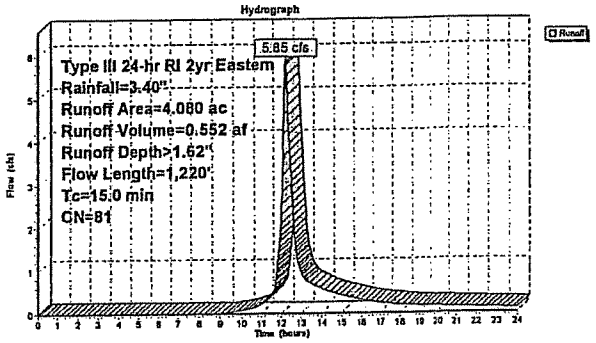
Runoff = 5.85 cfs @ 12.21 hrs, Volume= 0.552 af, Depth> 1.62"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 2yr Eastern Rainfall=3.40"

Area (ac)	CN	Description
4.080	81	1/3 acre lots, 30% Imp, HSG C
2.856		Pervious Area
1.224		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.2	86	0.0300	0.20		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
0.3	14	0.0100	0.73		Sheet Flow, B-C Smooth surfaces n= 0.011 P2= 3.40"
7.5	1,120	0.0150	2.49		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
15.0	1,220	Total			

Subcatchment 65S: Sub-watershed 65



Subcatchment 66S: Su-watershed 66

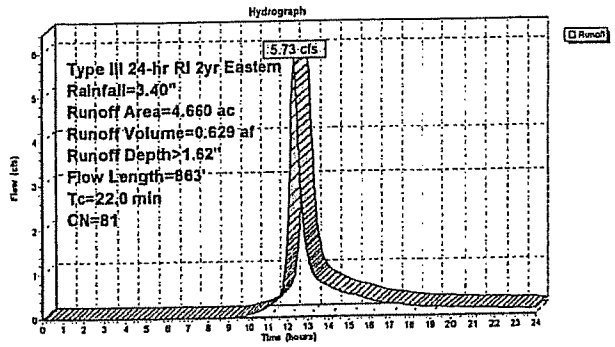
Runoff = 5.73 cfs @ 12.31 hrs, Volume= 0.629 af, Depth> 1.62"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 2yr Eastern Rainfall=3.40"

Area (ac)	CN	Description
4.660	81	1/3 acre lots, 30% Imp, HSG C
3.262		Pervious Area
1.398		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.4	100	0.0060	0.11		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
1.2	103	0.0390	1.38		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
5.4	660	0.0100	2.03		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
22.0	863	Total			

Subcatchment 66S: Su-watershed 66



Subcatchment 67S: Sub-watershed 67

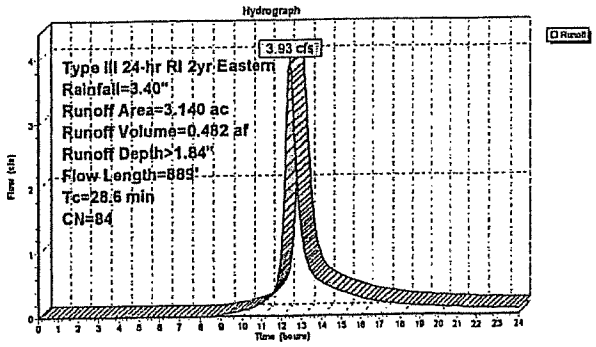
Runoff = 3.93 cfs @ 12.40 hrs, Volume= 0.482 af, Depth> 1.84"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 2yr Eastern Rainfall=3.40"

Area (ac)	CN	Description
0.790	81	1/3 acre lots, 30% Imp, HSG C
1.880	88	Fallow, crop residue, Good, HSG C
0.470	73	Woods, Fair, HSG C
3.140	84	Weighted Average
2.903		Pervious Area
0.237		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.5	100	0.0100	0.13		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
4.7	199	0.0200	0.71		Shallow Concentrated Flow, B-C Woodland Kv= 5.0 fps
10.7	490	0.0120	0.77		Shallow Concentrated Flow, C-D Short Grass Pasture Kv= 7.0 fps
0.7	100	0.0120	2.22		Shallow Concentrated Flow, D-E Paved Kv= 20.3 fps
28.6	889	Total			

Subcatchment 67S: Sub-watershed 67



Subcatchment 68S: Sub-watershed 68

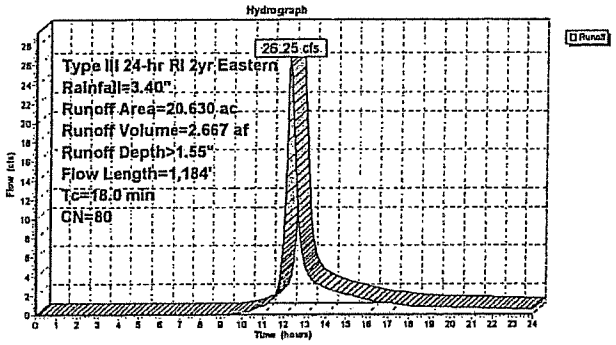
Runoff = 26.25 cfs @ 12.26 hrs, Volume= 2.667 af, Depth> 1.55"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 2yr Eastern Rainfall=3.40"

Area (ac)	CN	Description
2.350	79	Pasture/grassland/range, Fair, HSG C
2.470	88	Fallow, crop residue, Good, HSG C
1.970	70	Brush, Fair, HSG C
5.490	82	Woods/grass comb., Poor, HSG C
2.460	73	Woods, Fair, HSG C
5.890	81	1/3 acre lots, 30% imp, HSG C
20.630	80	Weighted Average
18.863		Pervious Area
1.767		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.3	100	0.0850	0.31		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
12.7	1,084	0.0410	1.42		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
18.0	1,184	Total			

Subcatchment 68S: Sub-watershed 68



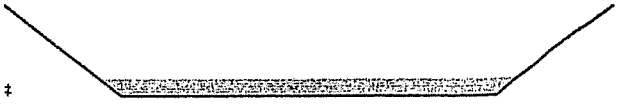
Reach 3R: Intermittent Stream

Inflow Area = 21.680 ac, Inflow Depth > 1.60" for RI 2yr Eastern event
Inflow = 15.60 cfs @ 12.62 hrs, Volume= 2.891 af
Outflow = 15.47 cfs @ 12.81 hrs, Volume= 2.868 af, Atten= 1%, Lag= 11.1 min

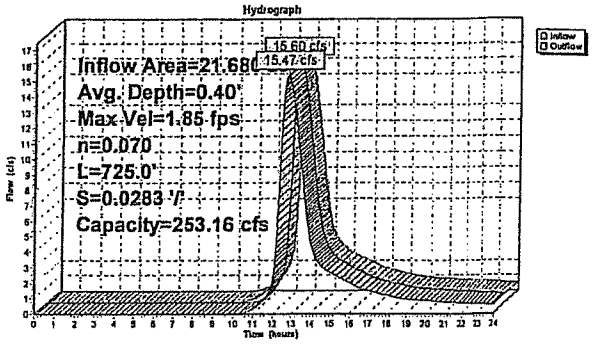
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Max. Velocity= 1.85 fps, Min. Travel Time= 6.5 min
Avg. Velocity = 0.75 fps, Avg. Travel Time= 16.1 min

Peak Storage= 6,071 cf @ 12.70 hrs, Average Depth at Peak Storage= 0.40'
Bank-Full Depth= 2.00', Capacity at Bank-Full= 253.16 cfs

20.00' x 2.00' deep channel, n= 0.070 Medium-dense brush, winter
Side Slope Z-value= 3.0 '/' Top Width= 32.00'
Length= 725.0' Slope= 0.0283 '/'
Inlet Invert= 113.50', Outlet Invert= 93.00'



Reach 3R: Intermittent Stream



Pond 2P: Highview Pond Existing

Inflow Area = 21.680 ac, Inflow Depth > 1.62" for RI 2yr Eastern event
Inflow = 26.53 cfs @ 12.31 hrs, Volume= 2.927 af
Outflow = 15.60 cfs @ 12.62 hrs, Volume= 2.891 af, Atten= 41%, Lag= 18.6 min
Primary = 15.60 cfs @ 12.62 hrs, Volume= 2.891 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs / 2
Peak Elev= 119.11' @ 12.62 hrs Surf.Area= 7,030 sf Storage= 24,195 cf

Plug-Flow detention time= 25.4 min calculated for 2.891 af (99% of inflow)
Center-of-Mass det. time= 18.4 min (867.0 - 848.6)

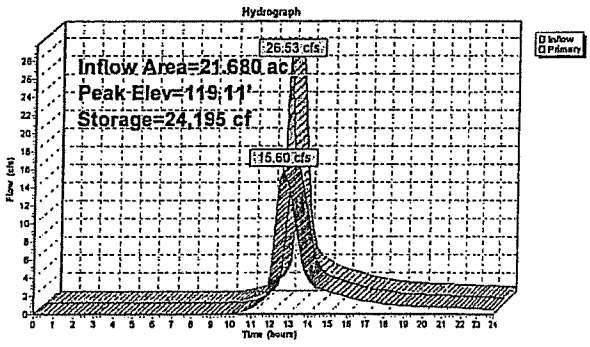
Volume	Invert	Avail.Storage	Storage Description
#1	115.00'	42,295 cf	Custom Stage Data (Prismatic)Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
115.00	4,620	0	0
118.00	6,496	16,674	16,674
121.00	7,936	21,648	38,322
122.00	10	3,973	42,295

Device	Routing	Invert	Outlet Devices
#1	Primary	115.00'	18.0" x 40.0' long Culvert RCP, end-section conforming to fill, Ke= 0.500 Outlet Invert= 114.40' S= 0.0150 '/' Cc= 0.900 n= 0.013
#2	Primary	121.00'	128.0' long x 1.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

Primary OutFlow Max=15.60 cfs @ 12.62 hrs HW=119.11' (Free Discharge)
1=Culvert (Inlet Controls 15.60 cfs @ 8.83 fps)
2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Pond 2P: Highview Pond Existing

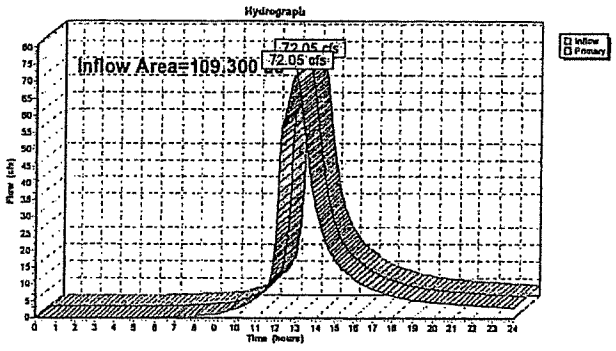


Link 68L: SW 59_SW 60

Inflow Area = 109.300 ac, Inflow Depth > 1.89" for RI 2yr Eastern event
Inflow = 72.05 cfs @ 12.98 hrs, Volume= 17.246 af
Primary = 72.05 cfs @ 12.98 hrs, Volume= 17.246 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

Link 68L: SW 59_SW 60

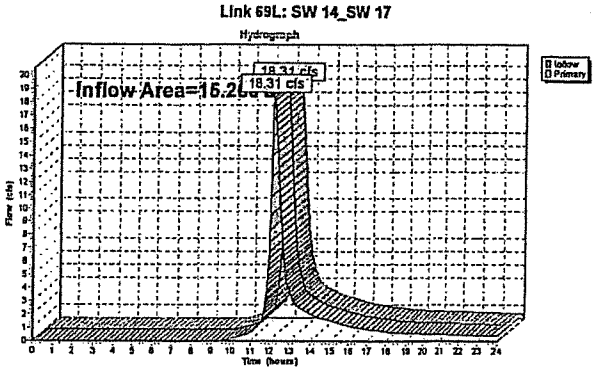


Link 69L: SW 14_SW 17

Inflow Area = 15.260 ac, Inflow Depth > 1.52" for RI 2yr Eastern event
Inflow = 18.31 cfs @ 12.21 hrs, Volume= 1.927 af
Primary = 18.31 cfs @ 12.21 hrs, Volume= 1.927 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

Link 69L: SW 14_SW 17

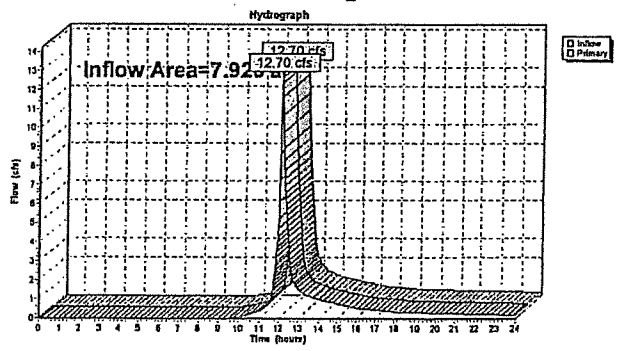


Link 70L: SW47_SW49

Inflow Area = 7.920 ac, Inflow Depth > 1.49" for RI 2yr Eastern event
Inflow = 12.70 cfs @ 12.12 hrs, Volume= 0.981 af
Primary = 12.70 cfs @ 12.12 hrs, Volume= 0.981 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

Link 70L: SW47_SW49

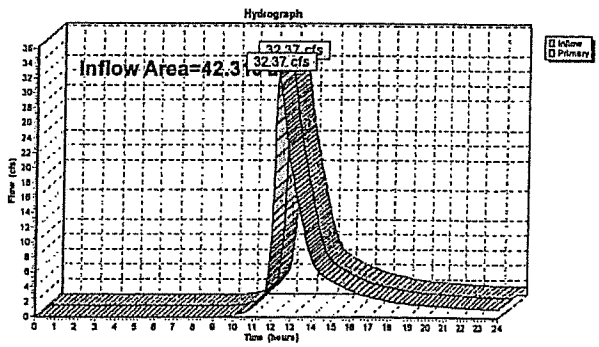


Link 71L: Elbow St

Inflow Area = 42.310 ac, Inflow Depth > 1.57" for RI 2yr Eastern event
Inflow = 32.37 cfs @ 12.29 hrs, Volume= 5.535 af
Primary = 32.37 cfs @ 12.29 hrs, Volume= 5.535 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

Link 71L: Elbow St



10-Year Storm

Time span=0.00-24.00 hrs, dt=0.02 hrs, 1201 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Sub-watershed 1 Runoff Area=18.400 ac Runoff Depth>4.20"
Flow Length=1,460' Tc=20.1 min CN=94 Runoff=57.46 cfs 6.435 af

Subcatchment 2S: Sub-watershed 2 Runoff Area=3.220 ac Runoff Depth>4.20"
Flow Length=792' Tc=10.2 min CN=94 Runoff=12.88 cfs 1.128 af

Subcatchment 3S: Sub-watershed 3 Runoff Area=27.500 ac Runoff Depth>2.97"
Flow Length=2,500' Tc=39.3 min CN=82 Runoff=47.92 cfs 6.798 af

Subcatchment 4S: Sub-watershed 4 Runoff Area=35.010 ac Runoff Depth>3.64"
Flow Length=3,096' Tc=50.9 min CN=89 Runoff=64.02 cfs 10.630 af

Subcatchment 5S: Sub-Watershed 5 Runoff Area=2.340 ac Runoff Depth>2.80"
Tc=5.0 min CN=80 Runoff=7.96 cfs 0.547 af

Subcatchment 6dS: Sub-watershed 6d Runoff Area=0.630 ac Runoff Depth>4.21"
Tc=5.0 min CN=94 Runoff=2.99 cfs 0.221 af

Subcatchment 6eS: Sub-watershed 6e Runoff Area=0.500 ac Runoff Depth>4.21"
Tc=5.0 min CN=94 Runoff=2.37 cfs 0.175 af

Subcatchment 6S: Sub-watershed 6 Runoff Area=10.610 ac Runoff Depth>3.57"
Flow Length=1,535' Tc=11.4 min CN=88 Runoff=36.43 cfs 3.154 af

Subcatchment 8S: Sub-watershed 8 Runoff Area=2.070 ac Runoff Depth>2.80"
Flow Length=419' Tc=11.6 min CN=80 Runoff=5.66 cfs 0.483 af

Subcatchment 9S: Sub-watershed 9 Runoff Area=3.780 ac Runoff Depth>3.36"
Flow Length=633' Tc=16.8 min CN=86 Runoff=10.73 cfs 1.060 af

Subcatchment 10S: Sub-watershed 10 Runoff Area=8.740 ac Runoff Depth>3.07"
Flow Length=1,337' Tc=19.3 min CN=83 Runoff=21.56 cfs 2.238 af

Subcatchment 11S: Sub-watershed 11 Runoff Area=24.460 ac Runoff Depth>3.66"
Flow Length=1,757' Tc=26.1 min CN=89 Runoff=62.00 cfs 7.460 af

Subcatchment 12S: Sub-watershed 12 Runoff Area=3.040 ac Runoff Depth>3.86"
Flow Length=995' Tc=15.8 min CN=91 Runoff=9.91 cfs 0.982 af

Subcatchment 13S: Sub-watershed 13 Runoff Area=6.760 ac Runoff Depth>2.89"
Tc=5.0 min CN=81 Runoff=23.72 cfs 1.631 af

Subcatchment 14S: Sub-watershed 14 Runoff Area=8.060 ac Runoff Depth>2.71"
Flow Length=1,715' Tc=11.6 min CN=79 Runoff=21.20 cfs 1.820 af

Subcatchment 15S: Sub-watershed 15 Runoff Area=21.680 ac Runoff Depth>2.88"
Flow Length=1,259' Tc=22.2 min CN=81 Runoff=47.53 cfs 5.211 af

Subcatchment 16S: Sub-watershed 16 Runoff Area=2.740 ac Runoff Depth>2.98"
Flow Length=709' Tc=13.2 min CN=82 Runoff=7.61 cfs 0.681 af

Subcatchment 17S: Sub-watershed 17 Runoff Area=7.200 ac Runoff Depth>2.79"
Flow Length=1,430' Tc=21.6 min CN=80 Runoff=15.46 cfs 1.676 af

Subcatchment 18S: Sub-watershed 18 Runoff Area=13.850 ac Runoff Depth>2.80"
Flow Length=1,868' Tc=11.2 min CN=80 Runoff=38.31 cfs 3.231 af

Subcatchment 19S: Sub-watershed 19 Runoff Area=29.160 ac Runoff Depth>2.50"
Flow Length=2,101' Tc=63.7 min CN=77 Runoff=32.77 cfs 6.083 af

Subcatchment 20S: Sub-watershed 20 Runoff Area=11.220 ac Runoff Depth>2.89"
Flow Length=1,264' Tc=17.0 min CN=81 Runoff=27.43 cfs 2.700 af

Subcatchment 21S: Sub-watershed 21 Runoff Area=2.540 ac Runoff Depth>4.21"
Flow Length=496' Tc=5.5 min CN=94 Runoff=11.85 cfs 0.890 af

Subcatchment 22S: Sub-watershed 22 Runoff Area=6.280 ac Runoff Depth>4.21"
Flow Length=1,194' Tc=7.2 min CN=94 Runoff=27.65 cfs 2.201 af

Subcatchment 23S: Sub-watershed 23 Runoff Area=0.900 ac Runoff Depth>4.21"
Tc=5.0 min CN=94 Runoff=4.27 cfs 0.315 af

Subcatchment 24S: Sub-watershed 24 Runoff Area=5.430 ac Runoff Depth>3.86"
Flow Length=1,015' Tc=12.7 min CN=91 Runoff=19.18 cfs 1.755 af

Subcatchment 25S: Sub-watershed 25 Runoff Area=7.910 ac Runoff Depth>2.80"
Flow Length=943' Tc=13.6 min CN=80 Runoff=20.42 cfs 1.845 af

Subcatchment 26S: Sub-watershed 26 Runoff Area=0.040 ac Runoff Depth>4.66"
Tc=5.0 min CN=98 Runoff=0.20 cfs 0.016 af

Subcatchment 27S: Sub-watershed 27 Runoff Area=0.090 ac Runoff Depth>3.08"
Tc=5.0 min CN=83 Runoff=0.33 cfs 0.023 af

Subcatchment 28S: Sub-watershed 28 Runoff Area=4.430 ac Runoff Depth>2.79"
Flow Length=1,025' Tc=22.5 min CN=80 Runoff=9.35 cfs 1.031 af

Subcatchment 29S: Sub-watershed 29 Runoff Area=9.890 ac Runoff Depth>2.98"
Flow Length=1,194' Tc=11.1 min CN=82 Runoff=29.18 cfs 2.459 af

Subcatchment 30S: Sub-watershed 30 Runoff Area=1.680 ac Runoff Depth>2.89"
Flow Length=716' Tc=13.0 min CN=81 Runoff=4.55 cfs 0.405 af

Subcatchment 31S: Sub-watershed 31 Runoff Area=27.350 ac Runoff Depth>2.52"
Flow Length=1,762' Tc=27.7 min CN=77 Runoff=47.63 cfs 5.754 af

Subcatchment 32S: Sub-watershed32 Runoff Area=45.010 ac Runoff Depth>2.27"
Flow Length=1,805' Tc=26.8 min CN=74 Runoff=71.09 cfs 8.518 af

Subcatchment 33S: Sub-watershed 33 Runoff Area=27.500 ac Runoff Depth>2.89"
Flow Length=1,541' Tc=10.9 min CN=81 Runoff=79.18 cfs 6.626 af

Subcatchment 34S: Sub-watershed 34 Runoff Area=5.470 ac Runoff Depth>2.89"
Flow Length=967' Tc=16.4 min CN=81 Runoff=13.58 cfs 1.316 af

Subcatchment 35S: Sub-watershed 35 Runoff Area=2.020 ac Runoff Depth>3.57"
Flow Length=401' Tc=11.6 min CN=88 Runoff=6.90 cfs 0.600 af

Subcatchment 36S: Sub-watershed 36 Runoff Area=114.100 ac Runoff Depth>3.07"
Flow Length=4,314' Tc=29.2 min CN=83 Runoff=235.31 cfs 29.158 af

Subcatchment 37S: Sub-watershed 37 Runoff Area=4.120 ac Runoff Depth>3.37"
Flow Length=852' Tc=9.7 min CN=86 Runoff=14.19 cfs 1.156 af

Subcatchment 38S: Sub-watershed 38 Runoff Area=1.590 ac Runoff Depth>3.67"
Tc=5.0 min CN=89 Runoff=6.88 cfs 0.487 af

Subcatchment 39S: Sub-watershed 39 Runoff Area=10.480 ac Runoff Depth>2.89"
Flow Length=1,018' Tc=12.8 min CN=81 Runoff=28.55 cfs 2.524 af

Subcatchment 40S: Sub-watershed 40 Runoff Area=0.240 ac Runoff Depth>2.89"
Flow Length=189' Tc=6.6 min CN=81 Runoff=0.80 cfs 0.058 af

Subcatchment 41S: Sub-watershed 41 Runoff Area=0.290 ac Runoff Depth>3.37"
Flow Length=182' Tc=6.2 min CN=86 Runoff=1.12 cfs 0.081 af

Subcatchment 42S: Sub-watershed 42 Runoff Area=0.070 ac Runoff Depth>3.37"
Flow Length=178' Tc=6.9 min CN=86 Runoff=0.26 cfs 0.020 af

Subcatchment 43S: Sub-watershed 43 Runoff Area=2.850 ac Runoff Depth>2.89"
Flow Length=570' Tc=10.1 min CN=81 Runoff=8.42 cfs 0.687 af

Subcatchment 44S: Sub-watershed 44 Runoff Area=1.720 ac Runoff Depth>2.53"
Flow Length=760' Tc=20.2 min CN=77 Runoff=3.43 cfs 0.362 af

Subcatchment 45S: Sub-watershed 45 Runoff Area=3.670 ac Runoff Depth>2.27"
Flow Length=865' Tc=21.2 min CN=74 Runoff=6.41 cfs 0.695 af

Subcatchment 46S: Sub-watershed 46 Runoff Area=1.370 ac Runoff Depth>2.27"
Flow Length=727' Tc=25.0 min CN=74 Runoff=2.23 cfs 0.259 af

Subcatchment 47S: Sub-watershed 47 Runoff Area=7.520 ac Runoff Depth>2.71"
Flow Length=701' Tc=8.1 min CN=79 Runoff=22.53 cfs 1.722 af

Subcatchment 48S: Sub-watershed 48 Runoff Area=1.320 ac Runoff Depth>3.17"
Flow Length=449' Tc=8.7 min CN=84 Runoff=4.45 cfs 0.349 af

Subcatchment 49S: Sub-watershed 49 Runoff Area=0.300 ac Runoff Depth>2.71"
Flow Length=130' Tc=7.3 min CN=79 Runoff=0.91 cfs 0.068 af

Subcatchment 50S: Sub-watershed 50 Runoff Area=1.900 ac Runoff Depth>2.71"
Flow Length=555' Tc=11.3 min CN=79 Runoff=5.07 cfs 0.429 af

Subcatchment 51S: Sub-wateshed 51 Runoff Area=3.850 ac Runoff Depth>3.86"
Tc=5.0 min CN=91 Runoff=17.35 cfs 1.246 af

Subcatchment 52S: Sub-watershed 52 Runoff Area=3.900 ac Runoff Depth>3.67"
Flow Length=598' Tc=9.6 min CN=89 Runoff=14.47 cfs 1.193 af

Subcatchment 53S: Sub-watershed 53 Runoff Area=4.840 ac Runoff Depth>3.77"
Flow Length=584' Tc=9.2 min CN=90 Runoff=18.59 cfs 1.522 af

Subcatchment 54S: Sub-watershed 54 Runoff Area=0.590 ac Runoff Depth>3.08"
Tc=5.0 min CN=83 Runoff=2.20 cfs 0.151 af

Subcatchment 55S: Sub-watershed 55 Runoff Area=1.880 ac Runoff Depth>3.87"
Flow Length=592' Tc=17.0 min CN=91 Runoff=5.96 cfs 0.607 af

Subcatchment 56S: Sub-watershed 56 Runoff Area=9.220 ac Runoff Depth>2.88"
Flow Length=951' Tc=23.1 min CN=81 Runoff=19.85 cfs 2.216 af

Subcatchment 57S: Sub-watershed 57 Runoff Area=2.690 ac Runoff Depth>2.89"
Flow Length=659' Tc=16.2 min CN=81 Runoff=6.71 cfs 0.647 af

Subcatchment 58S: Sub-watershed 58 Runoff Area=3.420 ac Runoff Depth>2.89"
Flow Length=774' Tc=17.4 min CN=81 Runoff=8.29 cfs 0.823 af

Subcatchment 59S: Sub-watershed 59 Runoff Area=90.930 ac Runoff Depth>3.04"
Flow Length=3,728' Tc=74.5 min CN=83 Runoff=113.61 cfs 23.012 af

Subcatchment 60S: Sub-watershed 60 Runoff Area=18.370 ac Runoff Depth>4.09"
Flow Length=2,475' Tc=20.8 min CN=93 Runoff=55.63 cfs 6.256 af

Subcatchment 61S: Sub-watershed 61 Runoff Area=15.630 ac Runoff Depth>2.98"
Flow Length=1,026' Tc=9.6 min CN=82 Runoff=48.33 cfs 3.887 af

Subcatchment 62S: Sub-watershed 62 Runoff Area=8.320 ac Runoff Depth>2.88"
Flow Length=991' Tc=22.5 min CN=81 Runoff=20.31 cfs 2.240 af

Subcatchment 63S: Sub-watershed 63 Runoff Area=9.850 ac Runoff Depth>2.89"
Flow Length=1,245' Tc=12.1 min CN=81 Runoff=27.39 cfs 2.373 af

Subcatchment 64S: Sub-watershed 64 Runoff Area=0.720 ac Runoff Depth>3.86"
Flow Length=133' Tc=9.7 min CN=91 Runoff=2.78 cfs 0.233 af

Subcatchment 65S: Sub-watershed 65 Runoff Area=4.080 ac Runoff Depth>2.89"
Flow Length=1,220' Tc=15.0 min CN=81 Runoff=10.47 cfs 0.982 af

Subcatchment 66S: Su-watershed 66 Runoff Area=4.660 ac Runoff Depth>2.86"
Flow Length=863' Tc=22.0 min CN=81 Runoff=10.26 cfs 1.120 af

Subcatchment 67S: Sub-watershed 67 Runoff Area=3.140 ac Runoff Depth>3.15"
Flow Length=889' Tc=28.6 min CN=84 Runoff=8.73 cfs 0.827 af

Subcatchment 68S: Sub-watershed 68 Runoff Area=20.630 ac Runoff Depth>2.80"
Flow Length=1,184' Tc=18.0 min CN=80 Runoff=47.75 cfs 4.807 af

Reach 3R: Intermittent Stream Avg. Depth=0.66' Max Vel=2.55 fps Inflow=43.97 cfs 5.169 af
n=0.070 L=725.0' S=0.0283 '/' Capacity=253.16 cfs Outflow=37.11 cfs 5.139 af

Pond 2P: Highview Pond Existing Peak Elev=121.16' Storage=39,519 cf Inflow=47.53 cfs 5.211 af
Outflow=43.97 cfs 5.169 af

Link 68L: SW 59_SW 60 Inflow=124.02 cfs 29.268 af
Primary=124.02 cfs 29.268 af

Link 69L: SW 14_SW 17 Inflow=33.78 cfs 3.496 af
Primary=33.78 cfs 3.496 af

Link 70L: SW47_SW49 Inflow=23.43 cfs 1.790 af
Primary=23.43 cfs 1.790 af

Link 71L: Elbow St Inflow=62.54 cfs 9.945 af
Primary=62.54 cfs 9.945 af

Total Runoff Area = 746.870 ac Runoff Volume = 190.298 af Average Runoff Depth = 3.06"
66.54% Pervious Area = 496.954 ac 33.46% Impervious Area = 249.916 ac

Subcatchment 1S: Sub-watershed 1

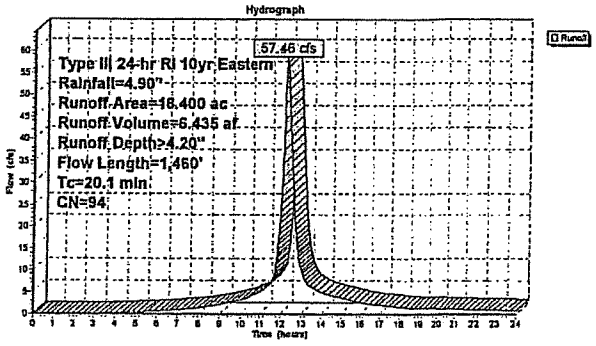
Runoff = 57.46 cfs @ 12.26 hrs, Volume= 6.435 af, Depth> 4.20"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 10yr Eastern Rainfall=4.90"

Area (ac)	CN	Description
18.400	94	Urban commercial, 85% Imp, HSG C
2.760		Pervious Area
15.640		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.7	100	0.0150	0.16		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
8.9	1,240	0.0210	2.33		Shallow Concentrated Flow, B-C Unpaved Kv= 16.1 fps
0.5	120	0.0330	3.69		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
20.1	1,460	Total			

Subcatchment 1S: Sub-watershed 1



Subcatchment 2S: Sub-watershed 2

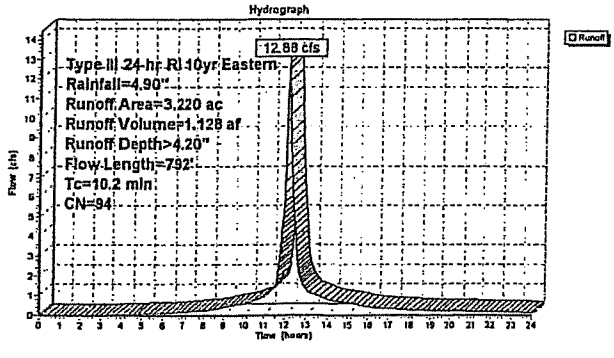
Runoff = 12.88 cfs @ 12.14 hrs, Volume= 1.128 af, Depth> 4.20"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 10yr Eastern Rainfall=4.90"

Area (ac)	CN	Description
3.220	94	Urban commercial, 85% Imp, HSG C
0.483		Pervious Area
2.737		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.1	100	0.0600	0.27		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
2.4	394	0.0280	2.69		Shallow Concentrated Flow, B-C Unpaved Kv= 16.1 fps
1.7	298	0.0200	2.87		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
10.2	792	Total			

Subcatchment 2S: Sub-watershed 2



Subcatchment 3S: Sub-watershed 3

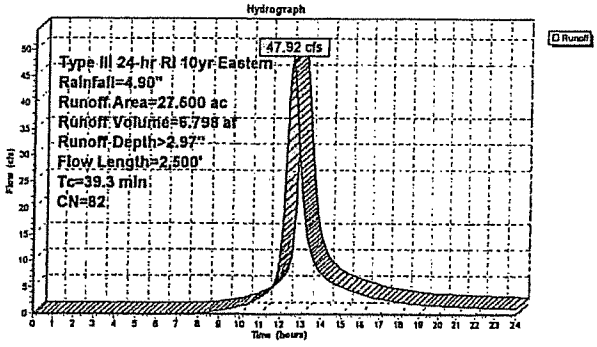
Runoff = 47.92 cfs @ 12.54 hrs, Volume= 6.798 af, Depth> 2.97"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 10yr Eastern Rainfall=4.90"

Area (ac)	CN	Description
13.750	86	Pasture/grassland/range, Poor, HSG C
10.750	80	1/2 acre lots, 25% Imp, HSG C
3.000	73	Woods, Fair, HSG C
27.500	82	Weighted Average
24.813		Pervious Area
2.688		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	100	0.0100	0.28		Sheet Flow, A-B Cultivated: Residue<=20% n= 0.060 P2= 3.40"
19.4	1,200	0.0217	1.03		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
13.9	1,200	0.0050	1.44		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
39.3	2,500	Total			

Subcatchment 3S: Sub-watershed 3



Subcatchment 4S: Sub-watershed 4

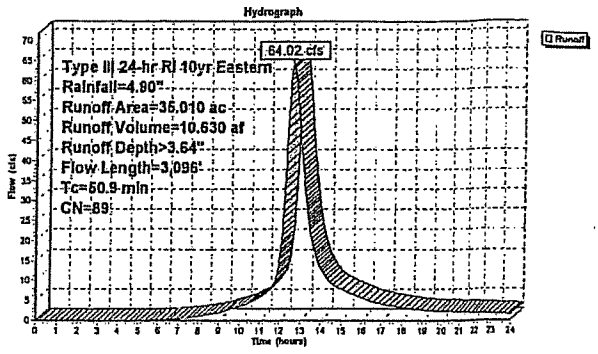
Runoff = 64.02 cfs @ 12.67 hrs, Volume= 10.630 af, Depth> 3.64"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 10yr Eastern Rainfall=4.90"

Area (ac)	CN	Description
5.901	90	Fallow, crop residue, Poor, HSG C
17.070	94	Urban commercial, 85% imp, HSG C
5.647	79	Pasture/grassland/range, Fair, HSG C
3.680	79	1 acre lots, 20% imp, HSG C
2.712	91	Urban industrial, 72% imp, HSG C
35.010	89	Weighted Average
17.812		Pervious Area
17.198		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.5	100	0.0200	0.18		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
1.8	106	0.0190	0.96		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
0.2	30	0.0170	2.65		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
0.6	70	0.0860	2.05		Shallow Concentrated Flow, D-E Short Grass Pasture Kv= 7.0 fps
0.7	82	0.0100	2.03		Shallow Concentrated Flow, E-F Paved Kv= 20.3 fps
24.2	322	0.0010	0.22		Shallow Concentrated Flow, F-G Short Grass Pasture Kv= 7.0 fps
13.9	2,386	0.0200	2.87		Shallow Concentrated Flow, G-H Paved Kv= 20.3 fps
50.9	3,096	Total			

Subcatchment 4S: Sub-watershed 4



Subcatchment 5S: Sub-Watershed 5

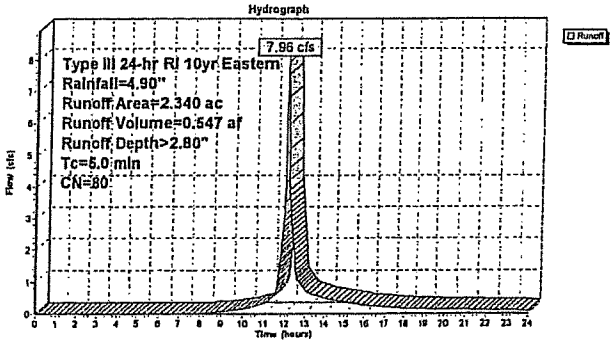
Runoff = 7.96 cfs @ 12.08 hrs, Volume= 0.547 af, Depth> 2.80"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 10yr Eastern Rainfall=4.90"

Area (ac)	CN	Description
2.340	80	1/2 acre lots, 25% Imp, HSG C
1.755		Pervious Area
0.585		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry, A-D

Subcatchment 5S: Sub-Watershed 5



Subcatchment 6dS: Sub-watershed 6d

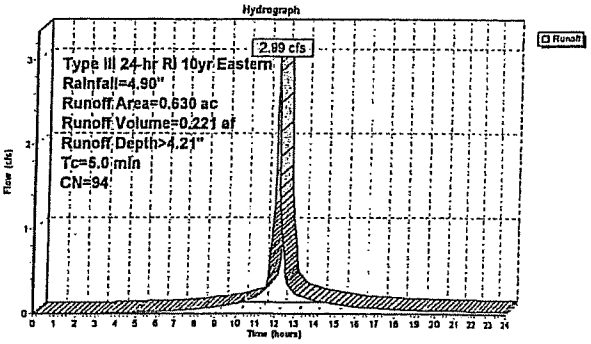
Runoff = 2.99 cfs @ 12.07 hrs, Volume= 0.221 af, Depth> 4.21"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 10yr Eastern Rainfall=4.90"

Area (ac)	CN	Description
0.630	94	Urban commercial, 85% Imp, HSG C
0.095		Pervious Area
0.535		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry, A-C

Subcatchment 6dS: Sub-watershed 6d



Subcatchment 6eS: Sub-watershed 6e

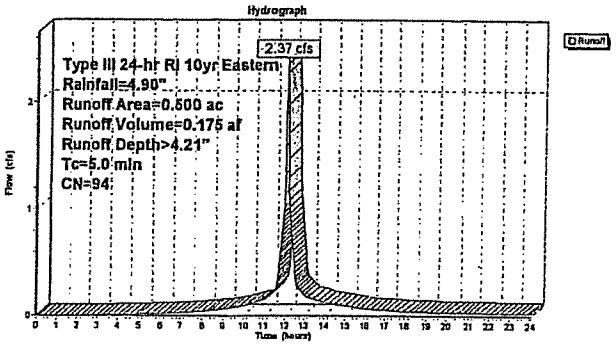
Runoff = 2.37 cfs @ 12.07 hrs, Volume= 0.175 af, Depth> 4.21"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 10yr Eastern Rainfall=4.90"

Area (ac)	CN	Description
0.500	94	Urban commercial, 85% Imp, HSG C
0.075		Pervious Area
0.425		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry, A-C

Subcatchment 6eS: Sub-watershed 6e



Subcatchment 6S: Sub-watershed 6

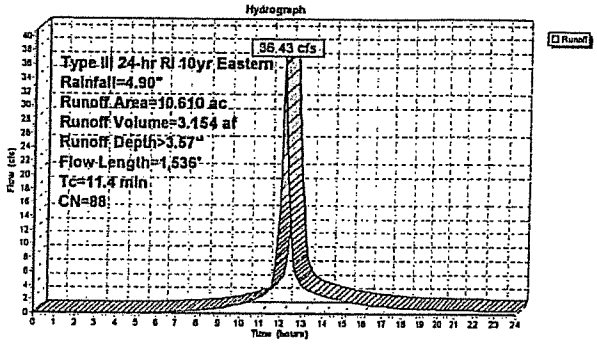
Runoff = 36.43 cfs @ 12.15 hrs, Volume= 3.154 af, Depth> 3.57"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 10yr Eastern Rainfall=4.90"

Area (ac)	CN	Description
8.380	87	Dirt roads, HSG C
2.230	94	Urban commercial, 85% Imp, HSG C
10.610	88	Weighted Average
8.714		Pervious Area
1.895		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.6	100	0.0900	2.59		Sheet Flow, A-B Smooth surfaces n= 0.011 P2= 3.40"
10.8	1,436	0.0120	2.22		Shallow Concentrated Flow, B-C Paved Kv= 20.3 fps
11.4	1,536	Total			

Subcatchment 6S: Sub-watershed 6



Subcatchment 8S: Sub-watershed 8

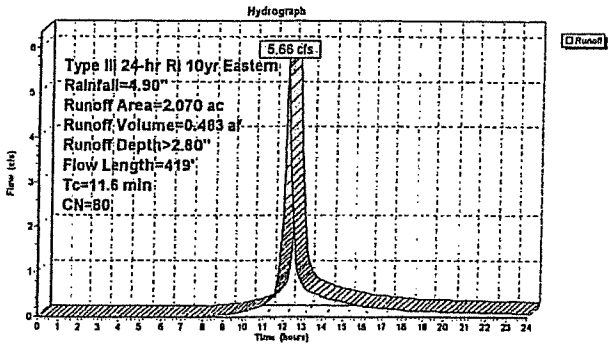
Runoff = 5.66 cfs @ 12.16 hrs, Volume= 0.483 af, Depth> 2.80"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 10yr Eastern Rainfall=4.90"

Area (ac)	CN	Description
2.070	80	1/2 acre lots, 25% Imp, HSG C
1.552		Pervious Area
0.517		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.1	100	0.0300	0.21		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
3.1	228	0.0300	1.21		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
0.4	91	0.0400	4.06		Shallow Concentrated Flow, B-C Paved Kv= 20.3 fps
11.6	419	Total			

Subcatchment 8S: Sub-watershed 8



Subcatchment 9S: Sub-watershed 9

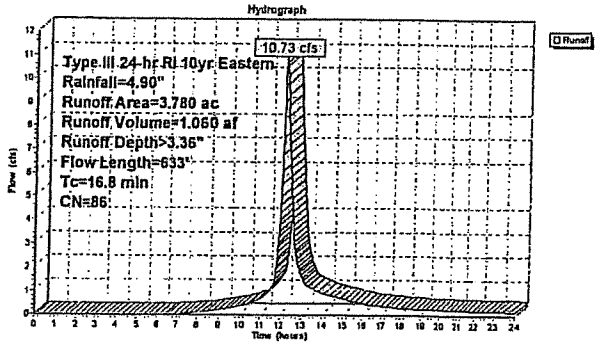
Runoff = 10.73 cfs @ 12.23 hrs, Volume= 1.060 af, Depth> 3.36"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 10yr Eastern Rainfall=4.90"

Area (ac)	CN	Description
2.990	90	1/8 acre lots, 65% Imp, HSG C
0.790	73	Woods, Fair, HSG C
3.780	86	Weighted Average
1.837		Pervious Area
1.944		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.5	100	0.0200	0.18		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
4.7	200	0.0200	0.71		Shallow Concentrated Flow, B-C Woodland Kv= 5.0 fps
1.7	160	0.0500	1.57		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
0.9	173	0.0230	3.08		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
16.8	633	Total			

Subcatchment 9S: Sub-watershed 9



Subcatchment 10S: Sub-watershed 10

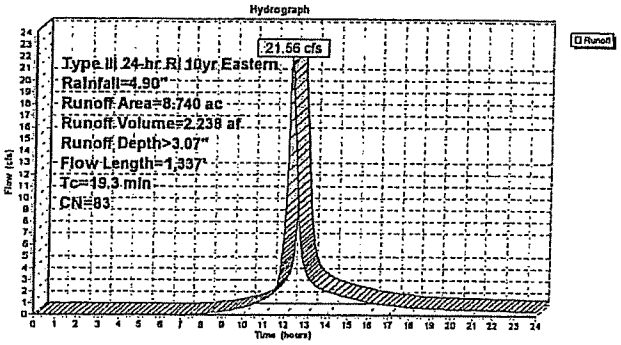
Runoff = 21.56 cfs @ 12.26 hrs, Volume= 2.238 af, Depth> 3.07"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 10yr Eastern Rainfall=4.90"

Area (ac)	CN	Description
8.740	83	1/4 acre lots, 38% imp, HSG C
5.419		Pervious Area
3.321		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.5	100	0.0200	0.18		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
3.8	196	0.0150	0.86		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
6.0	1,041	0.0200	2.87		Shallow Concentrated Flow, B-C Paved Kv= 20.3 fps
19.3	1,337	Total			

Subcatchment 10S: Sub-watershed 10



Subcatchment 11S: Sub-watershed 11

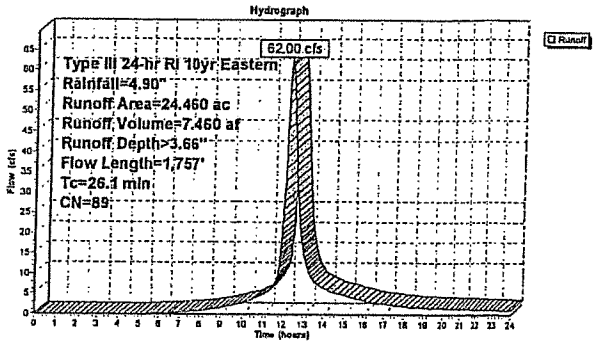
Runoff = 62.00 cfs @ 12.35 hrs, Volume= 7.460 af, Depth> 3.66"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 10yr Eastern Rainfall=4.90"

Area (ac)	CN	Description
5.370	90	Fallow, crop residue, Poor, HSG C
10.340	94	Urban commercial, 85% Imp, HSG C
8.750	83	1/4 acre lots, 38% Imp, HSG C
24.460	89	Weighted Average
12.346		Pervious Area
12.114		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.8	100	0.0200	0.36		Sheet Flow, A-B Cultivated: Residue<=20% n= 0.060 P2= 3.40"
12.0	504	0.0100	0.70		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
9.5	1,153	0.0100	2.03		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
26.1	1,757	Total			

Subcatchment 11S: Sub-watershed 11



Subcatchment 12S: Sub-watershed 12

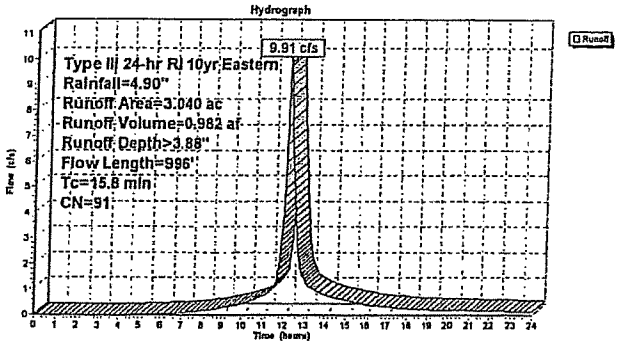
Runoff = 9.91 cfs @ 12.21 hrs, Volume= 0.982 af, Depth> 3.88"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 10yr Eastern Rainfall=4.90"

Area (ac)	CN	Description
2.130	94	Urban commercial, 85% Imp, HSG C
0.910	83	1/4 acre lots, 38% Imp, HSG C
3.040	91	Weighted Average
0.884		Pervious Area
2.156		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.1	100	0.0300	0.21		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
5.5	462	0.0400	1.40		Shallow Concentrated Flow, A-B Short Grass Pasture Kv= 7.0 fps
2.2	434	0.0270	3.34		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
15.8	996	Total			

Subcatchment 12S: Sub-watershed 12



Subcatchment 13S: Sub-watershed 13

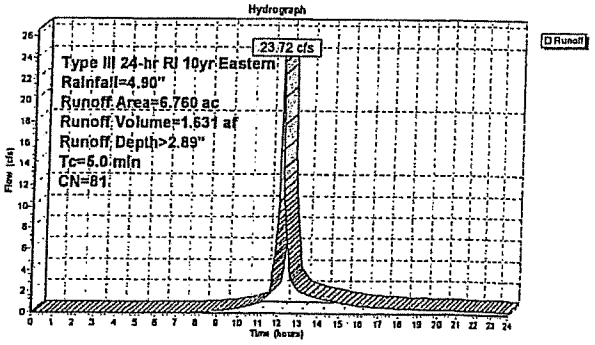
Runoff = 23.72 cfs @ 12.07 hrs, Volume= 1.631 af, Depth> 2.89"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 10yr Eastern Rainfall=4.90"

Area (ac)	CN	Description
6.760	81	1/3 acre lots, 30% Imp, HSG C
4.732		Pervious Area
2.028		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry, A-C

Subcatchment 13S: Sub-watershed 13



Subcatchment 14S: Sub-watershed 14

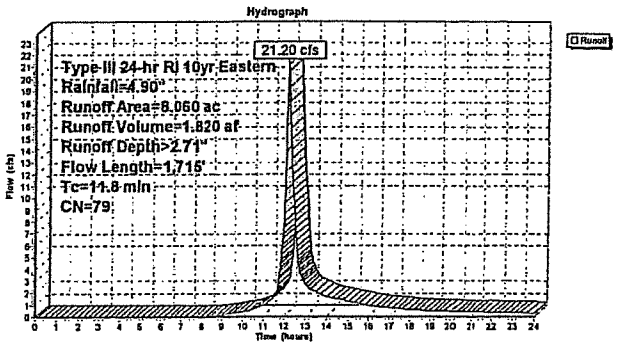
Runoff = 21.20 cfs @ 12.16 hrs, Volume= 1.820 af, Depth> 2.71"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 10yr Eastern Rainfall=4.90"

Area (ac)	CN	Description
0.240	94	Urban commercial, 65% imp, HSG C
7.820	79	1 acre lots, 20% imp, HSG C
8.060	79	Weighted Average
6.292		Pervious Area
1.768		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.6	100	0.0100	1.07		Sheet Flow, A-B Smooth surfaces n= 0.011 P2= 3.40"
10.2	1,615	0.0170	2.65		Shallow Concentrated Flow, B-C Paved Kv= 20.3 fps
11.8	1,715	Total			

Subcatchment 14S: Sub-watershed 14



Subcatchment 15S: Sub-watershed 15

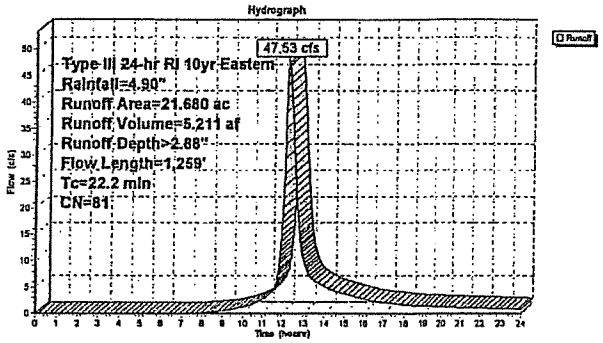
Runoff = 47.53 cfs @ 12.31 hrs, Volume= 5.211 af, Depth> 2.88"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 10yr Eastern Rainfall=4.90"

Area (ac)	CN	Description
15.390	79	1 acre lots, 20% imp, HSG C
5.090	80	1/8 acre lots, 65% imp, HSG C
1.200	76	Woods/grass comb., Fair, HSG C
21.680	81	Weighted Average
15.294		Pervious Area
6.387		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.1	100	0.0300	0.21		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
1.3	168	0.0120	2.22		Shallow Concentrated Flow, B-C Paved Kv= 20.3 fps
12.8	991	0.0340	1.29		Shallow Concentrated Flow, C-D Short Grass Pasture Kv= 7.0 fps
22.2	1,259	Total			

Subcatchment 15S: Sub-watershed 15



Subcatchment 16S: Sub-watershed 16

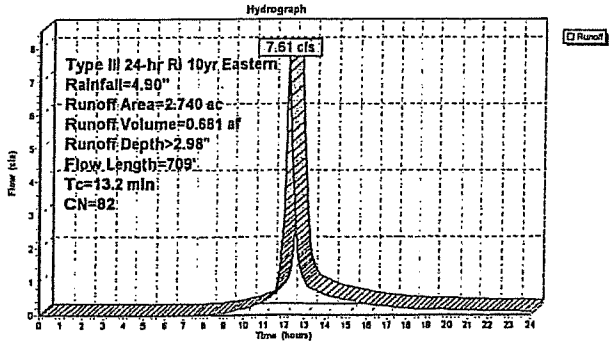
Runoff = 7.61 cfs @ 12.18 hrs, Volume= 0.681 af, Depth> 2.98"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 10yr Eastern Rainfall=4.90"

Area (ac)	CN	Description
2.330	81	1/3 acre lots, 30% imp, HSG C
0.410	91	Fallow, bare soil, HSG C
2.740	82	Weighted Average
2.041		Pervious Area
0.699		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.5	100	0.0200	0.18		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
2.0	161	0.0370	1.35		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
1.7	448	0.0450	4.31		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
13.2	709	Total			

Subcatchment 16S: Sub-watershed 16



Subcatchment 17S: Sub-watershed 17

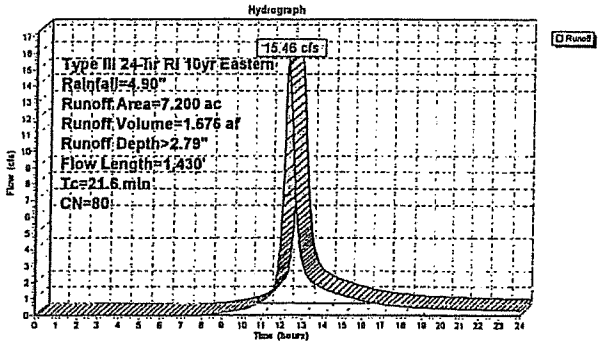
Runoff = 15.46 cfs @ 12.30 hrs, Volume= 1.676 af, Depth> 2.79"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 10yr Eastern Rainfall=4.90"

Area (ac)	CN	Description
7.200	80	1/2 acre lots, 25% imp, HSG C
5.400		Pervious Area
1.800		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.5	100	0.0100	0.13		Sheet Flow, A-C Grass: Short n= 0.150 P2= 3.40"
1.8	338	0.0240	3.14		Shallow Concentrated Flow, B-C Paved Kv= 20.3 fps
0.5	125	0.0400	4.06		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
2.9	260	0.0460	1.50		Shallow Concentrated Flow, D-E Short Grass Pasture Kv= 7.0 fps
3.9	607	0.0160	2.57		Shallow Concentrated Flow, E-F Paved Kv= 20.3 fps
21.6	1,430	Total			

Subcatchment 17S: Sub-watershed 17



Subcatchment 18S: Sub-watershed 18

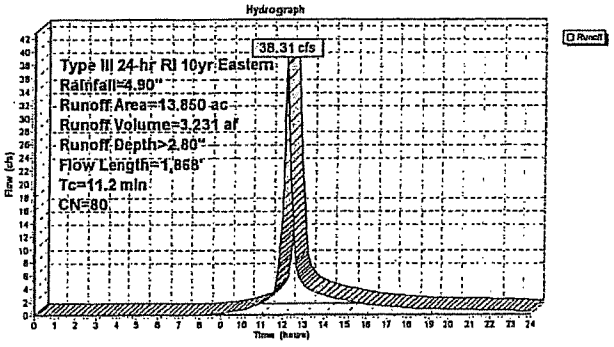
Runoff = 38.31 cfs @ 12.16 hrs, Volume= 3.231 af, Depth> 2.80"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 10yr Eastern Rainfall=4.90"

Area (ac)	CN	Description
13.160	80	1/2 acre lots, 25% Imp, HSG C
0.690	73	Woods, Fair, HSG C
13.850	80	Weighted Average
10.560		Pervious Area
3.290		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.8	100	0.0500	2.05		Sheet Flow, A-B Smooth surfaces n= 0.011 P2= 3.40"
3.3	299	0.0470	1.52		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
7.1	1,469	0.0290	3.46		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
11.2	1,868	Total			

Subcatchment 18S: Sub-watershed 18



Subcatchment 19S: Sub-watershed 19

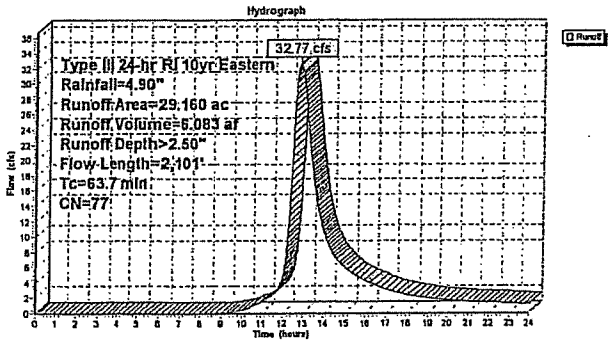
Runoff = 32.77 cfs @ 12.87 hrs, Volume= 6.083 af, Depth> 2.50"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 10yr Eastern Rainfall=4.90"

Area (ac)	CN	Description
1.460	94	Urban commercial, 85% Imp, HSG C
1.460	80	1/2 acre lots, 25% Imp, HSG C
26.240	76	Woods/grass comb., Fair, HSG C
29.160	77	Weighted Average
27.554		Pervious Area
1.606		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.1	100	0.0160	0.11		Sheet Flow, A-B Grass: Dense n= 0.240 P2= 3.40"
2.9	161	0.0170	0.91		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
0.1	17	0.0230	3.08		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
1.2	80	0.0250	1.11		Shallow Concentrated Flow, D-E Short Grass Pasture Kv= 7.0 fps
0.1	13	0.0200	2.87		Shallow Concentrated Flow, E-F Paved Kv= 20.3 fps
35.7	678	0.0040	0.32		Shallow Concentrated Flow, F-G Woodland Kv= 5.0 fps
8.6	1,052	0.0100	2.03		Shallow Concentrated Flow, G-H Paved Kv= 20.3 fps
63.7	2,101	Total			

Subcatchment 19S: Sub-watershed 19



Subcatchment 20S: Sub-watershed 20

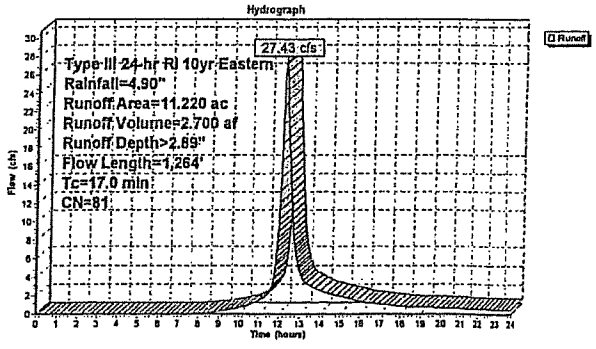
Runoff = 27.43 cfs @ 12.23 hrs, Volume= 2.700 af, Depth> 2.89"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 10yr Eastern Rainfall=4.90"

Area (ac)	CN	Description
11.220	81	1/3 acre lots, 30% Imp, HSG C
7.854		Pervious Area
3.366		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.1	100	0.0300	0.21		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
4.0	174	0.0110	0.73		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
4.9	990	0.0260	3.40		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
17.0	1,264	Total			

Subcatchment 20S: Sub-watershed 20



Subcatchment 21S: Sub-watershed 21

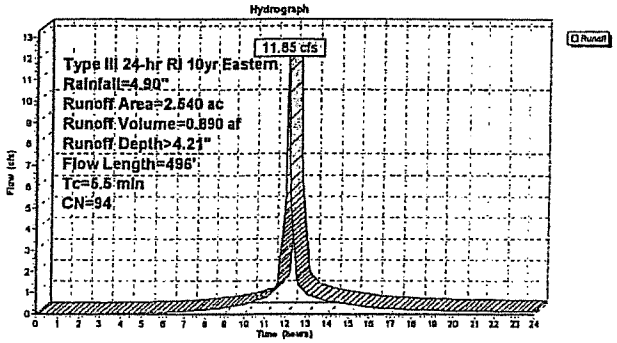
Runoff = 11.85 cfs @ 12.08 hrs, Volume= 0.890 af, Depth> 4.21"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 10yr Eastern Rainfall=4.90"

Area (ac)	CN	Description
2.540	94	Urban commercial, 85% Imp, HSG C
0.381		Pervious Area
2.159		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.8	70	0.1000	0.31		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
0.2	30	0.1200	2.28		Sheet Flow, B-C Smooth surfaces n= 0.011 P2= 3.40"
1.5	396	0.0450	4.31		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
5.5	496	Total			

Subcatchment 21S: Sub-watershed 21



Subcatchment 22S: Sub-watershed 22

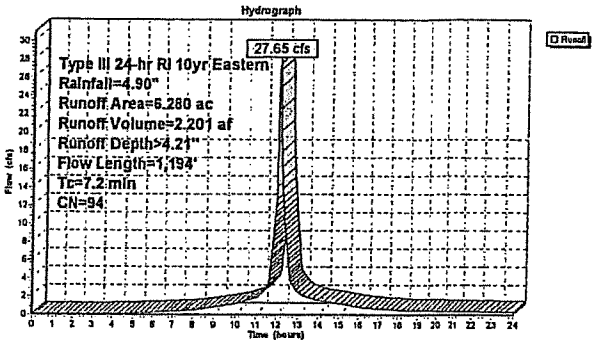
Runoff = 27.65 cfs @ 12.10 hrs, Volume= 2.201 af, Depth> 4.21"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 10yr Eastern Rainfall=4.90"

Area (ac)	CN	Description
6.280	94	Urban commercial, 85% Imp, HSG C
0.942		Pervious Area
5.338		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	100	0.0800	2.47		Sheet Flow, A-B Smooth surfaces n= 0.011 P2= 3.40"
6.5	1,094	0.0190	2.80		Shallow Concentrated Flow, B-C Paved Kv= 20.3 fps
7.2	1,194	Total			

Subcatchment 22S: Sub-watershed 22



Subcatchment 23S: Sub-watershed 23

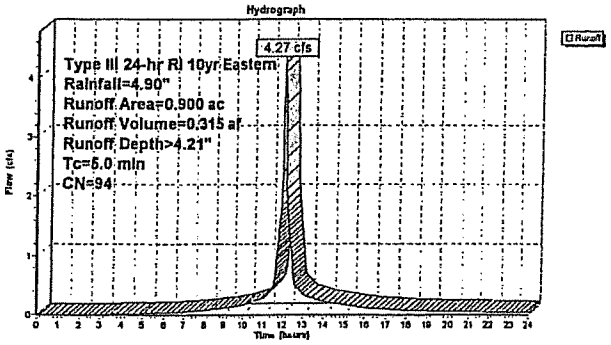
Runoff = 4.27 cfs @ 12.07 hrs, Volume= 0.315 af, Depth> 4.21"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 10yr Eastern Rainfall=4.90"

Area (ac)	CN	Description
0.900	94	Urban commercial, 85% Imp, HSG C
0.135		Pervious Area
0.765		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry, A-E

Subcatchment 23S: Sub-watershed 23



Subcatchment 24S: Sub-watershed 24

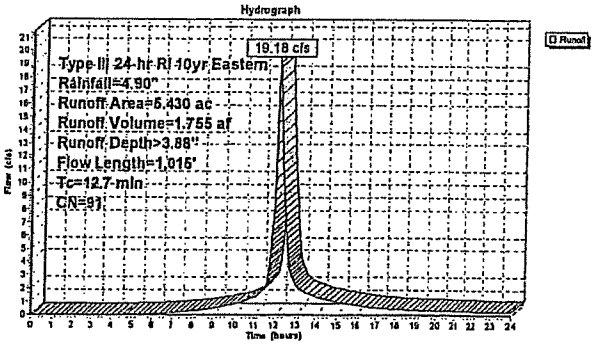
Runoff = 19.18 cfs @ 12.17 hrs, Volume= 1.755 af, Depth> 3.88"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 10yr Eastern Rainfall=4.90"

Area (ac)	CN	Description
4.340	94	Urban commercial, 85% Imp, HSG C
1.090	81	1/3 acre lots, 30% Imp, HSG C
5.430	91	Weighted Average
1.414		Pervious Area
4.016		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.5	100	0.0800	0.31		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
3.7	397	0.0650	1.78		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
3.5	518	0.0150	2.49		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
12.7	1,015	Total			

Subcatchment 24S: Sub-watershed 24



Subcatchment 25S: Sub-watershed 25

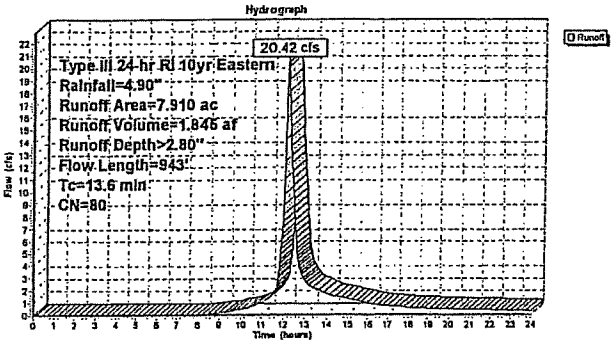
Runoff = 20.42 cfs @ 12.19 hrs, Volume= 1.845 af, Depth> 2.80"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 10yr Eastern Rainfall=4.90"

Area (ac)	CN	Description
7.120	81	1/3 acre lots, 30% Imp, HSG C
0.790	73	Woods, Fair, HSG C
7.910	80	Weighted Average
5.774		Pervious Area
2.136		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.2	100	0.0400	0.23		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
3.5	276	0.0360	1.33		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
2.9	567	0.0250	3.21		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
13.6	943	Total			

Subcatchment 25S: Sub-watershed 25



Subcatchment 26S: Sub-watershed 26

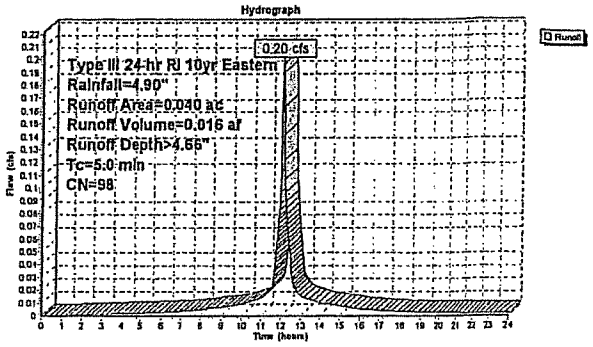
Runoff = 0.20 cfs @ 12.07 hrs, Volume= 0.016 af, Depth> 4.66"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 10yr Eastern Rainfall=4.90"

Area (ac)	CN	Description
0.040	98	Paved parking & roofs
0.040		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry, A-B

Subcatchment 26S: Sub-watershed 26



Subcatchment 27S: Sub-watershed 27

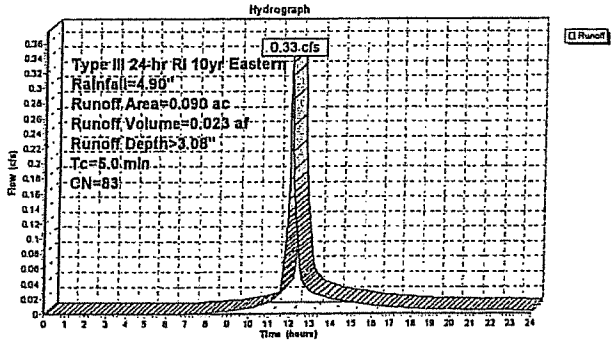
Runoff = 0.33 cfs @ 12.07 hrs, Volume= 0.023 af, Depth> 3.08"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 10yr Eastern Rainfall=4.90"

Area (ac)	CN	Description
0.090	83	1/4 acre lots, 38% Imp, HSG C
0.056		Pervious Area
0.034		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry, A-B

Subcatchment 27S: Sub-watershed 27



Subcatchment 28S: Sub-watershed 28

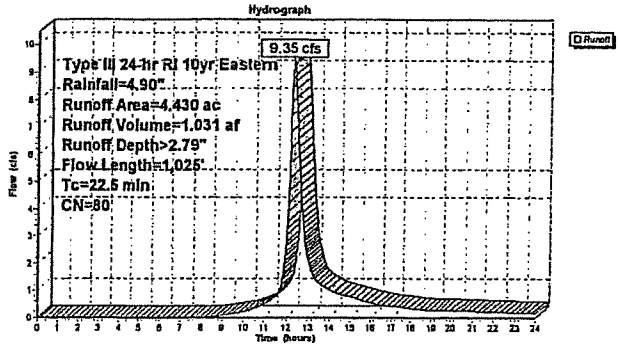
Runoff = 9.35 cfs @ 12.31 hrs, Volume= 1.031 af, Depth> 2.79"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 10yr Eastern Rainfall=4.90"

Area (ac)	CN	Description
3.990	81	1/3 acre lots, 30% Imp, HSG C
0.440	73	Woods, Fair, HSG C
4.430	80	Weighted Average
3.233		Pervious Area
1.197		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.5	100	0.0200	0.18		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
0.4	23	0.0220	1.04		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
0.1	19	0.0200	2.87		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
0.4	23	0.0200	0.99		Shallow Concentrated Flow, D-E Short Grass Pasture Kv= 7.0 fps
0.1	22	0.0200	2.87		Shallow Concentrated Flow, E-F Paved Kv= 20.3 fps
7.5	426	0.0360	0.95		Shallow Concentrated Flow, F-G Woodland Kv= 5.0 fps
1.2	100	0.0400	1.40		Shallow Concentrated Flow, G-H Short Grass Pasture Kv= 7.0 fps
3.3	312	0.0060	1.57		Shallow Concentrated Flow, H-I Paved Kv= 20.3 fps
22.5	1,025	Total			

Subcatchment 28S: Sub-watershed 28



Subcatchment 29S: Sub-watershed 29

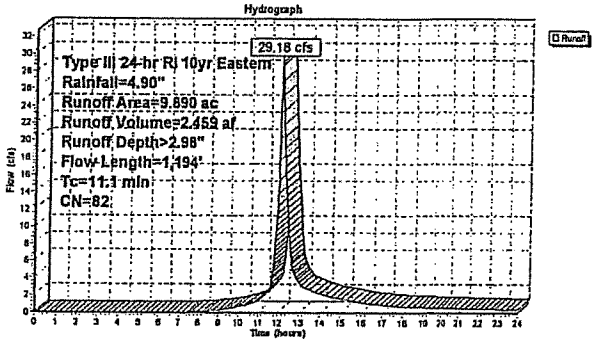
Runoff = 29.18 cfs @ 12.15 hrs, Volume= 2.459 af, Depth> 2.98"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 10yr Eastern Rainfall=4.90"

Area (ac)	CN	Description
0.490	74	>75% Grass cover, Good, HSG C
0.980	94	Urban commercial, 85% Imp, HSG C
8.420	81	1/3 acre lots, 30% Imp, HSG C
9.890	82	Weighted Average
6.531		Pervious Area
3.359		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.5	100	0.0110	1.12		Sheet Flow, A-B Smooth surfaces n= 0.011 P2= 3.40"
6.7	453	0.0260	1.13		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
2.9	641	0.0330	3.69		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
11.1	1,194	Total			

Subcatchment 29S: Sub-watershed 29



Subcatchment 30S: Sub-watershed 30

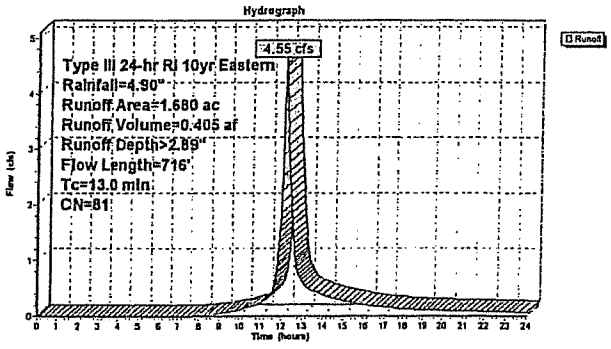
Runoff = 4.55 cfs @ 12.18 hrs, Volume= 0.405 af, Depth> 2.89"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 10yr Eastern Rainfall=4.90"

Area (ac)	CN	Description
1.680	81	1/3 acre lots, 30% Imp, HSG C
1.176		Pervious Area
0.504		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.5	100	0.0200	0.18		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
1.2	118	0.0510	1.58		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
2.3	498	0.0320	3.63		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
13.0	716	Total			

Subcatchment 30S: Sub-watershed 30



Subcatchment 31S: Sub-watershed 31

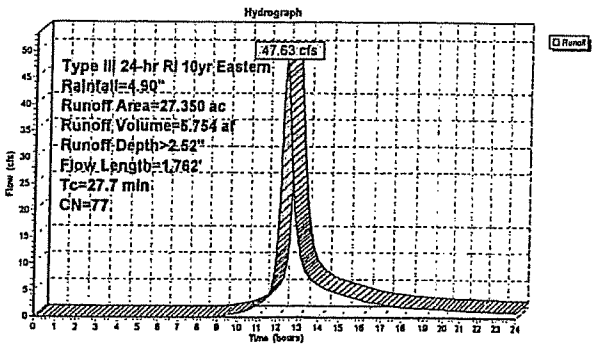
Runoff = 47.63 cfs @ 12.39 hrs, Volume= 5.754 af, Depth> 2.52"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 10yr Eastern Rainfall=4.90"

Area (ac)	CN	Description
12.350	81	1/3 acre lots, 30% Imp, HSG C
15.000	74	>75% Grass cover, Good, HSG C
27.350	77	Weighted Average
23.645		Pervious Area
3.705		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.6	100	0.0500	0.25		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
15.3	1,075	0.0280	1.17		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
5.8	587	0.0070	1.70		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
27.7	1,762	Total			

Subcatchment 31S: Sub-watershed 31



Subcatchment 32S: Sub-watershed32

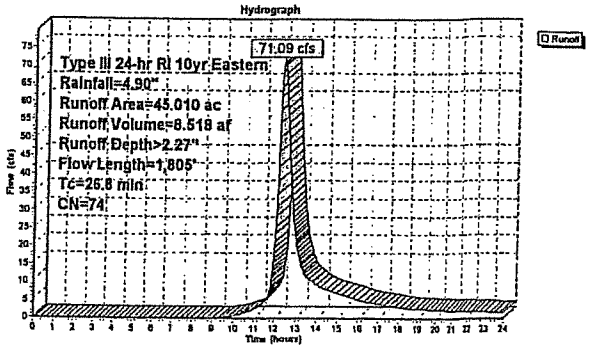
Runoff = 71.09 cfs @ 12.38 hrs, Volume= 8.518 af, Depth> 2.27"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 10yr Eastern Rainfall=4.90"

Area (ac)	CN	Description
14.440	81	1/3 acre lots, 30% imp, HSG C
13.320	69	50-75% Grass cover, Fair, HSG B
15.110	73	Woods, Fair, HSG C
0.900	88	Fallow, crop residue, Good, HSG C
1.240	56	Brush, Fair, HSG B
45.010	74	Weighted Average
40.678		Pervious Area
4.332		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.0	100	0.0840	0.14		Sheet Flow, A-B Grass: Bermuda n= 0.410 P2= 3.40"
2.3	179	0.0698	1.32		Shallow Concentrated Flow, B-C Woodland Kv= 5.0 fps
2.9	654	0.0528	3.70		Shallow Concentrated Flow, C-D Unpaved Kv= 16.1 fps
5.8	474	0.0738	1.36		Shallow Concentrated Flow, D-E Woodland Kv= 5.0 fps
3.8	398	0.0075	1.76		Shallow Concentrated Flow, E-F Paved Kv= 20.3 fps
26.8	1,805	Total			

Subcatchment 32S: Sub-watershed32



Subcatchment 33S: Sub-watershed 33

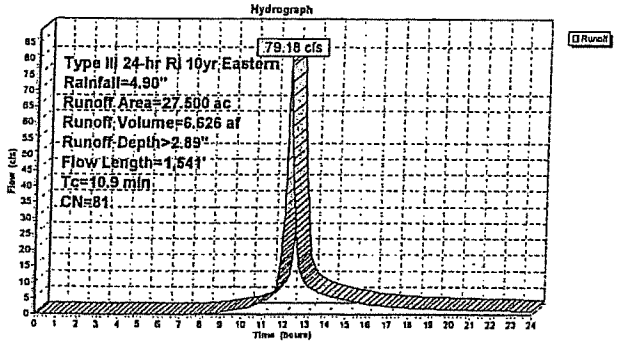
Runoff = 79.18 cfs @ 12.15 hrs, Volume= 6.626 af, Depth> 2.89"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 10yr Eastern Rainfall=4.90"

Area (ac)	CN	Description
0.960	94	Urban commercial, 85% Imp, HSG C
26.540	81	1/3 acre lots, 30% Imp, HSG C
27.500	81	Weighted Average
18.722		Pervious Area
8.778		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.6	100	0.1200	0.36		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
1.0	154	0.1400	2.62		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
5.3	1,287	0.0400	4.06		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
10.9	1,541	Total			

Subcatchment 33S: Sub-watershed 33



Subcatchment 34S: Sub-watershed 34

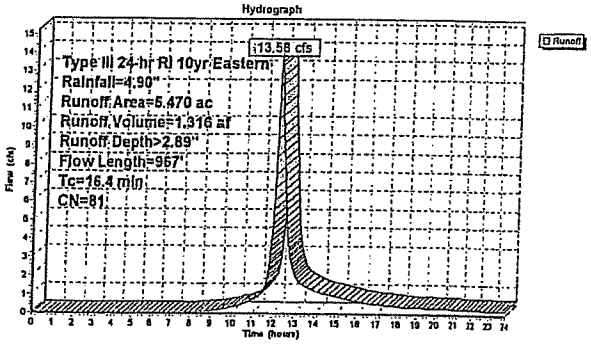
Runoff = 13.58 cfs @ 12.22 hrs, Volume= 1.316 af, Depth> 2.89"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 10yr Eastern Rainfall=4.90"

Area (ac)	CN	Description
5.470	81	1/3 acre lots, 30% Imp, HSG C
3.829		Pervious Area
1.641		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.5	100	0.0200	0.18		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
1.8	131	0.0300	1.21		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
5.1	736	0.0140	2.40		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
16.4	967	Total			

Subcatchment 34S: Sub-watershed 34



Subcatchment 35S: Sub-watershed 35

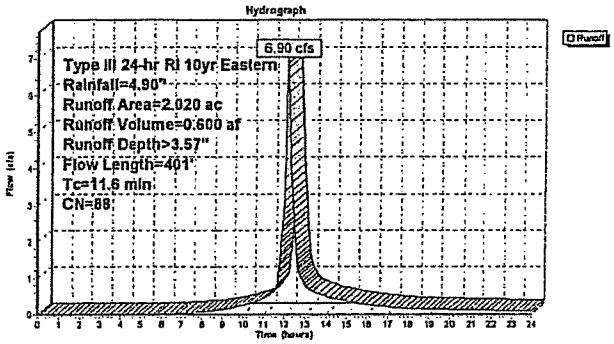
Runoff = 6.90 cfs @ 12.16 hrs, Volume= 0.600 af, Depth> 3.57"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 10yr Eastern Rainfall=4.90"

Area (ac)	CN	Description
1.010	94	Urban commercial, 85% imp, HSG C
1.010	81	1/3 acre lots, 30% imp, HSG C
2.020	88	Weighted Average
0.859		Pervious Area
1.161		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.1	100	0.0300	0.21		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
2.0	111	0.0180	0.94		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
1.5	190	0.0110	2.13		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
11.6	401	Total			

Subcatchment 35S: Sub-watershed 35



Subcatchment 36S: Sub-watershed 36

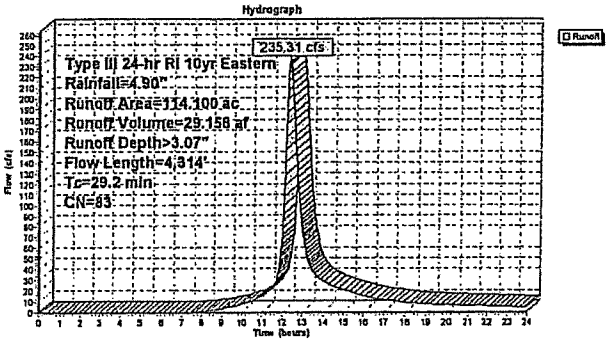
Runoff = 235.31 cfs @ 12.40 hrs, Volume= 29.158 af, Depth> 3.07"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 10yr Eastern Rainfall=4.90"

Area (ac)	CN	Description
81.170	83	1/4 acre lots, 38% Imp, HSG C
9.230	94	Urban commercial, 85% Imp, HSG C
6.090	60	Woods, Fair, HSG B
0.440	69	50-75% Grass cover, Fair, HSG B
4.160	56	Brush, Fair, HSG B
12.990	91	Urban Industrial, 72% Imp, HSG C
114.100	83	Weighted Average
66.057		Pervious Area
48.043		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.5	100	0.0200	0.18		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
1.4	172	0.0810	1.99		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
18.3	4,042	0.0330	3.69		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
29.2	4,314	Total			

Subcatchment 36S: Sub-watershed 36



Subcatchment 37S: Sub-watershed 37

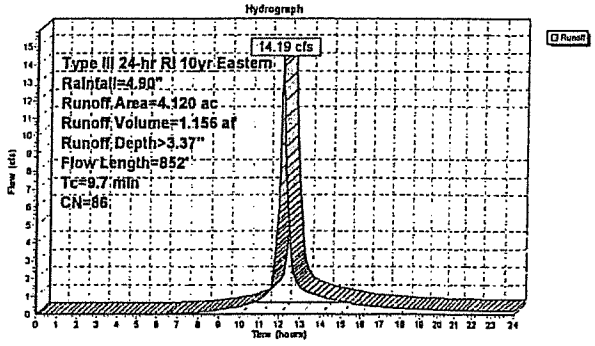
Runoff = 14.19 cfs @ 12.13 hrs, Volume= 1.156 af, Depth> 3.37"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 10yr Eastern Rainfall=4.90"

Area (ac)	CN	Description
1.240	81	1/3 acre lots, 30% Imp, HSG C
2.470	91	Urban Industrial, 72% Imp, HSG C
0.410	74	>75% Grass cover, Good, HSG C
4.120	86	Weighted Average
1.970		Pervious Area
2.150		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.0	100	0.0300	1.67		Sheet Flow, A-B Smooth surfaces n= 0.011 P2= 3.40"
8.7	752	0.0050	1.44		Shallow Concentrated Flow, B-C Paved Kv= 20.3 fps
9.7	852	Total			

Subcatchment 37S: Sub-watershed 37



Subcatchment 38S: Sub-watershed 38

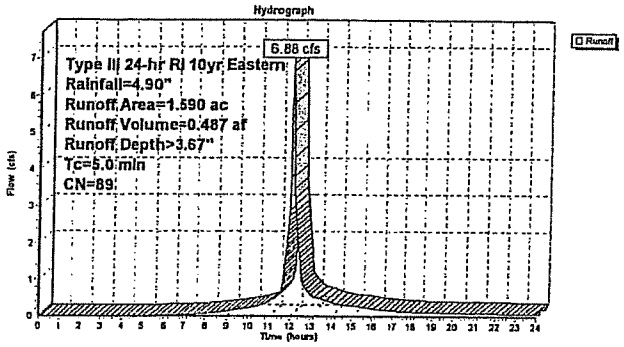
Runoff = 6.88 cfs @ 12.07 hrs, Volume= 0.487 af, Depth> 3.67"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 10yr Eastern Rainfall=4.90"

Area (ac)	CN	Description
0.160	91	Urban Industrial, 72% Imp, HSG C
0.320	79	Pasture/grassland/range, Fair, HSG C
1.110	91	Urban Industrial, 72% Imp, HSG C
1.590	89	Weighted Average
0.676		Pervious Area
0.914		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry, A-C

Subcatchment 38S: Sub-watershed 38



Subcatchment 39S: Sub-watershed 39

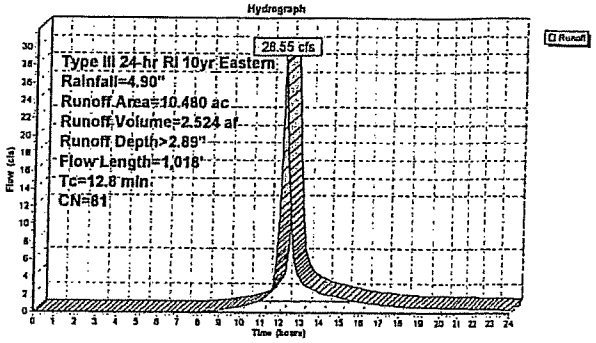
Runoff = 28.55 cfs @ 12.18 hrs, Volume= 2.524 af, Depth> 2.89"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 10yr Eastern Rainfall=4.90"

Area (ac)	CN	Description
0.520	79	Pasture/grassland/range, Fair, HSG C
9.960	81	1/3 acre lots, 30% Imp, HSG C
10.480	81	Weighted Average
7.492		Pervious Area
2.988		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.1	100	0.0600	0.27		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
1.8	212	0.0750	1.92		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
2.0	387	0.0260	3.27		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
2.9	319	0.0690	1.84		Shallow Concentrated Flow, D-E Short Grass Pasture Kv= 7.0 fps
12.8	1,018	Total			

Subcatchment 39S: Sub-watershed 39



Subcatchment 40S: Sub-watershed 40

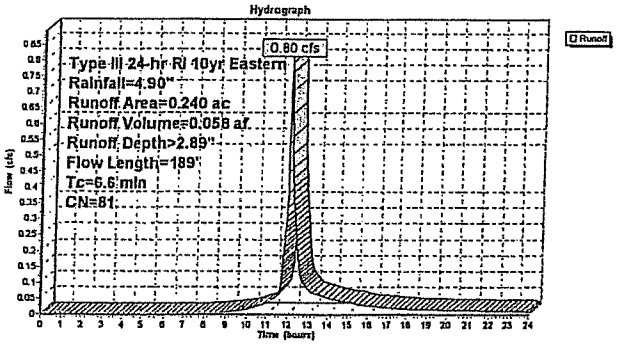
Runoff = 0.80 cfs @ 12.10 hrs, Volume= 0.058 af, Depth> 2.89"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 10yr Eastern Rainfall=4.90"

Area (ac)	CN	Description
0.240	81	1/3 acre lots, 30% Imp, HSG C
0.168		Pervious Area
0.072		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.1	100	0.0600	0.27		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
0.5	89	0.1500	2.71		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
6.6	189	Total			

Subcatchment 40S: Sub-watershed 40



Subcatchment 41S: Sub-watershed 41

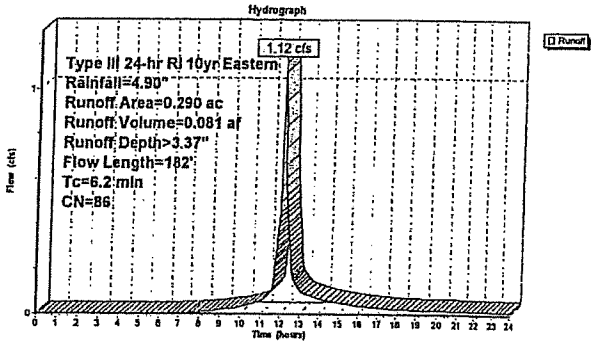
Runoff = 1.12 cfs @ 12.09 hrs, Volume= 0.081 af, Depth> 3.37"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 10yr Eastern Rainfall=4.90"

Area (ac)	CN	Description
0.290	86	Pasture/grassland/range, Poor, HSG C
0.290		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.5	100	0.0800	0.31		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
0.7	82	0.0730	1.89		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
6.2	182	Total			

Subcatchment 41S: Sub-watershed 41



Subcatchment 42S: Sub-watershed 42

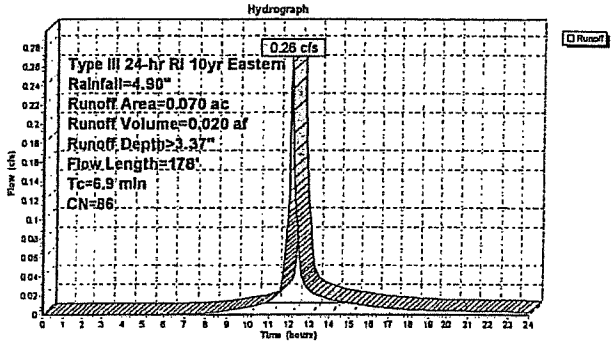
Runoff = 0.26 cfs @ 12.10 hrs, Volume= 0.020 af, Depth> 3.37"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 10yr Eastern Rainfall=4.90"

Area (ac)	CN	Description
0.070	86	Pasture/grassland/range, Poor, HSG C
0.070		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.1	100	0.0600	0.27		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
0.8	78	0.0510	1.58		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
6.9	178	Total			

Subcatchment 42S: Sub-watershed 42



Subcatchment 43S: Sub-watershed 43

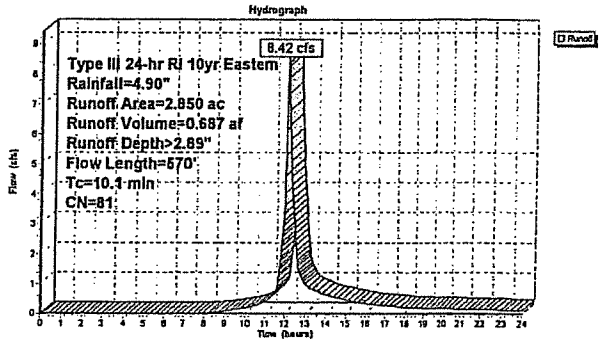
Runoff = 8.42 cfs @ 12.14 hrs, Volume= 0.687 af, Depth> 2.89"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 10yr Eastern Rainfall=4.90"

Area (ac)	CN	Description
2.850	81	1/3 acre lots, 30% Imp, HSG C
1.995		Pervious Area
0.855		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.1	100	0.0600	0.27		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
1.8	228	0.0880	2.08		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
1.7	206	0.0100	2.03		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
0.5	36	0.0280	1.17		Shallow Concentrated Flow, D-E Short Grass Pasture Kv= 7.0 fps
10.1	570	Total			

Subcatchment 43S: Sub-watershed 43



Subcatchment 44S: Sub-watershed 44

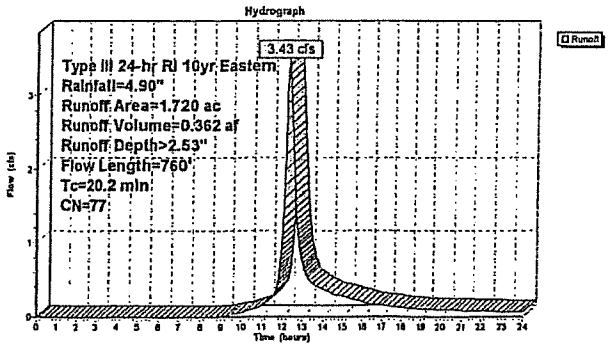
Runoff = 3.43 cfs @ 12.28 hrs, Volume= 0.362 af, Depth> 2.53"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 10yr Eastern Rainfall=4.90"

Area (ac)	CN	Description
0.860	81	1/3 acre lots, 30% Imp, HSG C
0.860	73	Woods, Fair, HSG C
1.720	77	Weighted Average
1.462		Pervious Area
0.258		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.4	100	0.0500	0.12		Sheet Flow, A-B Woods: Light underbrush n= 0.400 P2= 3.40"
4.3	262	0.0420	1.02		Shallow Concentrated Flow, B-C Woodland Kv= 5.0 fps
1.5	398	0.0450	4.31		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
20.2	760	Total			

Subcatchment 44S: Sub-watershed 44



Subcatchment 45S: Sub-watershed 45

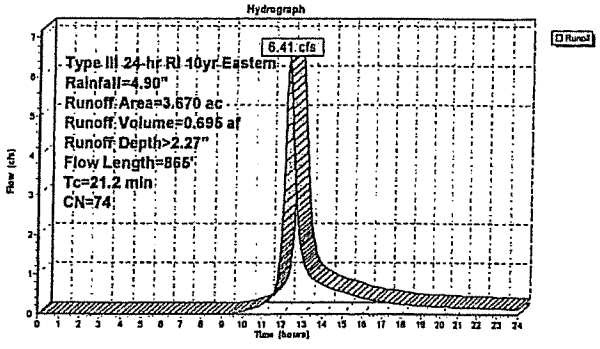
Runoff = 6.41 cfs @ 12.30 hrs, Volume= 0.695 af, Depth> 2.27"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 10yr Eastern Rainfall=4.90"

Area (ac)	CN	Description
3.120	73	Woods, Fair, HSG C
0.180	81	1/3 acre lots, 30% Imp, HSG C
0.370	82	Woods/grass comb., Poor, HSG C
3.670	74	Weighted Average
3.616		Pervious Area
0.054		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.1	100	0.0300	0.21		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
13.1	765	0.0380	0.97		Shallow Concentrated Flow, B-C Woodland Kv= 5.0 fps
21.2	865	Total			

Subcatchment 45S: Sub-watershed 45



Subcatchment 46S: Sub-watershed 46

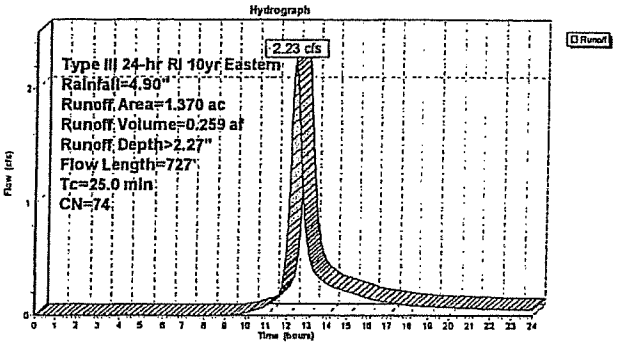
Runoff = 2.23 cfs @ 12.36 hrs, Volume= 0.259 af, Depth> 2.27"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 10yr Eastern Rainfall=4.90"

Area (ac)	CN	Description
1.230	73	Woods, Fair, HSG C
0.140	82	Woods/grass comb., Poor, HSG C
1.370	74	Weighted Average
1.370		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.8	100	0.0400	0.11		Sheet Flow, A-B Woods: Light underbrush n= 0.400 P2= 3.40"
7.6	373	0.0270	0.82		Shallow Concentrated Flow, B-C Woodland Kv= 5.0 fps
1.6	254	0.0160	2.57		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
25.0	727	Total			

Subcatchment 46S: Sub-watershed 46



Subcatchment 47S: Sub-watershed 47

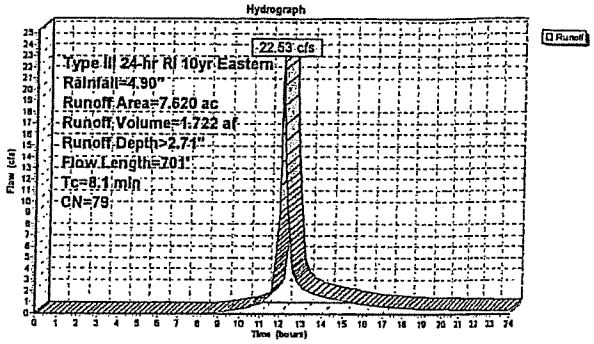
Runoff = 22.53 cfs @ 12.12 hrs, Volume= 1.722 af, Depth> 2.71"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 10yr Eastern Rainfall=4.90"

Area (ac)	CN	Description
7.620	79	50-75% Grass cover, Fair, HSG C
7.620		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0	100	0.1000	0.33		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
0.2	20	0.0500	1.57		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
2.9	581	0.0280	3.40		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
8.1	701	Total			

Subcatchment 47S: Sub-watershed 47



Subcatchment 48S: Sub-watershed 48

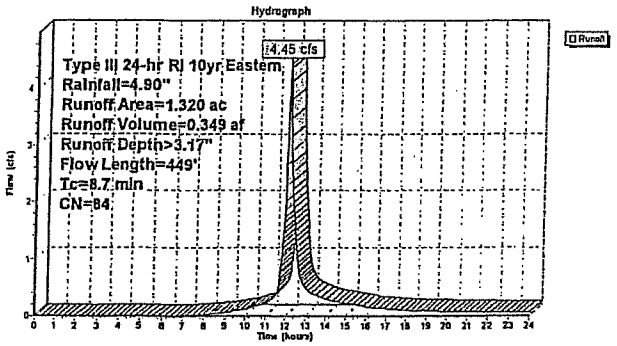
Runoff = 4.45 cfs @ 12.12 hrs, Volume= 0.349 af, Depth> 3.17"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 10yr Eastern Rainfall=4.90"

Area (ac)	CN	Description
1.320	84	50-75% Grass cover, Fair, HSG D
1.320		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.1	100	0.0600	0.27		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
0.4	39	0.0510	1.58		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
2.2	310	0.0130	2.31		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
8.7	449	Total			

Subcatchment 48S: Sub-watershed 48



Subcatchment 49S: Sub-watershed 49

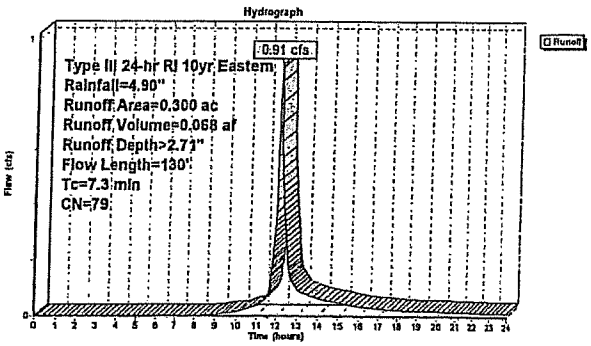
Runoff = 0.91 cfs @ 12.11 hrs, Volume= 0.068 af, Depth> 2.71"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 10yr Eastern Rainfall=4.90"

Area (ac)	CN	Description
0.300	79	50-75% Grass cover, Fair, HSG C
0.300		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.2	100	0.0400	0.23		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
0.1	11	0.1800	2.97		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
0.0	19	0.1100	6.73		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
7.3	130	Total			

Subcatchment 49S: Sub-watershed 49



Subcatchment 50S: Sub-watershed 50

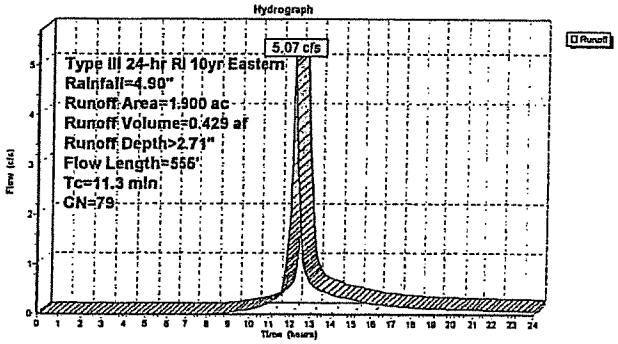
Runoff = 5.07 cfs @ 12.16 hrs, Volume= 0.429 af, Depth> 2.71"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 10yr Eastern Rainfall=4.90"

Area (ac)	CN	Description
1.900	79	50-75% Grass cover, Fair, HSG C
1.900		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.6	100	0.0500	0.25		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
4.5	419	0.0500	1.57		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
0.2	36	0.0170	2.65		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
11.3	555	Total			

Subcatchment 50S: Sub-watershed 50



Subcatchment 51S: Sub-wateshed 51

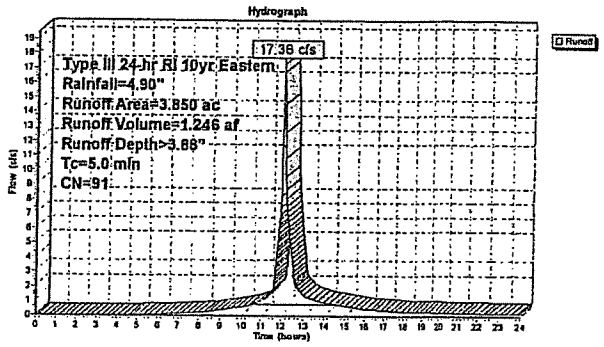
Runoff = 17.36 cfs @ 12.07 hrs, Volume= 1.246 af, Depth> 3.86"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 10yr Eastern Rainfall=4.90"

Area (ac)	CN	Description
3.850	91	Urban industrial, 72% imp, HSG C
1.078		Pervious Area
2.772		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry, A-C

Subcatchment 51S: Sub-wateshed 51



Subcatchment 52S: Sub-watershed 52

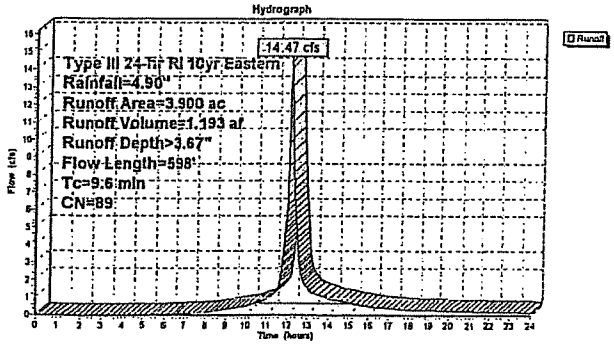
Runoff = 14.47 cfs @ 12.13 hrs, Volume= 1.193 af, Depth> 3.67"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 10yr Eastern Rainfall=4.90"

Area (ac)	CN	Description
3.510	90	1/8 acre lots, 65% Imp, HSG C
0.390	79	50-75% Grass cover, Fair, HSG C
3.900	89	Weighted Average
1.618		Pervious Area
2.282		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.6	100	0.1200	0.36		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
1.9	108	0.0190	0.96		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
2.8	361	0.0110	2.13		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
0.3	29	0.0690	1.84		Shallow Concentrated Flow, D-E Short Grass Pasture Kv= 7.0 fps
9.6	598	Total			

