

City of Loveland

Non-Residential Fast Track Permit Application

Building Division * 500 E 3rd St., Suite 110 * Loveland, CO 80537

General Information (970) 962-2505 * Inspection Line (970) 962-2100 * TDD (970) 962-2620 * FAX (970) 962-2904

Job Site Address: 204 12th St. SE. Loveland, CO 80537.			
General Contractor:		License #:	Phone:
Valuation: \$ 50,000		Email:	
Electrical Contractor:		License #:	Phone:
Valuation: \$		Email:	
Mechanical Contractor:		License #:	Phone:
Valuation: \$		Email:	
Plumbing Contractor:		License #:	Phone:
Valuation: \$ Rock Tool, LLC		Email:	
Owner Name: Mister Metal Works		Phone:	
Address: 204 12th St SE			
City: Loveland		State: CO	Zip: 80537
Contact:		Phone:	Fax:
New A/C <input type="checkbox"/>	A/C Upgrade <input type="checkbox"/>	New Furnace <input type="checkbox"/>	Furnace Upgrade <input type="checkbox"/> Gas Pipe Size
Roof Top Unit <input type="checkbox"/>	Water Heater Installation <input type="checkbox"/>	Electrical Work <input type="checkbox"/>	Service Size Amps
Re-Roof of Structure (Commercial Pitched Only) <input type="checkbox"/>	Roof Classification <input type="checkbox"/> A <input type="checkbox"/> B <input type="checkbox"/> C	Number of Squares	
Demo SF	Number of Buildings	Number of Stories	
Number of Dwellings	Number of Rooms	Number of Baths	
Current Use	Date of Demo to Water Service	Date of Demo to Electrical Service	
Other: (Please explain)			
Work Description: Drainage Report & Grading Plan.			
<p>** RECEPTACLES FOR HVAC EQUIPMENT: A 125-volt, 15- or 20-amp receptacle shall be located at an accessible location for the servicing of heating, air conditioning, and refrigeration equipment. The receptacle shall be located on the same level in a readily accessible location and within 25 feet of the equipment. For commercial installations where the equipment is located on the building rooftop or outdoors, the service receptacle needs to be GFCI protected. For residential installations, all service receptacles for equipment located at building exteriors, crawlspaces, and unfinished basements shall also have GFCI protection. All exterior receptacles located in damp or wet locations shall be a listed for weather-resistant type. In-use covers are required for receptacles installed in wet locations.</p> <p style="text-align: center;">Articles 210.63; 210.8 (A)(B); 406.9 2011 NEC</p>		Permit #: 12-01467	
		Received by: AD	
		Date: 8-15-12	
		Approvals:	
Building Division Comments		Total Fees Due: \$	
Planning Division Comments		Client notification:	

City of Loveland

Permit Statement

Permit BP-12-01467:Grading Modification Permit, Non-Res 378-03-02D-95243-14-004 204 12TH ST SE Rock Troll, LLC	Statement Printed Date: 08/21/2012
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Description	Item Amount	Total Due on Statement
A11a Grading PC (Other)	\$37.00	\$37.00
D11b Grading Permit Fee (Other)	\$37.00	\$37.00
Sub Total		\$74.00
		\$74.00

PAID
CK. NO. 20523
DATE 8/29/12

BUILDING PERMIT CONDITIONS OF APPROVAL

Site Address: 204 12TH ST SE

Permit #: BP-12-01467

Permit Type: Grading Modification Permit, Non-Res

Rock Troll, LLC

Work Description: Modify Grading

Building - Review: Dave Sprague Pass

Follow engineering report recommendations and requirements of Storm Water and other City reviewers.

SPECIAL INSPECTION REQUIRED: The Colorado design professional of record acting as the owner's agent shall employ one or more special inspectors who shall provide inspections during construction. The special inspector shall be a qualified person who shall demonstrate competence, to the satisfaction of the building official.

The special inspector shall furnish inspection reports to the building official, the Colorado design professional of record, and other designated persons. All discrepancies shall be brought to the immediate attention of the contractor for correction, then if uncorrected, to the proper design authority and to the building official. The special inspector shall submit a final signed report stating whether the work requiring special inspection was, to the best of the inspector's knowledge, in conformance with the approved plans and specifications and the applicable workmanship provision of this code provisions of this code.

Inspections include but not limited to, concrete, bolts installed in concrete, reinforcing steel, welding (certified welder required), high strength bolting, structural masonry, sprayed applied fireproofing, piling, drilled, piers and caissons, excavating, filling, and compaction (1704, IBC)

PW-Stormwater: Kevin Gingery Pass

No Conditions.