Subcatchment 52S: Sub-watershed 52



Subcatchment 53S: Sub-watershed 53

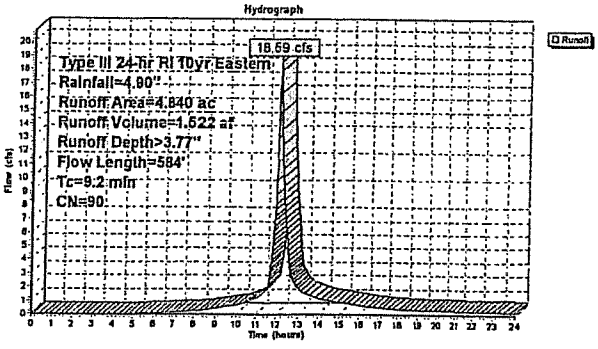
Runoff = 18.59 cfs @ 12.13 hrs, Volume= 1.522 af, Depth> 3.77"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 10yr Eastern Rainfall=4.90"

Area (ac)	CN	Description
4.840	90	1/8 acre lots, 65% Imp, HSG C
1.694		Pervious Area
3.146		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.6	100	0.0500	0.25		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
0.3	33	0.0610	1.73		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
2.3	451	0.0270	3.34		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
9.2	584	Total			

Subcatchment 53S: Sub-watershed 53



Subcatchment 54S: Sub-watershed 54

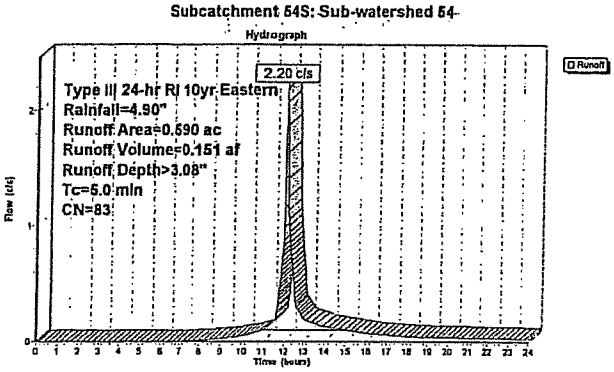
Runoff = 2.20 cfs @ 12.07 hrs, Volume= 0.151 af, Depth> 3.08"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 10yr Eastern Rainfall=4.90"

Area (ac)	CN	Description
0.590	83	1/4 acre lots, 38% Imp, HSG C
0.366		Pervious Area
0.224		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry, A-C

Subcatchment 54S: Sub-watershed 54



Subcatchment 55S: Sub-watershed 55

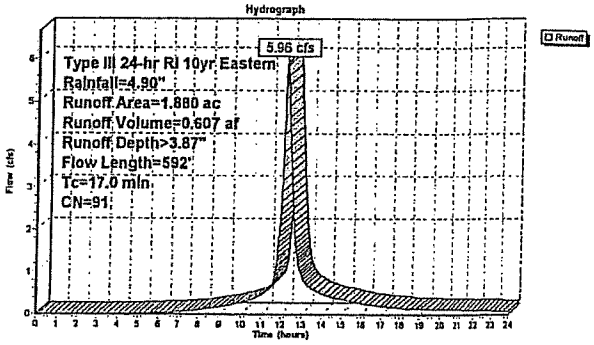
Runoff = 5.96 cfs @ 12.22 hrs, Volume= 0.607 af, Depth> 3.87"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 10yr Eastern Rainfall=4.90"

Area (ac)	CN	Description
1.880	91	Urban Industrial, 72% Imp, HSG C
0.526		Pervious Area
1.354		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.5	100	0.0100	0.13		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
4.5	492	0.0080	1.82		Shallow Concentrated Flow, B-C Paved Kv= 20.3 fps
17.0	592	Total			

Subcatchment 55S: Sub-watershed 55



Subcatchment 56S: Sub-watershed 56

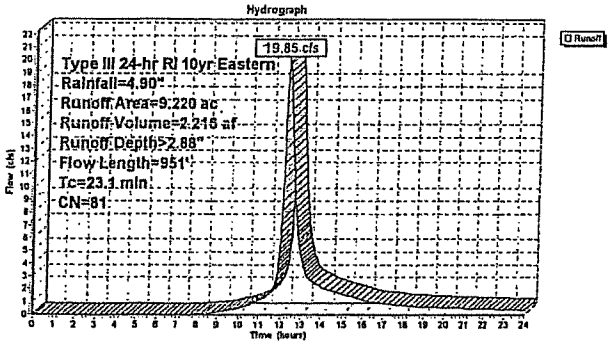
Runoff = 19.85 cfs @ 12.32 hrs, Volume= 2.216 af, Depth> 2.88"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 10yr Eastern Rainfall=4.90"

Area (ac)	CN	Description
9.220	81	1/3 acre lots, 30% Imp, HSG C
6.454		Pervious Area
2.766		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.5	100	0.0100	0.13		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
5.7	228	0.0090	0.66		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
4.9	623	0.0110	2.13		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
23.1	951	Total			

Subcatchment 56S: Sub-watershed 56



Subcatchment 57S: Sub-watershed 57

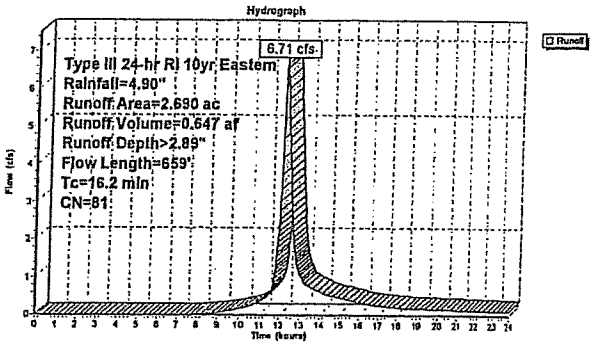
Runoff = 6.71 cfs @ 12.22 hrs, Volume= 0.647 af, Depth> 2.89"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 10yr Eastern Rainfall=4.90"

Area (ac)	CN	Description
2.690	81	1/3 acre lots, 30% Imp, HSG C
1.883		Pervious Area
0.807		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.4	100	0.0370	0.22		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
6.4	190	0.0050	0.49		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
2.2	349	0.0170	2.65		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
0.2	20	0.0500	1.57		Shallow Concentrated Flow, D-E Short Grass Pasture Kv= 7.0 fps
16.2	659	Total			

Subcatchment 57S: Sub-watershed 57



Subcatchment 58S: Sub-watershed 58

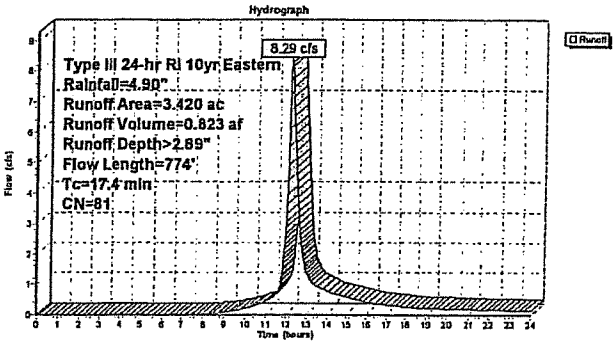
Runoff = 8.29 cfs @ 12.24 hrs, Volume= 0.823 af, Depth> 2.89"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 10yr Eastern Rainfall=4.90"

Area (ac)	CN	Description
3.420	81	1/3 acre lots, 30% Imp, HSG C
2.394		Pervious Area
1.026		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.5	100	0.0100	0.13		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
1.1	74	0.0270	1.15		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
3.8	600	0.0170	2.65		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
17.4	774	Total			

Subcatchment 58S: Sub-watershed 58



Subcatchment 59S: Sub-watershed 59

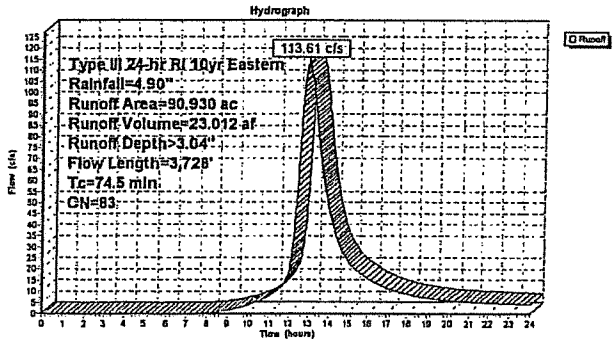
Runoff = 113.61 cfs @ 13.00 hrs, Volume= 23.012 af, Depth> 3.04"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 10yr Eastern Rainfall=4.90"

Area (ac)	CN	Description
35.570	83	1/4 acre lots, 38% Imp, HSG C
15.400	79	Pasture/grassland/range, Fair, HSG C
13.820	94	Urban commercial, 85% Imp, HSG C
2.410	91	Urban Industrial, 72% Imp, HSG C
8.840	86	Woods/grass comb., Poor, HSG D
12.190	73	Woods, Fair, HSG C
2.700	79	Pasture/grassland/range, Fair, HSG C
90.930	83	Weighted Average
63.931		Pervious Area
26.999		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.5	100	0.0050	0.10		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
49.4	2,858	0.0190	0.96		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
1.2	48	0.0010	0.64		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
2.9	164	0.0180	0.94		Shallow Concentrated Flow, D-E Short Grass Pasture Kv= 7.0 fps
3.5	377	0.0080	1.82		Shallow Concentrated Flow, E-F Paved Kv= 20.3 fps
1.0	181	0.0220	3.01		Shallow Concentrated Flow, F-G Paved Kv= 20.3 fps
74.5	3,728	Total			

Subcatchment 59S: Sub-watershed 59



Subcatchment 60S: Sub-watershed 60

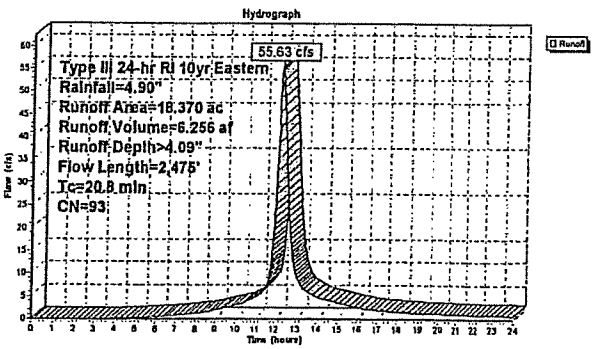
Runoff = 55.63 cfs @ 12.27 hrs, Volume= 6.256 af, Depth> 4.09"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 10yr Eastern Rainfall=4.90"

Area (ac)	CN	Description
5.510	91	Urban Industrial, 72% Imp, HSG C
12.860	94	Urban commercial, 85% Imp, HSG C
18.370	93	Weighted Average
3.472		Pervious Area
14.898		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.2	100	0.0400	0.23		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
0.6	83	0.1100	2.32		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
13.0	2,292	0.0210	2.94		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
20.8	2,475	Total			

Subcatchment 60S: Sub-watershed 60



Subcatchment 61S: Sub-watershed 61

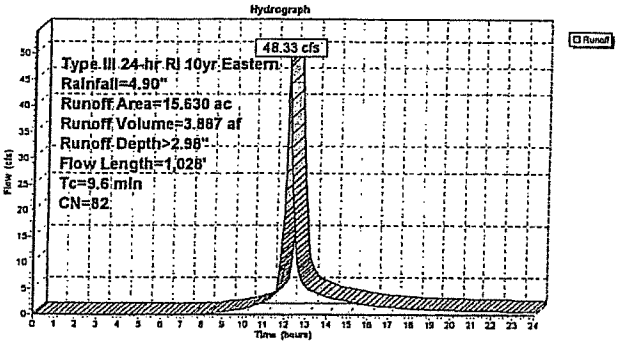
Runoff = 48.33 cfs @ 12.13 hrs, Volume= 3.887 af, Depth> 2.98"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 10yr Eastern Rainfall=4.90"

Area (ac)	CN	Description
14.070	81	1/3 acre lots, 30% Imp, HSG C
1.560	94	Urban commercial, 85% Imp, HSG C
15.630	82	Weighted Average
10.083		Pervious Area
5.547		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.8	100	0.0700	0.29		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
1.2	132	0.0700	1.85		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
2.6	796	0.0630	5.10		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
9.6	1,028	Total			

Subcatchment 61S: Sub-watershed 61



Subcatchment 62S: Sub-watershed 62

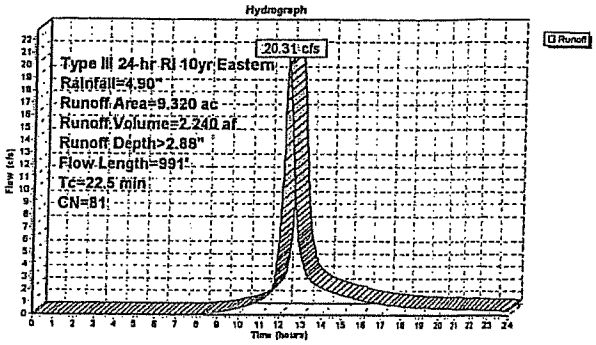
Runoff = 20.31 cfs @ 12.31 hrs, Volume= 2.240 af, Depth> 2.88"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 10yr Eastern Rainfall=4.90"

Area (ac)	CN	Description
9.320	81	1/3 acre lots, 30% Imp, HSG C
6.524		Pervious Area
2.796		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.5	100	0.0100	0.13		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
5.2	169	0.0060	0.54		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
4.8	722	0.0150	2.49		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
22.5	991	Total			

Subcatchment 62S: Sub-watershed 62



Subcatchment 63S: Sub-watershed 63

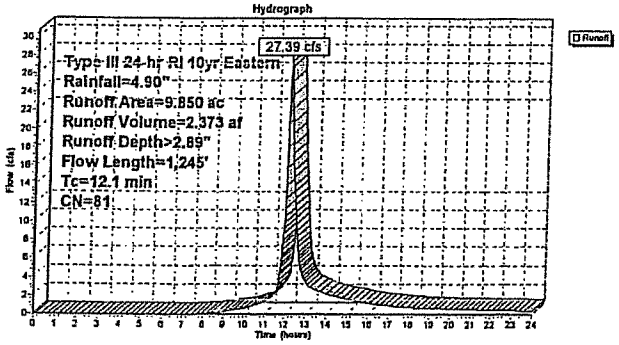
Runoff = 27.39 cfs @ 12.17 hrs, Volume= 2.373 af, Depth> 2.89"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 10yr Eastern Rainfall=4.90"

Area (ac)	CN	Description
9.850	81	1/3 acre lots, 30% Imp, HSG C
6.895		Pervious Area
2.955		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.9	37	0.0540	0.21		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
0.6	63	0.0460	1.83		Sheet Flow, B-C Smooth surfaces n= 0.011 P2= 3.40"
0.6	118	0.0250	3.21		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
2.0	188	0.0480	1.53		Shallow Concentrated Flow, D-E Short Grass Pasture Kv= 7.0 fps
6.0	839	0.0130	2.31		Shallow Concentrated Flow, E-F Paved Kv= 20.3 fps
12.1	1,245	Total			

Subcatchment 63S: Sub-watershed 63



Subcatchment 64S: Sub-watershed 64

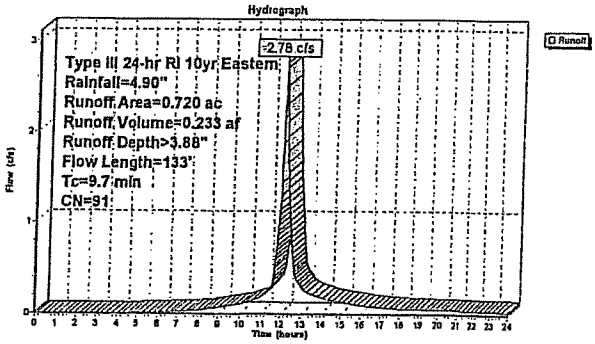
Runoff = 2.78 cfs @ 12.13 hrs, Volume= 0.233 af, Depth> 3.88"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 10yr Eastern Rainfall=4.90"

Area (ac)	CN	Description
0.720	91	Urban Industrial, 72% Imp, HSG C
0.202		Pervious Area
0.518		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.2	100	0.0400	0.23		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
2.5	33	0.0010	0.22		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
9.7	133	Total			

Subcatchment 64S: Sub-watershed 64



Subcatchment 65S: Sub-watershed 65

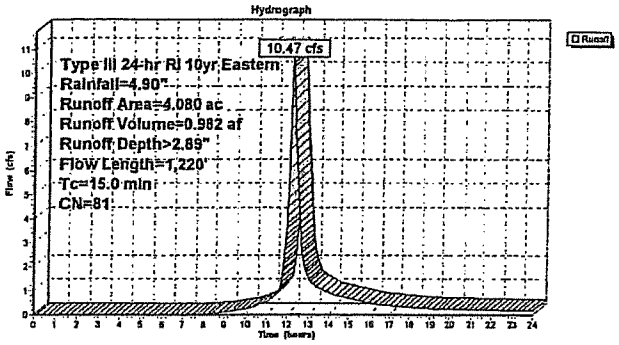
Runoff = 10.47 cfs @ 12.21 hrs, Volume= 0.982 af, Depth> 2.89"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 10yr Eastern Rainfall=4.90"

Area (ac)	CN	Description
4.080	81	1/3 acre lots, 30% imp, HSG C
2.856		Pervious Area
1.224		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.2	86	0.0300	0.20		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
0.3	14	0.0100	0.73		Sheet Flow, B-C Smooth surfaces n= 0.011 P2= 3.40"
7.5	1,120	0.0150	2.49		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
15.0	1,220	Total			

Subcatchment 65S: Sub-watershed 65



Subcatchment 66S: Su-watershed 66

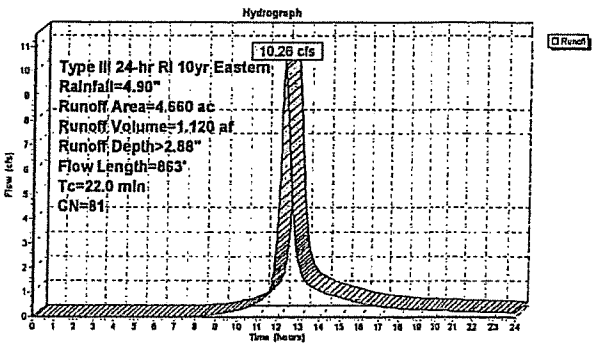
Runoff = 10.26 cfs @ 12.30 hrs, Volume= 1.120 af, Depth> 2.88"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 10yr Eastern Rainfall=4.90"

Area (ac)	CN	Description
4.660	81	1/3 acre lots, 30% imp, HSG C
3.262		Pervious Area
1.398		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.4	100	0.0060	0.11		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
1.2	103	0.0390	1.38		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
5.4	660	0.0100	2.03		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
22.0	863	Total			

Subcatchment 66S: Su-watershed 66



Subcatchment 67S: Sub-watershed 67

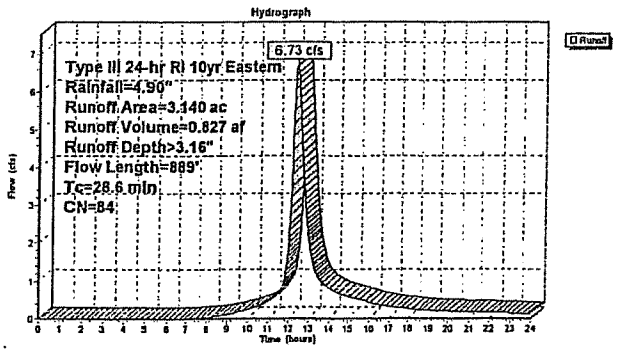
Runoff = 6.73 cfs @ 12.39 hrs, Volume= 0.827 af, Depth> 3.16"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 10yr Eastern Rainfall=4.90"

Area (ac)	CN	Description
0.790	81	1/3 acre lots, 30% imp, HSG C
1.880	88	Fallow, crop residue, Good, HSG C
0.470	73	Woods, Fair, HSG C
3.140	84	Weighted Average
2.903		Pervious Area
0.237		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.5	100	0.0100	0.13		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
4.7	199	0.0200	0.71		Shallow Concentrated Flow, B-C Woodland Kv= 5.0 fps
10.7	490	0.0120	0.77		Shallow Concentrated Flow, C-D Short Grass Pasture Kv= 7.0 fps
0.7	100	0.0120	2.22		Shallow Concentrated Flow, D-E Paved Kv= 20.3 fps
28.6	889	Total			

Subcatchment 67S: Sub-watershed 67



Subcatchment 68S: Sub-watershed 68

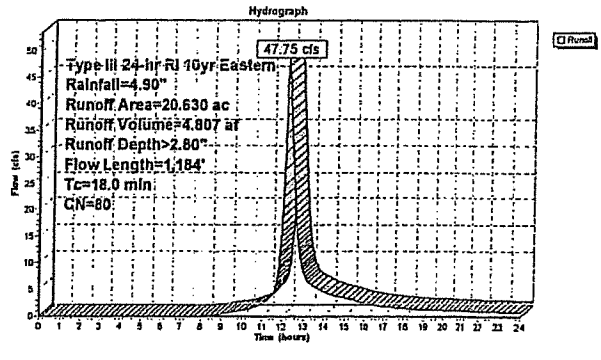
Runoff = 47.75 cfs @ 12.25 hrs, Volume= 4.807 af, Depth> 2.80"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 10yr Eastern Rainfall=4.90"

Area (ac)	CN	Description
2.350	79	Pasture/grassland/range, Fair, HSG C
2.470	88	Fallow, crop residue, Good, HSG C
1.970	70	Brush, Fair, HSG C
5.490	82	Woods/grass comb., Poor, HSG C
2.460	73	Woods, Fair, HSG C
5.890	81	1/3 acre lots, 30% imp, HSG C
20.630	80	Weighted Average
18.863		Pervious Area
1.767		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.3	100	0.0850	0.31		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
12.7	1,084	0.0410	1.42		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
18.0	1,184	Total			

Subcatchment 68S: Sub-watershed 68



Reach 3R: Intermittent Stream

Inflow Area = 21.680 ac, Inflow Depth > 2.86" for RI 10yr Eastern event
Inflow = 43.97 cfs @ 12.41 hrs, Volume= 5.169 af
Outflow = 37.11 cfs @ 12.57 hrs, Volume= 5.139 af, Atten= 16%, Lag= 9.8 min

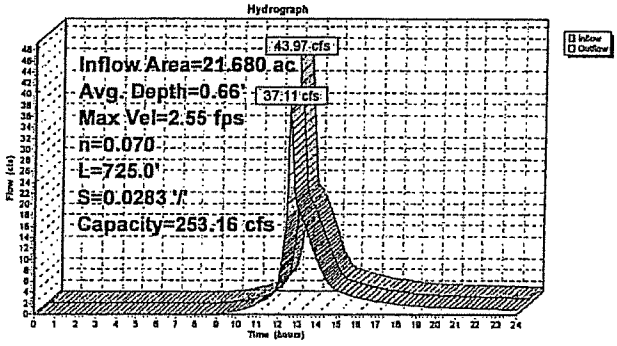
ting by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
. Velocity= 2.55 fps, Min. Travel Time= 4.7 min
.g. Velocity = 0.89 fps, Avg. Travel Time= 13.6 min

Peak Storage= 10,569 cf @ 12.49 hrs, Average Depth at Peak Storage= 0.66'
Bank-Full Depth= 2.00', Capacity at Bank-Full= 253.16 cfs

20.00' x 2.00' deep channel, n= 0.070 Medium-dense brush, winter
Side Slope Z-value= 3.0 '/' Top Width= 32.00'
Length= 725.0' Slope= 0.0283 '/'
Inlet Invert= 113.50', Outlet Invert= 93.00'

‡

Reach 3R: Intermittent Stream



Item C1.

Pond 2P: Highview Pond Existing

Inflow Area = 21.680 ac, Inflow Depth > 2.86" for RI 10yr Eastern event
Inflow = 47.53 cfs @ 12.31 hrs, Volume= 5.211 af
Outflow = 43.97 cfs @ 12.41 hrs, Volume= 5.169 af, Atten= 7%, Lag= 6.3 min
Primary = 43.97 cfs @ 12.41 hrs, Volume= 5.169 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs / 2
Peak Elev= 121.16' @ 12.40 hrs Surf.Area= 6,633 sf Storage= 39,519 cf

Plug-Flow detention time= 24.0 min calculated for 5.169 af (99% of inflow)
Center-of-Mass det. time= 19.2 min (851.4 - 832.3)

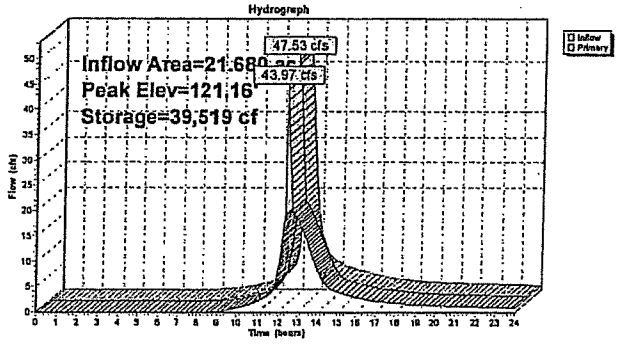
Volume	Invert	Avail.Storage	Storage Description
#1	115.00'	42,295 cf	Custom Stage Data (Prismatic)Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
115.00	4,620	0	0
118.00	6,496	16,674	16,674
121.00	7,936	21,648	38,322
122.00	10	3,973	42,295

Device	Routing	Invert	Outlet Devices
#1	Primary	115.00'	**18.0" x 40.0' long Culvert** RCP, end-section conforming to fill, Ke= 0.500 Outlet Invert= 114.40' S= 0.0150 '/' Cc= 0.900 n= 0.013
#2	Primary	121.00'	**128.0' long x 1.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

Primary OutFlow Max=42.62 cfs @ 12.41 hrs HW=121.16' (Free Discharge)
1=Culvert (Inlet Controls 19.80 cfs @ 11.20 fps)
2=Broad-Crested Rectangular Weir (Weir Controls 22.83 cfs @ 1.09 fps)

Pond 2P: Highview Pond Existing

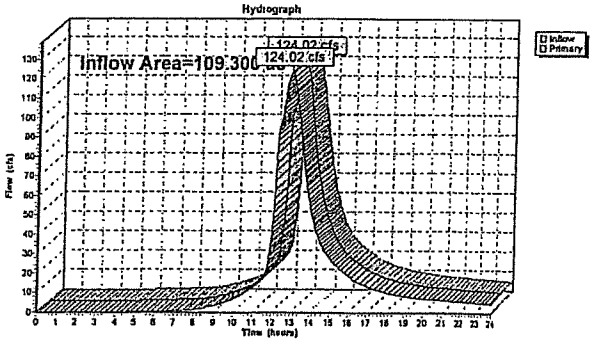


Link 68L: SW 59_SW 60

Inflow Area = 109.300 ac, Inflow Depth > 3.21" for RI 10yr Eastern event
Inflow = 124.02 cfs @ 12.93 hrs, Volume= 29.268 af
Primary = 124.02 cfs @ 12.93 hrs, Volume= 29.268 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

Link 68L: SW 59_SW 60

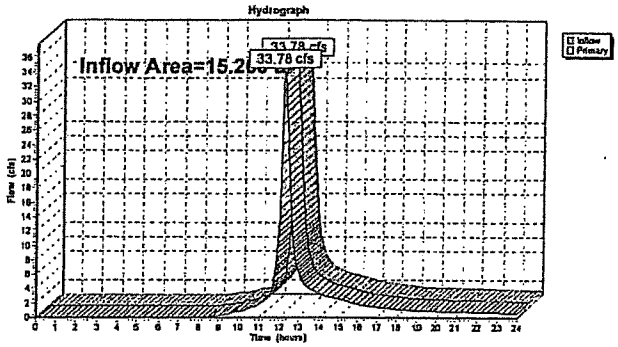


Link 69L: SW 14_SW 17

Inflow Area = 15.280 ac, Inflow Depth > 2.75" for RI 10yr Eastern event
Inflow = 33.78 cfs @ 12.20 hrs, Volume= 3.496 af
Primary = 33.78 cfs @ 12.20 hrs, Volume= 3.496 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

Link 69L: SW 14_SW 17

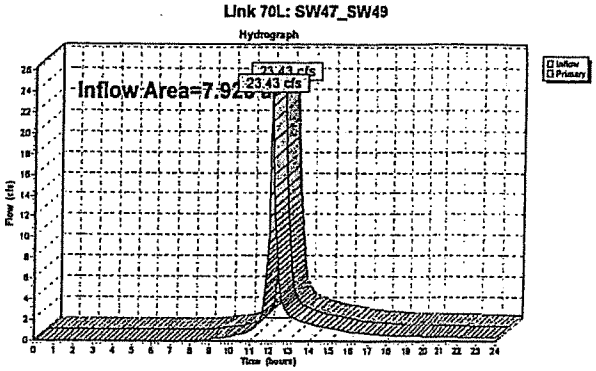


Link 70L: SW47_SW49

Inflow Area = 7.920 ac, Inflow Depth > 2.71" for RI 10yr Eastern event
Inflow = 23.43 cfs @ 12.12 hrs, Volume= 1.790 af
Primary = 23.43 cfs @ 12.12 hrs, Volume= 1.790 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

Link 70L: SW47_SW49

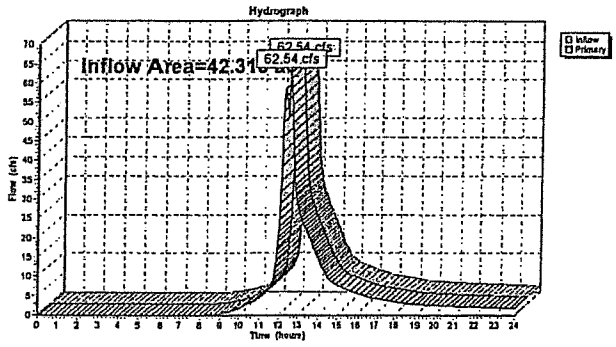


Link 71L: Elbow St

Inflow Area = 42.310 ac, Inflow Depth > 2.82" for RI 10yr Eastern event
Inflow = 62.54 cfs @ 12.54 hrs, Volume= 9.945 af
Primary = 62.54 cfs @ 12.54 hrs, Volume= 9.945 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

Link 71L: Elbow St



25-Year Storm

Time span=0.00-24.00 hrs, dt=0.02 hrs, 1201 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Sub-watershed 1 Runoff Area=16.400 ac Runoff Depth>4.98"
Flow Length=1,460' Tc=20.1 min CN=94 Runoff=67.63 cfs 7.643 af

chment 2S: Sub-watershed 2 Runoff Area=3.220 ac Runoff Depth>4.99"
Flow Length=792' Tc=10.2 min CN=94 Runoff=15.16 cfs 1.340 af

Subcatchment 3S: Sub-watershed 3 Runoff Area=27.500 ac Runoff Depth>3.68"
Flow Length=2,500' Tc=39.3 min CN=82 Runoff=59.31 cfs 8.443 af

Subcatchment 4S: Sub-watershed 4 Runoff Area=35.010 ac Runoff Depth>4.41"
Flow Length=3,096' Tc=50.9 min CN=89 Runoff=76.81 cfs 12.856 af

Subcatchment 5S: Sub-Watershed 5 Runoff Area=2.340 ac Runoff Depth>3.51"
Tc=5.0 min CN=80 Runoff=9.93 cfs 0.684 af

Subcatchment 6dS: Sub-watershed 6d Runoff Area=0.630 ac Runoff Depth>5.00"
Tc=5.0 min CN=94 Runoff=3.51 cfs 0.262 af

Subcatchment 6eS: Sub-watershed 6e Runoff Area=0.500 ac Runoff Depth>5.00"
Tc=5.0 min CN=94 Runoff=2.79 cfs 0.208 af

Subcatchment 6S: Sub-watershed 6 Runoff Area=10.610 ac Runoff Depth>4.33"
Flow Length=1,535' Tc=11.4 min CN=88 Runoff=43.84 cfs 3.828 af

Subcatchment 8S: Sub-watershed 8 Runoff Area=2.070 ac Runoff Depth>3.50"
Flow Length=419' Tc=11.6 min CN=80 Runoff=7.07 cfs 0.604 af

Subcatchment 9S: Sub-watershed 9 Runoff Area=3.780 ac Runoff Depth>4.11"
Flow Length=633' Tc=16.8 min CN=86 Runoff=13.03 cfs 1.296 af

Subcatchment 10S: Sub-watershed 10 Runoff Area=8.740 ac Runoff Depth>3.60"
Flow Length=1,337' Tc=19.3 min CN=83 Runoff=26.56 cfs 2.768 af

Subcatchment 11S: Sub-watershed 11 Runoff Area=24.460 ac Runoff Depth>4.43"
Flow Length=1,757' Tc=26.1 min CN=89 Runoff=74.35 cfs 9.022 af

Subcatchment 12S: Sub-watershed 12 Runoff Area=3.040 ac Runoff Depth>4.65"
Flow Length=996' Tc=15.8 min CN=91 Runoff=11.78 cfs 1.179 af

Subcatchment 13S: Sub-watershed 13 Runoff Area=6.760 ac Runoff Depth>3.61"
Tc=5.0 min CN=81 Runoff=29.45 cfs 2.033 af

Subcatchment 14S: Sub-watershed 14 Runoff Area=8.060 ac Runoff Depth>3.41"
Flow Length=1,715' Tc=11.8 min CN=79 Runoff=26.63 cfs 2.287 af

Subcatchment 15S: Sub-watershed 15 Runoff Area=21.680 ac Runoff Depth>3.60"
Flow Length=1,259' Tc=22.2 min CN=81 Runoff=59.12 cfs 6.498 af

Subcatchment 16S: Sub-watershed 16 Runoff Area=2.740 ac Runoff Depth>3.70"
Flow Length=709' Tc=13.2 min CN=82 Runoff=9.42 cfs 0.846 af

Subcatchment 17S: Sub-watershed 17 Runoff Area=7.200 ac Runoff Depth>3.50"
Flow Length=1,430' Tc=21.6 min CN=80 Runoff=19.32 cfs 2.098 af

Subcatchment 18S: Sub-watershed 18 Runoff Area=13.850 ac Runoff Depth>3.50"
Flow Length=1,868' Tc=11.2 min CN=80 Runoff=47.86 cfs 4.045 af

Subcatchment 19S: Sub-watershed 19 Runoff Area=29.160 ac Runoff Depth>3.17"
Flow Length=2,101' Tc=63.7 min CN=77 Runoff=41.65 cfs 7.714 af

Subcatchment 20S: Sub-watershed 20 Runoff Area=11.220 ac Runoff Depth>3.60"
Flow Length=1,264' Tc=17.0 min CN=81 Runoff=34.15 cfs 3.366 af

Subcatchment 21S: Sub-watershed 21 Runoff Area=2.540 ac Runoff Depth>5.00"
Flow Length=496' Tc=5.5 min CN=94 Runoff=13.94 cfs 1.057 af

Subcatchment 22S: Sub-watershed 22 Runoff Area=6.280 ac Runoff Depth>4.99"
Flow Length=1,194' Tc=7.2 min CN=94 Runoff=32.52 cfs 2.614 af

Subcatchment 23S: Sub-watershed 23 Runoff Area=0.900 ac Runoff Depth>5.00"
Tc=5.0 min CN=94 Runoff=5.02 cfs 0.375 af

Subcatchment 24S: Sub-watershed 24 Runoff Area=5.430 ac Runoff Depth>4.65"
Flow Length=1,015' Tc=12.7 min CN=91 Runoff=22.80 cfs 2.106 af

Subcatchment 25S: Sub-watershed 25 Runoff Area=7.910 ac Runoff Depth>3.50"
Flow Length=943' Tc=13.6 min CN=80 Runoff=25.52 cfs 2.309 af

Subcatchment 26S: Sub-watershed 26 Runoff Area=0.040 ac Runoff Depth>5.46"
Tc=5.0 min CN=98 Runoff=0.23 cfs 0.018 af

Subcatchment 27S: Sub-watershed 27 Runoff Area=0.090 ac Runoff Depth>3.81"
Tc=5.0 min CN=83 Runoff=0.41 cfs 0.029 af

Subcatchment 28S: Sub-watershed 28 Runoff Area=4.430 ac Runoff Depth>3.50"
Flow Length=1,025' Tc=22.5 min CN=80 Runoff=11.69 cfs 1.291 af

Subcatchment 29S: Sub-watershed 29 Runoff Area=9.890 ac Runoff Depth>3.70"
Flow Length=1,194' Tc=11.1 min CN=82 Runoff=36.09 cfs 3.053 af

Subcatchment 30S: Sub-watershed 30 Runoff Area=1.680 ac Runoff Depth>3.60"
Flow Length=716' Tc=13.0 min CN=81 Runoff=5.66 cfs 0.504 af

Subcatchment 31S: Sub-watershed 31 Runoff Area=27.350 ac Runoff Depth>3.20"
Flow Length=1,762' Tc=27.7 min CN=77 Runoff=60.47 cfs 7.294 af

Subcatchment 32S: Sub-watershed32 Runoff Area=45.010 ac Runoff Depth>2.92"
Flow Length=1,805' Tc=26.8 min CN=74 Runoff=91.86 cfs 10.943 af

Subcatchment 33S: Sub-watershed 33 Runoff Area=27.500 ac Runoff Depth>3.60"
Flow Length=1,541' Tc=10.9 min CN=81 Runoff=98.48 cfs 8.260 af

Subcatchment 34S: Sub-watershed 34 Runoff Area=5.470 ac Runoff Depth>3.60"
Flow Length=967' Tc=16.4 min CN=81 Runoff=16.88 cfs 1.641 af

Subcatchment 35S: Sub-watershed 35 Runoff Area=2.020 ac Runoff Depth>4.33"
Flow Length=401' Tc=11.6 min CN=88 Runoff=8.30 cfs 0.729 af

Subcatchment 36S: Sub-watershed 36 Runoff Area=114.100 ac Runoff Depth>3.79"
Flow Length=4,314' Tc=29.2 min CN=83 Runoff=289.78 cfs 36.069 af

Subcatchment 37S: Sub-watershed 37 Runoff Area=4.120 ac Runoff Depth>4.12"
Flow Length=852' Tc=9.7 min CN=86 Runoff=17.22 cfs 1.414 af

Subcatchment 38S: Sub-watershed 38 Runoff Area=1.590 ac Runoff Depth>4.44"
Tc=5.0 min CN=89 Runoff=8.24 cfs 0.589 af

Subcatchment 39S: Sub-watershed 39 Runoff Area=10.480 ac Runoff Depth>3.60"
Flow Length=1,018' Tc=12.8 min CN=81 Runoff=35.50 cfs 3.147 af

Subcatchment 40S: Sub-watershed 40 Runoff Area=0.240 ac Runoff Depth>3.61"
Flow Length=189' Tc=6.6 min CN=81 Runoff=0.99 cfs 0.072 af

Subcatchment 41S: Sub-watershed 41 Runoff Area=0.290 ac Runoff Depth>4.12"
Flow Length=182' Tc=6.2 min CN=86 Runoff=1.36 cfs 0.100 af

Subcatchment 42S: Sub-watershed 42 Runoff Area=0.070 ac Runoff Depth>4.12"
Flow Length=178' Tc=5.9 min CN=86 Runoff=0.32 cfs 0.024 af

Subcatchment 43S: Sub-watershed 43 Runoff Area=2.850 ac Runoff Depth>3.60"
Flow Length=570' Tc=10.1 min CN=81 Runoff=10.46 cfs 0.856 af

Subcatchment 44S: Sub-watershed 44 Runoff Area=1.720 ac Runoff Depth>3.21"
Flow Length=760' Tc=20.2 min CN=77 Runoff=4.36 cfs 0.459 af

Subcatchment 45S: Sub-watershed 45 Runoff Area=3.670 ac Runoff Depth>2.92"
Flow Length=865' Tc=21.2 min CN=74 Runoff=8.28 cfs 0.893 af

Subcatchment 46S: Sub-watershed 46 Runoff Area=1.370 ac Runoff Depth>2.92"
Flow Length=727' Tc=25.0 min CN=74 Runoff=2.88 cfs 0.333 af

atchment 47S: Sub-watershed 47 Runoff Area=7.620 ac Runoff Depth>3.41"
Flow Length=701' Tc=8.1 min CN=79 Runoff=28.28 cfs 2.164 af

Subcatchment 48S: Sub-watershed 48 Runoff Area=1.320 ac Runoff Depth>3.91"
Flow Length=449' Tc=8.7 min CN=84 Runoff=5.45 cfs 0.430 af

Subcatchment 49S: Sub-watershed 49 Runoff Area=0.300 ac Runoff Depth>3.41"
Flow Length=130' Tc=7.3 min CN=79 Runoff=1.14 cfs 0.085 af

Subcatchment 50S: Sub-watershed 50 Runoff Area=1.900 ac Runoff Depth>3.41"
Flow Length=555' Tc=11.3 min CN=79 Runoff=5.37 cfs 0.539 af

Subcatchment 51S: Sub-wateshed 51 Runoff Area=3.650 ac Runoff Depth>4.66"
Tc=5.0 min CN=91 Runoff=20.63 cfs 1.495 af

Subcatchment 52S: Sub-watershed 52 Runoff Area=3.900 ac Runoff Depth>4.44"
Flow Length=598' Tc=9.6 min CN=89 Runoff=17.34 cfs 1.443 af

Subcatchment 53S: Sub-watershed 53 Runoff Area=4.840 ac Runoff Depth>4.55"
Flow Length=584' Tc=9.2 min CN=90 Runoff=22.19 cfs 1.834 af

Subcatchment 54S: Sub-watershed 54 Runoff Area=0.590 ac Runoff Depth>3.81"
Tc=5.0 min CN=83 Runoff=2.70 cfs 0.187 af

Subcatchment 55S: Sub-watershed 55 Runoff Area=1.880 ac Runoff Depth>4.65"
Flow Length=592' Tc=17.0 min CN=91 Runoff=7.09 cfs 0.729 af

Subcatchment 56S: Sub-watershed 56 Runoff Area=9.220 ac Runoff Depth>3.60"
Flow Length=951' Tc=23.1 min CN=81 Runoff=24.69 cfs 2.763 af

Subcatchment 57S: Sub-watershed 57 Runoff Area=2.690 ac Runoff Depth>3.60"
Flow Length=659' Tc=16.2 min CN=81 Runoff=8.35 cfs 0.807 af

Subcatchment 58S: Sub-watershed 58 Runoff Area=3.420 ac Runoff Depth>3.60"
Flow Length=774' Tc=17.4 min CN=81 Runoff=10.31 cfs 1.026 af

Subcatchment 59S: Sub-watershed 59 Runoff Area=80.930 ac Runoff Depth>3.76"
Flow Length=3,728' Tc=74.5 min CN=83 Runoff=140.11 cfs 28.477 af

Subcatchment 60S: Sub-watershed 60 Runoff Area=18.370 ac Runoff Depth>4.87"
Flow Length=2,475' Tc=20.8 min CN=93 Runoff=55.69 cfs 7.457 af

Subcatchment 61S: Sub-watershed 61 Runoff Area=15.630 ac Runoff Depth>3.71"
Flow Length=1,028' Tc=9.6 min CN=82 Runoff=59.76 cfs 4.827 af

Subcatchment 62S: Sub-watershed 62 Runoff Area=9.320 ac Runoff Depth>3.60"
Flow Length=991' Tc=22.5 min CN=81 Runoff=25.24 cfs 2.793 af

Subcatchment 63S: Sub-watershed 63 Runoff Area=9.850 ac Runoff Depth>3.60"
Flow Length=1,245' Tc=12.1 min CN=81 Runoff=34.05 cfs 2.958 af

Subcatchment 64S: Sub-watershed 64 Runoff Area=0.720 ac Runoff Depth>4.66"
Flow Length=133' Tc=9.7 min CN=91 Runoff=3.30 cfs 0.279 af

Subcatchment 65S: Sub-watershed 65 Runoff Area=4.080 ac Runoff Depth>3.60"
Flow Length=1,220' Tc=15.0 min CN=81 Runoff=13.02 cfs 1.225 af

Subcatchment 6S: Su-watershed 6 Runoff Area=4.660 ac Runoff Depth>3.60"
Flow Length=863' Tc=22.0 min CN=81 Runoff=12.76 cfs 1.397 af

Subcatchment 7S: Sub-watershed 7 Runoff Area=3.140 ac Runoff Depth>3.90"
Flow Length=869' Tc=28.6 min CN=84 Runoff=8.25 cfs 1.020 af

Subcatchment 8S: Sub-watershed 8 Runoff Area=20.630 ac Runoff Depth>3.50"
Flow Length=1,184' Tc=18.0 min CN=80 Runoff=59.68 cfs 6.017 af

Reach 3R: Intermittent Stream Avg. Depth=0.81' Max Vel=2.89 fps Inflow=58.87 cfs 6.445 af
n=0.070 L=725.0' S=0.0283 '/' Capacity=253.16 cfs Outflow=52.64 cfs 6.412 af

Pond 2P: Highview Pond Existing Peak Elev=121.23' Storage=39,958 cf Inflow=59.12 cfs 6.498 af
Outflow=58.87 cfs 6.445 af

Link 68L: SW 59_SW 60 Inflow=152.48 cfs 35.934 af
Primary=152.48 cfs 35.934 af

Link 69L: SW 14_SW 17 Inflow=42.40 cfs 4.386 af
Primary=42.40 cfs 4.386 af

Link 70L: SW47_SW49 Inflow=29.41 cfs 2.249 af
Primary=29.41 cfs 2.249 af

Link 71L: Elbow St Inflow=91.35 cfs 12.428 af
Primary=91.35 cfs 12.428 af

Total Runoff Area = 746.870 ac Runoff Volume = 235.154 af Average Runoff Depth = 3.78"
66.54% Pervious Area = 496.954 ac 33.46% Impervious Area = 249.916 ac

Subcatchment 1S: Sub-watershed 1

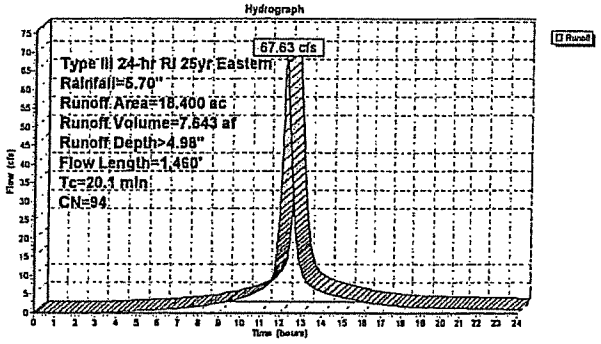
Runoff = 67.63 cfs @ 12.26 hrs, Volume= 7.643 af, Depth> 4.98"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 25yr Eastern Rainfall=5.70"

Area (ac)	CN	Description
18.400	94	Urban commercial, 85% Imp, HSG C
2.760		Pervious Area
15.640		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.7	100	0.0150	0.16		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
8.8	1,240	0.0210	2.33		Shallow Concentrated Flow, B-C Unpaved Kv= 16.1 fps
0.5	120	0.0330	3.69		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
20.1	1,460	Total			

Subcatchment 1S: Sub-watershed 1



Subcatchment 2S: Sub-watershed 2

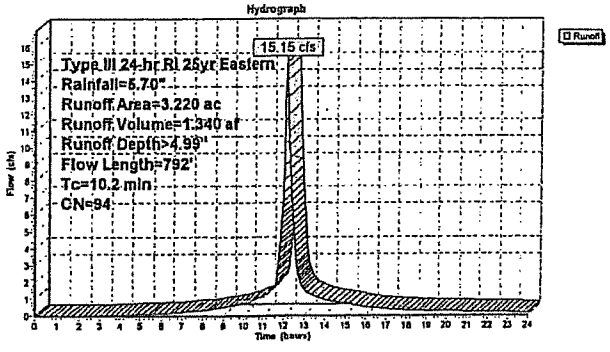
Runoff = 15.15 cfs @ 12.14 hrs, Volume= 1.340 af, Depth> 4.99"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 25yr Eastern Rainfall=5.70"

Area (ac)	CN	Description
3.220	94	Urban commercial, 85% Imp, HSG C
0.483		Pervious Area
2.737		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.1	100	0.0600	0.27		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
2.4	394	0.0280	2.69		Shallow Concentrated Flow, B-C Unpaved Kv= 16.1 fps
1.7	298	0.0200	2.87		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
10.2	792	Total			

Subcatchment 2S: Sub-watershed 2



Subcatchment 3S: Sub-watershed 3

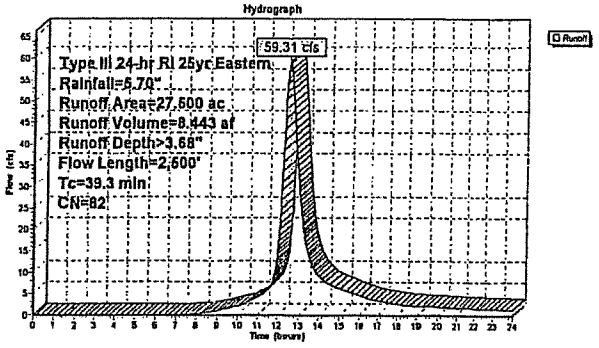
Runoff = 59.31 cfs @ 12.54 hrs, Volume= 8.443 af, Depth> 3.68"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 25yr Eastern Rainfall=5.70"

Area (ac)	CN	Description
13.750	86	Pasture/grassland/range, Poor, HSG C
10.750	80	1/2 acre lots, 25% Imp, HSG C
3.000	73	Woods, Fair, HSG C
27.500	82	Weighted Average
24.813		Pervious Area
2.688		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	100	0.0100	0.28		Sheet Flow, A-B Cultivated: Residue<=20% n= 0.060 P2= 3.40"
19.4	1,200	0.0217	1.03		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
13.9	1,200	0.0050	1.44		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
39.3	2,500	Total			

Subcatchment 3S: Sub-watershed 3



Subcatchment 4S: Sub-watershed 4

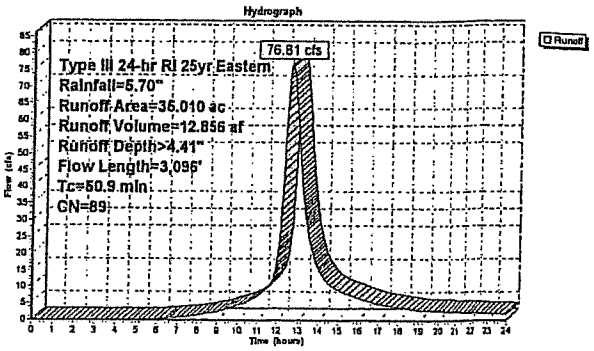
Runoff = 76.81 cfs @ 12.67 hrs, Volume= 12.856 af, Depth> 4.41"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 25yr Eastern Rainfall=5.70"

rea (ac)	CN	Description
5.901	90	Fallow, crop residue, Poor, HSG C
17.070	94	Urban commercial, 85% Imp, HSG C
5.647	79	Pasture/grassland/range, Fair, HSG C
3.680	79	1 acre lots, 20% Imp, HSG C
2.712	91	Urban Industrial, 72% Imp, HSG C
35.010	89	Weighted Average
17.812		Pervious Area
17.198		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.5	100	0.0200	0.18		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
1.8	106	0.0190	0.96		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
0.2	30	0.0170	2.65		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
0.6	70	0.0860	2.05		Shallow Concentrated Flow, D-E Short Grass Pasture Kv= 7.0 fps
0.7	82	0.0100	2.03		Shallow Concentrated Flow, E-F Paved Kv= 20.3 fps
24.2	322	0.0010	0.22		Shallow Concentrated Flow, F-G Short Grass Pasture Kv= 7.0 fps
13.9	2,386	0.0200	2.87		Shallow Concentrated Flow, G-H Paved Kv= 20.3 fps
50.9	3,096	Total			

Subcatchment 4S: Sub-watershed 4



Subcatchment 5S: Sub-Watershed 5

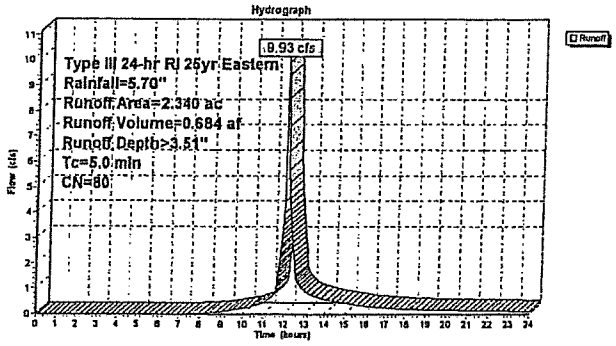
Runoff = 9.93 cfs @ 12.07 hrs, Volume= 0.684 af, Depth> 3.51"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 25yr Eastern Rainfall=5.70"

Area (ac)	CN	Description
2.340	80	1/2 acre lots, 25% Imp, HSG C
1.755		Pervious Area
0.585		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry, A-D

Subcatchment 5S: Sub-Watershed 5



Subcatchment 6dS: Sub-watershed 6d

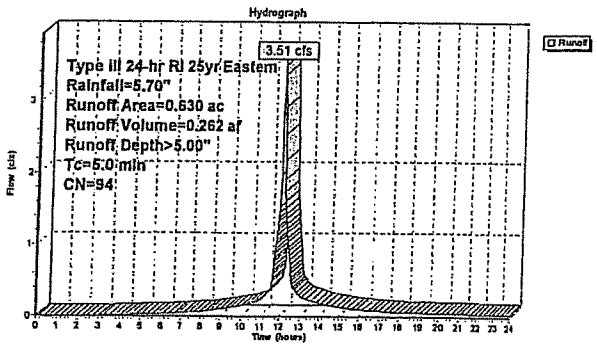
Runoff = 3.51 cfs @ 12.07 hrs, Volume= 0.262 af, Depth> 5.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 25yr Eastern Rainfall=5.70"

Area (ac)	CN	Description
0.630	94	Urban commercial, 85% Imp, HSG C
0.095		Pervious Area
0.535		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry, A-C

Subcatchment 6dS: Sub-watershed 6d



Subcatchment 6eS: Sub-watershed 6e

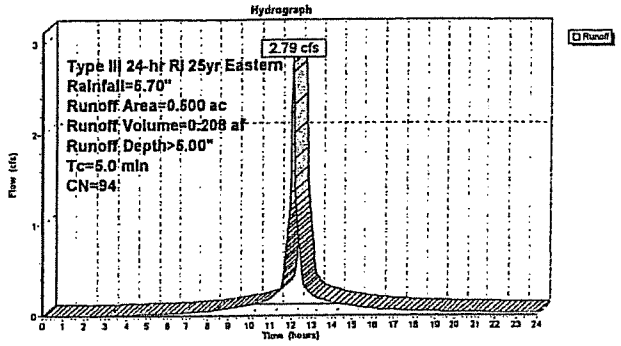
Runoff = 2.79 cfs @ 12.07 hrs, Volume= 0.208 af, Depth> 5.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 25yr Eastern Rainfall=5.70"

Area (ac)	CN	Description
0.500	94	Urban commercial, 85% Imp, HSG C
0.075		Pervious Area
0.425		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry, A-C

Subcatchment 6eS: Sub-watershed 6e



Subcatchment 6S: Sub-watershed 6

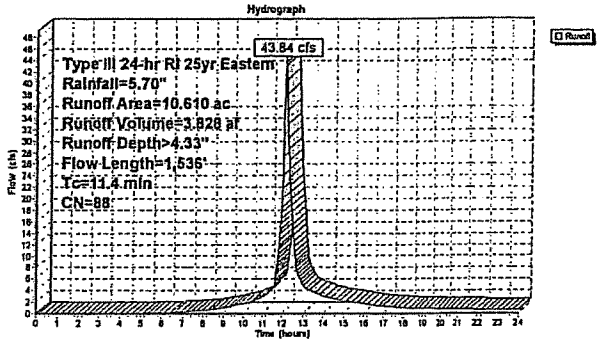
Runoff = 43.84 cfs @ 12.15 hrs, Volume= 3.828 af, Depth> 4.33"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 25yr Eastern Rainfall=5.70"

Area (ac)	CN	Description
8.380	87	Dirt roads, HSG C
2.230	94	Urban commercial, 85% Imp, HSG C
10.610	88	Weighted Average
8.714		Pervious Area
1.895		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.6	100	0.0900	2.59		Sheet Flow, A-B Smooth surfaces n= 0.011 P2= 3.40"
10.8	1,436	0.0120	2.22		Shallow Concentrated Flow, B-C Paved Kv= 20.3 fps
11.4	1,536	Total			

Subcatchment 6S: Sub-watershed 6



Subcatchment 8S: Sub-watershed 8

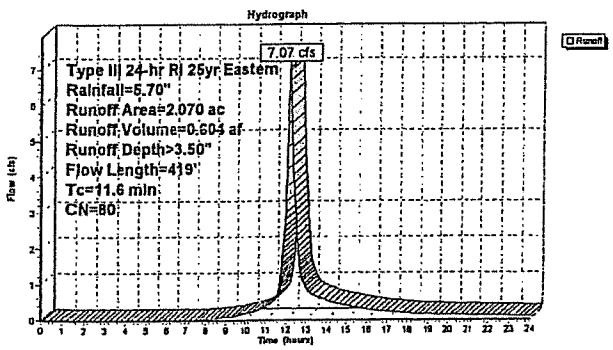
Runoff = 7.07 cfs @ 12.16 hrs, Volume= 0.604 af, Depth> 3.50"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 25yr Eastern Rainfall=5.70"

Area (ac)	CN	Description
2.070	80	1/2 acre lots, 25% Imp, HSG C
1.552		Pervious Area
0.517		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.1	100	0.0300	0.21		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
3.1	228	0.0300	1.21		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
0.4	91	0.0400	4.08		Shallow Concentrated Flow, B-C Paved Kv= 20.3 fps
11.6	419	Total			

Subcatchment 8S: Sub-watershed 8



Subcatchment 9S: Sub-watershed 9

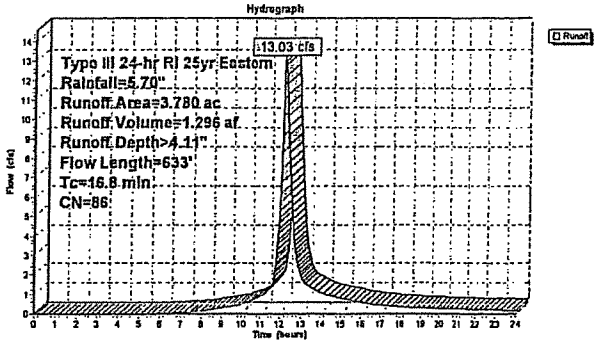
Runoff = 13.03 cfs @ 12.22 hrs, Volume= 1.296 af, Depth> 4.11"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 25yr Eastern Rainfall=5.70"

Area (ac)	CN	Description
2.990	90	1/8 acre lots, 65% Imp, HSG C
0.790	73	Woods, Fair, HSG C
3.780	86	Weighted Average
1.837		Pervious Area
1.944		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.5	100	0.0200	0.18		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
4.7	200	0.0200	0.71		Shallow Concentrated Flow, B-C Woodland Kv= 5.0 fps
1.7	160	0.0500	1.57		Shallow Concentrated Flow, B- C Short Grass Pasture Kv= 7.0 fps
0.9	173	0.0230	3.08		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
16.8	633	Total			

Subcatchment 9S: Sub-watershed 9



Subcatchment 10S: Sub-watershed 10

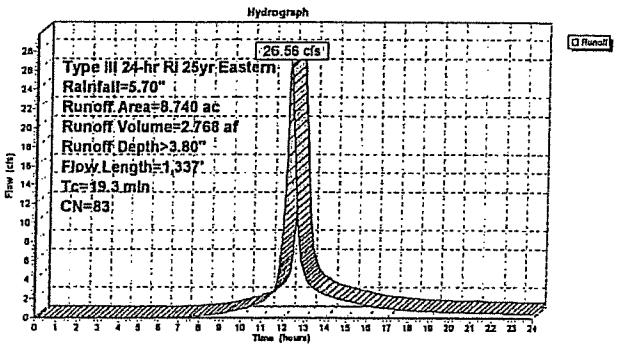
Runoff = 26.56 cfs @ 12.26 hrs, Volume= 2.768 af, Depth> 3.80"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 25yr Eastern Rainfall=5.70"

Area (ac)	CN	Description
8.740	83	1/4 acre lots, 38% Imp, HSG C
5.419		Pervious Area
3.321		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.5	100	0.0200	0.18		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
3.8	196	0.0150	0.86		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
6.0	1,041	0.0200	2.87		Shallow Concentrated Flow, B-C Paved Kv= 20.3 fps
19.3	1,337	Total			

Subcatchment 10S: Sub-watershed 10



Subcatchment 11S: Sub-watershed 11

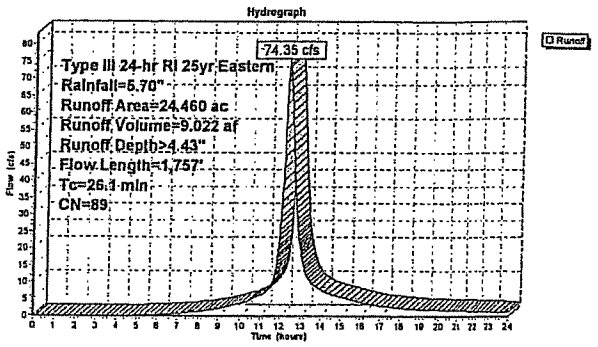
Runoff = 74.35 cfs @ 12.35 hrs, Volume= 9.022 af, Depth> 4.43"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 25yr Eastern Rainfall=5.70"

Area (ac)	CN	Description
5.370	90	Fallow, crop residue, Poor, HSG C
10.340	94	Urban commercial, 85% Imp, HSG C
8.750	83	1/4 acre lots, 38% Imp, HSG C
24.460	89	Weighted Average
12.346		Pervious Area
12.114		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.6	100	0.0200	0.36		Sheet Flow, A-B Cultivated: Residue<=20% n= 0.060 P2= 3.40"
12.0	504	0.0100	0.70		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
9.5	1,153	0.0100	2.03		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
26.1	1,757	Total			

Subcatchment 11S: Sub-watershed 11



Subcatchment 12S: Sub-watershed 12

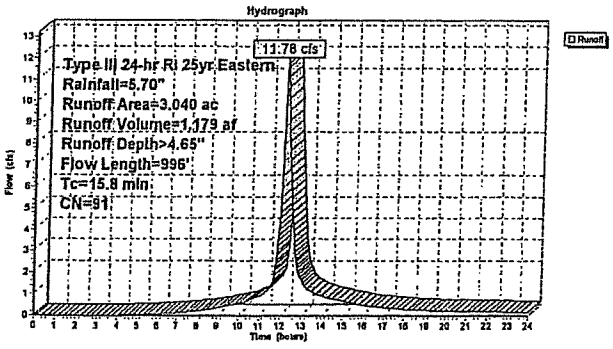
Runoff = 11.78 cfs @ 12.21 hrs, Volume= 1.179 af, Depth> 4.65"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 25yr Eastern Rainfall=5.70"

Area (ac)	CN	Description
2.130	94	Urban commercial, 85% Imp, HSG C
0.910	83	1/4 acre lots, 38% Imp, HSG C
3.040	91	Weighted Average
0.884		Pervious Area
2.156		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.1	100	0.0300	0.21		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
5.5	462	0.0400	1.40		Shallow Concentrated Flow, A-B Short Grass Pasture Kv= 7.0 fps
2.2	434	0.0270	3.34		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
15.8	996	Total			

Subcatchment 12S: Sub-watershed 12



Subcatchment 13S: Sub-watershed 13

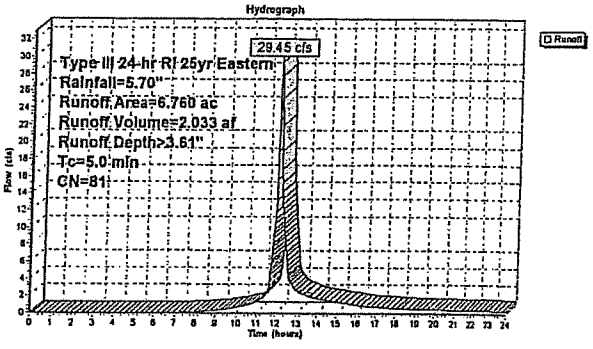
Runoff = 29.45 cfs @ 12.07 hrs, Volume= 2.033 af, Depth> 3.61"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 25yr Eastern Rainfall=5.70"

Area (ac)	CN	Description
6.760	81	1/3 acre lots, 30% Imp, HSG C
4.732		Pervious Area
2.028		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry, A-C

Subcatchment 13S: Sub-watershed 13



Subcatchment 14S: Sub-watershed 14

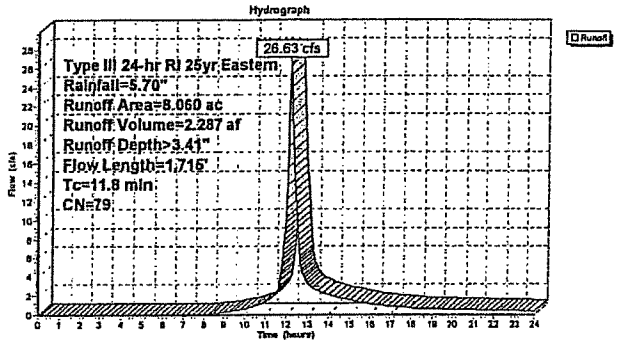
Runoff = 26.63 cfs @ 12.16 hrs, Volume= 2.287 af, Depth> 3.41"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 25yr Eastern Rainfall=5.70"

Area (ac)	CN	Description
0.240	94	Urban commercial, 85% imp, HSG C
7.820	79	1 acre lots, 20% imp, HSG C
8.060	79	Weighted Average
6.292		Pervious Area
1.768		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.6	100	0.0100	1.07		Sheet Flow, A-B Smooth surfaces n= 0.011 P2= 3.40"
10.2	1,615	0.0170	2.65		Shallow Concentrated Flow, B-C Paved Kv= 20.3 fps
11.8	1,715	Total			

Subcatchment 14S: Sub-watershed 14



Subcatchment 15S: Sub-watershed 15

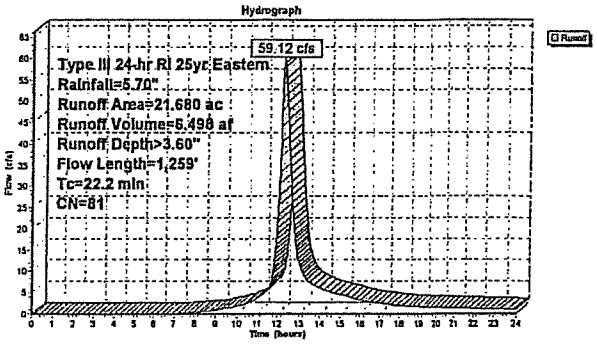
Runoff = 59.12 cfs @ 12.30 hrs, Volume= 6.498 af, Depth> 3.60"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 25yr Eastern Rainfall=5.70"

Area (ac)	CN	Description
15.390	79	1 acre lots, 20% imp, HSG C
5.090	90	1/8 acre lots, 65% imp, HSG C
1.200	76	Woods/grass comb., Fair, HSG C
21.680	81	Weighted Average
15.294		Pervious Area
6.387		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.1	100	0.0300	0.21		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
1.3	168	0.0120	2.22		Shallow Concentrated Flow, B-C Paved Kv= 20.3 fps
12.8	991	0.0340	1.29		Shallow Concentrated Flow, C-D Short Grass Pasture Kv= 7.0 fps
22.2	1,259	Total			

Subcatchment 15S: Sub-watershed 15



Subcatchment 16S: Sub-watershed 16

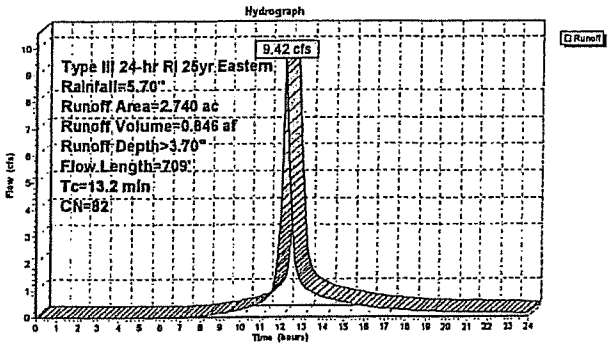
Runoff = 9.42 cfs @ 12.18 hrs, Volume= 0.846 af, Depth> 3.70"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 25yr Eastern Rainfall=5.70"

Area (ac)	CN	Description
2.330	81	1/3 acre lots, 30% imp, HSG C
0.410	91	Fallow, bare soil, HSG C
2.740	82	Weighted Average
2.041		Pervious Area
0.699		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.5	100	0.0200	0.18		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
2.0	161	0.0370	1.35		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
1.7	448	0.0450	4.31		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
13.2	709	Total			

Subcatchment 16S: Sub-watershed 16



Subcatchment 17S: Sub-watershed 17

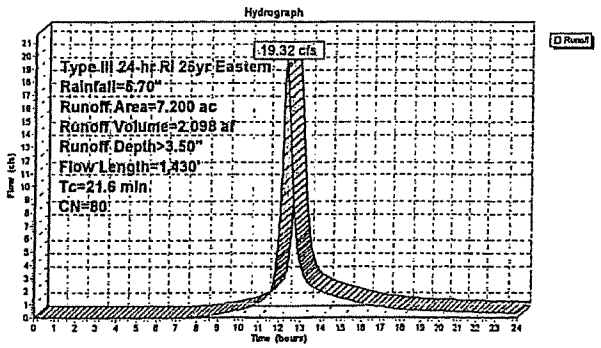
Runoff = 19.32 cfs @ 12.30 hrs, Volume= 2.098 af, Depth> 3.50"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 25yr Eastern Rainfall=5.70"

Area (ac)	CN	Description
7.200	80	1/2 acre lots, 25% imp, HSG C
5.400		Pervious Area
1.800		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.5	100	0.0100	0.13		Sheet Flow, A-C Grass: Short n= 0.150 P2= 3.40"
1.8	338	0.0240	3.14		Shallow Concentrated Flow, B-C Paved Kv= 20.3 fps
0.5	125	0.0400	4.06		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
2.9	260	0.0460	1.50		Shallow Concentrated Flow, D-E Short Grass Pasture Kv= 7.0 fps
3.9	607	0.0160	2.57		Shallow Concentrated Flow, E-F Paved Kv= 20.3 fps
21.6	1,430	Total			

Subcatchment 17S: Sub-watershed 17



Subcatchment 18S: Sub-watershed 18

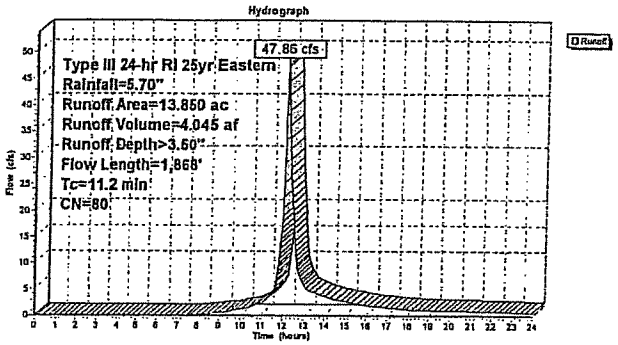
Runoff = 47.86 cfs @ 12.15 hrs, Volume= 4.045 af, Depth> 3.50"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 25yr Eastern Rainfall=5.70"

Area (ac)	CN	Description
13.160	80	1/2 acre lots, 25% Imp, HSG C
0.690	73	Woods, Fair, HSG C
13.850	80	Weighted Average
10.560		Pervious Area
3.290		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.8	100	0.0500	2.05		Sheet Flow, A-B Smooth surfaces n= 0.011 P2= 3.40"
3.3	299	0.0470	1.52		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
7.1	1,469	0.0290	3.46		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
11.2	1,868	Total			

Subcatchment 18S: Sub-watershed 18



Subcatchment 19S: Sub-watershed 19

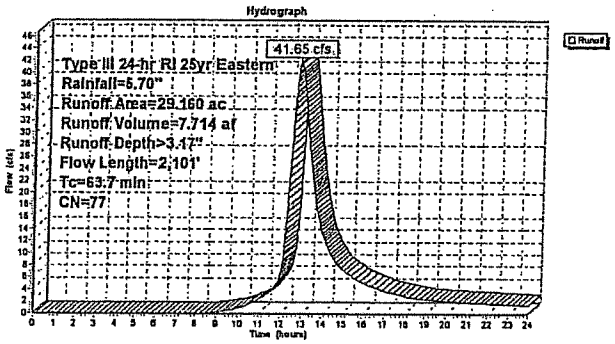
Runoff = 41.65 cfs @ 12.86 hrs, Volume= 7.714 af, Depth> 3.17"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 25yr Eastern Rainfall=5.70"

Area (ac)	CN	Description
1.460	94	Urban commercial, 85% Imp, HSG C
1.460	80	1/2 acre lots, 25% Imp, HSG C
26.240	76	Woods/grass comb., Fair, HSG C
29.160	77	Weighted Average
27.554		Pervious Area
1.606		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.1	100	0.0160	0.11		Sheet Flow, A-B Grass: Dense n= 0.240 P2= 3.40"
2.9	161	0.0170	0.91		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
0.1	17	0.0230	3.08		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
1.2	80	0.0250	1.11		Shallow Concentrated Flow, D-E Short Grass Pasture Kv= 7.0 fps
0.1	13	0.0200	2.87		Shallow Concentrated Flow, E-F Paved Kv= 20.3 fps
35.7	678	0.0040	0.32		Shallow Concentrated Flow, F-G Woodland Kv= 5.0 fps
8.6	1,052	0.0100	2.03		Shallow Concentrated Flow, G-H Paved Kv= 20.3 fps
63.7	2,101	Total			

Subcatchment 19S: Sub-watershed 19



Subcatchment 20S: Sub-watershed 20

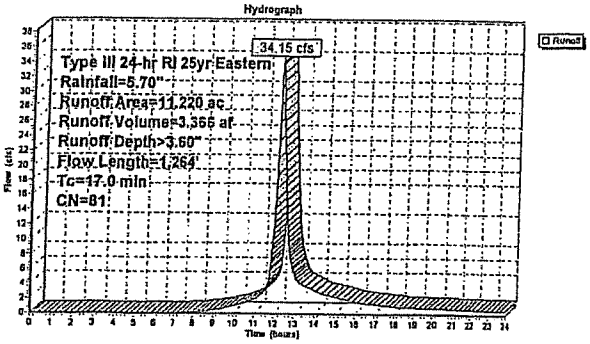
Runoff = 34.15 cfs @ 12.23 hrs, Volume= 3.366 af, Depth> 3.60"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 25yr Eastern Rainfall=5.70"

Area (ac)	CN	Description
11.220	81	1/3 acre lots, 30% Imp, HSG C
7.854		Pervious Area
3.366		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.1	100	0.0300	0.21		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
4.0	174	0.0110	0.73		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
4.9	990	0.0280	3.40		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
17.0	1,264	Total			

Subcatchment 20S: Sub-watershed 20



Subcatchment 21S: Sub-watershed 21

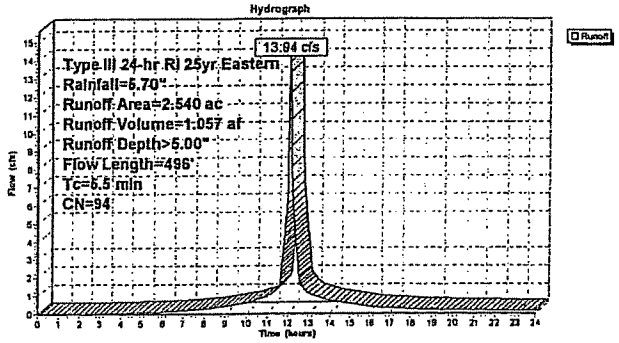
Runoff = 13.94 cfs @ 12.08 hrs, Volume= 1.057 af, Depth> 5.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 25yr Eastern Rainfall=5.70"

Area (ac)	CN	Description
2.540	94	Urban commercial, 85% imp, HSG C
0.381		Pervious Area
2.159		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.8	70	0.1000	0.31		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
0.2	30	0.1200	2.28		Sheet Flow, B-C Smooth surfaces n= 0.011 P2= 3.40"
1.5	396	0.0450	4.31		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
5.5	496	Total			

Subcatchment 21S: Sub-watershed 21



Subcatchment 22S: Sub-watershed 22

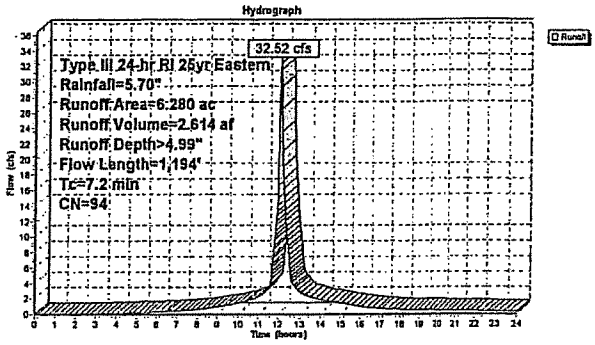
Runoff = 32.52 cfs @ 12.10 hrs, Volume= 2.614 af, Depth> 4.99"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 25yr Eastern Rainfall=5.70"

Area (ac)	CN	Description
6.280	94	Urban commercial, 85% imp, HSG C
0.942		Pervious Area
5.338		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	100	0.0800	2.47		Sheet Flow, A-B Smooth surfaces n= 0.011 P2= 3.40"
6.5	1,094	0.0190	2.80		Shallow Concentrated Flow, B-C Paved Kv= 20.3 fps
7.2	1,194	Total			

Subcatchment 22S: Sub-watershed 22



Subcatchment 23S: Sub-watershed 23

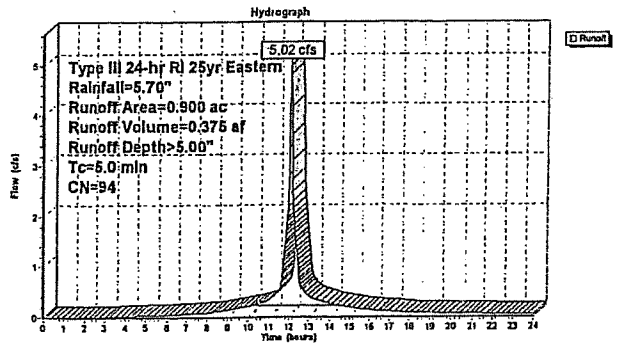
Runoff = 5.02 cfs @ 12.07 hrs, Volume= 0.375 af, Depth> 5.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 25yr Eastern Rainfall=5.70"

Area (ac)	CN	Description
0.900	94	Urban commercial, 85% imp, HSG C
0.135		Pervious Area
0.765		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry, A-E

Subcatchment 23S: Sub-watershed 23



Subcatchment 24S: Sub-watershed 24

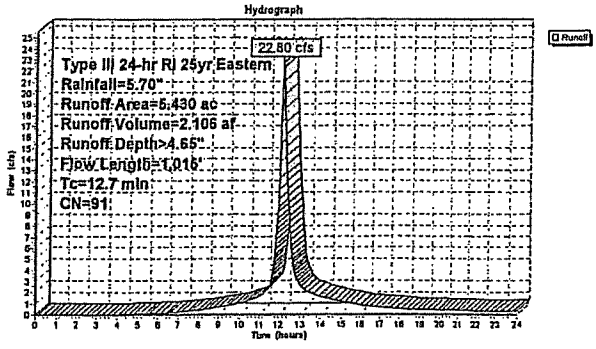
Runoff = 22.80 cfs @ 12.17 hrs, Volume= 2.105 af, Depth> 4.65"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 25yr Eastern Rainfall=5.70"

Area (ac)	CN	Description
4.340	94	Urban commercial, 85% imp, HSG C
1.090	81	1/3 acre lots, 30% imp, HSG C
5.430	91	Weighted Average
1.414		Pervious Area
4.016		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.5	100	0.0800	0.31		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
3.7	397	0.0650	1.78		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
3.5	518	0.0150	2.49		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
12.7	1,015	Total			

Subcatchment 24S: Sub-watershed 24



Subcatchment 25S: Sub-watershed 25

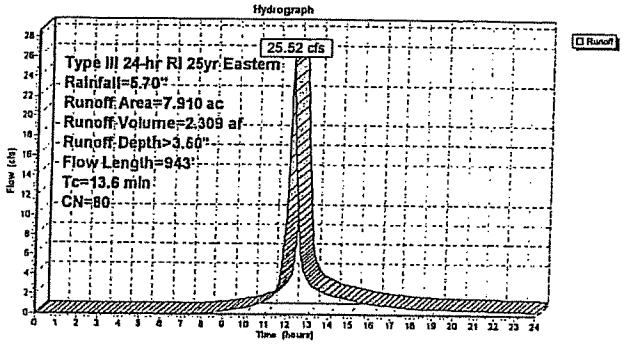
Runoff = 25.52 cfs @ 12.19 hrs, Volume= 2.309 af, Depth> 3.50"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 25yr Eastern Rainfall=5.70"

Area (ac)	CN	Description
7.120	81	1/3 acre lots, 30% imp, HSG C
0.790	73	Woods, Fair, HSG C
7.910	80	Weighted Average
5.774		Pervious Area
2.136		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.2	100	0.0400	0.23		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
3.5	276	0.0360	1.33		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
2.9	567	0.0250	3.21		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
13.6	943	Total			

Subcatchment 25S: Sub-watershed 25



Subcatchment 26S: Sub-watershed 26

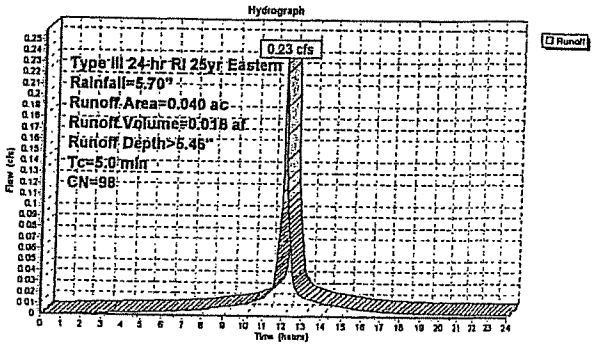
Runoff = 0.23 cfs @ 12.07 hrs, Volume= 0.018 af, Depth> 5.46"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 25yr Eastern Rainfall=5.70"

Area (ac)	CN	Description
0.040	98	Paved parking & roofs
0.040		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry, A-B

Subcatchment 26S: Sub-watershed 26



Subcatchment 27S: Sub-watershed 27

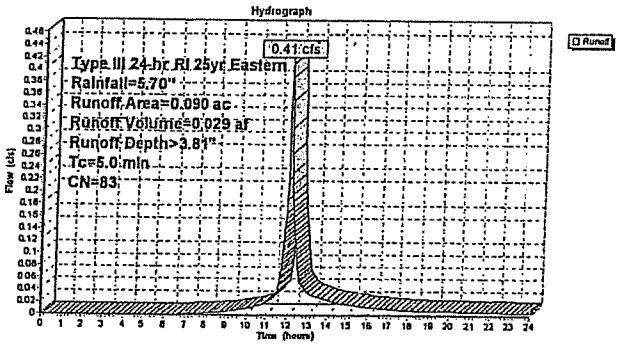
Runoff = 0.41 cfs @ 12.07 hrs, Volume= 0.029 af, Depth> 3.81"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 25yr Eastern Rainfall=5.70"

Area (ac)	CN	Description
0.090	83	1/4 acre lots, 38% imp, HSG C
0.056		Pervious Area
0.034		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry, A-B

Subcatchment 27S: Sub-watershed 27



Subcatchment 28S: Sub-watershed 28

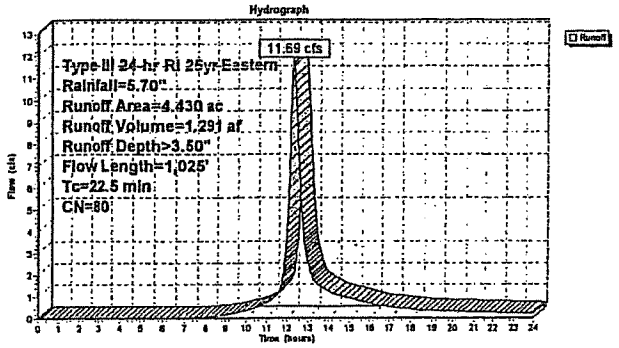
Runoff = 11.69 cfs @ 12.31 hrs, Volume= 1.291 af, Depth> 3.50"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 25yr Eastern Rainfall=5.70"

Area (ac)	CN	Description
3.990	81	1/3 acre lots, 30% imp, HSG C
0.440	73	Woods, Fair, HSG C
4.430	80	Weighted Average
3.233		Pervious Area
1.197		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.5	100	0.0200	0.18		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
0.4	23	0.0220	1.04		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
0.1	19	0.0200	2.87		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
0.4	23	0.0200	0.99		Shallow Concentrated Flow, D-E Short Grass Pasture Kv= 7.0 fps
0.1	22	0.0200	2.87		Shallow Concentrated Flow, E-F Paved Kv= 20.3 fps
7.5	426	0.0360	0.95		Shallow Concentrated Flow, F-G Woodland Kv= 5.0 fps
1.2	100	0.0400	1.40		Shallow Concentrated Flow, G-H Short Grass Pasture Kv= 7.0 fps
3.3	312	0.0060	1.57		Shallow Concentrated Flow, H-I Paved Kv= 20.3 fps
22.5	1,025	Total			

Subcatchment 28S: Sub-watershed 28



Subcatchment 29S: Sub-watershed 29

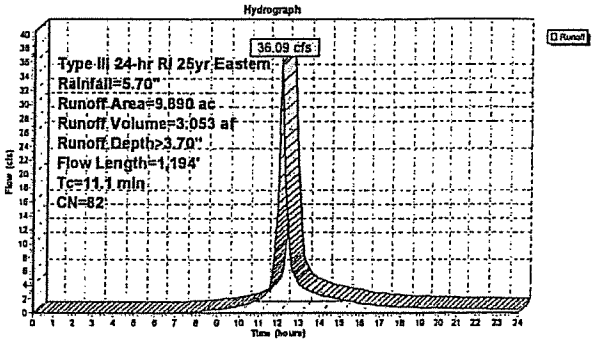
Runoff = 36.09 cfs @ 12.15 hrs, Volume= 3.053 af, Depth> 3.70"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 25yr Eastern Rainfall=5.70"

Area (ac)	CN	Description
0.490	74	>75% Grass cover, Good, HSG C
0.980	94	Urban commercial, 85% Imp, HSG C
8.420	81	1/3 acre lots, 30% Imp, HSG C
9.890	82	Weighted Average
6.531		Pervious Area
3.359		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.5	100	0.0110	1.12		Sheet Flow, A-B Smooth surfaces n= 0.011 P2= 3.40"
6.7	453	0.0260	1.13		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
2.9	641	0.0330	3.69		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
11.1	1,194	Total			

Subcatchment 29S: Sub-watershed 29



Subcatchment 30S: Sub-watershed 30

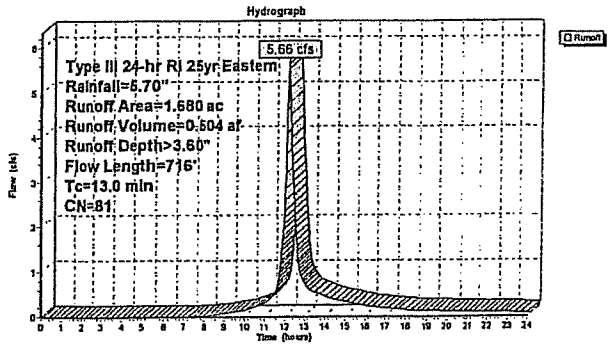
Runoff = 5.66 cfs @ 12.18 hrs, Volume= 0.504 af, Depth> 3.60"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 25yr Eastern Rainfall=5.70"

Area (ac)	CN	Description
1.680	81	1/3 acre lots, 30% Imp, HSG C
1.176		Pervious Area
0.504		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.5	100	0.0200	0.18		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
1.2	118	0.0510	1.58		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
2.3	498	0.0320	3.63		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
13.0	716	Total			

Subcatchment 30S: Sub-watershed 30



Subcatchment 31S: Sub-watershed 31

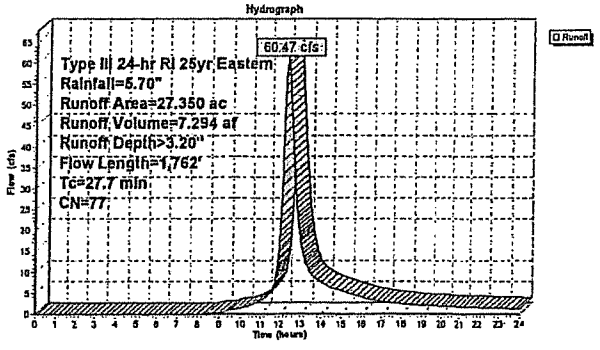
Runoff = 60.47 cfs @ 12.39 hrs, Volume= 7.294 af, Depth> 3.20"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 25yr Eastern Rainfall=5.70"

Area (ac)	CN	Description
12.350	81	1/3 acre lots, 30% Imp, HSG C
15.000	74	>75% Grass cover, Good, HSG C
27.350	77	Weighted Average
23.645		Pervious Area
3.705		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.6	100	0.0500	0.25		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
15.3	1,075	0.0280	1.17		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
5.8	587	0.0070	1.70		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
27.7	1,762	Total			

Subcatchment 31S: Sub-watershed 31



Subcatchment 32S: Sub-watershed32

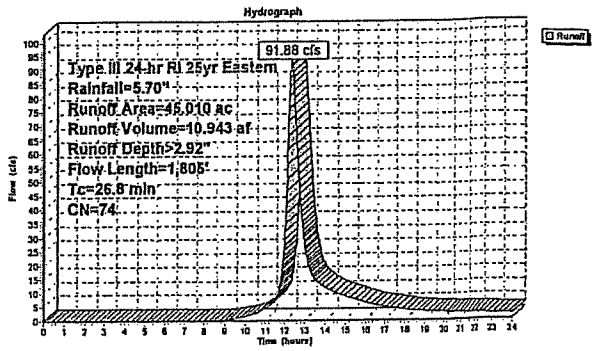
Runoff = 91.88 cfs @ 12.37 hrs, Volume= 10.943 af, Depth> 2.92"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
III 24-hr RI 25yr Eastern Rainfall=5.70"

Area (ac)	CN	Description
14.440	81	1/3 acre lots, 30% Imp, HSG C
13.320	69	50-75% Grass cover, Fair, HSG B
15.110	73	Woods, Fair, HSG C
0.900	88	Fallow, crop residue, Good, HSG C
1.240	56	Brush, Fair, HSG B
45.010	74	Weighted Average
40.678		Pervious Area
4.332		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.0	100	0.0840	0.14		Sheet Flow, A-B Grass: Bermuda n= 0.410 P2= 3.40"
2.3	179	0.0698	1.32		Shallow Concentrated Flow, B-C Woodland Kv= 5.0 fps
2.9	654	0.0528	3.70		Shallow Concentrated Flow, C-D Unpaved Kv= 16.1 fps
5.8	474	0.0738	1.36		Shallow Concentrated Flow, D-E Woodland Kv= 5.0 fps
3.8	398	0.0075	1.76		Shallow Concentrated Flow, E-F Paved Kv= 20.3 fps
26.8	1,805	Total			

Subcatchment 32S: Sub-watershed32



Subcatchment 33S: Sub-watershed 33

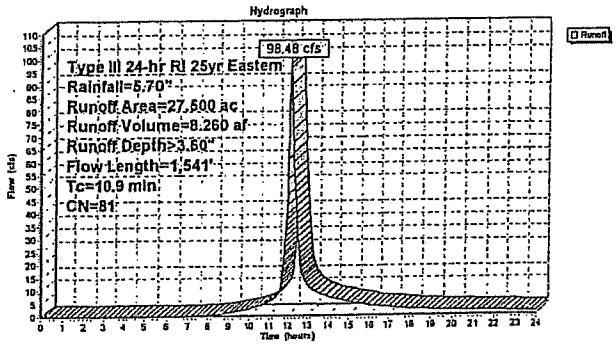
Runoff = 98.48 cfs @ 12.15 hrs, Volume= 8.260 af, Depth> 3.60"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 25yr Eastern Rainfall=5.70"

Area (ac)	CN	Description
0.960	94	Urban commercial, 85% Imp, HSG C
26.540	81	1/3 acre lots, 30% Imp, HSG C
27.500	81	Weighted Average
18.722		Pervious Area
8.778		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.6	100	0.1200	0.36		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
1.0	154	0.1400	2.62		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
5.3	1,287	0.0400	4.06		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
10.9	1,541	Total			

Subcatchment 33S: Sub-watershed 33



Subcatchment 34S: Sub-watershed 34

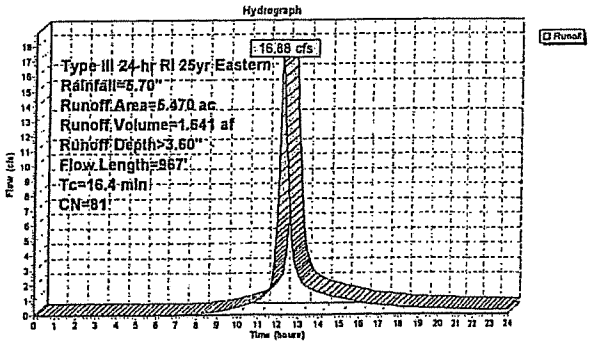
Runoff = 16.88 cfs @ 12.22 hrs, Volume= 1.641 af, Depth> 3.60"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 25yr Eastern Rainfall=5.70"

Area (ac)	CN	Description
5.470	81	1/3 acre lots, 30% Imp, HSG C
3.829		Pervious Area
1.641		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.5	100	0.0200	0.18		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
1.8	131	0.0300	1.21		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
5.1	736	0.0140	2.40		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
16.4	967	Total			

Subcatchment 34S: Sub-watershed 34



Subcatchment 35S: Sub-watershed 35

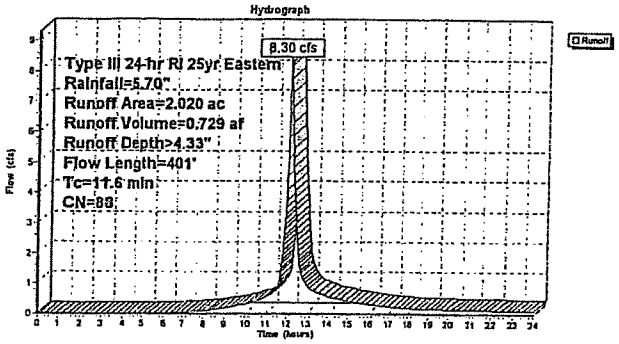
Runoff = 8.30 cfs @ 12.16 hrs, Volume= 0.729 af, Depth> 4.33"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 25yr Eastern Rainfall=5.70"

Area (ac)	CN	Description
1.010	94	Urban commercial, 85% Imp, HSG C
1.010	81	1/3 acre lots, 30% Imp, HSG C
2.020	88	Weighted Average
0.859		Pervious Area
1.161		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.1	100	0.0300	0.21		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
2.0	111	0.0180	0.94		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
1.5	190	0.0110	2.13		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
11.6	401	Total			

Subcatchment 35S: Sub-watershed 35



Subcatchment 36S: Sub-watershed 36

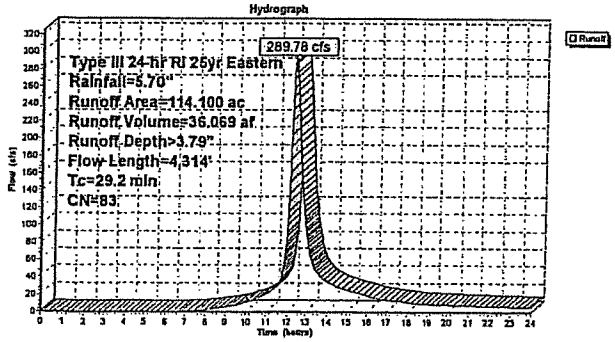
Runoff = 289.78 cfs @ 12.40 hrs, Volume= 36.069 af, Depth> 3.79"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 25yr Eastern Rainfall=5.70"

Area (ac)	CN	Description
81.170	83	1/4 acre lots, 38% Imp, HSG C
9.230	94	Urban commercial, 85% Imp, HSG C
6.090	60	Woods, Fair, HSG B
0.440	69	50-75% Grass cover, Fair, HSG B
4.180	56	Brush, Fair, HSG B
12.990	91	Urban Industrial, 72% Imp, HSG C
114.100	83	Weighted Average
66.057		Pervious Area
48.043		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.5	100	0.0200	0.18		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
1.4	172	0.0810	1.99		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
18.3	4,042	0.0330	3.69		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
29.2	4,314	Total			

Subcatchment 36S: Sub-watershed 36



Subcatchment 37S: Sub-watershed 37

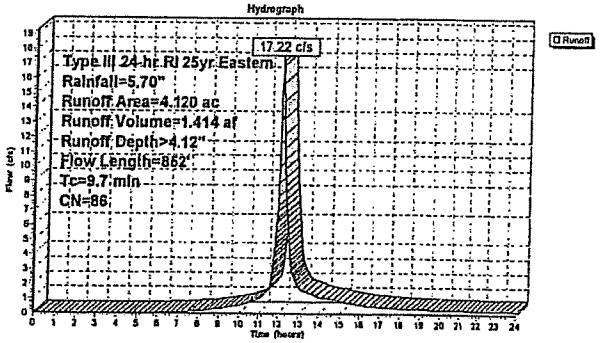
Runoff = 17.22 cfs @ 12.13 hrs, Volume= 1.414 af, Depth> 4.12"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 25yr Eastern Rainfall=5.70"

Area (ac)	CN	Description
1.240	81	1/3 acre lots, 30% Imp, HSG C
2.470	91	Urban Industrial, 72% Imp, HSG C
0.410	74	>75% Grass cover, Good, HSG C
4.120	86	Weighted Average
1.970		Pervious Area
2.150		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.0	100	0.0300	1.67		Sheet Flow, A-B Smooth surfaces n= 0.011 P2= 3.40"
8.7	752	0.0050	1.44		Shallow Concentrated Flow, B-C Paved Kv= 20.3 fps
9.7	852	Total			

Subcatchment 37S: Sub-watershed 37



Subcatchment 38S: Sub-watershed 38

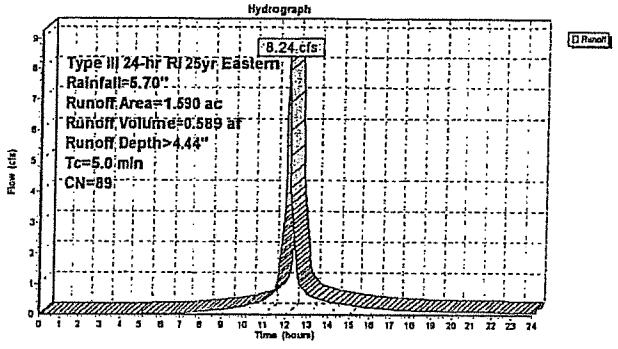
Runoff = 8.24 cfs @ 12.07 hrs, Volume= 0.589 af, Depth> 4.44"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 25yr Eastern Rainfall=5.70"

Area (ac)	CN	Description
0.160	91	Urban Industrial, 72% Imp, HSG C
0.320	79	Pasture/grassland/range, Fair, HSG C
1.110	91	Urban Industrial, 72% Imp, HSG C
1.590	89	Weighted Average
0.676		Pervious Area
0.914		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry, A-C

Subcatchment 38S: Sub-watershed 38



Subcatchment 39S: Sub-watershed 39

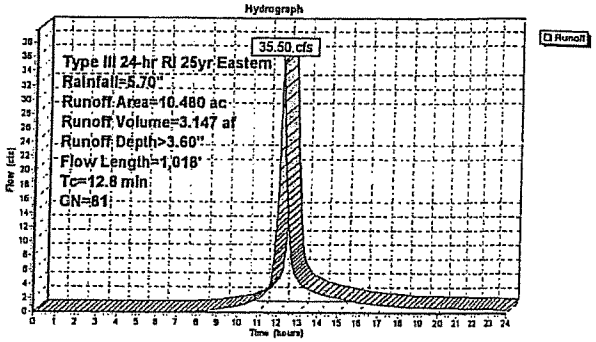
Runoff = 35.50 cfs @ 12.17 hrs, Volume= 3.147 af, Depth> 3.60"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 25yr Eastern Rainfall=5.70"

Area (ac)	CN	Description
0.520	79	Pasture/grassland/range, Fair, HSG C
9.960	81	1/3 acre lots, 30% Imp, HSG C
10.480	81	Weighted Average
7.492		Pervious Area
2.988		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.1	100	0.0600	0.27		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
1.8	212	0.0750	1.92		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
2.0	387	0.0260	3.27		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
2.9	319	0.0690	1.84		Shallow Concentrated Flow, D-E Short Grass Pasture Kv= 7.0 fps
12.8	1,018	Total			

Subcatchment 39S: Sub-watershed 39



Subcatchment 40S: Sub-watershed 40

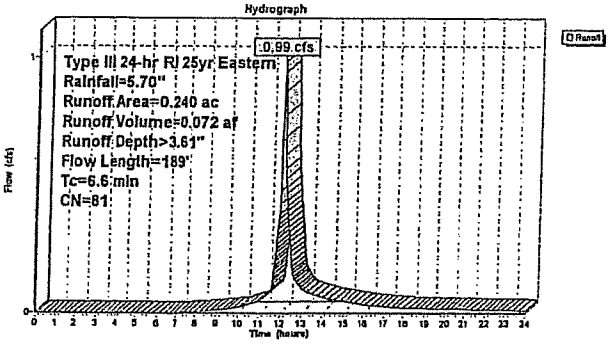
Runoff = 0.99 cfs @ 12.10 hrs, Volume= 0.072 af, Depth> 3.61"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 25yr Eastern Rainfall=5.70"

Area (ac)	CN	Description
0.240	81	1/3 acre lots, 30% Imp, HSG C
0.168		Pervious Area
0.072		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.1	100	0.0600	0.27		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
0.5	89	0.1500	2.71		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
6.6	189	Total			

Subcatchment 40S: Sub-watershed 40



Subcatchment 41S: Sub-watershed 41

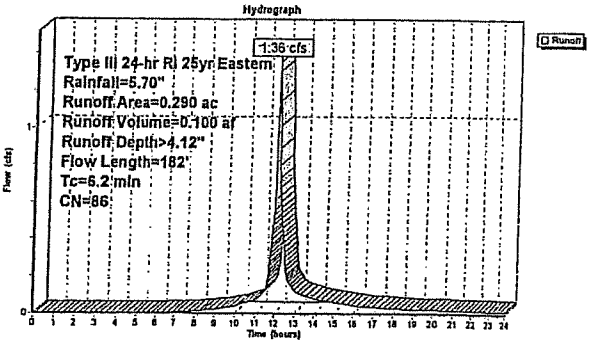
Runoff = 1.36 cfs @ 12.09 hrs, Volume= 0.100 af, Depth> 4.12"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 25yr Eastern Rainfall=5.70"

Area (ac)	CN	Description
0.290	86	Pasture/grassland/range, Poor, HSG C
0.290		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.5	100	0.0800	0.31		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
0.7	82	0.0730	1.89		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
6.2	182	Total			

Subcatchment 41S: Sub-watershed 41



Subcatchment 42S: Sub-watershed 42

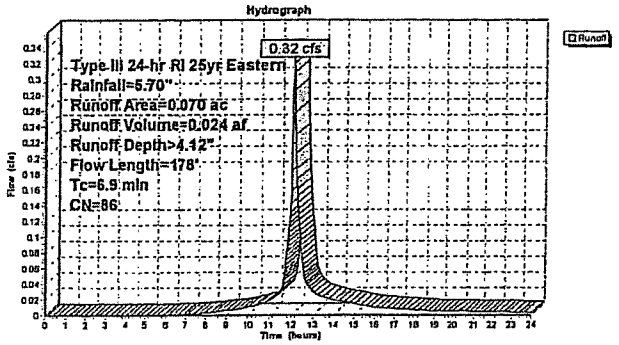
Runoff = 0.32 cfs @ 12.10 hrs, Volume= 0.024 af, Depth> 4.12"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 25yr Eastern Rainfall=5.70"

Area (ac)	CN	Description
0.070	86	Pasture/grassland/range, Poor, HSG C
0.070		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.1	100	0.0600	0.27		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
0.8	78	0.0510	1.58		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
6.9	178	Total			

Subcatchment 42S: Sub-watershed 42



Subcatchment 43S: Sub-watershed 43

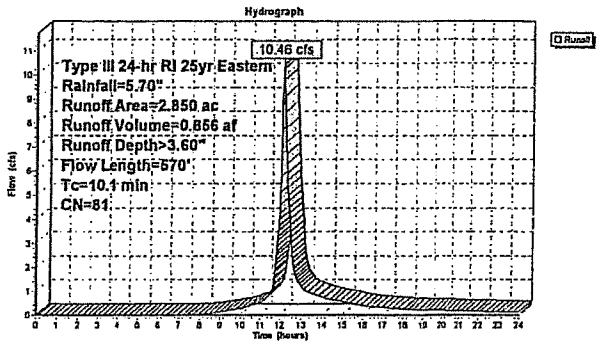
Runoff = 10.46 cfs @ 12.14 hrs, Volume= 0.856 af, Depth> 3.60"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 25yr Eastern Rainfall=5.70"

Area (ac)	CN	Description
2.850	81	1/3 acre lots, 30% Imp, HSG C
1.995		Pervious Area
0.855		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.1	100	0.0600	0.27		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
1.8	228	0.0880	2.08		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
1.7	206	0.0100	2.03		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
0.5	36	0.0280	1.17		Shallow Concentrated Flow, D-E Short Grass Pasture Kv= 7.0 fps
10.1	570	Total			

Subcatchment 43S: Sub-watershed 43



Subcatchment 44S: Sub-watershed 44

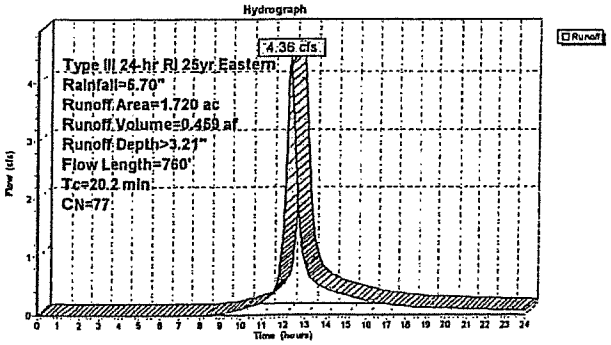
Runoff = 4.36 cfs @ 12.28 hrs, Volume= 0.459 af, Depth> 3.21"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 25yr Eastern Rainfall=5.70"

Area (ac)	CN	Description
0.860	81	1/3 acre lots, 30% Imp, HSG C
0.860	73	Woods, Fair, HSG C
1.720	77	Weighted Average
1.462		Pervious Area
0.258		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.4	100	0.0500	0.12		Sheet Flow, A-B Woods: Light underbrush n= 0.400 P2= 3.40"
4.3	262	0.0420	1.02		Shallow Concentrated Flow, B-C Woodland Kv= 5.0 fps
1.5	398	0.0450	4.31		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
20.2	760	Total			

Subcatchment 44S: Sub-watershed 44



Subcatchment 45S: Sub-watershed 45

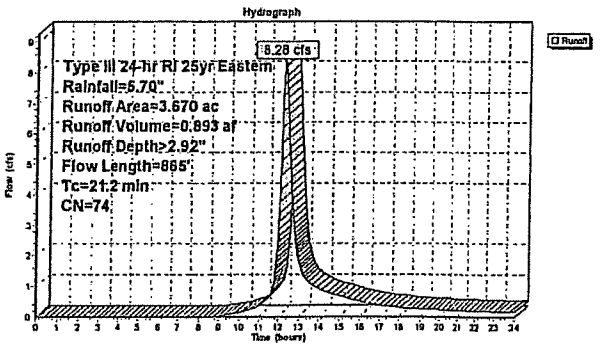
Runoff = 8.28 cfs @ 12.30 hrs, Volume= 0.893 af, Depth> 2.92"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 25yr Eastern Rainfall=5.70"

Area (ac)	CN	Description
3.120	73	Woods, Fair, HSG C
0.180	81	1/3 acre lots, 30% Imp, HSG C
0.370	82	Woods/grass comb., Poor, HSG C
3.670	74	Weighted Average
3.616		Pervious Area
0.054		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.1	100	0.0300	0.21		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
13.1	765	0.0380	0.97		Shallow Concentrated Flow, B-C Woodland Kv= 5.0 fps
21.2	865	Total			

Subcatchment 45S: Sub-watershed 45



Subcatchment 46S: Sub-watershed 46

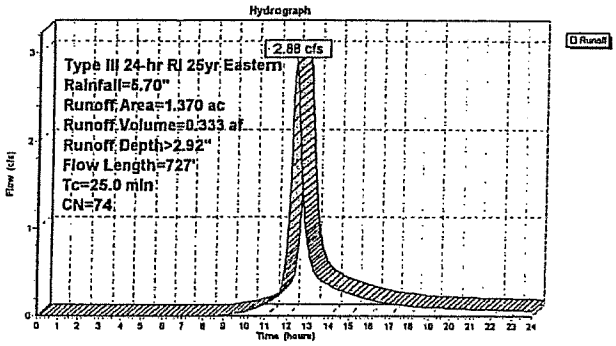
Runoff = 2.88 cfs @ 12.35 hrs, Volume= 0.333 af, Depth> 2.92"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 25yr Eastern Rainfall=5.70"

Area (ac)	CN	Description
1.230	73	Woods, Fair, HSG C
0.140	82	Woods/grass comb., Poor, HSG C
1.370	74	Weighted Average
1.370		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.8	100	0.0400	0.11		Sheet Flow, A-B Woods: Light underbrush n= 0.400 P2= 3.40"
7.6	373	0.0270	0.82		Shallow Concentrated Flow, B-C Woodland Kv= 5.0 fps
1.6	254	0.0160	2.57		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
25.0	727	Total			

Subcatchment 46S: Sub-watershed 46



Subcatchment 47S: Sub-watershed 47

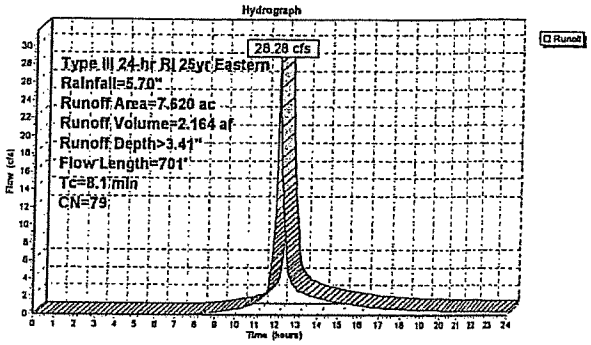
Runoff = 28.28 cfs @ 12.12 hrs, Volume= 2.164 af, Depth> 3.41"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 25yr Eastern Rainfall=5.70"

Area (ac)	CN	Description
7.620	79	50-75% Grass cover, Fair, HSG C
7.620		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0	100	0.1000	0.33		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
0.2	20	0.0500	1.57		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
2.9	581	0.0280	3.40		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
8.1	701	Total			

Subcatchment 47S: Sub-watershed 47



Subcatchment 48S: Sub-watershed 48

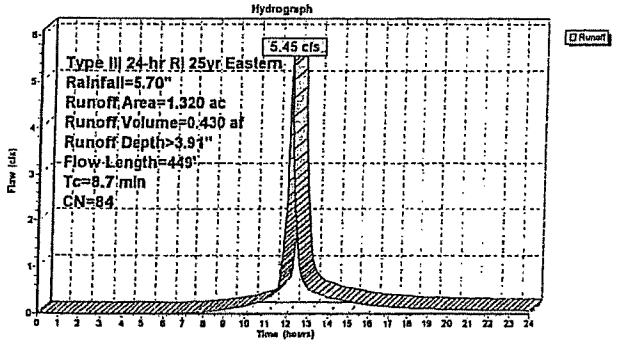
Runoff = 5.45 cfs @ 12.12 hrs, Volume= 0.430 af, Depth> 3.91"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 25yr Eastern Rainfall=5.70"

Area (ac)	CN	Description
1.320	84	50-75% Grass cover, Fair, HSG D
1.320		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.1	100	0.0600	0.27		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
0.4	39	0.0510	1.58		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
2.2	310	0.0130	2.31		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
8.7	449	Total			

Subcatchment 48S: Sub-watershed 48



Subcatchment 49S: Sub-watershed 49

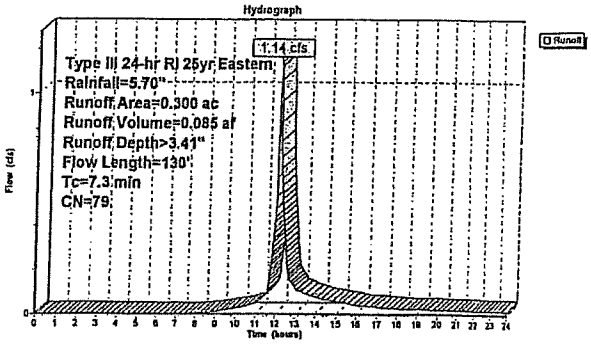
Runoff = 1.14 cfs @ 12.10 hrs, Volume= 0.085 af, Depth> 3.41"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 25yr Eastern Rainfall=5.70"

Area (ac)	CN	Description
0.300	79	50-75% Grass cover, Fair, HSG C
0.300		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.2	100	0.0400	0.23		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
0.1	11	0.1800	2.97		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
0.0	19	0.1100	6.73		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
7.3	130	Total			

Subcatchment 49S: Sub-watershed 49



Subcatchment 50S: Sub-watershed 50

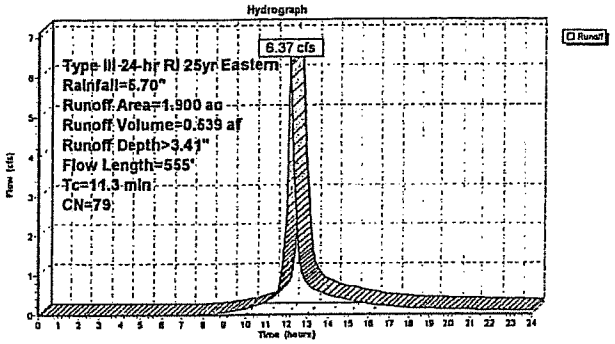
Runoff = 6.37 cfs @ 12.16 hrs, Volume= 0.539 af, Depth> 3.41"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 25yr Eastern Rainfall=5.70"

Area (ac)	CN	Description
1.900	79	50-75% Grass cover, Fair, HSG C
1.900		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.6	100	0.0500	0.25		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
4.5	419	0.0500	1.57		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
0.2	36	0.0170	2.65		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
11.3	555	Total			

Subcatchment 50S: Sub-watershed 50



Subcatchment 51S: Sub-wateshed 51

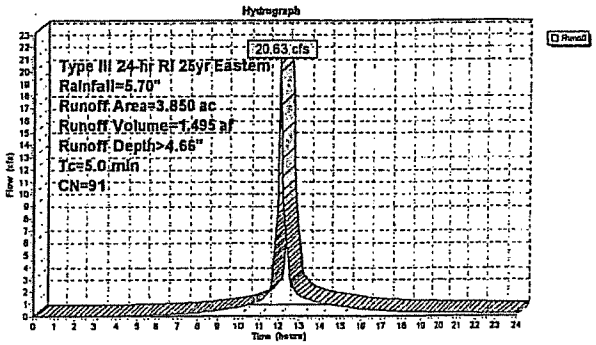
Runoff = 20.63 cfs @ 12.07 hrs, Volume= 1.495 af, Depth> 4.66"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 25yr Eastern Rainfall=5.70"

Area (ac)	CN	Description
3.850	91	Urban industrial, 72% Imp, HSG C
1.078		Pervious Area
2.772		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry, A-C

Subcatchment 51S: Sub-wateshed 51



Subcatchment 52S: Sub-watershed 52

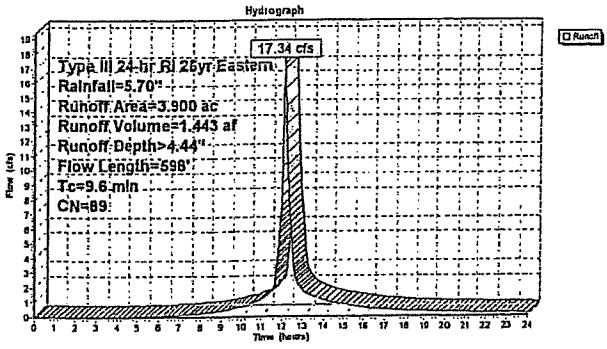
Runoff = 17.34 cfs @ 12.13 hrs, Volume= 1.443 af, Depth> 4.44"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 25yr Eastern Rainfall=5.70"

Area (ac)	CN	Description
3.510	90	1/8 acre lots, 65% Imp, HSG C
0.390	79	50-75% Grass cover, Fair, HSG C
3.900	89	Weighted Average
1.618		Pervious Area
2.282		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.6	100	0.1200	0.36		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
1.9	108	0.0190	0.96		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
2.8	361	0.0110	2.13		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
0.3	29	0.0690	1.84		Shallow Concentrated Flow, D-E Short Grass Pasture Kv= 7.0 fps
9.6	598	Total			

Subcatchment 52S: Sub-watershed 52



Subcatchment 53S: Sub-watershed 53

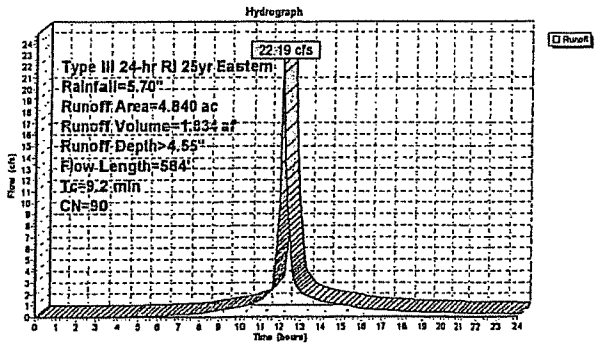
Runoff = 22.19 cfs @ 12.13 hrs, Volume= 1.834 af, Depth> 4.55"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 25yr Eastern Rainfall=5.70"

Area (ac)	CN	Description
4.840	90	1/8 acre lots, 65% Imp, HSG C
1.694		Pervious Area
3.146		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.6	100	0.0500	0.25		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
0.3	33	0.0610	1.73		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
2.3	451	0.0270	3.34		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
9.2	584	Total			

Subcatchment 53S: Sub-watershed 53



Subcatchment 54S: Sub-watershed 54

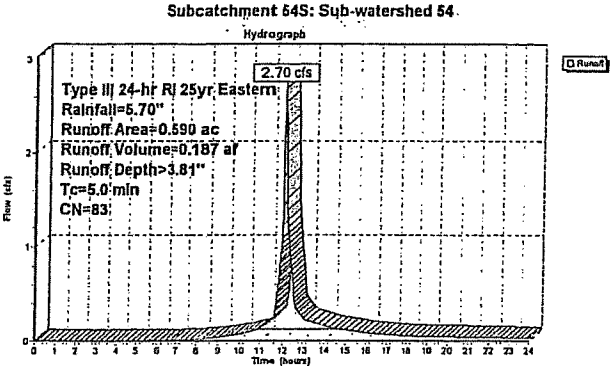
Runoff = 2.70 cfs @ 12.07 hrs, Volume= 0.187 af, Depth> 3.81"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 25yr Eastern Rainfall=5.70"

Area (ac)	CN	Description
0.590	83	1/4 acre lots, 38% Imp, HSG C
0.366		Pervious Area
0.224		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry, A-C

Subcatchment 54S: Sub-watershed 54



Subcatchment 55S: Sub-watershed 55

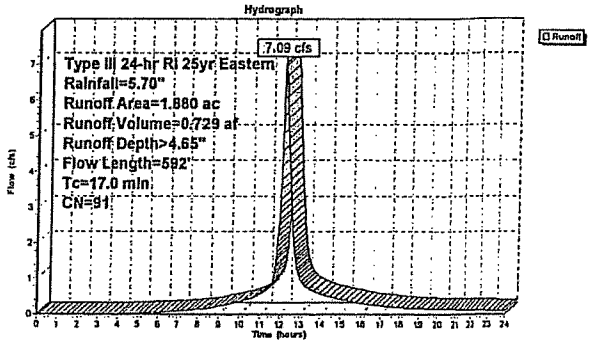
Runoff = 7.09 cfs @ 12.22 hrs, Volume= 0.729 af, Depth> 4.65"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 25yr Eastern Rainfall=5.70"

Area (ac)	CN	Description
1.880	91	Urban Industrial, 72% Imp, HSG C
0.526		Pervious Area
1.354		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.5	100	0.0100	0.13		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
4.5	492	0.0080	1.82		Shallow Concentrated Flow, B-C Paved Kv= 20.3 fps
17.0	592	Total			

Subcatchment 55S: Sub-watershed 55



Subcatchment 56S: Sub-watershed 56

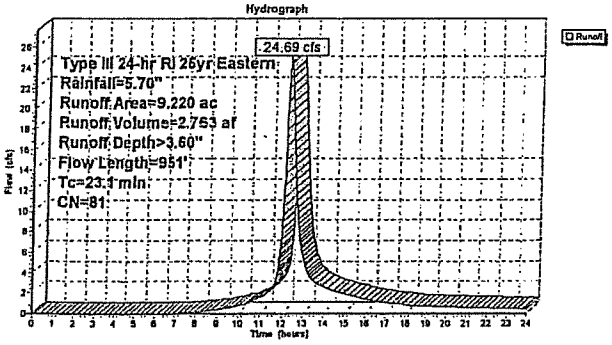
Runoff = 24.69 cfs @ 12.31 hrs, Volume= 2.763 af, Depth> 3.60"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 25yr Eastern Rainfall=5.70"

Area (ac)	CN	Description
9.220	81	1/3 acre lots, 30% Imp, HSG C
6.454		Pervious Area
2.766		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.5	100	0.0100	0.13		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
5.7	228	0.0090	0.66		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
4.9	623	0.0110	2.13		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
23.1	951	Total			

Subcatchment 56S: Sub-watershed 56



Subcatchment 57S: Sub-watershed 57

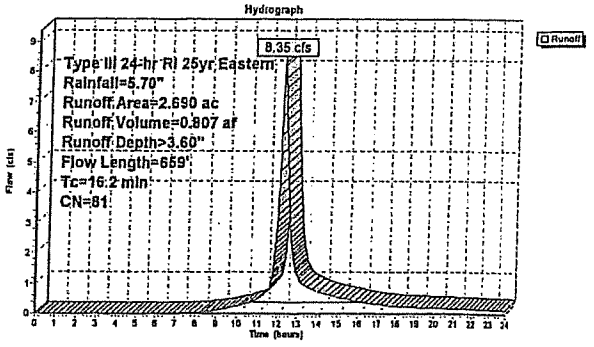
Runoff = 8.35 cfs @ 12.22 hrs, Volume= 0.807 af, Depth> 3.60"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 25yr Eastern Rainfall=5.70"

Area (ac)	CN	Description
2.690	81	1/3 acre lots, 30% Imp, HSG C
1.883		Pervious Area
0.807		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.4	100	0.0370	0.22		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
6.4	190	0.0050	0.49		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
2.2	349	0.0170	2.65		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
0.2	20	0.0500	1.57		Shallow Concentrated Flow, D-E Short Grass Pasture Kv= 7.0 fps
16.2	659	Total			

Subcatchment 57S: Sub-watershed 57



Subcatchment 58S: Sub-watershed 58

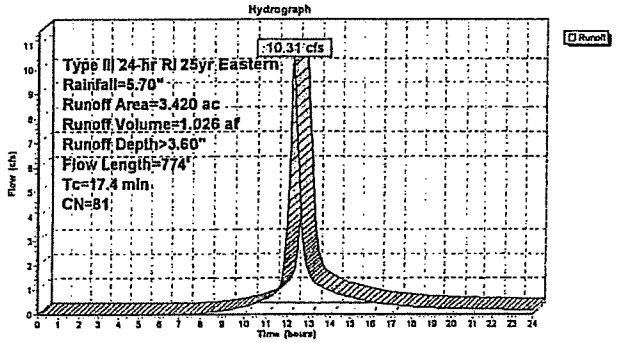
Runoff = 10.31 cfs @ 12.24 hrs, Volume= 1.026 af, Depth> 3.60"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 25yr Eastern Rainfall=5.70"

Area (ac)	CN	Description
3.420	81	1/3 acre lots, 30% Imp, HSG C
2.394		Pervious Area
1.026		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.5	100	0.0100	0.13		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
1.1	74	0.0270	1.15		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
3.8	600	0.0170	2.65		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
17.4	774	Total			

Subcatchment 58S: Sub-watershed 58



Subcatchment 59S: Sub-watershed 59

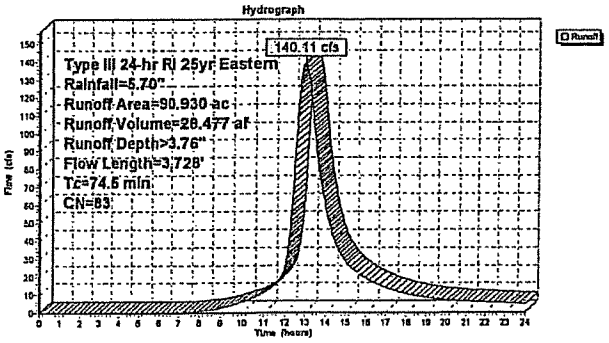
Runoff = 140.11 cfs @ 12.99 hrs, Volume= 28.477 af, Depth> 3.76"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 25yr Eastern Rainfall=5.70"

Area (ac)	CN	Description
35.570	83	1/4 acre lots, 38% Imp, HSG C
15.400	79	Pasture/grassland/range, Fair, HSG C
13.820	94	Urban commercial, 85% Imp, HSG C
2.410	91	Urban Industrial, 72% Imp, HSG C
8.840	86	Woods/grass comb., Poor, HSG D
12.190	73	Woods, Fair, HSG C
2.700	79	Pasture/grassland/range, Fair, HSG C
90.930	83	Weighted Average
63.931		Pervious Area
26.999		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.5	100	0.0050	0.10		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
49.4	2,858	0.0190	0.96		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
1.2	48	0.0010	0.64		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
2.9	164	0.0180	0.94		Shallow Concentrated Flow, D-E Short Grass Pasture Kv= 7.0 fps
3.5	377	0.0080	1.82		Shallow Concentrated Flow, E-F Paved Kv= 20.3 fps
1.0	181	0.0220	3.01		Shallow Concentrated Flow, F-G Paved Kv= 20.3 fps
74.5	3,728	Total			

Subcatchment 59S: Sub-watershed 59



Subcatchment 60S: Sub-watershed 60

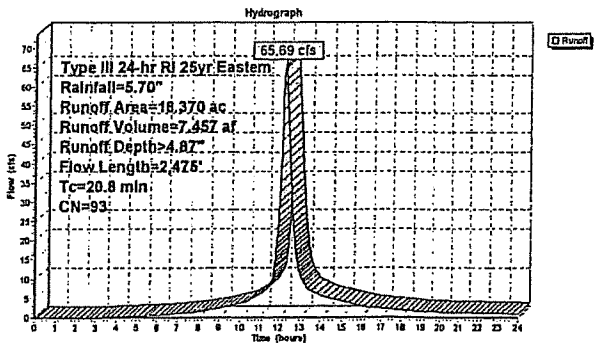
Runoff = 65.69 cfs @ 12.27 hrs, Volume= 7.457 af, Depth> 4.87"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 25yr Eastern Rainfall=5.70"

Area (ac)	CN	Description
5.510	91	Urban Industrial, 72% Imp, HSG C
12.860	94	Urban commercial, 85% Imp, HSG C
18.370	93	Weighted Average
3.472		Pervious Area
14.898		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.2	100	0.0400	0.23		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
0.6	83	0.1100	2.32		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
13.0	2,292	0.0210	2.94		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
20.8	2,475	Total			

Subcatchment 60S: Sub-watershed 60



Subcatchment 61S: Sub-watershed 61

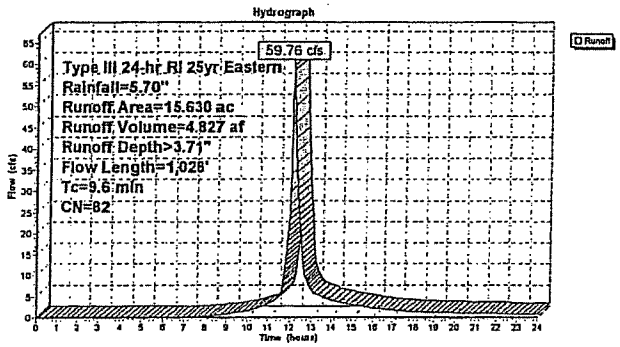
Runoff = 59.76 cfs @ 12.13 hrs, Volume= 4.827 af, Depth> 3.71"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 25yr Eastern Rainfall=5.70"

rea (ac)	CN	Description
14.070	81	1/3 acre lots, 30% Imp, HSG C
1.560	94	Urban commercial, 85% Imp, HSG C
15.630	82	Weighted Average
10.083		Pervious Area
5.547		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.8	100	0.0700	0.29		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
1.2	132	0.0700	1.85		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
2.6	796	0.0630	5.10		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
9.6	1,028	Total			

Subcatchment 61S: Sub-watershed 61



Subcatchment 62S: Sub-watershed 62

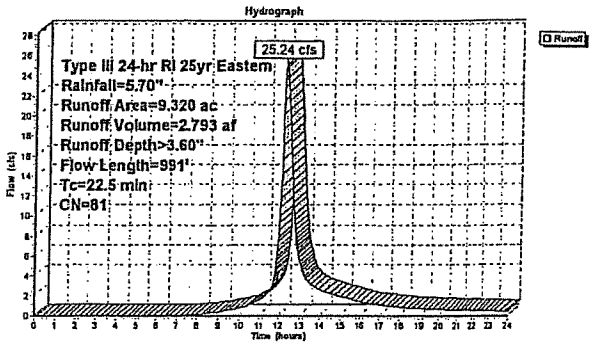
Runoff = 25.24 cfs @ 12.31 hrs, Volume= 2.793 af, Depth> 3.60"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 25yr Eastern Rainfall=5.70"

Area (ac)	CN	Description
9.320	81	1/3 acre lots, 30% Imp, HSG C
6.524		Pervious Area
2.796		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.5	100	0.0100	0.13		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
5.2	169	0.0060	0.54		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
4.8	722	0.0150	2.49		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
22.5	991	Total			

Subcatchment 62S: Sub-watershed 62



Subcatchment 63S: Sub-watershed 63

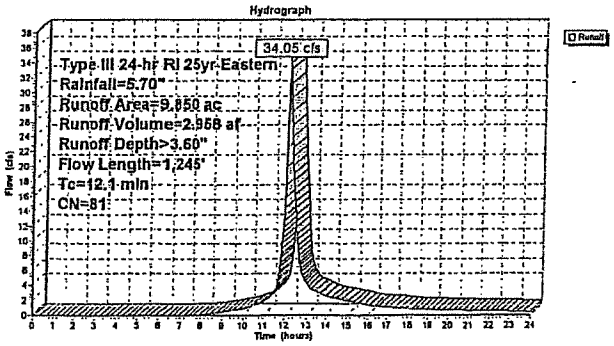
Runoff = 34.05 cfs @ 12.17 hrs, Volume= 2.958 af, Depth> 3.60"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 25yr Eastern Rainfall=5.70"

Area (ac)	CN	Description
9.850	81	1/3 acre lots, 30% Imp, HSG C
6.895		Pervious Area
2.955		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.9	37	0.0540	0.21		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
0.6	63	0.0460	1.83		Sheet Flow, B-C Smooth surfaces n= 0.011 P2= 3.40"
0.6	118	0.0250	3.21		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
2.0	188	0.0480	1.53		Shallow Concentrated Flow, D-E Short Grass Pasture Kv= 7.0 fps
6.0	839	0.0130	2.31		Shallow Concentrated Flow, E-F Paved Kv= 20.3 fps
12.1	1,245	Total			

Subcatchment 63S: Sub-watershed 63



Subcatchment 64S: Sub-watershed 64

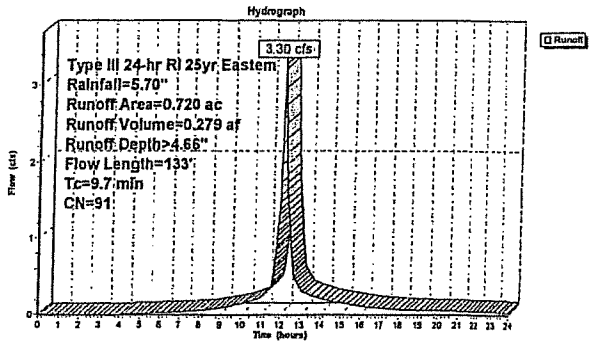
Runoff = 3.30 cfs @ 12.13 hrs, Volume= 0.279 af, Depth> 4.65"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 25yr Eastern Rainfall=5.70"

Area (ac)	CN	Description
0.720	91	Urban Industrial, 72% Imp, HSG C
0.202		Pervious Area
0.518		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.2	100	0.0400	0.23		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
2.5	33	0.0010	0.22		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
9.7	133	Total			

Subcatchment 64S: Sub-watershed 64



Subcatchment 65S: Sub-watershed 65

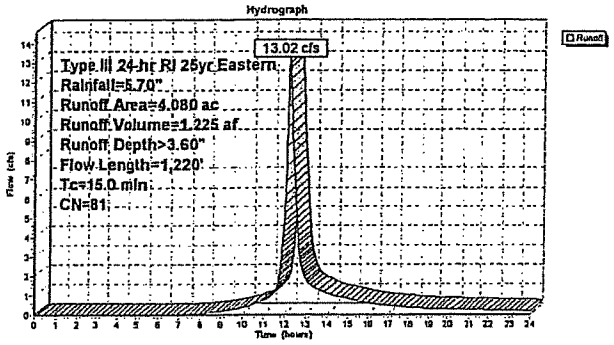
Runoff = 13.02 cfs @ 12.20 hrs, Volume= 1.225 af, Depth> 3.60"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 25yr Eastern Rainfall=5.70"

Area (ac)	CN	Description
4.080	81	1/3 acre lots, 30% Imp, HSG C
2.856		Pervious Area
1.224		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.2	85	0.0300	0.20		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
0.3	14	0.0100	0.73		Sheet Flow, B-C Smooth surfaces n= 0.011 P2= 3.40"
7.5	1,120	0.0150	2.49		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
15.0	1,220	Total			

Subcatchment 65S: Sub-watershed 65



Subcatchment 66S: Su-watershed 66

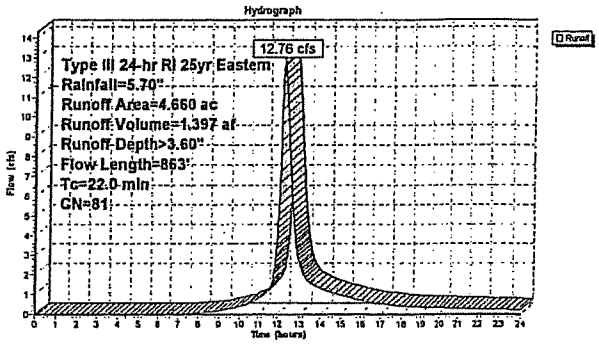
Runoff = 12.76 cfs @ 12.30 hrs, Volume= 1.397 af, Depth> 3.60"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 25yr Eastern Rainfall=5.70"

Area (ac)	CN	Description
4.660	81	1/3 acre lots, 30% Imp, HSG C
3.262		Pervious Area
1.398		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.4	100	0.0060	0.11		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
1.2	103	0.0390	1.38		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
5.4	660	0.0100	2.03		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
22.0	863	Total			

Subcatchment 66S: Su-watershed 66



Subcatchment 67S: Sub-watershed 67

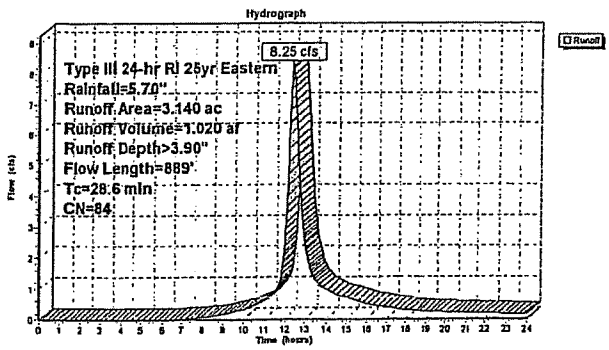
Runoff = 8.25 cfs @ 12.38 hrs, Volume= 1.020 af, Depth> 3.90"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 25yr Eastern Rainfall=5.70"

Area (ac)	CN	Description
0.790	81	1/3 acre lots, 30% Imp, HSG C
1.880	88	Fallow, crop residue, Good, HSG C
0.470	73	Woods, Fair, HSG C
3.140	84	Weighted Average
2.903		Pervious Area
0.237		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.5	100	0.0100	0.13		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
4.7	199	0.0200	0.71		Shallow Concentrated Flow, B-C Woodland Kv= 5.0 fps
10.7	490	0.0120	0.77		Shallow Concentrated Flow, C-D Short Grass Pasture Kv= 7.0 fps
0.7	100	0.0120	2.22		Shallow Concentrated Flow, D-E Paved Kv= 20.3 fps
28.6	889	Total			

Subcatchment 67S: Sub-watershed 67



Subcatchment 68S: Sub-watershed 68

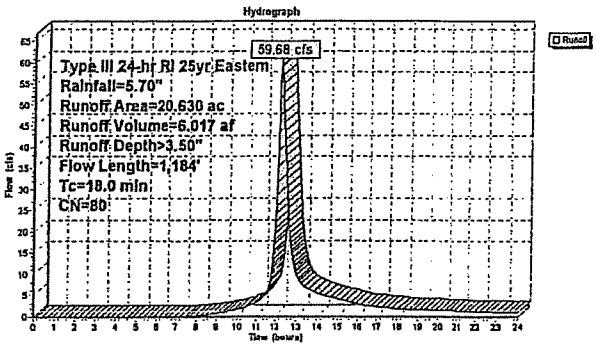
Runoff = 59.68 cfs @ 12.25 hrs, Volume= 6.017 af, Depth> 3.50"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 25yr Eastern Rainfall=5.70"

Area (ac)	CN	Description
2.350	79	Pasture/grassland/range, Fair, HSG C
2.470	88	Fallow, crop residue, Good, HSG C
1.970	70	Brush, Fair, HSG C
5.490	82	Woods/grass comb., Poor, HSG C
2.460	73	Woods, Fair, HSG C
5.890	81	1/3 acre lots, 30% Imp, HSG C
20.630	80	Weighted Average
18.863		Pervious Area
1.767		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.3	100	0.0850	0.31		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
12.7	1,084	0.0410	1.42		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
18.0	1,184	Total			

Subcatchment 68S: Sub-watershed 68



Reach 3R: Intermittent Stream

Inflow Area = 21.680 ac, Inflow Depth > 3.57" for RI 25yr Eastern event
Inflow = 58.87 cfs @ 12.32 hrs, Volume= 6.445 af
Outflow = 52.64 cfs @ 12.49 hrs, Volume= 6.412 af, Atten= 11%, Lag= 10.2 min

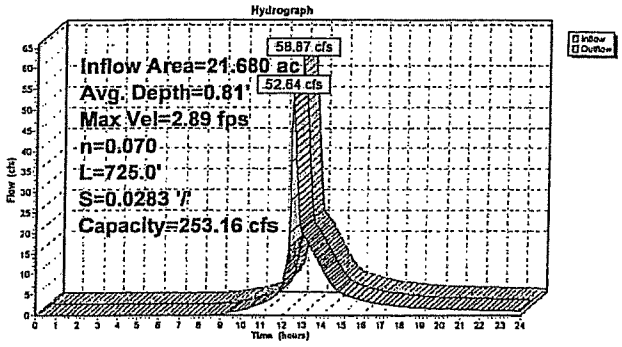
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Velocity= 2.89 fps, Min. Travel Time= 4.2 min
Velocity = 0.95 fps, Avg. Travel Time= 12.8 min

Peak Storage= 13,255 cf @ 12.42 hrs, Average Depth at Peak Storage= 0.81'
Bank-Full Depth= 2.00', Capacity at Bank-Full= 253.16 cfs

20.00' x 2.00' deep channel, n= 0.070 Medium-dense brush, winter
Side Slope Z-value= 3.0 '/' Top Width= 32.00'
Length= 725.0' Slope= 0.0283 '/'
Inlet Invert= 113.50', Outlet Invert= 93.00'

‡

Reach 3R: Intermittent Stream



Pond 2P: Highview Pond Existing

Inflow Area = 21.680 ac, Inflow Depth > 3.60" for RI 25yr Eastern event
Inflow = 59.12 cfs @ 12.30 hrs, Volume= 6.498 af
Outflow = 58.87 cfs @ 12.32 hrs, Volume= 6.445 af, Atten= 0%, Lag= 1.0 min
Primary = 58.87 cfs @ 12.32 hrs, Volume= 6.445 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs / 2
Peak Elev= 121.23' @ 12.32 hrs Surf.Area= 6,087 sf Storage= 39,958 cf

Plug-Flow detention time= 22.6 min calculated for 6.445 af (99% of inflow)
Center-of-Mass det. time= 17.8 min (843.8 - 826.1)

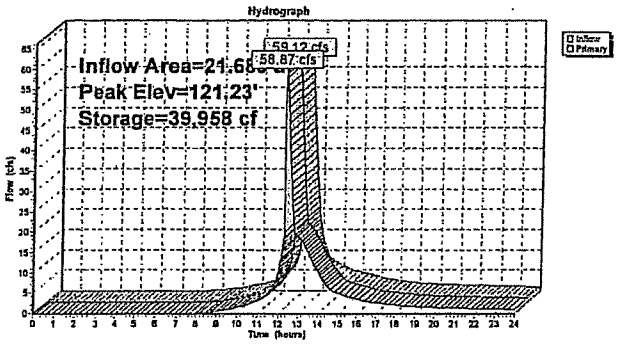
Volume	Invert	Avail.Storage	Storage Description
#1	115.00'	42,295 cf	Custom Stage Data (Prismatic)Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
115.00	4,620	0	0
118.00	6,496	16,674	16,674
121.00	7,936	21,648	38,322
122.00	10	3,973	42,295

Device	Routing	Invert	Outlet Devices
#1	Primary	115.00'	**18.0" x 40.0' long Culvert** RCP, end-section conforming to fill, Ke= 0.500 Outlet Invert= 114.40' S= 0.0150 '/' Cc= 0.900 n= 0.013
#2	Primary	121.00'	**128.0' long x 1.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

Primary OutFlow Max=58.81 cfs @ 12.32 hrs HW=121.23' (Free Discharge)
1=Culvert (Inlet Controls 19.92 cfs @ 11.28 fps)
2=Broad-Crested Rectangular Weir (Weir Controls 38.88 cfs @ 1.30 fps)

Pond 2P: Highview Pond Existing

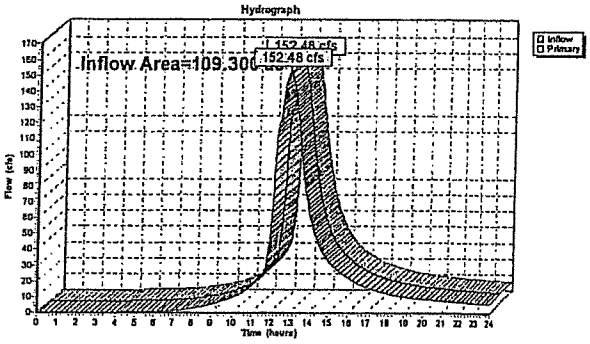


Link 68L: SW 59_SW 60

Inflow Area = 109.300 ac, Inflow Depth > 3.95" for RI 25yr Eastern event
Inflow = 152.48 cfs @ 12.92 hrs, Volume= 35.934 af
Primary = 152.48 cfs @ 12.92 hrs, Volume= 35.934 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

Link 68L: SW 59_SW 60

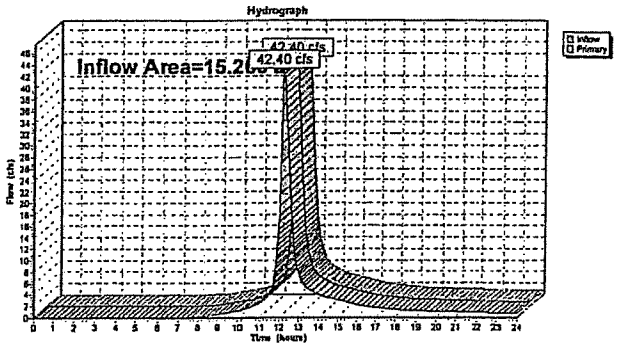


Link 69L: SW 14_SW 17

Inflow Area = 15.260 ac, Inflow Depth > 3.45" for RI 25yr Eastern event
Inflow = 42.40 cfs @ 12.19 hrs, Volume= 4.386 af
Primary = 42.40 cfs @ 12.19 hrs, Volume= 4.386 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

Link 69L: SW 14_SW 17

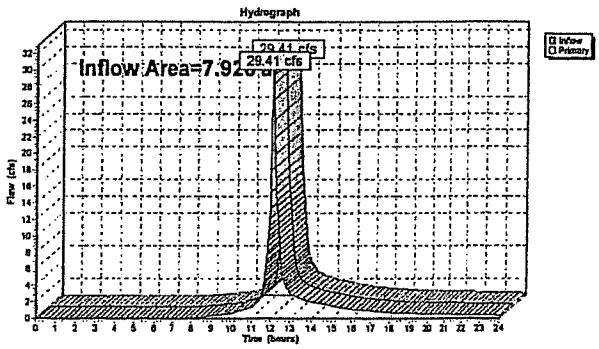


Link 70L: SW47_SW49

Inflow Area = 7.920 ac, Inflow Depth > 3.41" for RI 25yr Eastern event
Inflow = 29.41 cfs @ 12.11 hrs, Volume= 2.249 af
Primary = 29.41 cfs @ 12.11 hrs, Volume= 2.249 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

Link 70L: SW47_SW49

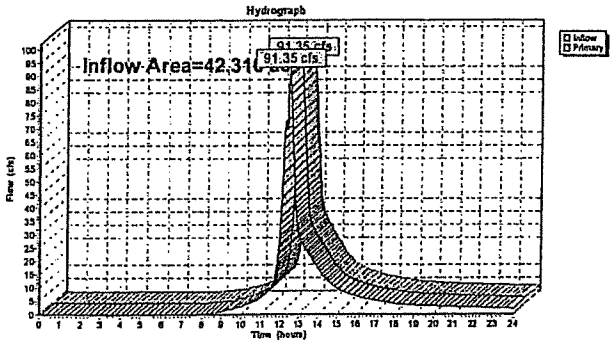


Link 71L: Elbow St

Inflow Area = 42.310 ac, Inflow Depth > 3.52" for RI 25yr Eastern event
Inflow = 91.35 cfs @ 12.46 hrs, Volume= 12.428 af
Primary = 91.35 cfs @ 12.46 hrs, Volume= 12.428 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

Link 71L: Elbow St



100-Year Storm

Time span=0.00-24.00 hrs, dt=0.02 hrs, 1201 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Sub-watershed 1 Runoff Area=18.400 ac Runoff Depth>6.37"
Flow Length=1,460' Tc=20.1 min CN=94 Runoff=85.31 cfs 9.766 af

Subcatchment 2S: Sub-watershed 2 Runoff Area=3.220 ac Runoff Depth>6.38"
Flow Length=702' Tc=10.2 min CN=94 Runoff=19.11 cfs 1.712 af

Subcatchment 3S: Sub-watershed 3 Runoff Area=27.500 ac Runoff Depth>4.97"
Flow Length=2,500' Tc=39.3 min CN=82 Runoff=79.44 cfs 11.400 af

Subcatchment 4S: Sub-watershed 4 Runoff Area=35.010 ac Runoff Depth>5.76"
Flow Length=3,098' Tc=50.9 min CN=89 Runoff=99.11 cfs 16.796 af

Subcatchment 5S: Sub-Watershed 5 Runoff Area=2.340 ac Runoff Depth>4.76"
Tc=5.0 min CN=80 Runoff=13.43 cfs 0.933 af

Subcatchment 6dS: Sub-watershed 6d Runoff Area=0.630 ac Runoff Depth>6.38"
Tc=5.0 min CN=94 Runoff=4.43 cfs 0.335 af

Subcatchment 6eS: Sub-watershed 6e Runoff Area=0.500 ac Runoff Depth>6.38"
Tc=5.0 min CN=94 Runoff=3.52 cfs 0.266 af

Subcatchment 6S: Sub-watershed 6 Runoff Area=10.610 ac Runoff Depth>5.68"
Flow Length=1,536' Tc=11.4 min CN=88 Runoff=56.74 cfs 5.023 af

Subcatchment 8S: Sub-watershed 8 Runoff Area=2.070 ac Runoff Depth>4.76"
Flow Length=419' Tc=11.6 min CN=80 Runoff=9.57 cfs 0.824 af

Subcatchment 9S: Sub-watershed 9 Runoff Area=3.780 ac Runoff Depth>5.45"
Flow Length=633' Tc=16.8 min CN=86 Runoff=17.05 cfs 1.716 af

Subcatchment 10S: Sub-watershed 10 Runoff Area=8.740 ac Runoff Depth>5.11"
Flow Length=1,337' Tc=18.3 min CN=83 Runoff=35.35 cfs 3.718 af

Subcatchment 11S: Sub-watershed 11 Runoff Area=24.460 ac Runoff Depth>5.78"
Flow Length=1,757' Tc=26.1 min CN=89 Runoff=95.85 cfs 11.785 af

Subcatchment 12S: Sub-watershed 12 Runoff Area=3.040 ac Runoff Depth>6.02"
Flow Length=996' Tc=15.8 min CN=91 Runoff=15.04 cfs 1.526 af

Subcatchment 13S: Sub-watershed 13 Runoff Area=6.760 ac Runoff Depth>4.89"
Tc=5.0 min CN=81 Runoff=39.58 cfs 2.757 af

Subcatchment 14S: Sub-watershed 14 Runoff Area=8.060 ac Runoff Depth>4.67"
Flow Length=1,715' Tc=11.8 min CN=79 Runoff=36.29 cfs 3.134 af

Subcatchment 15S: Sub-watershed 15 Runoff Area=21,660 ac Runoff Depth>4.88"
Flow Length=1,259' Tc=22.2 min CN=81 Runoff=79.62 cfs 8.815 af

Subcatchment 16S: Sub-watershed 16 Runoff Area=2,740 ac Runoff Depth>5.00"
Flow Length=709' Tc=13.2 min CN=82 Runoff=12.60 cfs 1.141 af

Subcatchment 17S: Sub-watershed 17 Runoff Area=7,200 ac Runoff Depth>4.77"
Flow Length=1,430' Tc=21.6 min CN=80 Runoff=26.19 cfs 2.861 af

Subcatchment 18S: Sub-watershed 18 Runoff Area=13,850 ac Runoff Depth>4.76"
Flow Length=1,668' Tc=11.2 min CN=80 Runoff=64.80 cfs 5.514 af

Subcatchment 19S: Sub-watershed 19 Runoff Area=29,160 ac Runoff Depth>4.40"
Flow Length=2,101' Tc=63.7 min CN=77 Runoff=57.74 cfs 10.689 af

Subcatchment 20S: Sub-watershed 20 Runoff Area=11,220 ac Runoff Depth>4.88"
Flow Length=1,264' Tc=17.0 min CN=81 Runoff=45.99 cfs 4.566 af

Subcatchment 21S: Sub-watershed 21 Runoff Area=2,540 ac Runoff Depth>6.38"
Flow Length=496' Tc=5.5 min CN=94 Runoff=17.57 cfs 1.351 af

Subcatchment 22S: Sub-watershed 22 Runoff Area=8,280 ac Runoff Depth>6.38"
Flow Length=1,194' Tc=7.2 min CN=94 Runoff=41.00 cfs 3.340 af

Subcatchment 23S: Sub-watershed 23 Runoff Area=0.900 ac Runoff Depth>6.38"
Tc=5.0 min CN=94 Runoff=6.33 cfs 0.479 af

Subcatchment 24S: Sub-watershed 24 Runoff Area=5,430 ac Runoff Depth>6.03"
Flow Length=1,015' Tc=12.7 min CN=91 Runoff=29.10 cfs 2.727 af

Subcatchment 25S: Sub-watershed 25 Runoff Area=7,910 ac Runoff Depth>4.76"
Flow Length=943' Tc=13.6 min CN=80 Runoff=34.56 cfs 3.148 af

Subcatchment 26S: Sub-watershed 26 Runoff Area=0.040 ac Runoff Depth>6.86"
Tc=5.0 min CN=98 Runoff=0.29 cfs 0.023 af

Subcatchment 27S: Sub-watershed 27 Runoff Area=0.090 ac Runoff Depth>5.12"
Tc=5.0 min CN=83 Runoff=0.55 cfs 0.038 af

Subcatchment 28S: Sub-watershed 28 Runoff Area=4,430 ac Runoff Depth>4.77"
Flow Length=1,025' Tc=22.5 min CN=80 Runoff=15.83 cfs 1.760 af

Subcatchment 29S: Sub-watershed 29 Runoff Area=9,690 ac Runoff Depth>5.00"
Flow Length=1,194' Tc=11.1 min CN=82 Runoff=48.28 cfs 4.121 af

Subcatchment 30S: Sub-watershed 30 Runoff Area=1,680 ac Runoff Depth>4.89"
Flow Length=716' Tc=13.0 min CN=81 Runoff=7.62 cfs 0.684 af

Subcatchment 31S: Sub-watershed 31 Runoff Area=27,350 ac Runoff Depth>4.43"
Flow Length=1,762' Tc=27.7 min CN=77 Runoff=83.46 cfs 10.102 af

Subcatchment 32S: Sub-watershed32 Runoff Area=45.010 ac Runoff Depth>4.11"
Flow Length=1,805' Tc=26.8 min CN=74 Runoff=129.77 cfs 15.406 af

Subcatchment 33S: Sub-watershed 33 Runoff Area=27.500 ac Runoff Depth>4.89"
Flow Length=1,541' Tc=10.9 min CN=81 Runoff=132.53 cfs 11.204 af

Subcatchment 34S: Sub-watershed 34 Runoff Area=5.470 ac Runoff Depth>4.66"
Flow Length=967' Tc=16.4 min CN=81 Runoff=22.74 cfs 2.226 af

Subcatchment 35S: Sub-watershed 35 Runoff Area=2.020 ac Runoff Depth>5.68"
Flow Length=401' Tc=11.6 min CN=88 Runoff=10.75 cfs 0.956 af

Subcatchment 36S: Sub-watershed 36 Runoff Area=114.100 ac Runoff Depth>5.10"
Flow Length=4,314' Tc=29.2 min CN=83 Runoff=385.76 cfs 48.456 af

Subcatchment 37S: Sub-watershed 37 Runoff Area=4.120 ac Runoff Depth>5.45"
Flow Length=852' Tc=9.7 min CN=86 Runoff=22.52 cfs 1.872 af

Subcatchment 38S: Sub-watershed 38 Runoff Area=1.590 ac Runoff Depth>5.80"
Tc=5.0 min CN=89 Runoff=10.61 cfs 0.769 af

Subcatchment 39S: Sub-watershed 39 Runoff Area=10.480 ac Runoff Depth>4.89"
Flow Length=1,018' Tc=12.8 min CN=81 Runoff=47.78 cfs 4.268 af

Subcatchment 40S: Sub-watershed 40 Runoff Area=0.240 ac Runoff Depth>4.89"
Flow Length=189' Tc=6.6 min CN=81 Runoff=1.33 cfs 0.098 af

Subcatchment 41S: Sub-watershed 41 Runoff Area=0.290 ac Runoff Depth>5.46"
Flow Length=182' Tc=6.2 min CN=86 Runoff=1.78 cfs 0.132 af

Subcatchment 42S: Sub-watershed 42 Runoff Area=0.070 ac Runoff Depth>5.46"
Flow Length=178' Tc=6.9 min CN=86 Runoff=0.42 cfs 0.032 af

Subcatchment 43S: Sub-watershed 43 Runoff Area=2.850 ac Runoff Depth>4.89"
Flow Length=570' Tc=10.1 min CN=81 Runoff=14.07 cfs 1.161 af

Subcatchment 44S: Sub-watershed 44 Runoff Area=1.720 ac Runoff Depth>4.44"
Flow Length=760' Tc=20.2 min CN=77 Runoff=6.02 cfs 0.636 af

Subcatchment 45S: Sub-watershed 45 Runoff Area=3.670 ac Runoff Depth>4.11"
Flow Length=865' Tc=21.2 min CN=74 Runoff=11.69 cfs 1.258 af

Subcatchment 46S: Sub-watershed 46 Runoff Area=1.370 ac Runoff Depth>4.11"
Flow Length=727' Tc=25.0 min CN=74 Runoff=4.07 cfs 0.469 af

Subcatchment 47S: Sub-watershed 47 Runoff Area=7.620 ac Runoff Depth>4.67"
Flow Length=701' Tc=8.1 min CN=79 Runoff=38.50 cfs 2.965 af

Subcatchment 48S: Sub-watershed 48 Runoff Area=1.320 ac Runoff Depth>5.23"
Flow Length=449' Tc=8.7 min CN=84 Runoff=7.21 cfs 0.575 af

Subcatchment 49S: Sub-watershed 49 Runoff Area=0.300 ac Runoff Depth>4.67"
Flow Length=130' Tc=7.3 min CN=79 Runoff=1.56 cfs 0.117 af

Subcatchment 50S: Sub-watershed 50 Runoff Area=1.900 ac Runoff Depth>4.67"
Flow Length=555' Tc=11.3 min CN=79 Runoff=8.68 cfs 0.739 af

Subcatchment 51S: Sub-wateshed 51 Runoff Area=3.850 ac Runoff Depth>6.03"
Tc=5.0 min CN=91 Runoff=26.31 cfs 1.936 af

Subcatchment 52S: Sub-watershed 52 Runoff Area=3.900 ac Runoff Depth>5.80"
Flow Length=598' Tc=9.6 min CN=89 Runoff=22.34 cfs 1.884 af

Subcatchment 53S: Sub-watershed 53 Runoff Area=4.840 ac Runoff Depth>5.91"
Flow Length=584' Tc=9.2 min CN=90 Runoff=28.43 cfs 2.385 af

Subcatchment 54S: Sub-watershed 54 Runoff Area=0.590 ac Runoff Depth>5.12"
Tc=5.0 min CN=83 Runoff=3.59 cfs 0.252 af

Subcatchment 55S: Sub-watershed 55 Runoff Area=1.880 ac Runoff Depth>6.02"
Flow Length=592' Tc=17.0 min CN=91 Runoff=9.05 cfs 0.943 af

Subcatchment 56S: Sub-watershed 56 Runoff Area=9.220 ac Runoff Depth>4.88"
Flow Length=951' Tc=23.1 min CN=81 Runoff=33.29 cfs 3.746 af

Subcatchment 57S: Sub-watershed 57 Runoff Area=2.690 ac Runoff Depth>4.88"
Flow Length=659' Tc=16.2 min CN=81 Runoff=11.24 cfs 1.095 af

Subcatchment 58S: Sub-watershed 58 Runoff Area=3.420 ac Runoff Depth>4.88"
Flow Length=774' Tc=17.4 min CN=81 Runoff=13.89 cfs 1.392 af

Subcatchment 59S: Sub-watershed 59 Runoff Area=80,930 ac Runoff Depth>5.05"
Flow Length=3,728' Tc=74.5 min CN=83 Runoff=186.85 cfs 38.275 af

Subcatchment 60S: Sub-watershed 60 Runoff Area=18.370 ac Runoff Depth>6.25"
Flow Length=2,475' Tc=20.8 min CN=93 Runoff=83.17 cfs 9.570 af

Subcatchment 61S: Sub-watershed 61 Runoff Area=15.630 ac Runoff Depth>5.00"
Flow Length=1,028' Tc=9.6 min CN=82 Runoff=79.92 cfs 6.515 af

Subcatchment 62S: Sub-watershed 62 Runoff Area=9.320 ac Runoff Depth>4.88"
Flow Length=991' Tc=22.5 min CN=81 Runoff=34.00 cfs 3.789 af

Subcatchment 63S: Sub-watershed 63 Runoff Area=9.850 ac Runoff Depth>4.89"
Flow Length=1,245' Tc=12.1 min CN=81 Runoff=45.83 cfs 4.012 af

Subcatchment 64S: Sub-watershed 64 Runoff Area=0.720 ac Runoff Depth>6.03"
Flow Length=133' Tc=9.7 min CN=91 Runoff=4.21 cfs 0.362 af

Subcatchment 65S: Sub-watershed 65 Runoff Area=4.080 ac Runoff Depth>4.89"
Flow Length=1,220' Tc=15.0 min CN=81 Runoff=17.54 cfs 1.661 af

Subcatchment 66S: Su-watershed 66 Runoff Area=4.660 ac Runoff Depth>4.86"
Flow Length=863' Tc=22.0 min CN=81 Runoff=17.19 cfs 1.895 af

Subcatchment 67S: Sub-watershed 67 Runoff Area=3.140 ac Runoff Depth>5.21"
Flow Length=869' Tc=28.6 min CN=84 Runoff=10.92 cfs 1.363 af

Subcatchment 68S: Sub-watershed 68 Runoff Area=20.630 ac Runoff Depth>4.77"
Flow Length=1,184' Tc=18.0 min CN=80 Runoff=80.86 cfs 8.203 af

Reach 3R: Intermittent Stream Avg. Depth=1.01' Max Vel=3.29 fps Inflow=79.54 cfs 8.762 af
n=0.070 L=725.0' S=0.0283 '/' Capacity=253.16 cfs Outflow=76.68 cfs 8.724 af

Pond 2P: Highview Pond Existing Peak Elev=121.31' Storage=40,393 cf Inflow=79.62 cfs 8.815 af
Outflow=79.54 cfs 8.762 af

Link 58L: SW 59_SW 60 Inflow=202.68 cfs 47.844 af
Primary=202.68 cfs 47.844 af

Link 69L: SW 14_SW 17 Inflow=57.76 cfs 5.995 af
Primary=57.76 cfs 5.995 af

Link 70L: SW47_SW49 Inflow=40.05 cfs 3.082 af
Primary=40.05 cfs 3.082 af

Link 71L: Elbow St Inflow=138.70 cfs 16.927 af
Primary=138.70 cfs 16.927 af

Total Runoff Area = 746.870 ac Runoff Volume = 315.669 af Average Runoff Depth = 5.07"
66.54% Pervious Area = 496.954 ac 33.46% Impervious Area = 249.916 ac

Subcatchment 1S: Sub-watershed 1

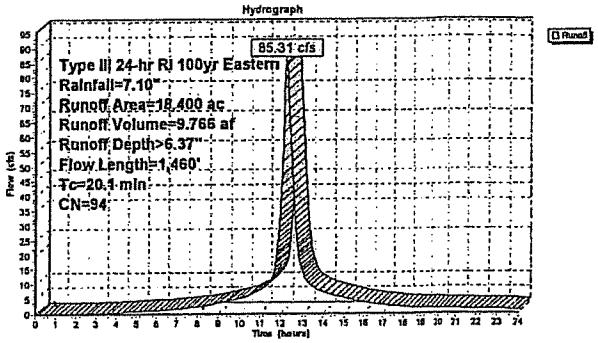
Runoff = 85.31 cfs @ 12.26 hrs, Volume= 9.766 af, Depth> 6.37"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 100yr Eastern Rainfall=7.10"

Area (ac)	CN	Description
18.400	94	Urban commercial, 85% imp, HSG C
2.760		Pervious Area
15.640		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.7	100	0.0150	0.16		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
8.9	1,240	0.0210	2.33		Shallow Concentrated Flow, B-C Unpaved Kv= 16.1 fps
0.5	120	0.0330	3.69		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
20.1	1,460	Total			

Subcatchment 1S: Sub-watershed 1



Subcatchment 2S: Sub-watershed 2

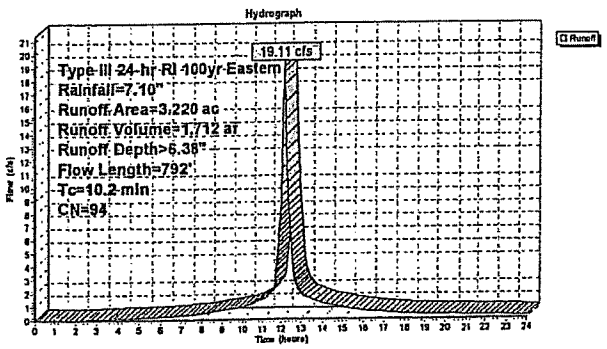
Runoff = 19.11 cfs @ 12.14 hrs, Volume= 1.712 af, Depth> 6.36"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 100yr Eastern Rainfall=7.10"

Area (ac)	CN	Description
3.220	94	Urban commercial, 85% imp, HSG C
0.483		Pervious Area
2.737		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.1	100	0.0600	0.27		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
2.4	394	0.0280	2.69		Shallow Concentrated Flow, B-C Unpaved Kv= 16.1 fps
1.7	298	0.0200	2.87		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
10.2	792	Total			

Subcatchment 2S: Sub-watershed 2



Subcatchment 3S: Sub-watershed 3

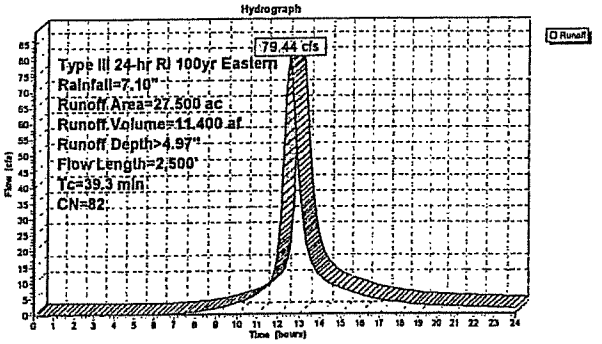
Runoff = 79.44 cfs @ 12.53 hrs, Volume= 11.400 af, Depth> 4.97"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 100yr Eastern Rainfall=7.10"

Area (ac)	CN	Description
13.750	86	Pasture/grassland/range, Poor, HSG C
10.750	80	1/2 acre lots, 25% imp, HSG C
3.000	73	Woods, Fair, HSG C
27.500	82	Weighted Average
24.813		Pervious Area
2.688		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	100	0.0100	0.28		Sheet Flow, A-B Cultivated: Residue<=20% n= 0.060 P2= 3.40"
19.4	1,200	0.0217	1.03		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
13.9	1,200	0.0050	1.44		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
39.3	2,500	Total			

Subcatchment 3S: Sub-watershed 3



Subcatchment 4S: Sub-watershed 4

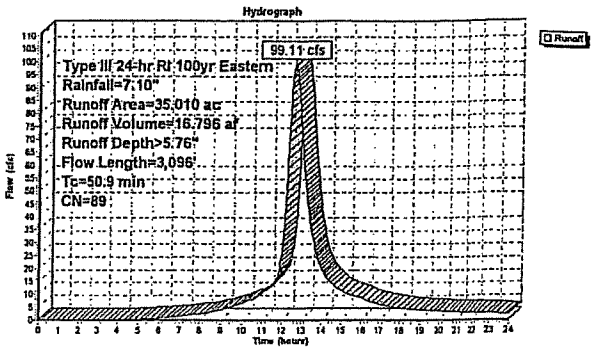
Runoff = 99.11 cfs @ 12.67 hrs, Volume= 16.796 af, Depth> 5.76"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
= III 24-hr RI 100yr Eastern Rainfall=7.10"

rea (ac)	CN	Description
5.901	90	Fallow, crop residue, Poor, HSG C
17.070	94	Urban commercial, 85% imp, HSG C
5.647	79	Pasture/grassland/range, Fair, HSG C
3.680	79	1 acre lots, 20% imp, HSG C
2.712	91	Urban industrial, 72% imp, HSG C
35.010	89	Weighted Average
17.812		Pervious Area
17.198		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.5	100	0.0200	0.18		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
1.8	106	0.0190	0.96		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
0.2	30	0.0170	2.65		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
0.6	70	0.0860	2.05		Shallow Concentrated Flow, D-E Short Grass Pasture Kv= 7.0 fps
0.7	82	0.0100	2.03		Shallow Concentrated Flow, E-F Paved Kv= 20.3 fps
24.2	322	0.0010	0.22		Shallow Concentrated Flow, F-G Short Grass Pasture Kv= 7.0 fps
13.9	2,386	0.0200	2.87		Shallow Concentrated Flow, G-H Paved Kv= 20.3 fps
50.9	3,096	Total			

Subcatchment 4S: Sub-watershed 4



Subcatchment 5S: Sub-Watershed 5

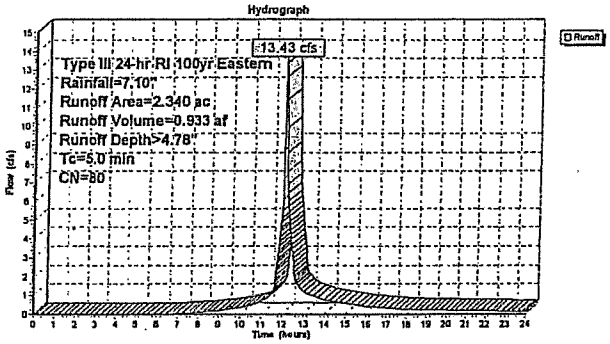
Runoff = 13.43 cfs @ 12.07 hrs, Volume= 0.933 af, Depth> 4.78"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 100yr Eastern Rainfall=7.10"

Area (ac)	CN	Description
2.340	80	1/2 acre lots, 25% Imp, HSG C
1.755		Pervious Area
0.585		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry, A-D

Subcatchment 5S: Sub-Watershed 5



Subcatchment 6dS: Sub-watershed 6d

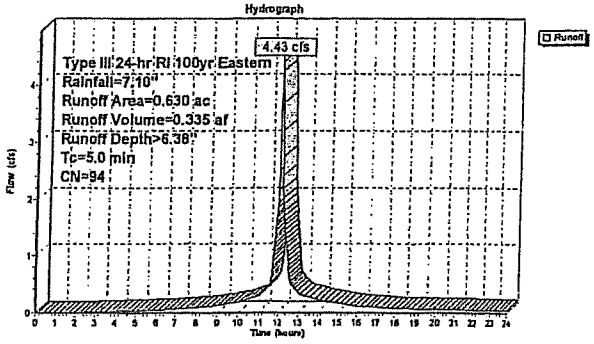
Runoff = 4.43 cfs @ 12.07 hrs, Volume= 0.335 af, Depth> 6.38"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 100yr Eastern Rainfall=7.10"

Area (ac)	CN	Description
0.630	94	Urban commercial, 85% Imp, HSG C
0.095		Pervious Area
0.535		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry, A-C

Subcatchment 6dS: Sub-watershed 6d



Subcatchment 6eS: Sub-watershed 6e

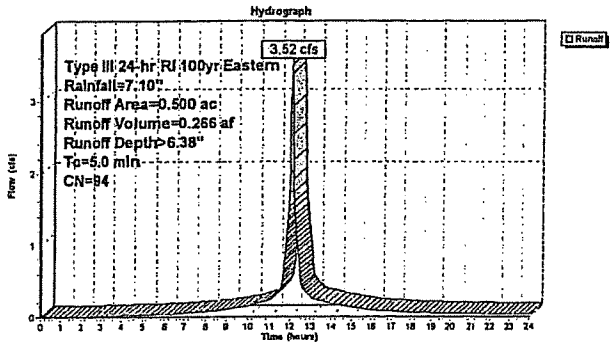
Runoff = 3.52 cfs @ 12.07 hrs, Volume= 0.266 af, Depth> 6.38"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 100yr Eastern Rainfall=7.10"

Area (ac)	CN	Description
0.500	94	Urban commercial, 85% imp, HSG C
0.075		Pervious Area
0.425		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry, A-C

Subcatchment 6eS: Sub-watershed 6e



Subcatchment 6S: Sub-watershed 6

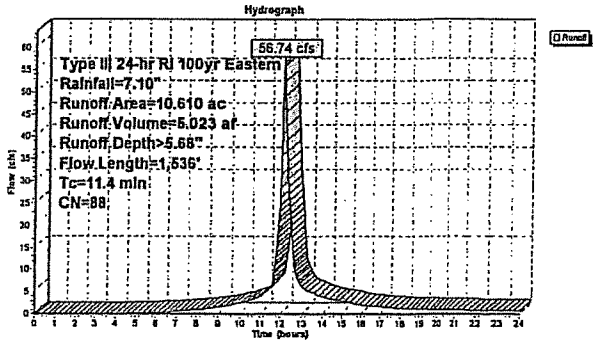
Runoff = 56.74 cfs @ 12.15 hrs, Volume= 5.023 af, Depth> 5.68"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 100yr Eastern Rainfall=7.10"

Area (ac)	CN	Description
8.380	87	Dirt roads, HSG C
2.230	94	Urban commercial, 85% imp, HSG C
10.610	88	Weighted Average
8.714		Pervious Area
1.895		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.6	100	0.0900	2.59		Sheet Flow, A-B Smooth surfaces n= 0.011 P2= 3.40"
10.8	1,436	0.0120	2.22		Shallow Concentrated Flow, B-C Paved Kv= 20.3 fps
11.4	1,536	Total			

Subcatchment 6S: Sub-watershed 6



Subcatchment 8S: Sub-watershed 8

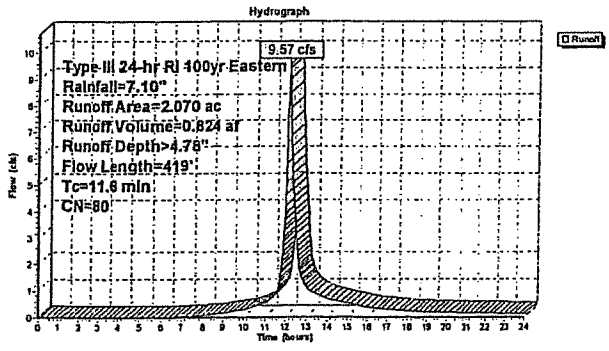
Runoff = 9.57 cfs @ 12.16 hrs, Volume= 0.824 af, Depth> 4.78"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 100yr Eastern Rainfall=7.10"

Area (ac)	CN	Description
2.070	80	1/2 acre lots, 25% imp, HSG C
1.552		Pervious Area
0.517		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.1	100	0.0300	0.21		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
3.1	228	0.0300	1.21		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
0.4	91	0.0400	4.06		Shallow Concentrated Flow, B-C Paved Kv= 20.3 fps
11.6	419	Total			

Subcatchment 8S: Sub-watershed 8



Subcatchment 9S: Sub-watershed 9

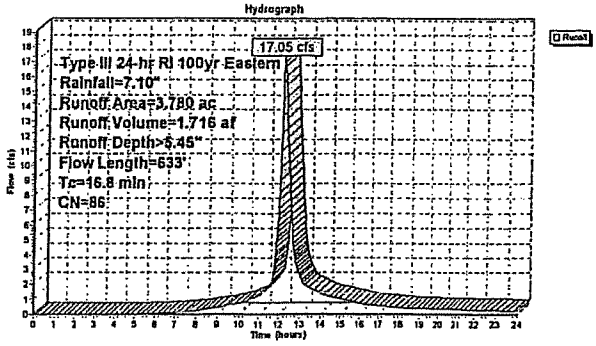
Runoff = 17.05 cfs @ 12.22 hrs, Volume= 1.716 af, Depth> 5.45"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 100yr Eastern Rainfall=7.10"

Area (ac)	CN	Description
2.990	90	1/8 acre lots, 65% imp, HSG C
0.790	73	Woods, Fair, HSG C
3.780	86	Weighted Average
1.837		Pervious Area
1.944		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.5	100	0.0200	0.18		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
4.7	200	0.0200	0.71		Shallow Concentrated Flow, B-C Woodland Kv= 5.0 fps
1.7	160	0.0500	1.57		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
0.9	173	0.0230	3.08		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
16.8	633	Total			

Subcatchment 9S: Sub-watershed 9



Subcatchment 10S: Sub-watershed 10

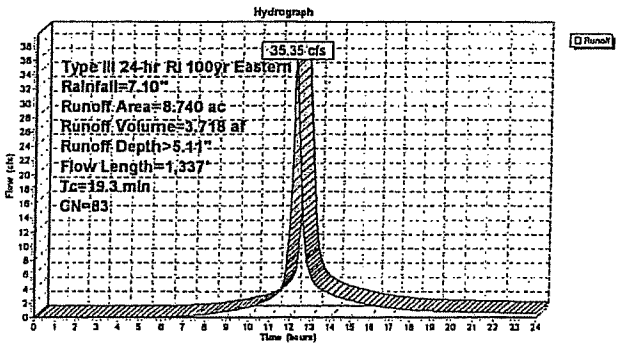
Runoff = 35.35 cfs @ 12.26 hrs, Volume= 3.718 af, Depth> 5.11"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 100yr Eastern Rainfall=7.10"

Area (ac)	CN	Description
8.740	83	1/4 acre lots, 38% Imp, HSG C
5.419		Pervious Area
3.321		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.5	100	0.0200	0.18		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
3.8	196	0.0150	0.86		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
6.0	1,041	0.0200	2.87		Shallow Concentrated Flow, B-C Paved Kv= 20.3 fps
19.3	1,337	Total			

Subcatchment 10S: Sub-watershed 10



Subcatchment 11S: Sub-watershed 11

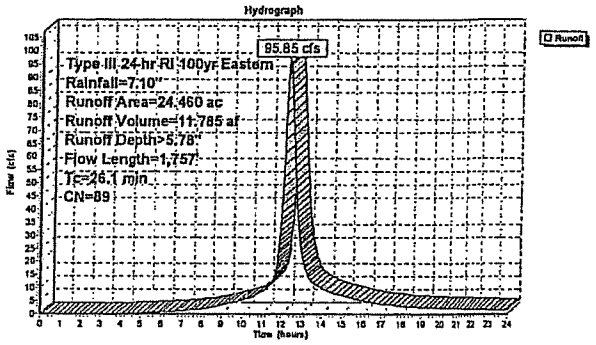
Runoff = 95.85 cfs @ 12.34 hrs, Volume= 11.785 af, Depth> 5.78"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 100yr Eastern Rainfall=7.10"

Area (ac)	CN	Description
5.370	90	Fallow, crop residue, Poor, HSG C
10.340	94	Urban commercial, 85% Imp, HSG C
8.750	83	1/4 acre lots, 38% Imp, HSG C
24.460	89	Weighted Average
12.346		Pervious Area
12.114		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.6	100	0.0200	0.36		Sheet Flow, A-B Cultivated: Residue<=20% n= 0.060 P2= 3.40"
12.0	504	0.0100	0.70		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
9.5	1,153	0.0100	2.03		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
26.1	1,757	Total			

Subcatchment 11S: Sub-watershed 11



Subcatchment 12S: Sub-watershed 12

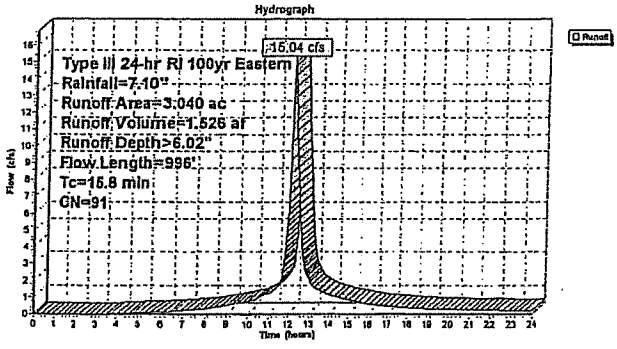
Runoff = 15.04 cfs @ 12.21 hrs, Volume= 1.526 af, Depth> 6.02"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 100yr Eastern Rainfall=7.10"

Area (ac)	CN	Description
2.130	94	Urban commercial, 85% Imp, HSG C
0.910	83	1/4 acre lots, 38% Imp, HSG C
3.040	91	Weighted Average
0.884		Pervious Area
2.156		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.1	100	0.0300	0.21		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
5.5	462	0.0400	1.40		Shallow Concentrated Flow, A-B Short Grass Pasture Kv= 7.0 fps
2.2	434	0.0270	3.34		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
15.8	996	Total			

Subcatchment 12S: Sub-watershed 12



Subcatchment 13S: Sub-watershed 13

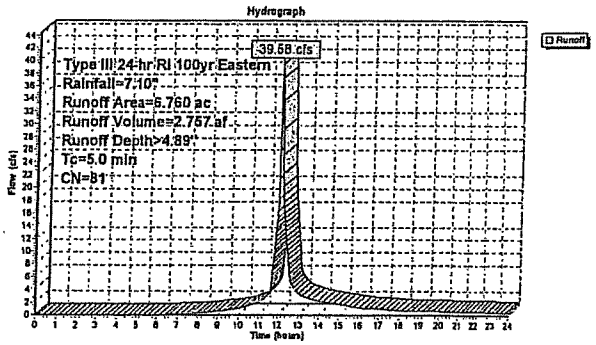
Runoff = 39.58 cfs @ 12.07 hrs, Volume= 2.757 af, Depth> 4.89"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 100yr Eastern Rainfall=7.10"

Area (ac)	CN	Description
6.760	81	1/3 acre lots, 30% Imp, HSG C
4.732		Pervious Area
2.028		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry, A-C

Subcatchment 13S: Sub-watershed 13



Subcatchment 14S: Sub-watershed 14

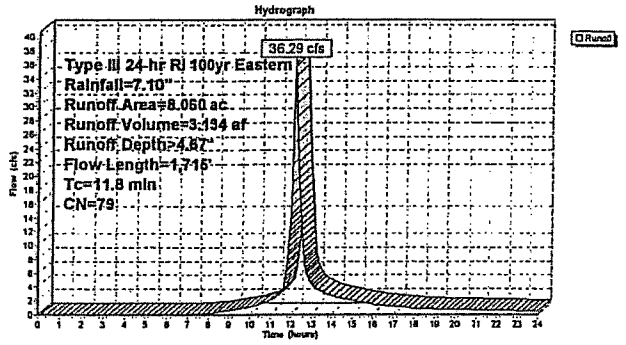
Runoff = 36.29 cfs @ 12.16 hrs, Volume= 3.134 af, Depth> 4.67"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 100yr Eastern Rainfall=7.10"

Area (ac)	CN	Description
0.240	94	Urban commercial, 85% Imp, HSG C
7.820	79	1 acre lots, 20% Imp, HSG C
8.060	79	Weighted Average
6.292		Pervious Area
1.768		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.8	100	0.0100	1.07		Sheet Flow, A-B Smooth surfaces n= 0.011 P2= 3.40"
10.2	1,615	0.0170	2.65		Shallow Concentrated Flow, B-C Paved Kv= 20.3 fps
11.8	1,715	Total			

Subcatchment 14S: Sub-watershed 14



Subcatchment 15S: Sub-watershed 15

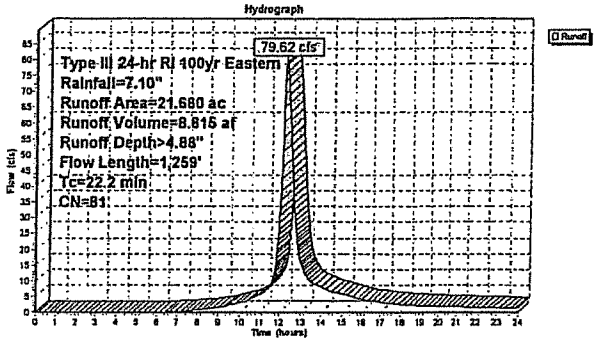
Runoff = 79.62 cfs @ 12.30 hrs, Volume= 8.815 af, Depth> 4.88"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 100yr Eastern Rainfall=7.10"

Area (ac)	CN	Description
15.390	79	1 acre lots, 20% Imp, HSG C
5.090	90	1/8 acre lots, 65% Imp, HSG C
1.200	76	Woods/grass comb., Fair, HSG C
21.680	81	Weighted Average
15.294		Pervious Area
6.387		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.1	100	0.0300	0.21		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
1.3	168	0.0120	2.22		Shallow Concentrated Flow, B-C Paved Kv= 20.3 fps
12.8	991	0.0340	1.29		Shallow Concentrated Flow, C-D Short Grass Pasture Kv= 7.0 fps
22.2	1,259	Total			

Subcatchment 15S: Sub-watershed 15



Subcatchment 16S: Sub-watershed 16

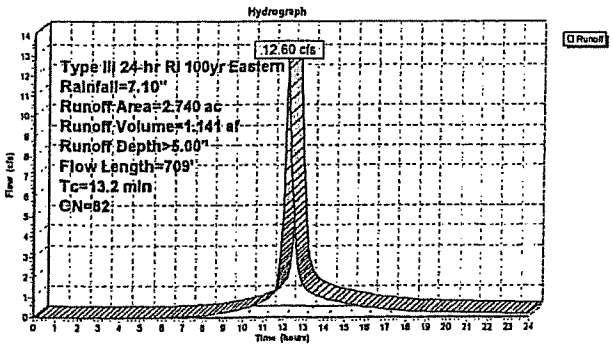
Runoff = 12.60 cfs @ 12.18 hrs, Volume= 1.141 af, Depth> 5.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 100yr Eastern Rainfall=7.10"

Area (ac)	CN	Description
2.330	81	1/3 acre lots, 30% Imp, HSG C
0.410	91	Fallow, bare soil, HSG C
2.740	82	Weighted Average
2.041		Pervious Area
0.699		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.5	100	0.0200	0.18		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
2.0	161	0.0370	1.35		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
1.7	448	0.0450	4.31		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
13.2	709	Total			

Subcatchment 16S: Sub-watershed 16



Subcatchment 17S: Sub-watershed 17

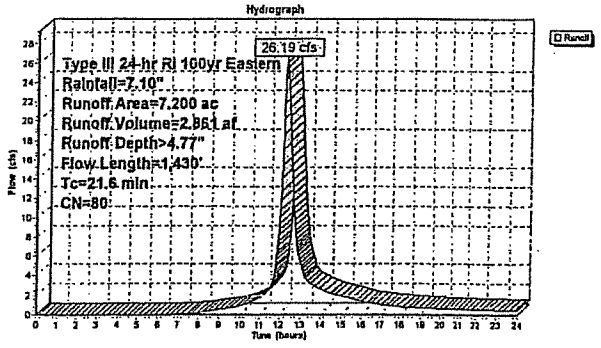
Runoff = 26.19 cfs @ 12.29 hrs, Volume= 2.861 af, Depth> 4.77"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 100yr Eastern Rainfall=7.10"

Area (ac)	CN	Description
7.200	80	1/2 acre lots, 25% Imp, HSG C
5.400		Pervious Area
1.800		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.5	100	0.0100	0.13		Sheet Flow, A-C Grass: Short n= 0.150 P2= 3.40"
1.8	338	0.0240	3.14		Shallow Concentrated Flow, B-C Paved Kv= 20.3 fps
0.5	125	0.0400	4.06		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
2.9	260	0.0460	1.50		Shallow Concentrated Flow, D-E Short Grass Pasture Kv= 7.0 fps
3.9	607	0.0160	2.57		Shallow Concentrated Flow, E-F Paved Kv= 20.3 fps
21.6	1,430	Total			

Subcatchment 17S: Sub-watershed 17



Subcatchment 18S: Sub-watershed 18

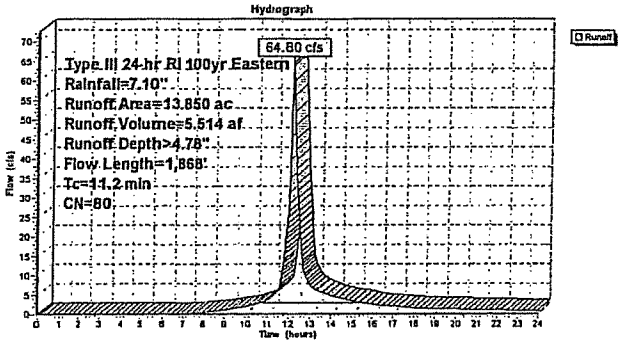
Runoff = 64.80 cfs @ 12.15 hrs, Volume= 5.514 af, Depth> 4.78"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 100yr Eastern Rainfall=7.10"

Area (ac)	CN	Description
13.160	80	1/2 acre lots, 25% Imp, HSG C
0.690	73	Woods, Fair, HSG C
13.850	80	Weighted Average
10.560		Pervious Area
3.290		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.8	100	0.0500	2.05		Sheet Flow, A-B Smooth surfaces n= 0.011 P2= 3.40"
3.3	299	0.0470	1.52		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
7.1	1,469	0.0290	3.46		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
11.2	1,868	Total			

Subcatchment 18S: Sub-watershed 18



Subcatchment 19S: Sub-watershed 19

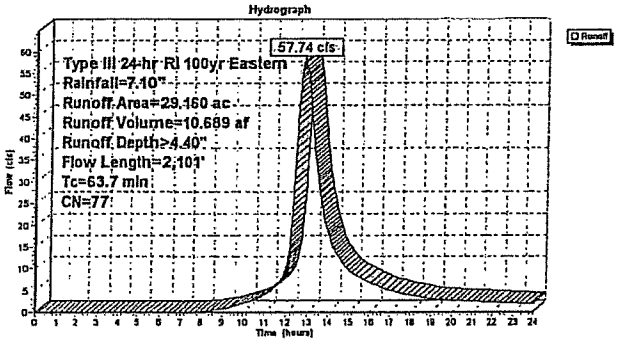
Runoff = 57.74 cfs @ 12.83 hrs, Volume= 10.669 af, Depth> 4.40"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 100yr Eastern Rainfall=7.10"

Area (ac)	CN	Description
1.460	94	Urban commercial, 85% Imp, HSG C
1.460	80	1/2 acre lots, 25% Imp, HSG C
26.240	76	Woods/grass comb., Fair, HSG C
29.160	77	Weighted Average
27.554		Pervious Area
1.606		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.1	100	0.0160	0.11		Sheet Flow, A-B Grass: Dense n= 0.240 P2= 3.40"
2.9	161	0.0170	0.91		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
0.1	17	0.0230	3.08		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
1.2	80	0.0250	1.11		Shallow Concentrated Flow, D-E Short Grass Pasture Kv= 7.0 fps
0.1	13	0.0200	2.87		Shallow Concentrated Flow, E-F Paved Kv= 20.3 fps
35.7	678	0.0040	0.32		Shallow Concentrated Flow, F-G Woodland Kv= 5.0 fps
8.6	1,052	0.0100	2.03		Shallow Concentrated Flow, G-H Paved Kv= 20.3 fps
63.7	2,101	Total			

Subcatchment 19S: Sub-watershed 19



Subcatchment 20S: Sub-watershed 20

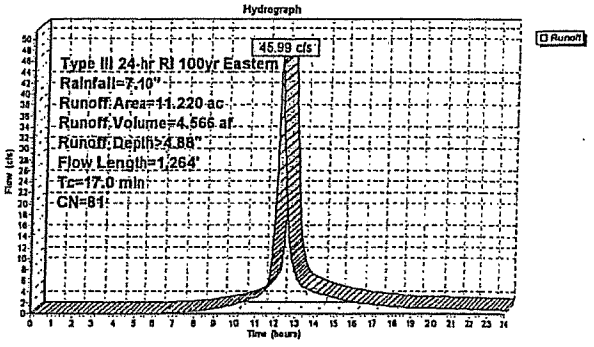
Runoff = 45.99 cfs @ 12.23 hrs, Volume= 4.566 af, Depth> 4.88"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 100yr Eastern Rainfall=7.10"

Area (ac)	CN	Description
11.220	81	1/3 acre lots, 30% Imp, HSG C
7.854		Pervious Area
3.366		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.1	100	0.0300	0.21		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
4.0	174	0.0110	0.73		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
4.9	990	0.0280	3.40		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
17.0	1,264	Total			

Subcatchment 20S: Sub-watershed 20



Subcatchment 21S: Sub-watershed 21

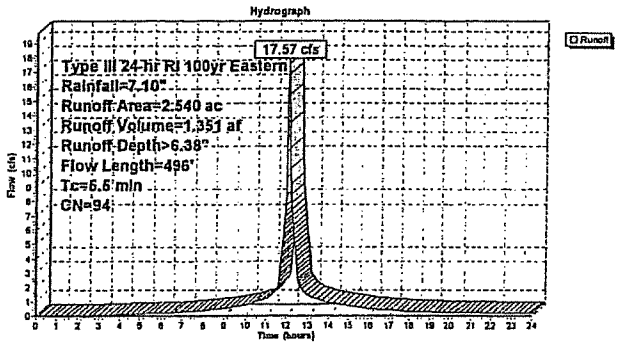
Runoff = 17.57 cfs @ 12.08 hrs, Volume= 1.351 af, Depth> 6.38"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 100yr Eastern Rainfall=7.10"

Area (ac)	CN	Description
2.540	94	Urban commercial, 85% Imp, HSG C
0.381		Pervious Area
2.159		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.8	70	0.1000	0.31		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
0.2	30	0.1200	2.28		Sheet Flow, B-C Smooth surfaces n= 0.011 P2= 3.40"
1.5	396	0.0450	4.31		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
5.5	496	Total			

Subcatchment 21S: Sub-watershed 21



Subcatchment 22S: Sub-watershed 22

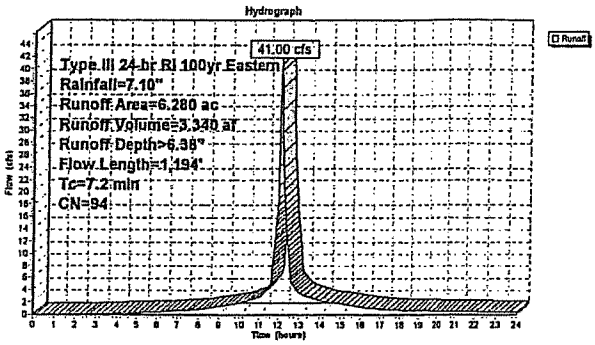
Runoff = 41.00 cfs @ 12.10 hrs, Volume= 3.340 af, Depth> 6.38"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 100yr Eastern Rainfall=7.10"

Area (ac)	CN	Description
6.280	94	Urban commercial, 85% Imp, HSG C
0.942		Pervious Area
5.338		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	100	0.0800	2.47		Sheet Flow, A-B Smooth surfaces n= 0.011 P2= 3.40"
6.5	1,094	0.0190	2.80		Shallow Concentrated Flow, B-C Paved Kv= 20.3 fps
7.2	1,194	Total			

Subcatchment 22S: Sub-watershed 22



Subcatchment 23S: Sub-watershed 23

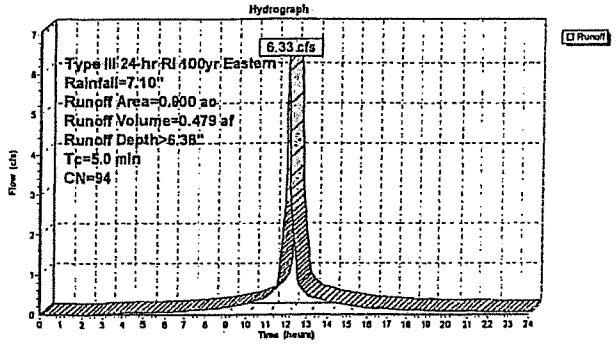
Runoff = 6.33 cfs @ 12.07 hrs, Volume= 0.479 af, Depth> 6.38"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 100yr Eastern Rainfall=7.10"

Area (ac)	CN	Description
0.900	94	Urban commercial, 85% Imp, HSG C
0.135		Pervious Area
0.765		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry, A-E

Subcatchment 23S: Sub-watershed 23



Subcatchment 24S: Sub-watershed 24

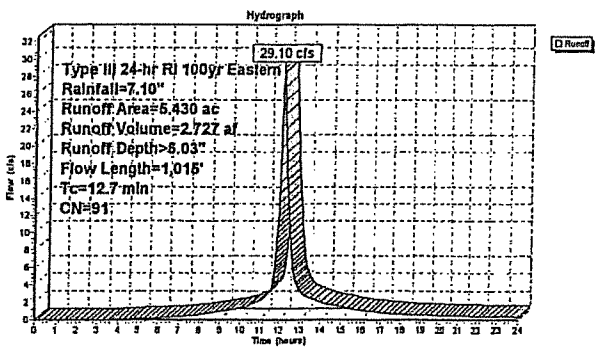
Runoff = 29.10 cfs @ 12.17 hrs, Volume= 2.727 af, Depth> 6.03"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 100yr Eastern Rainfall=7.10"

Area (ac)	CN	Description
4.340	94	Urban commercial, 85% Imp, HSG C
1.090	81	1/3 acre lots, 30% Imp, HSG C
5.430	91	Weighted Average
1.414		Pervious Area
4.016		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.5	100	0.0800	0.31		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
3.7	397	0.0650	1.78		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
3.5	518	0.0150	2.49		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
12.7	1,015	Total			

Subcatchment 24S: Sub-watershed 24



Subcatchment 25S: Sub-watershed 25

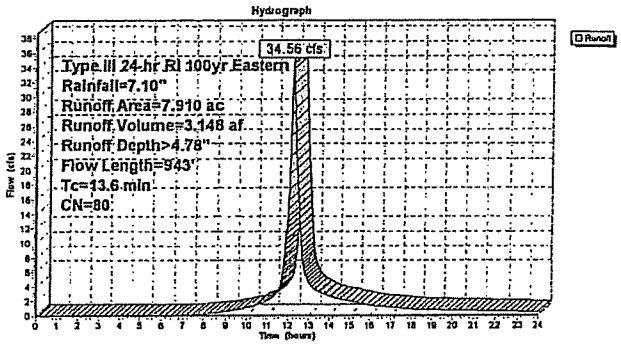
Runoff = 34.56 cfs @ 12.18 hrs, Volume= 3.148 af, Depth> 4.78"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 100yr Eastern Rainfall=7.10"

Area (ac)	CN	Description
7.120	81	1/3 acre lots, 30% Imp, HSG C
0.790	73	Woods, Fair, HSG C
7.910	80	Weighted Average
5.774		Pervious Area
2.136		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.2	100	0.0400	0.23		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
3.5	276	0.0360	1.33		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
2.9	567	0.0250	3.21		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
13.6	943	Total			

Subcatchment 25S: Sub-watershed 25



Subcatchment 26S: Sub-watershed 26

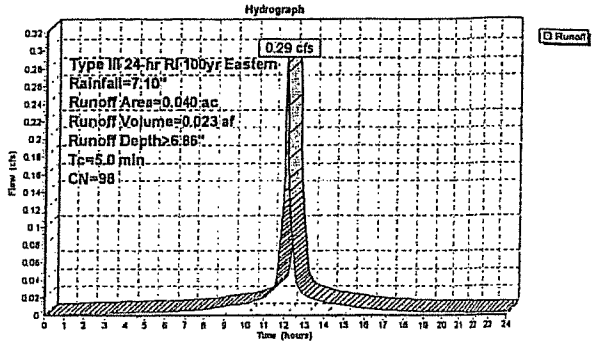
Runoff = 0.29 cfs @ 12.07 hrs, Volume= 0.023 af, Depth> 6.86"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 100yr Eastern Rainfall=7.10"

Area (ac)	CN	Description
0.040	98	Paved parking & roofs
0.040		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry, A-B

Subcatchment 26S: Sub-watershed 26



Subcatchment 27S: Sub-watershed 27

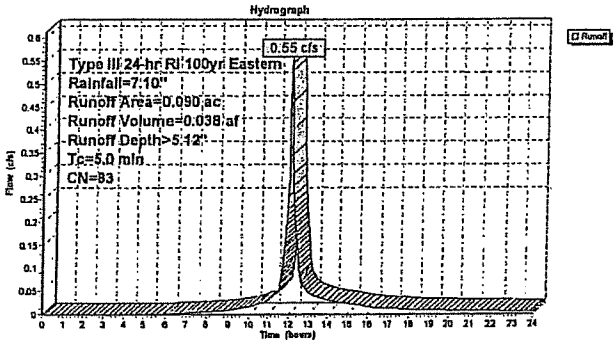
Runoff = 0.55 cfs @ 12.07 hrs, Volume= 0.038 af, Depth> 5.12"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 100yr Eastern Rainfall=7.10"

Area (ac)	CN	Description
0.090	83	1/4 acre lots, 38% Imp, HSG C
0.056		Pervious Area
0.034		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry, A-B

Subcatchment 27S: Sub-watershed 27



Subcatchment 28S: Sub-watershed 28

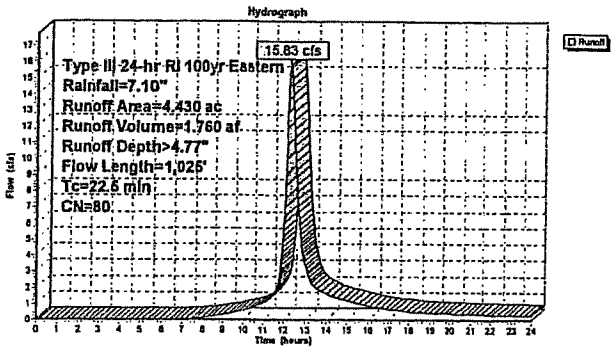
Runoff = 15.83 cfs @ 12.31 hrs, Volume= 1.760 af, Depth> 4.77"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 100yr Eastern Rainfall=7.10"

Area (ac)	CN	Description
3.990	81	1/3 acre lots, 30% Imp, HSG C
0.440	73	Woods, Fair, HSG C
4.430	80	Weighted Average
3.233		Pervious Area
1.197		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.5	100	0.0200	0.18		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
0.4	23	0.0220	1.04		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
0.1	19	0.0200	2.87		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
0.4	23	0.0200	0.99		Shallow Concentrated Flow, D-E Short Grass Pasture Kv= 7.0 fps
0.1	22	0.0200	2.87		Shallow Concentrated Flow, E-F Paved Kv= 20.3 fps
7.5	426	0.0360	0.95		Shallow Concentrated Flow, F-G Woodland Kv= 5.0 fps
1.2	100	0.0400	1.40		Shallow Concentrated Flow, G-H Short Grass Pasture Kv= 7.0 fps
3.3	312	0.0060	1.57		Shallow Concentrated Flow, H-I Paved Kv= 20.3 fps
22.5	1,025	Total			