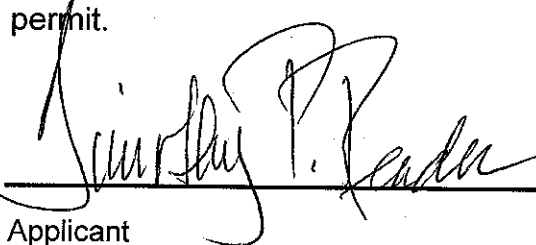
THIS STRUCTURE OR AREA OF CONSTRUCTION SHALL NOT BE OCCUPIED WITHOUT PRIOR APPROVAL FROM THE BUILDING OFFICIAL.

These building permits are issued with the requirement that all work will be completed according to the reviewed construction documents, including all corrections and/or additions noted on the construction documents and shall comply with all applicable

Loveland Municipal Codes, State and Federal laws//regulations. The work must comply with all conditions set forth on this permit. This permit is subject to the requirements of the Grading and Erosion Control permit issued by the City of Loveland Municipal Code Chapter 13.20. All construction activity undertaken in accordance with this building permit shall comply with the referenced stormwater quality requirements. Any violations of the above referenced requirements by any person within this subdivision or development may result in the issuance of a Stop Work Order for an individual lot, or for the entire development or subdivision.

At the time a building permit is issued, the City of Loveland Building Division calculates and collects a use tax deposit. The deposit is calculated by multiplying 50% of the total construction valuation by the City's current tax rate of 3.0%. The tax paid at the time a building permit is issued is a deposit. The final tax is calculated the completion of the project and reported to the City's Sales Tax Department. A final cost report is the means by which a contractor/applicant finalizes the use tax portion of a project constructed in the City of Loveland. This report allows the contractor/applicant to provide actual final costs of the project in order to determine if an outstanding tax liability exists or if a refund is due. Information provided on the report must be substantiated by appropriate records/invoices including subcontractor statements. The contractor/applicant and the owner of the project are jointly and separately responsible for the City tax. Any unpaid taxes arising from construction projects constitute a first and prior lien on the property. The owner or contractor is required by the Loveland Municipal Code to preserve all invoices, receipts, and statements showing purchases of construction supplies and tangible personal property for a period of three (3) years after the completion of construction. The City of Loveland may, within that three-year period, conduct an audit of all records of the contractor/applicant or the owner.

I understand and accept the conditions stated above for the issuance of this building permit.


Applicant

29 Aug 2012
Date

09-12-12 16:32 RCVD

Tom,

9-12-12

3:50 pm

Russ Morgan and I visited yesterday about Messinger Engineering's report regarding the property on SE 12th Street and I answered Russ's questions thereto the best I could. Russ was just trying to understand the engineering report and what it really said. He showed me several rain photos as well as told me that his neighbor cannot legally place fill/pavement on top of an existing utility easement.

Thanks,
Kevin

OFFICE
COPY

DRAINAGE INVESTIGATION AND REPORT

for

**LOT 2D, BLOCK 3, SOUTH LOVELAND INDUSTRIAL
PARK ADDITION, LOVELAND, COLORADO**

**MASTER METAL WORKS
204 12TH STREET S. E.
LOVELAND, COLORADO 80537**

REVIEWED PLANS
REVIEWED PLANS ARE NOT APPROVED PLANS.
FIELD INSPECTORS MAY REQUIRE CHANGES AS
NECESSARY TO MEET ORDINANCE OR
BUILDING CODE PROVISIONS ON THE JOB.

Prepared for:

**MASTER METAL WORKS
204 12th Street S. E.
Loveland, Colorado 80537**

PLEASE USE THE PERMIT
NUMBER & ADDRESS WHEN
CALLING FOR AN INSPECTION
THANK YOU.

August 2012

121467
INSPECTIONS REQUIRED
STORMWATER

Project No. 1029 - GRD - 12

ACCEPTED - NO EXCEPTION TAKEN

AUG 20 2012



Prepared by:

DENNIS R. MESSNER, P. E.

1355 N. Cleveland Ave., Ste #1

Loveland, Colorado 80537

Telephone: (970) 461-3501

Dennis R. Messner, P. E.