Subcatchment 28S: Sub-watershed 28



Subcatchment 29S: Sub-watershed 29

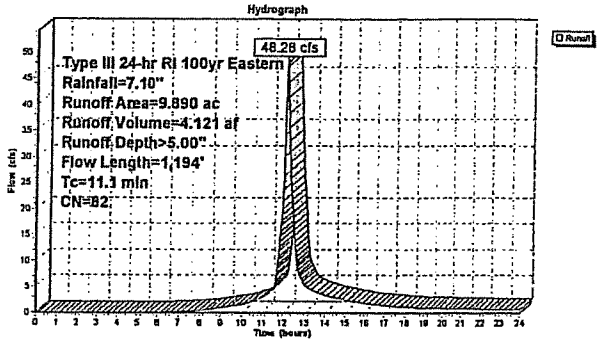
Runoff = 48.28 cfs @ 12.15 hrs, Volume= 4.121 af, Depth> 5.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 100yr Eastern Rainfall=7.10"

Area (ac)	CN	Description
0.490	74	>75% Grass cover, Good, HSG C
0.980	94	Urban commercial, 85% imp, HSG C
8.420	81	1/3 acre lots, 30% imp, HSG C
9.890	82	Weighted Average
6.531		Pervious Area
3.359		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.5	100	0.0110	1.12		Sheet Flow, A-B Smooth surfaces n= 0.011 P2= 3.40"
6.7	453	0.0260	1.13		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
2.9	641	0.0330	3.69		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
11.1	1,194	Total			

Subcatchment 29S: Sub-watershed 29



Subcatchment 30S: Sub-watershed 30

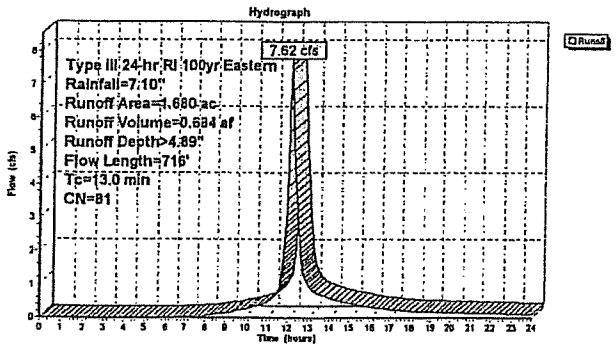
Runoff = 7.62 cfs @ 12.18 hrs, Volume= 0.684 af, Depth> 4.89"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 100yr Eastern Rainfall=7.10"

Area (ac)	CN	Description
1.680	81	1/3 acre lots, 30% imp, HSG C
1.176		Pervious Area
0.504		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.5	100	0.0200	0.18		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
1.2	118	0.0510	1.58		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
2.3	498	0.0320	3.63		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
13.0	716	Total			

Subcatchment 30S: Sub-watershed 30



Subcatchment 31S: Sub-watershed 31

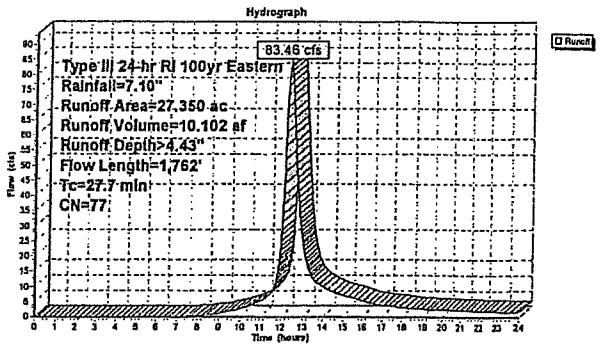
Runoff = 83.46 cfs @ 12.38 hrs, Volume= 10.102 af, Depth> 4.43"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 100yr Eastern Rainfall=7.10"

Area (ac)	CN	Description
12.350	81	1/3 acre lots, 30% imp, HSG C
15.000	74	>75% Grass cover, Good, HSG C
27.350	77	Weighted Average
23.645		Pervious Area
3.705		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.6	100	0.0500	0.25		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
15.3	1,075	0.0280	1.17		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
5.8	587	0.0070	1.70		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
27.7	1,762	Total			

Subcatchment 31S: Sub-watershed 31



Subcatchment 32S: Sub-watershed32

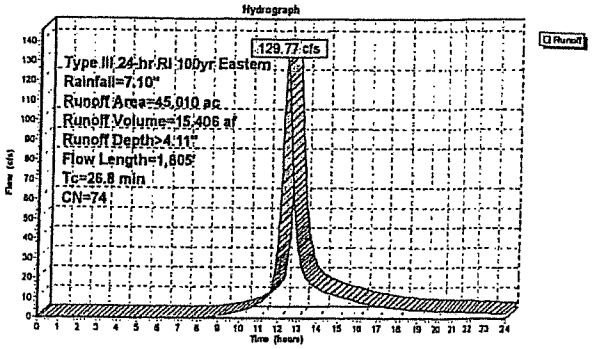
Runoff = 129.77 cfs @ 12.37 hrs, Volume= 15.406 af, Depth> 4.11"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 100yr Eastern Rainfall=7.10"

Area (ac)	CN	Description
14.440	81	1/3 acre lots, 30% Imp, HSG C
13.320	69	50-75% Grass cover, Fair, HSG B
15.110	73	Woods, Fair, HSG C
0.900	88	Fallow, crop residue, Good, HSG C
1.240	58	Brush, Fair, HSG B
45.010	74	Weighted Average
40.678		Pervious Area
4.332		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.0	100	0.0840	0.14		Sheet Flow, A-B Grass: Bermuda n= 0.410 P2= 3.40"
2.3	179	0.0698	1.32		Shallow Concentrated Flow, B-C Woodland Kv= 5.0 fps
2.9	654	0.0528	3.70		Shallow Concentrated Flow, C-D Unpaved Kv= 16.1 fps
5.8	474	0.0738	1.36		Shallow Concentrated Flow, D-E Woodland Kv= 5.0 fps
3.8	398	0.0075	1.76		Shallow Concentrated Flow, E-F Paved Kv= 20.3 fps
26.8	1,805	Total			

Subcatchment 32S: Sub-watershed32



Subcatchment 33S: Sub-watershed 33

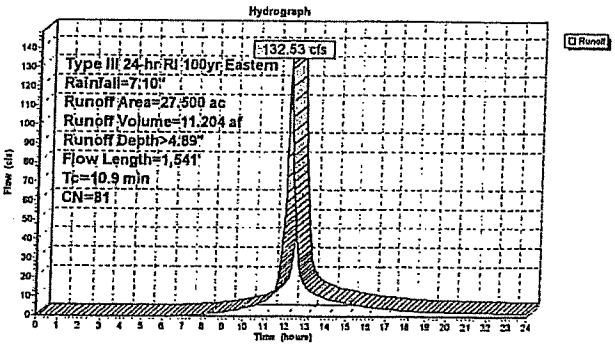
Runoff = 132.53 cfs @ 12.15 hrs, Volume= 11.204 af, Depth> 4.89"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 100yr Eastern Rainfall=7.10"

Area (ac)	CN	Description
0.960	94	Urban commercial, 85% Imp, HSG C
26.540	81	1/3 acre lots, 30% Imp, HSG C
27.500	81	Weighted Average
18.722		Pervious Area
8.778		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.6	100	0.1200	0.36		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
1.0	154	0.1400	2.62		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
5.3	1,287	0.0400	4.06		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
10.9	1,541	Total			

Subcatchment 33S: Sub-watershed 33



Subcatchment 34S: Sub-watershed 34

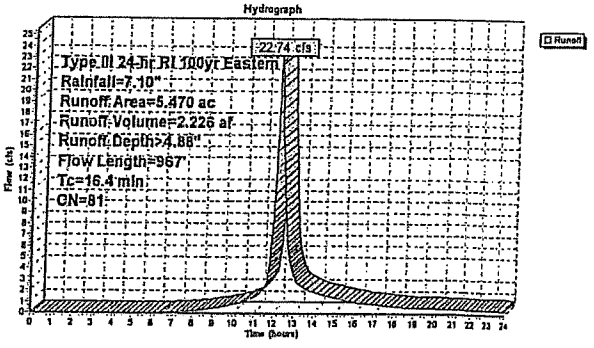
Runoff = 22.74 cfs @ 12.22 hrs, Volume= 2.226 af, Depth> 4.88"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 100yr Eastern Rainfall=7.10"

Area (ac)	CN	Description
5.470	81	1/3 acre lots, 30% Imp, HSG C
3.829		Pervious Area
1.641		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.5	100	0.0200	0.18		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
1.8	131	0.0300	1.21		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
5.1	736	0.0140	2.40		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
16.4	967	Total			

Subcatchment 34S: Sub-watershed 34



Subcatchment 35S: Sub-watershed 35

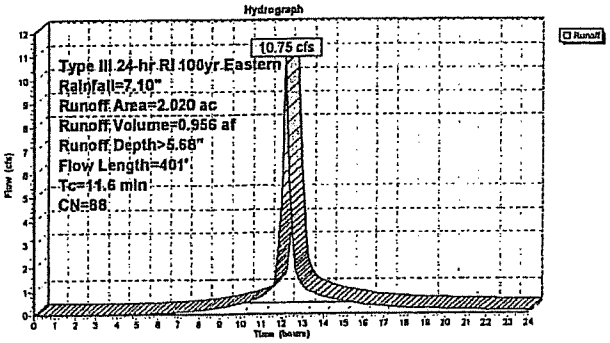
Runoff = 10.75 cfs @ 12.16 hrs, Volume= 0.956 af, Depth> 5.68"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 100yr Eastern Rainfall=7.10"

Area (ac)	CN	Description
1.010	94	Urban commercial, 85% Imp, HSG C
1.010	81	1/3 acre lots, 30% Imp, HSG C
2.020	88	Weighted Average
0.859		Pervious Area
1.161		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.1	100	0.0300	0.21		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
2.0	111	0.0180	0.94		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
1.5	190	0.0110	2.13		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
11.6	401	Total			

Subcatchment 35S: Sub-watershed 35



Subcatchment 36S: Sub-watershed 36

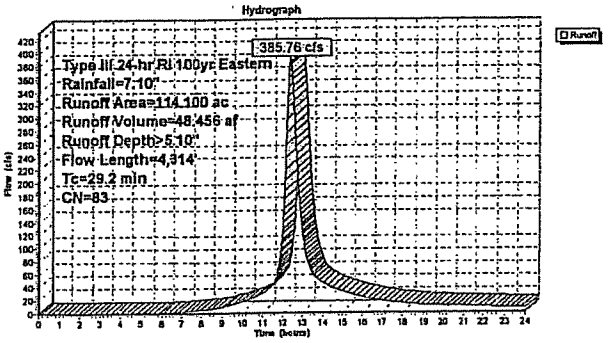
Runoff = 385.76 cfs @ 12.39 hrs, Volume= 48.456 af, Depth> 5.10"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 100yr Eastern Rainfall=7.10"

Area (ac)	CN	Description
81.170	83	1/4 acre lots, 38% Imp, HSG C
9.230	94	Urban commercial, 85% Imp, HSG C
6.090	60	Woods, Fair, HSG B
0.440	69	50-75% Grass cover, Fair, HSG B
4.180	56	Brush, Fair, HSG B
12.990	91	Urban Industrial, 72% Imp, HSG C
114.100	83	Weighted Average
66.057		Pervious Area
48.043		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.5	100	0.0200	0.18		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
1.4	172	0.0810	1.99		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
18.3	4,042	0.0330	3.69		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
29.2	4,314	Total			

Subcatchment 36S: Sub-watershed 36



Subcatchment 37S: Sub-watershed 37

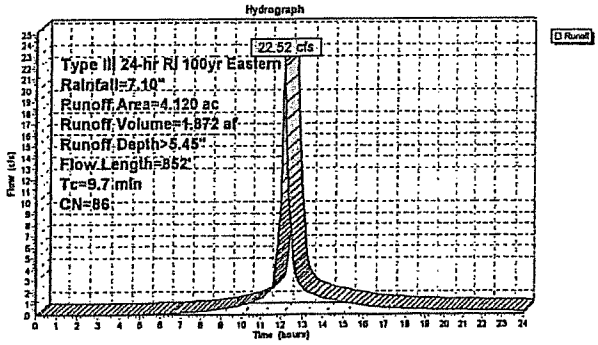
Runoff = 22.52 cfs @ 12.13 hrs, Volume= 1.872 af, Depth> 5.45"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 100yr Eastern Rainfall=7.10"

Area (ac)	CN	Description
1.240	81	1/3 acre lots, 30% Imp, HSG C
2.470	91	Urban Industrial, 72% Imp, HSG C
0.410	74	>75% Grass cover, Good, HSG C
4.120	86	Weighted Average
1.970		Pervious Area
2.150		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.0	100	0.0300	1.67		Sheet Flow, A-B Smooth surfaces n= 0.011 P2= 3.40"
8.7	752	0.0050	1.44		Shallow Concentrated Flow, B-C Paved Kv= 20.3 fps
9.7	852	Total			

Subcatchment 37S: Sub-watershed 37



Subcatchment 38S: Sub-watershed 38

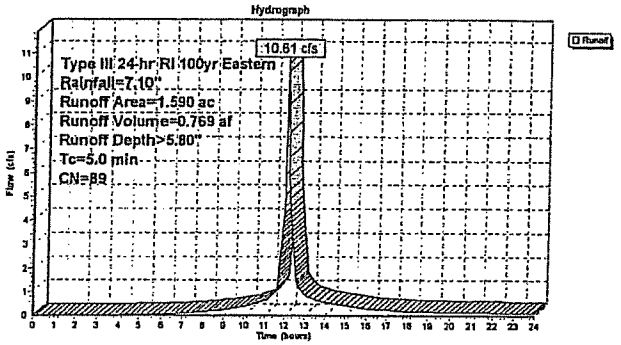
Runoff = 10.61 cfs @ 12.07 hrs, Volume= 0.769 af, Depth> 5.80"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 100yr Eastern Rainfall=7.10"

Area (ac)	CN	Description
0.160	91	Urban industrial, 72% Imp, HSG C
0.320	79	Pasture/grassland/range, Fair, HSG C
1.110	91	Urban Industrial, 72% Imp, HSG C
1.590	89	Weighted Average
0.676		Pervious Area
0.914		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry, A-C

Subcatchment 38S: Sub-watershed 38



Subcatchment 39S: Sub-watershed 39

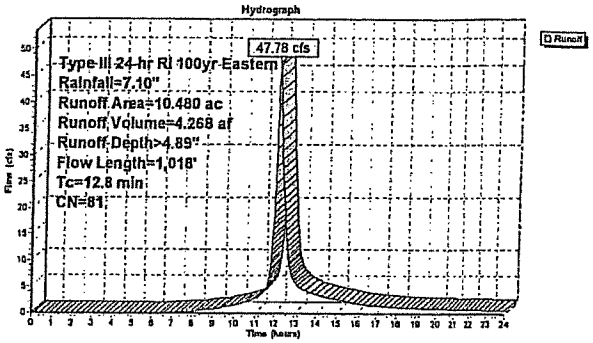
Runoff = 47.78 cfs @ 12.17 hrs, Volume= 4.268 af, Depth> 4.89"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 100yr Eastern Rainfall=7.10"

Area (ac)	CN	Description
0.520	79	Pasture/grassland/range, Fair, HSG C
9.960	81	1/3 acre lots, 30% Imp, HSG C
10.480	81	Weighted Average
7.492		Pervious Area
2.988		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.1	100	0.0600	0.27		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
1.8	212	0.0750	1.92		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
2.0	387	0.0260	3.27		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
2.9	319	0.0690	1.84		Shallow Concentrated Flow, D-E Short Grass Pasture Kv= 7.0 fps
12.8	1,018	Total			

Subcatchment 39S: Sub-watershed 39



Subcatchment 40S: Sub-watershed 40

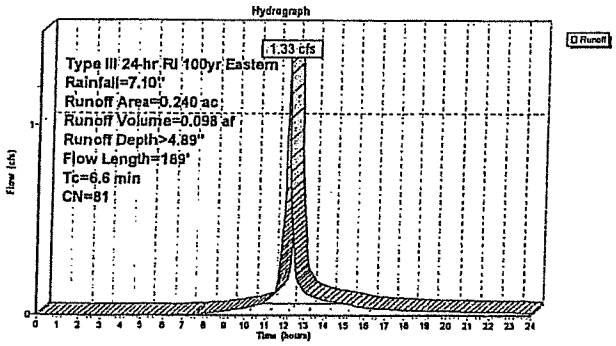
Runoff = 1.33 cfs @ 12.09 hrs, Volume= 0.098 af, Depth> 4.89"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 100yr Eastern Rainfall=7.10"

Area (ac)	CN	Description
0.240	81	1/3 acre lots, 30% Imp, HSG C
0.168		Pervious Area
0.072		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.1	100	0.0600	0.27		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
0.5	89	0.1500	2.71		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
6.6	189	Total			

Subcatchment 40S: Sub-watershed 40



Subcatchment 41S: Sub-watershed 41

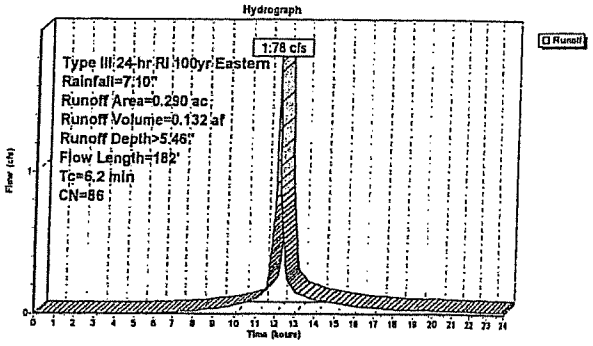
Runoff = 1.78 cfs @ 12.09 hrs, Volume= 0.132 af, Depth> 5.46"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 100yr Eastern Rainfall=7.10"

Area (ac)	CN	Description
0.290	86	Pasture/grassland/range, Poor, HSG C
0.290		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.5	100	0.0600	0.31		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
0.7	82	0.0730	1.89		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
6.2	182	Total			

Subcatchment 41S: Sub-watershed 41



Subcatchment 42S: Sub-watershed 42

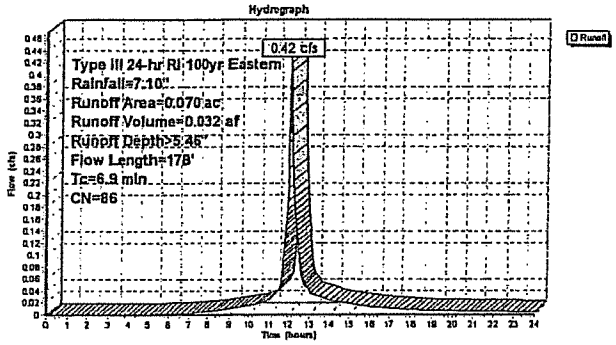
Runoff = 0.42 cfs @ 12.10 hrs, Volume= 0.032 af, Depth> 5.46"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 100yr Eastern Rainfall=7.10"

Area (ac)	CN	Description
0.070	86	Pasture/grassland/range, Poor, HSG C
0.070		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.1	100	0.0600	0.27		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
0.8	78	0.0510	1.58		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
6.9	178	Total			

Subcatchment 42S: Sub-watershed 42



Subcatchment 43S: Sub-watershed 43

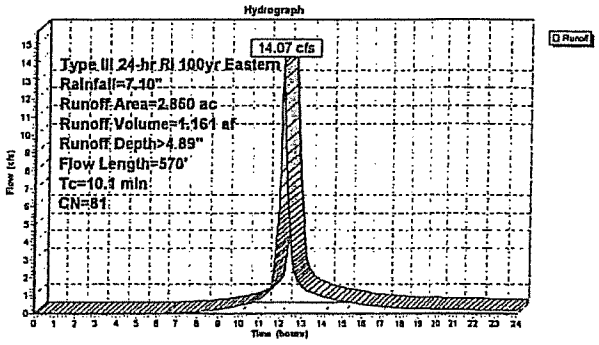
Runoff = 14.07 cfs @ 12.14 hrs, Volume= 1.161 af, Depth> 4.89"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 100yr Eastern Rainfall=7.10"

Area (ac)	CN	Description
2.860	81	1/3 acre lots, 30% imp, HSG C
1.995		Pervious Area
0.855		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.1	100	0.0600	0.27		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
1.8	228	0.0880	2.08		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
1.7	206	0.0100	2.03		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
0.5	36	0.0280	1.17		Shallow Concentrated Flow, D-E Short Grass Pasture Kv= 7.0 fps
10.1	570	Total			

Subcatchment 43S: Sub-watershed 43



Subcatchment 44S: Sub-watershed 44

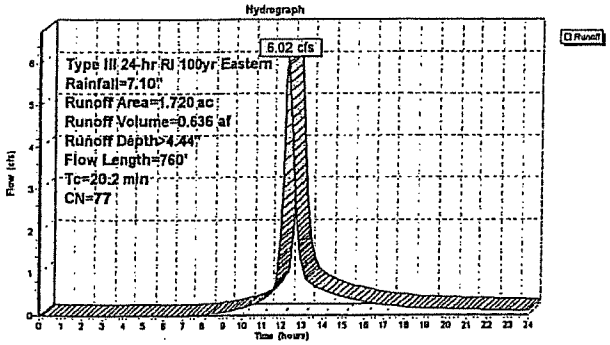
Runoff = 6.02 cfs @ 12.28 hrs, Volume= 0.636 af, Depth> 4.44"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 100yr Eastern Rainfall=7.10"

Area (ac)	CN	Description
0.860	81	1/3 acre lots, 30% imp, HSG C
0.860	73	Woods, Fair, HSG C
1.720	77	Weighted Average
1.462		Pervious Area
0.258		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.4	100	0.0500	0.12		Sheet Flow, A-B Woods: Light underbrush n= 0.400 P2= 3.40"
4.3	262	0.0420	1.02		Shallow Concentrated Flow, B-C Woodland Kv= 5.0 fps
1.5	398	0.0450	4.31		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
20.2	760	Total			

Subcatchment 44S: Sub-watershed 44



Subcatchment 45S: Sub-watershed 45

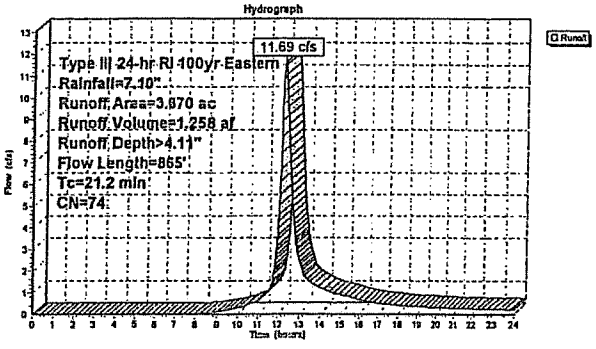
Runoff = 11.69 cfs @ 12.29 hrs, Volume= 1.258 af, Depth> 4.11"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 100yr Eastern Rainfall=7.10"

Area (ac)	CN	Description
3.120	73	Woods, Fair, HSG C
0.180	81	1/3 acre lots, 30% imp, HSG C
0.370	82	Woods/grass comb., Poor, HSG C
3.670	74	Weighted Average
3.616		Pervious Area
0.054		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.1	100	0.0300	0.21		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
13.1	765	0.0380	0.97		Shallow Concentrated Flow, B-C Woodland Kv= 5.0 fps
21.2	865	Total			

Subcatchment 45S: Sub-watershed 45



Subcatchment 46S: Sub-watershed 46

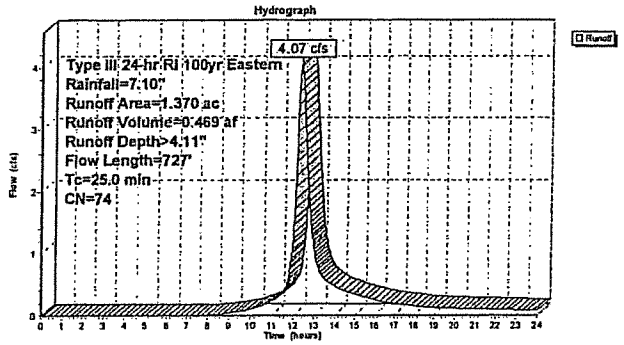
Runoff = 4.07 cfs @ 12.35 hrs, Volume= 0.469 af, Depth> 4.11"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 100yr Eastern Rainfall=7.10"

Area (ac)	CN	Description
1.230	73	Woods, Fair, HSG C
0.140	82	Woods/grass comb., Poor, HSG C
1.370	74	Weighted Average
1.370		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.8	100	0.0400	0.11		Sheet Flow, A-B Woods: Light underbrush n= 0.400 P2= 3.40"
7.6	373	0.0270	0.82		Shallow Concentrated Flow, B-C Woodland Kv= 5.0 fps
1.6	254	0.0160	2.57		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
25.0	727	Total			

Subcatchment 46S: Sub-watershed 46



Subcatchment 47S: Sub-watershed 47

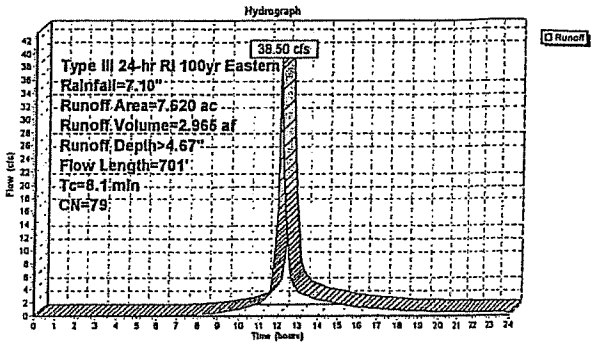
Runoff = 38.50 cfs @ 12.11 hrs, Volume= 2.965 af, Depth> 4.67"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 100yr Eastern Rainfall=7.10"

Area (ac)	CN	Description
7.620	79	50-75% Grass cover, Fair, HSG C
7.620		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0	100	0.1000	0.33		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
0.2	20	0.0500	1.57		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
2.9	581	0.0280	3.40		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
8.1	701	Total			

Subcatchment 47S: Sub-watershed 47



Subcatchment 48S: Sub-watershed 48

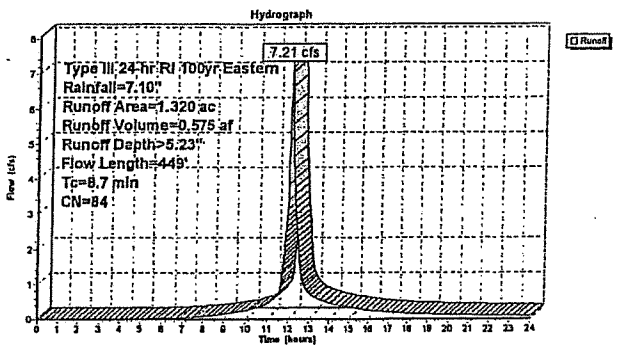
Runoff = 7.21 cfs @ 12.12 hrs, Volume= 0.575 af, Depth> 5.23"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 100yr Eastern Rainfall=7.10"

Area (ac)	CN	Description
1.320	84	50-75% Grass cover, Fair, HSG D
1.320		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.1	100	0.0600	0.27		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
0.4	39	0.0510	1.58		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
2.2	310	0.0130	2.31		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
8.7	449	Total			

Subcatchment 48S: Sub-watershed 48



Subcatchment 49S: Sub-watershed 49

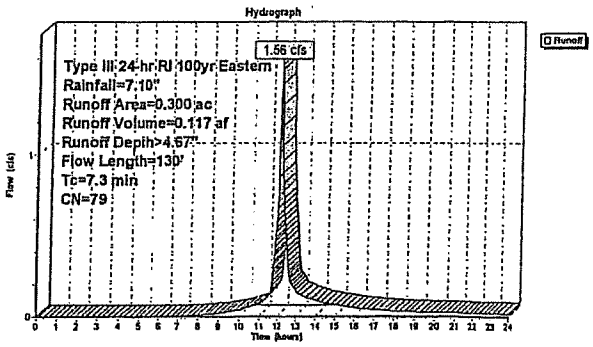
Runoff = 1.56 cfs @ 12.10 hrs, Volume= 0.117 af, Depth> 4.67"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 100yr Eastern Rainfall=7.10"

Area (ac)	CN	Description
0.300	79	50-75% Grass cover, Fair, HSG C
0.300		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.2	100	0.0400	0.23		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
0.1	11	0.1800	2.97		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
0.0	19	0.1100	6.73		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
7.3	130	Total			

Subcatchment 49S: Sub-watershed 49



Subcatchment 50S: Sub-watershed 50

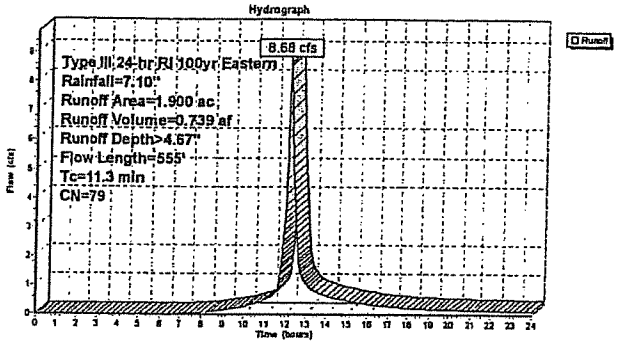
Runoff = 8.68 cfs @ 12.15 hrs, Volume= 0.739 af, Depth> 4.67"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 100yr Eastern Rainfall=7.10"

Area (ac)	CN	Description
1.900	79	50-75% Grass cover, Fair, HSG C
1.900		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.6	100	0.0500	0.25		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
4.5	419	0.0500	1.57		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
0.2	36	0.0170	2.65		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
11.3	555	Total			

Subcatchment 50S: Sub-watershed 50



Subcatchment 51S: Sub-wateshed 51

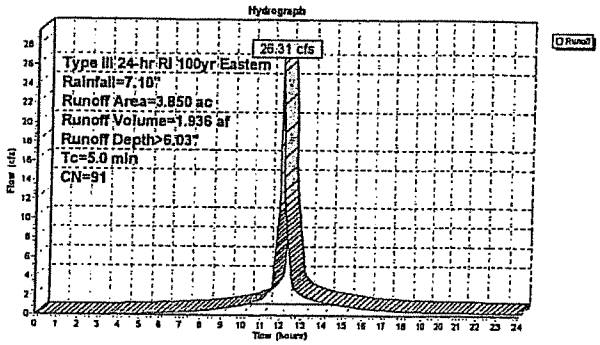
Runoff = 26.31 cfs @ 12.07 hrs, Volume= 1.936 af, Depth> 6.03"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 100yr Eastern Rainfall=7.10"

Area (ac)	CN	Description
3.850	91	Urban Industrial, 72% Imp, HSG C
1.078		Pervious Area
2.772		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry, A-C

Subcatchment 51S: Sub-wateshed 51



Subcatchment 52S: Sub-watershed 52

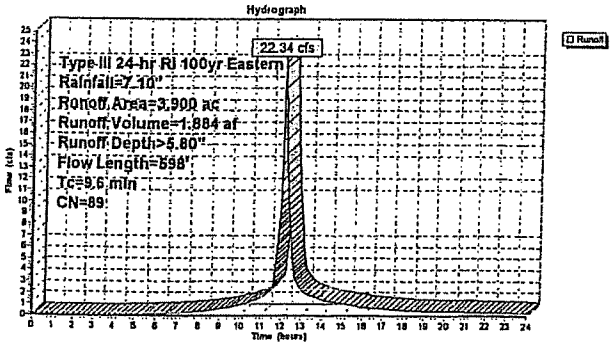
Runoff = 22.34 cfs @ 12.13 hrs, Volume= 1.884 af, Depth> 5.80"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 100yr Eastern Rainfall=7.10"

Area (ac)	CN	Description
3.510	90	1/8 acre lots, 65% Imp, HSG C
0.390	79	50-75% Grass cover, Fair, HSG C
3.900	89	Weighted Average
1.618		Pervious Area
2.282		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.6	100	0.1200	0.36		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
1.9	108	0.0190	0.96		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
2.8	361	0.0110	2.13		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
0.3	29	0.0690	1.84		Shallow Concentrated Flow, D-E Short Grass Pasture Kv= 7.0 fps
9.6	598	Total			

Subcatchment 52S: Sub-watershed 52



Subcatchment 53S: Sub-watershed 53

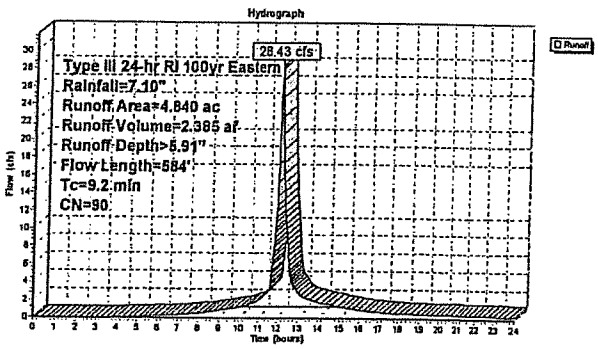
Runoff = 28.43 cfs @ 12.12 hrs, Volume= 2.385 af, Depth> 5.91"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 100yr Eastern Rainfall=7.10"

Area (ac)	CN	Description
4.840	90	1/8 acre lots, 65% Imp, HSG C
1.694		Pervious Area
3.146		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.6	100	0.0500	0.25		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
0.3	33	0.0610	1.73		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
2.3	451	0.0270	3.34		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
9.2	584	Total			

Subcatchment 53S: Sub-watershed 53



Subcatchment 54S: Sub-watershed 54

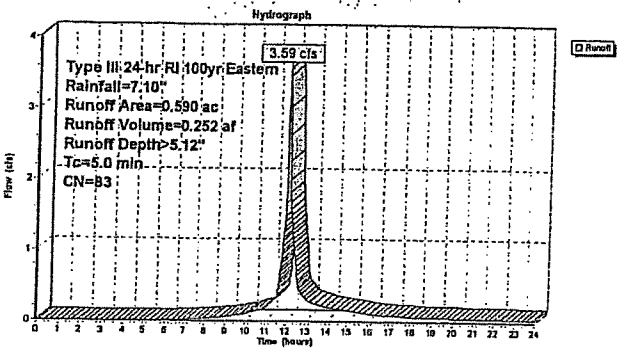
Runoff = 3.59 cfs @ 12.07 hrs, Volume= 0.252 af, Depth> 5.12"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 100yr Eastern Rainfall=7.10"

Area (ac)	CN	Description
0.590	83	1/4 acre lots, 38% Imp, HSG C
0.366		Pervious Area
0.224		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry, A-C

Subcatchment 54S: Sub-watershed 54



Subcatchment 55S: Sub-watershed 55

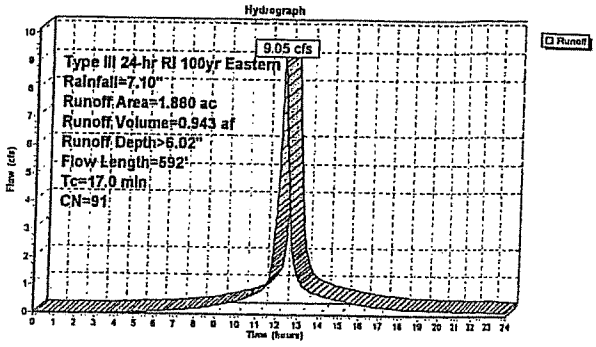
Runoff = 9.05 cfs @ 12.22 hrs, Volume= 0.943 af, Depth> 6.02"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 100yr Eastern Rainfall=7.10"

Area (ac)	CN	Description
1.880	91	Urban Industrial, 72% Imp, HSG C
0.526		Pervious Area
1.354		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.5	100	0.0100	0.13		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
4.5	492	0.0080	1.82		Shallow Concentrated Flow, B-C Paved Kv= 20.3 fps
17.0	592	Total			

Subcatchment 55S: Sub-watershed 55



Subcatchment 56S: Sub-watershed 56

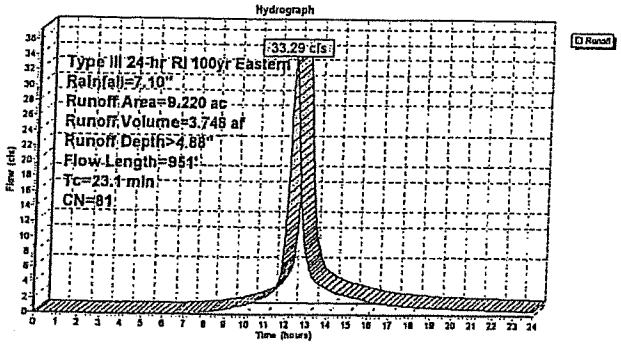
Runoff = 33.29 cfs @ 12.31 hrs, Volume= 3.748 af, Depth> 4.88"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 100yr Eastern Rainfall=7.10"

Area (ac)	CN	Description
9.220	81	1/3 acre lots, 30% Imp, HSG C
6.454		Pervious Area
2.766		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.5	100	0.0100	0.13		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
5.7	228	0.0090	0.66		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
4.9	623	0.0110	2.13		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
23.1	951	Total			

Subcatchment 56S: Sub-watershed 56



Subcatchment 57S: Sub-watershed 57

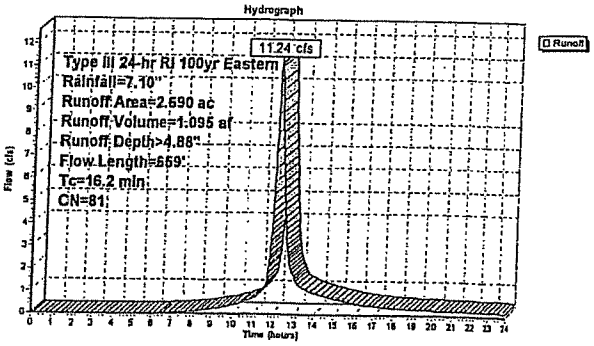
Runoff = 11.24 cfs @ 12.22 hrs, Volume= 1.095 af, Depth> 4.88"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 100yr Eastern Rainfall=7.10"

Area (ac)	CN	Description
2.690	81	1/3 acre lots, 30% Imp, HSG C
1.883		Pervious Area
0.807		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.4	100	0.0370	0.22		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
6.4	190	0.0050	0.49		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
2.2	349	0.0170	2.65		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
0.2	20	0.0500	1.57		Shallow Concentrated Flow, D-E Short Grass Pasture Kv= 7.0 fps
16.2	659	Total			

Subcatchment 57S: Sub-watershed 57



Subcatchment 58S: Sub-watershed 58

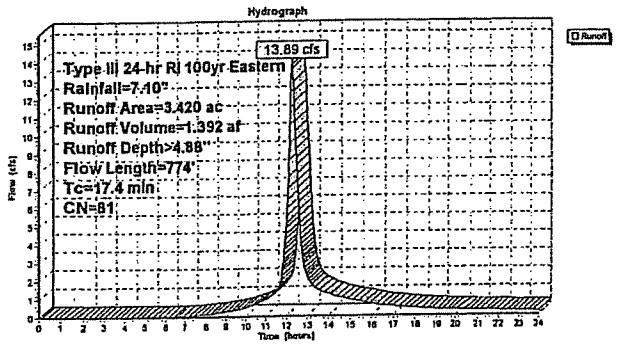
Runoff = 13.89 cfs @ 12.23 hrs, Volume= 1.392 af, Depth> 4.88"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 100yr Eastern Rainfall=7.10"

Area (ac)	CN	Description
3.420	81	1/3 acre lots, 30% Imp, HSG C
2.394		Pervious Area
1.026		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.5	100	0.0100	0.13		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
1.1	74	0.0270	1.15		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
3.8	600	0.0170	2.65		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
17.4	774	Total			

Subcatchment 58S: Sub-watershed 58



Subcatchment 59S: Sub-watershed 59

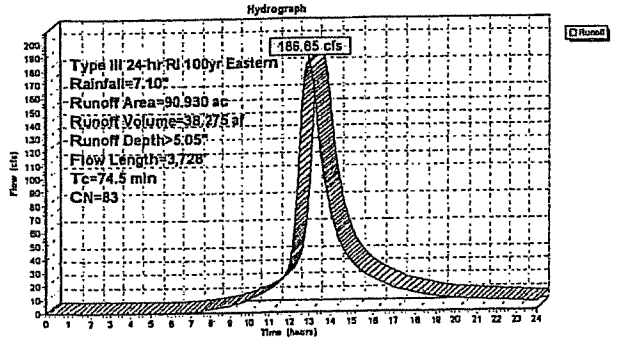
Runoff = 186.85 cfs @ 12.99 hrs, Volume= 38.275 af, Depth> 5.05"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 100yr Eastern Rainfall=7.10"

Area (ac)	CN	Description
35.570	83	1/4 acre lots, 38% Imp, HSG C
15.400	79	Pasture/grassland/range, Fair, HSG C
13.820	84	Urban commercial, 85% Imp, HSG C
2.410	91	Urban Industrial, 72% Imp, HSG C
8.840	88	Woods/grass comb., Poor, HSG D
12.190	73	Woods, Fair, HSG C
2.700	79	Pasture/grassland/range, Fair, HSG C
90.930	83	Weighted Average
63.931		Pervious Area
26.999		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.5	100	0.0050	0.10		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
49.4	2,858	0.0190	0.96		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
1.2	48	0.0010	0.64		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
2.9	164	0.0180	0.94		Shallow Concentrated Flow, D-E Short Grass Pasture Kv= 7.0 fps
3.5	377	0.0080	1.82		Shallow Concentrated Flow, E-F Paved Kv= 20.3 fps
1.0	181	0.0220	3.01		Shallow Concentrated Flow, F-G Paved Kv= 20.3 fps
74.5	3,728	Total			

Subcatchment 59S: Sub-watershed 59



Subcatchment 60S: Sub-watershed 60

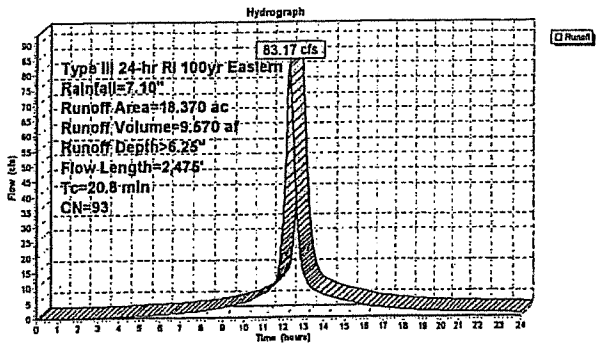
Runoff = 83.17 cfs @ 12.27 hrs, Volume= 9.570 af, Depth> 6.25"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 100yr Eastern Rainfall=7.10"

Area (ac)	CN	Description
5.510	91	Urban Industrial, 72% Imp, HSG C
12.860	94	Urban commercial, 85% Imp, HSG C
18.370	93	Weighted Average
3.472		Pervious Area
14.898		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.2	100	0.0400	0.23		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
0.6	83	0.1100	2.32		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
13.0	2,292	0.0210	2.94		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
20.8	2,475	Total			

Subcatchment 60S: Sub-watershed 60



Subcatchment 61S: Sub-watershed 61

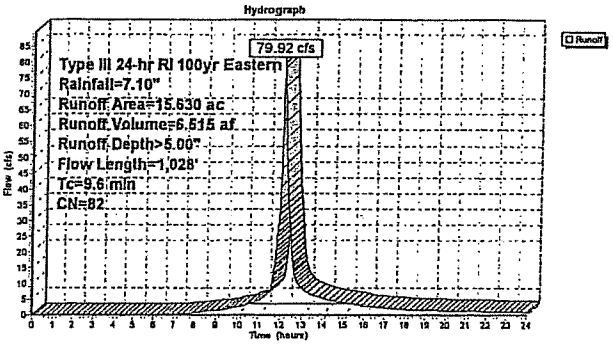
Runoff = 79.92 cfs @ 12.13 hrs, Volume= 6.515 af, Depth> 5.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
e III 24-hr RI 100yr Eastern Rainfall=7.10"

Area (ac)	CN	Description
14.070	81	1/3 acre lots, 30% Imp, HSG C
1.560	94	Urban commercial, 85% Imp, HSG C
15.630	82	Weighted Average
10.083		Pervious Area
5.547		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.8	100	0.0700	0.29		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
1.2	132	0.0700	1.85		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
2.6	796	0.0630	5.10		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
9.6	1,028	Total			

Subcatchment 61S: Sub-watershed 61



Subcatchment 62S: Sub-watershed 62

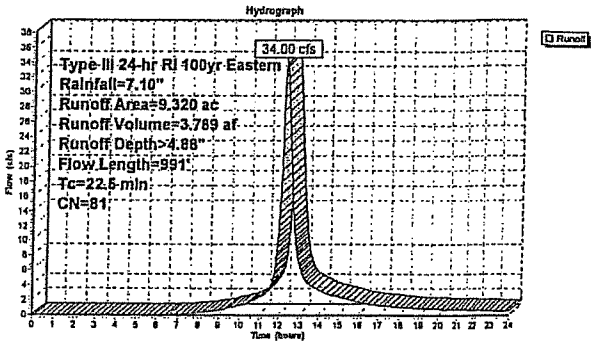
Runoff = 34.00 cfs @ 12.30 hrs, Volume= 3.789 af, Depth> 4.88"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 100yr Eastern Rainfall=7.10"

Area (ac)	CN	Description
9.320	81	1/3 acre lots, 30% Imp, HSG C
6.524		Pervious Area
2.796		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.5	100	0.0100	0.13		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
5.2	169	0.0060	0.54		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
4.8	722	0.0150	2.49		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
22.5	991	Total			

Subcatchment 62S: Sub-watershed 62



Subcatchment 63S: Sub-watershed 63

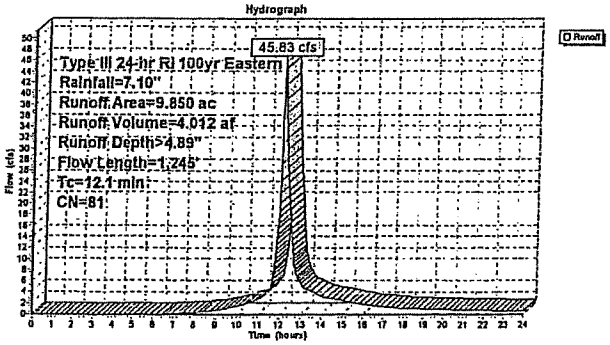
Runoff = 45.83 cfs @ 12.16 hrs, Volume= 4.012 af, Depth> 4.89"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 100yr Eastern Rainfall=7.10"

Area (ac)	CN	Description
9.850	81	1/3 acre lots, 30% Imp, HSG C
6.895		Pervious Area
2.955		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.9	37	0.0540	0.21		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
0.6	63	0.0480	1.83		Sheet Flow, B-C Smooth surfaces n= 0.011 P2= 3.40"
0.6	118	0.0250	3.21		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
2.0	188	0.0480	1.53		Shallow Concentrated Flow, D-E Short Grass Pasture Kv= 7.0 fps
6.0	839	0.0130	2.31		Shallow Concentrated Flow, E-F Paved Kv= 20.3 fps
12.1	1,245	Total			

Subcatchment 63S: Sub-watershed 63



Subcatchment 64S: Sub-watershed 64

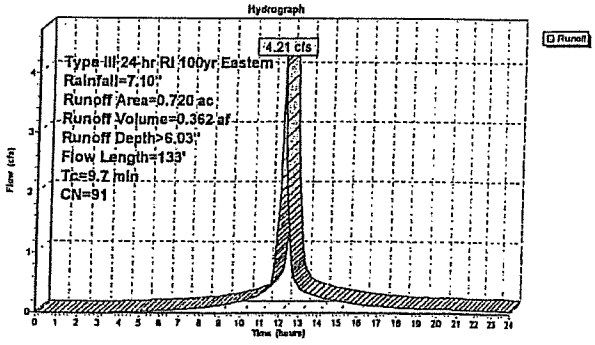
Runoff = 4.21 cfs @ 12.13 hrs, Volume= 0.362 af, Depth> 6.03"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 100yr Eastern Rainfall=7.10"

Area (ac)	CN	Description
0.720	91	Urban Industrial, 72% Imp, HSG C
0.202		Pervious Area
0.518		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.2	100	0.0400	0.23		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
2.5	33	0.0010	0.22		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
9.7	133	Total			

Subcatchment 64S: Sub-watershed 64



Subcatchment 65S: Sub-watershed 65

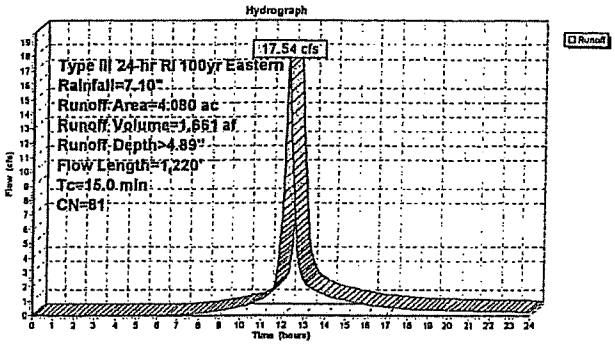
Runoff = 17.54 cfs @ 12.20 hrs, Volume= 1.661 af, Depth> 4.89"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 100yr Eastern Rainfall=7.10"

Area (ac)	CN	Description
4.080	81	1/3 acre lots, 30% Imp, HSG C
2.856		Pervious Area
1.224		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.2	86	0.0300	0.20		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
0.3	14	0.0100	0.73		Sheet Flow, B-C Smooth surfaces n= 0.011 P2= 3.40"
7.5	1,120	0.0150	2.49		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
15.0	1,220	Total			

Subcatchment 65S: Sub-watershed 65



Subcatchment 66S: Su-watershed 66

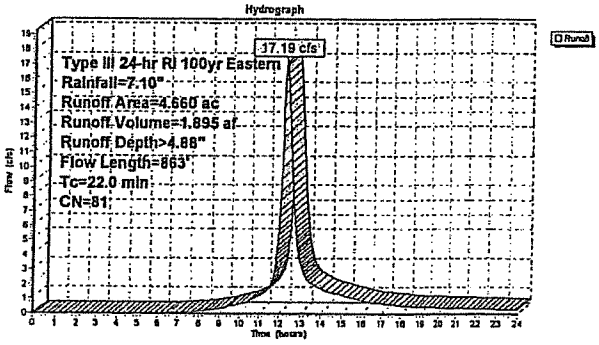
Runoff = 17.19 cfs @ 12.30 hrs, Volume= 1.895 af, Depth> 4.88"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 100yr Eastern Rainfall=7.10"

Area (ac)	CN	Description
4.660	81	1/3 acre lots, 30% Imp, HSG C
3.262		Pervious Area
1.398		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.4	100	0.0060	0.11		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
1.2	103	0.0390	1.38		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
5.4	660	0.0100	2.03		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
22.0	863	Total			

Subcatchment 66S: Su-watershed 66



Subcatchment 67S: Sub-watershed 67

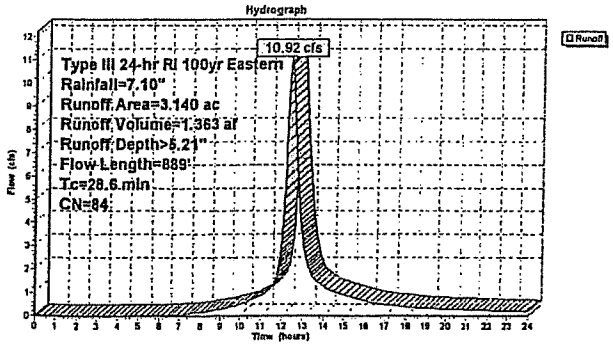
Runoff = 10.92 cfs @ 12.38 hrs, Volume= 1.363 af, Depth> 5.21"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 100yr Eastern Rainfall=7.10"

Area (ac)	CN	Description
0.780	81	1/3 acre lots, 30% Imp, HSG C
1.880	88	Fallow, crop residue, Good, HSG C
0.470	73	Woods, Fair, HSG C
3.140	84	Weighted Average
2.903		Pervious Area
0.237		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.5	100	0.0100	0.13		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
4.7	199	0.0200	0.71		Shallow Concentrated Flow, B-C Woodland Kv= 5.0 fps
10.7	490	0.0120	0.77		Shallow Concentrated Flow, C-D Short Grass Pasture Kv= 7.0 fps
0.7	100	0.0120	2.22		Shallow Concentrated Flow, D-E Paved Kv= 20.3 fps
28.6	889	Total			

Subcatchment 67S: Sub-watershed 67



Subcatchment 68S: Sub-watershed 68

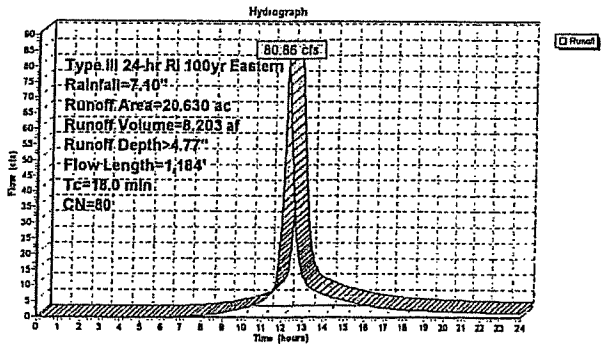
Runoff = 80.86 cfs @ 12.24 hrs, Volume= 8.203 af, Depth> 4.77"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr RI 100yr Eastern Rainfall=7.10"

Area (ac)	CN	Description
2.350	79	Pasture/grassland/range, Fair, HSG C
2.470	88	Fallow, crop residue, Good, HSG C
1.970	70	Brush, Fair, HSG C
5.490	82	Woods/grass comb., Poor, HSG C
2.460	73	Woods, Fair, HSG C
5.890	81	1/3 acre lots, 30% Imp, HSG C
20.630	80	Weighted Average
18.863		Pervious Area
1.767		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.3	100	0.0850	0.31		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.40"
12.7	1,084	0.0410	1.42		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
18.0	1,184	Total			

Subcatchment 68S: Sub-watershed 68



Reach 3R: Intermittent Stream

Inflow Area = 21.680 ac, Inflow Depth > 4.85" for RI 100yr Eastern event
Inflow = 79.54 cfs @ 12.30 hrs, Volume= 8.762 af
Outflow = 76.68 cfs @ 12.43 hrs, Volume= 8.724 af, Atten= 4%, Lag= 7.3 min

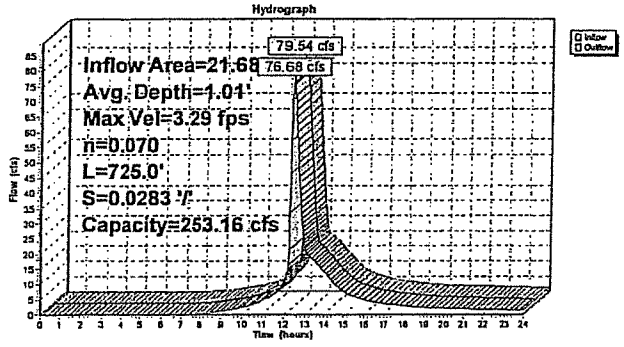
...ng by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Velocity= 3.29 fps, Min. Travel Time= 3.7 min
Velocity = 1.03 fps, Avg. Travel Time= 11.7 min

Peak Storage= 16,917 cf @ 12.36 hrs, Average Depth at Peak Storage= 1.01'
Bank-Full Depth= 2.00', Capacity at Bank-Full= 253.16 cfs

20.00' x 2.00' deep channel, n= 0.070 Medium-dense brush, winter
Side Slope Z-value= 3.0 '/' Top Width= 32.00'
Length= 725.0' Slope= 0.0283 '/'
Inlet Invert= 113.50', Outlet Invert= 93.00'

‡

Reach 3R: Intermittent Stream



Pond 2P: Highview Pond Existing

Inflow Area = 21.680 ac, Inflow Depth > 4.88" for RI 100yr Eastern event
Inflow = 79.62 cfs @ 12.30 hrs, Volume= 8.815 af
Outflow = 79.54 cfs @ 12.30 hrs, Volume= 8.762 af, Atten= 0%, Lag= 0.3 min
Primary = 79.54 cfs @ 12.30 hrs, Volume= 8.762 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs / 2
Peak Elev= 121.31' @ 12.30 hrs Surf.Area= 5,491 sf Storage= 40,393 cf

Plug-Flow detention time= 19.4 min calculated for 8.762 af (99% of inflow)
Center-of-Mass det. time= 15.8 min (833.3 - 817.5)

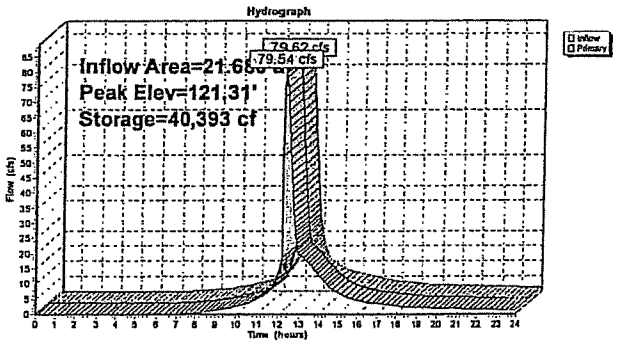
Volume	Invert	Avail.Storage	Storage Description
#1	115.00'	42,295 cf	Custom Stage Data (Prismatic)Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
115.00	4,620	0	0
118.00	6,496	16,674	16,674
121.00	7,936	21,648	38,322
122.00	10	3,973	42,295

Device	Routing	Invert	Outlet Devices
#1	Primary	115.00'	**18.0" x 40.0' long Culvert** RCP, end-section conforming to fill, Ke= 0.500 Outlet Invert= 114.40' S= 0.0150 '/' Cc= 0.900 n= 0.013
#2	Primary	121.00'	**128.0' long x 1.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

Primary OutFlow Max=79.35 cfs @ 12.30 hrs HW=121.31' (Free Discharge)
1=Culvert (Inlet Controls 20.06 cfs @ 11.35 fps)
2=Broad-Crested Rectangular Weir (Weir Controls 59.29 cfs @ 1.50 fps)

Pond 2P: Highview Pond Existing

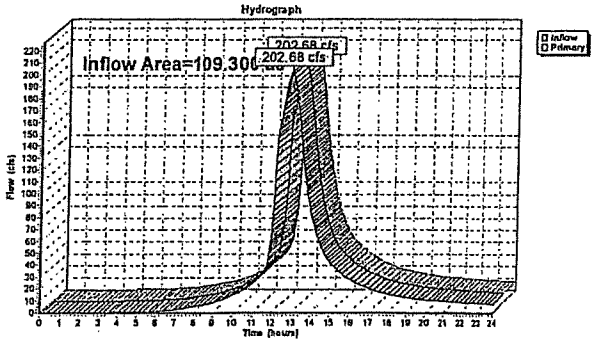


Link 68L: SW 59_SW 60

Inflow Area = 109.300 ac, Inflow Depth > 5.25" for RI 100yr Eastern event
Inflow = 202.68 cfs @ 12.92 hrs, Volume= 47.844 af
Primary = 202.68 cfs @ 12.92 hrs, Volume= 47.844 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

Link 68L: SW 59_SW 60

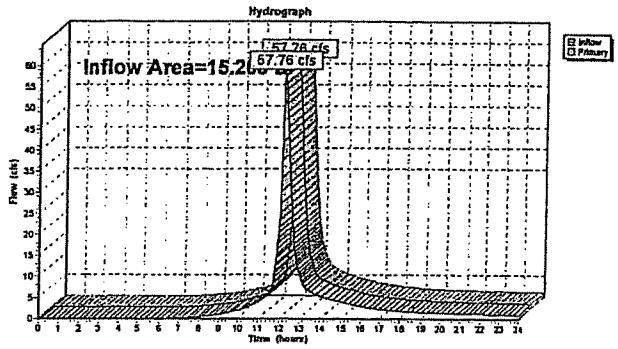


Link 69L: SW 14_SW 17

Inflow Area = 15.260 ac, Inflow Depth > 4.71" for RI 100yr Eastern event
Inflow = 57.76 cfs @ 12.19 hrs, Volume= 5.995 af
Primary = 57.76 cfs @ 12.19 hrs, Volume= 5.995 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

Link 69L: SW 14_SW 17

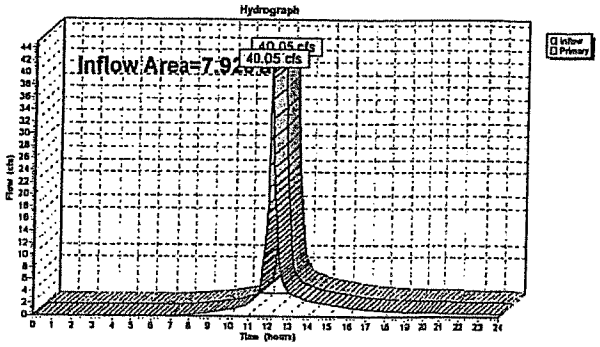


Link 70L: SW47_SW49

Inflow Area = 7.920 ac, Inflow Depth > 4.67" for RI 100yr Eastern event
Inflow = 40.05 cfs @ 12.11 hrs, Volume= 3.082 af
Primary = 40.05 cfs @ 12.11 hrs, Volume= 3.082 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

Link 70L: SW47_SW49

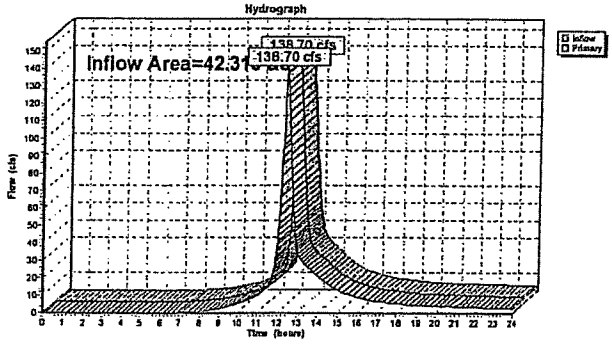


Link 71L: Elbow St

Inflow Area = 42.310 ac, Inflow Depth > 4.80" for RI 100yr Eastern event
Inflow = 138.70 cfs @ 12.37 hrs, Volume= 16.927 af
Primary = 138.70 cfs @ 12.37 hrs, Volume= 16.927 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

Link 71L: Elbow St



Hydraflow – Pipe Capacity Analysis

Storm Sewer Tabulation

Page 1

Station Line	Station To Line	Len (ft)	Dmg Area Incr (ac)	Dmg Area Total (ac)	Rnoff coeff (C)	Area x C Incr	Area x C Total	Tc Inlet (min)	Tc Syst (min)	Rain (I) (in/hr)	Total flow (cfs)	Cap full (cfs)	Vel (ft/s)	Pipe Size (in)	Pipe Slope (%)	Invert Elev Up (ft)	Invert Elev Dn (ft)	HGL Elev Up (ft)	HGL Elev Dn (ft)	Grnd / Rim Elev Up (ft)	Grnd / Rim Elev Dn (ft)	Line ID
1	End	56.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	1.00	31.25	2.66	24	1.91	83.25	82.00	83.61	82.35	0.00	0.00	Watershed 1
2	End	39.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	1.00	9.13	2.05	15	2.00	85.78	85.00	86.18	85.40	0.00	0.00	Watershed 2
3	End	181.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	1.00	20.25	2.66	24	0.80	98.20	98.00	99.64	98.35	0.00	0.00	Watershed 3
4	End	195.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	1.00	97.64	2.48	36	1.03	82.00	80.00	82.32	80.32	0.00	0.00	Watershed 4
5	End	48.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	1.00	7.01	3.15	12	2.30	116.10	114.00	116.52	114.42	0.00	0.00	Watershed 5
6	End	190.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	1.00	66.69	2.48	36	1.00	72.60	70.70	72.92	71.02	0.00	0.00	Watershed 6
7	End	30.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	1.00	4.83	3.15	12	1.00	75.30	75.00	75.72	75.42	0.00	0.00	Watershed 6d
8	End	11.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	1.00	0.78	3.15	12	3.64	73.40	73.00	73.82	73.42	0.00	0.00	Watershed 6e
9	End	182.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	1.00	2.21	2.75	12	9.38	114.70	114.00	115.23	114.42	0.00	0.00	Watershed 8
10	End	162.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	1.00	0.85	3.15	12	3.70	91.20	85.20	91.62	85.62	0.00	0.00	Watershed 9
11	End	91.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	1.00	23.71	2.68	24	1.10	93.00	92.00	93.35	92.35	0.00	0.00	Watershed 10
12	End	18.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	1.00	18.87	2.05	15	8.67	93.00	92.00	93.40	92.40	0.00	0.00	Watershed 11
13	End	42.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	1.00	7.77	3.15	12	4.76	82.30	80.30	82.72	80.72	0.00	0.00	Watershed 12
14	End	31.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	1.00	5.72	3.15	12	8.06	89.70	87.20	90.12	87.62	0.00	0.00	Watershed 13
15	End	182.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	1.00	5.53	3.15	12	7.58	128.96	113.20	127.38	112.62	0.00	0.00	Watershed 14
16	End	103.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	1.00	32.30	2.66	24	2.04	117.50	115.50	117.95	115.85	0.00	0.00	Watershed 15
17	End	60.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	1.00	6.64	2.05	15	0.78	120.30	119.83	120.70	120.09	0.00	0.00	Watershed 16
18	End	130.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	1.00	5.84	2.47	18	1.00	106.00	104.84	106.47	105.02	0.00	0.00	Watershed 17
19	End	84.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	1.00	83.27	2.48	36	1.56	83.00	82.00	83.32	82.32	0.00	0.00	Watershed 18
20	End	23.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	1.00	3.58	3.15	12	1.00	122.90	122.67	123.32	123.09	0.00	0.00	Watershed 19
21	End	32.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	1.00	2.01	2.56	12	1.00	101.00	100.68	101.57	101.10	0.00	0.00	Watershed 20

Project File: Pipe Capacity.stm | Number of lines: 67 | Run Date: 09-14-2007

NOTES: Intensity = 11.13 / (Inlet time + 1.60) ^ 0.61; Return period = 2 Yrs.

Hydraflow Storm Sewers 2005

Storm Sewer Tabulation

Station Line	Station To Line	Len (ft)	Dmg Area Incr (ac)	Dmg Area Total (ac)	Rnoff coeff (C)	Area x C Incr	Area x C Total	Tc Inlet (min)	Tc Syst (min)	Rain (I) (in/hr)	Total flow (cfs)	Cap full (cfs)	Vel (ft/s)	Pipe Size (in)	Pipe Slope (%)	Invert Elev Up (ft)	Invert Elev Dn (ft)	HGL Elev Up (ft)	HGL Elev Dn (ft)	Grnd / Rim Elev Up (ft)	Grnd / Rim Elev Dn (ft)	Line ID
22	End	221.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	1.00	66.88	2.48	36	1.00	79.55	88.34	79.87	88.66	0.00	0.00	Wa
23	End	81.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	1.00	8.05	2.82	18	0.69	58.30	58.00	58.88	58.38	0.00	0.00	Wa
24	End	104.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	1.00	4.83	3.15	12	1.00	64.60	63.96	65.02	63.98	0.00	0.00	Wa
25	End	193.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	1.00	3.86	3.15	12	1.00	80.80	78.87	81.02	78.09	0.00	0.00	Wa
26	End	16.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	1.00	10.50	2.82	18	1.00	58.70	58.54	57.08	56.92	0.00	0.00	Wa
27	End	40.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	1.00	0.25	11.46	4	1.00	80.40	80.00	80.80	80.33	0.00	0.00	Wa
28	End	9.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	1.00	0.73	5.15	6	1.00	58.49	58.40	58.05	58.87	0.00	0.00	Wa
29	End	6.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	1.00	12.10	3.15	12	6.83	58.50	58.09	58.92	58.51	0.00	0.00	Wa
30	End	85.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	1.00	13.95	2.82	18	6.55	58.40	55.36	58.78	55.73	0.00	0.00	Wa
31	End	127.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	1.00	1.24	2.81	10	1.00	59.90	58.63	60.95	59.07	0.00	0.00	Wa
32	End	16.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	1.00	3.58	3.15	12	1.00	30.50	30.34	30.82	30.75	0.00	0.00	Wa
33	End	403.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	1.00	16.52	0.83	18	7.75	55.50	24.50	56.63	56.61	0.00	0.00	Wa
34	End	51.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	1.00	6.94	2.50	18	1.00	8.20	4.89	6.56	5.07	0.00	0.00	Wa
35	End	30.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	1.00	1.71	2.49	12	0.72	3.20	2.94	3.86	3.36	0.00	0.00	Wa
36	End	40.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	1.00	5.46	2.95	15	1.00	5.80	5.60	7.30	6.90	0.00	0.00	Wa
37	End	91.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	1.00	41.01	2.56	30	1.00	4.60	3.69	4.83	4.02	0.00	0.00	Wa
38	End	92.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	1.00	10.60	2.82	18	1.00	2.70	2.78	4.08	3.18	0.00	0.00	Wa
39	End	243.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	1.00	8.38	2.85	15	1.00	4.80	2.37	5.20	2.77	0.00	0.00	Wa
40	End	131.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	1.00	3.65	2.50	15	1.00	8.60	7.48	8.32	7.89	0.00	0.00	Wa
41	End	215.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	1.00	0.73	5.15	6	1.00	22.60	20.35	24.61	20.82	0.00	0.00	Wa
42	End	80.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	1.00	1.57	3.79	6	1.00	17.10	16.30	17.67	16.77	0.00	0.00	Wa

Project File: Pipe Capacity.stm | Number of lines: 67 | Run Date: 09-14-2007

NOTES: Intensity = 11.13 / (Inlet time + 1.60) ^ 0.61; Return period = 2 Yrs.

Hydraflow S

Storm Sewer Tabulation

Page 3

Station Line	Station To Line	Len (ft)	Dmg Area Incr (ac)	Dmg Area Total (ac)	Rnoff coeff (C)	Area x C Incr	Area x C Total	Tc Inlet (min)	Tc Syst (min)	Rain (I) (in/hr)	Total flow (cfs)	Cap full (cfs)	Vel (ft/s)	Pipe Size (in)	Pipe Slope (%)	Invert Elev Up (ft)	Invert Elev Dn (ft)	HGL Elev Up (ft)	HGL Elev Dn (ft)	Grnd / Rim Elev Up (ft)	Grnd / Rim Elev Dn (ft)	Line ID
43	End	87.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	1.00	0.73	5.15	6	1.00	12.00	11.13	13.00	11.80	0.00	0.00	Watershed 42
44	End	164.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	1.00	20.14	2.56	24	0.79	27.30	25.00	27.65	26.35	0.00	0.00	Watershed 43
45	End	67.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	1.00	0.55	5.15	6	1.00	44.50	43.83	46.31	44.30	0.00	0.00	Watershed 44
46	End	28.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	1.00	2.01	2.67	12	1.00	58.00	57.71	58.57	58.13	0.00	0.00	Watershed 45
47	End	133.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	1.00	2.01	2.56	12	1.00	57.00	55.67	57.65	56.09	0.00	0.00	Watershed 46
48	End	103.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	1.00	2.01	2.56	12	1.00	57.00	55.97	57.65	56.09	0.00	0.00	Watershed 47
49	End	52.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	1.00	5.94	2.49	18	1.00	27.00	26.00	27.41	26.42	0.00	0.00	Watershed 48
50	End	54.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	1.00	2.01	2.56	12	1.00	45.20	44.66	45.60	45.10	0.00	0.00	Watershed 49
51	End	18.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	1.00	0.25	11.46	4	1.00	30.50	29.00	30.02	30.39	0.00	0.00	Watershed 50
52	End	87.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	1.00	10.50	2.82	18	1.00	51.30	51.11	51.68	51.49	0.00	0.00	Watershed 51
53	End	72.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	1.00	2.01	1.53	12	1.00	22.90	22.03	23.67	23.32	0.00	0.00	Watershed 52
54	End	29.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	1.00	3.58	3.15	12	1.04	22.50	21.75	22.92	22.17	0.00	0.00	Watershed 53
55	End	72.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	1.00	3.83	3.15	12	1.00	91.20	91.00	91.62	91.42	0.00	0.00	Watershed 54
56	End	164.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	1.00	1.66	3.79	8	1.01	90.68	89.68	91.05	90.32	0.00	0.00	Watershed 55
57	End	24.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	1.00	38.31	2.66	24	2.53	69.42	68.74	69.77	67.09	0.00	0.00	Watershed 56
58	End	52.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	1.00	2.01	2.56	12	1.00	62.30	62.06	62.85	62.48	0.00	0.00	Watershed 57
59	End	278.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	1.00	174.2	2.33	54	0.78	58.20	57.68	58.80	58.10	0.00	0.00	Watershed 58
60	End	267.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	1.00	65.68	2.48	36	0.97	49.90	47.31	50.22	47.63	0.00	0.00	Watershed 59
61	End	121.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	1.00	20.40	2.56	24	2.55	40.80	37.52	40.85	37.57	0.00	0.00	Watershed 61
62	End	49.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	1.00	2.01	2.56	12	1.00	68.16	68.00	69.74	69.08	0.00	0.00	Watershed 62
63	End	93.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	1.00	3.85	2.52	15	1.00	6.40	6.47	6.92	6.87	0.00	0.00	Watershed 63

Project File: Pipe Capacity.stm | Number of lines: 67 | Run Date: 09-14-2007

NOTES: Intensity = 11.13 / (Inlet time + 1.60) ^ 0.61; Return period = 2 Yrs.

Hydraflow Storm Sewers 2005

Storm Sewer Tabulation

Station Line	Station To Line	Len (ft)	Dmg Area Incr (ac)	Dmg Area Total (ac)	Rnoff coeff (C)	Area x C Incr	Area x C Total	Tc Inlet (min)	Tc Syst (min)	Rain (I) (in/hr)	Total flow (cfs)	Cap full (cfs)	Vel (ft/s)	Pipe Size (in)	Pipe Slope (%)	Invert Elev Up (ft)	Invert Elev Dn (ft)	HGL Elev Up (ft)	HGL Elev Dn (ft)	Grnd / Rim Elev Up (ft)	Grnd / Rim Elev Dn (ft)	Line ID
64	End	84.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	1.00	3.58	3.15	12	1.00	9.10	8.26	8.62	8.88	0.00	0.00	Wa
65	End	20.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	1.00	10.50	2.82	18	1.00	128.60	128.40	128.68	128.78	0.00	0.00	Wa
66	End	38.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	1.00	6.31	2.76	18	0.42	127.49	127.33	127.68	127.71	0.00	0.00	Wa
67	End	111.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	1.00	4.88	2.26	18	0.20	128.54	128.42	129.19	128.80	0.00	0.00	Wa

Project File: Pipe Capacity.stm | Number of lines: 67 | Run Date: 09-14-2007

NOTES: Intensity = 11.13 / (Inlet time + 1.60) ^ 0.61; Return period = 2 Yrs.

Item C1.

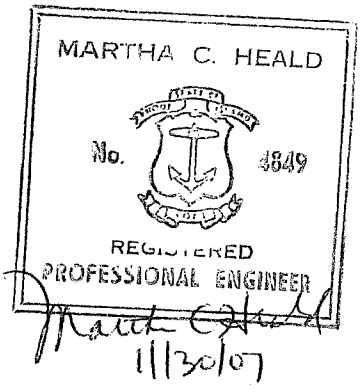
Silver Creek

Drainage Study

Bristol, RI

Prepared for:

Town of Bristol.
10 Court Street
Bristol, RI 02809



Prepared by:

BETA
ENGINEERS • SCIENTISTS

6 Blackstone Valley Place, Lincoln, RI 02865
315 Norwood Park South, Norwood, MA 02062

November 2007

Silver Creek Drainage Study

Table of Contents

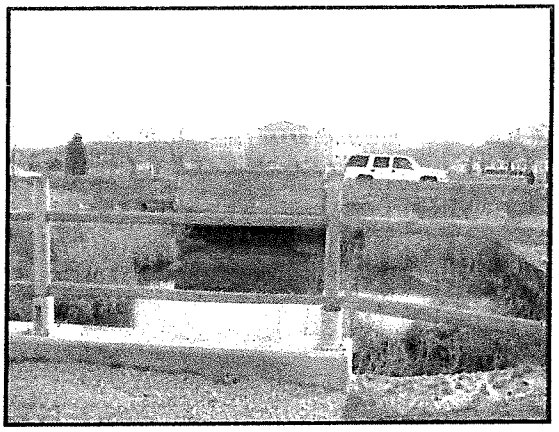
Description	Page
Introduction and Project Scope	1
Data Collection and Field Observations	3
Watershed Analysis	5
Problem Areas	14
Proposed Improvements	21
Recommendations	23
Cost Estimates	24

Appendix

Appendix A	Watershed Analysis
Appendix B	Silver Creek Analysis
Appendix C	Problem Area Analysis
Appendix D	Estimates
Appendix E	Map of Study Area

Introduction and Project Scope

The Town of Bristol retained the services of BETA Group, Inc. to complete a drainage study of the Silver Creek watershed. The 2-square mile watershed extends from Tupelo Street near the Town's northerly border discharging into Bristol Harbor under Route 114 and the East Bay Bicycle Path. The study is one of several projects currently underway to identify existing drainage facilities within the Town and to improve the storm water infrastructure. The primary objective of the study was to determine the causes of flooding within the watershed, and to identify remedial projects which the Town may advance as money becomes available either through grants or bonds.



The Silver Creek watershed contains at least 66 subwatershed areas in 1,250 acres, and contains approximately 170 acres of regulated freshwater and saltwater wetlands. Runoff from approximately 60% of the watershed enters the creek and associated wetlands via closed drainage systems (i.e. pipes and drainage structures), while the runoff from the remaining 40% flows overland to the wetlands and stream channels. Silver Creek begins as two (2) separate channels, identified as the East Branch and the West Branch, which merge into one creek south of Chestnut Street in the large marshy area north of the Guitaris School. The boundaries of the watershed were determined through the use of GIS, dry-weather opening of the drainage structures, and field observations of the wet-condition overland flows. The watershed is identified in Figure No. 1. The Silver Creek watershed falls under the jurisdiction of both the Coastal Resources Management Council (CRMC) and the Rhode Island Department of Environmental Management Freshwater Wetlands Section (RIDEM). The RIDEM regulates the wetlands within the watershed north of Chestnut Street and east of Sherry Avenue. Figure No. 2 illustrates the boundaries of the two (2) regulatory agencies.

There are numerous man-made ponds or detention basins which were built to contain or mitigate storm water flows to the receiving wetlands. Some of these have been modified by property owners over the years to improve local conditions, or not properly maintained, resulting in flooding downstream.

In addition to the flow of freshwater runoff via overland and piped flows, the Silver Creek is tidally influenced at the outfall at Bristol Harbor. High tides during storm events reduces the discharge capacity of Silver Creek at Route 114 preventing the upper watershed from draining, resulting in flooding at the fringes of the wetland areas and at the restrictions of piped sections under roadways and through private property. Displaced riprap under the Silver Creek bridge further restricts the flow of saltwater into and out of the salt marsh area adjacent to the Guitarius School and the recreation fields, resulting in insufficient salt water to maintain the marsh characteristics. Sediments have allowed phragmites to invade the area, reducing available flood storage. This is described in much greater detail in the discussion on sediments.

Coordination with Other Projects

The Natural Resources Conservation Services (NRCS) has conducted a study of the lower portion of the watershed including the restrictions under the Silver Creek Bridge No. 153 and the East Bay Bikepath Bridge, developing a HEC-RAS model of the marsh. This model was used in the development of the overall model for the Silver Creek watershed, described in the Methodology section of this report. The NRCS project looked at the effects of removing the rocks to allow for salt water intrusion into the lower creek area to kill off the freshwater invasive plants, and to re-establish the marsh characteristics south of the footbridge. This project is currently in the permitting stage, with construction expected in 2008.

The Town has several smaller projects either in the conceptual design stage, or under construction in 2007 which have either a direct or indirect impact on the study, as well as our recommendations. Chestnut Street, which runs in an east-west direction from Metacom Avenue (Route 136) to Hope Street (Route 114) is a major route within the watershed providing access to the Mount Hope High School, the Benjamin Church Manor, Naomi Street and the St. Mary Cemetery. The east and west branches of the Silver Creek pass under Chestnut Street, and there is an older closed drainage system within the roadway. The Town is currently constructing "1R Improvements" to Chestnut Street including new sidewalks, pavement overly, etc. No work to the drainage system is being done under this contract.

Elbow Street is an extension of Waterman Street, and is the location of chronic flooding problems. Caputo and Wick has designed and permitted a project which will replace the existing 12" CMP with

new pipes including an increase in the pipe conveying the flow under the road with an 18" HDPE. Construction on this project is schedules for Fall 2007. This project is discussed in greater detail later in the report, as this area of Elbow Street has been identified as one of the problematic areas.

Also discussed in the report is Sherry Avenue. New sidewalks will be constructed in 2007. Caputo and Wick developed a Conceptual Plan for new drainage within the existing Right-of-Way, utilizing 48" pipes to provide storage. This plan would change the drainage patterns by conveying all the stormwater toward Chestnut Street, as opposed to the current route through private property toward Varnum Avenue. This project is also discussed in further detail.

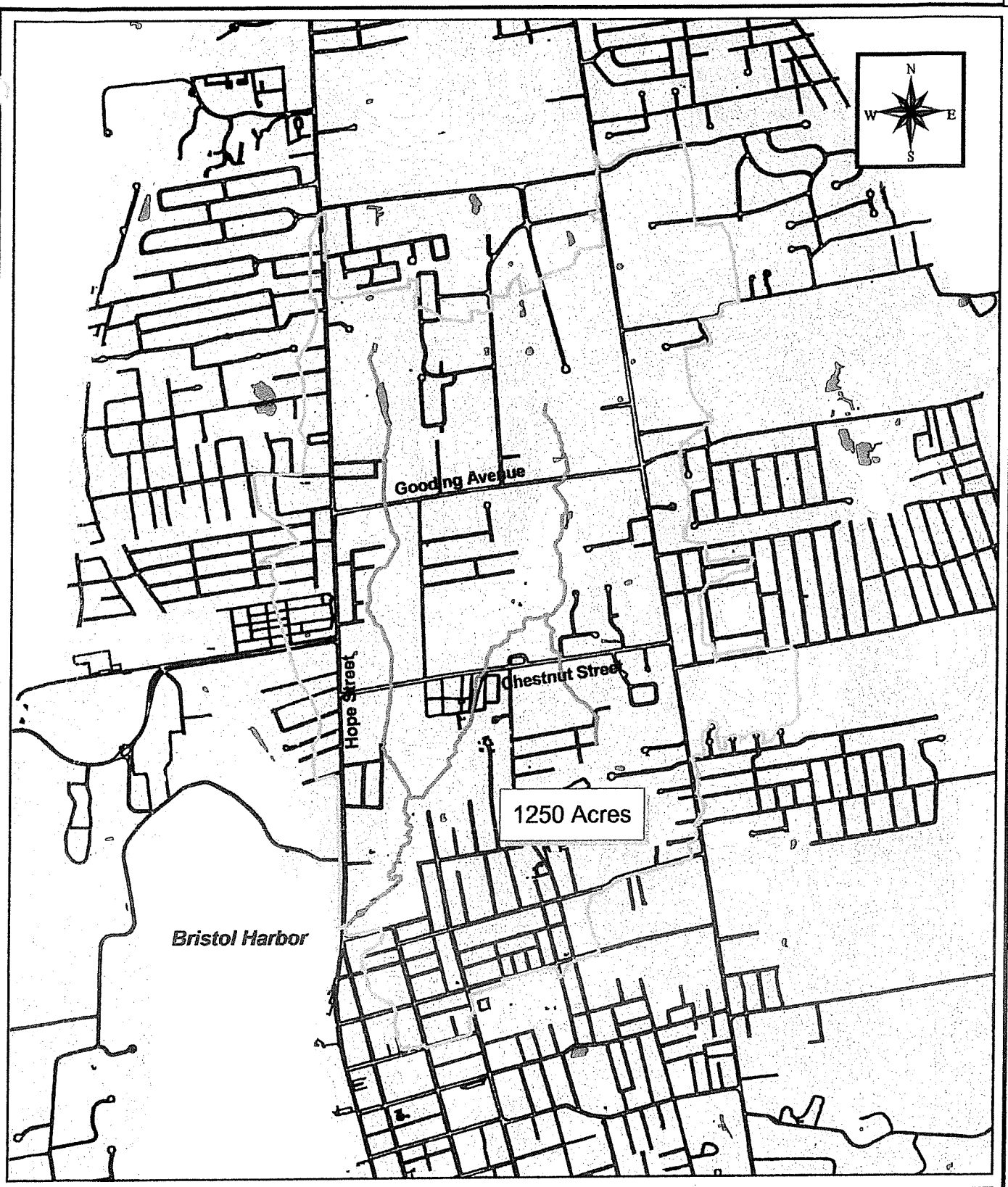
Data Collection and Field Observations

Data Collection

As part of the study and to determine accurate limits of the watershed, BETA completed an inventory of the existing drainage catch basins and manholes, as well as all outfalls and detention facilities within the 1,250 acre watershed. Catch basins were located using GPS equipment and opened to identify structure and pipe materials, pipe inverts and sizes, condition and the presence of silt or standing water. Approximately 1,000 catch basins were opened along with 250 drain manholes. Information collected regarding pipe size and invert elevations allows us to identify closed drainage systems which in turn can be used calculate the system capacity.

As previously stated, it was determined that there are 66 separate drainage systems which collect runoff on local streets and developments, and then discharge to the Silver Creek. BETA used contour information provided by aerial mapping to determine the limits or reach of each individual subwatershed area. These subwatersheds have been compiled on a large scale map which is included in the report Appendix. Once the contributing areas are determined from this map, a hydrologic analysis was completed using Hydrocad software. The program calculates the watershed yield, or the rate of runoff directed to each individual closed drainage system. By comparing the capacity of each system with the calculated yield, we can determine those subsystems that are over-capacity and thus theoretically in a flooded state for storms of varying frequency (i.e. 2-year, 10-year, 100 year frequencies).

Figure 3 illustrates the town-owned parcels within the study area. This map is important in that it provides potential areas where improvements can be made without the acquisition of private property.



Legend

Silver Creek Model Reaches

Silver Creek Watershed

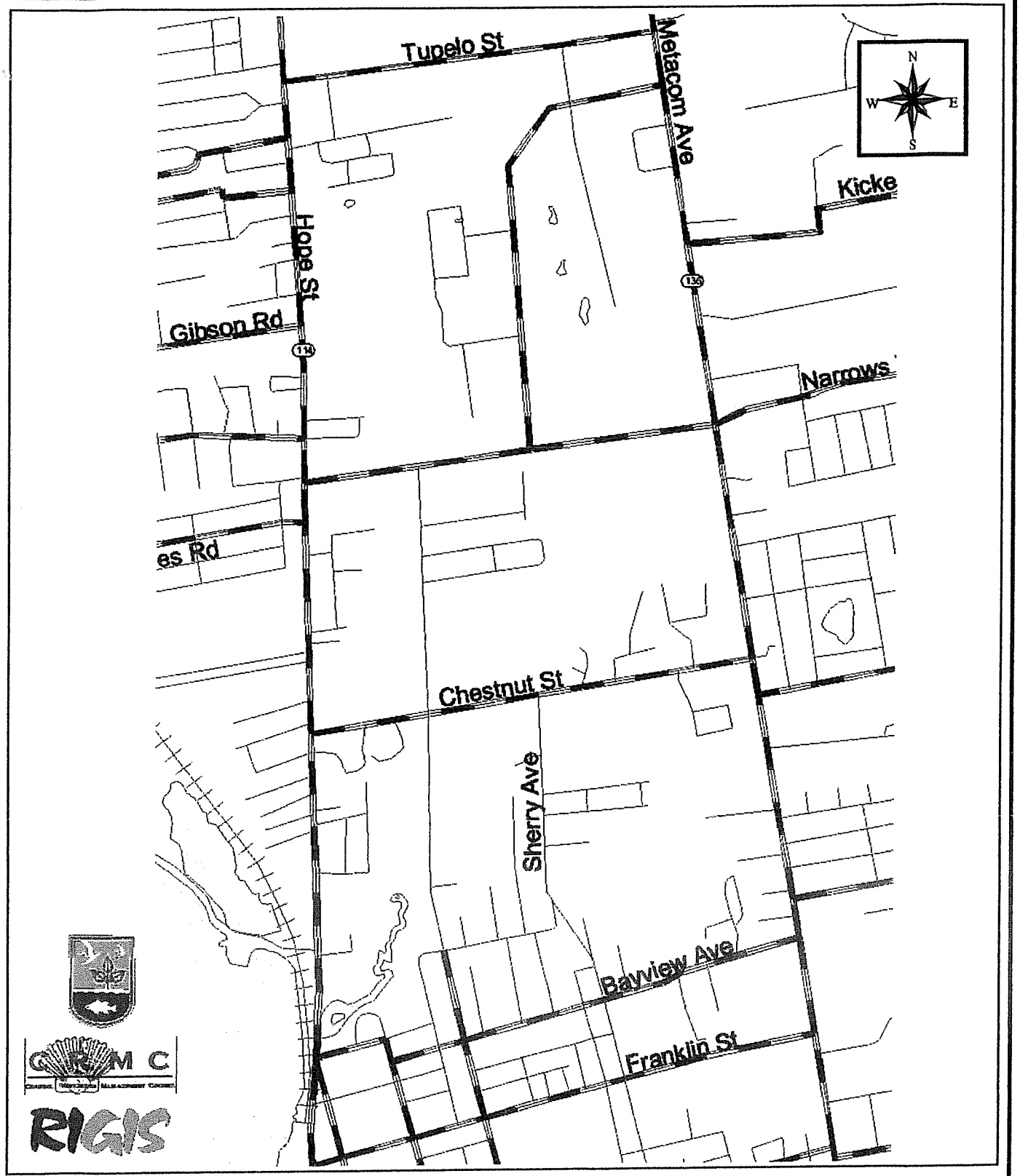
Town of Bristol Rhode Island

Silver Creek

NOT TO SCALE

Figure 1

Silver Creek Watershed



Legend

CRMC

RIDEM

Town of Bristol Rhode Island

Silver Creek

NOT TO SCALE

Figure 2

Jurisdictional Boundary

Legend

- Town-Owned Parcel
- Wetland
- River or Stream
- Lake or Pond

Town of Bristol
Rhode Island

Silver Creek

NOT TO SCALE

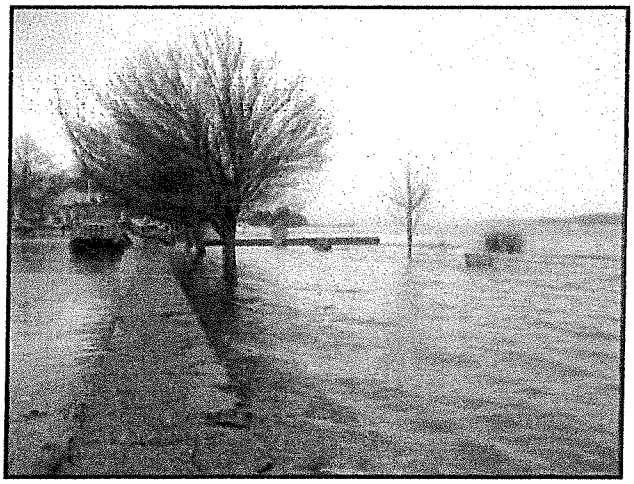
Figure 3

Town-Owned Property

Field Observations

In addition to the catch basin data and the plan development, BETA on several occasions inventoried much of the upland areas and the wetland conditions. It was observed that filling in of fringe areas or buffers was prevalent in several locations, including grass clippings, leaves, and small tree branches. Although "No Dumping" signs were observed at the end of several streets, this fill material, even though organic in nature, occupies space that would otherwise be used for flood storage.

Over the study period, the area experienced several measurable storm events, which provided the opportunity to witness the effects of the runoff throughout the watershed. During high-intensity, short duration storms, where the rain falls over a relatively short timeframe (i.e. heavy downpours), localized street flooding occurred on several of the major roadways including Gooding Avenue, Hope Street at the Silver Creek Bridge, Sherry Avenue and Washington Street. This indicated that there was a catchment problem on several of the streets. During long duration storms, where the rain continued to fall over a 24-hour period at a significantly lower rate, the flooding was confined to the lower watershed area, and the upper watershed and wetland areas were capable of containing the volume of water. This photo shows the water level approximately 2-3 feet above ground, with the bikepath and Route 114 completely covered.



During the period of high tide on March 3, 2007, the water level in Bristol Harbor was estimated to be approximately 4 feet above mean high tide level, and the entire area from Washington Street to the Topside Restaurant was flooded. RIDOT's efforts to pump the area were futile until the tide subsided. Also, during these storm events, sediments were observed in the open channels leading to the creek and associated wetlands. These included runoff from soil stockpiles with incorrect erosion controls, parking lots, and other paved areas.

Public Meetings

In addition to the field data collections and observations, BETA attended a Public Meeting with residents to hear first-hand of their perceived drainage problems, and the historical nature of the flooding. During

this meeting, the residents identified several areas where chronic flooding occurs and affects their private property and commercial businesses. In addition to the Public Meeting, BETA attended a meeting of the storm water committee to determine which projects currently under consideration fall within the Silver Creek watershed, and to gain insight into the problems which have been identified by the Town's engineer and planning department.

The Draft Report was presented to the Bristol Town Council on October 17, 2007. BETA summarized the findings and recommendations for members of the Town Council and local residents at this workshop, and answered questions from the audience. Input from this meeting has been used to modify the recommendations, emphasizing the improvements which can be done without extensive environmental permitting, and for relatively low costs.

Watershed Analysis

Hydrocad Analysis

The 1,250 acre watershed was separated into 66 subwatershed areas to review the capacity of each individual drainage system, and the actual rate of stormwater runoff flowing to each area. These subwatershed areas were analyzed using the Hydrocad software, which utilizes TR-20 technology to determine yield for storms of varying intensities, which can then be compared with the capacity of the existing pipe. As previously indicated, the pipe capacities were calculated based on the existing system characteristics (i.e. size, slope, inverts, etc.). The systems were analyzed for the 2-year and 10-year storms. In the 2-year storm, with 3.4 inches of rainfall in a 24-hour period, it was found that 32 of the 66 areas did not have sufficient capacity to handle the runoff. This included 5 areas where the capacity deficit exceeded 20 cubic feet per second (cfs), and 13 areas where the deficit was greater than 10 cfs.

The 10-year analysis (4.9 inches of rainfall in a 24-hour period) showed that an additional 12 watershed areas do not have existing capacity to handle the rate of runoff. The storms and watershed areas are summarized in Table 1. The figure demonstrating the watershed areas for the closed drainage systems can be found in the appendix.

HEC-RAS

The Hydraulic Engineering Centers River Analysis System (HEC-RAS) program was used to analyze the river and floodplain portions of the watershed. This program allows for both open-channel analysis of

Silver Creek Drainage Study
Pipe Capacity vs. Watershed Yield
Table 1

Watershed	Pipe Size (in.)	Pipe Capacity	Watershed Yield (cfs)			
			2 Year	10 Year	25 Year	100 Year
1	24	31	38	58	38	85
2	15	9	9	13	15	19
3	24	20	27	48	59	79
4	36	68	40	64	77	99
5	12	7	5	8	10	13
6	36*	67	23	36	44	57
6d	12*	5	2	3	4	4
6e	12	7	2	2	3	4
8	12	2	3	6	7	10
9	12	7	7	11	13	17
10	24	24	12	22	27	35
11	15	17	39	62	74	96
12	12	8	6	10	12	15
13	12	6	13	24	30	40
15	12	32	28	50	61	81
16	24	6	4	8	9	13
14 & 17	18	6	18	34	42	58
18	18	83	21	38	48	65
19	36*	4	17	33	42	58
20	12*	2	15	27	34	46
21	36*	67	8	12	14	18
22	18	8	18	28	33	41
23	12*	5	3	4	5	6
24	12*	4	12	19	23	29
25	18*	11	11	21	26	35
26	4	1	0.5	0.5	0.5	0.5
27	6*	1	0.5	0.5	0.5	0.5
28	12	12	5	9	12	16
29	18	14	17	29	36	48
30	10*	1	3	5	6	8
31	12*	4	25	48	61	84
32	18*	17	35	71	92	130
33	18*	6	44	79	99	133
34	12	2	8	14	17	23
35	15*	6	4	7	8	11
36	30*	41	136	235	290	386
37	18*	11	9	14	17	23
38	18*	8	4	7	8	11
39	15*	4	16	29	36	48
40	6*	1	0.5	0.5	1	1
41	8*	2	0.5	1	1	2
42	6*	1	0.5	0.5	0.5	0.5
43	24	20	5	8	11	14
44	6*	1	2	3	4	6
45	12*	2	3	6	8	12

ANDREWS DANDRIDGE DIXON

* Due to limited information about these systems, the slope was assumed to be 1%.

Silver Creek Drainage Study
Pipe Capacity vs. Watershed Yield
Table 1

Watershed	Pipe Size (in.)	Pipe Capacity	Watershed Yield (cfs)			
			2 Year	10 Year	25 Year	100 Year
46	12*	2	1	2	3	4
47	18*	6	13	23	30	40
48	12*	2	3	4	5	7
50	4*	0.50	3	5	6	9
51	18*	11	11	17	21	26
52	12*	2	9	14	17	22
53	12	4	12	19	22	28
54	12	4	1	2	3	4
55	8	2	4	6	7	9
56	24	36	11	20	25	33
57	12*	2	4	7	8	11
58	12*	2	5	8	10	14
59 & 60	54/36	240	72	124	152	203
61	24	20	27	48	60	80
62	12*	2	11	20	25	34
63	15*	4	15	27	34	46
64	12*	4	2	3	3	4
65	18*	11	6	10	13	18
66	18	7	6	10	13	17
67	18	5	4	7	8	11
68	12	2	26	48	60	81

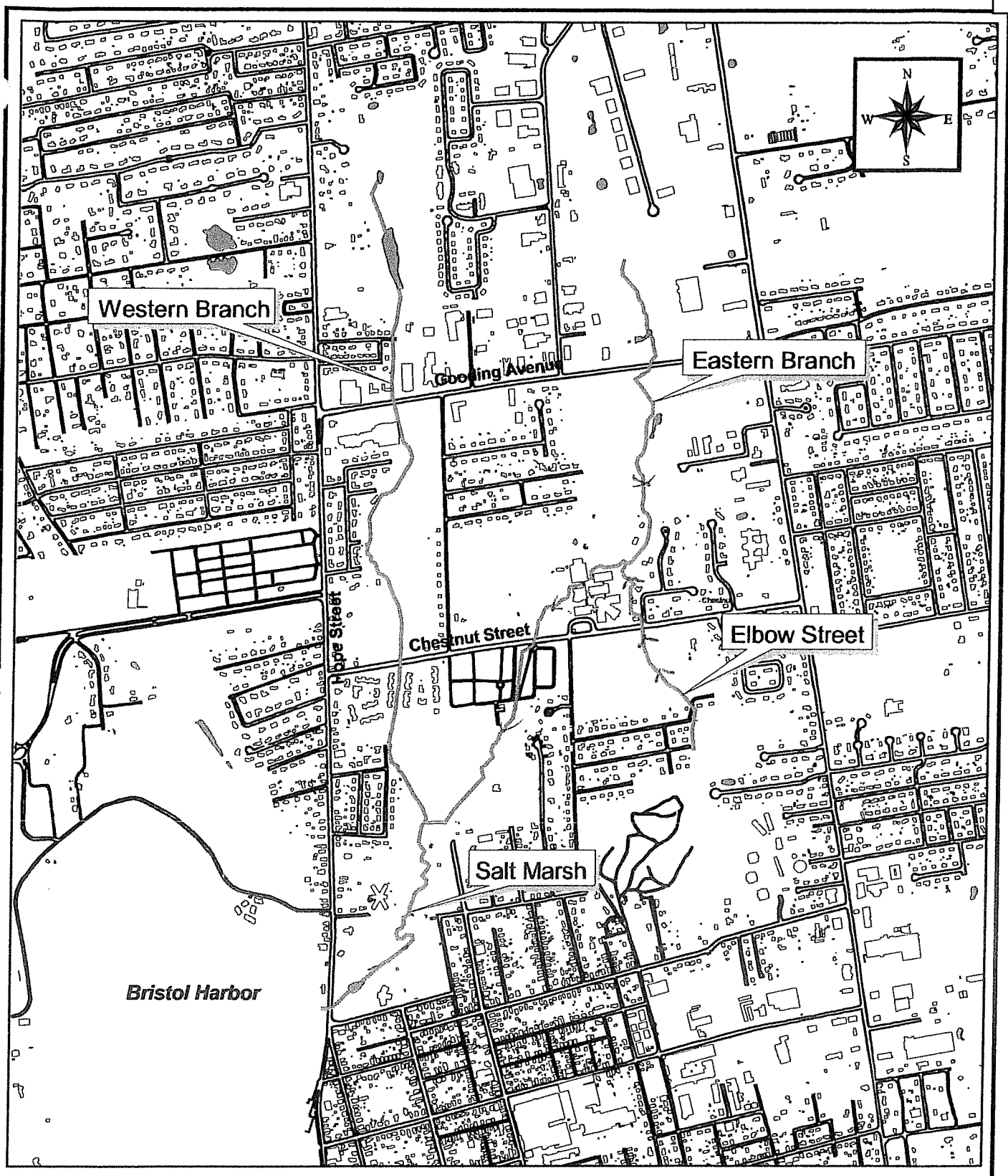
* Due to limited information about these systems, the slope was assumed to be 1%.

the river portions of the east and west branches (northern reaches), and the pond areas of the lower watershed as well as those areas where flows back up as a result of restrictions from piped sections. In order to calculate the input runoff at key locations, the total watershed area was broken down into 45 subwatershed areas, each with a discharge point and volume of stormwater runoff. It should be noted that these 45 subwatershed areas are different from the 66 subwatershed areas identified in the pipe-flow analysis as they have different discharge points and characteristics. The figure illustrating the subwatershed areas for the Silver Creek analysis can be found in the appendix.