Consulting Civil Engineer

Project No. 1029 - GRD - 12

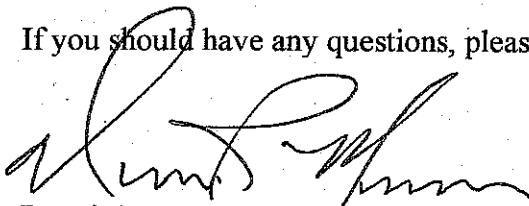
August 13, 2012

Mary Shann
City of Loveland
Code Enforcement
500 E. 3rd Street
Loveland, Colorado 80537

Dear Ms. Shann,

Enclosed you will find three (3) copies of the Drainage Investigation Report for 204 - 12th Street S. E. for Stormwater's review and acceptance.

If you should have any questions, please feel free to contact this office.



Dennis R. Messner, P. E.
Consulting Civil Engineer

Dennis R. Messner, P. E.

Consulting Civil Engineer

August 12, 2012
Project No. 1029-GRD-12

Mr. Kevin W. Gingery, P.E.
City of Loveland
Stormwater
410 E. 5th Street
Loveland, Colorado 80537

Re: **Drainage Investigation Report for MASTER METAL WORKS, 204 12th Street S. E.,
Loveland, Colorado 80537**

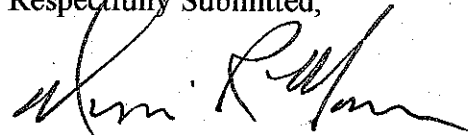
Dear Mr. Gingery:

I am pleased to submit for your review and acceptance, this Drainage Investigation Report for Lot 2D of the Replat of Lots 5 & 6, Block 1 and Lot 2, Block 3 of the South Loveland Industrial Park Addition, Loveland, Colorado.

The investigation and design within this report have been performed according to the criteria established in the City of Loveland's "Storm Drainage Criteria."

I sincerely appreciate your time and consideration in the review of this project. If you should have any questions, please feel free to contact this office.

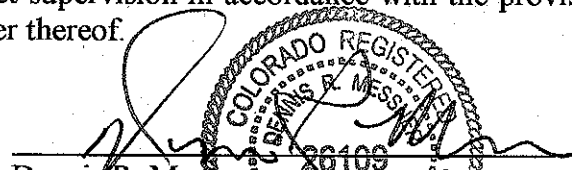
Respectfully Submitted,

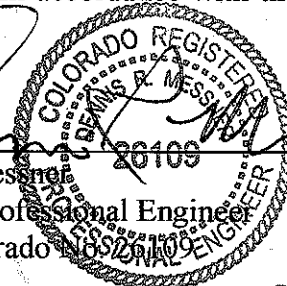


Dennis R. Messner, P. E.

cc: Master Metal Works

I hereby state that the attached "Drainage Investigation Report for Lot 2D, Block 3 of the Relpat of Lot 5 & 6, Block 1 and Lot 2, Block 3 of the South Loveland Industrial Park Addition, Loveland, Colorado" was prepared by me or under my direct supervision in accordance with the provisions of the City of Loveland Drainage Criteria for the owner thereof.


Dennis R. Messner
Registered Professional Engineer
State of Colorado



8-12-12

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Drainage Calculations

APPENDIX II

Charts, Graphs, Figures and Details

I. General Location and Description:

A. Location

1. The MASTER METAL WORKS facility is located in the Southwest Quarter of Section 24, Township 5 North, Range 69 West of the 6th P.M. in the City of Loveland, Larimer County, Colorado.
2. The site is more specifically located at 204 12th Street S. E. on the south side of 12th Street S. E. between South Garfield Avenue and South Cleveland Avenue. (Refer to the enclosed Vicinity Map.)
3. Several structures utilized for commercial and industrial activities border the site along its east boundary. 12th Street S. E. abuts the northern boundary of the site. The Century Link Maintenance Facility borders the site along its southern boundary. Commercial and industrial uses border the western boundary of the site.

B. Description of property

1. The MASTER METAL WORKS site contains approximately 0.58 acres. The site consists of a single story metal structure containing an office and product manufacturing and assembly facility. The open area consists of outside material storage, vehicle parking and material loading facilities.
2. The existing ground cover consists mainly of an asphalt pavement.
3. The "Soil Survey of Larimer County Area, Colorado" prepared by the U.S. Department of Agriculture, Soil Conservation Service, indicated that the surface soils consist of "Caruso clay loam." The soil typical of this series is described as level soil on low terraces and bottom lands. The "Soil Survey" identifies the runoff potential as slow, and the hazard of erosion from wind as slight and the erosion hazard from water as slight.
4. The site is generally considered flat with ground surface slopes ranging from 0.5% to 1.5%.
5. The existing structure on the Master Metal Works site has a building footprint of approximately 7,225 square feet. Landscaping and gravel surfaces consists of approximately 4,060 square feet. The balance of the site, approximately 13,960 square feet, is considered to be paved or hard surfaced. (Area based upon survey performed July 2012.)