To determine the open channel characteristics of the channel, the creek was analyzed from upstream of Gooding Avenue to the discharge point west of Hope Street. The creek was divided into four reaches: the Eastern Branch, Western Branch, Salt Marsh and Elbow Street. These reaches can be seen in Figure 4. The Eastern and Western Branches extend from north of Gooding Avenue to south of Chestnut Street where they converge in the salt marsh and continue to the outfall. The Elbow Street reach was modeled because many of the previously discussed problem areas discharge to the wetland north of Elbow Street. This wetland area flows to a culvert which crosses Chestnut Street and discharges on the northern side. The Elbow Street reach then converges with the Eastern Branch before flowing to the culverts under the high school. The model would help to determine if the problems in these areas were due to the hydraulic characteristics of the creek or the inadequate capacity of the individual drainage systems.

Methodology

The hydrologic and hydraulic analysis for this project was completed using HydroCad and HEC-RAS computer software. The overall watershed was divided into approximately 45 subwatersheds. HydroCAD was utilized to determine the watershed yield for each of the subwatersheds. The watershed yield assumes that the peak flow reaches the creek regardless of the restrictions the closed drainage systems may create. HydroCAD utilizes the Soil Conservation Services Technical Release 55 (TR-55). Additionally, the Rhode Island Intensity-Duration-Frequency (IDF) curve was used to determine intensity values based on the time of concentration. A lag time, ranging anywhere from 20 to 60 minutes, was calculated for each subwatershed based on the amount of time it would take to travel in the creek from the discharge point of one subwatershed to the next. The peak discharge for each subwatershed was determined for the 2, 10 and 100 year design storm events. The results of the HydroCad analysis for each storm event are included in the Appendix.



Legend

Silver Creek Model Reaches

Town of Bristol Rhode Island

Silver Creek

NOT TO SCALE

Figure 4

Silver Creek Model Reaches

The hydraulic conditions in the creek were computed by a steady flow simulation in HEC-RAS using the derived peak flows for the 2, 10, and 100 year design storms obtained from HydroCad. The hydraulic analysis was completed for the existing condition and several alternatives to mitigate flooding during various design storm events.

Existing Condition

DESCRIPTION

The existing condition is defined as the existing creek channel, assuming that the rock sill upstream of the bike path has been lowered by the ongoing project. The alignment of the river channel and the cross sections were defined using the 2-foot contour intervals obtained from the Town's GIS. The geometry of the bridge crossings or hydraulic opening and cross culverts were defined and quantified using information obtained from the Town's GIS, the Natural Resources Conservation Service (NRCS) Silver Creek Study and Model, and field data obtained during this study. It is assumed that these culverts are not damaged or collapsed and able to convey flow at full capacity. For analysis purposes, if required information was not available, the characteristics of the system were assumed using the best available information and the topography of the area.

The river bed and wetland elevations were derived from the 2-foot contours except in the Salt Marsh reach. NRCS had performed a more detailed survey of the salt marsh area for their study of Silver Creek. The cross-sections from their HEC-RAS model through the salt marsh area were incorporated into our model. The hydraulic openings for the pedestrian, Hope Street and the bike path bridges were also taken from the NRCS model.

The outfall downstream of the bike path is tidally influenced. The tailwater only affects the creek from the outfall to just upstream of where the eastern and the western branches converge (approximately 3,000 feet), mostly through the marsh area. Upstream of this point, the elevation of the creek is higher than the tailwater elevation. The HEC-RAS simulation was performed for four different tailwater scenarios. The first scenario assumed the bike path culvert had no tailwater (empty), the second scenario assumed the culvert was half full, the third scenario assumed the culvert was fully submerged but not overtopping the bike path, and the last scenario assumed the culvert was fully submerged and overtopping the bike path by six inches. Each of these conditions was used as the boundary condition downstream for the

simulation. The only tailwater condition that affected the water surface elevation (more than 0.05 feet) or the discharging flow at Hope Street or the bike path was the last scenario representing the fully submerged culvert and overtopping of the bike path by six inches. The discharging flow from Hope Street causes the bike path to act as a weir which overtops and discharges to the harbor. Until the tailwater elevation is above the bike path, the weir flow from the bike path is able to discharge sufficient flow without increasing the water surface elevation upstream of Hope Street. Therefore, only the two extreme tailwater scenarios were used in the simulation: no tailwater and a tailwater elevation which overtops the bike path by six inches (referred to as the tailwater condition throughout the rest of this study).

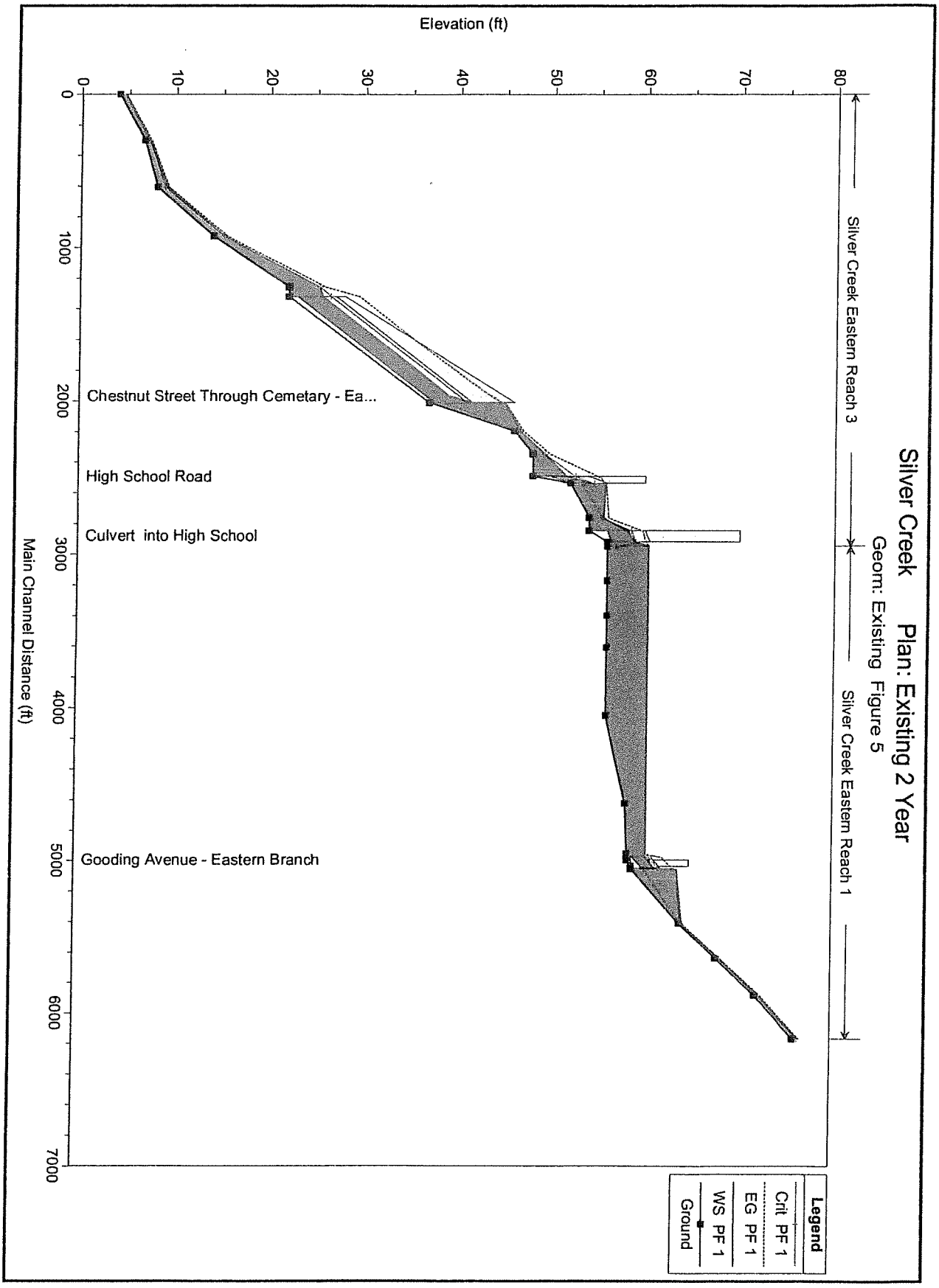
The pedestrian bridge located upstream of Hope Street in the marsh is flooded for the 2, 10 and 100-year storm events. In agreement with the previous NRCS Study, it was determined that this bridge does not change the characteristics of the flow through this area and therefore will not be discussed further as part of the following results.

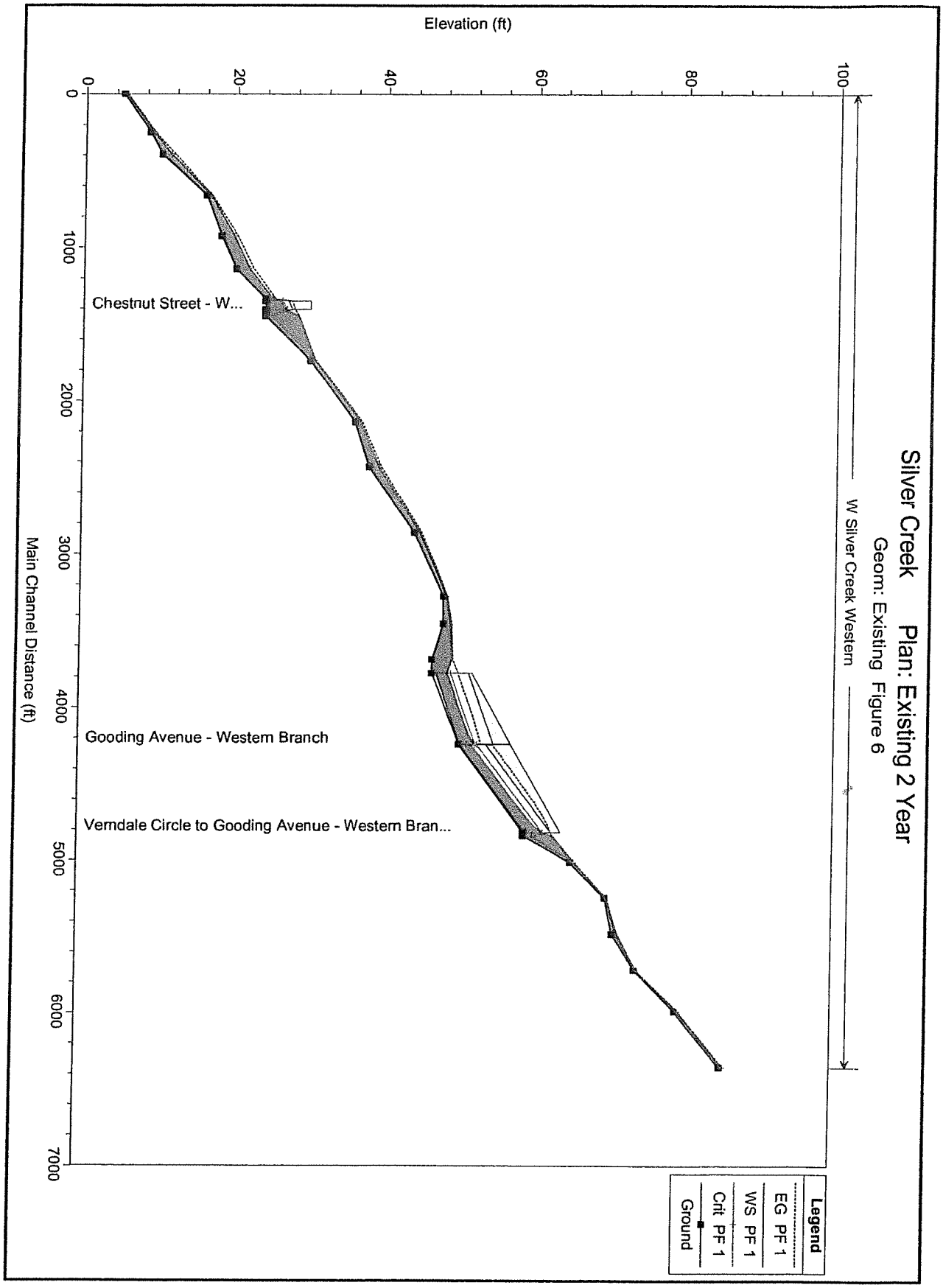
RESULTS

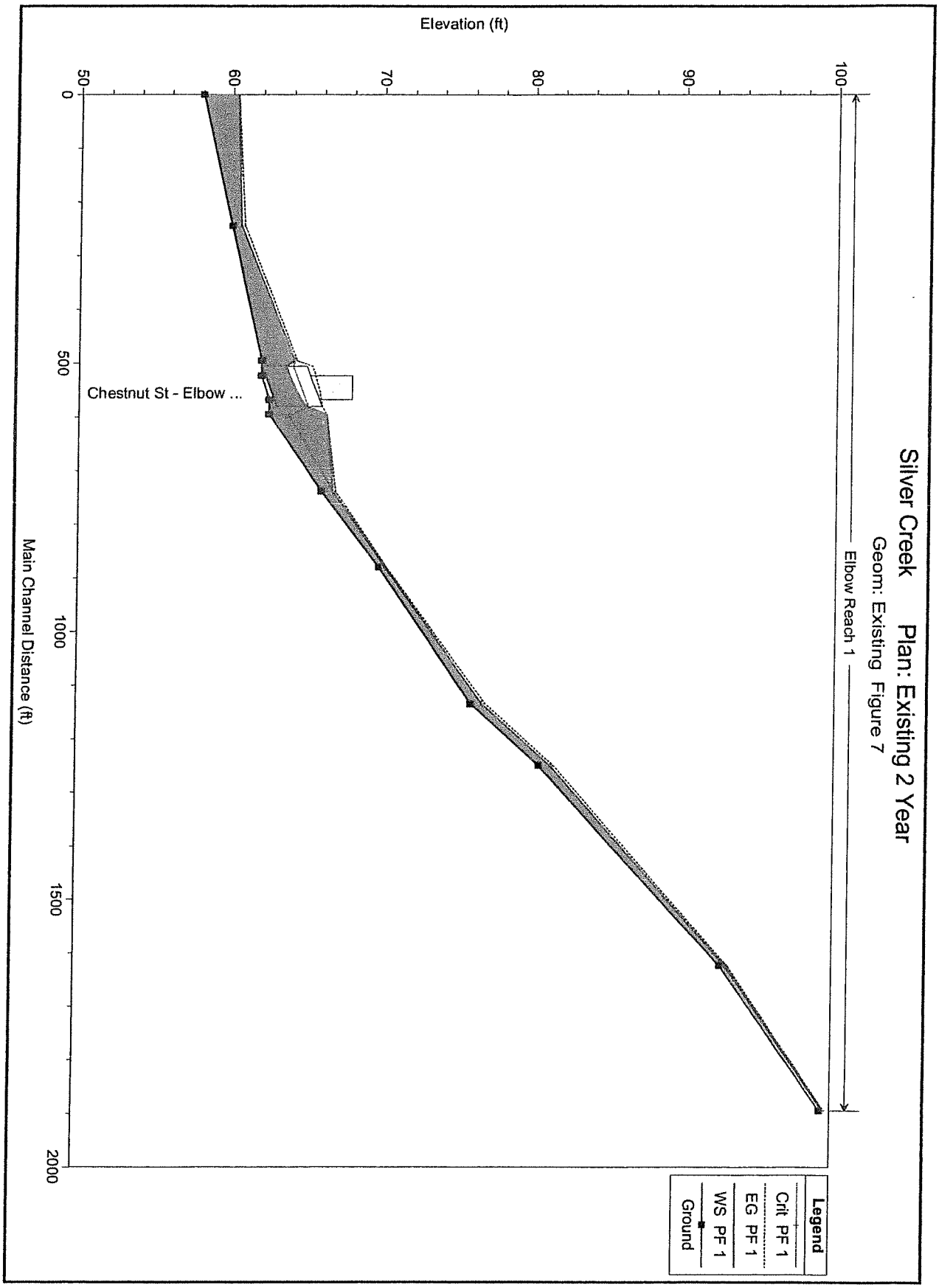
Based on the model, there are two areas throughout the watershed that seem to flood periodically. These areas are the marsh upstream of Hope Street and the area from the eastern branch between Gooding Ave and the high school. The topography is very flat in these areas and the creek is restricted downstream by culverts at Hope Street and the high school. The bike path bridge and the tidal influence at the outfall also impede the flow. Table 2 summarizes the elevations at the bike path, Hope Street, the marsh and the area between Gooding Avenue and Chestnut Street for the eastern branch for all three of the design storms with the tailwater condition and without. Each storm will have profiles to represent the eastern branch, western branch and Elbow Street and the marsh will have a profile with the tailwater condition and without if necessary. The results will also be presented in a summary table which can be found in the appendix with the output of the model.

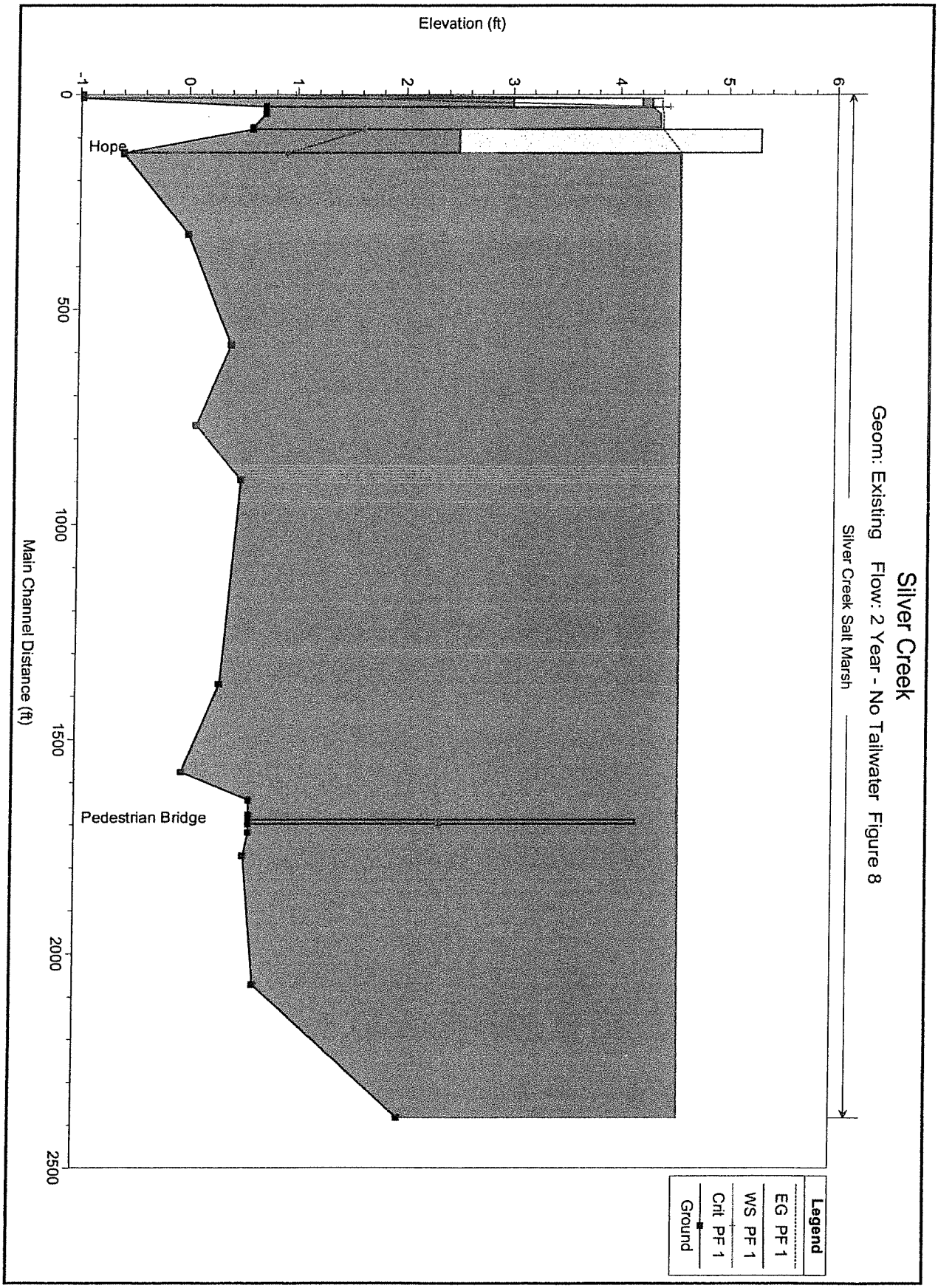
Two-Year Design Storm

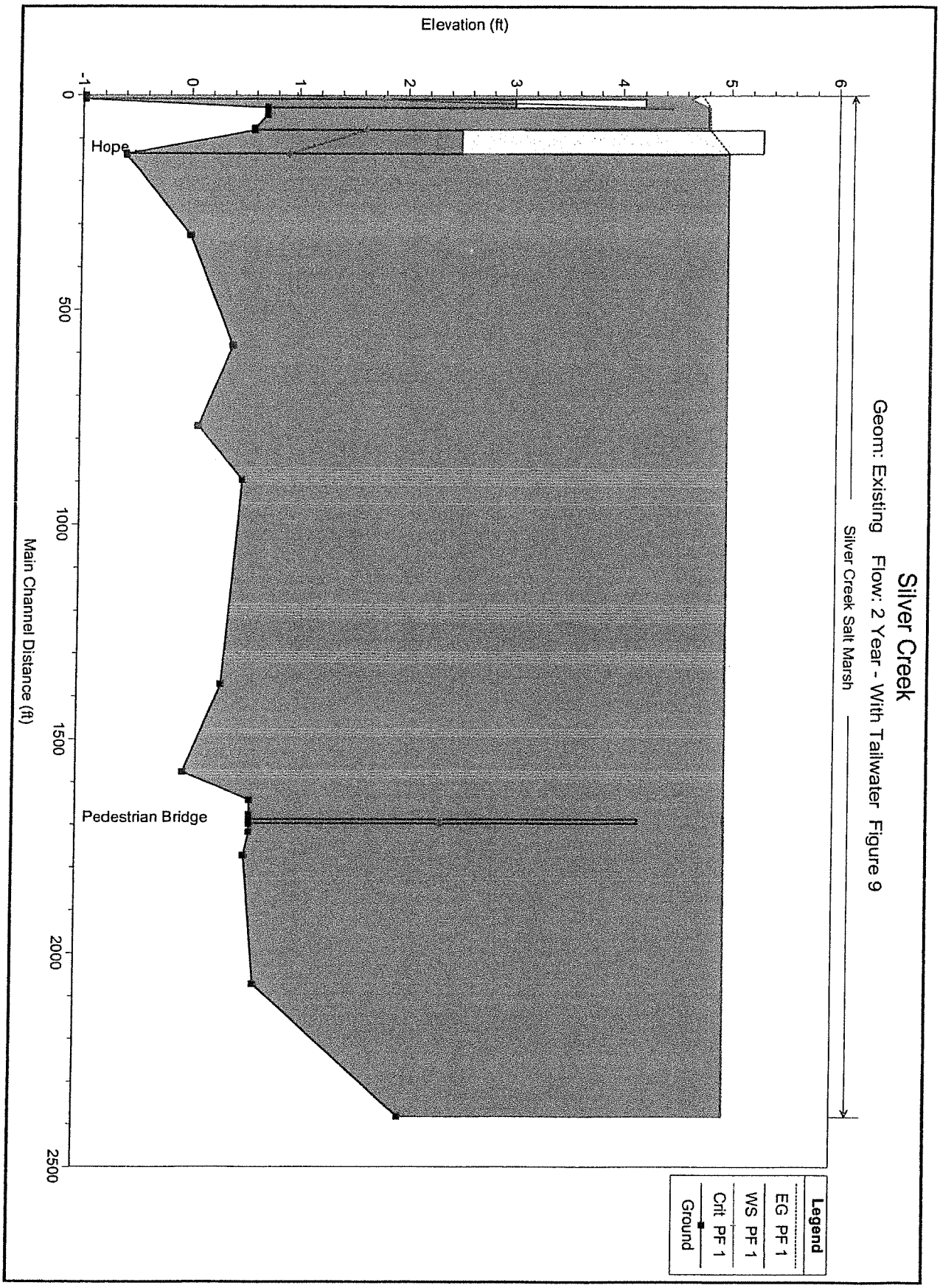
As previously mentioned, the creek was divided into four reaches: Eastern Branch, Western Branch, Salt Marsh and Elbow Street. The creek has the available capacity to convey the peak discharge of 210 cfs associated with a 2-year storm event. The culverts and hydraulic openings of the bridges are sufficient (see Figures 5-9). The only bridge that overtops is the bike path. The approximate elevations of the bike


Silver Creek Plan: Existing 2 Year
Geom: Existing Figure 5
Silver Creek Eastern Reach 3
Silver Creek Eastern Reach 1
Elevation (ft)
Main Channel Distance (ft)
Chestnut Street Through Cemetary - Ea...
High School Road
Culvert into High School
Gooding Avenue - Eastern Branch
Legend
Crit PF 1
EG PF 1
WS PF 1
Ground


Silver Creek Plan: Existing 2 Year
Geom: Existing Figure 6
W Silver Creek Western
Elevation (ft)
Main Channel Distance (ft)
Chestnut Street - W...
Gooding Avenue - Western Branch
Verndale Circle to Gooding Avenue - Western Bran...
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground


Silver Creek Plan: Existing 2 Year
Geom: Existing Figure 7
Elbow Reach 1
Elevation (ft)
Main Channel Distance (ft)
Chestnut St - Elbow ...
Legend
Crit PF 1
EG PF 1
WS PF 1
Ground


Silver Creek
Geom: Existing Flow: 2 Year - No Tailwater Figure 8
Silver Creek Salt Marsh
Elevation (ft)
Main Channel Distance (ft)
Hope
Pedestrian Bridge
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground


Silver Creek
Geom: Existing Flow: 2 Year - With Tailwater Figure 9
Silver Creek Salt Marsh
Elevation (ft)
Main Channel Distance (ft)
Hope
Pedestrian Bridge
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground

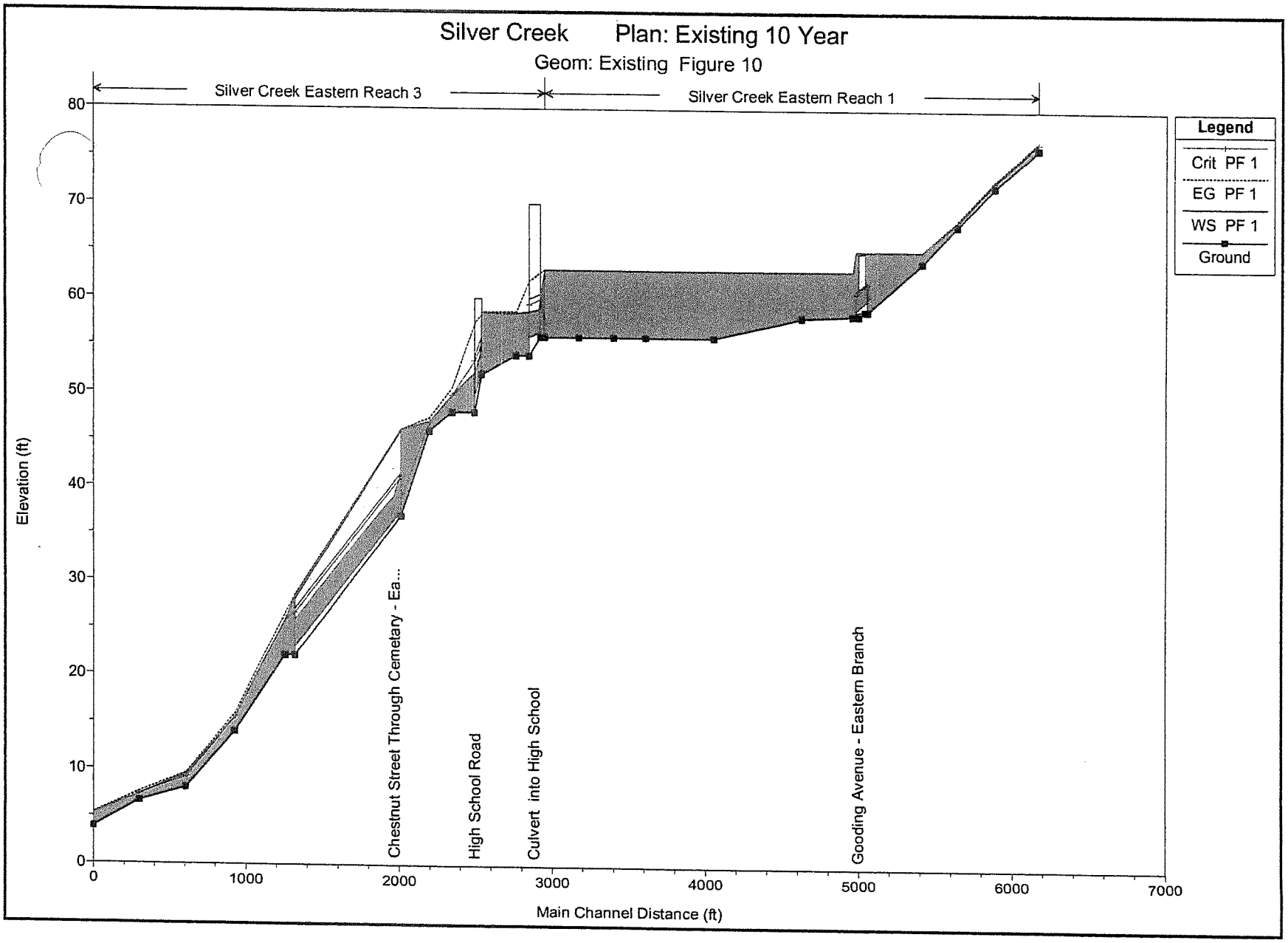
path and Hope Street are 4.2 feet and 5.3 feet, respectively. The water surface elevation is 0.10 feet above the bike path elevation with no tailwater and 0.5 feet above with the tailwater condition. Hope Street is not flooded by this design storm whether a tailwater condition is applied or not. The water surface elevation increases throughout the marsh to just upstream of Hope Street by 0.5 feet, bringing it to approximately 5.0 feet, when the tailwater condition is applied. As shown in Figure 5, the water surface elevation in the area between Gooding Avenue and the high school is approximately 60.4 feet. As previously mentioned, the tailwater does not affect the creek this far upstream.

Ten-Year Design Storm

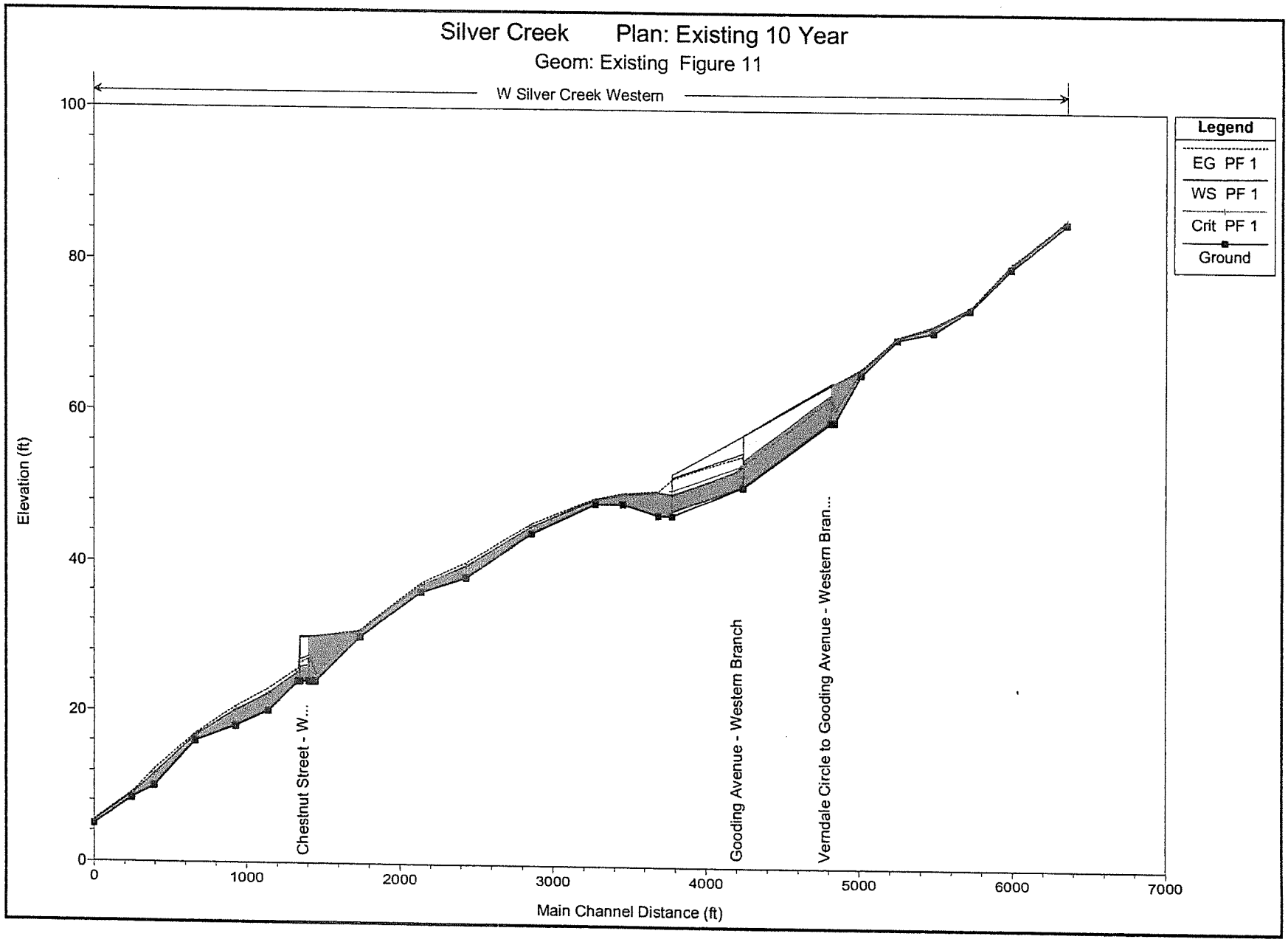
The ten-year storm, which produces a peak discharge of 377 cfs, overtops Gooding Avenue and Chestnut Street in the eastern branch (See Figure 10) and Verndale Circle (upstream of Gooding Avenue) and Chestnut Street in the western branch (See Figure 11) by approximately 0.10 feet. As shown in Figure 12, the flow from the Elbow Street area overtops Chestnut by less than 0.10 feet. These structures may not actually flood or overtop during this design storm. More detailed survey information would be needed to determine the exact elevations of the culverts and hydraulic openings in these areas. As shown in Table 2, the water surface elevation at the bike path with no tailwater condition is 4.4 feet and 4.7 feet with a tailwater condition (see Figures 13-14). Hope Street does not overtop until a tailwater (high tide) condition is applied with the ten-year design storm. Hope Street barely floods with the tailwater condition and the corresponding elevation in the marsh rises to 5.32 feet, which is 0.02 feet above the street's normal grade. The flood elevation between Gooding Avenue and the high school is approximately 63 feet.

One Hundred-Year Design Storm

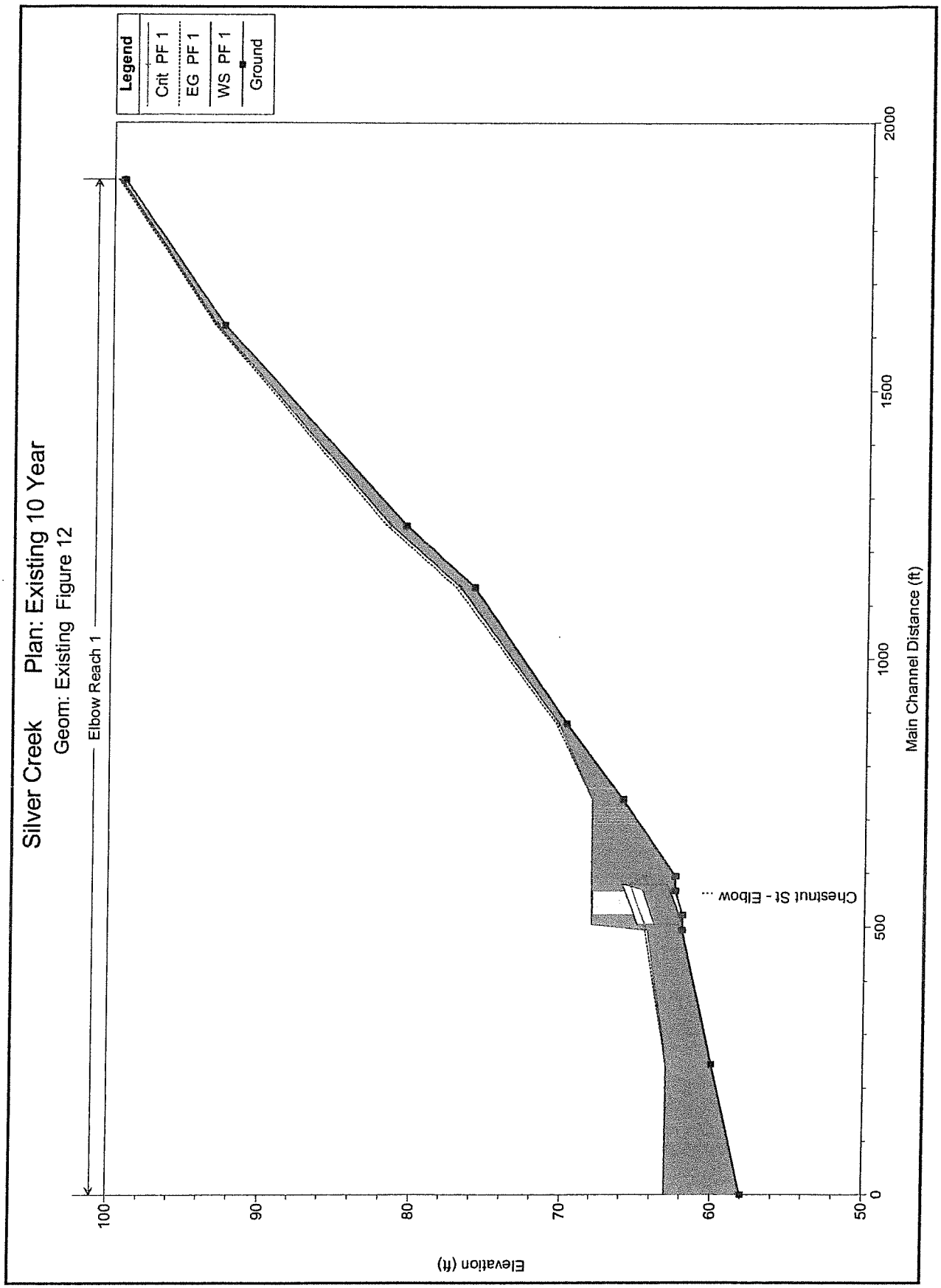
As shown in Figures 15-18, the peak flow of 639 cfs from the one hundred-year design storm overtops all of the bridges and culverts except the high school. The water surface elevations are the same regardless of whether a tailwater condition was simulated. The water surface elevation at the bike path is 5.1 feet and 5.6 feet at Hope Street. The elevation throughout the marsh is 5.7 feet and 67.0 feet between Gooding Avenue and the high school for the eastern branch.

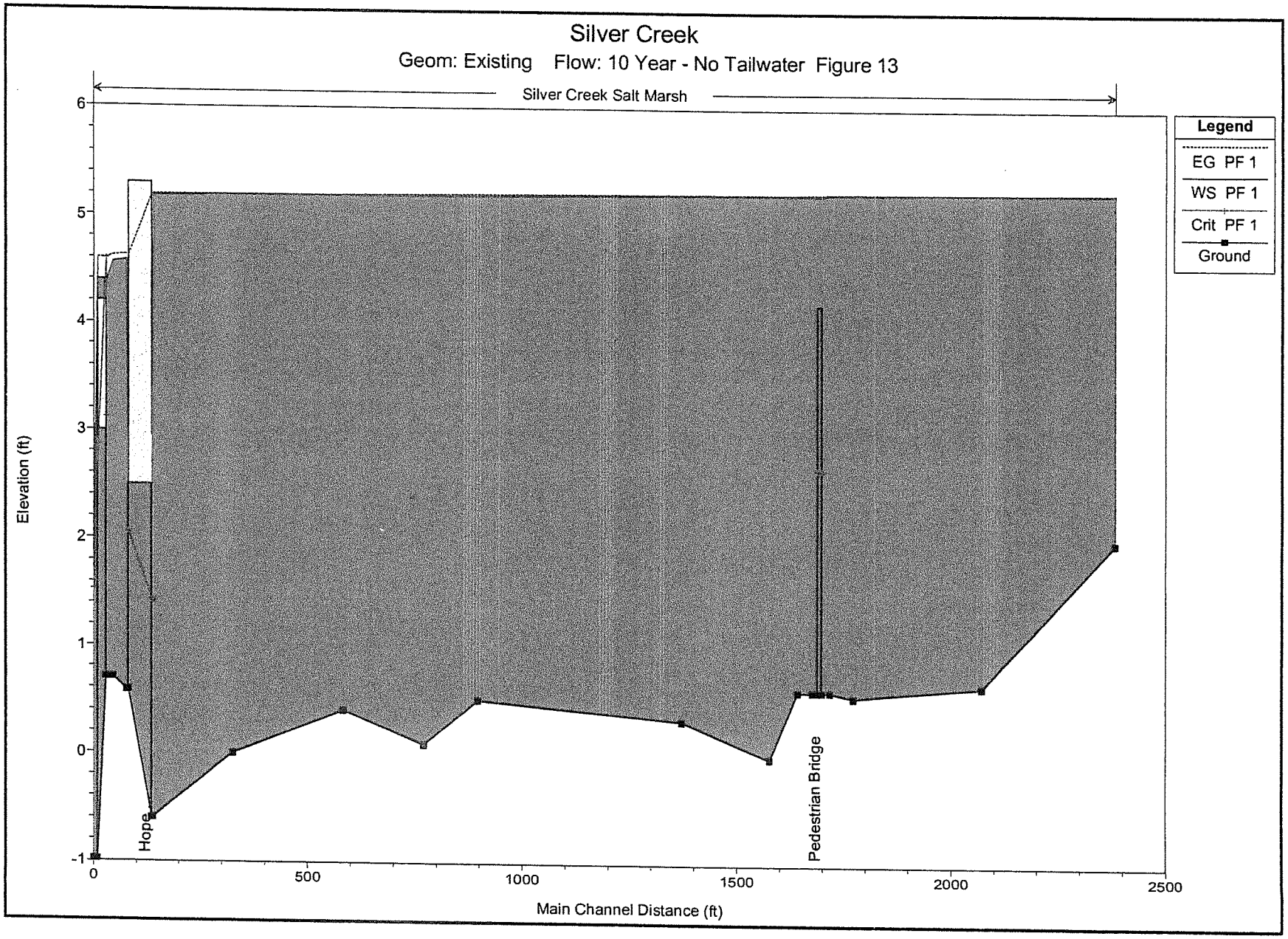

Silver Creek Plan: Existing 10 Year
Geom: Existing Figure 10
Silver Creek Eastern Reach 3
Silver Creek Eastern Reach 1
Legend
Crit PF 1
EG PF 1
WS PF 1
Ground
Elevation (ft)
Main Channel Distance (ft)
Chestnut Street Through Cemetary - Ea...
High School Road
Culvert into High School
Gooding Avenue - Eastern Branch
0
10
20
30
40
50
60
70
80
0
1000
2000
3000
4000
5000
6000
7000

Item C1.

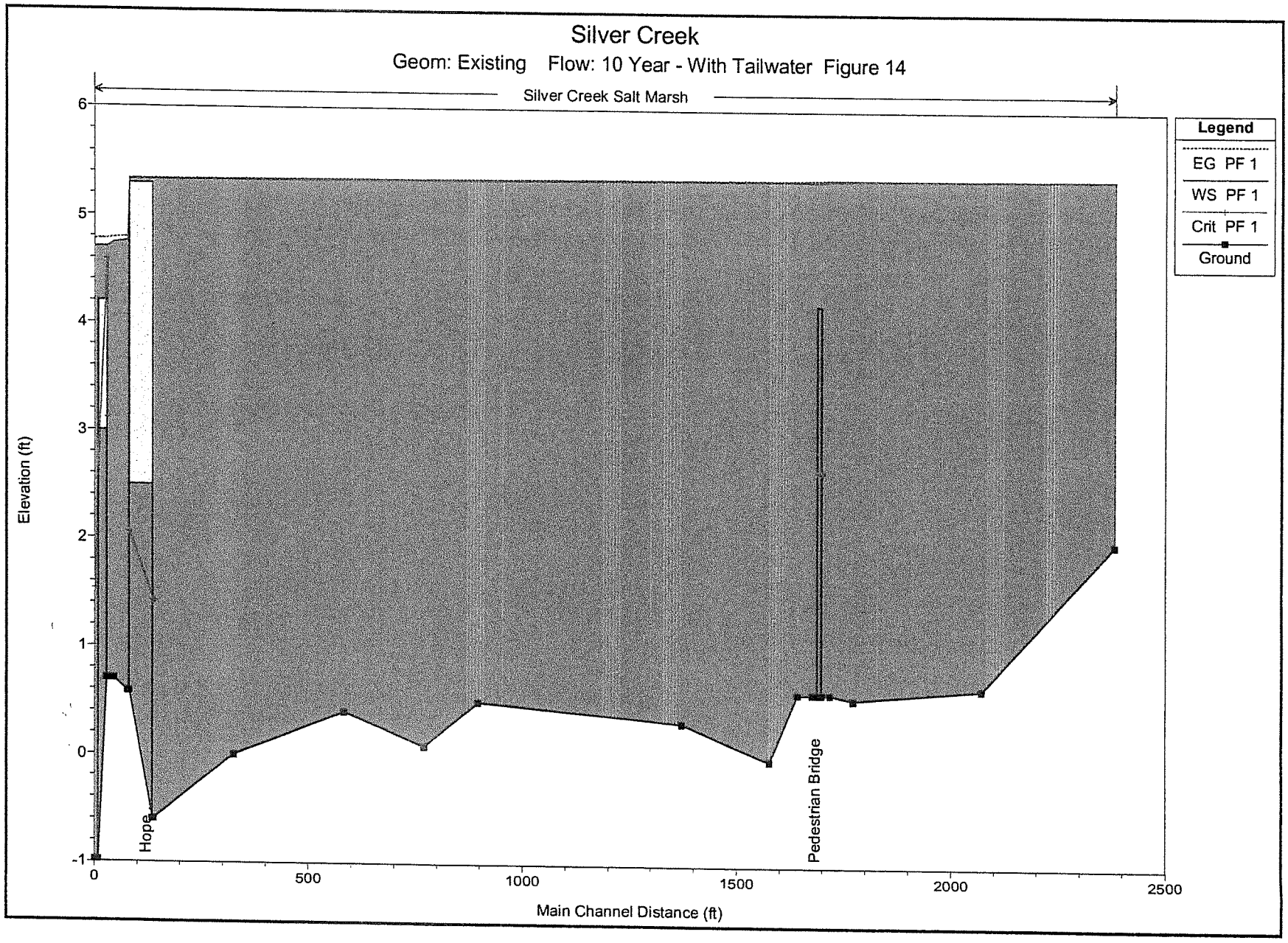

Silver Creek Plan: Existing 10 Year
Geom: Existing Figure 11
W Silver Creek Western
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Elevation (ft)
Main Channel Distance (ft)
Chestnut Street - W...
Gooding Avenue - Western Branch
Verndale Circle to Gooding Avenue - Western Bran...
0
20
40
60
80
100
0
1000
2000
3000
4000
5000
6000
7000

Item C1.

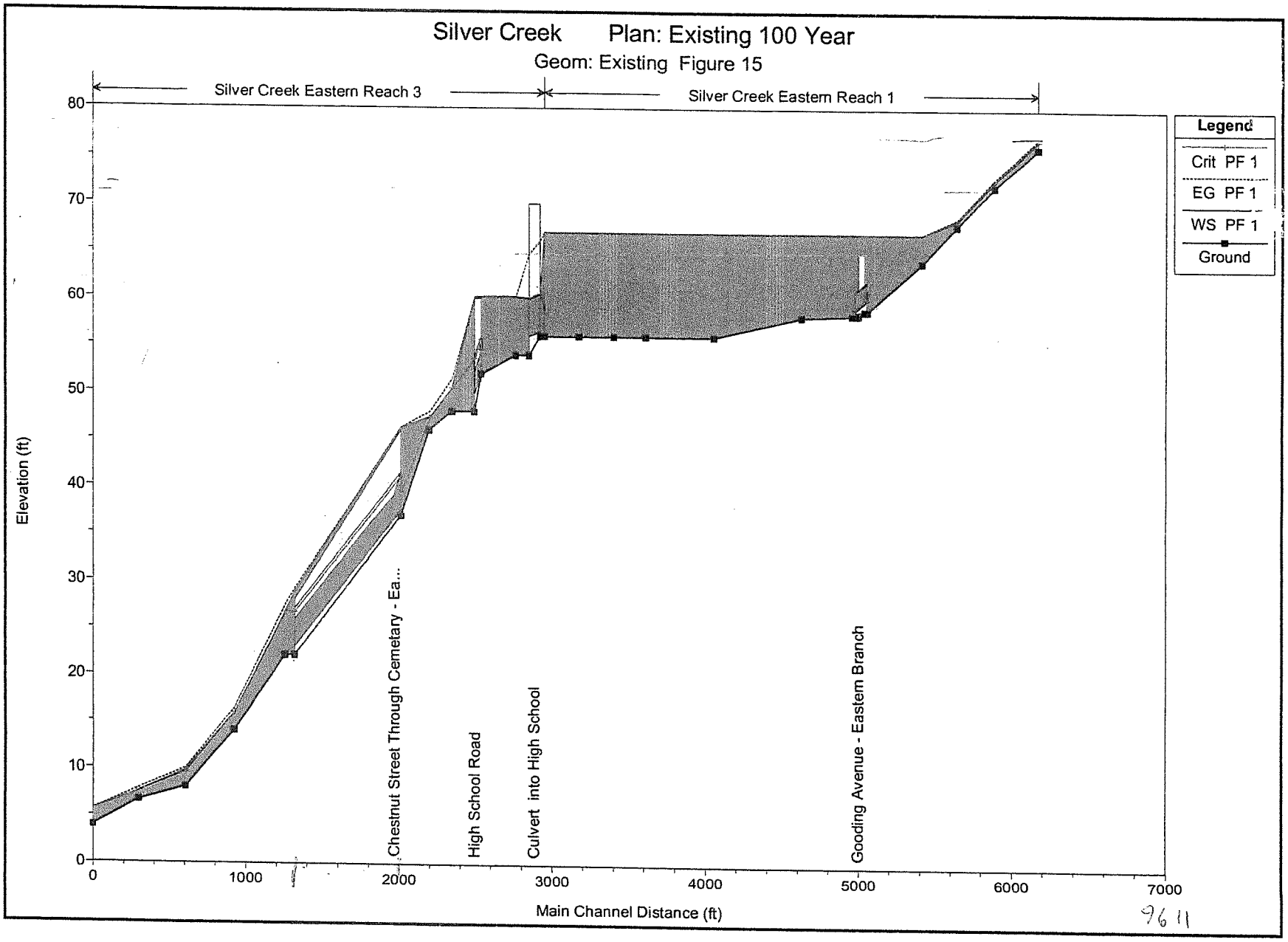

Silver Creek Plan: Existing 10 Year
Geom: Existing Figure 12
Elbow Reach 1
Legend
Crit PF 1
EG PF 1
WS PF 1
Ground
Chestnut St - Elbow
Elevation (ft)
Main Channel Distance (ft)
100
90
80
70
60
50
0
500
1000
1500
2000


Silver Creek
Geom: Existing Flow: 10 Year - No Tailwater Figure 13
Silver Creek Salt Marsh
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Elevation (ft)
Main Channel Distance (ft)
Hope
Pedestrian Bridge
6
5
4
3
2
1
0
-1
0
500
1000
1500
2000
2500

Item C1.

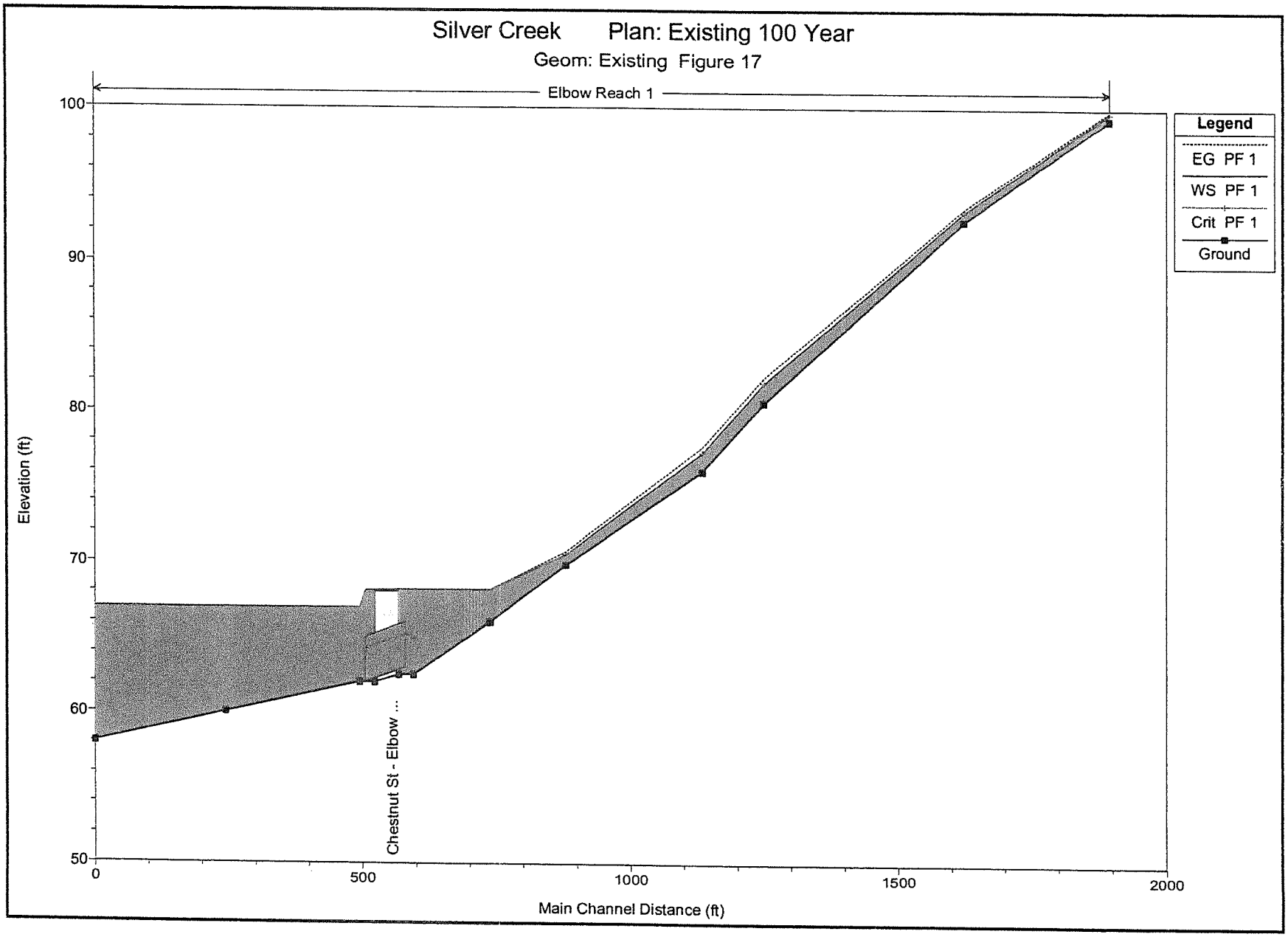

Silver Creek
Geom: Existing Flow: 10 Year - With Tailwater Figure 14
Silver Creek Salt Marsh
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Elevation (ft)
Main Channel Distance (ft)
Hope
Pedestrian Bridge
6
5
4
3
2
1
0
-1
0
500
1000
1500
2000
2500

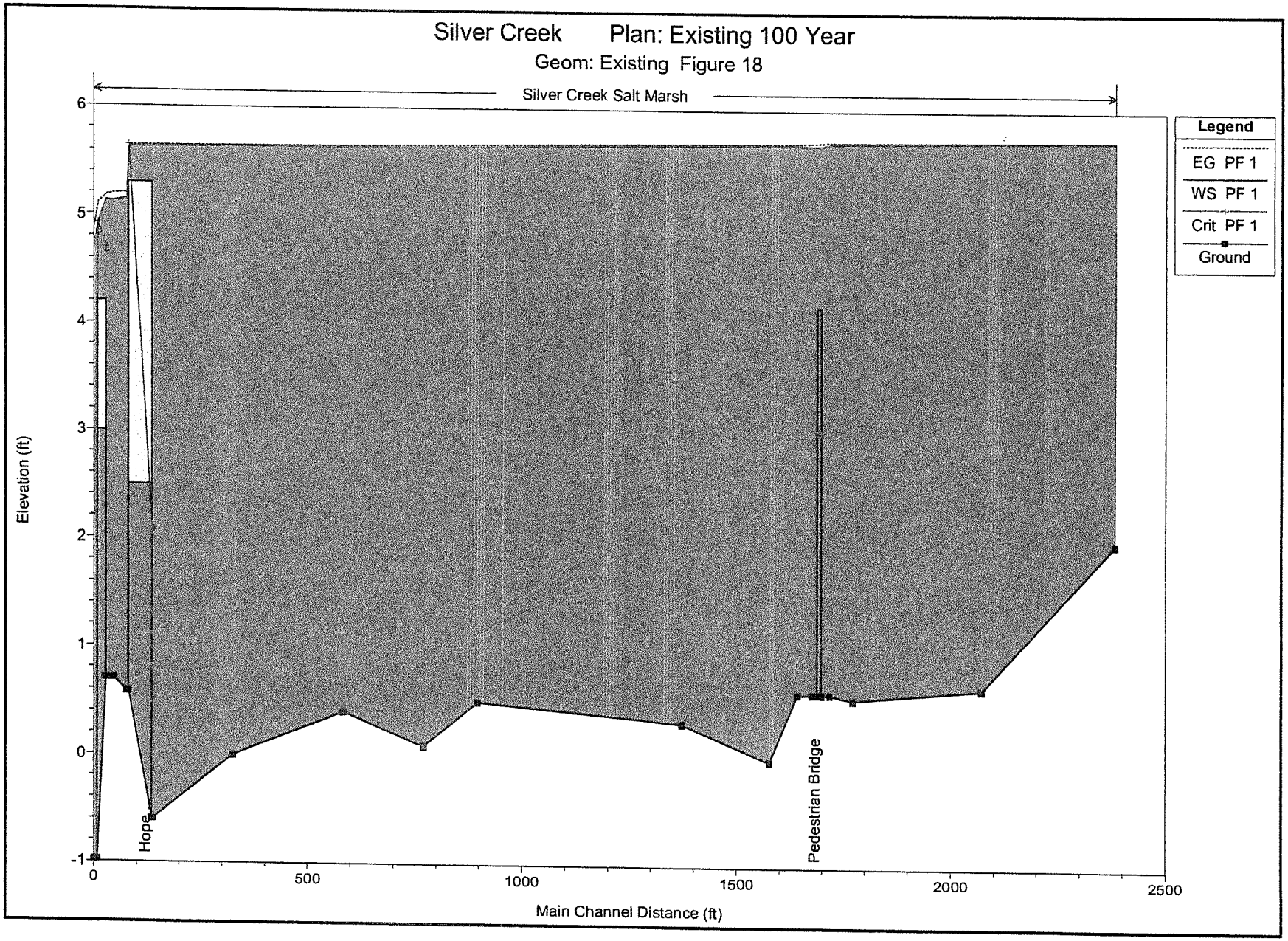
Item C1.


Silver Creek Plan: Existing 100 Year
Geom: Existing Figure 15
Silver Creek Eastern Reach 3
Silver Creek Eastern Reach 1
Legend
Crit PF 1
EG PF 1
WS PF 1
Ground
Elevation (ft)
Main Channel Distance (ft)
Chestnut Street Through Cemetary - Ea...
High School Road
Culvert into High School
Gooding Avenue - Eastern Branch
0
10
20
30
40
50
60
70
80
0
1000
2000
3000
4000
5000
6000
7000

9611

Item C1.


Silver Creek Plan: Existing 100 Year
Geom: Existing Figure 17
Elbow Reach 1
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Elevation (ft)
100
90
80
70
60
50
0
500
1000
1500
2000
Main Channel Distance (ft)
Chestnut St - Elbow ...


Silver Creek Plan: Existing 100 Year
Geom: Existing Figure 18
Silver Creek Salt Marsh
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Elevation (ft)
6
5
4
3
2
1
0
-1
Hope
Pedestrian Bridge
0
500
1000
1500
2000
2500
Main Channel Distance (ft)

Item C1.

Table 2 Water Surface Elevations

Design Storm Event	Water Surface Elevations (Feet)			
	Bike Path (EL. 4.2)	Hope Street (EL. 5.3)	Marsh (Tidal)	Eastern Branch Between Gooding Ave and High School
2 Year No Tailwater	4.3	Does Not Overtop	4.6	60.4
2 Year Tailwater Condition	4.7	Does Not Overtop	5.0	60.4
10 Year No Tailwater	4.4	Does Not Overtop	5.2	63.0
10 Year Tailwater Condition	4.7	5.3	5.3	63.0
100 Year No Tailwater	5.1	5.6	5.7	67.0
100 Year Tailwater Condition	5.1	5.6	5.7	67.0

Sediment Removal from Marsh

DESCRIPTION

The model was used to determine what effect removing sediment from the marsh would have on the hydraulic capacity of the creek. The cross-sections though the marsh for the existing conditions were altered to represent removing 1 foot of sediment. The three design storms were simulated with a tailwater condition and without.

RESULTS

Two-Year Design Storm

As shown in Figure 19, the two year design storm without a tailwater condition does not overtop the bike path or Hope Street with the sediment removed. The level in the marsh does rise to 4.7 feet which is 0.10 feet above the existing condition elevation. The bike path is not acting as a weir and therefore less flow is being discharged and the elevation in the marsh rises. When the tailwater condition is simulated, the

Since the existing creek has the capacity to convey the two-year design storm, and this culvert would not be designed to convey the one hundred-year design storm, only the ten-year design storm was considered for this alternative. As previously stated, the tailwater condition at the outfall at Hope Street does not affect the creek this far upstream, and therefore was not taken into consideration.

RESULTS

Ten-Year Design Storm

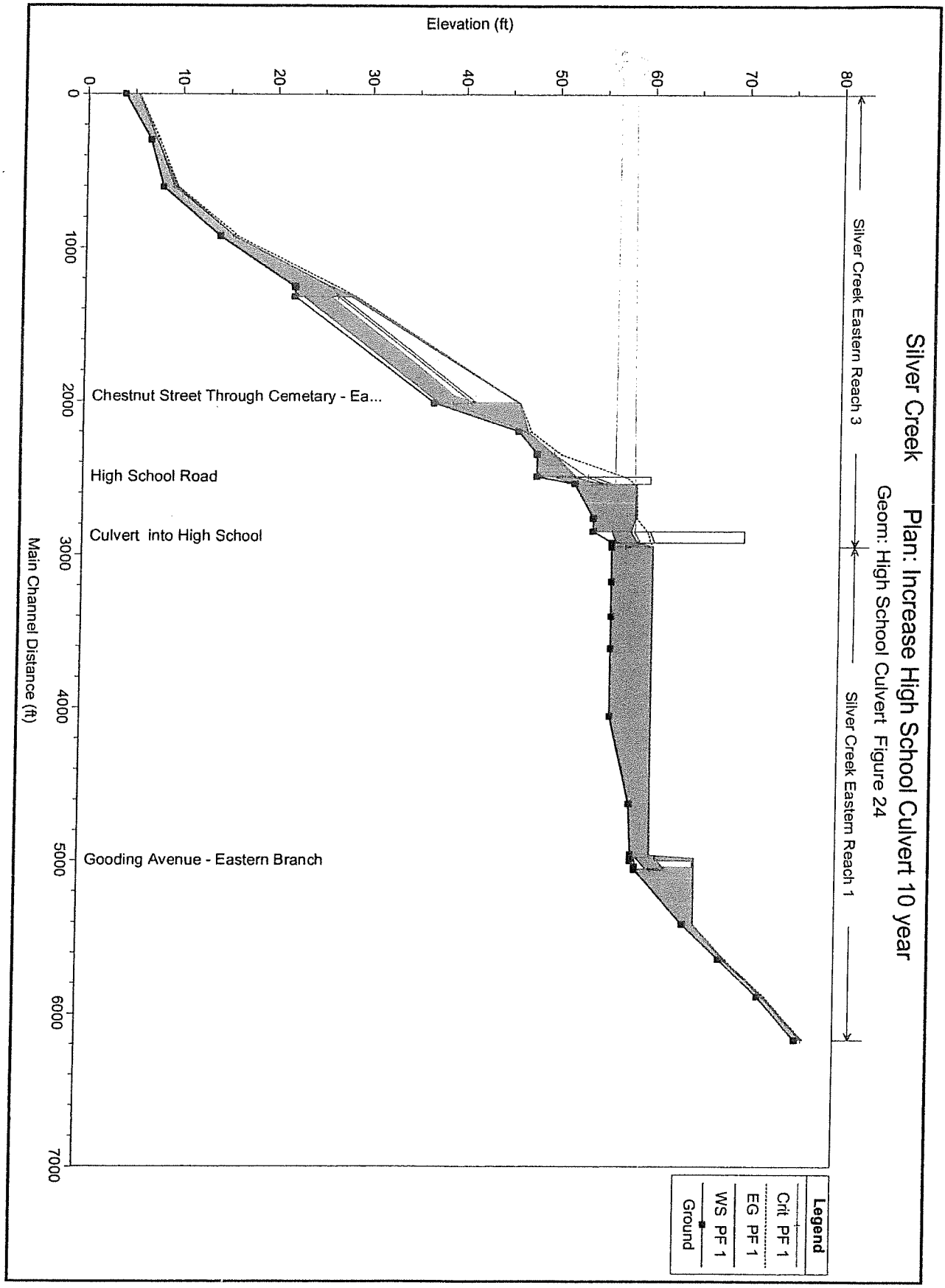
The model was run while replacing the existing culverts with twin 6-feet wide by 4-feet deep box culverts. The feasibility of this option would have to be investigated in greater detail. As shown in Figure 24, increasing the culverts would decrease the water surface elevation between Gooding Avenue and the high school from 63.0 feet (existing) to 60.3 feet. This does not impact the creek downstream. The culvert through the cemetery south of Chestnut Street, assuming it is not damaged or collapsed, has an adequate capacity to the increased peak flow. The water surface continues to overtop Chestnut Street by 0.10 feet as it does in the existing model.

Diminished Capacity at Chestnut Street/Cemetery due to deteriorated pipe

DESCRIPTION

There is a flooding problem along the Eastern branch of the creek downstream of Chestnut Street through the cemetery. There are many possible factors in this area to account for the flooding problems. Two 48-inch culverts flow from the northern side of Chestnut Street and discharge to one 48-inch pipe which then conveys flow through the cemetery. This area is a low point for about a 17 acre watershed that flows overland to the creek and is conveyed by a closed drainage system from Chestnut Street and Sherry Avenue. When the creek is surcharged the systems from Chestnut Street and Sherry Avenue can not discharge, so this area will flood and flow overland through the cemetery to the open channel portion of the creek south of the cemetery. Even if the creek is not surcharged, based on the topography of the area, if the basins on Sherry Avenue do not intercept all of the runoff generated in that area this runoff will continue to flow overland through the cemetery.

As stated previously, the HEC-RAS model is based on the assumption that the pipes and culverts are not damaged or collapsed and can physically convey their full capacity. Concerns about the condition of the 48-inch pipe which flows through the cemetery prompted the use of a camera to determine the condition


Silver Creek Plan: Increase High School Culvert 10 year
Geom: High School Culvert Figure 24
Elevation (ft)
Main Channel Distance (ft)
Silver Creek Eastern Reach 3
Silver Creek Eastern Reach 1
Chestnut Street Through Cemetary - Ea...
High School Road
Culvert into High School
Gooding Avenue - Eastern Branch
Legend
Crit PF 1
EG PF 1
WS PF 1
Ground

of the pipe. The results of the television inspection revealed that the two-48" RCP culverts under Chestnut Street are at least one third full of debris and sediment, including large stones, and the bottom of the 48" corrugated metal pipe which runs through the cemetery pipe is extremely deteriorated, with the entire bottom of the pipe rotted away. The model was run with the 48-inch pipe being replaced with a 32-inch pipe to simulate the existing pipe being one third full of debris. Examination of the structure where the pipes are reduced from 2 -48" RCP to 1-48" CMP revealed that the brick cap originally constructed is intact despite the velocities through the drainage structure. Also noted by the Truax video inspection, there is a very large pile of sediment at the outfall south of the cemetery, as well as several trees which have fallen into the channel, indicating a lack of maintenance of the pipe and open channel.

RESULTS

Ten-Year Design Storm

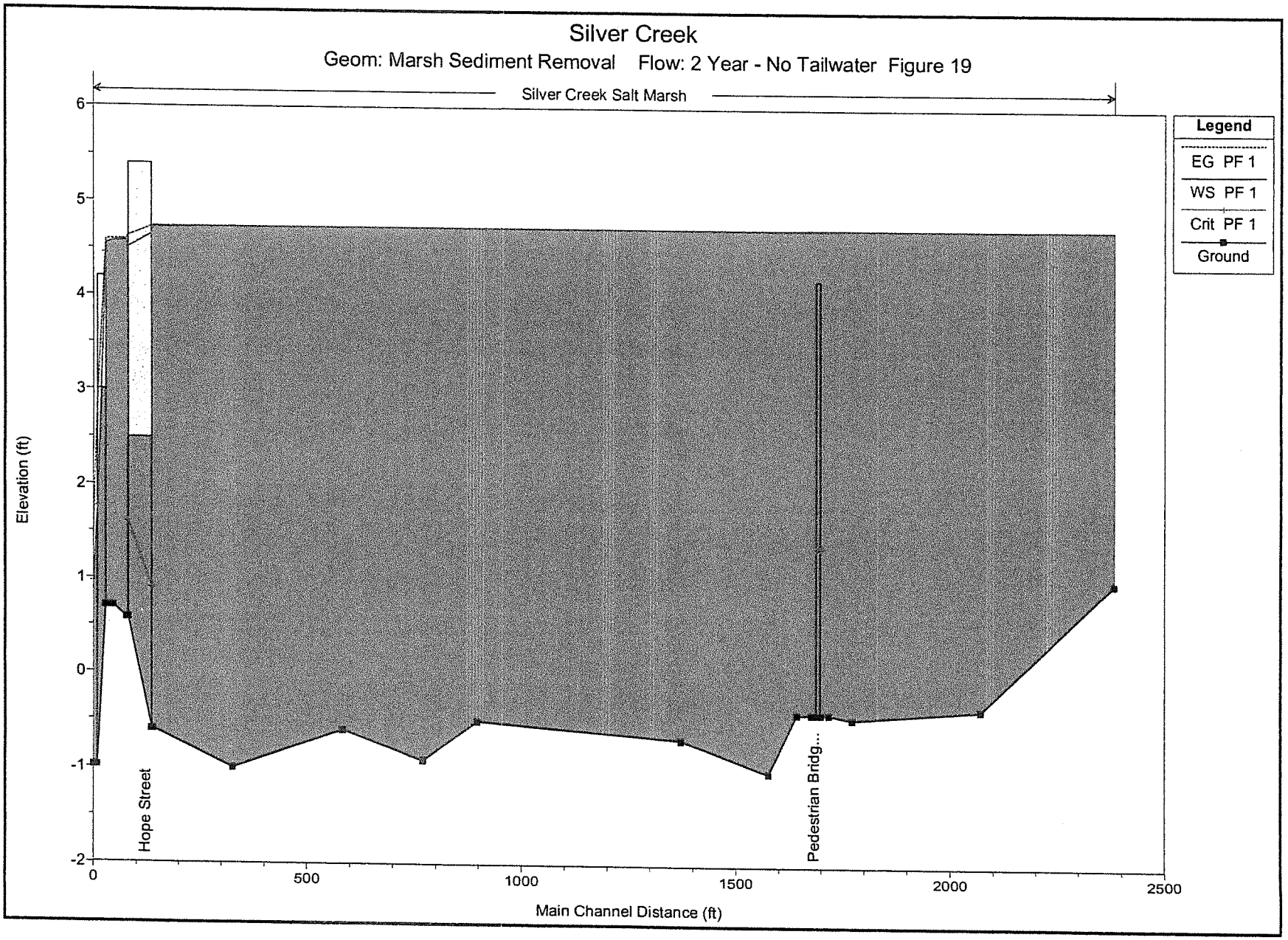
The diminished capacity of the pipe due to the debris results in an increase in water surface elevation north of Chestnut Street of 0.10 feet. As shown in Table 3 and 4, the 48-inch culvert could convey approximately 154 cfs. When the pipe size is decreased to 32 inches, the conveyed flow is decreased to approximately 68 cfs. The condition of this pipe is a contributing factor to the flooding in this area.

HEC-RAS Plan: Existing 10 Yr River: Silver Creek Reach: Eastern Reach 3 Profile: PF 1 Table 3 48" Culvert Capacity 4947 Culvert 1

Reach	River Sta	Profile	E.G. US.	W.S. US.	E.G. IC	E.G. OC	Min El Weir Flow	Q Culv Group	Q Weir	Delta WS	Culv Vel US	Culv Vel DS
			(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(ft)	(ft/s)	(ft/s)
Eastern Reach 3	5881 Culvert #1	PF 1	63.04	63.04	63.04	62.12	70.01	123.93		4.60	9.86	14.45
Eastern Reach 3	5881 Culvert #2	PF 1	63.04	63.04	63.04	62.12	70.01	123.93		4.60	9.86	14.45
Eastern Reach 3	5497 Culvert #1	PF 1	58.50	58.49	58.50	57.64	60.01	124.50		8.69	9.91	18.51
Eastern Reach 3	5497 Culvert #2	PF 1	58.50	58.49	58.50	57.64	60.01	124.50		8.69	9.91	18.51
Eastern Reach 3	4947 Culvert #1	PF 1	46.13	46.13	46.13	44.21	46.01	154.16	97.35	20.13	12.27	16.11

HEC-RAS Plan: Existing 10 Yr River: Silver Creek Reach: Eastern Reach 3 Profile: PF 1 Table 4 32" Culvert Capacity 4947 Culvert 1

Reach	River Sta	Profile	E.G. US.	W.S. US.	E.G. IC	E.G. OC	Min El Weir Flow	Q Culv Group	Q Weir	Delta WS	Culv Vel US	Culv Vel DS
			(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(ft)	(ft/s)	(ft/s)
Eastern Reach 3	5881 Culvert #1	PF 1	63.04	63.04	63.04	62.12	70.01	123.93		4.60	9.86	14.45
Eastern Reach 3	5881 Culvert #2	PF 1	63.04	63.04	63.04	62.12	70.01	123.93		4.60	9.86	14.45
Eastern Reach 3	5497 Culvert #1	PF 1	58.50	58.49	58.50	57.64	60.01	124.50		8.69	9.91	18.51
Eastern Reach 3	5497 Culvert #2	PF 1	58.50	58.49	58.50	57.64	60.01	124.50		8.69	9.91	18.51
Eastern Reach 3	4947 Culvert #1	PF 1	46.19	46.19	46.19	46.19	46.01	67.45	182.04	20.19	12.05	12.05


Silver Creek
Geom: Marsh Sediment Removal Flow: 2 Year - No Tailwater Figure 19
Silver Creek Salt Marsh
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Elevation (ft)
6
5
4
3
2
1
0
-1
-2
Hope Street
Pedestrian Bridg...
0
500
1000
1500
2000
2500
Main Channel Distance (ft)

Item C1.

water surface level in the marsh is 0.10 feet lower than the existing condition, setting the elevation at 4.9 as opposed to 5.0 feet. As shown in Figure 20, the bike path bridge does flood.

Ten-Year Design Storm

As shown in Figure 21, the ten-year design storm without a tailwater condition does not overtop the bike path or Hope Street with the sediment removed. The level in the marsh does rise to 5.25 feet which is 0.05 feet above the existing condition elevation. When the tailwater condition is simulated, neither the bike path nor Hope Street are overtopped and therefore neither structure acts as a weir and the culverts are restrictions. This causes the water surface elevation in the marsh to rise to 5.74 feet which is 0.44 feet higher than the existing conditions. So Hope Street will not flood, but the level in the marsh will rise for a short period of time. This is also illustrated in Figure 22.

One Hundred-Year Design Storm

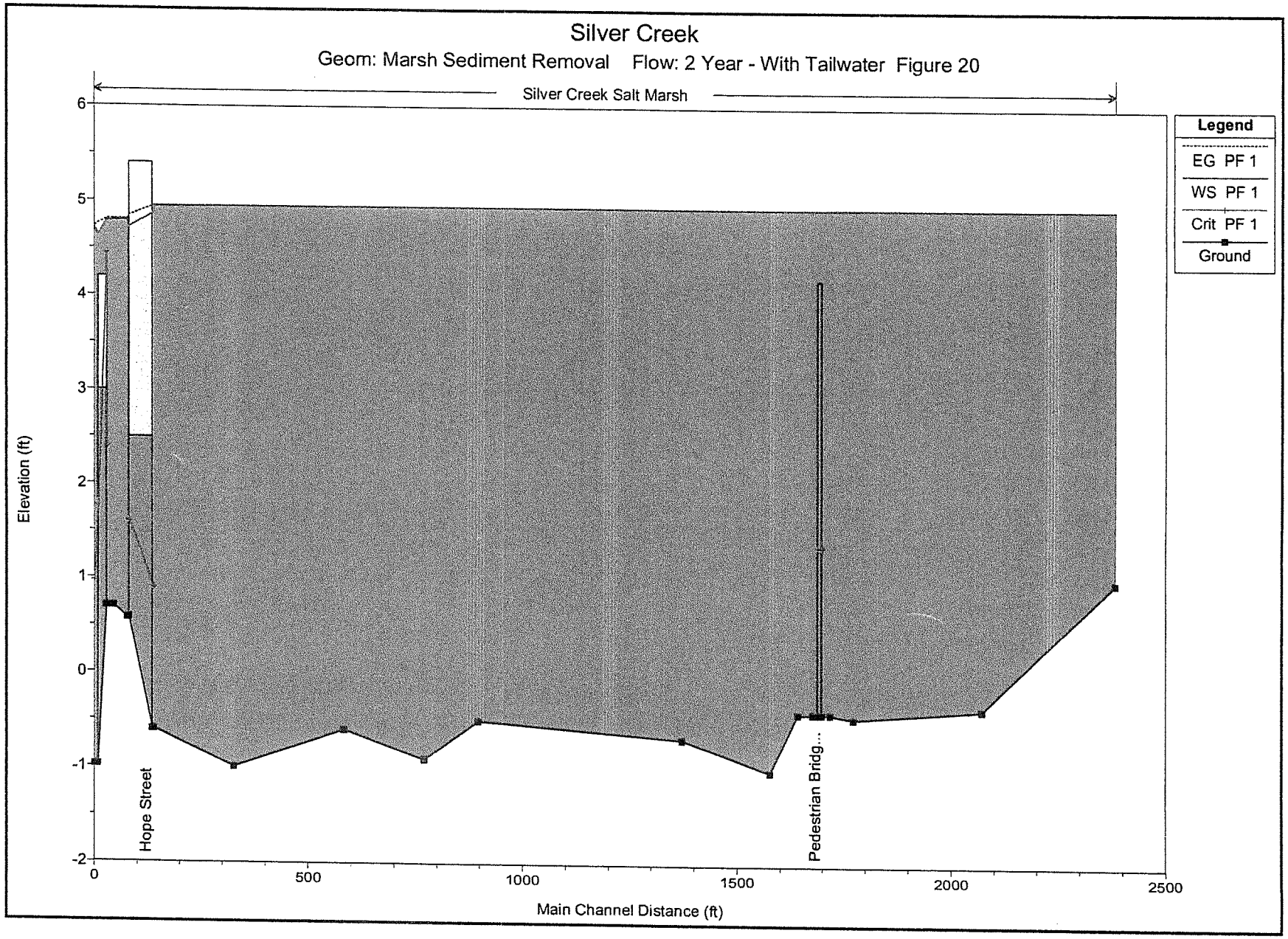
As shown in Figure 23, the flow from the one hundred-year design storm overtops the bike path and Hope Street. The water surface elevations are the same regardless of whether a tailwater condition was simulated. The elevation throughout the marsh is 6.07 feet which is 0.37 feet above the existing condition

Removing 1 foot of sediment from the marsh relieves the flooding at the bike path and Hope Street for the ten-year storm event. Hope Street floods under the existing condition for a ten-year design storm with the tailwater condition. Dredging the marsh allows for more storage and Hope Street does not appear to flood for these same conditions.

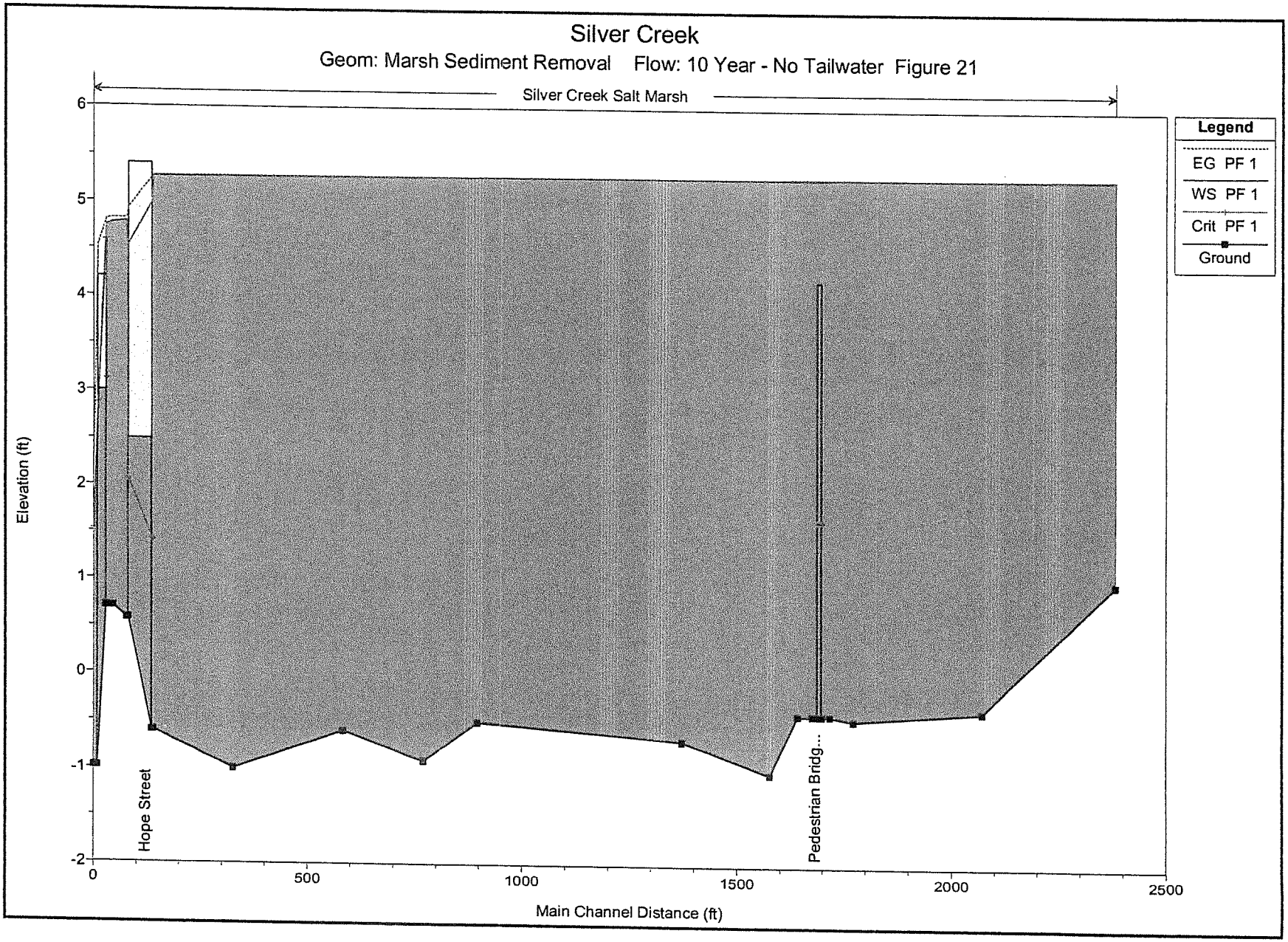
Increase Capacity of High School Culverts

DESCRIPTION

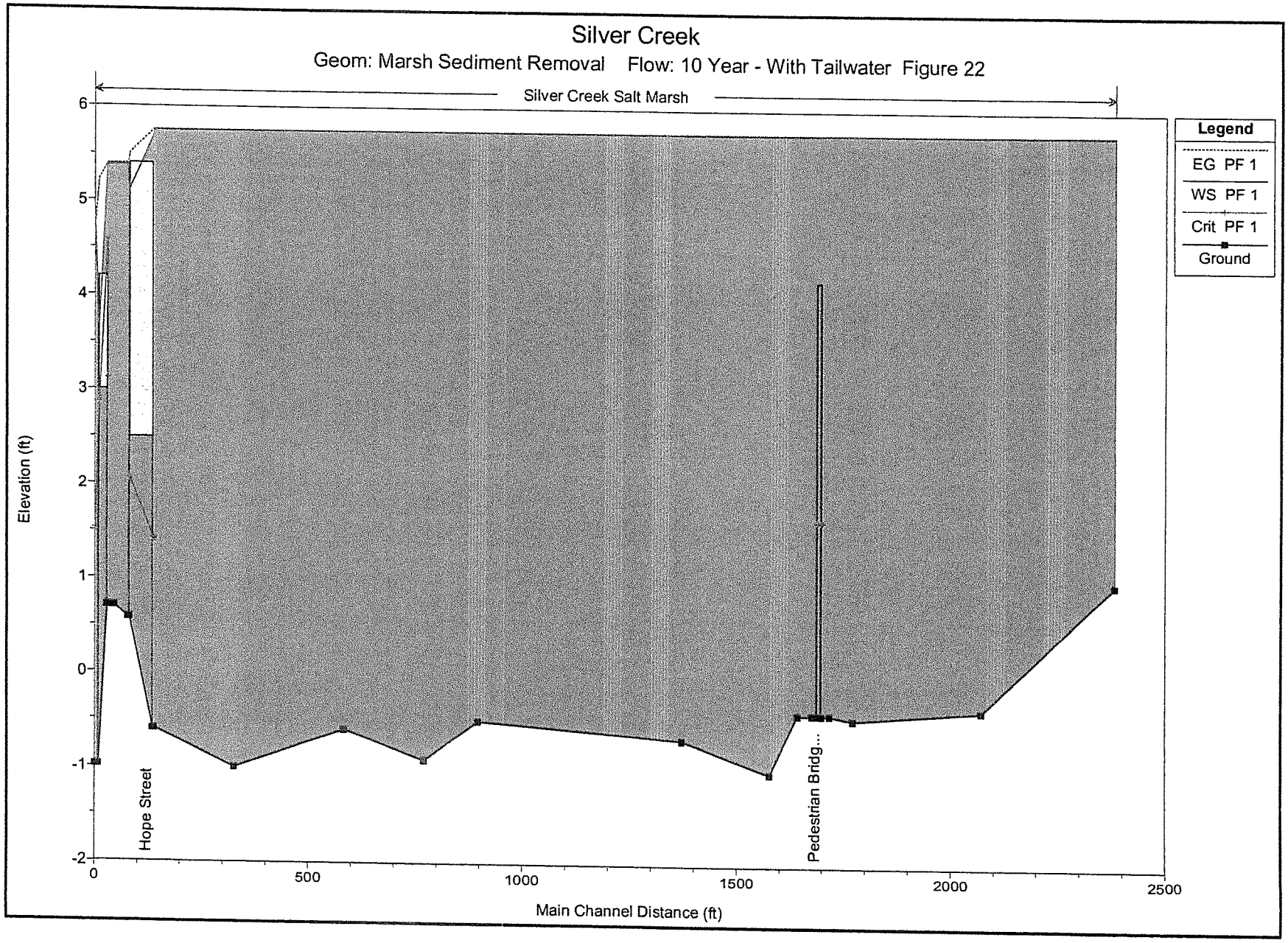
The model was used to determine what effect increasing the capacity of the culverts through the high school would have on the hydraulic characteristics of the creek in this area. Only the size of the twin 48" culverts was altered from the existing condition model. The model shows that the existing culverts are the restriction in the upstream portion of the eastern branch of the creek. Some of the flooding between Gooding Avenue and the high school could be relieved by increasing the size of the existing culverts. Once the size was increased, the impacts downstream were examined. Residents from the Town have stated that there is a flooding problem through the cemetery south of the high school and Chestnut Street.


Silver Creek
Geom: Marsh Sediment Removal Flow: 2 Year - With Tailwater Figure 20
Silver Creek Salt Marsh
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Elevation (ft)
Main Channel Distance (ft)
Hope Street
Pedestrian Bridg...
6
5
4
3
2
1
0
-1
-2
0
500
1000
1500
2000
2500

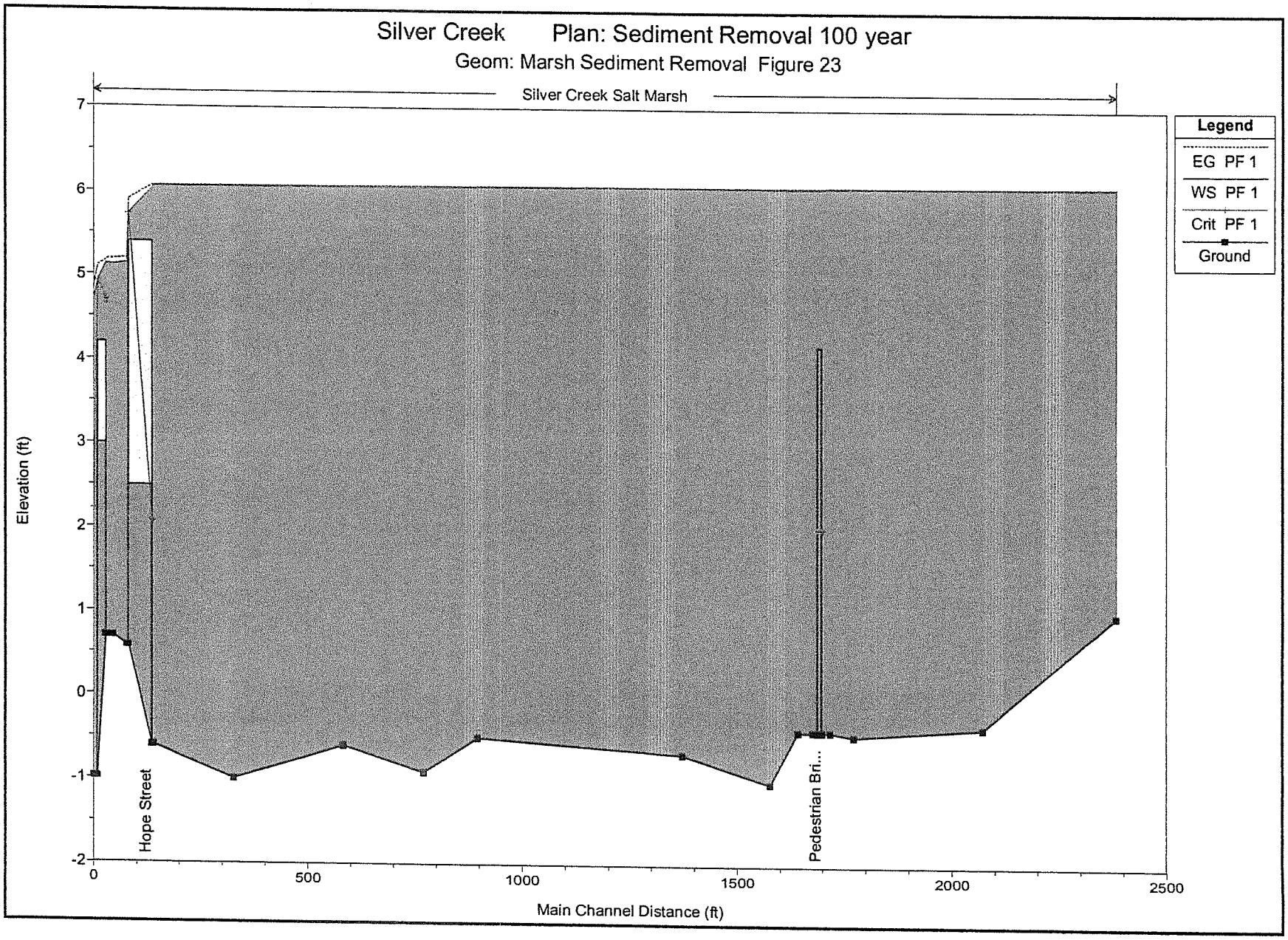
Item C1.

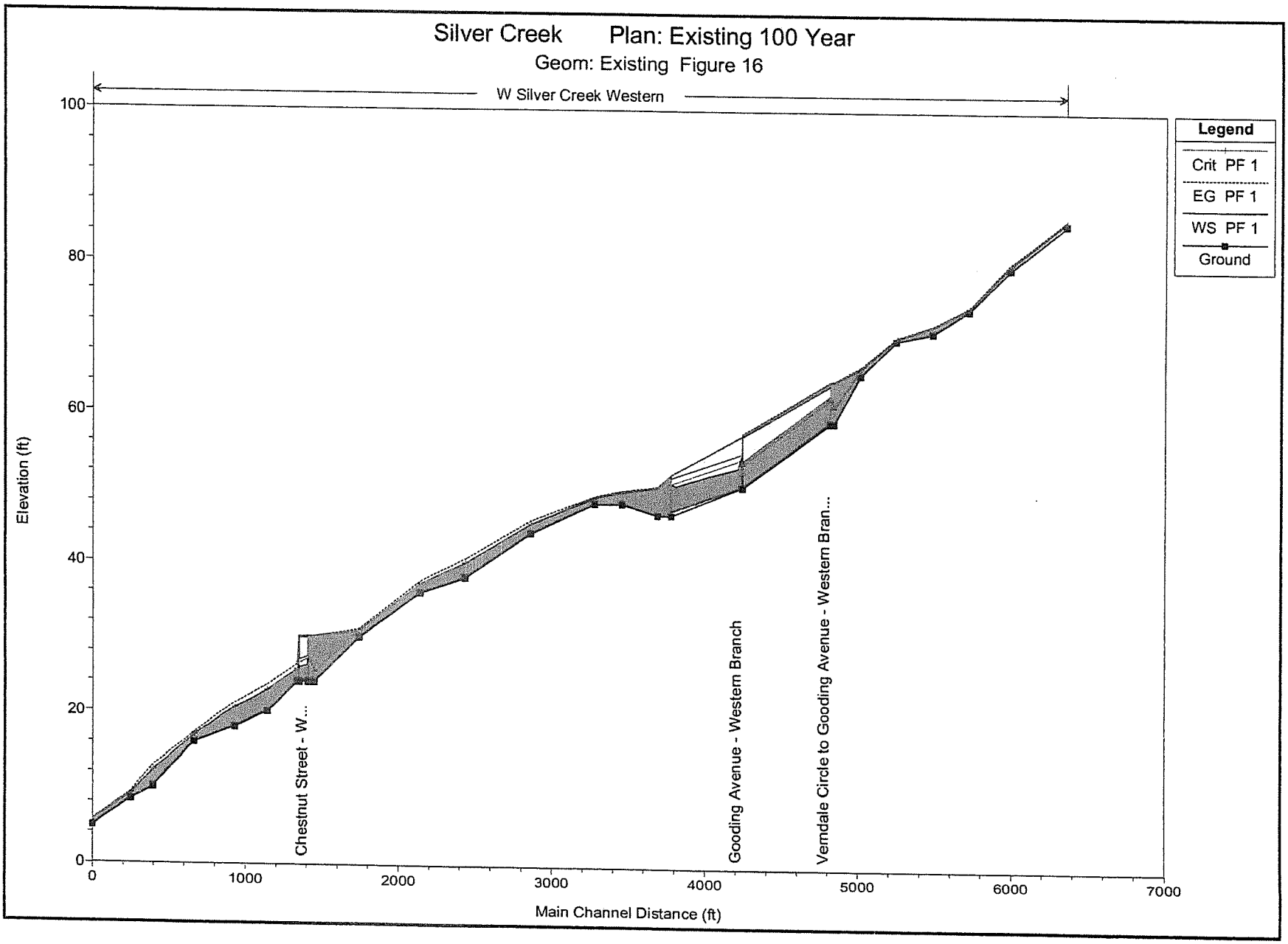

Silver Creek
Geom: Marsh Sediment Removal Flow: 10 Year - No Tailwater Figure 21
Silver Creek Salt Marsh
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Elevation (ft)
6
5
4
3
2
1
0
-1
-2
0
500
1000
1500
2000
2500
Main Channel Distance (ft)
Hope Street
Pedestrian Bridg...

Item C1.


Silver Creek
Geom: Marsh Sediment Removal Flow: 10 Year - With Tailwater Figure 22
Silver Creek Salt Marsh
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Elevation (ft)
6
5
4
3
2
1
0
-1
-2
Hope Street
Pedestrian Bridg...
0
500
1000
1500
2000
2500
Main Channel Distance (ft)

Item C1.


Silver Creek Plan: Sediment Removal 100 year
Geom: Marsh Sediment Removal Figure 23
Silver Creek Salt Marsh
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Elevation (ft)
Main Channel Distance (ft)
Hope Street
Pedestrian Bri...
7
6
5
4
3
2
1
0
-1
-2
0
500
1000
1500
2000
2500


Silver Creek Plan: Existing 100 Year
Geom: Existing Figure 16
W Silver Creek Western
Legend
Crit PF 1
EG PF 1
WS PF 1
Ground
Elevation (ft)
Main Channel Distance (ft)
Chestnut Street - W...
Gooding Avenue - Western Branch
Vemdale Circle to Gooding Avenue - Western Bran...
0
20
40
60
80
100
0
1000
2000
3000
4000
5000
6000
7000

Item C1.

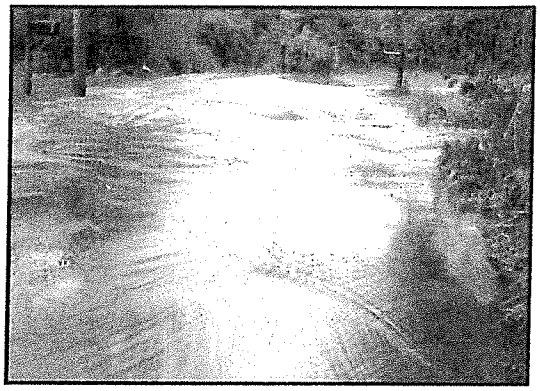
Problem Areas

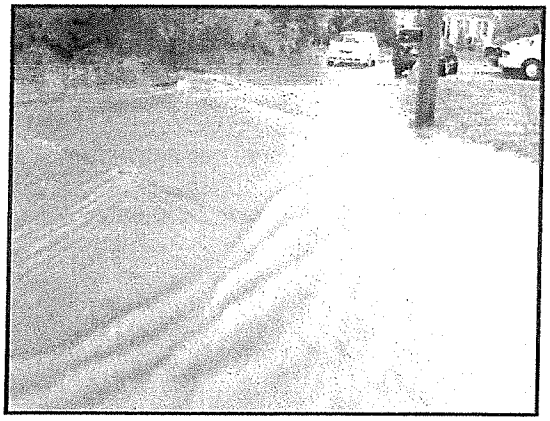
Both the Hydrocad analysis and the HEC-RAS model identified several areas of particular concern, where the yields exceeded the existing pipe capacities and the areas require extensive attention. While these six (6) areas are by no means the only areas with flooding problems within the watershed, they have been identified as those most problematic, both from an analytical point as well as what was discussed at the Public Meeting.

Area 1 – Elbow Street/Waterman Avenue

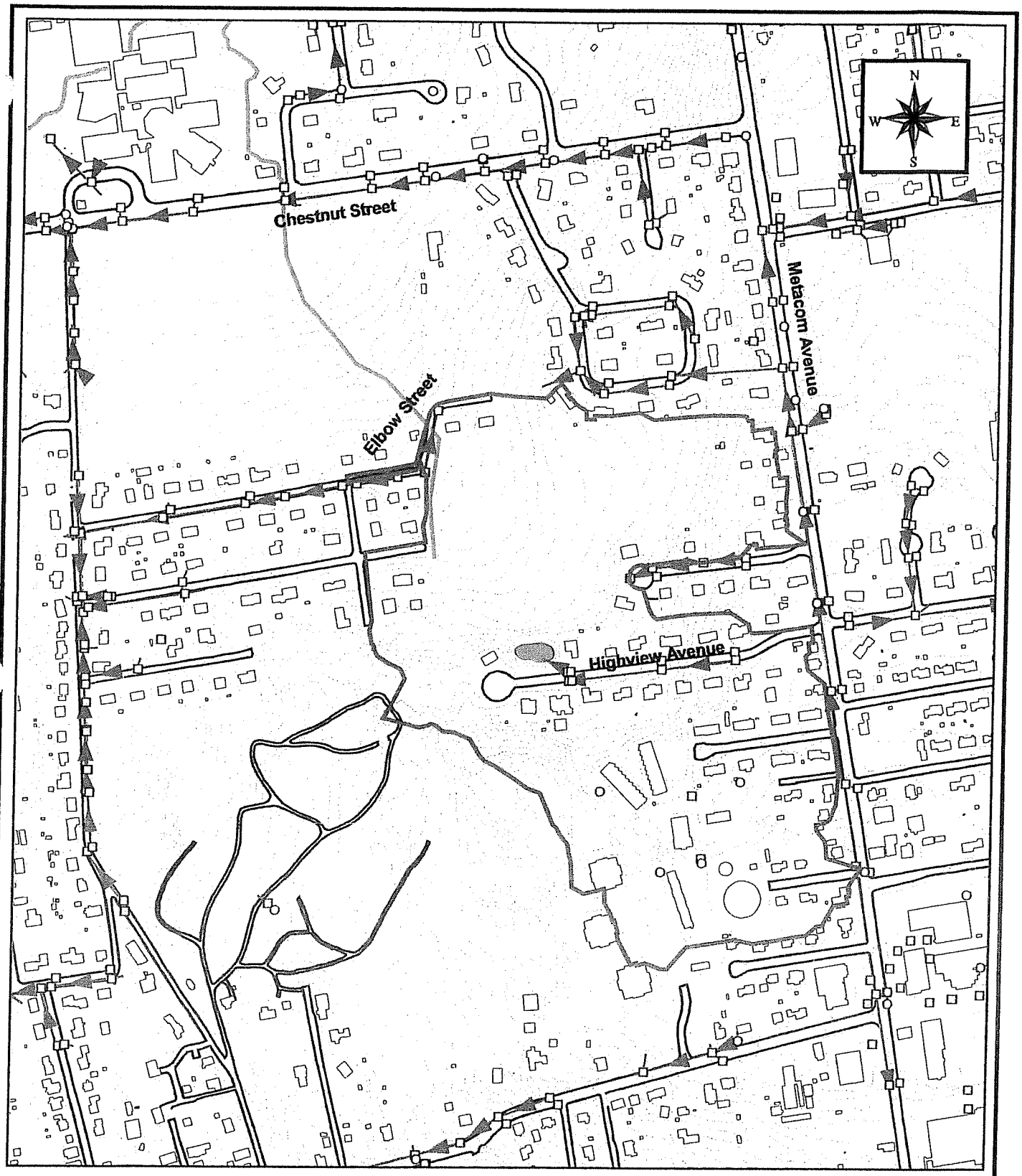
Existing Conditions

Elbow Street is an extension of Waterman Avenue, located east of Sherry Avenue. As shown in Figure 25, this 44-acre subwatershed area receives runoff from the south and east of Elbow Street, from Jane Lane, Highview Drive, Francesca Lane, Kennedy Court, Carr Lane and a portion of Hattie Brown Lane and King Street. A small detention pond was constructed at the end of Highview Drive. The pond was originally designed to retain the increase in runoff from the new subdivision only, and was not designed to detain the flows it is receiving from other areas upstream. This detention pond is discussed further in Area 4 – Highview Drive.





That issue aside, the runoff from the pond and other overland flow is directed to Elbow Street in a drainage channel, or as an intermittent stream, where it was designed to flow under Elbow Street to a wetland area north and west of the roadway. However, the existing 12" CMP under Elbow Street is crushed or collapsed, according to a report by Caputo and Wick, further reducing the capacity. The roadway is flat in this area, with a low point near the culvert. The stormwater runoff tops the roadway and flows across the pavement, as shown in the photographs.



Legend

Existing Drain Pipes

Problem Area Watershed

Town of Bristol
Rhode Island

Silver Creek

NOT TO SCALE

Figure 25

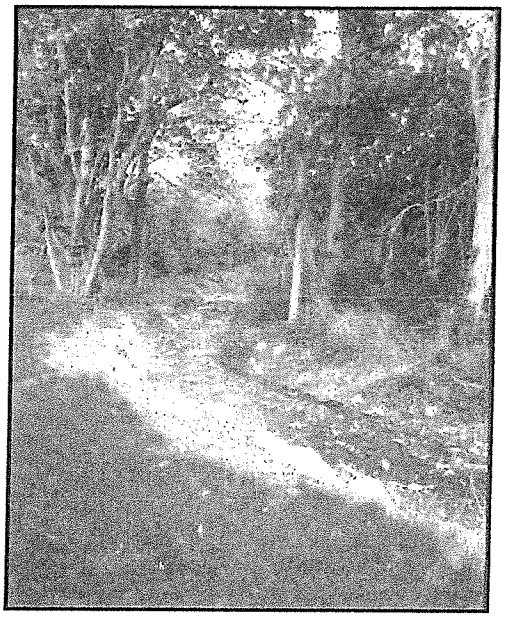
Elbow Street/
Waterman Avenue

Inspection of the basins on Elbow Street revealed that there was silt and water in most of the structures. Our calculations show that the flow to this area in the 2-year storm is approximately 30 cfs, and 60 cfs for the 10-year storm. The collapsed pipe results in the stormwater overtopping the pavement and entering the wetland via a swale along the northwesterly side of the road. It should be noted here that information from the Caputo and Wick report was used in our calculations as the pipe and invert information was not available due to sediments in the structures.

The Town has recently advertised and awarded a contract to replace the existing 12" CMP pipe with a new 18" HDPE pipe and a new flared end section to capture the intermittent stream flowing from south to north. It is anticipated that this work will be completed in the Fall 2007. This pipe will increase the capacity and provide improvement during minor storm events. However, our calculations show that this area will remain subject to flooding during major storms without additional improvements.

Recommended Improvements

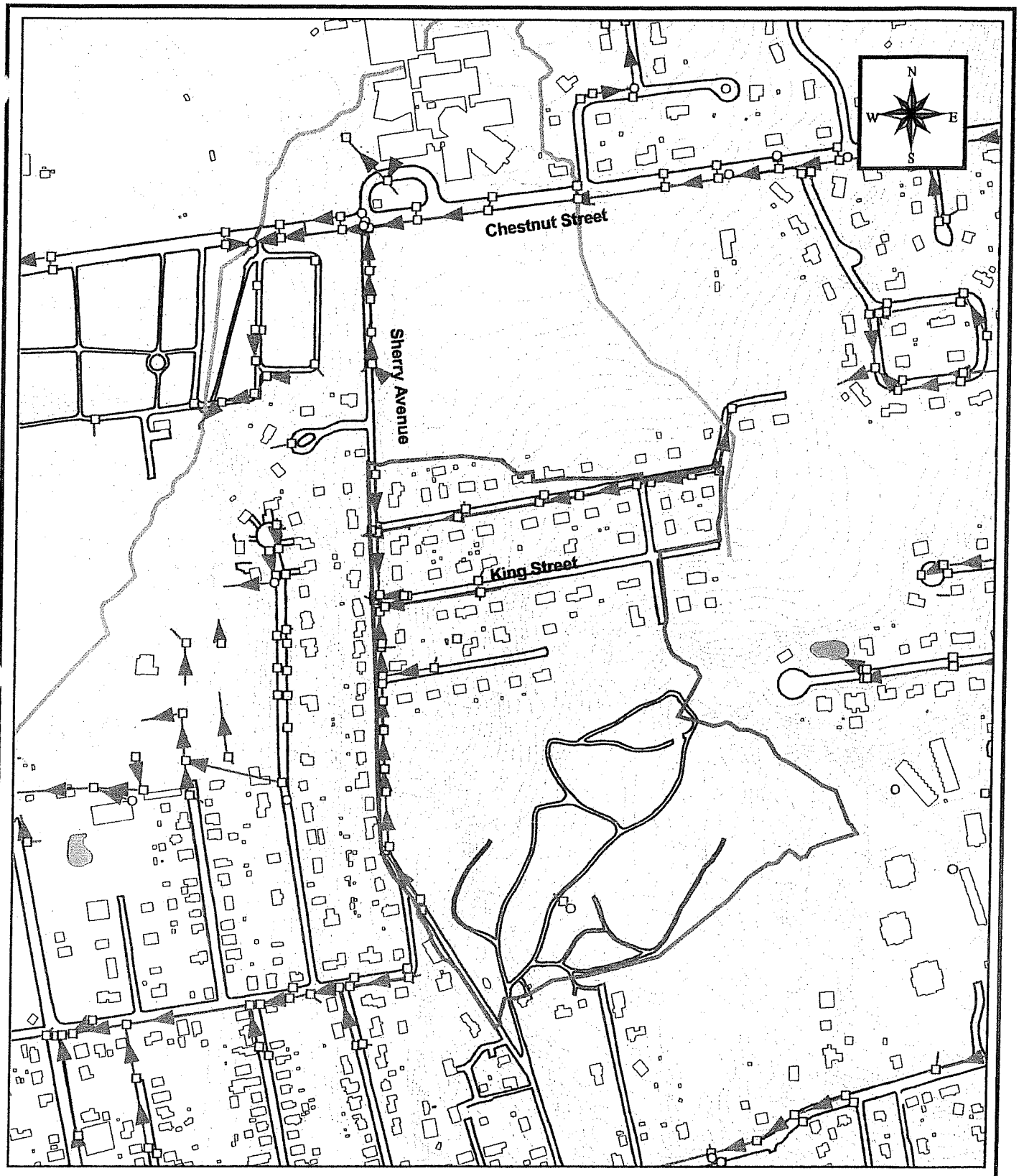
Because of the large rate of runoff generated from the areas east of Elbow Street, it is suggested that the Town attempt to identify possible property available for stormwater retention. Enlarging the existing detention pond on Highview Drive may alleviate some of the flooding downstream. Although the plans call for the existing 12" pipe to be replaced with an 18" HDPE pipe, our calculations indicate that 25 cfs is currently flowing across the pavement, and would require the capacity of a 30" pipe. This project should be considered a long-term goal as part of a complex upgrade of the drainage pipes from Elbow Street to Chestnut Street and through the cemetery.



Area 2 – Sherry Avenue

Existing Conditions

Sherry Avenue is a north-south roadway which provides an alternate route to Wood Street and the down town area from Chestnut Street (See Figure 26). Located opposite Mount Hope High School, it borders the Saint Mary Cemetery to the west, and town-owned land to the north. The remaining length of the roadway, from Silver Creek Court south is residential. There is a closed drainage system in Sherry



Legend

Existing Drain Pipes

Problem Area Watershed

Town of Bristol Rhode Island

Silver Creek

NOT TO SCALE

Figure 26

Sherry Avenue

Avenue, with approximately 500 feet of the roadway draining toward Chestnut Street. The remaining roadway collects flows from the closed drainage systems in King Street and Lugent Lane, and conveys the flow to Varnum Street via a 16" corrugated metal pipe in a prescriptive easement area. However, our calculations indicate that these pipes are undersized and the drainage structures are ineffective in collecting the runoff, resulting in overtopping of Sherry Avenue flooding local properties and Varnum Avenue to the west. The existing outfall, west of Varnum Avenue, flows to a stone swale, which in turn flows through a manmade pond on the DaPonte property. Although it appears that the Elbow Street and Waterman Street drainage system would be connected to the closed drainage system in Sherry Avenue, because of the crushed pipe under Elbow Street, and pipes with negative slopes, our analysis shows that minimal (if any) runoff from Elbow Street reaches Sherry Avenue, and therefore, the 44-acre subwatershed area was analyzed separately using Hydraflow.

Our field inspections revealed that 21 of the drainage structures were filled with sediment, and one structure was filled with water. Many of the pipes do not have sufficient capacity to convey the 2-year storm. The result is that the stormwater runoff floods Sherry Avenue, and then runs down the hill to Varnum Avenue, and through private property before entering the east branch of the Silver Creek.

The photos illustrate the private pond on Mr. Seraphin DaPonte's property, under dry conditions and flooded conditions.

Proposed Improvements

It is recommended that the existing closed drainage system on Sherry Avenue be replaced with a new closed drainage system consisting of RCP and new precast concrete structures with oversized sumps. The existing 16" outfall pipe should be replaced with a 30" RCP to provide sufficient capacity in a 10-year storm to safely convey the runoff from Sherry Avenue through the existing easement area to the discharge point. A new BMP (i.e. Vortechs or similar structure) is recommended prior to the cross-country run to remove sediments. Although it would appear that we are increasing the flow to this outfall, the increase in runoff should be negligible as the flows currently reach this point via overland (flooded) flow, due to the steepness of the properties and the well-manicured lawns. The proposed state would result in reduced flooding of private property as well as reduced erosion and removal of sediment. In addition to the 450 linear feet of 30" RCP, approximately 570 LF of 24" RCP and 1,050 LF of 18"RCP would replace the existing undersized pipes in Sherry Avenue and intersecting sidestreets. The remaining 300 LF of 12" corrugated pipe would be replaced with 12" RCP at slopes sufficient to increase the capacity to accommodate the 10 year storm. New structures and grates would provide sufficient storage for sediments while reducing the depth of stormwater on the roadway surfaces. The outfall would be located so as to pose no flooding to private property, with discharge to the open waters of the Silver Creek.

It is also recommended that additional storage be provided within this subwatershed area to reduce the rate and volume of water flowing downstream toward the Silver Creek. Possible areas include the town-owned land east of Sherry Avenue, and land west of Varnum Street. This land, since it currently is not town-owned, would need to be purchased for this purpose.

We have reviewed the conceptual design to place two 48" pipes within the existing Right-of-Way from Lugent Lane to Chestnut Street, with a control structure to be constructed in Chestnut Street to restrict the flow and use the 48" pipes as storage. BETA believes this design would be more costly and would require additional maintenance. In addition to the costs and maintenance issues, sending more water to the Chestnut Street system even at a reduced rate, would increase the volume of water in this already over-capacity system, resulting in greater flows as the longer peaks from the Sherry Avenue system would coincide with the peak flows coming from the High School.

Area 3 – Perry Street

Existing Conditions

As shown in Figure 27, Perry Street receives runoff from approximately 28 acres, extending from Sherry Avenue to Monroe Avenue. The grades are extremely steep (in excess of 7%), with no curbing or berm to contain the runoff within the roadway, resulting in flooding and erosion of abutting properties. The closed drainage system is ineffective with grates incapable of intercepting but a fraction of the existing gutter flow. The pipes seem to be an older system that has been modified over the years, with larger pipes being added to smaller pipes downstream, creating restrictions and surcharging basins. Pipe materials include 6" asbestos cement (AC) pipe, 24" RCP, 15" CMP, 4" cast iron pipe, and 10" vitrified clay (VC) pipe. In one instance, the capacity of a pipe is approximately 2 cfs, although the runoff is in excess of 28 cfs.

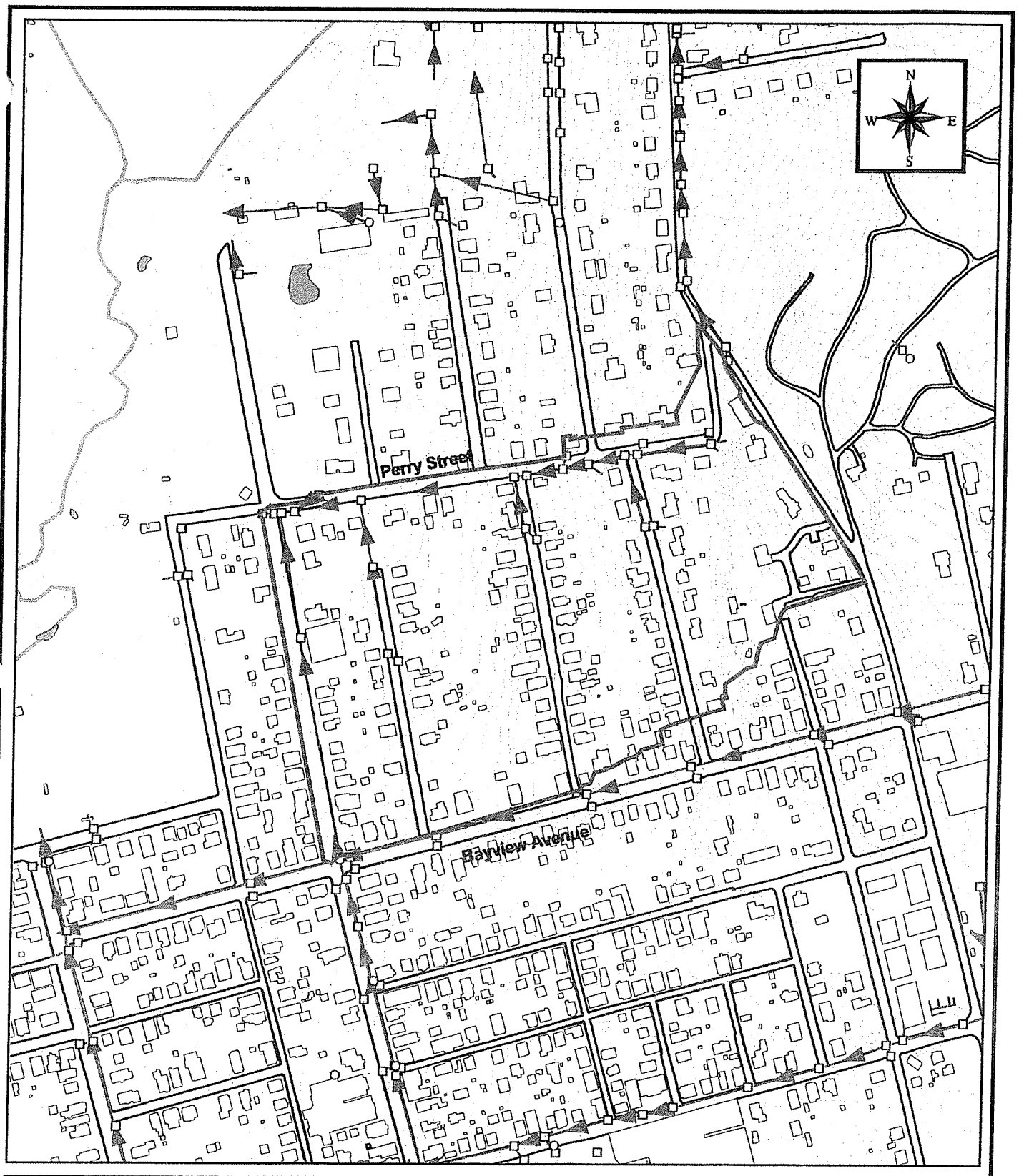
Proposed Improvements

It is recommended that a new trunkline be installed on Perry Street, gradually increasing in size from an 18" pipe to the east, to a 30" RCP near the outfall at Monroe Avenue. The lateral pipes would be replaced, requiring 180 LF of 24" RCP, 770 LF of 18" RCP, and 300 LF of 12" RCP. New structures would be proposed incorporating high-capacity double grates where warranted on the steep grades and at low points. Bituminous berm or curbing is recommended along both sides of the roadway to channelize the flows and prevent flooding of adjacent properties. Catch basins would be located upstream of all intersections and crosswalks to minimize localized flooding. High capacity grates are needed to catch the flow, reducing the splash-over velocity due to the steepness of the roadway. As this is a residential area in close proximity to schools, an alternate grate to the RI standard high capacity grate could be selected which would not create a trip hazard.

Area 4 – Highview Drive

Existing Conditions

Highview Drive is located off Metacom Avenue south of Chestnut Street (See Figure 28). This area has been mentioned as requiring improvements. The existing drainage system in Highview Drive includes a closed drainage system which is connected to the swale from Kennedy Lane and Carr Lane. Our data collection program revealed that 7 of the 8 structures on Highview Drive contained silt, and one structure surcharges during storm events. The existing system was analyzed using Hydraflow and this activity was reproduced in the model. The open channel flow from Carr Lane enters the closed drainage system via an 18" HDPE flared end section, with the connecting pipe at a 5% slope. This water rushes into the



Legend

Existing Drain Pipes

Problem Area Watershed

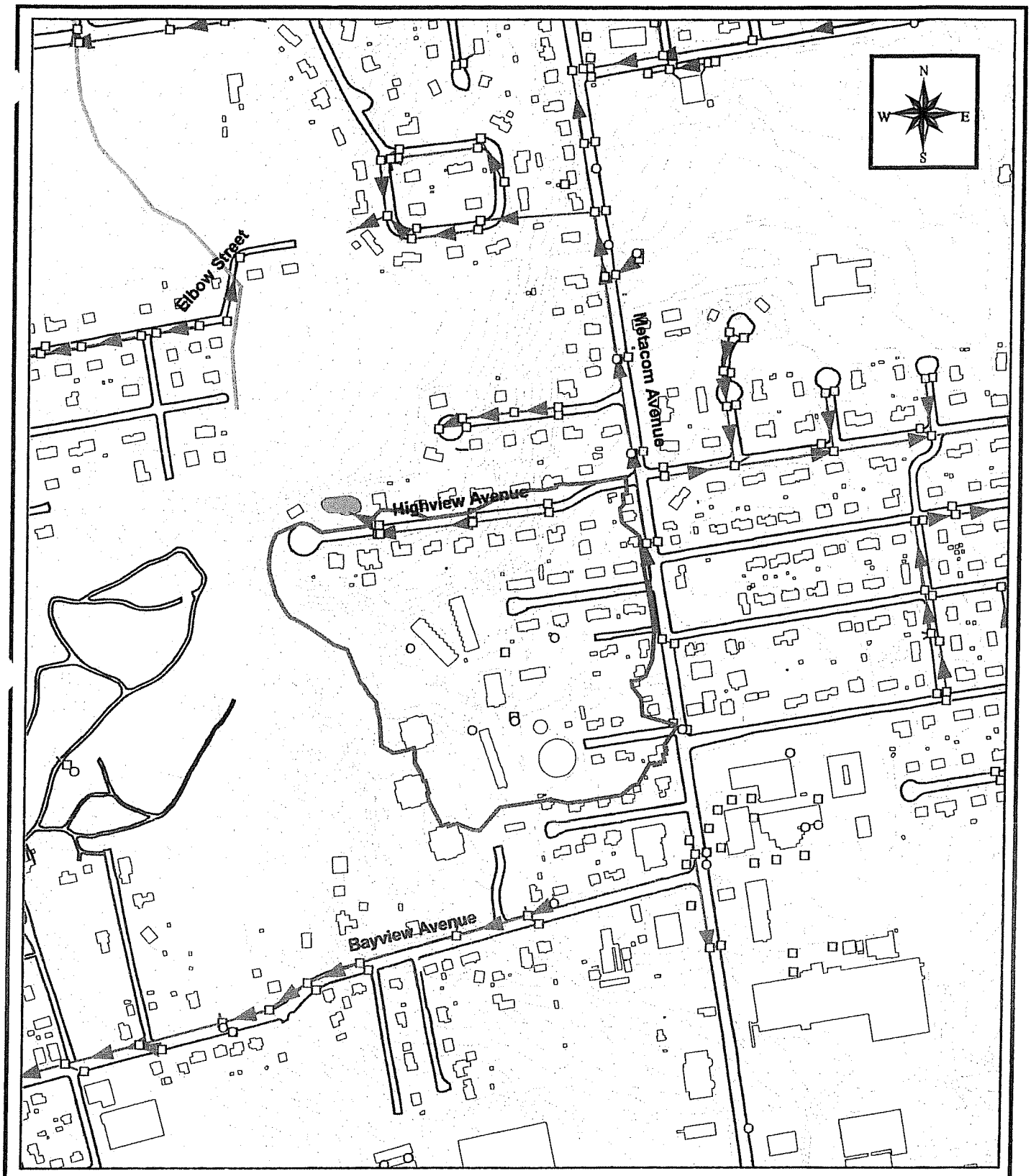
Town of Bristol Rhode Island

Silver Creek

NOT TO SCALE

Figure 27

Perry Street


N
W
E
S
Elbow Street
Metacom Avenue
Highview Avenue
Bayview Avenue
Legend
Existing Drain Pipes
Problem Area Watershed
Town of Bristol
Rhode Island
Silver Creek
NOT TO SCALE
Figure 28
Highview Avenue

closed drainage system increasing the hydraulic grade line and surcharging the system. One pipe is under capacity for the 2 and 10 year storms, while two pipes are under capacity for the 10 year storms.

A detention pond exists at the end of Highview Drive and there have been some misconceptions about the pond including that the pond is not operating properly, and modifications have been performed on the northern wall of the pond. The pond has not been properly maintained, and the overgrown vegetation obstructed the inspection of the northern wall of the basin. The basin was cleaned by the Town during the week of July 16, 2007, removing accumulated silts and vegetation from the interior of the basin. Although it was first thought to have been modified, and not effective in the retention of runoff from this closed drainage system, a visual inspection of the basin revealed that it has not been modified by man; however, approximately 24" caliper trees are growing inside the detention pond. These trees are removing a portion of the storage volume.

An assessment of the design calculations, including a review of the inlet and outlet structures, indicates that in the original design, the pond was sized to mitigate the increase in runoff, but was not sized to hold the total volume of runoff which flows into the structure during the 2, 10 and 50 year storms. The runoff from the areas south of the detention pond was designed to pass through the detention pond. BETA analyzed the basin and the calculations and determined that the decrease in storage volume results in the pond overtopping, flooding out downstream properties (Elbow Street). A more detailed review of the basin, including a survey of the existing contours and inlet and outlet structures, would reveal the extent of the decease in storage volume from the trees.

Proposed Improvements

It is recommended that the velocity of the flow from Carr Lane be reduced by increasing the pipe diameter and reducing the slope of the pipe from 5% to 1.25%. Other minor modifications include increasing one pipe from a 12" CMP to an 18" RCP, and changing the slope of a 24" pipe to increase the capacity.

As noted in the discussion of Elbow Street, it is recommended that the detention pond be reviewed to see if the size can be increased to retain or detain the volume of water which is directed to it from areas to the south. This will have a positive impact on properties downstream.

Area 5 – Jane Lane

Existing Conditions

As shown in Figure 29, Jane Lane is a looped roadway servicing approximately 20 homes off of Chestnut Street. The closed drainage system in Jane Lane is connected to the drainage system in Metacom Avenue (a State highway) via an 18" corrugated metal pipe. The flows from Metacom Avneue exceeds the pipe capacity for the 10 year storm by approximately 10%, yet the pipes in Jane Lane and connecting to Chestnut Street are insufficient to handle the 2 year storm, causing flooding within the subdivision. Also, our field inspections noted sump pumps connected to the catch basins with algae growth, indicating a chronic problem.

Proposed Improvements

It is recommended that the pipes from Metacom Avenue be video-inspected to identify possible collapse of the CMP. It is recommended that the 18" CMP be replaced with an 18" RCP, which would provide increased capacity and structural soundness. Other pipes within the roadway should be upgraded to 18" RCP, and the outlet pipe discharging to the wetland east of Elbow Street should be a 24" RCP. These improvements should alleviate the flooding in this immediate area.

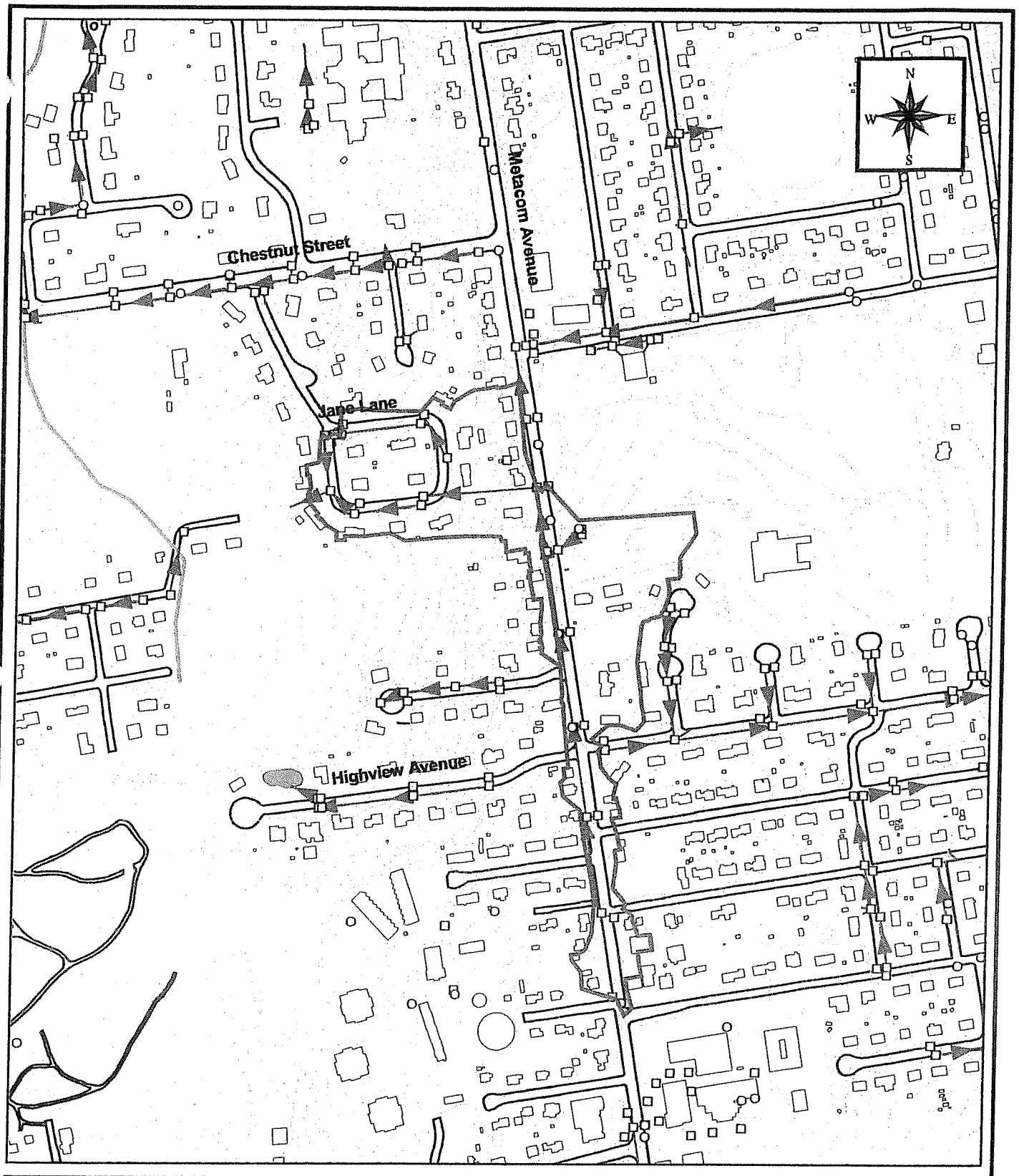
Area 6 – Paull Street/Hillside Road

Existing Conditions

This area is different from the other areas in that it is located adjacent to the Silver Creek wetlands area, and is located within an "AE Zone" as shown on the Flood Insurance Rate Map (RIRM) No. 44001C0014G. The roadways are located within a Special Flood Hazard Area, commonly referred to as the 100-year floodplain. As shown in Figure 30, there is an existing closed drainage system within the roadways consisting of approximately eight (8) catch basins, with several pipes undersized for the 2-year storm. Several of the basins are filled with silt, resulting in roadway flooding. Also, during storms, the Silver Creek and associated wetlands encroaches on the yards of the properties along Paull Street, particularly during periods of high tide when the water cannot flow out to the harbor.

Proposed Improvements

Cleaning and/or upgrading the pipes and catch basins within the roadways will reduce the roadway flooding somewhat, however, in order to alleviate the flooding from the east, additional flood storage area must be created either through dredging of the creek and marsh areas, or by constructing large retention areas in the upper reaches of the watershed.



Legend

Existing Drain Pipes

Problem Area Watershed

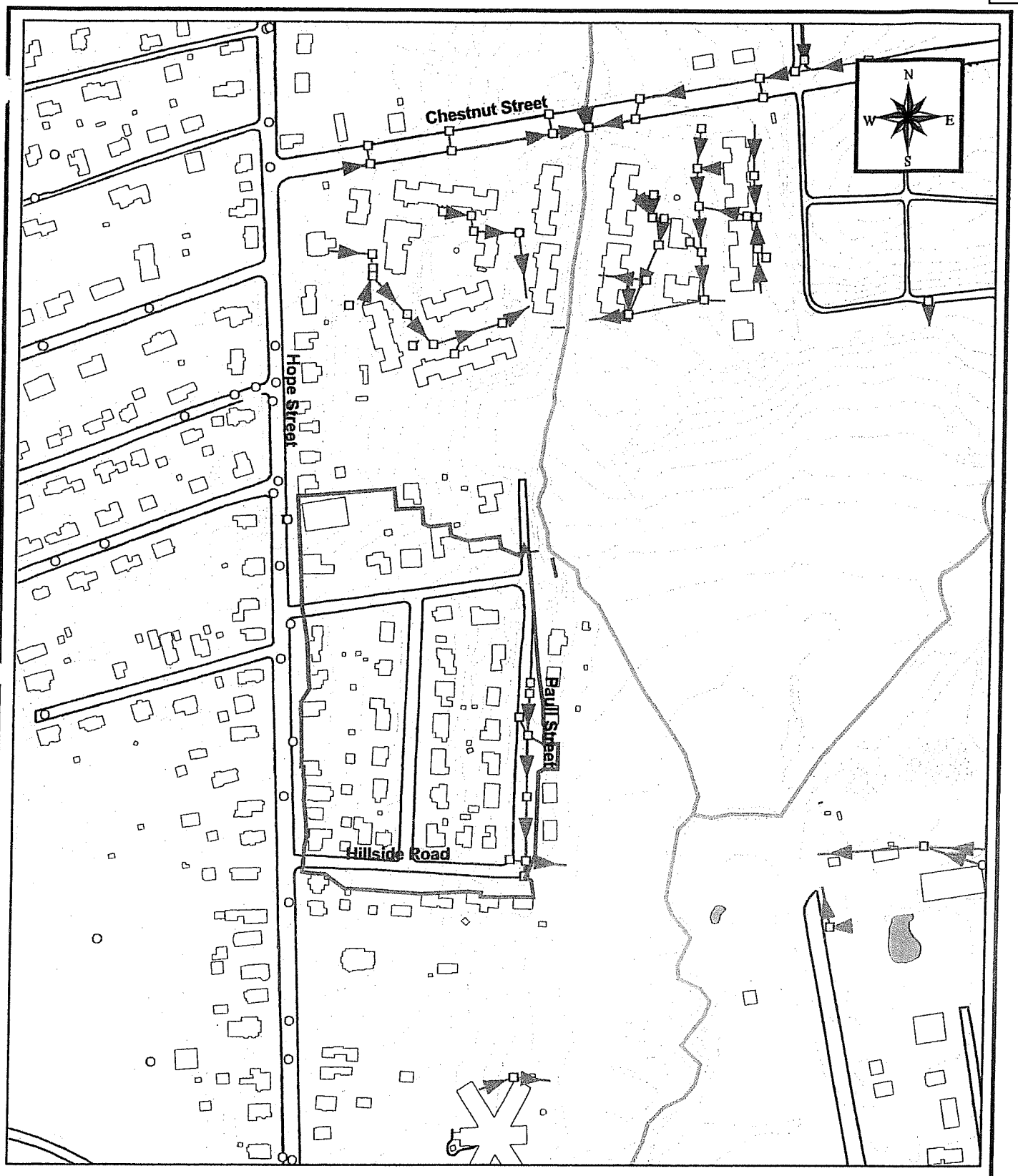
Town of Bristol
Rhode Island

Silver Creek

NOT TO SCALE

Figure 29

Jane Lane



Legend

Existing Drain Pipes

Problem Area Watershed

Town of Bristol Rhode Island

Silver Creek

NOT TO SCALE

Figure 30

Paull Street/ Hillside Road

Additional Problem Areas

At the October 17 workshop, a resident from the area north of Perry Street, and west of Varnum Street noted a problem that had not previously been identified: This area is at the base of a very steep grade. Several of the roadways do not have catch basins in them, and the runoff flows down the hill via private property, at a high velocity. When the runoff reaches the bottom of the hill, where the ground is relatively flat prior to entering the creek, water accumulates and ponds in the roadway and on lawns. A review of the plans and a site visit resulted in the recommendation of placing new pipes and catch basins within the roadways, including Varnum Street, Baker Street and Jones Street. These pipes could be tied into the upgraded system proposed for Perry Street, as described in the report.

Silver Creek

Proposed Improvements

As the study progressed, it became increasingly clear that the solutions to reducing flooding associated with the Silver Creek would be complex. The 1,250 acre watershed was separated into 45 subwatershed areas for purposes of analysis, and the aerial mapping provided contour data to enable us to develop approximate cross sections of the creek from the outlet at Hope Street, up to the farthest reaches of the stream channels south of Tupelo Street. The storm water model identified areas where the open channel overtops roadways such as Gooding Avenue, Chestnut Street, and Hope Street near Washington Street. These restrictions upstream create localized flooding, however, if the restrictions were removed, downstream neighborhoods would receive stormwater runoff at a much quicker rate, increasing flooding associated with the tides and expanding the flood zones farther into the neighborhoods.

It is recommended that additional storage be constructed, particularly upstream of the local areas currently experiencing flooding, and on other vacant land, to retain stormwater runoff until the peak flows have safely passed and/or until the hide tide period has passed. Possible locations include along Gooding Avenue, Naomi Street, within the Mount Hope High School campus, or within the Benjamin Church property. Enlarging existing detention ponds should also be considered at locations where it has been determined that doing so would reduce downstream flows.

Another means of increasing flood storage throughout the watershed is to remove and properly dispose of materials that have been dumped in wooded areas near outfalls. While signs are posted at several

locations where roadways dead-end near the stream and associated wetlands, this illegal activity continues, with the dumping of grass clippings, leaves, small trees and other organic materials. Removing this fill and re-establishing the outfalls with proper erosion controls (i.e. riprap) would enable local drainage systems to function better while reducing the sediments entering the drainage system.

Dredging the open waters section of the creek, from Hope Street to the point where the two branches converge behind Paull Street would provide additional storage, and allow for further salt water intrusion into the area, re-establishing the marsh and killing off the invasive fresh-water plants. This project would require an Assent from the CRMC, and would be a costly undertaking, but would have the greatest impact on the flooding problems experienced throughout the watershed.

The primary restriction identified through the model and the connection of individual closed drainage systems is related to the 48" corrugated metal pipe through the middle of the cemetery. The existing pipe has corroded, and the pipes under Chestnut Street are one-third filled with large rocks, most likely from displaced riprap upstream, reducing the capacity, and creating a restriction of the flows coming toward Chestnut Street from the high school and Gooding Avenue to the north, and Elbow Street to the east.

This would require a major undertaking, to replace the existing 48" corrugated metal pipe through the cemetery with 2-48" RCP pipes, or a concrete box culvert of sufficient capacity to convey the 100-year storm. Since upgrading the pipes under the high school is not a feasible option, a new pipe should be constructed in Chestnut Street to intercept the flow from the Elbow Street area, eliminating the crossing under Chestnut Street east of the high school. This will reduce the flow to the wetland behind the high school and reduce the flows through the high school property. Picking up the flow at Chestnut Street and carrying it down to the cemetery pipe would allow for additional pipes to be constructed under Elbow Street, to alleviate flooding during the major storm events without adverse effects downstream. This project would be a major undertaking, requiring permitting with CRMC and RIDEM, but would have the greatest impact on the watershed.

The other project which would also result in tangible improvements to the area would be to upgrade the pipes on Sherry Avenue and the intersecting sidestreets to convey the 10 year storm to a suitable discharge point where the outfall does not flood private properties. Intercepting the flow on Sherry would relieve the flow of surface water onto the St. Mary Cemetery property as well.

RECOMMENDATIONS

1. The Town should develop a Capital Improvements Plan to upgrade drainage systems within the Silver Creek Watershed that are currently under capacity. These pipes should be capable of carrying the runoff from at least a 10-year storm with no surcharge or overtopping of local roadways. Also as part of this Capital Improvement Plan, new detention/retention ponds should be constructed where practical to reduce flows downstream and increase flood storage throughout the watershed. Care must be taken when determining the order in which the improvements occur to make sure areas downstream have sufficient capacity to convey the increased runoff without damage to properties downstream.

2. Many of the problems identified in the easterly portion of the watershed are associated with runoff received from Metacom Avenue. As this is a State highway, the Town should approach RIDOT to try to get them to participate in the upgrading of several of these closed drainage systems to reduce flooding on local streets.

3. The Town should actively enforce the "No Dumping" policy at all areas within the Silver Creek Watershed. Residents should be made aware of this policy, including the ramifications of illegal dumping from both an environmental standpoint as well as from the enforcement angle. This education can be accomplished through the Public Meeting process as well as through local newspapers, flyers, etc.

4. The Town should implement Best Management Practices (BMPs) at the municipal discharges to reduce sediment loading into the channel. The suggested BMPs to reduce sediment, also known as total suspended solids (TSS) would be swirl concentrators, such as a Vortechnics® System. These systems have proven to reduce a net annual target of 80% TSS, if designed and sized properly, and maintained.

5. The Town should undertake a project to dredge the lower open water sections of the Silver Creek, to re-establish the salt marsh and increase available flood storage. This would allow for the large flows due to storms to flow out to Bristol Harbor more efficiently, resulting in a better eco-environment for the marsh and reduced flooding for property owners.

Cost Estimates

BETA has prepared preliminary cost estimates for the projects requiring replacement/installation of pipes or BMPs. Detailed breakdowns are included in the Appendix.

Sherry Avenue: Replace existing storm drains with pipes and drainage structures with capacity to convey the 10 year storm, with Vortechs : $675,000.

Perry Street: Install bituminous berm along pavement edge, replace existing drainage system with new pipes and catch basins, and incorporate high capacity grates: $550,000.

Highview Drive: Minor modifications to the existing closed drainage system, and possible increase in size of the existing drainage pond: $100,000.

Jane Lane: Replace selected pipes to increase capacity: $150,000.

Paul Street: Upgrade selected pipes: $120,000.

Chestnut Street: Install new 48" pipe in Chestnut Street, and replace existing 48" pipe with box culvert through cemetery: $1.1 million

Elbow Street: Install new pipes and erosion control, to be installed as same project as Chestnut Street: $80,000.

Other recommendations that should be implemented as part of the annual maintenance of stormwater facilities include catch basin cleaning, removal of sediments from channels, and removal of dumped organic materials (i.e. grass clippings, trees, etc.). These are acceptable maintenance activities that do not require permits from RIDEM or CRMC, and will increase available storage and extend the life of the existing systems while improving water quality.

TOWN OF BRISTOL
COMMUNITY DEV.

2026 JAN 23 AM 10: 30

SUPPORTING MATERIAL FOR

Spinard's Presentation before the Bristol Planning Board

Public Meeting on Proposed Gooding Ave. Hotel January 8, 2026

For Peer Engineer Review

There is a serious flooding problem downstream of the location of the proposed hotel

Table of Contents

The facts are:

- There is a bad flooding problem downstream of the proposed development that affects neighborhoods, Mount Hope High School, Gooding Avenue, Chestnut Street and Hope Street. (see pictures)
- The flooding issue is a concern of the neighborhood and Town, as expressed in the Petition signed by over 100 residents, and 35 opposition letters to RIDEM granting a wetland alteration permit. (see letters)
- One of the major functional values of wetlands is flood storage and mitigation of downstream flooding. (see slides)
- The Town of Bristol had commissioned a flood study, *Silver Creek Drainage Study*, Bristol, RI (Beta Engineers-Scientists, November 2007) to identify the flooding problem and recommend mitigation measures

  (see attached Study)

Infiltration

Infiltration used by the Applicant and agreed by RIDEM to reduce the volume of flood flow

Table of Contents

- **Copy of infiltration statement by Applicant "Stormwater Management Report."**
- **Copy of RIDEM Engineer Review 6/30/2023**

Soil Textural Classification and Infiltration Rate

Table of Contents

- NRCS Soil Survey and Soil Description and Test Pit Location
- 2.0 Site Conditions 2.1 Soils Stormwater Management Report (DiPrete)
- Pittstown Soil Sample Photographs from test pit
- Soil testing sieve analysis
- Sieve analysis results
- Infiltration Rates based on *RI Stormwater Design and Installation Standard Manual,* Table 5.3 Design Infiltration Rates for Different Soil Textures
- 3.5.1 Soils Stormwater Management Report (DiPrete) "soil has a texture of sandy loam
- RIDEM review of SITC soils (same as Applicant used) 6/10/2015
- Soil classification of Pittstown and infiltration for new high school Stormwater Management Report (Pare Corporation June 2025)

Errors within HydroCAD stormwater system model

Table of Contents

- Slide Stormwater Model System
- Slide Modeling Stormwater Management System HydroCAD
- Slide Runoff Hydrographs
- HydroCAD Routing Diagram comparing DiPrete and Recreated Models
- Summary HydroCAD analysis DiPrete 100-year storm event
- Summary HydroCAD analysis Recreated100-year storm event
- Slide Model Shows Error Results when using the new infiltration rate of 0.27 in/hr
- Slide explanation of Error Messages
- Warning messages explained
- Detailed printout recreated HydroCAD analysis 100-year storm event with revised infiltration rate (0.27 in/hr)

Downstream Analysis

Table of Contents

- Slide - Known Flooding Problems and Coincident Peaks requiring a Downstream Analysis
- Slide – Possible Coincident Peaks
- Pertinent sections of the *RI Stormwater Design Manual and Installation Manual* related to Downstream Analysis

Downstream Analysis – Wrong Method completed by Applicant

Table of Contents

- Summary of RIDEM request for DiPrete to perform a Downstream Analysis
- RIDEM review by Engineer dated 1/04/2016 requesting downstream analysis
- RIDEM review by Engineer dated 12/12/2017 requesting downstream analysis
- DiPrete's response to RIDEM review by the Engineer dated 01/23/2018, requesting downstream analysis
- RIDEM review by Engineer dated 3/12/2018 (missing from RIDEM Wetland File) requesting downstream analysis
- DiPrete's response to RIDEM review by the Engineer dated 04/10/2018, requesting downstream analysis
- RIDEM review by Engineer dated 7/12/2022 requesting downstream analysis
- DiPrete's response to RIDEM review by the Engineer dated 1/04/2023, requesting downstream analysis
- Reach analysis using HydoCAD for downstream analysis
- RIDEM review by Engineer dated 06/30/2023 accepted DiPrete's analysis
- Graphic representative of Uniform and Non-Uniform Flow
- Section of HydroCAD Stormwater Modeling System Manual indicating that the HydroCAD is not to be used for determining constant river flow and flood elevations
- Comment on DiPrete HydroCADreach model results

Downstream Analysis

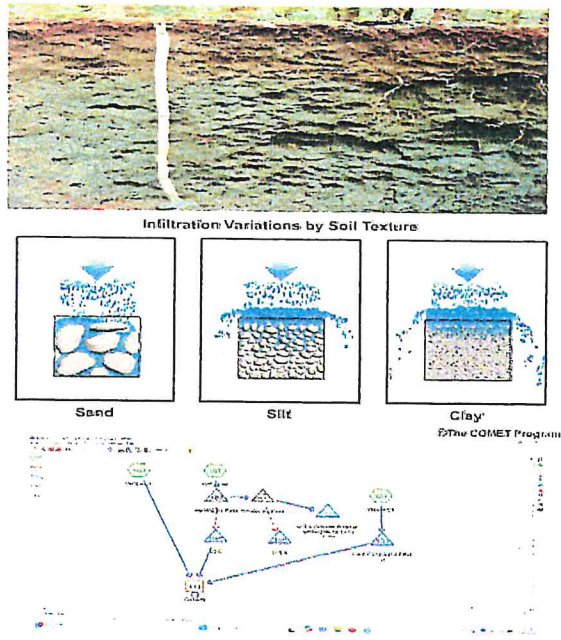
- Downstream Analysis – HEC RAS
- Slide HEC RAS (River Analysis)
- Slide – Natural Streams Characteristics
- Slide – HEC RAS Silver Creek Cross Section
- Slide – HEC RAS Silver Creek Cross Section
- The Standard Step Procedure in HEC RAS
- HEC RAS Abbreviations
- Sample HEC RAS analysis printout
- Slide Silver Creek Flood Examination (Spinard)
- Silver Creek Flood Examination Report

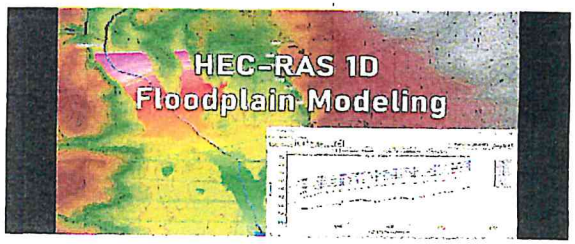
Slide Storm Chamber SC-740 is being discontinued

Technical Deficiencies

It is my opinion that the submitted Application's Stormwater Management Report has technical deficiencies that the Planning Board should consider before the Project moves forward.

- Wrong Identification of the Soil Textural Classification
- Incorrect Infiltration Rate
- Errors within the HydroCAD stormwater system model
- Improper Downstream Analysis Examination
- Discontinue use of *StormTech SC-740* infiltration chambers





Item C1.

There is a serious flooding problem downstream of the location of the proposed hotel

Table of Contents

The facts are:

- There is a bad flooding problem downstream of the proposed development that affects neighborhoods, Mount Hope High School, Gooding Avenue, Chestnut Street and Hope Street. (see pictures)
- The flooding issue is a concern of the neighborhood and Town, as expressed in the Petition signed by over 100 residents, and 35 opposition letters to RIDEM granting a wetland alteration permit. (see letters)
- One of the major functional values of wetlands is flood storage and mitigation of downstream flooding. (see slides)
- The Town of Bristol had commissioned a flood study, *Silver Creek Drainage Study*, Bristol, RI (Beta Engineers-Scientists, November 2007) to identify the flooding problem and recommend mitigation measures

  (see attached Study)

Proposed Gooding Avenue Hotel

The Facts

RAISE THE RED FLAG

The facts are:

- There is a bad flooding problem downstream of the proposed development that affects neighborhoods, Mount Hope High School, Gooding Avenue, Chestnut Street and Hope Street.
- The flooding issue is a concern of the neighborhood and Town, as expressed in the Petition signed by over 100 residents, and 35 opposition letters to RIDEM granting a wetland alteration permit.
- One of the major functional values of wetlands is flood storage and mitigation of downstream flooding.
- The Town of Bristol had commissioned a flood study, *Silver Creek Drainage Study*, Bristol, RI (Beta Engineers-Scientists, November 2007) to identify the flooding problem and recommend mitigation measures

Forested Wetlands, Silver Creek

Item C1.

TOWN OF BRISTOL, RHODE ISLAND

TOWN COUNCIL
Nathan T. Calouro, *Chairman*
Mary A. Parella, *Vice Chairwoman*
Antonio A. Teixeira
Timothy E. Sweeney
Aaron J. Ley

Council Clerk
Melissa Cordeiro

December 8, 2023

Department of Environmental Management
Office of Water Resources -Freshwater Wetlands Program
Attn: Martin D. Wencek
235 Promenade Street
Providence, RI 02908

Subject: Comments re Application #22-0264 - Council Concerns and Additional Information

Dear Mr. Wencek;

I am writing on behalf of the Bristol Town Council to bring to your attention certain matters discussed during our recent council meeting on December 6, 2023, regarding DEM Application #22-0264. It was noted that the applicant asserted the town's support for the application; however, the Council wishes to clarify that the Town has neither taken a position in favor of nor against the said application.

The Council places great importance on the due diligence process in the review of both local and state board approvals. It is imperative to ensure compliance with regulations and to safeguard the interests of the community. Therefore, we find it necessary to communicate with the Department of Environmental Management (DEM) to underscore our concerns and share pertinent information.

During the council meeting, it was emphasized that flooding concerns on wetlands must be carefully considered in the application process. To assist in your evaluation, we have enclosed a copy of the Silver Creek Drainage Study for the Silver Creek watershed, which provides a comprehensive analysis of the area and highlights relevant factors.

Additionally, the Council believes it is crucial to bring to your attention the recent approval of a school bond by the town. This bond will facilitate the construction of a new high school in close proximity to the location covered by Permit #22-0264. When conducting your assessment, please consider the potential effects of the proposed development on the future high school in this location, as identified in the Bristol Tax Assessor Map Plat 117 lots 3 & 5.

In light of these factors, the Council kindly requests that the DEM thoroughly evaluates all aspects of Application No.#22-0264, including the concerns raised about flooding, the information provided in the Silver Creek Drainage Study, and the potential impact on the construction of a new school in the area.

We appreciate your attention to these matters and trust that the DEM will conduct a comprehensive review to ensure the protection of our community and the environment.

Please do not hesitate to contact us if you require any further clarification or additional information.

Thank you for your time and cooperation.

Sincerely,

Melissa Cordeiro
Town Clerk/Council Clerk

cc: Town Administrator
Director of Community Development

x/c Docket 1/17/2024

December 7, 2023

To: RIDEM Freshwater Wetlands Program
Martin Wencek, Program Supervisor
From: The Bristol Conservation Commission
Re: Application 22-0264

Dear Mr. Wencek;

The Bristol Conservation Commission has reviewed the noted application to alter freshwater wetlands in order to build a hotel on Gooding Avenue in Bristol. After extensive review, we have concluded we cannot support Application 22-0264 as currently proposed.

In our view, the proposal to build on almost 50,000 square feet of swamp and wetlands would seriously and negatively impact the function and value of that wetland, as it will no longer protect the subject property, nor properties downstream (Silver Creek runs just to the East). Significantly, one of those properties is the location of the current and future Mount Hope High School.

The extensive engineering work proposed, in our view, doesn't mitigate wetlands impact, it effectively destroys that portion of the wetlands it will be constructed in. It is also not clear that, with storm frequency and intensity increasing, it will sufficiently handle extreme events. The potential for the man-made system to be regularly overwhelmed would create an ongoing hazard for downstream properties.

We have, therefore, concluded that the risk of this alteration, effectively a "re-architecting" of nature, to adversely impact a wetland and surrounding properties is far greater than any benefit it may promise. Protection of our wetlands, and their benefits, is of paramount concern. We are very concerned this proposal not only doesn't protect or even "alter" a wetland, it destroys a large portion of it and, with it, will cause more problems downstream.

Respectfully,

The Bristol Conservation Commission
Tony Morettini, Chair

December 6, 2023

Mr. Martin D. Wencek, Permitting Supervisor
Office of Water Resources/Permitting Section
Rhode Island Department of Environmental Management
235 Promenade Street
Providence, RI 02908-5767

RE: DEM Wetland Application #22-0264 Request to Alter Wetlands on Plat 111/Lot 1 located on Gooding Avenue, Bristol, RI.
Applicant/Organization name: KenDan, LLC
Proposed Project: To build Mainstay/Sleep Inn

Dear Mr. Wencek:

This letter is written **in objection** to Rhode Island Department of Environmental Management (DEM) in issuing a permit to Alter Freshwater Wetlands on Plat 111/Lot 1 located on Gooding Avenue, Bristol, RI. The objection is based on:

"We oppose the granting of this application because it is our opinion: that it will increase the already problematic flooding in our neighborhoods; it will degrade Silver Creek …. The preservation of wetland is crucial to provide flood storage to mitigate flooding of our homes, schools, nursing facilities, and streets." (Petition Against 2023)

I have resided in Bristol my entire life, as have many of my neighbors, and have lived at 35 Dartmouth Street for more than 50 years. I am very familiar with this area of Bristol, especially the wooded wetlands, which border Andrew's Court, Dixon Avenue, and Dartmouth Street. I believe it is necessary for DEM to hear personal accounts of our wetlands and flooding problems.

The Petition in Opposition to the Proposed Development

In 2015, I submitted to DEM a Petition in Opposition to the proposed hotel on Plat111/Lot 1 with 28 signatures of my neighbors on Andrew's, Dixon, and Dartmouth. Today, I present a Petition with more than 100 signatures of neighbors who are affected by flooding and oppose the filling in and alteration of these wetlands. The petitioners are worried that a bad flooding situation will become worse with the filling in of wetlands caused by this project. My neighbors have personally expressed their concerns to me and wanted to convey them by signing the Petition (Attachment A: Petition Against 2023). In addition, the following are some of their comments of concern:

"Cutting down trees leads to flooding because these trees absorb water."

"She would like to sign the petition but is afraid DEM would put her in a floodplain making her purchase flood insurance."

"He's not only worried about flooding because of wetland filling, but the impact of the rise in sea level on flooding."

"In the storm of 2021, I experienced flooding of garage walls and flooding of basement."

"She knows the seriousness of flooding and its economic consequences particularly high insurance rates."

"Building in wetlands would never happen in Massachusetts."

"Had to run two sump pumps, and water was still going into the basement."

Gooding Avenue, Site of Proposed Mainstay/Sleep Inn

Most of this land (Plat 111/Lot 1) for the proposed development is wetlands and has been identified as such by qualified biologists hired by the Applicant and reviewed by DEM. The land east of Plat 111/Lot 1 to Metacom Avenue is mapped wetlands, and the land south of Plat 111/Lot1 to Mt. Hope High School is mapped wetlands. This Plat also borders the 100 -Year Flood Zone. (FEMA (100 Year Flood Zone Map) This wetland area is part of the Eastern Branch of the Silver Creek Watershed. (Silver Creek Drainage Study, Beta Engineers-Scientists, November 2007). Mr. Ed Tanner, Bristol Town Planner, called this watershed massive encompassing schools, nursing facilities, and about 100 homes. (Bristol Phoenix January 30, 2020. p. 3)

Wetlands Function and Values

I realize that wetlands serve a valuable function of storing rainwater and snowmelt, and for allowing the water to run at a slower rate to prevent harmful flooding. The trees and vegetation within wetlands absorb water; thus, the elimination of such leads to flooding. The wetland areas are wildlife habitats. Disturbance of the habitats forces these animals into other areas such as our yards. Our yards are not a suitable habitat for wildlife, which can affect their mortality. The wetland areas also provide for recreation, such a nature trail or controlled hunting.

Flooding Concerns Increasing

My neighborhood abuts this watershed. During heavy rains my yard, as well as my neighbors' yards are susceptible to surface ponding and flooding. We all have sump pumps to control basement flooding, but flooding still occurs. There is flooding on our streets. Moreover, what I have experienced these past few years is an increase in the intensity and occurrence of flooding. As I went around the neighborhood with the petition, neighbors expressed the same concern. What is more alarming is that there is now pooling of inches of water in our yards even after a rainstorm with a short duration. (Attachment B: Photos August 18, 2023). The soils in this area are hardpan that permits very little infiltration; thus, the rainwater just stays on the surface. Filling in wetlands, will exacerbate the problem of ponding of water in our yards. The soil can't absorb the water, the wetlands are eliminated so the rainwater must go somewhere and that

somewhere is our yards. Additionally, neighbors are reporting water in their basements, even with sump pumps working.

September 2, 2021 Major Flooding throughout the Eastern Branch of the Silver Creek Watershed

As described by Mr. Tanner, this watershed covers a good part of the interior of Bristol. (Bristol Phoenix January 20, 2020. p. 3) And as mentioned before, the proposed development lies within this watershed. The land south of the proposed development floods. Mt. Hope High School and Guiteras Elementary School flood. The river flows through a series of culverts, which restrict the passage of flood water, at Mt. Hope High School causing overflow onto Chestnut Street and thus flooding of the street. The flood waters prevent vehicles from using the roadway. Culverts under Hope Street also overflow; and the areas of Hope, Washington, and Thames Streets were under 3 to 4 feet of water. (Providence Journal September 3, 2021, p.12A) It is important to note that on September 2, 2021, we did not suffer from a storm surge at the harbor. If there were a storm surge, interior flooding within this watershed would have been far more extensive. Rivers flowing from this watershed enter Silver Creek on Hope Street, and then exit into Bristol Harbor. A storm surge and sea level rise would create a perilously wide flooding situation throughout the watershed. As one person who signed the petition said, he/she may not suffer from problematic flooding now but fears the real potential if the proposed development eliminates over 50,000 square feet of wetlands coupled with sea level rise.

Added to the damage of flooding of homes, yards, and schools is the real concern of street closures and its effect on our neighborhood. Traffic is detoured through Naomi Street, a very narrow residential roadway connecting Chestnut and Gooding Avenue. Naomi St. is the only exit for the residents of the 60 plus homes on Andrew's Court, Dixon Ave, and Dartmouth St. These streets dead end in wetland areas of Silver Creek. Traffic backup on Naomi St. poses a serious problem for immediate rescue or evacuation of my neighbors.

The Effects of altering/clearing of wetlands on Plat 111/Lot 1

In August 2021, the applicant/owner Kendan began to clear a portion of Lot 1. Trees were axed and vegetation removed. Several weeks later, on September 2, 2021, as already described, there was significant property flooding downstream of this watershed. Today, we have more basement flooding and pooling of water in our yards than ever before. Our yards have become homes to skunks, rabbits, and deer. The fox and pheasant are no longer seen.

It is our opinion expressed by the Petition, that the balance of nature has already been disturbed and our property has since experienced more flooding by the minimal clearing on Lot 1 in August of 2021. The applicant has a right to develop his/her land within the parameters of laws. However, he/she does not have the right to develop that would result in harm to others. Rhode Island's Wetland Act of 1971 recognizes the value and function of wetlands and the need to preserve them. The applicant's proposal is to alter this wetland area, and as such will cause financial hardship for property owners, erase potential recreational property, and destroy wildlife

habitats. We believe that we have already begun to witness the effects of altering this wetland area; therefore, we are very concerned about increased flooding that could occur if over 50,000 square feet of wetland is covered by impervious area.

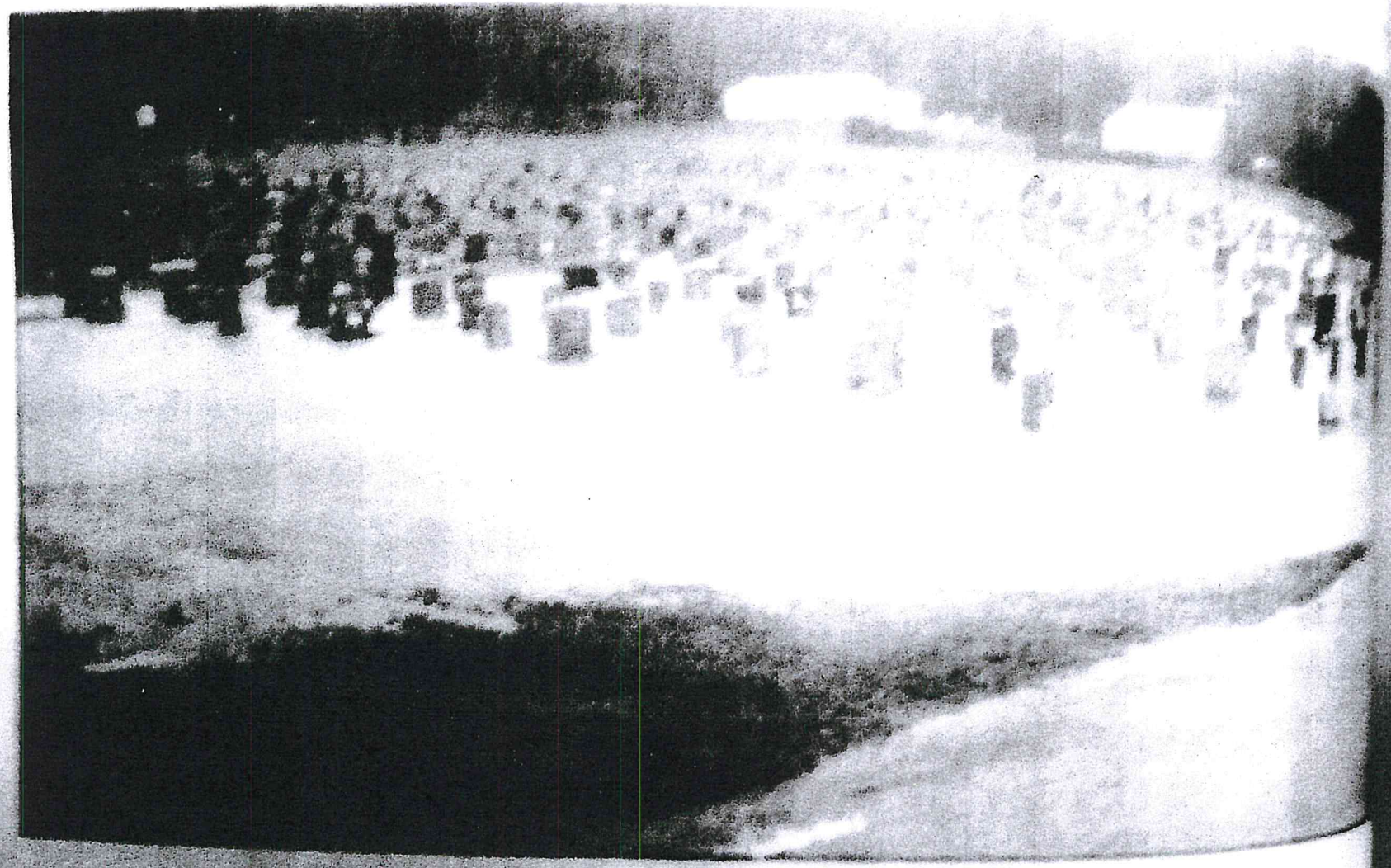
For the reasons stated above it is my opinion that RIDEM should deny the permit application #22-0264 to alter Wetlands on Plat 111/Lot 1 located on Gooding Avenue in Bristol, RI.

Sincerely,

Emily Spinard
35 Dartmouth Street
Bristol, RI 02809

Attachments: Attachment A Petition 2023
Attachment B Photographs

April 2010



St. Mary's Cemetery along Chestnut Street was swimming Tues
to traffic and barricaded for muc

Item C1.

4/2012

Chestnut Street

St. Mary's Cemetery

Flooding is a Serious Problem in Our Neighborhood

There is a severe flooding problem downstream of the proposed development that affects our neighborhood .

2021

Item C1.

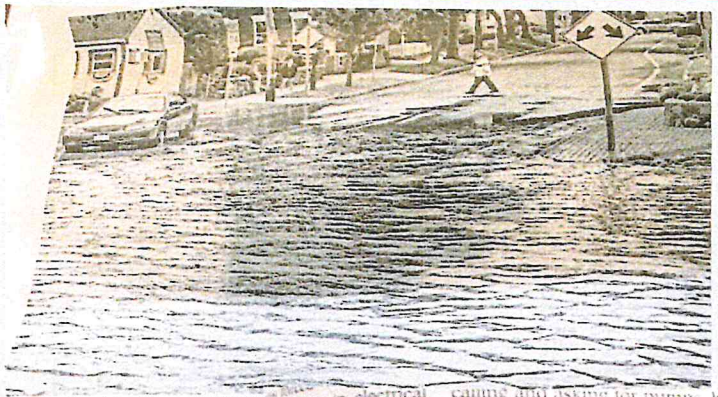
Sept. 2, 2021

Environmental Impact – Flooding in Town

It is a Town Concern

Hope Street and Gu School 2021

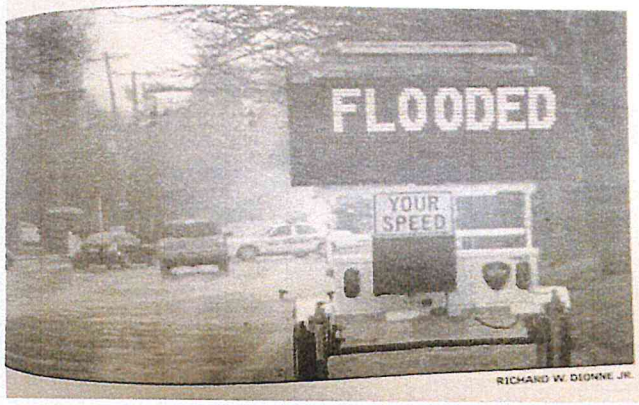
Guiteras



flooding in electrical
animated voicemail

calling and asking for pumps, but
they had none to offer and

quickly. "I could have sold 300 or
400 pumps yesterday," he said.



RICHARD W. DIONNE JR.

Non-residents were warned with a large sign on Hope Street before traveling beyond Gooding Avenue.

Storm
Sept 8, 2021

Enormous storm floods streets, stresses sewer system

worked and freshwater dilutes sewage quite a bit, the water tests done after the storm showed that, though the flooding caused elevated bacteria

the Tanyard Brook project that are done (phase 1 and 2), we saw none of the historic flooding we have seen from past

Item C1.

Aug 2023 Side yard Dartmouth St.

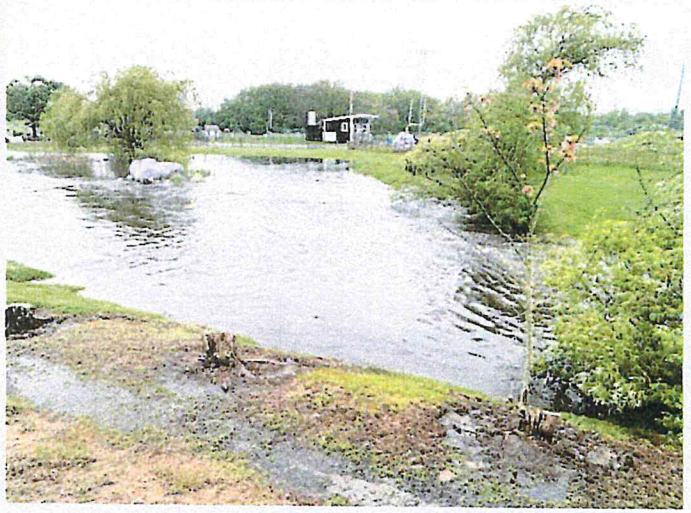
Item C1.

March 2025

Rainstorms are more frequent and with more intensity, May 15, 2025

~~Gooding Ave.~~ Chestnut St.
Car is disable in flood waters

High School



December 13, 2023

Mr. Martin Wencek, Program Supervisor
Rhode Island Department of Environmental Management
Office of Water Resources
235 Promenade Street
Providence, RI 02809

RE: Wetland Application No. 22-0264
Mainstay/Sleep Inn Hotel

Dear Mr. Wencek:

I have reviewed the recent submittal by D&M BOCA Development LLC dated May 2023 to the R.I. Department of Environmental Management seeking a Permit to Alter Freshwater Wetlands. On behalf of the residents of the neighborhoods downstream of the proposed development, it is our opinion and we respectively request that the RIDEM **deny the issuing of the wetland permit** since **essential information has not been provided and what has been provided contains incomplete and inaccurate information leading to unsubstantiated and false conclusions.**

The facts of the case have not changed since the original submittal in September 2015.
The facts of the case are:

- There is a bad flooding problem downstream of the proposed development that affects neighborhoods, Mount Hope High School, Gooding Avenue and Chestnut Street.
- The flooding issue is a concern of the neighborhood, as expressed in the Petition signed by over 100 residents (see letter to Mr. Martin Wencek, Program Supervisor from Emily Spinard dated December 7, 2023).
- One of the major functional values of wetlands is flood storage and mitigation of downstream flooding.
- The Town of Bristol had commissioned a flood study, *Silver Creek Drainage Study*, Bristol RI (Beta Engineers-Scientists, November 2007) to identify the flooding problem and recommend mitigation measures.
- The Rhode Island Stormwater Design and Installation Manual (RDEM and CRMC, 2015) has increased the rainfall amount associated with the 100-year Storm Event.
- The Petition signatures have expressed their belief that flooding has increase since the Applicant cleared the hotel site in 2018.

The Applicant needs to seriously consider the potential impacts of their development by completing a comprehensive and sincere assessment. **This assessment needs to include**:

- Using **the appropriate infiltration rate (lower)** as identified by the National Resources Conservation Service (NRCS). Also, the effect of sea level rise on increasing flood level elevations needs to be considered.

- **A flood analysis of the downstream effects** of the proposed development on the already programmatic flooding problem by using the appropriate method developed by the Army Corp of Engineers and utilized by Beta in their *Silver Creek Drainage Study.* Also, the effect of sea level rise on increasing flood level elevations needs to be considered.
-
- **An assessment of shadow effect on wetlands**. The finish floor elevation of the hotel at 81.5 feet plus 35 feet for the height of the hotel totaling 117.5 feet where the wetland elevation adjacent to the development is Elev. 66 feet.

The following facts substantiate and justify the reasons for denial:

Continues to use the wrong infiltration rate. It appears that there is a fatal flaw in the submission as the Applicant used the incorrect infiltration rate. The current NRCS Soil Interpretation Record identifies Stissing and Pittstown soil series as belonging to Group 1 that has a permeability range in inches per hour of (0.06-0.2) consistent with other hardpan soils in R.I. (Attachment A Current NRCS Soil Interpretation Record). The site is composed of Stissing and Pittstown soils and the applicant used a permeability rate of 0.52 inches per hour. **The Applicant permeability rate is much higher than what the soils can absorb. Thus, their calculations of reducing peak runoff into the swamp and Silver Creek by infiltration needs to be reexamined**. Less infiltration will cause more runoff that will affect the flooding issue. Also, the *Rhode Island Stormwater Design and Installation Manual* requires an infiltration rate of at least 0.5 inches per hour to be acceptable for infiltration Best Management Practices.

The original wetland application submitted by SITEC in February 2015 used an infiltration rate of 0.27 inches per hour. The soils on the site have not changed and DiPrete is currently using SITEC soil information in their latest wetland alternation application.

Conclusion: It is my opinion that RIDEM review the Applicant's infiltration rate and determine if it is consistent with the Current NRCS Soil Interpretation Record. Also examine if the appropriate infiltration rate was used in the stormwater analysis and determine if infiltration is a viable method for mitigating the increased runoff rate from the proposed development.

Flooding - There is a **flooding problem** downstream of the proposed development that affects the neighborhoods, Mount Hope High School, and Chestnut Street. The **problem of flooding was confirmed recently by the September 2, 2021 storm event that closed streets including Chestnut and Hope Streets, and flooded property including Mt. Hope High School, and classrooms and play areas at Guiteras School**. This storm event had 6.5 inches of rain which is by engineering standards a 25-year storm event. (Supporting document *Rhode Island Stormwater Design and Installation Manual,* RIDM and CRMC, 2015).

- *Ignored Neighbor's Concerns* - The Applicant continues to **disregard the concerns of the neighborhoods** by ignoring the flooding issues and by not responding to the serious issues identified in our previous letter to RIDEM (to Martin Wencek, dated February 10, 2018).

- *Flooding is a major concern for the Town: Recent rain and flooding on September 2, 2021* Flooding is not only a major concern within our neighborhood, the High School, and Chestnut Street but also throughout the total land area downstream of the proposed development (the eastern branch of the Silver Creek watershed). During the most recent large rain stormon September 2, 2021, flooding occurred throughout this land area. The rivers flowing through the culverts at the high school and Chestnut Street overflowed, flooded, and closed traffic onto Chestnut Street. Silver Creek at Hope Street overflowed and the areas of Hope, Washington, and Thames Streets were under 3 to 4 feet of water. Classrooms and play areas at Guiteras School were flooded. Flooding is destructive and costly for the residents of Bristol, and impacts everyone. With road closures of Chestnut and Hope Streets, the detour traffic backup onto residential streets that are not capable of handling the heavy traffic volumes. This heavy traffic volumes on the residential streets causes concerns of the residents of the neighborhoods of the inability of rescue vehicles to travel freely responding to emergency situations. (Attached B photos)

Silver Creek Drainage Study -The Town of Bristol retained Beta engineering consultants to perform a drainage study of the Silver Creek watershed. **The Beta study confirmed what everybody in the neighborhood knew: there is a flooding problem in our immediate neighborhood, the high school, Chestnut Street and areas downstream as well.** The study identified the cause and extent of the flooding in the Silver Creek watershed and recommend possible remedial actions including reserving land (upstream) to provide additional storage areas for flood surge. (Supporting document *Silver Creek Drainage Study,* Beta Engineers, November 2007).

- *Updated Drainage Study*-In 2010, Rhode Island Department of Environmental Management (RI DEM) presented a new *Rhode Island Stormwater Design and Installation Standards Manual* (subsequently amended in 2015) that revised the rainfall amounts, particularly for the 100-year storm event. **The 100-year storm event rainfall amount increased from the 2007 value of 7.10 inches, to 8.6 inches, which is the current amount.**

I created a HEC-RAS model (Attachment B *Silver Creek Flood Examination Table of Contents and Executive Summary),* similar to the Beta model in order to better understand the impact of flooding to the neighborhoods and the possible effects of the revised rainfall amounts. The hypothesis of my examination **is that since the rainfall amounts have increased, the runoff into Silver Creek will also increase.** The greater volume of water entering and being conveyed by Silver Creek will result in an increase in the flood elevations and flooded areas than those originally identified by the Beta Study.

The revised HEC-RAS model, created by my examination, showed an increase in flood elevations and flood areas along Silver Creek, without considering the effects of sea rise. The examination considered a free flow condition at the outfall into Bristol Harbor. **The HEC-RAS model demonstrates that there is an increase in flood elevations and flooded areas resulting from the increase in rainfall amount. It reinforces the concern of the downstream residents of the**

flooding problems along Silver Creek and the need for a thoughtful and comprehensive examination. The Applicant must do this same analysis using the HEC-RAS method.

- **RIDEM has requested in numerous reviews that the Applicant perform a Downstream Analysis.**
  A RIDEM review dated December 12, 2017 recognized the downstream flooding and requested that the applicant perform a downstream analysis considering the existing limitation at the twin 48"culverts at the high school. The RIDEM review request is based the *R.I Stormwater Design and Installation Standards Manual* that states when there is a known flooding problem, regardless of whether the peak runoff rates from the proposed development are decreased, a downstream analysis is still required. DiPrete response was that the drainage system, at the proposed hotel site, not only reduced the peak flow rates but also resulted in a decrease in flood volumes from pre to post conditions. This did not represent a valid response to RIDEM request (DiPrete response dated January 23, 2018 p.3).

  Since the previous response to RIDEM request for a downstream analysis was inadequate. A RIDEM review on March 12, 2018, Item 2 requested the downstream analysis and even suggested that "a downstream analysis would be to revise the existing *Silver Creek Drainage Study.* DiPrete response was that there is no increase in peak runoff, however in order to verify that peaks do not create flood rate, "we completed a rough drainage analysis….**not having the raw watershed data from Beta study**…" (DiPrete response dated May 11, 2018 p.2).

  Again, on August 1, 2022, RIDEM requested on Engineering Review Comments No. 11 that you (the Applicant) submitted analysis indicates pre and post project drainage diagrams of flows to Bristol Harbor. No analysis was provided. DiPrete response was that they completed a rough drainage analysis for Silver Creek (using the wrong methodology) **because "not having the raw watershed data from the Beta Study"** (DiPrete response dated January 4, 2023.

  RIDEM complete their review on June 30, 2023 concluding that" the designer has addressed potential downstream flooding concerns by indicating that the submitted analysis shows that the total runoff volume of runoff to the receiving wetlands will be decreased in 1, 10, and 100-year 24 hour Type III storm events". This is not consistent with RIDEM regulations concerning the requirement for a Downstream Analysis if it there is a decrease in the peak runoff rates from the proposed development.

Conclusion A Downstream Analysis should be completed. It is my opinion, that after several RIDEM reviews of the Applicant's submittals and numerous requests to conduct the analysis, using the appropriate HEC-RAS method, RIDEM accepted a useless and erroneous assessment. RIDEM accepted the Applicant excuse of "Not having the raw watershed data from the BETA study, we model the following parameters. A more detail discussion of the Downstream Analysis and the Applicants erroneous response is contained in Attachment C Downstream Analysis. It is curious why RIDEM ignored their own requirements and accepted such a useless assessment of the flooding issues.

It is important that RIDEM fully understand the Town's flooding concerns and assure that the Applicant will perform a comprehensive and detailed analysis of the effects of downstream flooding from the proposed development. Such an analysis should be consistent with applicable engineering standards and the *Silver Creek Drainage Study*.

This is particularly important, at this time, as the bond issue for $200 million was approved, by the residents of Bristol and Warren, to build a new high school. The new high school, will be located in the same general area as the existing high school, that is adjacent to Silver Creek. A major issue will be the need to control flooding not only for the new school building but also for the adjacent neighborhoods.

Accurate Erosion and Sedimentation Control Plan

The submitted (E&S) plan sheet (Sheet No. 4 Erosion and Sedimentation Control Plan) is based on the existing surface elevations, where the purposed surface condition is to raise the site two to ten feet in height (Supporting documents Grading Plan Sheet 6, Mainstay/Sleep Inn 1-4-2023). Applicant referenced a E&S Control Plan in Notes 5 and 6 (Sheet 3 of 10 title: *General Notes and Legend*) identifying that sequence and phasing of construction is required).

For example, the floor elevation of the new building is proposed to be at Elevation 81.5 feet. During construction, an infiltration area is proposed to be located just south of the building site at the existing elevation of 72 to 74 feet. The difference in elevation is almost ten feet with a horizontal separation difference of 10 feet. This could result in a very steep slope if it is really feasible to construct.

How does the Applicant proposed to build and maintain the slope? What erosion measures will be used to stabilize the slope? What E&S measures will be used when the infiltration area is being filled to grade to construct the parking lot? It is my opinion that t**his needs to be provided to show how wetlands are being protected during construction as the site is filled to a new and noticeably increase in height.**

In conclusion, it is my opinion and I respectively request that RIDEM **deny the wetland alternation permit** presented by D&M Boca Development for the proposed Mainstay/Sleep Inn Hotel since **essential information has not been provided and what has been provided contains incomplete and inaccurate information leading to unsubstantiated and false conclusions.** Thank you for your consideration of this request.

Sincerely:
Edward J Spinard
Edward Spinard
35 Dartmouth Street, Bristol RI

Attachment A Current NRCS Soil Interpretation Record
Attachment B *Silver Creek Flood Examnation*
Attachment C Downstream Analysis

LETTER TO THE EDITOR

Hotel Wetlands Permit Granted without Merit

As described by RIDEM, the proposed hotel development will alter and disturb 4,717 square feet of swamp and 45,200 square feet of perimeter wetlands. This wetland area is part of the eastern branch of the Silver Creek Watershed; wetlands provide flood storage, which helps mitigate flooding. As many of us know, a serious flooding problem is already occurring downstream of this proposed hotel site. Filling in and altering wetlands will only increase the severity of flooding for the residents of Bristol.

RIDEM required that objections to the proposal be written and "must relate to the proposed project's impacts on the functions and values provided by the freshwater wetlands to be altered."

During the public comment period, RIDEM received thirty-five (35) letters of opposition and a petition signed by over 100 residents. The correspondence included residents facing flooding problems. Just as important, the letters were authored by knowledgeable professionals: engineers, wetland specialists, geologists, and individuals with PhDs. The Bristol Conservation Committee informed RIDEM of their concern about the impact 'of building on 50,000 square feet of wetlands', and its negative effect on property downstream of Silver Creek.

Moreover, the Town Council informed RIDEM of their flooding concerns and the potential impact of the hotel development on the new high school site. The Town clearly stated that RIDEM should thoroughly examine all aspects of the flooding problems. The Town reiterated that they trust RIDEM to perform a comprehensive assessment to ensure the protection of our Town from filling in wetlands that will increase flooding.

However, RIDEM determined that the written objections did not rise to a substantive nature and stated that the proposed hotel does not represent: "a random, undesirable, and alteration of freshwater wetlands".

One can only wonder how RIDEM arbitrarily and capriciously dismissed 35 letters. It is inconceivable that such concerns/objections did not rise to the standard of a substantive nature. RIDEM did not provide any explanation. RIDEM's decision is insulting and condescending; we trusted them to conduct a comprehensive assessment and safeguard our community. The Wetland Act of 1971 was designed to protect our wetlands because wetlands protect us. RIDEM has failed us and covers its decision with: "In permitting the proposed alterations, the Department assumes no responsibility for damages…" The Town deserves to know how RIDEM arrived at this paradoxical decision.

Ted and Emily Spinard

Dartmouth Steet

(Note the Petition and Letters were submitted and are included in the Public Records for the Comfort Inn files)

Proposed Gooding Avenue Hotel

Wetland Functional Values

RAISE THE RED FLAG

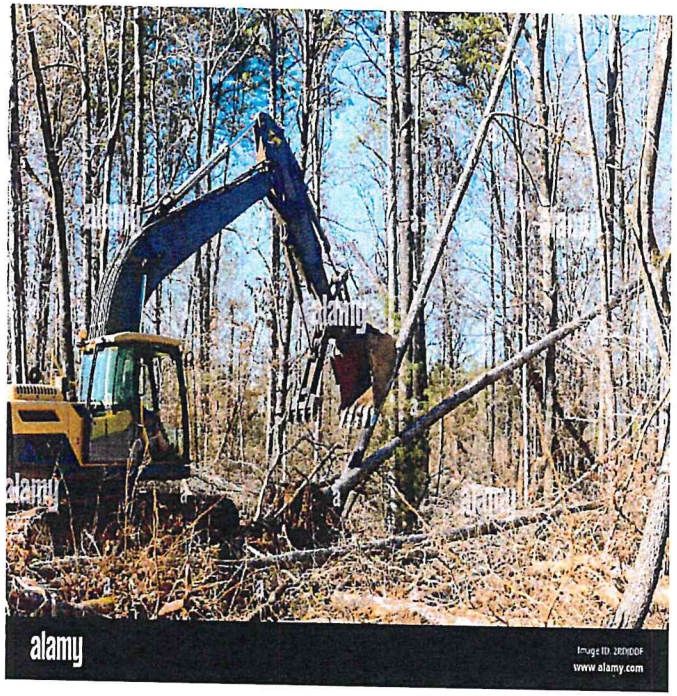
Forested Wetlands, Silver Creek

- Wetlands improve water quality by filtering contaminants and sediments

- Wetlands provide flood mitigation by storing and infiltrating floodwaters

Proposed Gooding Avenue Hotel

Wetlands Functional Value



The proposed hotel will result in the loss of **4,717** square feet of swamp and approximately **45,2000** square feet of perimeter wetland. (RIDEM) Public Notice of November 22, 2023)

- Filling in wetlands destroys their functional value, which requires artificial means to try to replicate what nature has created

Item C1.

Soil Textural Classification and Infiltration Rate

Table of Contents

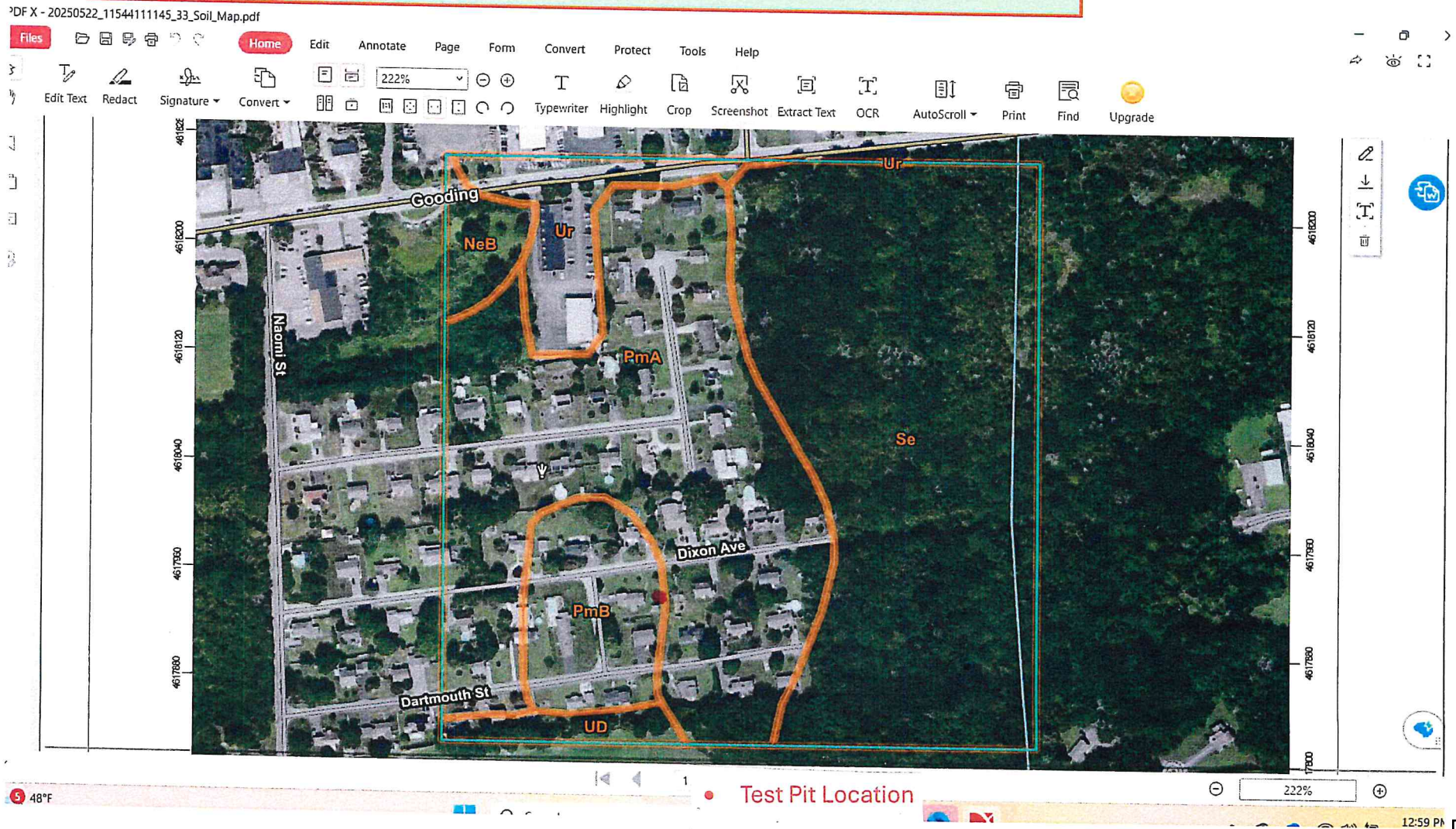
- **NRCS Soil Survey and Soil Description and Test Pit Location**
- **2.0 Site Conditions 2.1 Soils Stormwater Management Report (DiPrete)**
- **Pittstown Soil Sample Photographs from test pit**
- **Soil testing sieve analysis**
- **Sieve analysis results**
- **Infiltration Rates based on *RI Stormwater Design and Installation Standard Manual,* Table 5.3 Design Infiltration Rates for Different Soil Textures**
- **3.5.1 Soils Stormwater Management Report (DiPrete) "soil has a texture of sandy loam**
- **RIDEM review of SITC soils (same as Applicant used) 6/10/2015**
- **Soil classification of Pittstown and infiltration for new high school Stormwater Management Report (Pare Corporation June 2025)**

Proposed Gooding Avenue Hotel

Determining Soil Texture

NRCS Soil Survey

RAISE THE RED FLAG



Item C1.

Soil Description -Pittstown

RAISE THE RED FLAG

NRCS
Natural Resources Conservation Service

The soil layer is very dark grayish-brown, about 8 inches thick. The subsoil is 20 inches thick, dark yellowish-brown and olive-brown, silt loam that is mottled in the lower part. The substratum is olive-gray, mottled, silt loam to a depth of 60 inches or more.

The permeability of this soil is slow in the substratum

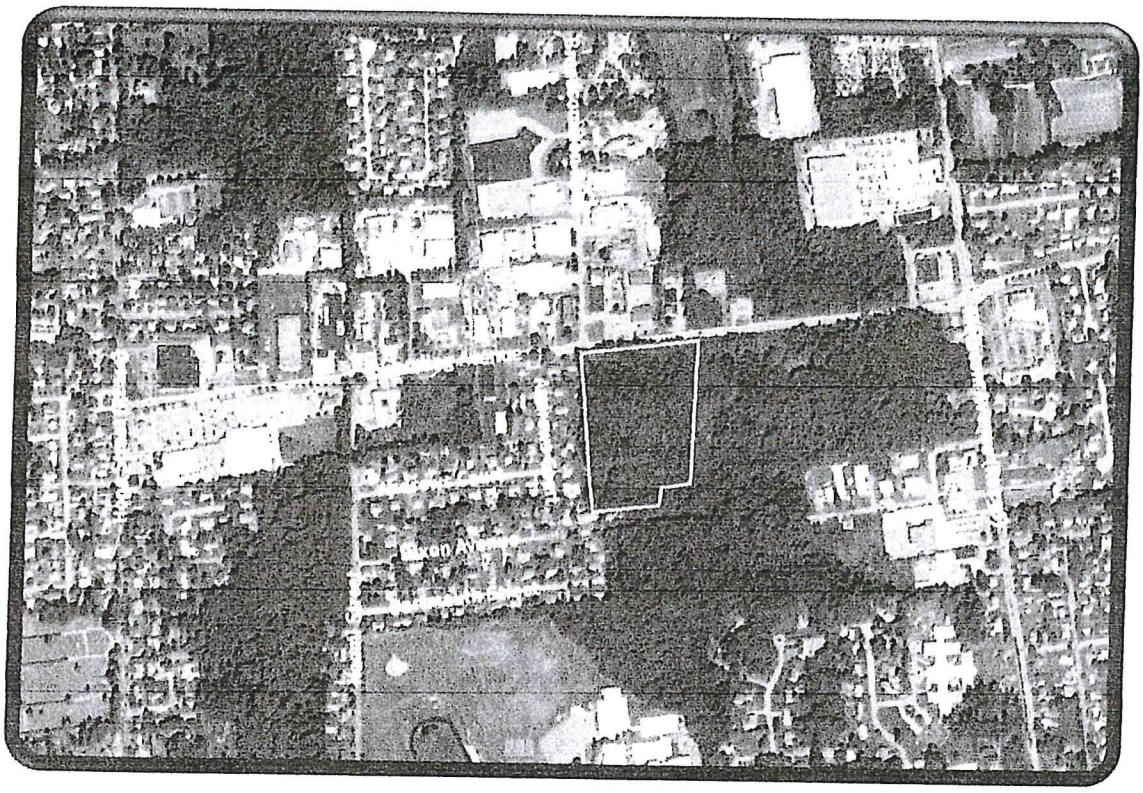
2015 RIGIS Soil Survey Attribute Information

Group 1 includes the Stissing series and the Pittstown series They were included to make the Stissing and Pittstown series consistent with other hardpan soils in RI. Group 1 has a Permeability range of in the B and C horizons of < 0.2 inches per hour

Item C1.

DiPrete Engineering

Stormwater Management Report



KEVIN DEMERS
No. 8557
REGISTERED
PROFESSIONAL ENGINEER
CIVIL
4/7/2025

Gooding Avenue Development

Located in Bristol, Rhode Island

Applicant: Kendan, LLC.

1-19-2018

Revised: 3-27-2025

1.0 Project Description

The purpose of this report is to specify a Storm Water Management System to be implemented at the new project on Gooding Avenue.

The site totals 9.78 acres located on Assessor's Plat 111 Lot 1 in Bristol, Rhode Island. The site is located south of Gooding Avenue near the intersection of Broadcommon Road. A National Forest to the east of the site provides a buffer between the site and Silver Creek.

The proposed development will include a new 13,364 sf hotel building, associated parking and access driveways. The site will be serviced by public water and sewer. Water will be provided by Bristol Country Water Authority and Sewer will be provided by the Town of Bristol.

The stormwater quality will be improved by utilizing Best Management Practices (BMPs) as established by the RISDISM for the treatment of stormwater runoff from the proposed development. BMPs will consist of a sand filter and underground infiltration/detention system. The systems have been designed to meet the RIDEM Stormwater Design and Installations Standards Manual.

2.0 Site Conditions

2.1 SOILS

There are the following soil types within the analyzed area of the Site as mapped by the NRCS USDA Soil Conservation service:

Soil Symbol	Description	Hydrologic Group
PmA	Pittstown silt loam, 0 to 3 percent slopes	C
PmB	Pittstown silt loam, 3 to 8 percent slopes	C
Se	Stissing silt loam	D

Site specific soil evaluations can be found in Appendix A2.1.

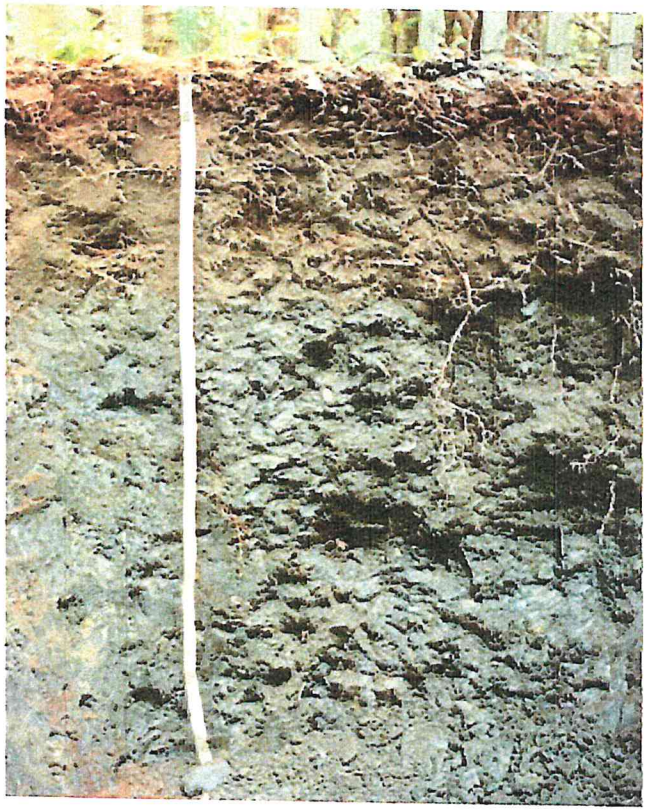
2.2 EXISTING SITE CONDITIONS

Currently the site is undeveloped and predominately woods. All stormwater from the site discharges directly to the onsite wetland areas and ultimately to Silver Creek. The site is largely made up of wetland and perimeter wetland areas and is almost entirely Hydrologic Group D soils. Groundwater tables range from 24" to 36" below existing grade. There is an existing sewer easement that bisects the site.

The entire site slopes diagonally from the higher elevation at the northwest corner along Gooding Avenue to the southeast with all existing slopes < 15%. Stormwater from the site flows overland following the existing slopes. Gooding Avenue has curbing along both sides of the road and a closed drainage network that prevents stormwater from Gooding Avenue from flowing onto the site. However,

Pittstown Soil Sample

RAISE THE RED FLAG



Soil Profile Soil Survey of RI

Soil profile was collected from an undisturbed area of property at 20 Dixon Ave. This area is identified as (Pm) Pittstown soils by NRCS. See the previous slide for the location.

Item C1.

Proposed Gooding Avenue Hotel
Restricted *Infiltration*

Soil Mottled blue and organ color

Restricted infiltration water is retained in the test hole

Item C1.

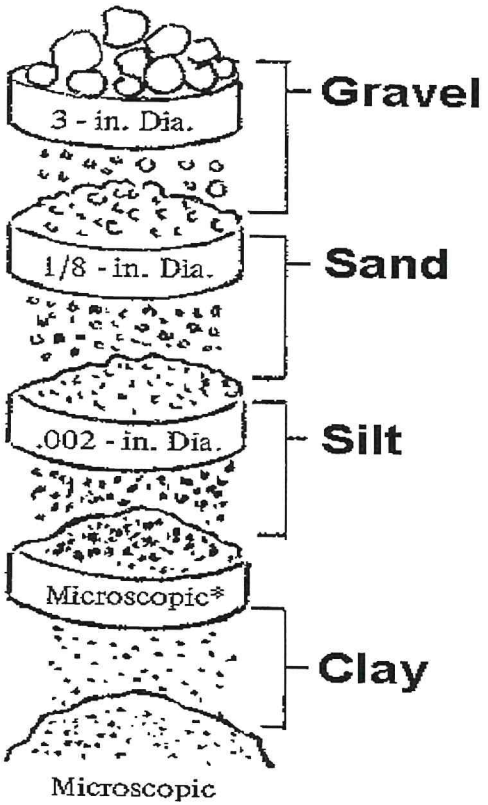
Proposed Gooding Avenue Hotel

Determining Soil Texture

Sieve Analysis

RAISE THE RED FLAG

- A sieve analysis is used to separate soils into different grain sizes.
  - Coarse-grained
  - Fine-grained
- Based on the
  - size of soil particles
  - distribution and characteristics
  - moisture content



Proposed Gooding Avenue Hotel

Recommended Procedure

RAISE THE RED FLAG

Sieve Stack

- Weigh each sieve that is to be used
- Select the test sample that is representative of the soil to be tested
- Weigh the oven-dry sample to be tested
- Sieve the soil through a nest of sieves for at least 10 minutes
- Weigh each sieve with the soil retained on it

Soil Shaker (sieves placed inside)

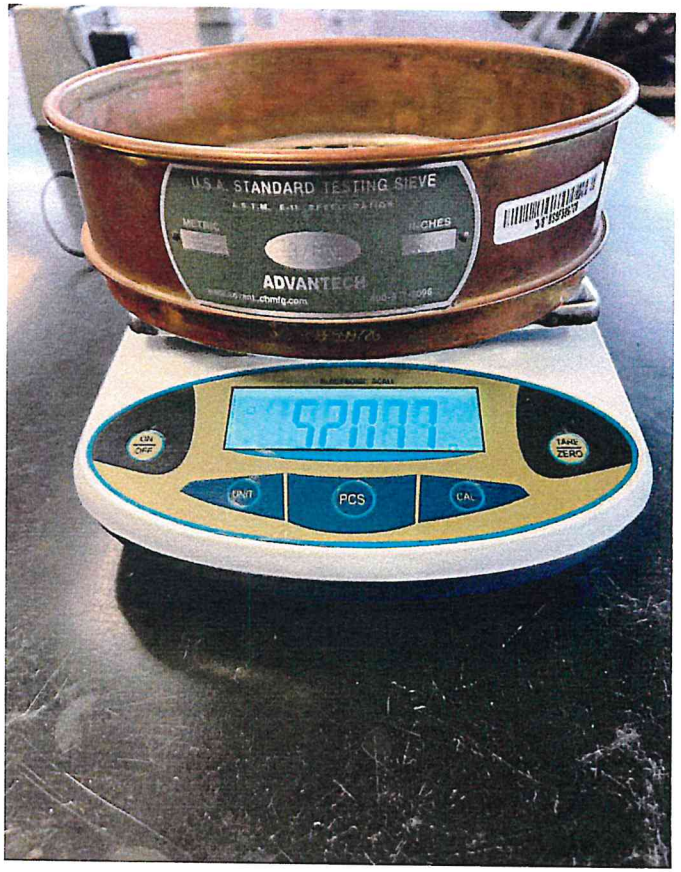
Item C1.

Proposed Gooding Avenue Hotel

Recommended Procedure

RAISE THE RED FLAG

Sieves used in the analysis



Weighing of the sieve and soil retained
On 3/8 inch sieve opening

Item C1.

Proposed Gooding Avenue Hotel

Determining Soil Texture

Sieve Analysis Results

US Sieve Opening Size (inches)	Sieve Weight (grams)	Sieve & Sample (grams)	Mass Retained (grams)	Cumulative Mass Retained (grams)	Cumulative Mas Passed (grams)	Weight Retained %	Percent Finer (%)
#3/8	520.77	517.17	3.60	3.60	356.71	1%	99%
#4	505.28	490.81	14.47	18.07	342.24	5%	95%
#10	481.74	474.53	7.21	25.28	335.03	7%	93%
#20	391.07	370.36	20.71	45.99	314.32	13%	87%
#40	357.59	331.46	26.13	72.12	288.19	20%	80%
#60	348.32	330.31	18.01	90.13	270.18	25%	75%
#100	323.44	305.41	18.03	108.16	252.15	30%	70%
#200	252.29	216.33	35.96	144.12	216.19	40%	60%

Sample Total Weight 360.31 grams

Item C1.

Proposed Gooding Avenue Hotel

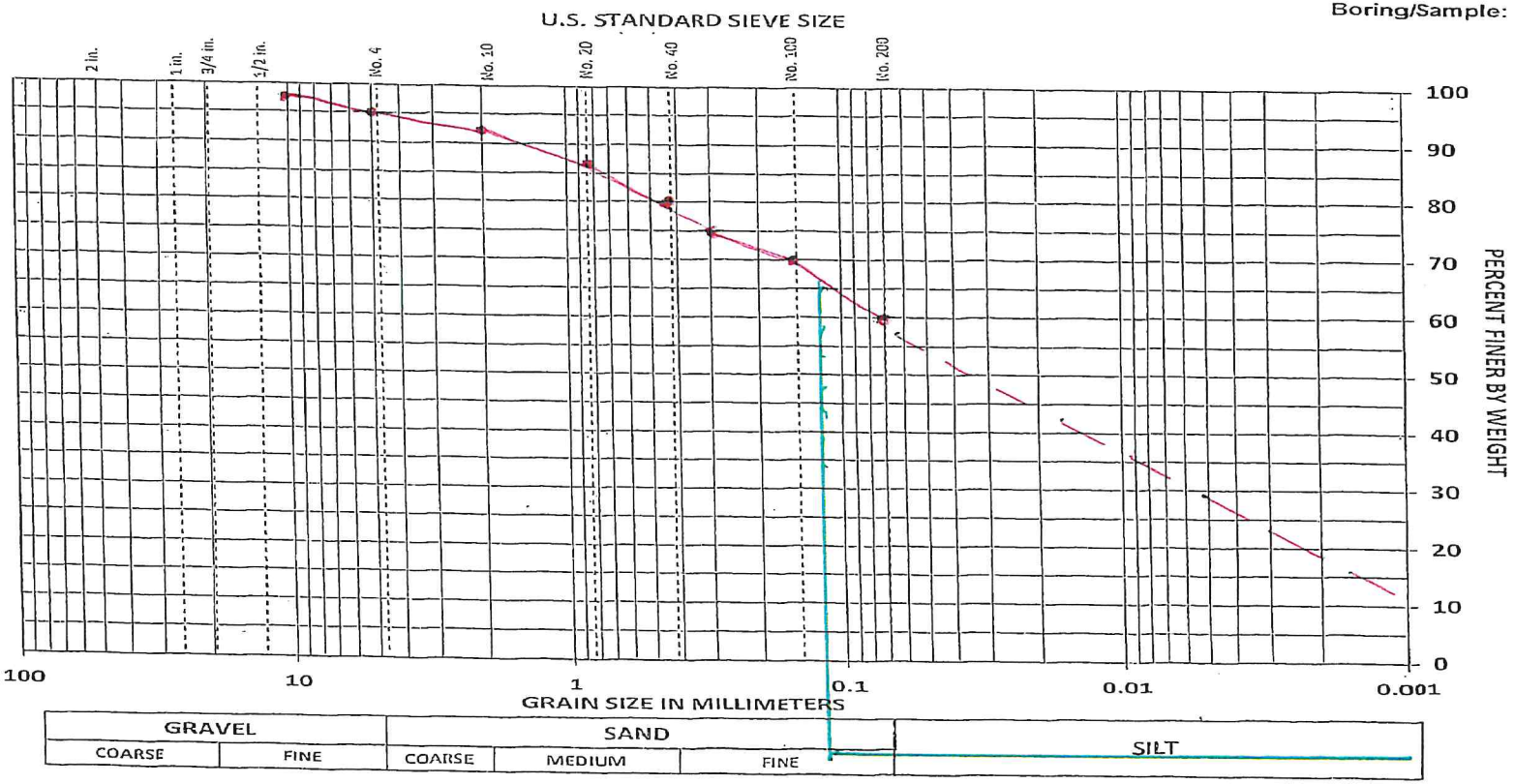
Determining Soil Texture

Sieve Analysis Results

Project:
Job. No.:

GRADATION TEST

Date:
Tech./Reviewer:
Boring/Sample:

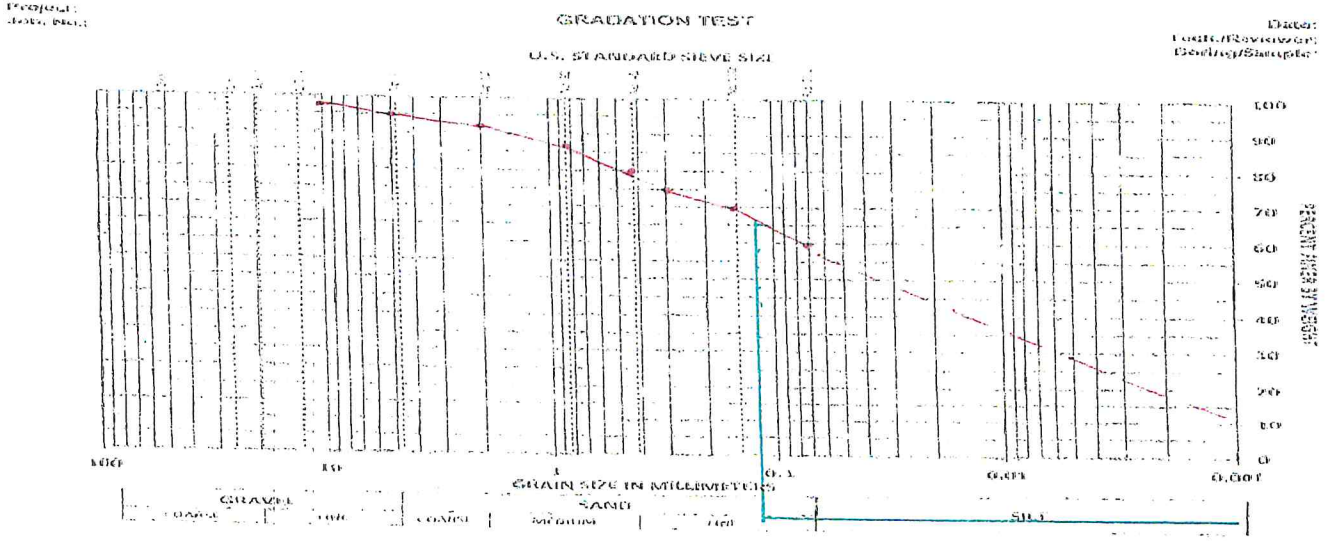


Item C1.

Sieve Analysis Results show the soil to be Silt Loam, with 60% being classified as silt or clay

US Sieve Opening Size (inches)	Sieve Weight (grams)	Sieve & Sample (grams)	Mass Retained (grams)	Cumulative Mass Retained (grams)	Cumulative Mas Passed (grams)	Weight Retained %	Percent Finer (%)
#3/8	520.77	517.17	3.60	3.60	356.71	1%	99%
#4	505.28	490.81	14.47	18.07	342.24	5%	95%
#10	481.74	474.53	7.21	25.28	335.03	7%	93%
#20	391.07	370.36	20.71	45.99	314.32	13%	87%
#40	357.59	331.46	26.13	72.12	288.19	20%	80%
#60	348.32	330.31	18.01	90.13	270.18	25%	75%
#100	323.44	305.41	18.03	108.16	252.15	30%	70%
#200	252.29	216.33	35.96	144.12	216.19	40%	60%

Sample Total Weight 360.31 grams

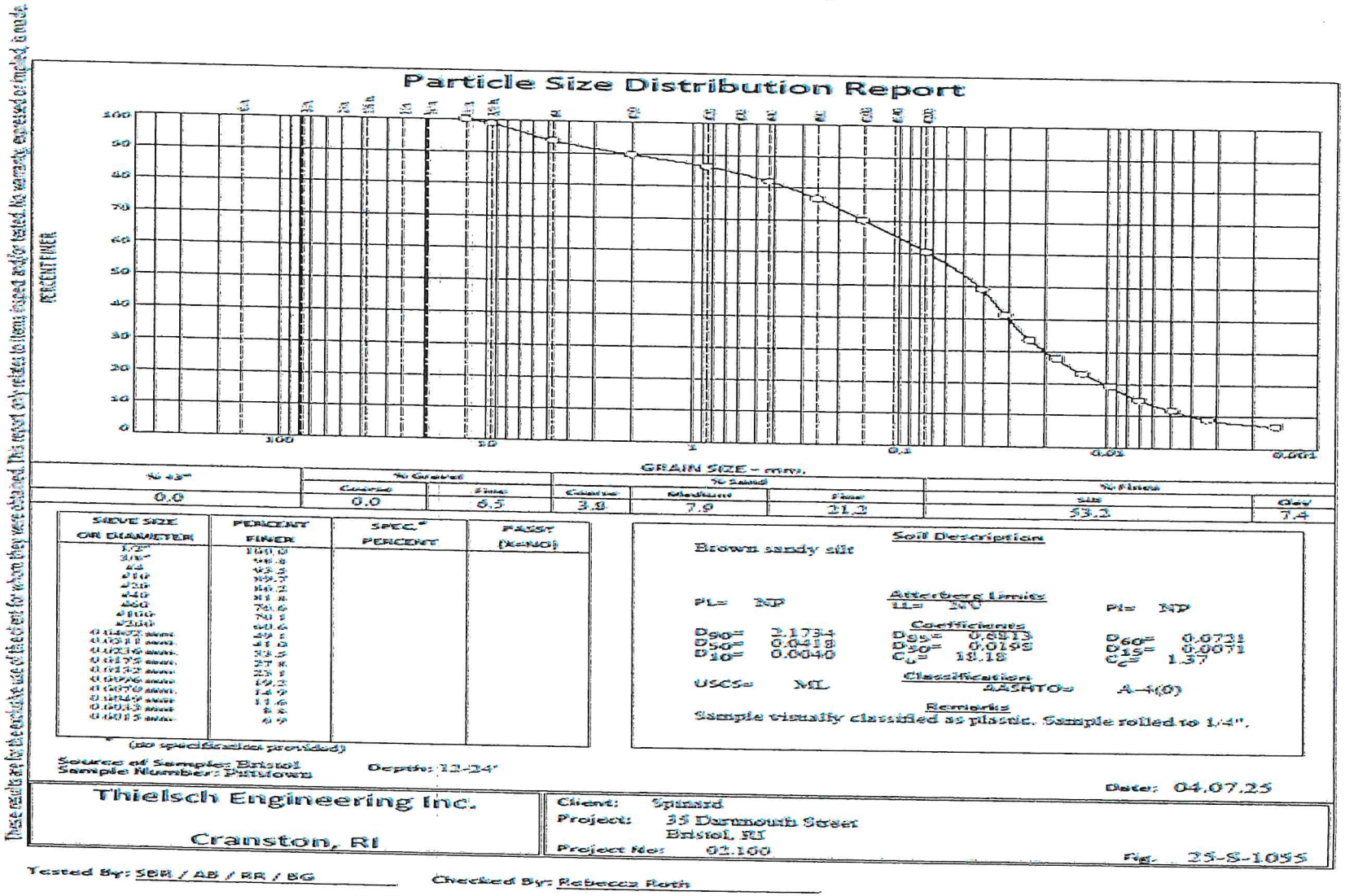


Item C1.

Certified Lab Sieve Analysis Results confirm that the soil is Silt Loam

RED FLAG WARNING

Lab results classified the soil as ML Silty Loam



Particle Size Distribution Report

PERCENT FINER

GRAIN SIZE - mm.

% +3"	% Gravel		% Sand			% Fines		
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay	
0.0	0.0	6.5	3.8	7.9	21.2	53.2	7.4	

SIEVE SIZE OR DIAMETER	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1/2"	100.0		
3/8"	98.8		
#4	93.5		
#10	89.3		
#20	84.2		
#40	81.8		
#60	78.6		
#100	76.1		
#200	60.6		
0.0307 mm.	45.1		
0.0218 mm.	41.0		
0.0146 mm.	33.3		
0.0105 mm.	27.8		
0.0062 mm.	25.1		
0.0045 mm.	19.2		
0.0032 mm.	14.9		
0.0023 mm.	11.6		
0.0013 mm.	8.8		
0.0012 mm.	6.9		

* (no specification provided)

Source of Sample: Bristol Depth: 12-24'
Sample Number: Pittstown

Soil Description
Brown sandy silt

Atterberg Limits
PL= NP LL= NV PI= NP

Coefficients
D_{90}= 2.1734 D_{95}= 0.8813 D_{60}= 0.0731
D_{50}= 0.0418 D_{30}= 0.0198 D_{15}= 0.0071
D_{10}= 0.0040 C_u= 18.18 C_c= 1.37

Classification
USCS= ML AASHTO= A-4(0)

Remarks
Sample visually classified as plastic. Sample rolled to 1/4".

Date: 04.07.25

Thielsch Engineering Inc.
Cranston, RI

Client: Spinard
Project: 35 Dartmouth Street
Bristol, RI
Project No: 02.160
Fig. 35-S-1055

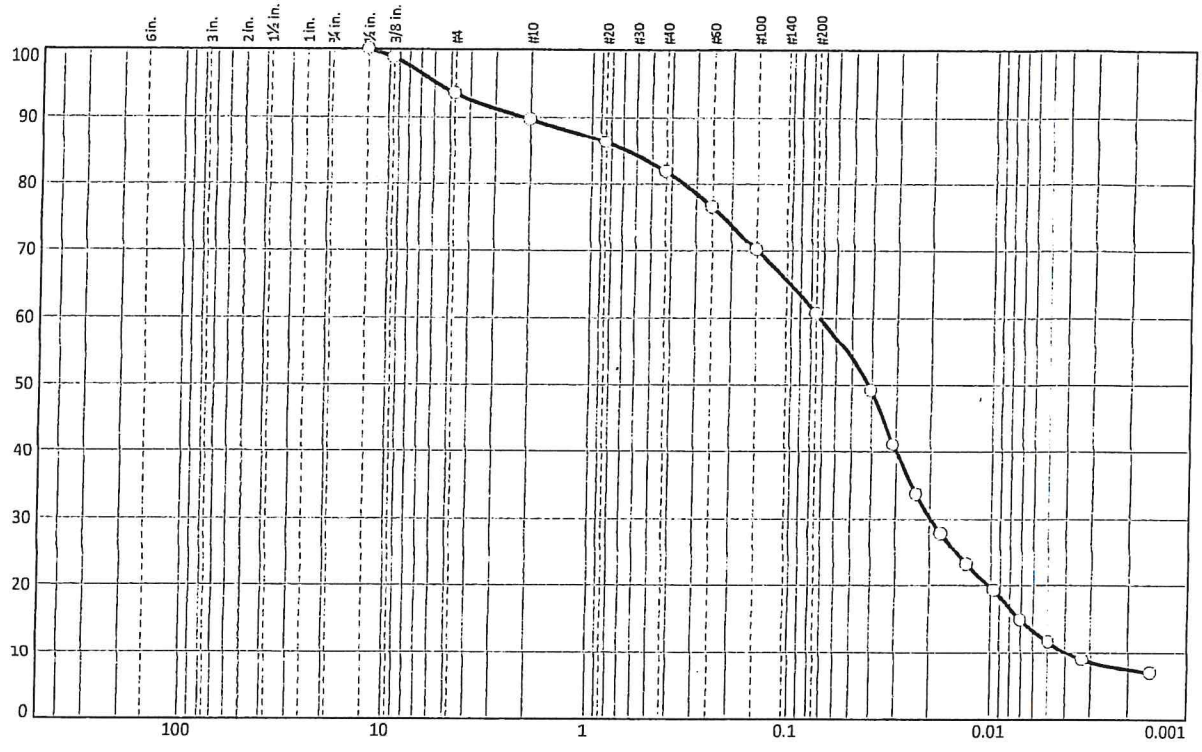
Tested By: SBR / AB / RR / BG Checked By: Rebecca Roth

These results are for the sample as received by the lab and only relate to items tested. No warranty, expressed or implied, is made.

Item C1.

These results are for the exclusive use of the client for whom they were obtained. This report only relates to items inspect and/or tested. No warranty, expressed or implied, is made.

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	6.5	3.8	7.9	21.2	53.2	7.4

SIEVE SIZE OR DIAMETER	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1/2"	100.0		
3/8"	98.8		
#4	93.5		
#10	89.7		
#20	86.2		
#40	81.8		
#60	76.6		
#100	70.1		
#200	60.6		
0.0402 mm.	49.1		
0.0311 mm.	41.0		
0.0236 mm.	33.5		
0.0175 mm.	27.8		
0.0132 mm.	23.1		
0.0096 mm.	19.2		
0.0070 mm.	14.9		
0.0049 mm.	11.6		
0.0033 mm.	8.8		
0.0015 mm.	6.9		

* (no specification provided)

Soil Description

Brown sandy silt

Atterberg Limits

PL= NP LL= NV PI= NP

Coefficients

D_{90}= 2.1734 D_{85}= 0.6813 D_{60}= 0.0721
D_{50}= 0.0418 D_{30}= 0.0198 D_{15}= 0.0071
D_{10}= 0.0040 C_u= 18.18 C_c= 1.37

Classification

USCS= ML AASHTO= A-4(0)

Remarks

Sample visually classified as plastic. Sample rolled to 1/4".

Source of Sample: Bristol
Sample Number: Pittstown

Date: 04.07.25

Thielsch Engineering Inc.
Cranston, RI

Client: Spinard
Project: 35 Dartmouth Street
Bristol, RI
Project No: 02.100

Fig. 25-S-1055

Tested By: SBR / AB / RR / BG **Checked By:** Rebecca Roth

Proposed Gooding Avenue Hotel

USCS Soil Classification

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS GRAPH	SYMBOLS LETTER	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	CLEAN GRAVELS		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		(LITTLE OR NO FINES)		GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
	MORE THAN 50% OF COARSE FRACTION RETAINED ON NO 4 SIEVE	GRAVELS WITH FINES		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
		(APPRECIABLE AMOUNT OF FINES)		GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	SAND AND SANDY SOILS	CLEAN SANDS		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
		(LITTLE OR NO FINES)		SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
	MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	SANDS WITH FINES		SM	SILTY SANDS, SAND - SILT MIXTURES
		(APPRECIABLE AMOUNT OF FINES)		SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
EXISTING FILL				FILL	EXISTING FILL MATERIALS

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

Letter	Definition
G	gravel
S	sand
M	silt
C	clay
O	organic

Lab results classified the soil as ML

Inorganic Silts and Very Fine Sand, Rock Flour, Silty or Clayey Fine Sands or Clayey Silts

Item C1.

Proposed Gooding Avenue Hotel

Infiltration Feasibility & Rate

Rhode Island Stormwater Design and Installation Standards Manual

5.3.1 Feasibility

Required Elements

- To be suitable for infiltration, underlying soils shall have an in-situ infiltration rate of at least 0.5 inches per hour, as initially determined from NRCS soil textural
- Soils shall also have a clay content of less than 20% and a silt content of less than 60%.
- All infiltration systems shall be designed to fully de-water the entire WQ_v within 48 hours after the storm event.

Table 5-3 Design Infiltration Rates for Different Soil Textures (Rawls et al., 1982)

USDA Soil Texture	Design Infiltration Rate (f_c) (in/hr)	Design Infiltration Rate (f_c) (ft/min)
Sand	8.27	0.0115
Loamy Sand	2.41	0.0033
Sandy Loam	1.02	0.0014
Loam	0.52	0.0007
Silt Loam	0.27	0.0004

Item C1.

Infiltration Rate Should be 0.27in/hr for Silt Loam, not 0.5 in/hr (much higher) (Sandy Loam) Used by Applicant

RIDEM Table 5-3 Design Infiltration Rates for Different Soil Textures
Silt Loom 0.27 in/hr infiltration rate

SITC classified the soil as silt loam, and DEM accepted this infiltration rate, but did not allow it to be used for infiltration BMPs

"With respect to the proposed underground retention/ detention system, because the infiltration rate is slower than the minimal standard of 0.5 inches per hour, this proposed BMP cannot be considered an acceptable infiltration practice. With respect to the proposed isolator Row-TM portion of this proposed BMP, it cannot be considered to be an acceptable water quality BMP for full treatment of water quality volume. This is because the Isolator Row-TM practice relies on infiltration as an integral part of its system. Without an acceptable infiltration rate of at least 0.5 inches per hour it is not considered to be a valid water quality BMP" (RI DEM Engineering Review of SITEC Proposed Hotel Facility 6/10/2015)

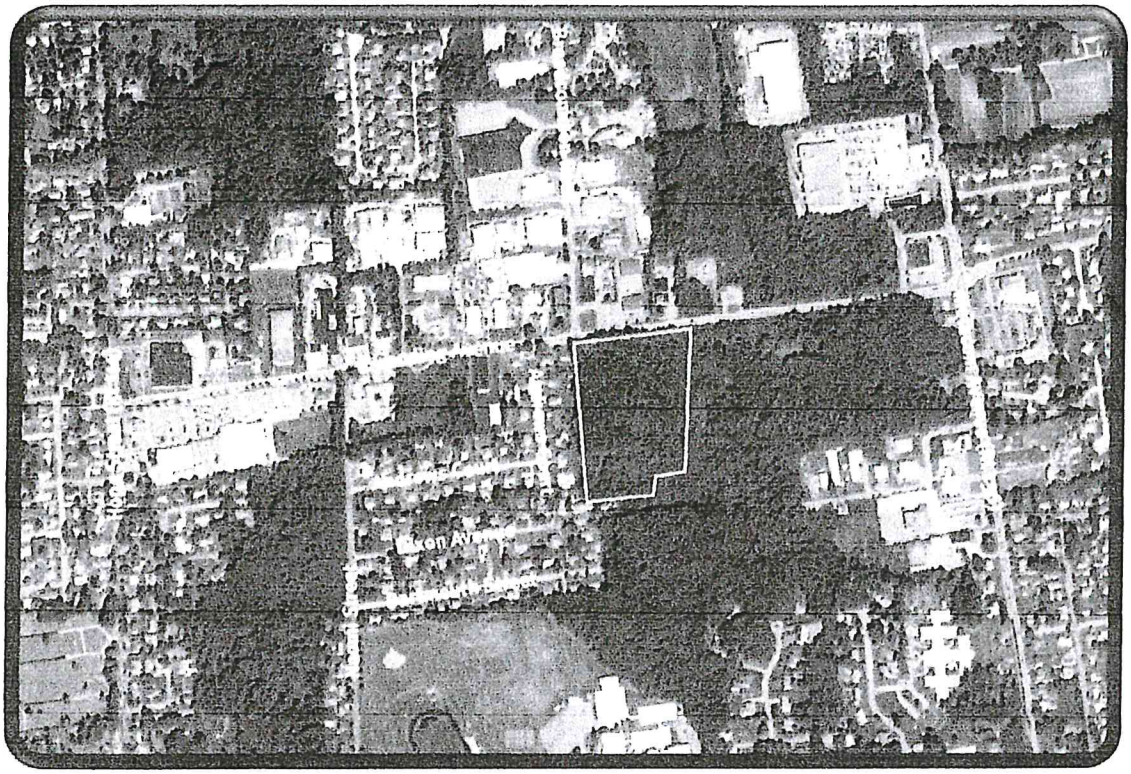
Pare Corporation used an infiltration rate of 0.27 in/h based on the results of many test pits that showed Pittstoen soils.

" The bottom of the underground infiltration system is set in native soils...Considering the presence of silt loam, an infiltration rate of 0.27 was used..." (*Mt. Hope High School Stormwater Management*, p.15, June 2025)

Item C1.

DiPrete Engineering

Stormwater Management Report



KEVIN DEMERS
No. 8557
REGISTERED
PROFESSIONAL ENGINEER
CIVIL
4/7/2025

Gooding Avenue Development

Located in Bristol, Rhode Island

Applicant: Kendan, LLC.

1-19-2018

Revised: 3-27-2025

3.5 Minimum Standard 5: Overbank Flood Protection & Downstream Analysis

3.5.1 Method of Analysis

USDA Soil Conservation Service Method as defined by Technical Release No. 20 (TR-20) determines Stormwater runoff rate and volume. Type III rainfall distribution is utilized. Time of concentration is determined using Technical Release No 55 (TR-55) methodology, through the computer program *HydroCAD ver. 10.0* by Applied Microcomputer Systems.

Soil evaluations have been performed by SITEC, Inc. The existing soil has a texture of sandy loam. Due to the presence of wetland areas and HSG D soils, the soils have been modeled as a loam texture for a more conservative approach. Based on table 5.3 of the RIDISM an infiltration rate of 0.52 in/hr has been used in HydroCAD.

The drainage system has been designed to mitigate all stormwater flows for the 1 through 100 year storm events. The emergency outlets have been sized to handle the 100 year storm event.

3.5.2 Design Storm

Analysis of 1-year, 10-year, 25-year, and 100-year frequency storms are included. The following 24-hour rainfall intensities are obtained from the Rhode Island Stormwater Design and Installation Standards Manual, Table 3-1 for Bristol County.

1 year =	2.8 inches
10 year =	4.9 inches
25 year =	6.1 inches
100 year=	8.6 inches

3.5.3 Design Point Breakdown

The site is analyzed as one watershed area. In the pre development stage there is 1 subcatchment. In the post development stage there are 3 subcatchments. The watershed will demonstrate zero increase in runoff rate due to the proposed development. A description of each subcatchment is summarized as follows:

Design Point #1: Wetland

Watershed #1 flows to Design Point- 1 (DP-1). The design point is the on-site wetland.

In pre development conditions there is only one watershed to the Design Point. Pre-01 (10) contains the entire site and some off-site areas. Stormwater reaches DP-1 (11) via overland flow. Pre-01 is predominately woods with some grass areas along Gooding Avenue. The watershed also includes two residential homes with driveways along Gooding Avenue to the west of the site. A Tc value of 14.6 minutes was used.

In post development conditions there are 3 sub watersheds:

Post-01 (100) contains all undetained areas surrounding the proposed development. These areas will either be grass or undisturbed areas from pre-conditions. Stormwater will reach the design point via overland flow as in existing conditions. Some stormwater will be directed around the proposed

Hotel Development
Gooding Avenue
Bristol, Rhode Island

Test Pits to Determine Groundwater
John Keegan RI Soil Evaluator D-4008
12/12/14

TestPit#	Depth	Horizon	Texture	Color	REDOX	Depth
1	0"-12"	Ap	SL	10YR 3/2		
	12"-20"	Bw1	SL	2.5Y4/4		
	20"- 24"	Bw2	SL	5Y4/3	m2p 10YR4/4	24"
	24"-72"	Cd	SL	5Y 5/1	m3p 10YR4/4	36"

Till becomes denser and rocky with depth
Hole is dry

TestPit#	Depth	Horizon	Texture	Color	REDOX	Depth
2	0"-12"	Ap	SL	10YR 3/2		
	12"-20"	Bw1	SL	2.5Y4/4		
	20"- 30"	Bw2	SL	5Y4/3	m2p 10YR4/4	30"
	30"-77"	Cd	SL	5Y 5/1	m3p 10YR4/4	32"

Till becomes denser and rocky with depth
Hole is dry

TestPit#	Depth	Horizon	Texture	Color	REDOX	Depth
3	0"-12"	Ap	SL	10YR 3/2		
	12"-20"	Bw1	SL	2.5Y4/4		
	20"- 30"	Bw2	SL	5Y4/3	m2p 10YR4/4	28"
	30"-72"	Cd	SL	5Y 5/1	m3p 10YR4/4	32"

Till becomes denser and rocky with depth
Hole is dry

TestPit#	Depth	Horizon	Texture	Color	REDOX	Depth
4	0"-12"	Ap	SL	10YR 3/2		
	12"-20"	Bw1	SL	2.5Y4/4		
	20"- 30"	Bw2	SL	5Y4/3	m2p 10YR4/4	30"
	30"-72"	Cd	SL	5Y 5/1	m3p 10YR4/4	32"

Till becomes denser and rocky with depth
Hole is dry

TestPit#	Depth	Horizon	Texture	Color	REDOX	Depth
5	0"-12"	Ap	SL	10YR 3/2		
	12"-20"	Bw1	SL	2.5Y4/4		
	20"- 30"	Bw2	SL	5Y4/3	m2p 10YR4/4	28"
	30"-60"	Cd	SL	5Y 5/1	m3p 10YR4/4	32"

Till becomes denser and rocky with depth
Hole is dry

Hotel Development
Gooding Avenue
Bristol, Rhode Island

TestPit#	Depth	Horizon	Texture	Color	REDOX	Depth
6	0"-12"	Ap	SL	10YR 3/2		
	12"-20"	Bw1	SL	2.5Y4/4		
	20"- 36"	Bw2	SL	5Y4/3	m2p 10YR4/4	36"
	36"-77"	Cd	SL	5Y 5/1	m3p 10YR4/4	38"

Sandy lenses and Mixing at 30"
Till becomes denser and rocky with depth
Hole is dry

TestPit#	Depth	Horizon	Texture	Color	REDOX	Depth
7	0"-12"	Ap	SL	10YR 3/2		
	12"-20"	Bw1	SL	2.5Y4/4		
	20"- 36"	Bw2	SL	5Y4/3	m2p 10YR4/4	36"
	36"-72"	Cd	SL	5Y 5/1	m3p 10YR4/4	38"

Till becomes denser and rocky with depth
Hole is dry

Item C1.

RHODE[illegible]AND DEPARTMENT OF ENVIRONME[illegible]L MANAGEMENT
OFFICE OF WATER RESOURC[illegible]
STORMWATER ENGINEERING REVIEW
REQUEST FOR ADDITIONAL INFORMATION

Date 6/10/2015 **Reviewer** Nicholas A Pisani, P E Nicholas A. Pisani P.E

Application Number	**FWW#**	15-0033
	WQC#	
	GWD/UIC#	001650
	RIPDES#	RIR101247
	OTHER	

Applicant Name KenDan, LLC

Project Name Proposed Hotel Facility

Plans and Analysis Reviewed Plans and Reports received by DEM on 3/04/2015 and revised plans and report received 5/28/2015

Engineering Review conducted with Checklist rev date **2/20/2014**

Interim Review Findings

1) **Drainage Issues-** Drainage design with respect to mitigation of peak runoff discharge rates may not function as modeled because the proposed detention storage is assumed to be empty at the start of storm Due to slow infiltration rates and potential for clogging a more conservative assumption of assuming the basins are full at the start of storm event would better address the mitigation of peak runoff discharge rates Final review to be completed upon receipt of responses to the issues explained in the comments below
2) **Floodplain Issues-** Not indicated as being within an area of 100-year floodplain

Interim Technical Justification If the site plans for the proposed development include a BMP that does not fully comply with all the applicable design requirements of the RISDISM, then please note below

1) NA

Review Comments

(1) Table A 2-1 Best Management Practices in the Appendix A checklist is incomplete Specifically
- The detention ponds and the storage within the underground retention / detention practice need to be listed for their function in management of peak runoff discharge rates (overbank protection or Q_p)
- The table needs to address what BMPs will provide channel protection volume storage

(2) With respect to the proposed underground "Retention / Detention System" because the infiltration rate is slower than the minimum standard of 0 5 inches per hour, this proposed BMP cannot be considered as an acceptable infiltration practice With respect to the proposed Isolator Row-TM portion of this proposed BMP, it cannot be considered to be an acceptable water quality BMP for full treatment of the water quality volume This is because the Isolator Row-TM practice relies on infiltration as an integral part of its function Without an acceptable infiltration rate of at least 0 5 inches per hour, it is not considered to be a valid water quality BMP It can only be credited as a pretreatment device However, because the Rhode Island Stormwater Design and Installation Manual (RISDISM) does not require pretreatment for roof runoff, its use is therefore

considered to be unnecessary Therefore, the proposed underground practice can only be considered to be acceptable as a detention practice Please revise the design so as to provide an alternate water quality management practice to provide the required water quality treatment for the proposed rooftop impervious area One option might be to provide adequate sizing of the down-gradient water quality BMP (the MWS-L water quality treatment unit) so as to also accommodate the water quality volume from the contributing rooftop impervious area

(3) Please include an appropriate and representative level of infiltration value for the expected small (sub-standard) amount of infiltration to the groundwater from the proposed underground retention / detention practice If none is anticipated, then please revise the submitted routing analysis so as to utilize an initial water level equal to the inlet of the lowest surface water outlet Please note that no water quality credit is allowed for any minor amount of infiltration estimated, because the design does not provide the minimum 0 5 inches per hour infiltration rate

(4) Please explain the basis of the waiver of the channel protection volume Please note that in the initial submittal it was indicated that the 1-year storm flow was 0 47 cfs This does not appear to be an accurate statement Please note that the inflow volume to each basin must be less than 2 cfs for the automatic waiver to be applicable Therefore, please redesign the site detention practices to provide extended detention of the channel protection volume such that the average release rate of the total runoff volume in the 1-year 24-hour storm event is calculated by dividing this total runoff volume by 24 hours (86,400 seconds) Also, please provide the CPv for the underground practice Given the indicated soil and the presumptive rate of 0 27 in/hr, the infiltration of the 2' in the sump will take about 88 9 hours Based on this, the volume in this sump may not be completely empty prior to the next storm Therefore please revise the analysis so as to assume an initial water level equal to the elevation of the lowest surface outlet elevation If it is not possible to revise the design for the channel protection volume and its associated restricted release rate, please explain why this cannot be accomplished and provide a technical justification as to why the channel protection standard would not need to be applied Please note that the proposed design concept presents a special problem with respect to the discharge of the channel protection volume Specifically, please note that any flow release as part of the channel protection volume release flow must first have its water quality volume fraction acceptably treated by an acceptable water quality treatment practice prior to being discharges to the any receiving wetland

(5) The submitted analysis indicates that both of the proposed detention ponds will have their bottom elevations situated below the lowest outlet weir This creates a sump which needs to be addressed in the submitted analysis of each pond Please specifically address the expected pre-storm pond water level in narrative and in the accompanying drainage analysis If the pond is expected to be full at the start of the design storm event, each of the analyses will need to indicate an existing water level assumption of the pond being full to the level of the crest elevation of the lowest outlet weir (Please note that with the potential for long term clogging of the bottoms of these basins, any slow infiltration may be lost and the basins may tend to act as wet basins Therefore, at least from a peak flow management perspective, it would be appropriate to be conservative in the modeling of the basins and assume that they will be full at the start of the storm event) If the soils will allow for infiltration of the volume within each sump, the analysis will need to account for the infiltration rate of the soils present at the

bottom of each detention pond Please provide a revised hydrologic analysis for the proposed project after making any pertinent revisions Provide analysis for the 1, 10, and 100-year 24-hour Type III storm events, as well as the 1 2" 24-hour Type III storm water quality event (using the split pervious / impervious flow option for this 1 2" event only)

(6) Please provide a diagram with flow direction arrows to depict the flow path through the proposed MWS-L units in both the water quality flow event and in a larger storm event, such as the 10-year storm

(7) Please address how the revision to include an initial water level in the detention ponds will affect the design flows to the proposed MWS-L water quality treatment units With the ponds being full between storm events, a greater outflow rates in the 1 2" storm events can be expected Please demonstrate that the outflow for each of the proposed detention basins in the 1 2" storm event will not exceed the capacity of the proposed MWS-L water quality treatment units If the ponds are not expected to be full at the start of the design storm event, please address whether the water quality volume will actually reach the proposed MWS units, as opposed to very slowly infiltrating into the slowly-infiltrating soils with less than a 3' separation to groundwater Please address any associated water quality impacts from the exfiltrated flow Please note that it does not appear that exfiltration through the bottom of each detention basin will pass through the minimum standard 3' of soil prior to encountering the seasonal high groundwater table

(8) Please provide detailed calculations which will demonstrate that the proposed MWS-L water quality treatment units have been properly sized so as to accommodate the contributing impervious areas and the flows that will be discharged from the detention basins in the 1 2" storm events Please specifically demonstrate that the design of each of the proposed MWS-L water quality treatment units will provide sufficient operation head to provide the requisite water quality treatment Please also address whether or not larger flows that outlet the detention ponds in the larger storm events will automatically bypass the proposed water quality treatment practice

(9) Please revise the submitted water quality flow analysis from the submitted 1 3" storm event to a 1 2" storm event using the split pervious / impervious option included in the HydroCAD-TM software package Using this split pervious / impervious option will provide a close approximation to the water quality flow (WQf) referred to in the Rhode Island Stormwater Design and Installation Standards Manual (RISDISM)

(10) Please explain the operating head indicated for the MWS-L-4-8-V water quality treatment unit It is indicated as having a 3 4' operating head per the note on the design detail on the cross-section plan However, the difference in elevation between the inlet weir crest and the outlet pipe invert is 1 87' (69 87' minus 68 00') Please demonstrate that the proposed design provides a sufficient operating head to provide adequate water quality treatment per manufacturer's specifications

(11) Please provide a typical structural cross-section of the proposed detention basin fill embankment Show type of soil material to be used to construct the fill embankment and the method of compaction Also show that all unsuitable soils (such as organic soils) will be removed and not used as part of the structural

embankment Provide a typical detail of the detention basin embankment cover protection, be sure to show any erosion protection materials to be used

(12) With respect to the submitted long term Operation and Maintenance Plan (O & M Plan) please be more specific regarding the mandatory items that will be required as part of the long term O & M of the proposed MWS-L treatment practices Please include an itemized list of all mandatory items

(13) With respect to the submitted O & M Plan the submitted 8 5" x 11" map is not legible in its depiction of the location of each of the proposed stormwater management "best management practices" (BMPs) to be maintained Please provide a more legible map An 11" x 17" map may be used, if necessary

(14) With respect to the submitted O & M Plan, at this time please at least provide a draft O & M agreement (Stormwater Facility Maintenance Agreement) between the owner and the RI DEM

21+19=233

STORMWATER MANAGEMENT REPORT

Pare Project No. 23099.01

Mt. Hope High School
199 Chestnut Street
Bristol, Rhode Island 02809

Assessors Map 117, Lot 3, 4, 5, 6, & 7

Prepared for:

Bristol Warren Regional
School District
235 High Street
Bristol, RI 02809

Prepared by:

Pare Corporation
8 Blackstone Valley Place
Lincoln, RI 02865

JANUARY 2025
SUPPLEMENTAL REVISIONS:
JUNE 2025

PARE CORPORATION

ENGINEERS SCIENTISTS PLANNERS

Bioretention Area with Subdrains

The bioretention areas have been designed in accordance with RIDEM Standards to promote water quality. The bioretention areas include filter media with a mulch upper layer, vegetated side slopes, a raised outlet, and spillway. Stormwater is piped to the sediment forebay, which provides pretreatment, prior to entering the bioretention area. An impermeable liner with a stone layer and perforated subdrain is placed under the filter media to discharge the treated water for Bioretention Area-02 and Bioretention Area-03. The liner is provided because the minimum separation to groundwater is not provided. The raised outlet is elevated to store the water quality volume for 24-hours while it slowly drains through the subdrain system following the storm event. Any excess stormwater that enters the bioretention area will overflow into the catch basin and discharge into the drainage network.

Bioretention Area with Exfiltration

The bioretention areas have been designed in accordance with RIDEM Standards to promote water quality. The bioretention areas include filter media with a mulch upper layer, vegetated side slopes, a raised catch basin, and spillway. Stormwater for Bioretention -01 is piped to the sediment forebay, which provides pretreatment, prior to entering the bioretention area. The outlet is elevated to exfiltrate the entire water quality volume through the surrounding soils for Bioretention Area-01. Stormwater for Bioretention -04 is piped to the bioretention area for treatment. Bioretention -04 provides water quality treatment for non-vehicular traveled sidewalks, therefore no pretreatment was provided. The outlet is elevated to exfiltrate the entire water quality volume through the surrounding soils for Bioretention -04. Excess stormwater that enters Bioretention-04 during larger storm events will overflow into the catch basin and discharge into the drainage network. Bioretention Area-01 is designed offline with diversion structures upstream for larger storm events to bypass the BMP.

Per the RISDISM, exfiltration through the soils observed on-site would be modeled with a Rawls Rate of 1.02 in/hr (C Soils) or 0.27 in/hr (D Soils). In an effort to be conservative, an infiltration rate of 0.27 in/hr was used to model exfiltration from all BMP's that exfiltrate to existing soils.

Sand Filters with Subdrains

The sand filters have been designed in accordance with RIDEM Standards to promote water quality.. The sand filter includes a vegetated bottom, 36" deep layer of ASTM C-33 sand,

to provide ground water recharge to the maximum extents practicable within the Silver Creek Watershed to reduce stormwater volume per the Town of Bristol's regulations for projects within Silver Creek.

Underground Infiltration System

The underground infiltration system (UGIS) has been designed in accordance with RIDEM Standards to promote water quality, and recharge. The UGIS is sized to infiltrate the water quality volume based on upstream impervious areas.

The bottom of the underground infiltration system is set in native soils, and a minimum of 36" from the estimated seasonal high groundwater table. Considering the presence of silt loam, an infiltration rate of 0.27 in/hr was used for conservative measures. A technical justification is requested to permit a stormwater infiltration practice within anticipated 0.27 in/hr soils based on the goal to provide ground water recharge to the maximum extents practicable within the Silver Creek Watershed to reduce stormwater volume per the Town of Bristol's regulations for projects within Silver Creek.

UGIS-01 has been designed to infiltrate the synthetic turf field impervious surface to provide water quality treatment. The synthetic turf field profile includes dual 15" HDPE pipes embedded within crushed stone reservoir to provide storage for the athletic field prior to entering the UGIS system. Larger stormwater events will bypass the UGIS system via a diversion structure upstream of the system. A pretreatment row is not provided for the UGIS system due to the UGIS's design intention to treat only the synthetic turf field with no other contributing drainage areas. Due to the infiltration practice being within 50 feet of a slope greater than 15%, a 40 mil PVC liner is proposed to limit potential for horizontal seepage. The liner will be installed along the southern and western boundaries of the underground system to prevent water seepage against the 3:1 slope.

Wet Swale

The wet swale along the east parking lot has been designed in accordance with the RISDISM to treat runoff for water quality requirements. The wet swale includes a 12" deep bioretention soil bed with a crushed stone sump. Soil media shall meet the specifications outlined for bioretention media to include a well-aged leaf compost per the RISDISM section 5.7.4. This wet swale also

includes runoff that flows to the wetland in the southwest corner of the site. A portion of the stormwater runoff directed to the southwest wetland enters an existing detention basin through a piped drainage system and is discharged through an outlet control structure into the southwest wetland.

The Silver Creek East Branch subwatershed (East subwatershed) includes runoff that flows to Silver Creek and the culvert beneath Chestnut Street. The northeast wetland flows into Silver Creek which flows to an existing pond on campus with a controlled outlet dam and two culverts. Stormwater runoff from the East subwatershed enters the stream through overland flow and a piped drainage system. The effective FIRM established in 2014 is the regulatory floodplain information currently available for the project site. Based on this information, compensatory storage calculations and culvert hydrology were assessed using the available published data.

According to the Soil Survey of Rhode Island (US Department of Agriculture Soil Conservation Service 1981), the soils located at the site are a mix of primarily Udorthents-Urban land complex (UD), Urban Land (Ur) and Stissing silt loam (Se). There are less significant sections of Pittstown silt loam (PmA), and Pittstown silt loam (PmB). The soils on-site are in hydrologic soil group C and D and are generally poorly drained.

Test pit labels represent the year excavated and numbering in that year. For example, TP10-02 would be TP-2 from the 2010 test pits. Refer to the updated test pit plan as part of Appendix A of the stormwater report for the note describing the nomenclature used for labeling the test pit data on site.

Ten test pits were excavated on July 18, 2024 to review below grade conditions at the site. Locations can be found on the plan and test pit logs found in Appendix A. The on-site soils generally consist of fill atop a layer of sandy loam atop a layer of silty loam. Fill material from previous grading and site development operations was observed at depths ranging from 6" to 70" throughout the site. Based upon the classification of soils surrounding the site and soil properties observed during the test pit excavations, the on-site soils are modeled within Hydrologic Group "C" in this analysis. The estimated seasonal high groundwater table varies across the site. Redoximorphic features were observed in all of the test pits with depths ranging from 10" to 38" below grade.

Item C1.

to provide ground water recharge to the maximum extents practicable within the Silver Creek Watershed to reduce stormwater volume per the Town of Bristol's regulations for projects within Silver Creek.

Underground Infiltration System

The underground infiltration system (UGIS) has been designed in accordance with RIDEM Standards to promote water quality, and recharge. The UGIS is sized to infiltrate the water quality volume based on upstream impervious areas.

The bottom of the underground infiltration system is set in native soils, and a minimum of 36" from the estimated seasonal high groundwater table. Considering the presence of silt loam, an infiltration rate of 0.27 in/hr was used for conservative measures. A technical justification is requested to permit a stormwater infiltration practice within anticipated 0.27 in/hr soils based on the goal to provide ground water recharge to the maximum extents practicable within the Silver Creek Watershed to reduce stormwater volume per the Town of Bristol's regulations for projects within Silver Creek.

UGIS-01 has been designed to infiltrate the synthetic turf field impervious surface to provide water quality treatment. The synthetic turf field profile includes dual 15" HDPE pipes embedded within crushed stone reservoir to provide storage for the athletic field prior to entering the UGIS system. .Larger stormwater events will bypass the UGIS system via a diversion structure upstream of the system. A pretreatment row is not provided for the UGIS system due to the UGIS's design intention to treat only the synthetic turf field with no other contributing drainage areas. Due to the infiltration practice being within 50 feet of a slope greater than 15%, a 40 mil PVC liner is proposed to limit potential for horizontal seepage. The liner will be installed along the southern and western boundaries of the underground system to prevent water seepage against the 3:1 slope.

Wet Swale

The wet swale along the east parking lot has been designed in accordance with the RISDISM to treat runoff for water quality requirements. The wet swale includes a 12" deep bioretention soil bed with a crushed stone sump. Soil media shall meet the specifications outlined for bioretention media to include a well-aged leaf compost per the RISDISM section 5.7.4. This wet swale also

STATE OF RHODE ISLAND AND PROVIDENCE PLANTATIONS
Department of Environmental Management
Office of Water Resources

Site Evaluation Form
Part A - Soil Profile Description Application Number N/A

Property Owner: Town of Bristol, Rhode Island
Property Location: Mount Hope High School Chestnut Street & Naomi Street Bristol, RI
Date of Test Hole: February 22, 2010
Soil Evaluator: Site Evaluation – Robin E Dyer License Number: D3077
Weather: Sunny 45°F Shaded: Yes ☐ No ☒ Time: 9:00am

TH–01 Horizon	Depth	Horizon Boundaries Dist	Horizon Boundaries Topo	Soil Colors Matrix	Soil Colors Re-Dox Features	Re-Dox Description Ab. S. Con.	Texture	Structure	Consistence	Soil Category
A	4"	g	s	10yr3/2			sl	0–m	fr	6
B	9"	c	s	10yr4/2			sl	0–m	fi	8
Cd1	27"	a	s	10yr4/2	10yr7/8 5y7/2	c 2 d	cbsil	0–m	fi	9
Cd2	44"	a	s	N2.5/	10yr7/8 5y7/2	f 1 f	gsil	0–m	fi	9
Cd3	65"			5y3/2	10yr7/8 5y7/2	c 2 f	cbsil	0–m	vfi	9

TH–02 Horizon	Depth	Horizon Boundaries Dist	Horizon Boundaries Topo	Soil Colors Matrix	Soil Colors Re-Dox Features	Re-Dox Description Ab. S. Con.	Texture	Structure	Consistence	Soil Category
A	8"	g	s	2.5y3/3			sl	0–m	fr	6
B	16"	c	s	10yr5/3	10yr6/8 2.5y7/1	c 2 d	sl	0–m	fi	8
Cd1	40"	a	s	10yr4/4	10yr5/6 2.5y7/2	c 2 f	cbsil	0–m	fi	9
Cd2	74"			10yr4/4	10yr5/6 2.5y7/2	c 1 f	gsil	0–m	fi	9

Soil Class: Pittstown Silt Loam
Depth to Groundwater Seepage: TH–01 60" TH–02 57"
Estimated Seasonal High Water Table: TH–01 27" TH–02 27"
Total Depth of eachTest Hole: TH–01 65" TH–02 74"
Depth to Impervious or Limiting Layer: Not encountered
Comments: Redox features apparent in between 8" & 27" appear to be a result of slow downward movement of water through soil.

STATE OF RHODE ISLAND AND PROVIDENCE PLANTATIONS
Department of Environmental Management
Office of Water Resources

Site Evaluation Form
Part A - Soil Profile Description Application Number _____

Property Owner: Town of Bristol, Rhode Island
Property Location: Mount Hope High School Chestnut Street & Naomi Street Bristol, RI
Date of Test Hole: February 22, 2010
Soil Evaluator: Site Evaluation – Robin E Dyer License Number: D3077
Weather: Sunny 45°F Shaded: Yes ☐ No ☒ Time: 10:30am

TH–03 Horizon	Depth	Horizon Boundaries: Dist	Horizon Boundaries: Topo	Soil Colors: Matrix	Soil Colors: Re-Dox Features	Re-Dox Description: Ab. S. Con.	Texture	Structure	Consistence	Soil Category
A	4"	g	s	10yr4/3			sl	0–m	fr	6
B	23"	c	s	10yr6/3	10yr6/8 2.5y7/2	c 2 d	sl	0–m	fi	8
Cd1	33"	a	s	10yr4/1	10yr6/8 2.5y7/2	c 2 d	cbsil	0–m	fi	9
Cd2	67"			N2.5/	10yr6/8 2.5y7/2	f 1 f	gsil	0–m	vfi	9

TH–04 Horizon	Depth	Horizon Boundaries: Dist	Horizon Boundaries: Topo	Soil Colors: Matrix	Soil Colors: Re-Dox Features	Re-Dox Description: Ab. S. Con.	Texture	Structure	Consistence	Soil Category
A	4"	g	s	10yr4/3			sl	0–m	fr	6
B	12"	c	s	10yr6/3			sl	0–m	fi	8
Cd	69"			10yr6/1	10yr6/8 2.5y7/2	c 2 f	cbsl	0–m	vfi	9

Soil Class: Pittstown Silt Loam
Depth to Groundwater Seepage: TH–03 16" TH–04 52"
Estimated Seasonal High Water Table: TH–03 33" TH–04 30"
Total Depth of eachTest Hole: TH–03 67" TH–04 69"
Depth to Impervious or Limiting Layer: TH–04 Rippable ledge @24"
Comments: Redox features apparent in between 16" & [illegible] result of slow downward movement of water through soil. Existing pipe adjacent

STATE OF RHODE ISLAND AND PROVIDENCE PLANTATIONS
Department of Environmental Management
Office of Water Resources

Site Evaluation Form
Part A - Soil Profile Description

Application Number N/A

Property Owner: Town of Bristol, Rhode Island
Property Location: Mount Hope High School Chestnut Street & Naomi Street Bristol, RI
Date of Test Hole: February 22, 2010
Soil Evaluator: Site Evaluation – Robin E Dyer License Number: D3077
Weather: Sunny 45°F Shaded: Yes ☐ No ☒ Time: 11:15am

TH–05 Horizon	Depth	Horizon Boundaries Dist	Horizon Boundaries Topo	Soil Colors Matrix	Soil Colors Re-Dox Features	Re-Dox Description Ab. S. Con.	Texture	Structure	Consistence	Soil Category
A	12"	g	s	10yr4/2			sl	0–m	fr	6
B	24"	c	s	10yr6/3	10yr6/8 2.5y7/2	c 2 d	sl	0–m	fi	8
Cd	67"			2.5y4/3	10yr5/6 2.5y7/1	c 2 d	gsl	0–m	vfi	9

TH–06 Horizon	Depth	Horizon Boundaries Dist	Horizon Boundaries Topo	Soil Colors Matrix	Soil Colors Re-Dox Features	Re-Dox Description Ab. S. Con.	Texture	Structure	Consistence	Soil Category
A	5"	g	s	N2.5/			sl	0–m	fr	6
B	13"	c	s	10yr4/1	10yr4/3 2.5y7/2	c 1 f	sl	0–m	fri	6
C	38"	a	s	10yr7/3	10yr6/8 2.5y7/2	c 2 d	sil	0–m	fri	7
Cd1	57"			2.5y4/1	10yr6/8 2.5y7/2	c 2 d	gsl	0–m	vfi	9

Soil Class: Pittstown Silt Loam
Depth to Groundwater Seepage: TH–05 45" TH–06 33"
Estimated Seasonal High Water Table: TH–05 12" TH–02 12"

Total Depth of eachTest Hole: TH–05 67" TH–06 57"
Depth to Impervious or Limiting Layer: Not encountered
Comments:

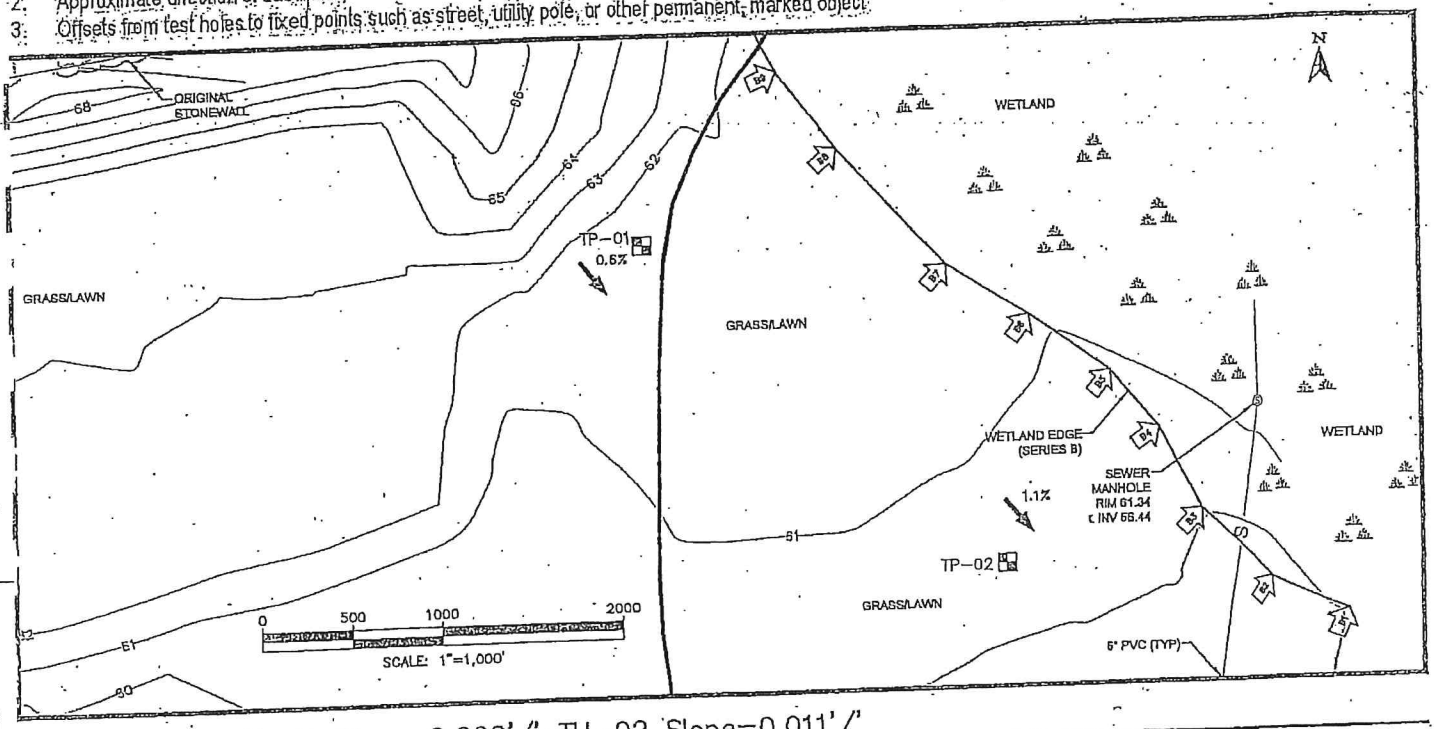
Part B

Site Evaluation - to be completed by Class II or III Designer or Soil Evaluator

Please use the area below to locate:

1. Test holes
2. Approximate direction of due north
3. Offsets from test holes to fixed points such as street, utility pole, or other permanent, marked object

Key:
- Approximate location of test holes
- Estimated gradient and direction of slope
- Approximate direction of due north



1. Relief and Slope: TH-01 Slope=0.006'/' TH-02 Slope=0.011'/'
2. Presence of any watercourse, wetlands or surface water bodies, within 200 feet of test hles: YES☒ NO☐ If yes, locate on above sketch.
3. Presence of existing or proposed private drinking water wells within 200 feet of test holes: YES☐ NO☒ If yes, locate on above sketch.
4. Public drinking water well's within 500 feet of test hles: YES☐ NO☒ If yes, locate on above sketch.
5. Is site within the watershed of a public drinking water reservoir or other critical area defined in SD 19.00? YES☐ NO☒
6. Has soil been excavated from or fill deposited on site? YES☐ NO☒ If yes, locate on above sketch.
7. Site's potential for flooding or ponding: NONE☐ SLIGHT☐ MODERATE☒ SEVERE☐
8. Landscape position: Athletic field
9. Vegetation: Grass
10. Indicate approximate location of property lines and roadways.
11. Additional comments, site constraints or additional information regarding site: The westerly portion of the site adjacent to the existing wetlands falls within a Flood Zone AE with elevations established. Ponding occurs within the soil as a result of the poor surface soil conditions.

Certification

The undersigned hereby certifies that all information on this application and accompanying forms, submittals and sketches are true and accurate and that I have been authorized by the owner(s) to conduct these necessary field investigations and submit this request.

Part A prepared by: _____ License # _____ Signature _____

Part B prepared by: _____ D3077 License # _____ Signature _____

FOR OFFICE USE ONLY

Decision: Approved ☐ Disclaimed ☐

Comments: _____

_____ Date _____

Signature Authorized Agent

revised 5/8/01

Silver Creek Flood Examination

Eastern Branch and Elbow Tributary

Edward J. Spinard, Jr., P.E.

11/30/18

Bristol, RI

Contents

Executive Summary 0
Purpose of the Examination: 0
Results 0
Conclusion 0
Declaration: 1
Purpose of Examination 1
Background: 2
Recent Floods 2
Recreate Beta HEC RAS Model 7
Modified Beta Model 9
Hydrologic Study 9
Hydraulic Study 12
Cross-Section 12
Roughness Factor 12
Flood Profile 13
Beta Study Hydraulic Analysis 13
Recreated Hydraulic Analysis 13
Cross-Sections 14
Culverts Along Silver Creek 15
Silver Creek Flood Profile (recreated/modified) 18
Change in Condition 20
Revised Flood Profile 20
Hydrology 20
Hydraulic Analysis 21
Potential Floodway Determination 23
Conclusion 23
Declaration 24
Appendix A Beta's 100-year Summary Profile from the *Silver Creek Drainage Study*
Appendix B Eastern Branch and the Elbow Street tributary 16 Subwatersheds

Appendix C Flood Profiles and Profile Summary for the Recreated HEC RAS Model for the 100-Year Storm Event

Appendix D Revised Peak Runoff Rates for each of the Watersheds produced Using the 8.5 inches of rainfall

Executive Summary

Purpose of the Examination:

This examination evaluates how increased rainfall affects flooding in Silver Creek (East Branch), Bristol, RI, and aims to improve my understanding of natural stream dynamics and hydraulic modeling in HEC RAS. The Town of Bristol hired Beta engineering consultants to conduct a drainage study (*Silver Creek Drainage Study*, Beta Engineers/Scientists, Lincoln, RI, November 2007) to identify the causes of flooding and suggest possible solutions.

In 2010, Rhode Island Department of Environmental Management (RI DEM) presented a new *Rhode Island Design and Installation Standards Manual* (subsequently amended in 2015) that revised the rainfall amounts, particularly for the 100-year storm event. The 100-year storm event rainfall amount increased from the 2007 value of 7.10 inches, to 8.6 inches, which is the current amount.

This examination hypothesizes that increased rainfall will raise runoff amounts, leading to higher flood elevations and larger inundation areas in Silver Creek compared to the Beta Study. To test this, the original model was recreated to calculate runoff and simulate river flow along the East Branch of Silver Creek and Elbow Tributary.

The models were deemed comparable when the recreated hydrology and hydraulic models yielded results similar to the Beta Study's. With this similarity established, the new rainfall amounts can be used in the models to assess their effect on flood elevations and areas.

Results

The updated HEC RAS model indicates that flood elevations along Silver Creek have risen by about 2 inches to 1 foot due to increased rainfall, with an average rise of 0.44 feet. This higher flood elevation results in a larger flooded area, highlighting the persistent flooding issues along Silver Creek and the need for a thorough analysis.

Conclusion

This examination confirms the Beta Study's analysis, indicating increased flood risk between Gooding Avenue and Chestnut Street and within St Mary Cemetery. It supports the Silver Creek Drainage Study's recommendation for additional upstream stormwater storage, especially on vacant land near Gooding Avenue, Naomi Street, and Mount Hope High School. The findings also highlight the crucial role of existing wetlands in mitigating flood elevations and areas.

Declaration:

I conducted this examination independently; it reflects my findings and opinions. No town, regulatory agency, or advocacy group commissioned or funded the study. My neighbors' concerns about potential wetland development and increased flooding prompted this work.

This study does not predict exact flood elevations or the specific extent of a 100-year storm event. It uses the Beta model for comparative purposes and offers a similar confidence level. The goal was to better understand possible rises in flood elevations and inundation area along Silver Creek, highlight current flooding issues, and emphasize wetlands' role in flood mitigation. This supports the need for a comprehensive review of flooding along Silver Creek.

Purpose of Examination:

The purpose of this examination is to evaluate the impact of the increased rainfall amounts on the flooding issues associated with Silver Creek (East Branch) in Bristol, RI. Runoff is excess surface water generated by rainfall. The amount of runoff is determined primarily by the amount of rain that falls. Rainfall creates stromwater runoff that eventually enters a river. Flooding can occur when the quantity of stromwater runoff , entering the river, exceeds the capacity of the river to convey the stromwater by its normal channel area.

The Town of Bristol retained Beta engineering consultants to perform a drainage study of the Silver Creek watershed (*Silver Creek Drainage Study*, Beta Engineers/Scientists, Lincoln, RI, November 2007) (Beta Study). The primary purpose of Beta Study was to determine the cause of the flooding in the Silver Creek watershed and to identify possible remedial actions.

Beta used a hydrology and a hydraulic computer model to simulate stormwater runoff from the watershed into Silver Creek. One models (*HydroCAD*) generate runoff quantities from rainfall amounts from different storm events and the second model (HES RAS) replicate the hydraulic of water flow through the river. Using these two models, the elevation and special delineations of the flood water was determined.

Beta identified the "area from the eastern branch between Gooding Ave and the high school," as one of two areas along Silver Creek that flood periodically (p8. *Silver Creek Drainage Study*). The results of Beta's HEC RAS analysis confirmed this assessment. It also showed that the flood elevations are greater than those that are officially identified in the FEMA Flood Maps (*Flood Insurance Study, Bristol County, Rhode Island,* Federal Emergency Management Agency, February 2013). The hydraulic analysis for the FEMA study: "Hydraulic analysis for the East Branch Silver Creek, Walker Creek and West Branch Silver Creek were obtained from the original FIS for the Town of Bristol (U.S. Department of Urban and Housing Development, 1971) (p11 FEMA Study).

In 2010, Rhode Island Department of Environmental Management (RI DEM) presented a new *Rhode Island Design and Installation Standards Manual* (subsequently amended in 2015) that revised the rainfall amounts, particularly for the 100-year storm event. The 100-year storm event rainfall amount increased from the 2007 value of 7.10 inches, to 8.6 inches, which is the current amount.

Since the rainfall amount have changes, the runoff amounts will increase. The greater volume of water entering and being conveyed by Silver Creek will result in an increase in the flood elevations and size of the area being inundated. The *HydroCAD* and HES RAS models used in the Beta Study were not available. Thus, this examination first had to recreate those models, to produce

similar results to the Beta Silver Creek models in order to examine the effect of increased rainfall amounts on the flooding problems along Silver Creek.

This examination replicates the Beta flood study using the new rainfall amount for the 100-year storm event. It recreates the *HydoCAD* and *HEC RAS* models used in the Beta study. The models were considered to be comparable when the recreated hydrology and hydraulic models produced similar results for flood water elevations to the Beta Study's models. With the recreated models providing similar results to the Beta Study models, the new rainfall amounts can be incorporated into this examination's recreated models to examination the impact on the flood elevations and flooding areas from the increased rainfall amounts along Silver Creek (Eastern Branch).

Background:

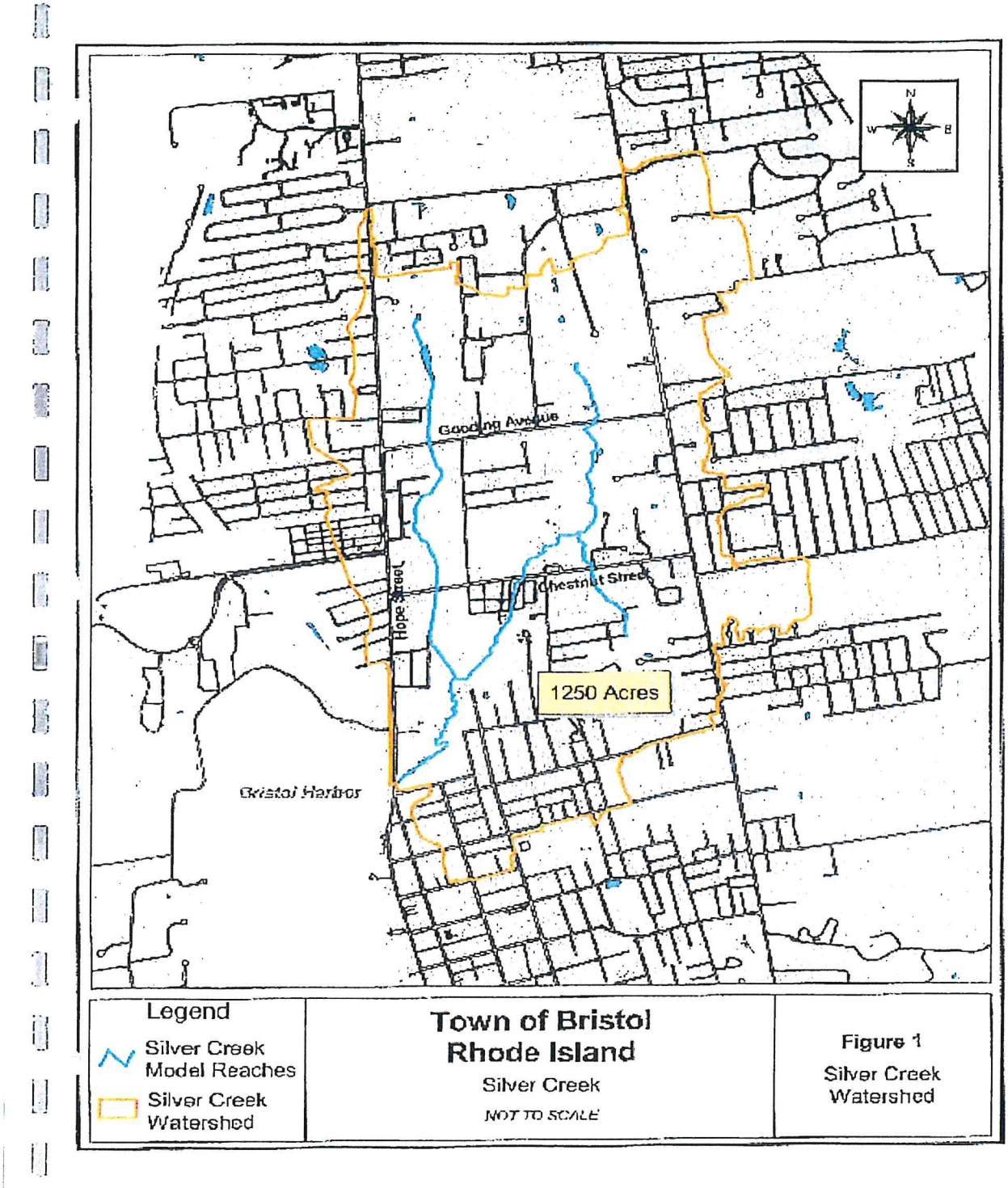
The watershed of the river is identified in order to determine the depth of flood waters and to determine the size or width of floodplains. The watershed will determine the amount of water that will reach a stream and be carried by the stream during normal rainfall and flooding events. A watershed is an area where all the rain that falls within that area, is drained into a common river. The boundaries of the watershed are formed by high areas or ridges along the perimeter of the river. The river is in the low central area of the watershed. The watershed is generally shaped like a bowl.

Figure 1 (from the Beta Study) identifies the boundaries of the Silver Creek watershed. Silver Creek watershed is about 1,250 acres in size. Silver Creek begins as two separate river channels identified as the Eastern Branch and Western Branch that merge into one river that flows into a large marshy area and then discharges into Bristol Harbor. Figure 2 (from the Beta Study) shows the Silver Creek river channel. A third river channel identified as Elbow Street is a tributary that flows into the Eastern Branch. The subject of this examination is the Eastern Branch and Elbow Street tributary of Silver Creek.

Recent Floods

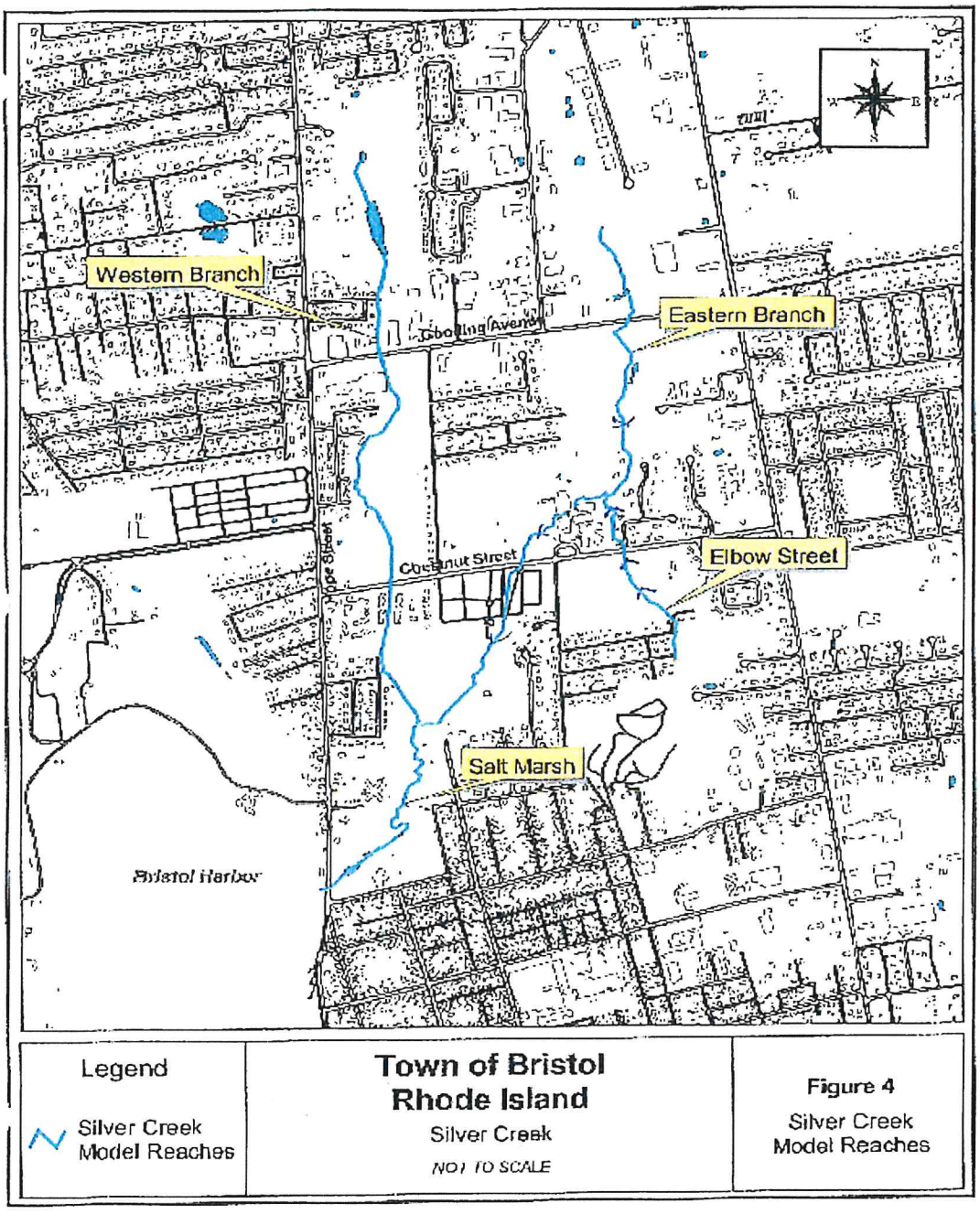
Silver Creek historically has had flooding issues. The photographs on the following pages obtained from the *Bristol Phonic* show Chestnut Street and St Mary Cemetery inundated by flood waters from Silver Creek. The photographs are from April 2010.

Figure 1 …. Silver Creek Watershed

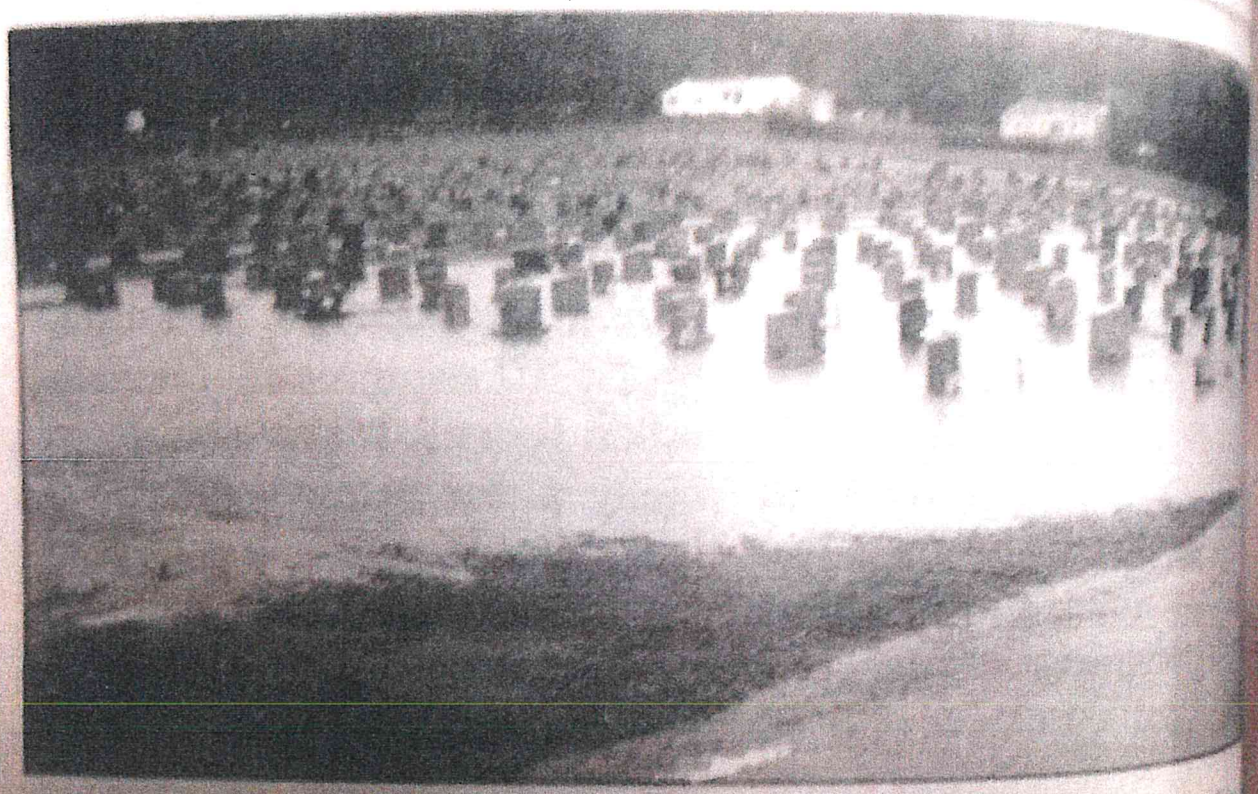


Source : Beta Study p.

Figure 2.... Silver Creek River Channels

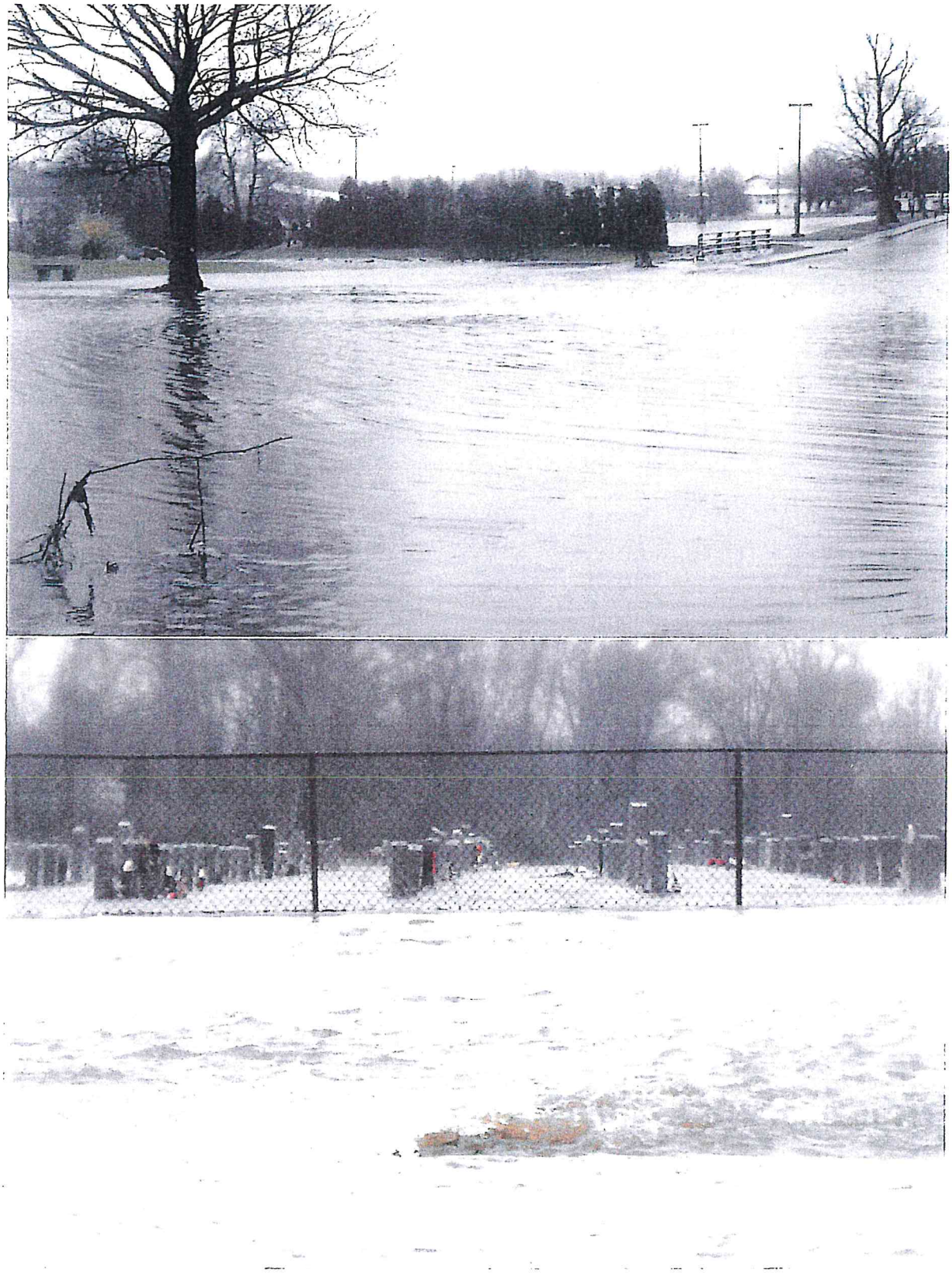


Source : Beta Study p.



St. Mary's Cemetery along Chestnut Street was swimming Tuesda
morning. The road was closed to traffic and barricaded for much

April 2010



Recreate Beta HEC RAS Model

The first step was to recreate the Beta model with the information provided in the *Silver Creek Drainage Study*. The Beta Study used HEC RAS Version 4.1 to perform the hydraulic analysis for Silver Creek. There are five steps in creating a HEC RAS model:

- Starting a new project
- Entering geometric data
- Entering the flow data
- Performing the hydraulic calculations
- Viewing and printing results

The Beta Study report did not identify the input parameters used for the HEC RAS evaluation. The study did not show cross sections, identify roughness factors or the size and slope of the culverts. The Beta Study did include the results of the HES RAS computations including Flood Profiles and the Profile Summary report. A more in-depth and detail discussion of these input parameters is included in the following sections of this examination.

The Beta Study used the *HydroCAD* model (HydroCAD Software Solutions LLC) which employs the TR-20 and TR-55 method to determine peak runoff rates. TR-55 and TR-20 methods are the accepted procedures for estimating runoff peak rates.

The data used in the Hydraulic Study are usually processed using a computer model, most commonly HEC-RAS, which was developed by the U.S. Army Corps of Engineers' Hydrologic Engineering Center (*HEC-RAS Hydraulic Reference Manual* 5.1, ACOE, 2015). The hydraulic study produces flood water elevations and floodplain areas at each cross section along the river of the watershed areas. These elevations are the primary source of data used to map the area of a floodplain.

The *Silver Creek Drainage Study* included the Summary Profile for Beta's HES RAS model for the 100-year flood using the rainfall amount of 7.1 inches. The profile included information that was used to provide geometric and flow data to recreate the Beta model for this examination. The information included River Stations, flow data (Q), minimum channel elevation and water surface elevation. Appendix A shows Beta's 100-year Summary Profile from the *Silver Creek Drainage Study*. The goal was to use this data to recreate the Beta model and have the recreated model provide similar resulting water surface elevations for the 100-year flood event.

Table 1 provides a comparison between the Original Beta model and the Recreated Model for this examination for the 100-years storm event for the Eastern Section of Silver Creek and the Elbow Tributary. The flood water surface elevations are similar. Appendix A contains the Profile Summary for the Recreated Beta model created for this examination.

Table 1…Comparison between Beta Study Model and This Examination Recreated Model

Beta Study			Recreated Beta Model		
River Station	Min. Channel Elev (feet)	Water Surface Elev (feet)	River Station	Min. Chanel Elev (feet)	Water Surface Elev (feet)
9611	76.00	76.76			
9326	72.00	72.64	9325	72.00	74.27
9081	67.88	68.44	9181	67.88	68.60
8854	64.00	66.97	8692	64.00	66.48
8483	58.85	66.97	8421	58.85	66.47
8483	Gooding Ave Culvert		8371		
8375	58.36	66.96	8341	58.36	66.47
8046	58.14	66.96	7933	58.14	66.47
7473	56.00	66.96	7793	56.00	66.47
6821	56.00	66.96	7414	56.00	66.47
6595	56.00	66.96	7114	56.00	66.47
6359	56.00	66.96	6750	56.00	66.47
5909	56.00	66.96	5847	56.00	66.46
5881	High School Culvert		5819	High School Culvert	
5722	54.00	60.16	5722	54.00	61.75
5498	52.00	60.17	5630	52.00	59.09
5496	High School Road Culvert		5475	High School Road Culvert	
5307	48.00	50.51	5277	48.00	52.79
5158	46.00	47.32	5096	46.00	49.81
45.784975	36.93	45.31	4987	39.93	45.78
	St Mary's Cemetery Culvert		4240	St Mary's Cemetery Culvert	
4219	22.03	26.67	4070	22.03	24.76
3889	14.00	15.99	3933	14.00	15.24
3568	8.00	9.81	3307	8.00	10.44
3263	6.62	7.63	3008	6.44	7.43
2964	3.90	6.09	2607	3.92	5.65
	Elbow Tributary			Elbow Tributary	
2128	99.32	99.68			
1857	92.62	93.25	1935	92.62	93.15
1483	80.58	81.90	1330	80.58	80.91
1369	76.00	77.26	1118	76.00	76.33
1114	69.80	70.53	1052	69.80	69.97
972	66.00	68.15	765	66.00	68.40
829	62.50	68.16	700	62.50	68.38
793	Chestnut Culvert St.		675	Chestnut St. Culvert	
729	62.00	66.96	655	62.00	66.37
479	60.00	66.96	361	60.00	66.45
234	58.00	66.96	54	58.00	66.45

Since the Recreated Model HEC RAS produced similar results for water surface elevations to the Original Beta model, it can be used to form the basic model for examining the impact of the increased rainfall amounts on the flood water level elevations along Silver Creek (Eastern Branch).

The Recreated model used input parameters of flow data and river cross sections geometry from the Original Beta model obtained from Summary Profile contained in the *Silver Creek Drainage Study.* These parameters were not independently created for providing the data inputs into the Recreated Model. For example, the recreated model utilized the topographic data included in the *Map of the Study* area contained in the *Silver Creek Drainage Study.* The cross-section geometry was created by examining the minimum channel elevation identified in the Summary Profile and making a subjective determination of where this cross section may be located on the topographic map. This is one reason why the River Stations on the Original Beta model and the Recreated model are not identical. In order to produce a model that will adequately examine the impact of the increased rainfall amounts, all input parameters must be independently created and consistent with the Original and Recreated models.

Modified Beta Model

The goal of the Modified Beta Model is to independently create all the required input parameters for the HEC RAS Silver Creek examination. The input parameters include flow data, minimum channel depth, cross section geometry, culvert size and inverts. In order to better understand the dynamic of the river flow, additional cross-sections were also created along Silver Creek.

Flood Study Method

There are generally three major phases to a flood study of a river:

- Assess the flow (usually involving a hydrologic study)
- Determine the flood elevations and floodway (usually involving a hydraulic study)
- Map the floodplain and floodway

Hydrologic Study

Runoff is the amount of rainfall that reaches the stream. Any increase in the amount of runoff will, in turn, result in an increase in flood discharge. Discharge, measured in cubic feet per seconds, is the amount of water flowing down a stream channel. Runoff amounts and the resulting discharge rates vary depending on soil type, ground slope and land use. In general, more runoff occurs on non-vegetated land, on paved and built-on urban land, and on steeper slopes. Discharges are estimated by using rainfall and historical stream discharges records. Computer models incorporate numerous watershed characteristics into the hydrologic analyses that when completed show flood discharges for various size rainstorms that are generated along different arears along river.

The Beta Study used the HydroCAD model (HydroCAD Software Solutions LLC) which employs the TR-20 and TR-55 method to determine peak runoff rates. TR-55 and TR-20 methods are the accepted procedures for estimating runoff peak rates. They were developed by the Natural Resources Conservation Service, formerly the Soil Conservation Service that uses the specific watershed parameters to determine the peak runoff rates.

The Beta Study divided the Eastern Branch and the Elbow Street tributary into 16 different subwatersheds. For each subwatershed, their specific subwatershed characteristics of land use, soil types, and topography was entered into the *HydroCAD* model. The model produced the peak runoff rates for each subwatershed. The 16 subwatershed are shown in Appendix B of this examination. The Beta Study Appendix "HydroCAD – 2, 10- and 100-Year Storm Events" shows the specific subwatershed characteristics and the resulting peak flows rates.

This examination used *HydroCAD* (Version 10) to recreate the Beta Study *HydroCAD* model. The same subwatershed parameters used in the Beta Study were used in this examination's recreated *HydroCAD* model. Appendix B of this report includes the recreated *HydroCAD* model that identifies each subwatershed, their specific characteristic and the resulting peak runoff rates for the 100-Year Storm event. Figure 3 shows the routing diagram for the Eastern Branch and the Elbow Street Tributary. Table 2 compares the peak runoff rates from the Beta Study and with this examination's recreated *HydroCAD* model for the 100-Year Storm Event using the 7.10 inches of rainfall. The peak runoff rates are for the Eastern Branch of Silver Creek Upper and Lower Reaches.

Table 2....100 Year Peak Rate Runoff Comparison

Subwatersheds	Beta Study (cfs)	Recreated Model (cfs)
E9611	88.64	88.53
E9326	57.47	57.43
E9081	44.85	44.63
E8497	198.62	198.58
E8046	163.96	163.21
E7473	160.77	160.69
E6821	104.76	104.61
E6369	35.08	34.94
E5909	9.70	9.63
E5498	19.83	19.76
E5158	35.72	35.72
E4975	42.03	42.03
E4219	27.91	27.87
E3889	21.86	21.86
E3568	101.31	101.31
E2964	70.62	70.62

HydroCAD Routing Diagram

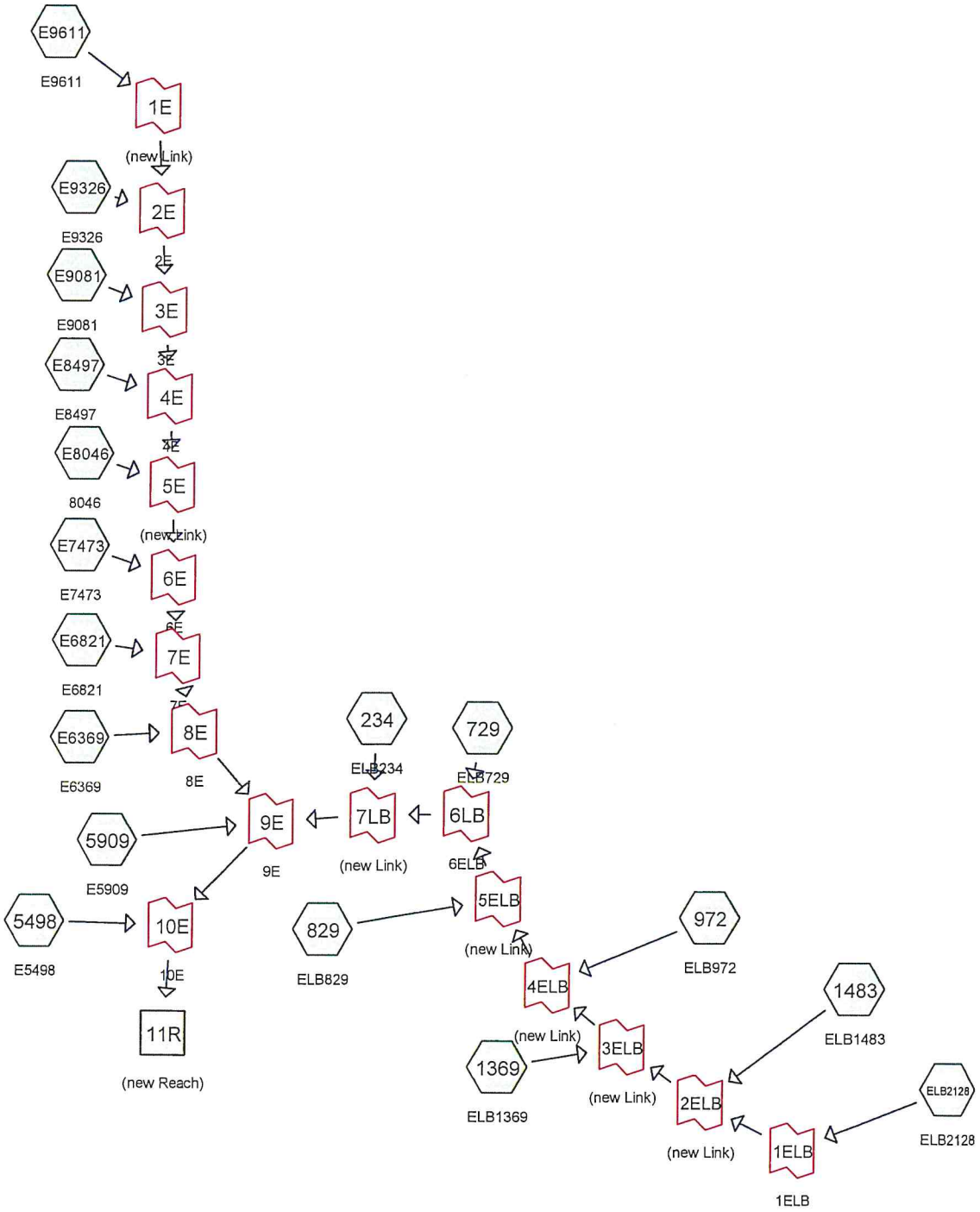


Table 2 shows the peak runoff rates are the same for both studies. The *Hydro CAD* results for Elbow Street Tributary are also the same peak runoff rates. This comparison demonstrates that the recreated *HydroCAD* model has been calibrated to the Beta Study model Thus, the recreated *HydroCAD* model can provide predicable, measurable and reliable results similar to the Beta Study model for this Silver Creek examination.

Hydraulic Study

Hydraulics is the study of fluids in motion. It is used to determine how a quantity of water will flow through a channel or floodplain. Hydraulic analysis combines:

- Flood hydrology, or discharges, (from the Hydrologic Study)
- The cross section data of a river shows how much area there is to carry the water during flooding events, and
- Stream characteristics — roughness, slope, locations and sizes of structures that effect the conveyance of water through the channel.

The data used in the Hydraulic Study are usually processed using a computer model, most commonly HEC-RAS, which was developed by the U.S. Army Corps of Engineers' Hydrologic Engineering Center (*HEC-RAS Hydraulic Reference Manual* 5.1, ACOE, 2015). The hydraulic study produces determinations of flood elevations and floodplain widths at each cross section for a range of river flow discharges. These elevations are the primary source of data used to map the area of the floodplain. The Beta Study used a "A lag time, ranging anywhere from 20 to 60 minutes, was calculated for each watershed based on the amount of time it would take to travel in the creek from the discharge point of the watershed to the next" (p6. Beta Study). The lag time for each watershed was identified in the Appendix of the Bata study and was used in this examination.

Cross-Section

A cross section is a slice through a corridor such as a river. It is perpendicular to the river and provides data on the river's geometry such as on the size and shape of the channel, the area of the floodplain, and the changes in the elevation resulting from watersheds discharges of the flowing water. Cross sections are also taken at areas that are obstructions to water flow such as culverts, buildings and bridges.

Roughness Factor

The roughness factor along the floodplain is used to determine how fast floodwater will flow through the area. Roughness factors are related to ground surface conditions, and they reflect changes in river's velocity due to ground friction. For example, water will flow faster over mowed grass and pavement than it will over an area covered in bushes and trees.

Flood Profile

The hydraulic computer program HEC RAS generates potential flood elevations at each cross section. The flood elevations at locations between the cross sections are determined by plotting the elevations at the cross sections on a graph and connecting the plotted points. The resulting graph is called a flood profile. The bottom of the graph (the horizontal axis or x-axis) shows the distance along the stream. Generally, when profiles are plotted, the slope of the streambed will rise as you read the graph from left to right or downstream to upstream. The left and right sides of the graph (the vertical axis or y-axis) show elevations in feet (NGVD 88).

Beta Study Hydraulic Analysis

The Beta Study used HEC RAS Version 4.1 to perform the hydraulic analysis for Silver Creek. As mentioned previously, the Eastern Branch was divided into 16 subwatersheds and Elbow Street tributary into nine (9) subwatersheds. Elbow Street tributary was included in the Beta Study as it flows under Chestnut Street and joins the Eastern Branch of Silver Creek near the high school. The tributary contributes to flooding problem of Silver Creek.

The Beta Study report did not identify the input parameters used for the HEC RAS evaluation. The study did not show cross sections, identify roughness factors or the size and slope of the culverts. The Beta Study included the results of the HES RAS analysis including Flood Profiles and the Profile Summary report. Appendix A contains the Flood Profile and Profile Summary from the Beta Study for the 100-year storm event using the rainfall amount of 7.10 inches. The goal of the recreated hydraulic examination is to duplicate the flood profile and profile summary data of the Beta Study. Once the recreated HEC-RAS model provides similar results to the Beta Study HEC-RAS analysis, then the new 100-year rainfall amount of 8.6 inches can be studied. Appendix A contains the Flood Profiles and Profile Summary for Eastern Branch of Silver Creek and Elbow Street Tributary for the 100-Year storm event with a rainfall amount of 7.5 inches from the Beta Study.

Recreated Hydraulic Analysis

The Recreated Hydraulic Analysis used HEC RAS Version 5.1 which is the updated computer model for flood plain analysis. The model requires three components to undertake the flood plain analysis. The components are: Geometry data, Flow data and Plan data. The geometry data includes a description of the size, shape and roughness factor for the stream cross sections. The flow data is the discharges rates from the watersheds along the stream (Hydrologic) and the plan data is parameters related to the computations of the model such as topography, cross section locations and culverts.

Cross-Sections

To analyze the Eastern Branch of Silver Creek and the Elbow Street tributary, the channel's geometry needs to be determined. The first step in creating the channel's geometry is obtain topography information along and adjacent to the stream.

For this examination, the topographic data was obtained from *Rhode Island Geographic System (RIGIS)*. RIGIS provides access to a wide variety of location based (geospatial data) for the State. One set of geospatial data is topographic information. "Statewide elevation contour lines (2-ft intervals) derived from a digital elevation model originally produced as part of the Northeast LiDAR Project in 2011." The contours lines for the Silver Creek watershed were obtained from RIGIS. The Beta Study identified the watersheds associated with Eastern Branch and Elbow Street tributary. The watersheds are identified in Appendix B "Silver Creek Watersheds". The Beta study used the same source to obtain topographic information but only an earlier version.

Cross-Sections were created using the RIGIS topographic information. The HEC RAS model can extract detailed cross sections generated by AutoDesk Civil 3D. "AutoDesk Civil 3D is an engineering software application used by civil engineers to plan, design, and manage civil engineering projects. These projects fall under the three main categories; land development, water, and transportation projects and flood plain analysis. Civil 3D is well known in the civil engineering community and widely used on a variety of infrastructure design projects."

The topographic information from RIGIS was imported into Civil 3D and converted into a surface model. The surface model is a 3D representation of the ground surface showing contours line indicating lines of different elevations. The surface model was created with one-foot contour lines by Civil 3D. A topographic and cross-section model was created in Civil 3D and exported into HEC RAS for the flood plain analysis.

The cross sections are created by using Civil 3D to define an alignment and then creating cross sections along the alignment. The alignment is a line that identifies the centerline of the Eastern Branch of Silver Creek and the Elbow Street tributary. Lines were then drawn perpendicular to both alignments crossing the detailed topographic surface model to create cross-sections. The location of the cross-sections was generally in the same place as the Beta Study.

The Beta Study cross-sections locations were identified in the Profile Summary reference as River Stations. These cross-sections represented areas were the flow rate changes along the river as a result of input from the various sub watersheds. Additional cross-sections were produced in this examination to provide a better correlation with the Beta Study and a more detailed understanding of the river flow and flooding dynamics.

Figure 4 shows an example of a cross-section along the Eastern Branch of Silver Creek. The figure shows a photograph of the natural river and the created model image of this cross section. Figure 5 shows an example of the model created cross-section of an existing culvert along Silver Creek. The cross-sections identify the River Station. The axis to the left is the elevations and the bottom

axis is the length of the cross-section from left to right looking downstream. The cross-sections are generally in the shape of a V, U or semi-circle with the lowest elevation representing the bottom of the stream and the ascending lines indicating the banks of the stream.

Culverts Along Silver Creek

Culverts are structures that carry water under a road or other manmade structures. They allow vehicles or pedestrians to cross over the stream while allowing water to move through the culvert. There are seven culverts that convey water from Eastern Branch of Silver Creek and the Elbow Street Tributary. Table 3 shows the location of the culverts and their sizes.

Table 3…Culverts

River Reach	Location	Size
Upper Eastern Branch	Gooding Avenue	48" Circular
Lower Eastern Branch	High School	Twin 48" Circular
Lower Eastern Branch	High School	Twin 48" Circular
Lower Eastern Branch	High School Road	Twin 48" Circular
Lower Eastern Branch	Chestnut Street	Twin 48" Circular
Lower Easter Branch	St Mary's Cemetery	48" Circular
Elbow Street Tributary	Chestnut Street	48" Circular

The Beta Study report did not provide information on the culverts. It appears the Study estimated the culverts to be 48" circular in size with a slope of 1 percent. The elevation of the road above the culvert and the inverts of the culvert were obtained from an interpretation of the flood profile included in the Beta Study. The Profile is drawn to scale with elevations on the y axis and distances along the river on the x axis. The Profile showed the culverts and the road or building above the culverts.

Based on this profile, the elevations of the roadways and buildings and the inverts of the culverts was obtained from the Profile. These elevations were correlated with the topographic information. Cross -sections were created immediately before and after the culverts to complete the culvert inputs into the HEC RAS model.

The culvert examination involved interpretation of the Beta culvert information from the profile. This information was verified and supplemented by a plan produced in 2013 for drainage improvements at Mt Hope High School (*Mt Hope High Schools Drainage Improvements*, JMMA, September 2013). The plan set contained an Existing Condition Plan, that was based on a Record Survey Plan, with elevations using NGVD 1929. The existing vertical datum is NVGD 1988.

However, with proper conversion, the plan was useful in obtaining the sizes and inverts of the culverts along the High School section of Silver Creek. The plan corroborated this examination's interpretation of the Beta Study's culvert information.

Figure 4 Cross Section

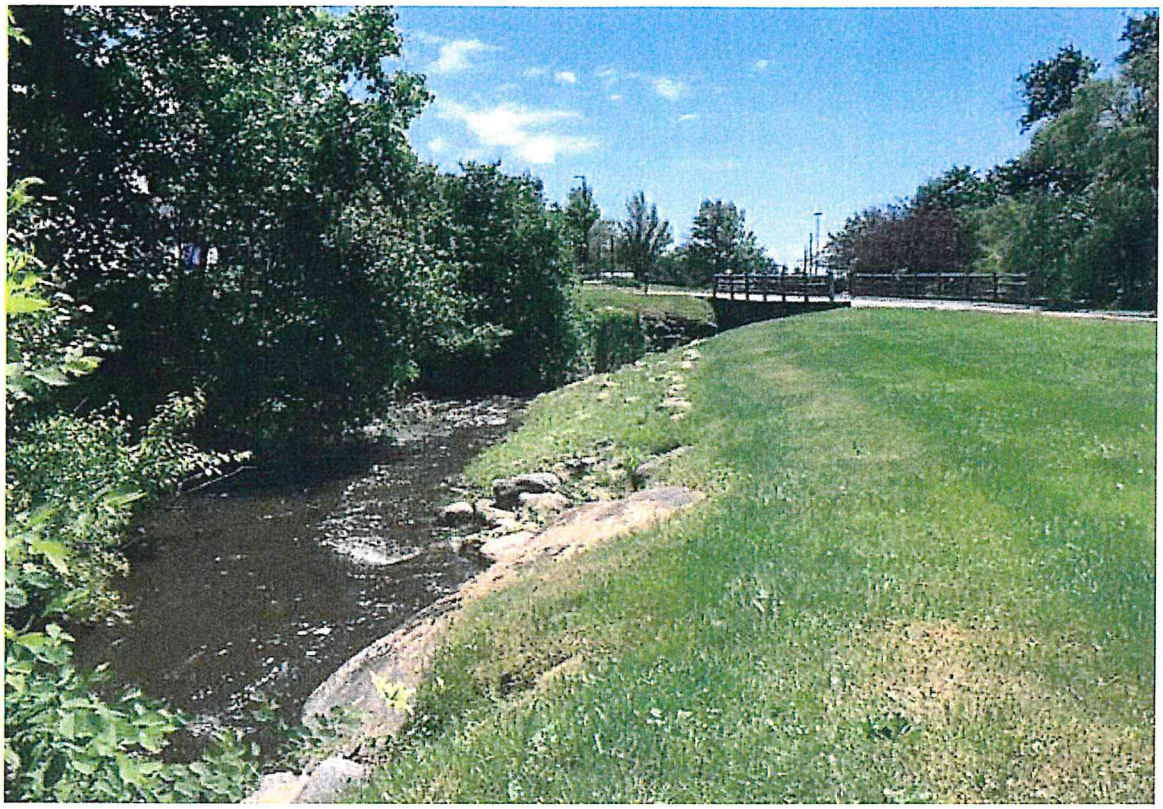


Figure 4...River Section 5551 Near High School Bridge (Looking Downstream)

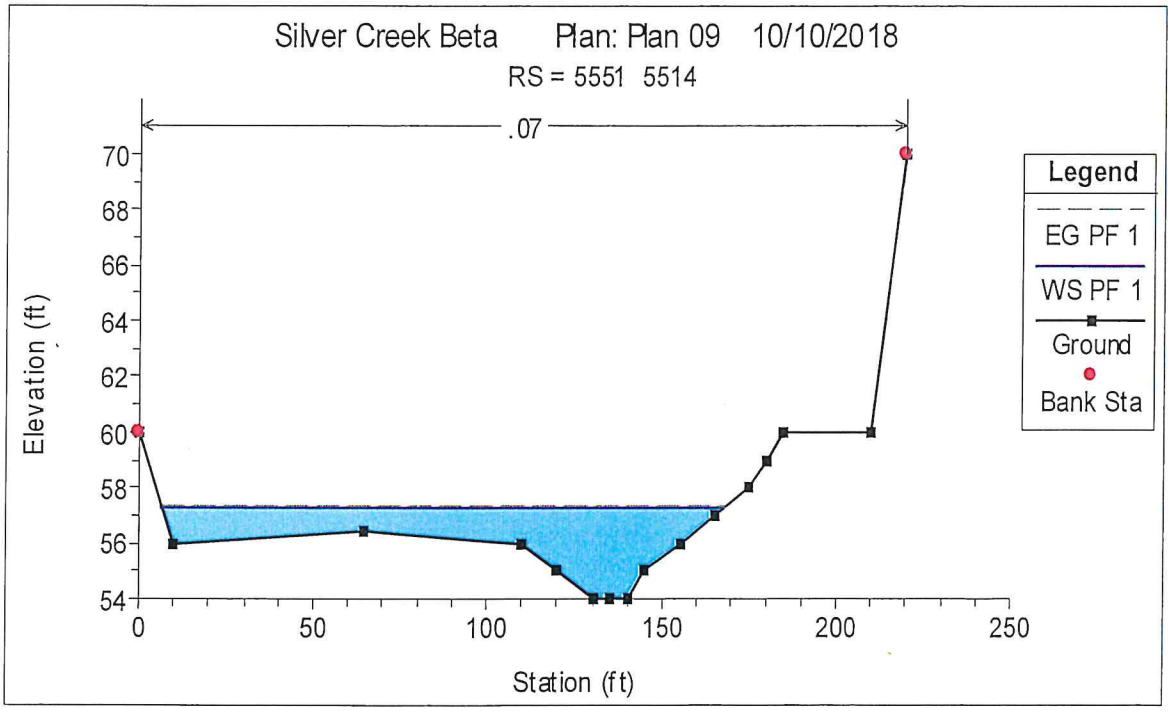
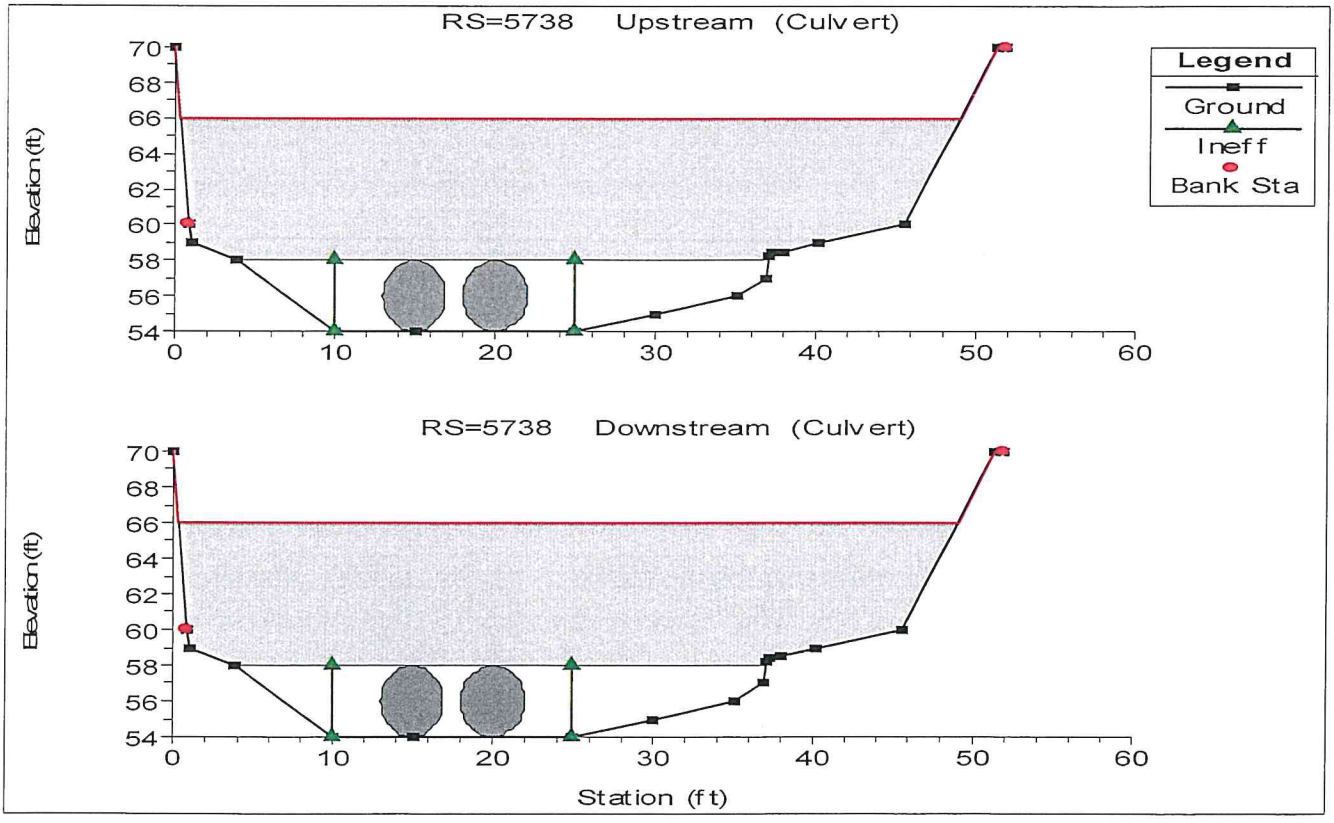


Figure 4...HEC RAS Cross Section Model River Section 5551 Near High School Bridge (Looking Upstream)

Figure 5...River Station 5738 twin 48" Culverts under High School (looking upstream)

Figure 5...HEC RAS Cross-Section Model River Station 5738 twin 48" Culverts under High School



Silver Creek Flood Profile (recreated/modified)

HEC RAS combines the Hydrologic and Hydraulic studies to produce the flood profile. Figure 6 shows the schematic layout of the Eastern Branch of Silver Creek and Elbow Street tributary from HEC RAS recreated model. The layout shows the location of the cross-sections and culverts along the stream.

The Flood Profiles and Profile Summary for the recreated HEC RAS model for the 100-year storm event for this examination is included in Appendix C. Table 4 shows a comparison of the Beta Study HEC RAS model and the recreated HEC RAS model. The two key components the comparison are minimum channel elevation and the resulting water surface elevation. The resulting water surface elevation is considered the flood elevation of the river at each of the identified river stations. Table 4 shows the river stations for the Beta model and the recreated model. It also shows the minimum channel elevation and water surface elevation at each river station. These values were obtained from the computation of the HEC RAS model resulting from the Hydrologic and Hydraulic data inputs. The Profile Summary for the Beta model is in Appendix b and from the Recreated Model in Appendix C.

Figure 6… Schematic Layout Silver Creek and Elbow Street Tributary

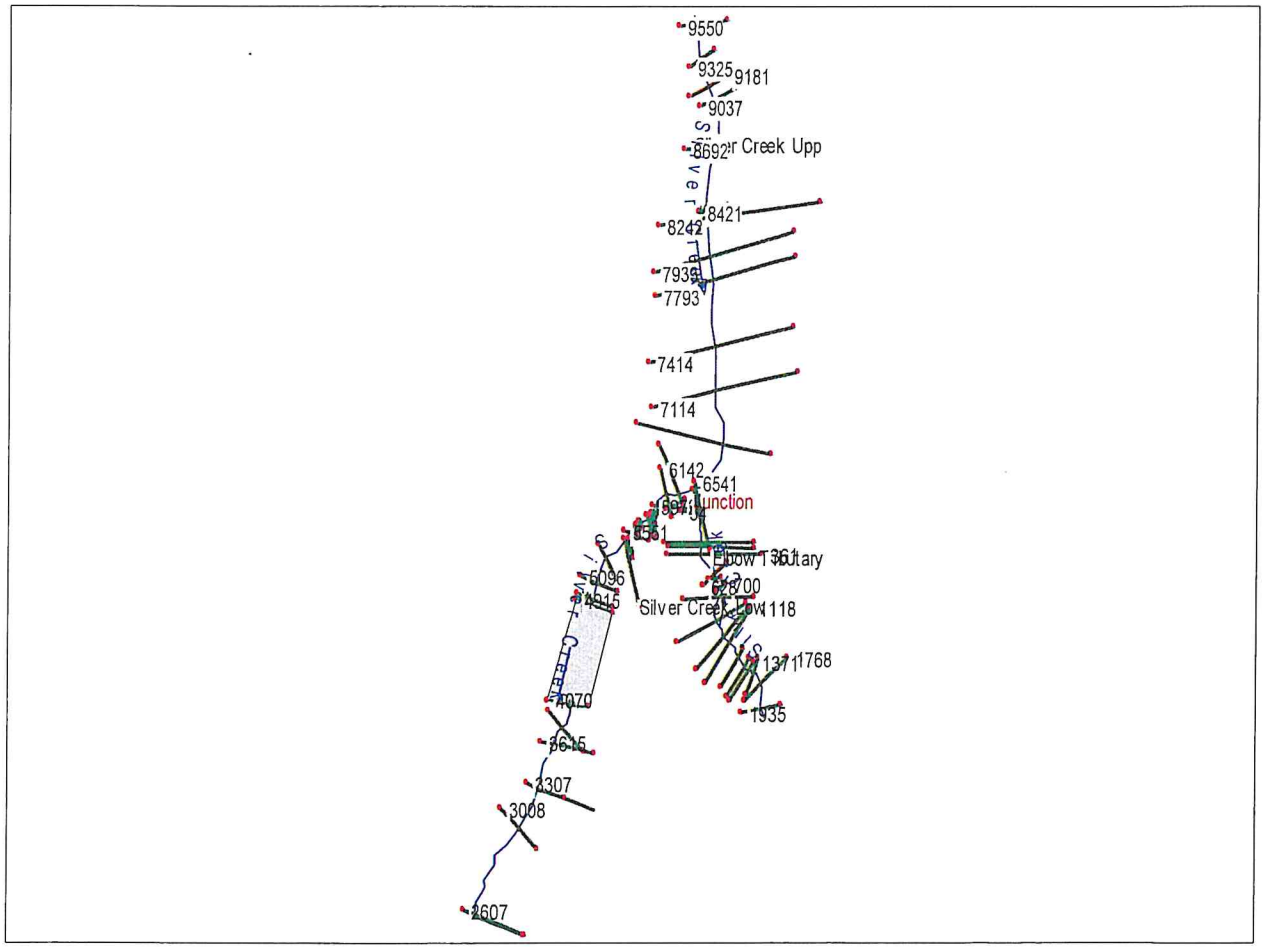


Table 4…Comparison between Beta Study Model and This Examination Recreated Model

Beta Study			Recreated Model		
River Station	Min. Channel Elev (feet)	Water Surface Elev (feet)	River Station	Min. Chanel Elev (feet)	Water Surface Elev (feet)
9611			9550	78.00	79.30
9326	76.00	76.76	9325	75.00	76.16
9081	72.00	72.64	9181	72.00	73.01
	67.88	68.44	9037	69.00	70.07
8854	64.00	66.97	8692	64.00	67.25
			8483	64.00	67.25
8483		58.85	66.97	58.85	67.24
8483	Gooding Ave Culvert		8371	Gooding Ave Culvert	
8375	58.36	66.96	8341	58.26	67.24
			8242	58.26	67.24
8046	58.14	66.96	7933	58.14	67.24
7473	56.00	66.96	7793	57.00	67.24
6821	56.00	66.96	7414	56.00	67.24
6595	56.00	66.96	7114	56.00	67.24
6359	56.00	66.96	6750	56.00	67.24
			6541	55.50	67.24
			6315	55.00	67.24
			6142	55.00	67.24
			5972	55.00	67.24
			5854	55.00	67.23
5909	56.00	66.96	5847	54.00	67.22
5881	High School Culvert		5819	High School Culvert	
			5809	54.00	66.45
			5774	54.00	66.45
			5766	54.00	66.45
			5758	54.00	66.43
			5738	High School Culvert	
5722	54.00	60.16	5722	54.00	59.37
5498	52.00	60.17	5630	54.00	57.95
			5551	54.00	57.40
			5490	51.00	56.85
5496	High School Road Culvert		5475	High School Road Culvert	
			5465	50.00	54.50
			5388	50.00	53.19
5307	48.00	50.51	5277	46.00	49.79
5158	46.00	47.32	5096	43.00	48.70
4975	36.93	45.31	4987	39.93	48.60
4947	Chestnut St/St Mary's Cemetery Culvert		4950	Chestnut Street Culvert	
			4801	36.00	48.58
	St Mary's Cemetery Culvert		4240	St Mary's Cemetery Culvert	
4219	22.03	26.67	4070	22.03	26.93
3889	14.00	15.99	3933	14.00	15.60
			3615	8.00	10.39
3568	8.00	9.81	3307	6.12	7.00
3263	6.62	7.63	3008	3.61	6.04
2964	3.90	6.09	2607	2.50	5.85
			2603	2.00	5.65

Table 4 shows the resulting water surface elevations for each model at the comparable locations of the river stations. The water surface flood elevations created by each model results in essentially the same elevations.

Since the flood water surface elevations for both models are relatively the same, the cross sections and their represented flood elevations for the recreated model are similar to the Beta model. This is one of the more important parameters that must be consistent between the two models in order to confirm the two models produce similar results.

This comparison demonstrates that the recreated HES RAS model, generated for this examination, has been created/calibrated to the original Beta Study model. Thus, the recreated HEC RAS model can be used to provide predicable, measurable and reliable results similar to the HEC RAS Beta Study model.

Change in Condition

Since the Beta Study was completed, the RIDEM has revised the *Rhode Island Design and Installation Standards Manual (*The Manual) specifically the 24-Hour Type III Rainfall Amounts. The Betal model utilized the 2007 rainfall amounts.

However, in 2010, RI DEM presented a new *Rhode Island Design and Installation Standards Manual* (subsequently amended in 2015) that revised the rainfall amounts particularly for the 100-year storm event. The 100-year storm event rainfall amount increased from the 2007 value of 7.10 inches that the Beta used in their study to 8.6 inches. The 8.6 inches is the current value mandated by the regulatory agencies for the 100-year storm. (The Manual, Table 3-1 Rainfall Amounts for Rhode Island, p3-1). "All Rhode Island rainfall values were obtained from the Northeast Regional Climate Center (NRCC) using regional data processed by NRCC from the period through December 2008" (The Manual p.4). All proposed developments must comply with the revised Manual.

Revised Flood Profile

Hydrology

With the recreated HEC RAS models, in this examination, providing similar results to the original Beta Study HEC RAS model, the new rainfall amount for the 100-Year storm event can be incorporated into the recreated model to examine the potential impact on the flood elevations and flooding areas along Silver Creek. The first step in this analysis is to use the recreated *HydroCAD* model to produce the peak runoff rates from a storm with a rainfall amount of 8.6 inches. This examination used *HydroCAD* (Version 10) to recreate the Beta Study *HydroCAD* model. The same subwatershed parameters used in the Beta Study were used in the recreated *HydroCAD* model for the new rainfall amount of 8.6 inches. Appendix B of this report includes the recreated *HydroCAD* that identifies each subwatershed, their specific characteristic and the resulting peak runoff rates for the 100-Year Storm event.

Hydraulic Analysis

The Recreated Hydraulic Analysis used HEC RAS Version 5.1 which is the updated computer model for flood plain analysis. The model requires three components to undertake the flood plain analysis. The components are: Geometry data, Flow data and Plan data. The only parameter that changes is the flow date. The revised peak runoff rates from the recreated *HydroCAD* model were entered into the recreated HEC RAS model.

Table 5 below shows the original peak runoff rates for each of the Beta Study watersheds using the 100-year storm rainfall amount of 7.5 inches. The revised peak runoff rates for each of the watersheds were produced using the 8.5 inches of rainfall. Appendix D contains the revised HydroCAD examination.

Table 5.... Revised 100-Year Peak Runoff Rates

Subwatersheds	Original Recreated Model (cfs) (7.5 inches)	Revised Recreated Model (cfs) (8.5 inches)
E9611	88.6	110.91
E9326	57.43	75.47
E9081	44.63	57.01
E8497	198.58	258.13
E8046	163.21	203.79
E7473	160.69	206.22
E6821	104.61	133.84
E6369	34.94	45.50
E5909	9.63	12.21
E5498	19.76	25.03
E5158	35.72	43.72
E4975	42.03	54.19
E4219	27.87	36.66
E3889	21.86	28.32
E3568	101.31	135.58
E2964		125.65

The next step was to incorporate the revised runoff rates into the recreated HES RAS model. The revised runoff rates, as expected, increase the Q total for water flow along Silver Creek. The higher Q total resulted in a higher flood elevation. Table 6 on the next page shows the higher flow elevations resulting for the higher rainfall amount of 8.5 inches for the 100-Year storm for Silver Creek. Appendix D rainfall 8.6 inches contains the HEC RAS Summary Profile for the new flow rates.

Table 6 … Water Surface Elevation

River Station	Water Surface Elev (feet)	Revised Water Surface Elev (feet)	Difference (feet)
9550	79.30	79.41	0.11
9325	76.16	76.29	0.13
9181	73.01	73.12	0.11
9037	70.07	70.10	0.03
8692	67.25	67.76	0.51
8483	67.25	67.75	0.5
8421	67.24	67.75	0.51
8371	Gooding Ave. Culvert		
8341	67.24	67.75	0.51
8242	67.24	67.75	0.51
7933	67.24	67.75	0.51
7793	67.24	67.75	0.51
7414	67.24	67.75	0.51
7114	67.24	67.75	0.51
6750	67.24	67.75	0.51
6541	67.24	67.75	0.51
6315	67.24	67.75	0.51
6142	67.24	67.75	0.51
5972	67.24	67.75	0.51
5854	67.23	67.74	0.51
5847	67.22	67.71	0.49
5819	High School Culvert		
5809	66.45	67.01	0.56
5774	66.45	67.01	0.56
5766	66.45	67.00	0.55
5758	66.43	66.98	0.55
5738	High School Culvert		
5722	59.37	59.91	0.54
5631	57.95	58.21	0.26
5551	57.40	57.70	0.3
5490	56.85	57.11	0.26
5475	High School Road Culvert		
5465	54.50	54.90	0.4
5388	53.19	53.63	0.44
5277	49.79	50.27	0.48
5096	48.70	49.01	0.31
4987	48.60	48.86	0.26
4950	Chestnut St Culvert		
4915	48.58	48.83	0.25
4240	St Mary Cemetery Culvert		
4070	26.93	27.95	1.02
3933	15.60	15.83	0.23
3615	10.39	10.54	0.15
3307	7.00	7.17	0.17
3008	6.04	6.80	0.76
2607	5.85	6.67	0.82
2603	5.65	6.49	0.84

Potential Floodway Determination

A floodway is a corridor of effective flood area. It usually consists of a stream channel and any adjacent areas that are needed to convey a particular flood event. HEC RAS is used to describe the physical properties of a river and to route flows through the river. Using the peak flows, HEC RAS computes the resulting water surface elevations at each cross-section. These elevations along with distance from the stream center line for each of the cross sections can be plotted on the topographic map. The plotted elevations on the topographic plan potentially shows the boundaries and aerial extent of flood inundation.

The water surface elevations from the HEC RAS Recreated model for each cross section were plotted on the topographic map for Silver Creek. The water surface elevations along Silver Creek and Elbow Tributary were plotted as Spot Elevation using Civil 3D. These spot elevations or points were then connected by a polyline. The polyline represents the potential boundaries and aerial extent of flood inundation.

The fold out map included with this examination shows the potential floodway determination. The most noticeable visual of the map is the extent that the wetland areas mitigate the flood waters. Most of the existing wetland areas are within the boundaries of the flood inundation. It is precisely for this function that wetland areas are protected from development. It is also for this reason that development should not occur within these areas as it will be susceptible to damage caused by flood waters.

The fold out map also shows how the water flow of Silver Creek is constrained by the culverts and buildings as it passes through the high school. This causes the flood waters to back up and spread out in the upstream areas. Most of this inundation areas are wetlands although some private properties are affected. A similar situation occurs within St Mary's Cemetery where the single 48" diameter pipe has insufficient capacity to convey the volume of flood waters. This causes the flood waters to overflow the pipe and flow along the surface.

Conclusion

The revised HEC RAS model showed an increase in flood elevations along Silver Creek ranging from about 2 inches to 1 foot. The average increase in flood water elevation is 0.44 feet or a little over 5 inches. The increase in flood water level elevation should be anticipated as the characteristics of the watersheds have not changed but the rainfall amount has increased. The increase in flood water elevation is not intended to be predictive but to provide a numerical identification of the range of possible flood elevations escalations.

This examination demonstrates that these is a potential increase in flood elevations and flooding areas resulting from the increase rainfall amount. It reinforces Beta's Study's results that the flooding problems along Silver Creek require a thoughtful and comprehensive examination to mitigate the flooding.

The HEC RAS model in this examination seems to shows that flood elevations between Gooding Avenue and Chestnut Street are affected by the culverts under the high school and the high schools'

buildings above these culverts. The model shows that the culverts have insufficient capacity to convey the amount of flood waters being generated by the upstream watersheds. The flood water rises above the culverts. The waters are then blocked by the buildings above the culverts causing an increase in flood elevations and the water to flow over the surface. The model calibrations look as if the buildings acts like a dam restricting the flow of the flood water.

The model is very sensitive to the culverts under the high school. The high school's walkway connecting the high schools' buildings can act as dam restricting the flood waters. It appears to be also causing flooding inside some of the high school buildings. This needs to be examine more closely. For a more precise and detail examinations, the HEC RAS model should be supplemented by detail cross sections survey of the culverts and critical cross sections along the river.

This examination confirms and reinforces the analysis of the Beta Study. It shows the potential for increased flooding between Gooding Avenue and Chestnut Street and within St Mary Cemetery as a result of the increased rainfall amount. It supports and reinforces the conclusion of the *Silver Creek Drainage Study* that the existing wetland areas are critical to controlling and mitigating the flood elevations and the resulting extent of flood areas.

The Study's conclusion that "**It is recommended that additional storage be constructed, particularly upstream of the local areas currently experiencing flooding, and on vacant land, to retain stormwater runoff until the peak flows have safety passed....Possible locations include along Gooding Avenue, Naomi Street, within the Mount Hope High School campus ....**" (p.21 The *Silver Creek Drainage Study*).

Declaration

My examination was conducted solely by myself. It represents my work product and my opinions. It was not commissioned or supported financially by the Town, any regulatory agency or any advocatory group. It resulted from concerns expressed by my neighbors that any development within wetland areas could cause increased flooding to their property.

My study was conducted to gain a better understanding of the potential increase of flood water elevations and extent of flooding areas along Silver Creek. It was meant to provide a recognition of the existing flooding issues and the need to recognize the important role that wetland areas have in mitigating flood areas. It provides support, in my opinion, for a comprehensive examination of the flooding issues along Silver Creek. It recognizes that the *Silver Creek Drainage Study* provides a solid basis for such an examination. A supplementary Study should be supported with detail survey data. It should also be integrated with the FEMA maps to provide a better mechanism for controlling flooding along Silver Creek.

The study is not meant to be predicative of the exact flood elevations or flooding areas. It is based on the comparative recreation of the Beta model. An exact recreation of the Beta model is difficult without having access to their cross-section data or their culvert parameters. Yet this examination's recreated and modified models do produces comparative results with the Beta model consistent with the purpose of this examination. It is my opinion, that given the consistency

of this examination's modes with the original Beta model, the increase rainfall amount model can be useful in identifying the potential for more severe flooding along Silver Creek and the need for timely response action.

Although the overall results (100-year elevations) will most likely not change significantly, a better understanding and greater confidence levels can be obtained by a more in-depth examination of the HEC RAS model parameters. These include:

- Historic Flood High water Marks - Where the data exists, this floodplain examination could be complemented by comparing the estimated elevations with known high-water marks from actual past floods.

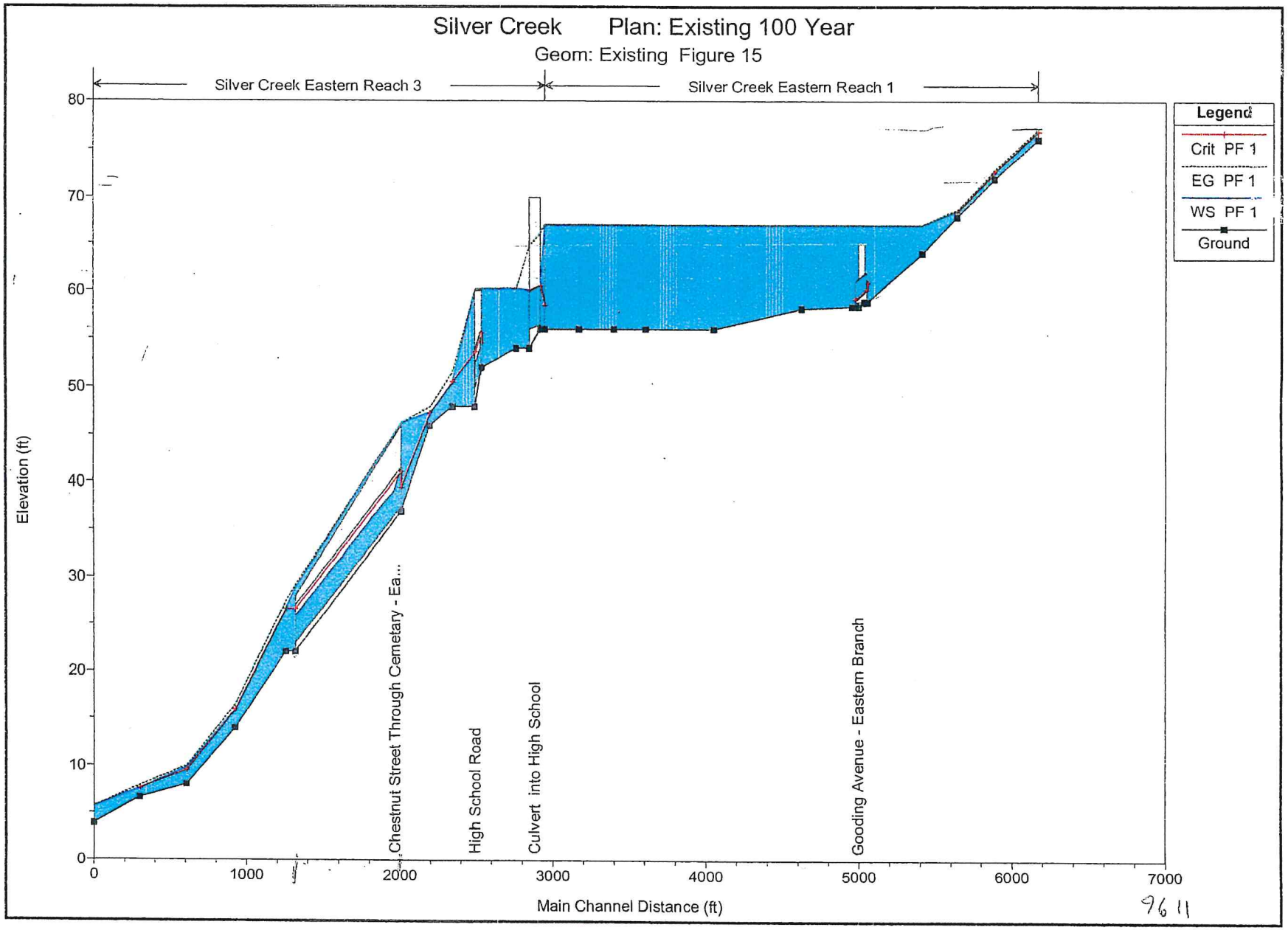
- Roughness coefficients – Specific site examination of the type of surface characteristic for each cross-section. This would include site examination to visually observe and identify specific site characteristics.

- Survey Culverts – A survey of the culverts will provide the detail information on size, lengths, inverts, material and condition.

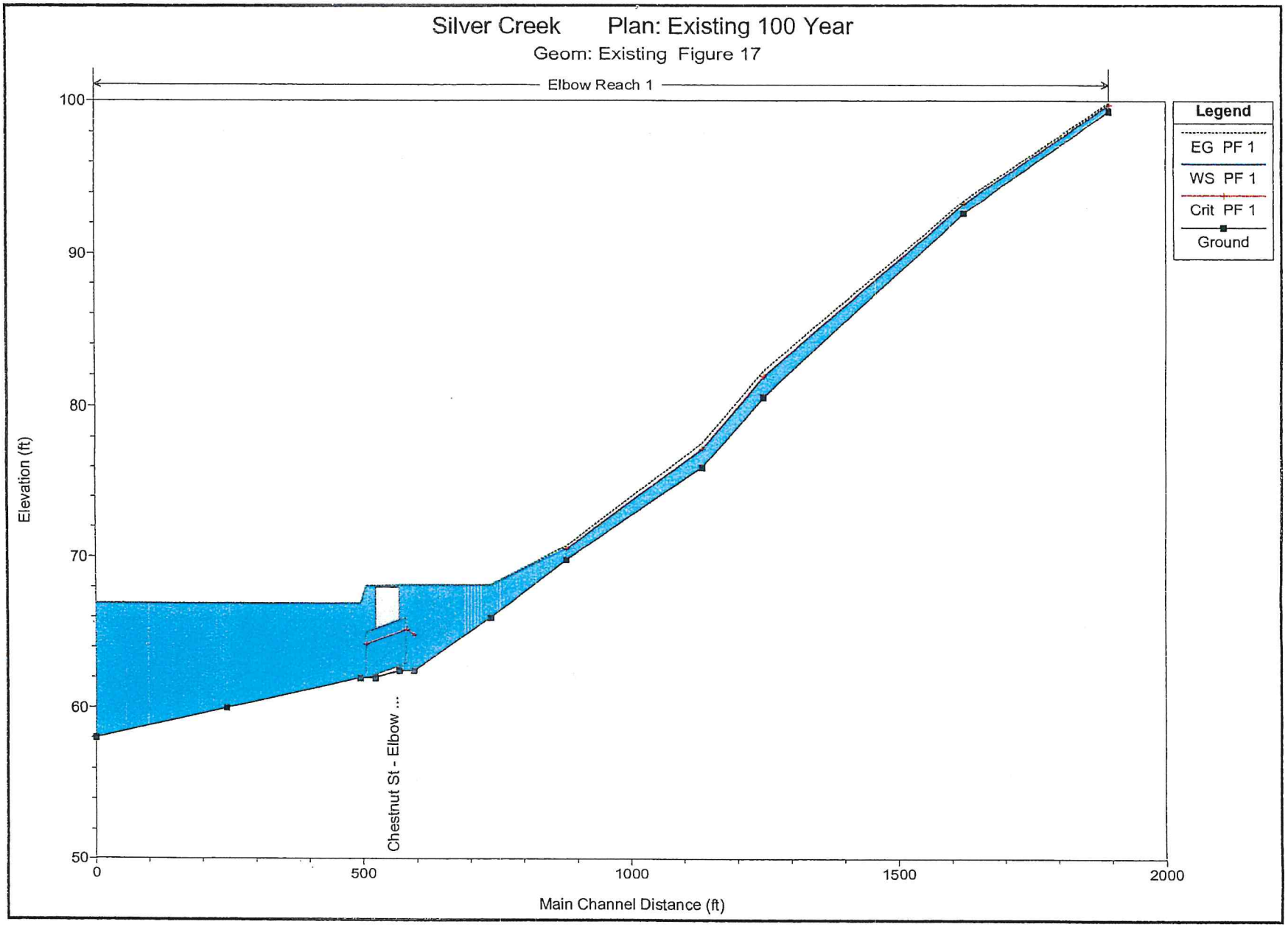
- Survey Critical Cross-Sections – A survey, of the critical cross-sections will provide detail information on width, specific point elevations alongg

APPENDIX A

Beta's 100-year Summary Profile from the *Silver Creek Drainage Study*


Silver Creek Plan: Existing 100 Year
Geom: Existing Figure 15
Silver Creek Eastern Reach 3
Silver Creek Eastern Reach 1
Legend
Crit PF 1
EG PF 1
WS PF 1
Ground
Elevation (ft)
Main Channel Distance (ft)
Chestnut Street Through Cemetary - Ea...
High School Road
Culvert into High School
Gooding Avenue - Eastern Branch
0
10
20
30
40
50
60
70
80
0
1000
2000
3000
4000
5000
6000
7000

Item C1.


Silver Creek Plan: Existing 100 Year
Geom: Existing Figure 17
Elbow Reach 1
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Elevation (ft)
100
90
80
70
60
50
0
500
1000
1500
2000
Main Channel Distance (ft)
Chestnut St - Elbow ...

Item C1.

HEC-RAS Plan: Plan 09 River: Silver Creek Reach: Silver Creek Upp Profile: PF 1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Silver Creek Upp	9325	PF 1	88.64	72.00	73.75	72.84	73.84	0.007318	2.41	36.77	22.07	0.33
Silver Creek Upp	9181	PF 1	88.64	67.88	68.43	68.43	68.64	0.096840	3.68	24.06	57.77	1.01
Silver Creek Upp	8692	PF 1	143.08	64.00	66.52		66.52	0.000022	0.11	1254.35	1014.00	0.02
Silver Creek Upp	8421	PF 1	337.53	58.85	66.50	62.37	66.50	0.000075	0.42	802.37	229.95	0.04
Silver Creek Upp	8371		Culvert									
Silver Creek Upp	8341	PF 1	337.53	58.36	66.45		66.46	0.000099	0.46	739.39	229.55	0.04
Silver Creek Upp	7933	PF 1	337.53	58.14	66.46		66.46	0.000001	0.06	5873.49	1156.58	0.00
Silver Creek Upp	7793	PF 1	337.53	56.00	66.46		66.46	0.000001	0.06	5959.88	1156.39	0.00
Silver Creek Upp	7414	PF 1	361.40	56.00	66.46		66.46	0.000000	0.05	7773.95	1249.51	0.00
Silver Creek Upp	7114	PF 1	361.40	56.00	66.45		66.45	0.000000	0.04	8475.35	1249.51	0.00
Silver Creek Upp	6541	PF 1	373.98	56.00	66.45		66.45	0.000002	0.10	3621.19	456.45	0.01

Item C1.

HEC-RAS Plan: Plan 09 River: Silver Creek Reach: Elbow Tributary Profile: PF 1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Elbow Tributary	1935	PF 1	78.21	92.62	93.15		93.16	0.008027	0.96	81.45	226.89	0.28
Elbow Tributary	1330	PF 1	129.10	80.58	80.91	80.91	80.98	0.152630	2.15	60.05	455.01	1.04
Elbow Tributary	1118	PF 1	129.10	76.00	76.33		76.35	0.014962	1.13	114.26	398.02	0.37
Elbow Tributary	1052	PF 1	133.04	69.80	69.97	69.97	70.04	0.114594	2.16	61.51	372.45	0.94
Elbow Tributary	765	PF 1	134.83	66.00	68.40		68.40	0.000081	0.26	525.32	337.91	0.04
Elbow Tributary	700	PF 1	134.83	62.50	68.38	63.97	68.39	0.000438	0.69	195.82	99.09	0.09
Elbow Tributary	675		Culvert									
Elbow Tributary	655	PF 1	198.89	62.00	66.37		66.52	0.006039	3.06	65.05	75.19	0.34
Elbow Tributary	361	PF 1	198.89	60.00	66.45		66.46	0.000177	0.57	350.48	122.18	0.06
Elbow Tributary	54	PF 1	198.89	58.00	66.45		66.45	0.000002	0.08	2405.60	537.64	0.01

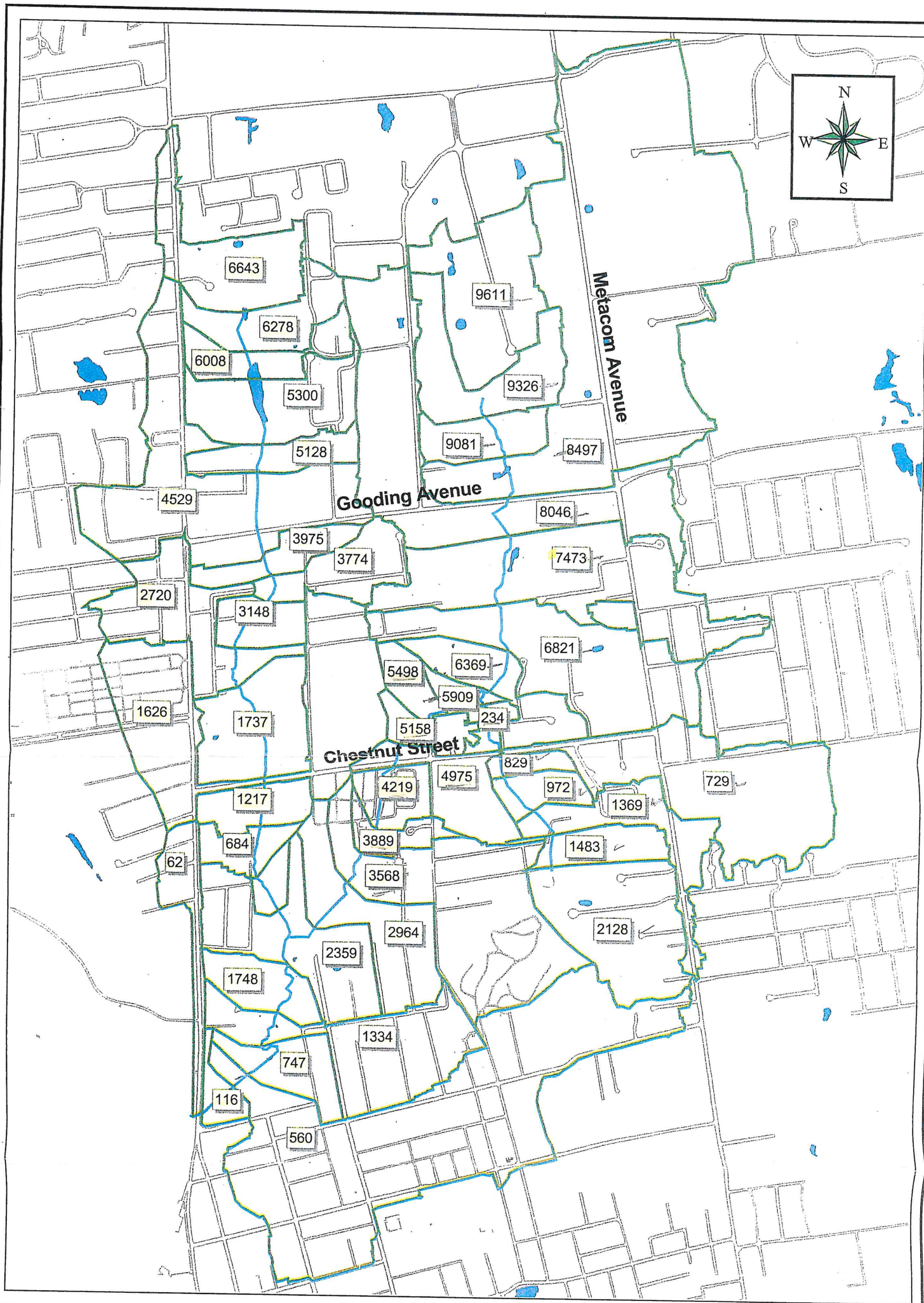
HEC-RAS Plan: Plan 09 River: Silver Creek Reach: Silver Creek Low Profile: PF 1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Silver Creek Low	5847	PF 1	358.46	56.00	66.44	58.60	66.45	0.000140	0.84	426.78	58.87	0.05
Silver Creek Low	5819		Culvert									
Silver Creek Low	5809	PF 1	358.46	56.00	61.75		61.83	0.003215	2.28	156.89	56.05	0.24
Silver Creek Low	5722	PF 1	358.46	54.00	59.23		59.41	0.008041	3.42	104.84	40.31	0.37
Silver Creek Low	5490	PF 1	429.34	52.00	56.81	54.91	56.90	0.006583	2.47	173.49	98.08	0.33
Silver Creek Low	5475		Culvert									
Silver Creek Low	5388	PF 1	429.34	48.00	52.91		52.98	0.004081	2.09	205.21	105.46	0.26
Silver Creek Low	5277	PF 1	429.34	46.00	49.81	49.81	50.80	0.064603	7.96	53.91	27.44	1.00
Silver Creek Low	4987	PF 1	429.34	36.93	45.78	39.10	45.81	0.000945	1.50	286.97	78.16	0.14
Silver Creek Low	4240		Culvert									
Silver Creek Low	4070	PF 1	435.58	22.00	24.76	24.54	25.74	0.048506	7.95	54.81	21.65	0.88
Silver Creek Low	3933	PF 1	436.44	14.00	15.24	15.24	15.82	0.069461	6.14	71.07	61.37	1.01
Silver Creek Low	3615	PF 1	436.44	8.00	10.44	9.70	10.45	0.002967	1.09	400.67	438.00	0.20
Silver Creek Low	3307	PF 1	443.30	6.44	7.43	7.43	7.67	0.094181	3.99	111.08	231.64	1.02
Silver Creek Low	3008	PF 1	443.30	3.90	5.88		5.90	0.001399	1.15	386.41	221.69	0.15
Silver Creek Low	2607	PF 1	446.09	2.00	5.65	3.08	5.66	0.000500	0.90	498.06	190.06	0.10

Item C1.

APPENDIX B

Eastern Branch and the Elbow Street tributary 16 Subwatersheds



Legend

Silver Creek

Silver Creek Watersheds

Town of Bristol Rhode Island

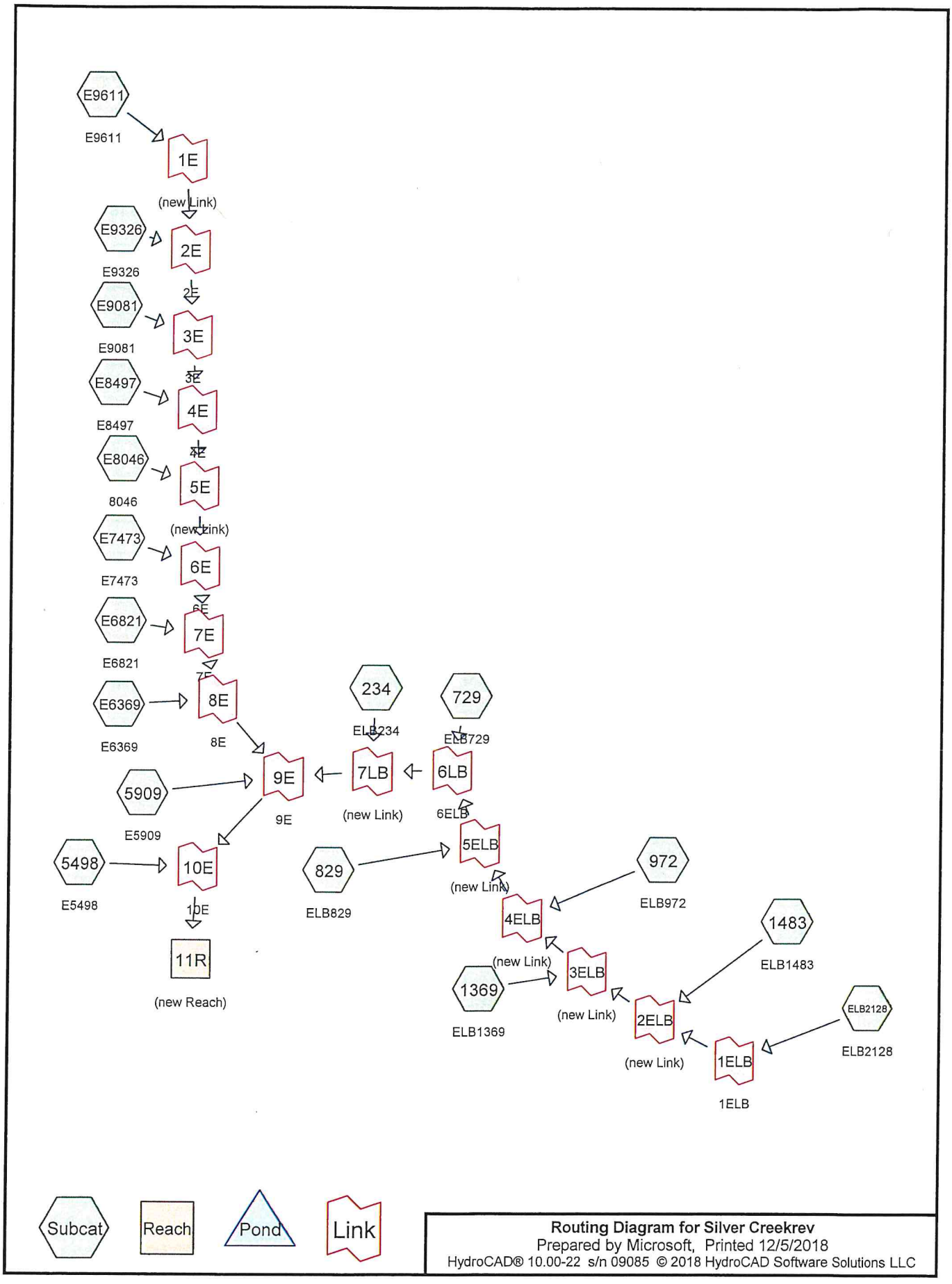
Silver Creek

NOT TO SCALE

Appendix

Silver Creek Watersheds

Item C1.


E9611
E9611
1E
(new Link)
E9326
2E
E9326
2E
E9081
3E
E9081
3E
E8497
4E
E8497
4E
E8046
5E
8046
(new Link)
E7473
6E
E7473
6E
E6821
7E
E6821
7E
E6369
8E
E6369
8E
234
ELB234
729
ELB729
5909
9E
7LB
6LB
E5909
9E
(new Link)
6ELB
5498
10E
E5498
10E
829
ELB829
5ELB
(new Link)
972
ELB972
4ELB
1483
ELB1483
(new Link)
1369
3ELB
ELB1369
(new Link)
2ELB
ELB2128
(new Link)
1ELB
ELB2128
1ELB
11R
(new Reach)
Subcat
Reach
Pond
Link
Routing Diagram for Silver Creekrev
Prepared by Microsoft, Printed 12/5/2018
HydroCAD® 10.00-22 s/n 09085 © 2018 HydroCAD Software Solutions LLC

Summary for Subcatchment 829: ELB829

Runoff = 14.85 cfs @ 12.42 hrs, Volume= 1.936 af, Depth= 5.47"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-yearnew Rainfall=8.60"

Area (ac)	CN	Description
0.750	81	1/3 acre lots, 30% imp, HSG C
3.500	73	Woods, Fair, HSG C
4.250	74	Weighted Average
4.025		94.71% Pervious Area
0.225		5.29% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
22.2	150	0.0400	0.11		**Sheet Flow, Sheet** Woods: Light underbrush n= 0.400 P2= 3.30"
10.0	600	0.0400	1.00		**Shallow Concentrated Flow, Concentrated** Woodland Kv= 5.0 fps
32.2	750	Total			

Summary for Subcatchment 972: ELB972

Runoff = 28.03 cfs @ 12.35 hrs, Volume= 3.384 af, Depth= 5.47"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-yearnew Rainfall=8.60"

Area (ac)	CN	Description
1.000	81	1/3 acre lots, 30% imp, HSG C
6.430	73	Woods, Fair, HSG C
7.430	74	Weighted Average
7.130		95.96% Pervious Area
0.300		4.04% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.7	150	0.0400	0.17		**Sheet Flow, Sheet** Grass: Dense n= 0.240 P2= 3.30"
12.5	750	0.0400	1.00		**Shallow Concentrated Flow, Shallow Concentrated** Woodland Kv= 5.0 fps
27.2	900	Total			

Summary for Subcatchment 5498: E5498

Runoff = 25.03 cfs @ 12.49 hrs, Volume= 3.642 af, Depth= 6.55"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-yearnew Rainfall=8.60"

Area (ac)	CN	Description
* 2.620	94	
* 4.050	76	
6.670	83	Weighted Average
6.670		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.7	150	0.0400	0.17		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.30"
23.9	850	0.0140	0.59		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
38.6	1,000	Total			

Summary for Subcatchment 5909: E5909

Runoff = 12.21 cfs @ 12.68 hrs, Volume= 2.108 af, Depth= 6.55"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-yearnew Rainfall=8.60"

Area (ac)	CN	Description
1.480	94	Urban commercial, 85% imp, HSG C
2.380	76	Woods/grass comb., Fair, HSG C
3.860	83	Weighted Average
2.602		67.41% Pervious Area
1.258		32.59% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
42.2	150	0.0080	0.06		**Sheet Flow, Sheet** Woods: Light underbrush n= 0.400 P2= 3.30"
11.2	300	0.0080	0.45		**Shallow Concentrated Flow, Concentrated** Woodland Kv= 5.0 fps
53.4	450	Total			

Summary for Subcatchment E6369: E6369

Runoff = 45.50 cfs @ 12.83 hrs, Volume= 8.537 af, Depth= 5.83"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-yearnew Rainfall=8.60"

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.8	200	0.0600	0.31		**Sheet Flow, Sheet** Grass: Short n= 0.150 P2= 3.30"
2.9	300	0.0600	1.71		**Shallow Concentrated Flow, Concentrated** Short Grass Pasture Kv= 7.0 fps
22.9	1,065	0.0240	0.77		**Shallow Concentrated Flow, Shallow** Woodland Kv= 5.0 fps
36.6	1,565	Total			

Summary for Subcatchment E8046: 8046

Runoff = 203.79 cfs @ 12.72 hrs, Volume= 37.291 af, Depth= 7.03"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-yearnew Rainfall=8.60"

Area (ac)	CN	Description
36.960	91	Urban industrial, 72% imp, HSG C
2.300	83	1/4 acre lots, 38% imp, HSG C
10.840	94	Urban commercial, 85% imp, HSG C
13.510	70	Brush, Fair, HSG C
63.610	87	Weighted Average
26.911		42.31% Pervious Area
36.699		57.69% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.8	150	0.0250	0.14		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.30"
15.3	2,275	0.0150	2.49		**Shallow Concentrated Flow, Concentrated** Paved Kv= 20.3 fps
24.4	1,010	0.0190	0.69		**Shallow Concentrated Flow, Concentrated** Woodland Kv= 5.0 fps
57.5	3,435	Total			

Summary for Subcatchment E8497: E8497

Runoff = 258.13 cfs @ 13.73 hrs, Volume= 80.115 af, Depth> 5.95"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-yearnew Rainfall=8.60"

	Area (ac)	CN	Description
*	161.630	78	Woods
	161.630		100.00% Pervious Area

Summary for Subcatchment E9611: E9611

Runoff = 110.91 cfs @ 12.68 hrs, Volume= 19.417 af, Depth= 6.91"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-yearnew Rainfall=8.60"

Area (ac)	CN	Description
12.370	72	Woods/grass comb., Good, HSG C
21.330	94	Urban commercial, 85% imp, HSG C
33.700	86	Weighted Average
15.569		46.20% Pervious Area
18.131		53.80% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.5	150	0.0300	0.15		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.30"
37.3	1,500	0.0180	0.67		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
53.8	1,650	Total			

Summary for Subcatchment ELB2128: ELB2128

Runoff = 100.23 cfs @ 12.79 hrs, Volume= 18.485 af, Depth= 6.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-yearnew Rainfall=8.60"

Area (ac)	CN	Description
6.960	90	1/8 acre lots, 65% imp, HSG C
4.870	60	Woods, Fair, HSG B
4.870	77	Woods, Poor, HSG C
19.850	81	1/3 acre lots, 30% imp, HSG C
36.550	79	Weighted Average
26.071		71.33% Pervious Area
10.479		28.67% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
50.9	150	0.0200	0.05		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 3.30"
10.3	750	0.0590	1.21		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
61.2	900	Total			

Summary for Link 3ELB: (new Link)

Inflow Area = 66.500 ac, 24.72% Impervious, Inflow Depth = 6.00" for 100-yearnew event
Inflow = 166.32 cfs @ 12.92 hrs, Volume= 33.227 af
Primary = 166.14 cfs @ 13.26 hrs, Volume= 33.227 af, Atten= 0%, Lag= 20.1 min

Primary outflow = Inflow delayed by 20.0 min, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Summary for Link 4E: 4E

Inflow Area = 231.810 ac, 11.42% Impervious, Inflow Depth > 6.06" for 100-yearnew event
Inflow = 434.13 cfs @ 14.05 hrs, Volume= 117.014 af
Primary = 434.13 cfs @ 14.80 hrs, Volume= 117.008 af, Atten= 0%, Lag= 45.0 min

Primary outflow = Inflow delayed by 45.0 min, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Summary for Link 4ELB: (new Link)

Inflow Area = 73.930 ac, 22.64% Impervious, Inflow Depth = 5.94" for 100-yearnew event
Inflow = 171.39 cfs @ 13.25 hrs, Volume= 36.611 af
Primary = 171.22 cfs @ 13.58 hrs, Volume= 36.611 af, Atten= 0%, Lag= 20.0 min

Primary outflow = Inflow delayed by 20.0 min, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Summary for Link 5E: (new Link)

Inflow Area = 295.420 ac, 21.38% Impervious, Inflow Depth > 6.27" for 100-yearnew event
Inflow = 463.53 cfs @ 14.79 hrs, Volume= 154.299 af
Primary = 463.53 cfs @ 15.79 hrs, Volume= 154.277 af, Atten= 0%, Lag= 60.0 min

Primary outflow = Inflow delayed by 60.0 min, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Summary for Link 5ELB: (new Link)

Inflow Area = 78.180 ac, 21.70% Impervious, Inflow Depth = 5.92" for 100-yearnew event
Inflow = 173.69 cfs @ 13.58 hrs, Volume= 38.546 af
Primary = 173.53 cfs @ 13.91 hrs, Volume= 38.546 af, Atten= 0%, Lag= 20.0 min

Primary outflow = Inflow delayed by 20.0 min, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Summary for Link 6E: 6E

Inflow Area = 351.470 ac, 22.53% Impervious, Inflow Depth > 6.25" for 100-yearnew event
Inflow = 479.20 cfs @ 15.79 hrs, Volume= 183.188 af
Primary = 479.20 cfs @ 16.79 hrs, Volume= 183.118 af, Atten= 0%, Lag= 60.0 min

Primary outflow = Inflow delayed by 60.0 min, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

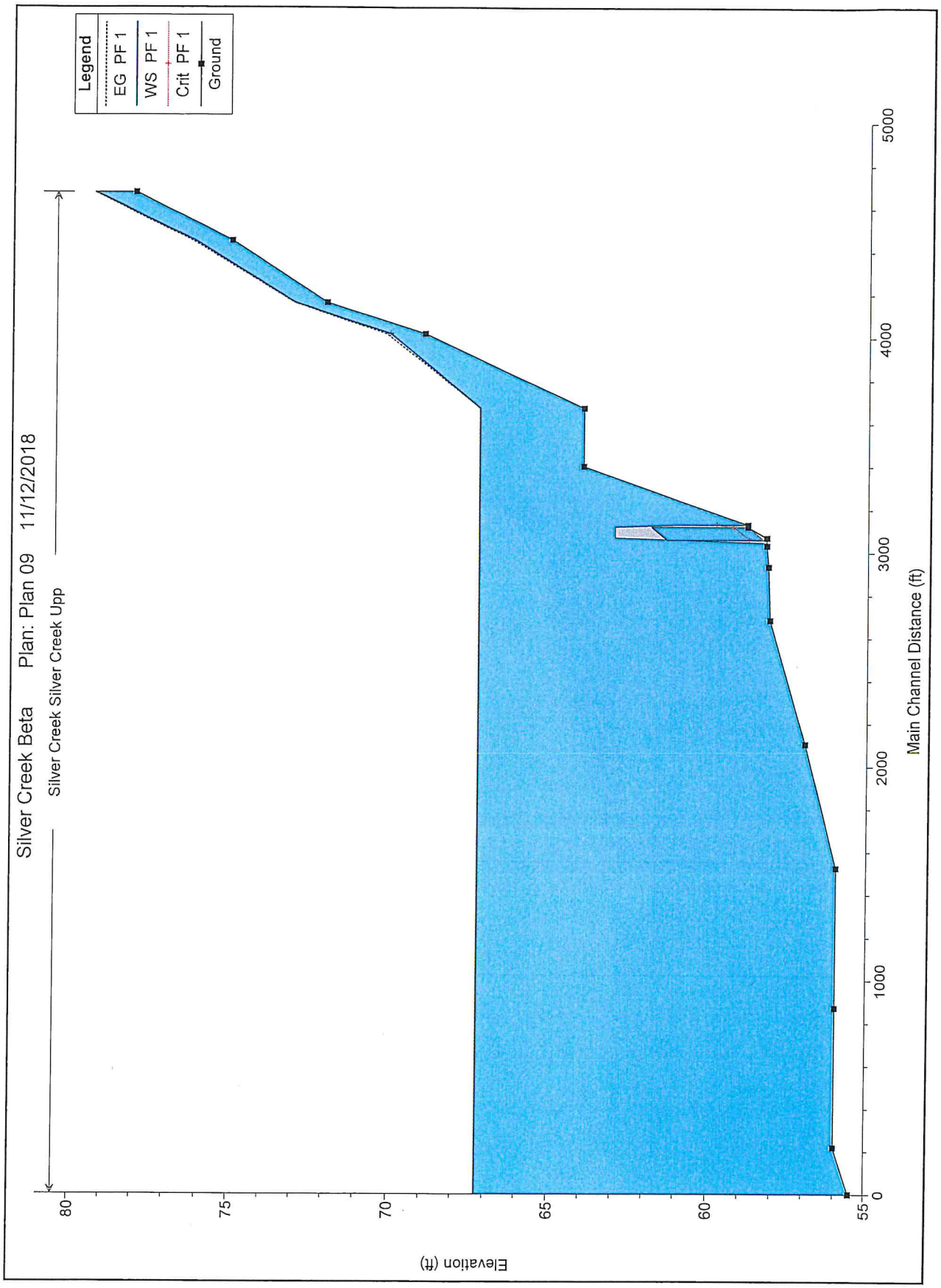
APPENDIX C

Flood Profiles and Profile Summary for the

Recreated HEC RAS Model for the 100-Year Storm Event

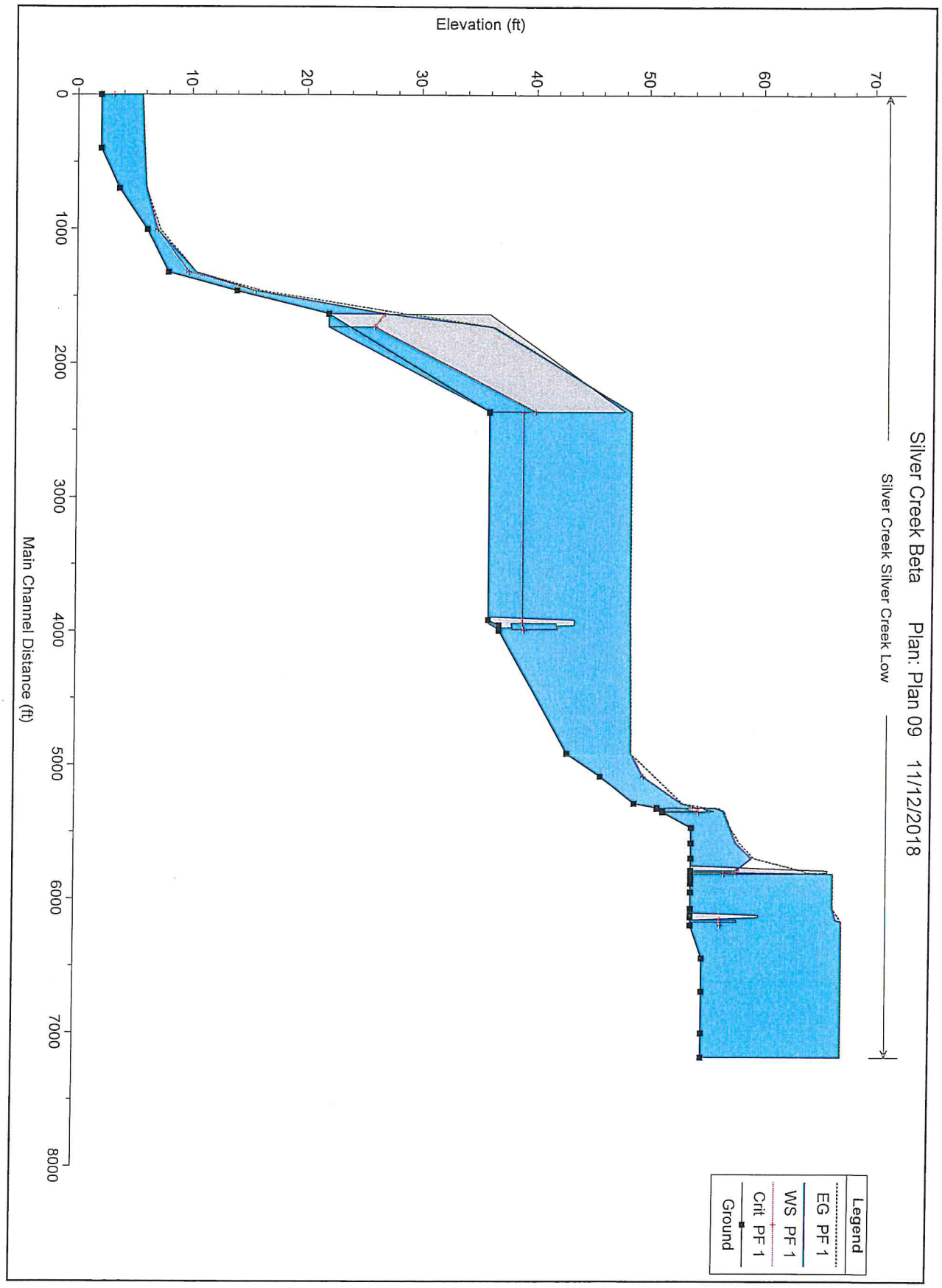
HEC-RAS Plan: Plan 09 River: Silver Creek Reach: Silver Creek Upp Profile: PF 1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Silver Creek Upp	9550	PF 1	88.64	78.00	79.30		79.33	0.010192	1.47	60.41	106.37	0.34
Silver Creek Upp	9325	PF 1	143.08	75.00	76.16		76.24	0.016940	2.19	65.41	92.61	0.46
Silver Creek Upp	9181	PF 1	143.08	72.00	73.01		73.04	0.007746	1.31	109.35	186.54	0.30
Silver Creek Upp	9037	PF 1	143.08	69.00	70.07	70.07	70.18	0.121157	2.74	52.28	231.78	1.02
Silver Creek Upp	8692	PF 1	143.08	64.00	67.25		67.25	0.000005	0.07	1987.80	1014.00	0.01
Silver Creek Upp	8483	PF 1	143.08	64.00	67.25		67.25	0.000005	0.07	1986.51	1014.00	0.01
Silver Creek Upp	8421	PF 1	149.10	58.85	67.24	59.81	67.24	0.000008	0.15	995.22	250.00	0.01
Silver Creek Upp	8371		Culvert									
Silver Creek Upp	8341	PF 1	149.10	58.26	67.24		67.24	0.000011	0.16	909.99	250.00	0.02
Silver Creek Upp	8242	PF 1	337.53	58.20	67.24		67.24	0.000001	0.06	6064.95	1084.48	0.00
Silver Creek Upp	7933	PF 1	337.53	58.14	67.24		67.24	0.000001	0.05	6822.06	1213.00	0.00
Silver Creek Upp	7793	PF 1	337.53	57.00	67.24		67.24	0.000001	0.05	6870.40	1213.00	0.00
Silver Creek Upp	7414	PF 1	361.40	56.00	67.24		67.24	0.000000	-0.04	8755.56	1249.51	0.00
Silver Creek Upp	7114	PF 1	361.40	56.00	67.24		67.24	0.000000	0.04	9457.06	1249.51	0.00
Silver Creek Upp	6750	PF 1	373.98	56.00	67.24		67.24	0.000000	0.04	8691.22	1161.91	0.00
Silver Creek Upp	6541	PF 1	373.98	55.50	67.24		67.24	0.000001	0.09	3995.25	457.24	0.01


Silver Creek Beta Plan: Plan 09 11/12/2018
Silver Creek Silver Creek Upp
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Elevation (ft)
80
75
70
65
60
55
0
1000
2000
3000
4000
5000
Main Channel Distance (ft)

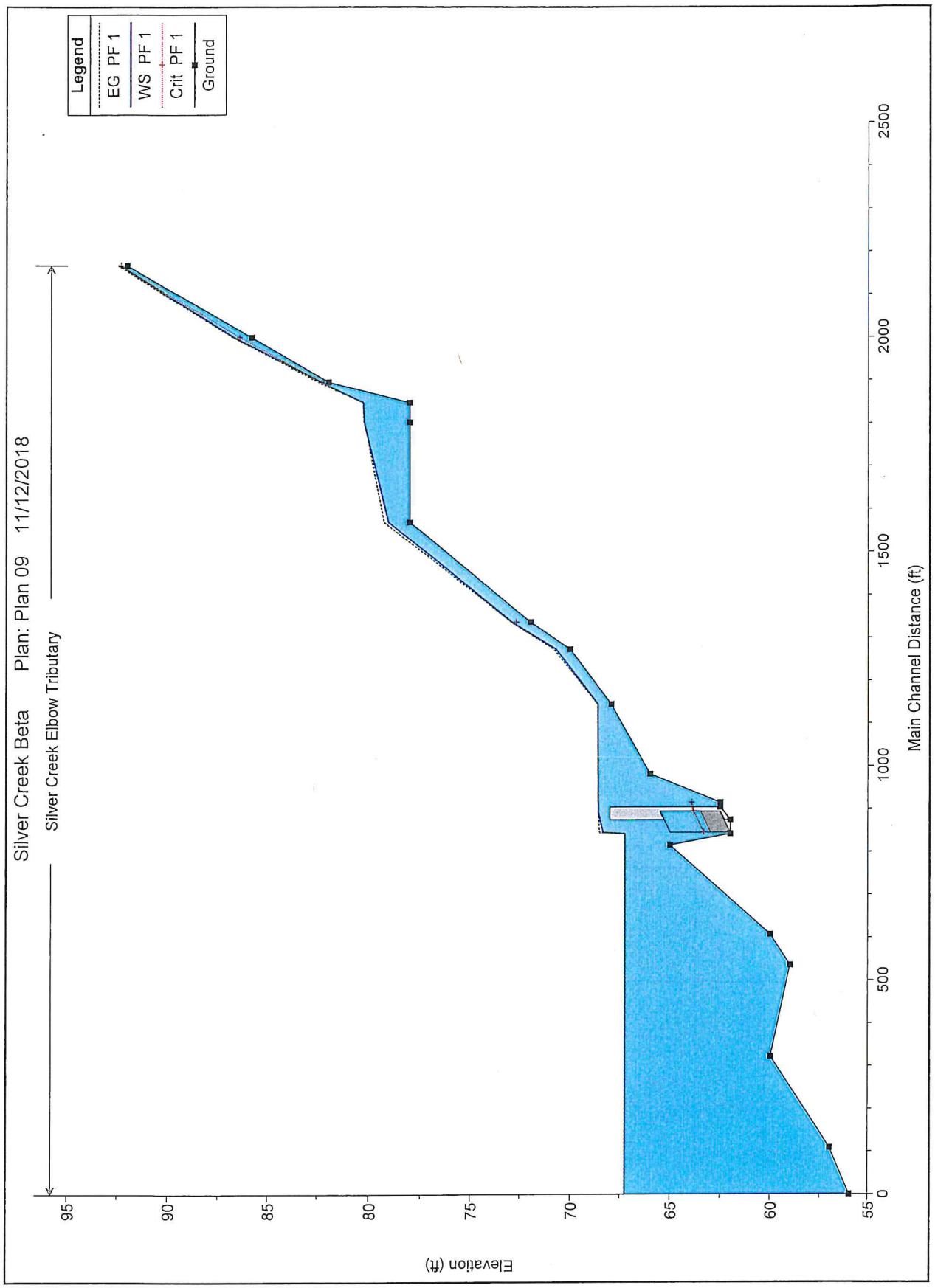
HEC-RAS Plan: Plan 09 River: Silver Creek Reach: Silver Creek Low Profile: PF 1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Silver Creek Low	6315	PF 1	358.46	55.00	67.24		67.24	0.000001	0.10	3622.33	370.00	0.01
Silver Creek Low	6142	PF 1	358.46	55.00	67.24		67.24	0.000001	0.11	3229.14	330.00	0.01
Silver Creek Low	5972	PF 1	358.46	55.00	67.24		67.24	0.000001	0.11	3145.59	320.00	0.01
Silver Creek Low	5854	PF 1	358.46	55.00	67.23		67.24	0.000058	0.65	552.03	57.92	0.04
Silver Creek Low	5847	PF 1	358.46	54.00	67.22	56.60	67.22	0.000060	0.64	560.55	59.33	0.04
Silver Creek Low	5819		Culvert									
Silver Creek Low	5809	PF 1	358.46	54.00	66.45		66.46	0.000077	0.70	515.35	58.87	0.04
Silver Creek Low	5774	PF 1	358.46	54.00	66.45		66.46	0.000015	0.32	1125.60	139.34	0.02
Silver Creek Low	5766	PF 1	358.46	54.00	66.45		66.45	0.000038	0.50	712.11	77.39	0.03
Silver Creek Low	5758	PF 1	427.56	54.00	66.45		66.45	0.000035	0.45	960.24	133.38	0.03
Silver Creek Low	5748	PF 1	427.56	54.00	66.43	56.92	66.45	0.000138	0.98	438.19	48.92	0.06
Silver Creek Low	5738		Culvert									
Silver Creek Low	5722	PF 1	427.56	54.00	59.37		59.60	0.009892	3.87	110.40	41.06	0.42
Silver Creek Low	5630	PF 1	427.56	54.00	57.95		58.27	0.013489	4.59	93.10	34.66	0.49
Silver Creek Low	5551	PF 1	427.56	54.00	57.40		57.45	0.003759	1.72	248.28	162.54	0.25
Silver Creek Low	5490	PF 1	427.56	51.50	56.85	54.64	56.93	0.005316	2.31	185.16	98.48	0.30
Silver Creek Low	5475		Culvert									
Silver Creek Low	5465	PF 1	429.34	51.00	54.50	54.50	55.41	0.063964	7.65	56.10	31.02	1.00
Silver Creek Low	5388	PF 1	429.34	49.00	53.19		53.26	0.004724	2.11	203.90	116.61	0.28
Silver Creek Low	5277	PF 1	429.34	46.00	49.79	49.79	50.80	0.066173	8.04	53.43	27.32	1.01
Silver Creek Low	5096	PF 1	430.96	43.00	48.70		48.70	0.000088	0.53	810.85	181.87	0.04
Silver Creek Low	4987	PF 1	430.96	36.93	48.60	39.10	48.60	0.000138	0.61	712.18	183.70	0.05
Silver Creek Low	4950		Culvert									
Silver Creek Low	4915	PF 1	430.96	36.00	48.58	38.95	48.59	0.000241	0.72	602.37	182.15	0.07
Silver Creek Low	4240		Culvert									
Silver Creek Low	4070	PF 1	435.58	22.03	26.93	26.88	28.60	0.072394	10.37	42.00	12.31	0.99
Silver Creek Low	3933	PF 1	436.44	14.00	15.60	15.60	16.22	0.069415	6.29	69.36	57.46	1.01
Silver Creek Low	3615	PF 1	436.44	8.00	10.39	9.70	10.41	0.003448	1.14	381.33	433.12	0.22
Silver Creek Low	3307	PF 1	443.30	6.12	7.00	7.00	7.28	0.089989	4.23	104.78	193.06	1.01
Silver Creek Low	3008	PF 1	443.30	3.61	6.04		6.05	0.000900	0.99	449.57	232.87	0.13
Silver Creek Low	2607	PF 1	446.09	2.00	5.85		5.86	0.000483	0.83	539.31	225.75	0.09
Silver Creek Low	2603	PF 1	446.09	2.00	5.65	3.08	5.66	0.000500	0.90	498.06	190.06	0.10


Silver Creek Beta Plan: Plan 09 11/12/2018
Silver Creek Silver Creek Low
Elevation (ft)
Main Channel Distance (ft)
0
10
20
30
40
50
60
70
0
1000
2000
3000
4000
5000
6000
7000
8000
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground

HEC-RAS Plan: Plan 09 River: Silver Creek Reach: Elbow Tributary Profile: PF 1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Elbow Tributary	1935	PF 1	78.21	92.00	92.34	92.32	92.45	0.086134	2.66	29.45	105.79	0.89
Elbow Tributary	1768	PF 1	78.21	85.81	86.67	86.39	86.73	0.018183	1.83	42.82	83.99	0.45
Elbow Tributary	1422	PF 1	97.00	81.92	82.27	82.27	82.41	0.120101	3.00	32.29	123.36	1.04
Elbow Tributary	1371	PF 1	97.03	78.00	80.25		80.25	0.000998	0.65	148.61	153.93	0.12
Elbow Tributary	1330	PF 1	97.03	78.00	80.20		80.20	0.001162	0.69	141.00	151.22	0.13
Elbow Tributary	1244	PF 1	129.10	78.00	79.02		79.22	0.038706	3.58	36.10	45.23	0.71
Elbow Tributary	1118	PF 1	129.10	71.97	72.88	72.67	72.92	0.019716	1.55	83.50	223.41	0.45
Elbow Tributary	1052	PF 1	133.04	70.00	70.69		70.79	0.065129	2.60	51.13	153.59	0.79
Elbow Tributary	926	PF 1	133.04	67.94	68.60		68.62	0.007466	1.21	109.98	205.34	0.29
Elbow Tributary	765	PF 1	134.83	66.00	68.58		68.59	0.000055	0.20	685.47	486.49	0.03
Elbow Tributary	700	PF 1	134.83	62.50	68.58	63.91	68.58	0.000077	0.41	330.18	99.09	0.04
Elbow Tributary	675		Culvert									
Elbow Tributary	655	PF 1	148.19	62.00	67.24		67.25	0.000096	0.47	312.80	88.34	0.04
Elbow Tributary	628	PF 1	148.19	65.00	67.24		67.24	0.000474	0.49	299.66	270.00	0.08
Elbow Tributary	361	PF 1	148.19	60.00	67.24		67.24	0.000002	0.07	2197.94	538.02	0.01
Elbow Tributary	234	PF 1	148.19	59.00	67.24		67.24	0.000000	0.03	4914.69	725.00	0.00
Elbow Tributary	149	PF 1	198.19	59.98	67.24		67.24	0.000003	0.10	1948.61	454.60	0.01
Elbow Tributary	54	PF 1	198.19	57.00	67.24		67.24	0.000001	0.10	1991.05	200.00	0.01
Elbow Tributary	41	PF 1	199.45	56.00	67.24		67.24	0.000003	0.11	1790.90	172.66	0.01


Silver Creek Beta Plan: Plan 09 11/12/2018
Silver Creek Elbow Tributary
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Elevation (ft)
95
90
85
80
75
70
65
60
55
0
500
1000
1500
2000
2500
Main Channel Distance (ft)

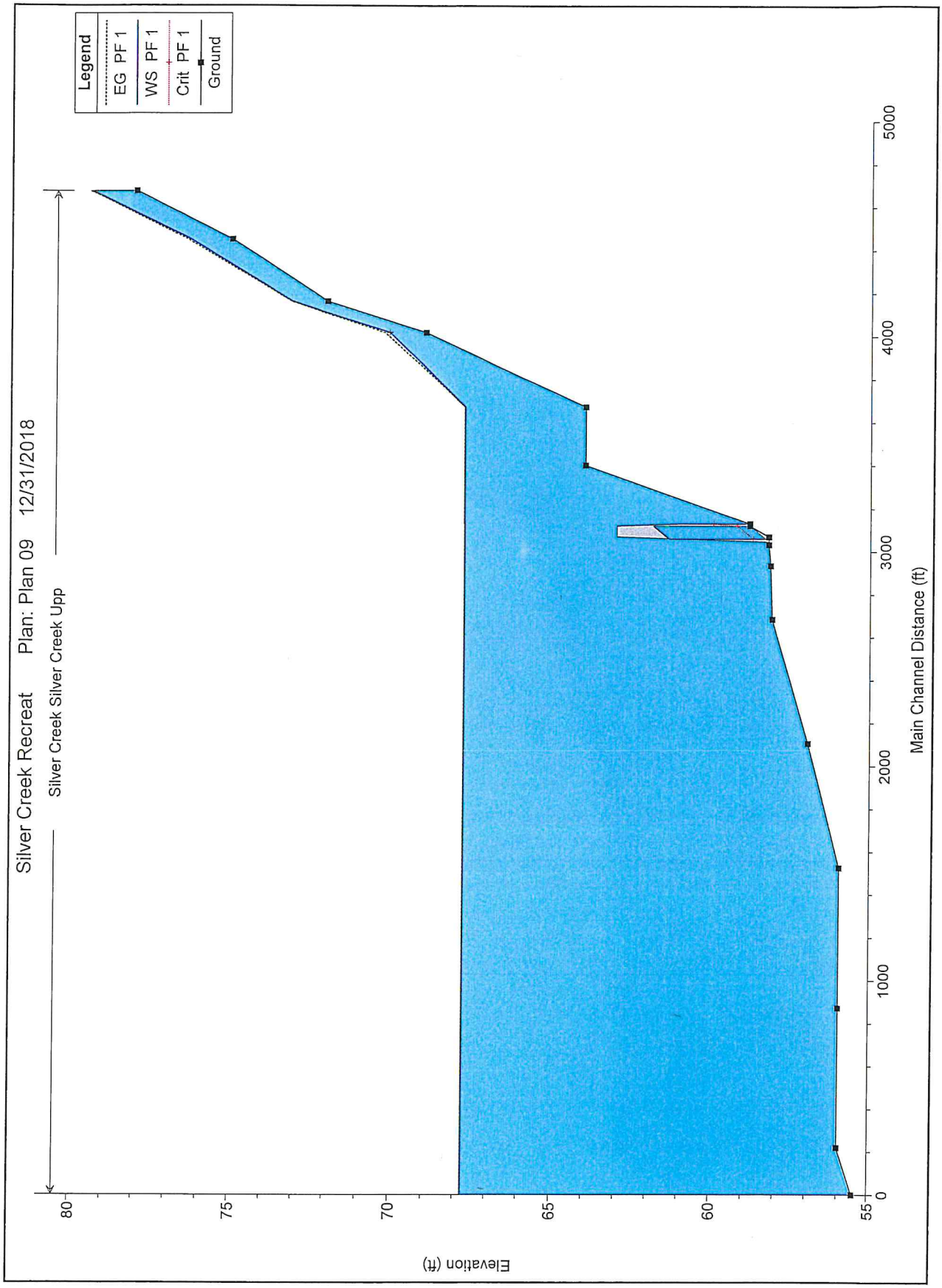
APPENDIX D

Revised Peak Runoff Rates for each of the Watersheds

Produced Using the 8.5 inches of rainfall

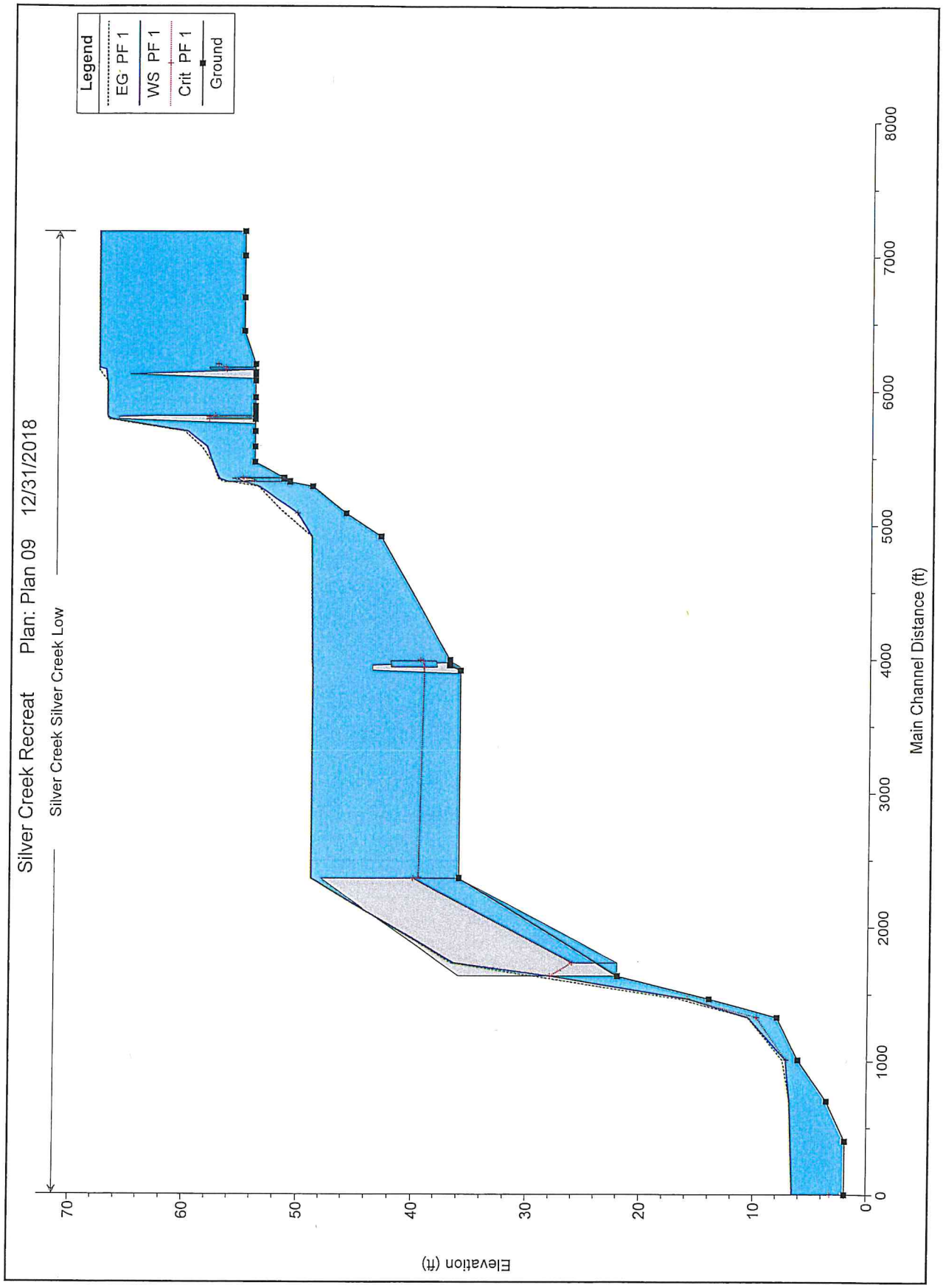
HEC-RAS Plan: Plan 09 River: Silver Creek Reach: Silver Creek Upp Profile: PF 1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Silver Creek Upp	9550	PF 1	110.91	78.00	79.41		79.45	0.009782	1.50	73.92	122.10	0.34
Silver Creek Upp	9325	PF 1	182.65	75.00	76.29		76.38	0.017174	2.34	78.00	100.75	0.47
Silver Creek Upp	9181	PF 1	182.65	72.00	73.12		73.15	0.007798	1.40	130.85	203.63	0.31
Silver Creek Upp	9037	PF 1	182.65	69.00	70.10	70.10	70.24	0.129975	3.05	59.85	237.59	1.07
Silver Creek Upp	8692	PF 1	182.65	64.00	67.76		67.76	0.000004	0.07	2504.24	1014.00	0.01
Silver Creek Upp	8483	PF 1	182.65	64.00	67.76		67.76	0.000004	0.07	2503.27	1014.00	0.01
Silver Creek Upp	8421	PF 1	190.21	58.85	67.75	59.96	67.75	0.000009	0.17	1122.65	250.00	0.01
Silver Creek Upp	8371		Culvert									
Silver Creek Upp	8341	PF 1	190.21	58.26	67.75		67.75	0.000011	0.18	1037.82	250.00	0.02
Silver Creek Upp	8242	PF 1	434.13	58.20	67.75		67.75	0.000001	0.07	6627.30	1115.16	0.00
Silver Creek Upp	7933	PF 1	434.13	58.14	67.75		67.75	0.000001	0.06	7442.24	1213.00	0.00
Silver Creek Upp	7793	PF 1	434.13	57.00	67.75		67.75	0.000001	0.06	7490.48	1213.00	0.00
Silver Creek Upp	7414	PF 1	463.53	56.00	67.75		67.75	0.000000	0.05	9394.23	1249.51	0.00
Silver Creek Upp	7114	PF 1	463.53	56.00	67.75		67.75	0.000000	0.05	10095.68	1249.51	0.00
Silver Creek Upp	6750	PF 1	463.63	56.00	67.75		67.75	0.000000	0.05	9285.01	1161.91	0.00
Silver Creek Upp	6541	PF 1	490.22	55.50	67.75		67.75	0.000002	0.12	4229.01	457.75	0.01


Silver Creek Recreat Plan: Plan 09 12/31/2018
Silver Creek Silver Creek Upp
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Elevation (ft)
80
75
70
65
60
55
0
1000
2000
3000
4000
5000
Main Channel Distance (ft)

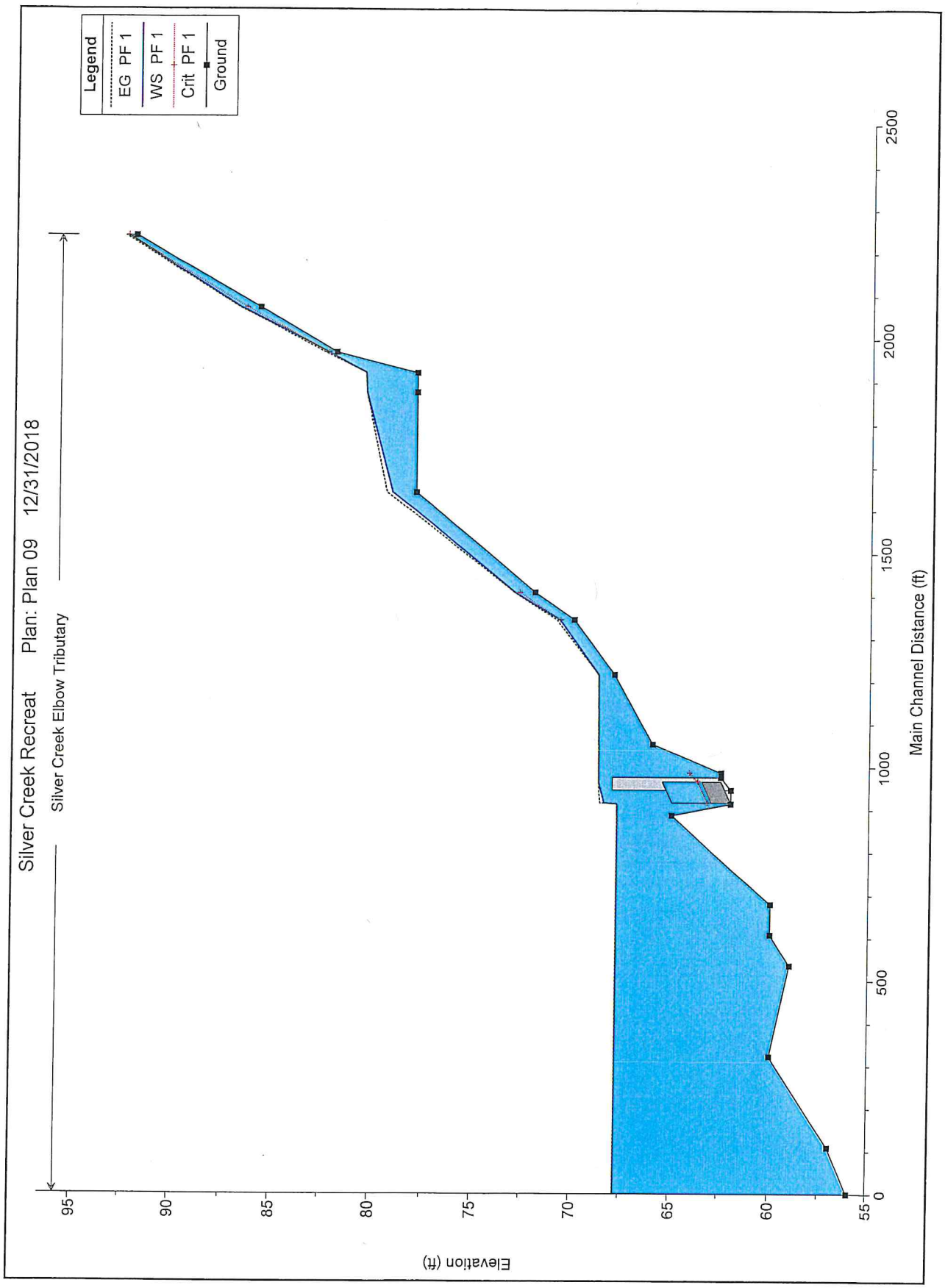
HEC-RAS Plan: Plan 09 River: Silver Creek Reach: Silver Creek Low Profile: PF 1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Silver Creek Low	6315	PF 1	493.48	55.00	67.75		67.75	0.000002	0.13	3811.36	370.00	0.01
Silver Creek Low	6142	PF 1	493.48	55.00	67.75		67.75	0.000002	0.15	3397.68	330.00	0.01
Silver Creek Low	5972	PF 1	493.48	55.00	67.75		67.75	0.000002	0.15	3308.94	320.00	0.01
Silver Creek Low	5854	PF 1	493.48	55.00	67.74		67.75	0.000095	0.85	581.40	58.41	0.05
Silver Creek Low	5847	PF 1	493.48	54.00	67.71	57.22	67.72	0.000098	0.84	590.03	59.63	0.05
Silver Creek Low	5819		Culvert									
Silver Creek Low	5809	PF 1	493.48	54.00	67.03		67.04	0.000196	1.10	446.67	52.43	0.07
Silver Creek Low	5774	PF 1	493.48	54.00	67.03		67.03	0.000023	0.41	1205.99	139.37	0.02
Silver Creek Low	5766	PF 1	493.48	54.00	67.02		67.03	0.000060	0.65	756.63	77.65	0.04
Silver Creek Low	5758	PF 1	553.24	54.00	67.02		67.03	0.000047	0.53	1037.31	134.86	0.03
Silver Creek Low	5748	PF 1	553.24	54.00	67.00	57.48	67.02	0.000218	1.26	440.47	47.56	0.07
Silver Creek Low	5738		Culvert									
Silver Creek Low	5722	PF 1	553.24	54.00	59.91		60.18	0.009725	4.14	133.57	44.06	0.42
Silver Creek Low	5630	PF 1	553.24	54.00	58.21		58.66	0.018407	5.38	102.75	38.18	0.58
Silver Creek Low	5551	PF 1	553.24	54.00	57.70		57.75	0.003587	1.87	296.60	166.21	0.25
Silver Creek Low	5490	PF 1	553.24	51.50	57.11	55.01	57.22	0.005932	2.62	211.51	101.12	0.32
Silver Creek Low	5475		Culvert									
Silver Creek Low	5465	PF 1	561.63	51.00	54.90	54.90	55.93	0.061220	8.16	68.82	33.39	1.00
Silver Creek Low	5388	PF 1	561.63	49.00	53.61		53.68	0.004456	2.20	255.47	131.18	0.28
Silver Creek Low	5277	PF 1	561.63	46.00	50.27	50.27	51.35	0.062142	8.35	67.22	31.06	1.00
Silver Creek Low	5096	PF 1	563.33	43.00	49.01		49.01	0.000122	0.65	866.95	184.71	0.05
Silver Creek Low	4987	PF 1	563.33	36.93	48.86	39.49	48.87	0.000194	0.74	761.47	187.73	0.06
Silver Creek Low	4950		Culvert									
Silver Creek Low	4915	PF 1	563.33	36.00	48.83	39.52	48.85	0.000332	0.87	648.51	186.01	0.08
Silver Creek Low	4240		Culvert									
Silver Creek Low	4070	PF 1	563.33	22.03	27.95	27.95	29.37	0.068123	9.57	58.89	29.46	1.00
Silver Creek Low	3933	PF 1	563.33	14.00	15.83	15.83	16.56	0.065862	6.83	82.47	57.88	1.01
Silver Creek Low	3615	PF 1	573.19	8.00	10.54	9.78	10.57	0.003691	1.28	446.52	449.37	0.23
Silver Creek Low	3307	PF 1	573.19	6.12	7.17	7.12	7.44	0.069128	4.18	137.19	211.38	0.91
Silver Creek Low	3008	PF 1	573.19	3.61	6.80		6.81	0.000529	0.90	633.53	250.50	0.10
Silver Creek Low	2607	PF 1	576.49	2.00	6.67		6.67	0.000387	0.72	803.73	353.59	0.08
Silver Creek Low	2603	PF 1	576.49	2.00	6.49	3.20	6.50	0.000500	0.78	741.45	350.38	0.09


Silver Creek Recreat Plan: Plan 09 12/31/2018
Silver Creek Silver Creek Low
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Elevation (ft)
Main Channel Distance (ft)
0
10
20
30
40
50
60
70
0
1000
2000
3000
4000
5000
6000
7000
8000

HEC-RAS Plan: Plan 09 River: Silver Creek Reach: Elbow Tributary Profile: PF 1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Elbow Tributary	1935	PF 1	100.23	92.00	92.40	92.37	92.52	0.074960	2.80	35.85	107.36	0.85
Elbow Tributary	1520	PF 1	100.23	85.81	86.76	86.46	86.82	0.019295	1.98	50.66	92.13	0.47
Elbow Tributary	1422	PF 1	125.31	81.92	82.32	82.32	82.48	0.106815	3.20	39.18	124.76	1.01
Elbow Tributary	1371	PF 1	125.31	78.00	80.43		80.44	0.000982	0.71	177.09	160.65	0.12
Elbow Tributary	1330	PF 1	125.31	78.00	80.38		80.39	0.001128	0.74	169.27	159.23	0.13
Elbow Tributary	1244	PF 1	166.32	78.00	79.12		79.38	0.047252	4.09	40.70	48.42	0.79
Elbow Tributary	1118	PF 1	166.32	71.97	72.98	72.72	73.02	0.017467	1.55	107.60	263.00	0.43
Elbow Tributary	1052	PF 1	166.32	70.00	70.70	70.68	70.85	0.089455	3.12	53.39	155.32	0.94
Elbow Tributary	926	PF 1	171.39	67.94	68.72		68.74	0.006622	1.27	135.30	215.43	0.28
Elbow Tributary	765	PF 1	171.39	66.00	68.70		68.70	0.000068	0.23	741.52	488.96	0.03
Elbow Tributary	700	PF 1	171.39	62.50	68.69	64.10	68.69	0.000112	0.50	341.30	99.09	0.05
Elbow Tributary	675		Culvert									
Elbow Tributary	655	PF 1	173.21	62.00	67.75		67.76	0.000094	0.48	360.34	98.27	0.04
Elbow Tributary	628	PF 1	173.21	65.00	67.75		67.75	0.000184	0.40	437.94	270.00	0.05
Elbow Tributary	429	PF 1	173.21	60.00	67.75		67.75	0.000001	0.07	2420.07	500.43	0.01
Elbow Tributary	361	PF 1	173.21	60.00	67.75		67.75	0.000001	0.07	2420.02	500.43	0.01
Elbow Tributary	234	PF 1	173.21	59.00	67.75		67.75	0.000000	0.03	5285.34	725.00	0.00
Elbow Tributary	149	PF 1	255.39	59.98	67.75		67.75	0.000004	0.12	2184.53	468.50	0.01
Elbow Tributary	54	PF 1	255.39	57.00	67.75		67.75	0.000002	0.12	2093.25	200.00	0.01
Elbow Tributary	41	PF 1	255.39	56.00	67.75		67.75	0.000005	0.14	1879.11	172.66	0.01


Silver Creek Recreat Plan: Plan 09 12/31/2018
Silver Creek Elbow Tributary
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Elevation (ft)
95
90
85
80
75
70
65
60
55
0
500
1000
1500
2000
2500
Main Channel Distance (ft)