II. Drainage Basins and Sub-basins:

situated along the north side of the gravel pit.

The specific area considered by this investigation is the eastern boundary of the site. The runoff flowed northerly along the eastern property line in an earthen and gravel surfaced drainage course that was poorly defined. Four structures are situated on the property to the east. The height of the floor levels of those structures varies with respect to the ground along the property line. The height varies from approximately ten inches at the southern most building to one inch at the northern most building. The area along the drainage course appears to have been poorly maintained. The ground cover consists mainly of weeds and numerous vehicles in various states of repair are stored in this area. The area directly south of 12th Street S.E. is paved. The asphalt pavement has been placed so that the southern edge is approximately level with the ground surface at the northeast corner of the site.

III. Drainage Design Criteria:

A. Development Regulations

1. Design criteria from the City of Loveland Storm Drainage Criteria (Addendum to the Urban Storm Drainage Criteria Manuals Volumes 1, 2 and 3) were utilized.

B. Development Criteria Reference and Constraints

1. The historic drainage pattern has been affected by the re-construction of the paved area on the site in that flows had been concentrated and channelized prior to the re-construction of the paved area on the site. Although the re-construction of the paved area has produced more runoff than the historic amount when this area was previously paved, The runoff from the re-constructed pavement is now confined to the site and does not drain to the eastern property boundary. The re-constructed improvements include curbing situated along the southern and eastern border of the paved area.
2. Runoff from the property will not negatively impact adjacent properties. Any drainage that previously flowed onto the property to the east will be intercepted by the curbing situated along the southern and eastern border of the paved area. The curbing directs the runoff from the site to the north and directly to 12th Street S. E.
3. The drainage impact of this site have been negated by the constructed improvements and will not adversely affect streets or utilities.

C. Hydrological Criteria

1. The Rainfall-Intensity-Duration curves for the City of Loveland were used in

conjunction with the Rational Method for determining peak flows at various concentration points.

2. The 2-year, 10-year and 100-year storms were analyzed in the design of the storm water management infrastructure in accordance with the City of Loveland Storm Drainage Criteria.
3. The storm runoff flows were determined using the Rational Method.

D. Hydraulic Criteria

1. Analysis of the flows is based upon use of the Manning Formula with cross section data taken for each surface material encountered.
 - a. The Manning s roughness coefficient for all open swale capacity calculations is 0.015 for paved surfaces and 0.027 for gravel surfaces as dictated in Section 4.4.1 of the City of Loveland Storm Drainage Criteria.

IV. Drainage Facility Design:

A. General Concept

In order to provide a reference of comparison, the Final Drainage Investigation & Erosion Control Report for Lot 5, Block 3 of South Loveland Industrial Park (Qwest Communications Construction & Maintenance Facility, 175 14th Street S. E., Loveland, Colorado 80537) was utilized. This investigation analyzed three cross-sections located along the eastern boundary of the subject site.

The cross-sections are referenced from Station 0+00 located at the Southeast property corner. The stationing increases from south to north along the eastern boundary.

The analysis performed considers the flows concentrating at each cross-section both prior to the reconstruction of the onsite paved area and after re-construction. The width and depth of flow at each cross-section was determined. The following is a chart comparing both the "pre" and "post" re-construction conditions.

5

Design Point	Prior Contributing Area (Acre)	Exist. Contributing Area (Acre)	Prior Percent (%) Imperviousness	Exist. Percent (%) Imperviousness	Prior Peak 2-Year (c.f.s.)	Exist. Peak 2-Year (c.f.s.)	Prior Peak 10-Year (c.f.s.)	Exist. Peak 10-Year (c.f.s.)	Prior Peak 100-Year (c.f.s.)	Exist. Peak 100-Year (c.f.s.)
#1 (0+37.84)	0.57	0.51	59.56	60.81	0.61	0.56	1.28	1.17	2.51	2.29
#2 (0+93.10)	0.73	0.59	63.11	59.85	0.79	0.6	1.63	1.27	3.14	2.48
#3 (1+76.40)	0.98	0.7	66.94	59.41	1.11	0.69	2.24	1.48	4.22	2.9

V. Erosion & Storm Water Quality Control:

No Erosion Control or Storm Water Quality issues were considered as a part of this analysis and investigation.

VI. Conclusions:

A. Compliance with Standards

1. All drainage design conforms to the criteria and requirements of the City of Loveland Storm Drainage Criteria.
- 2.

B. Drainage Concept

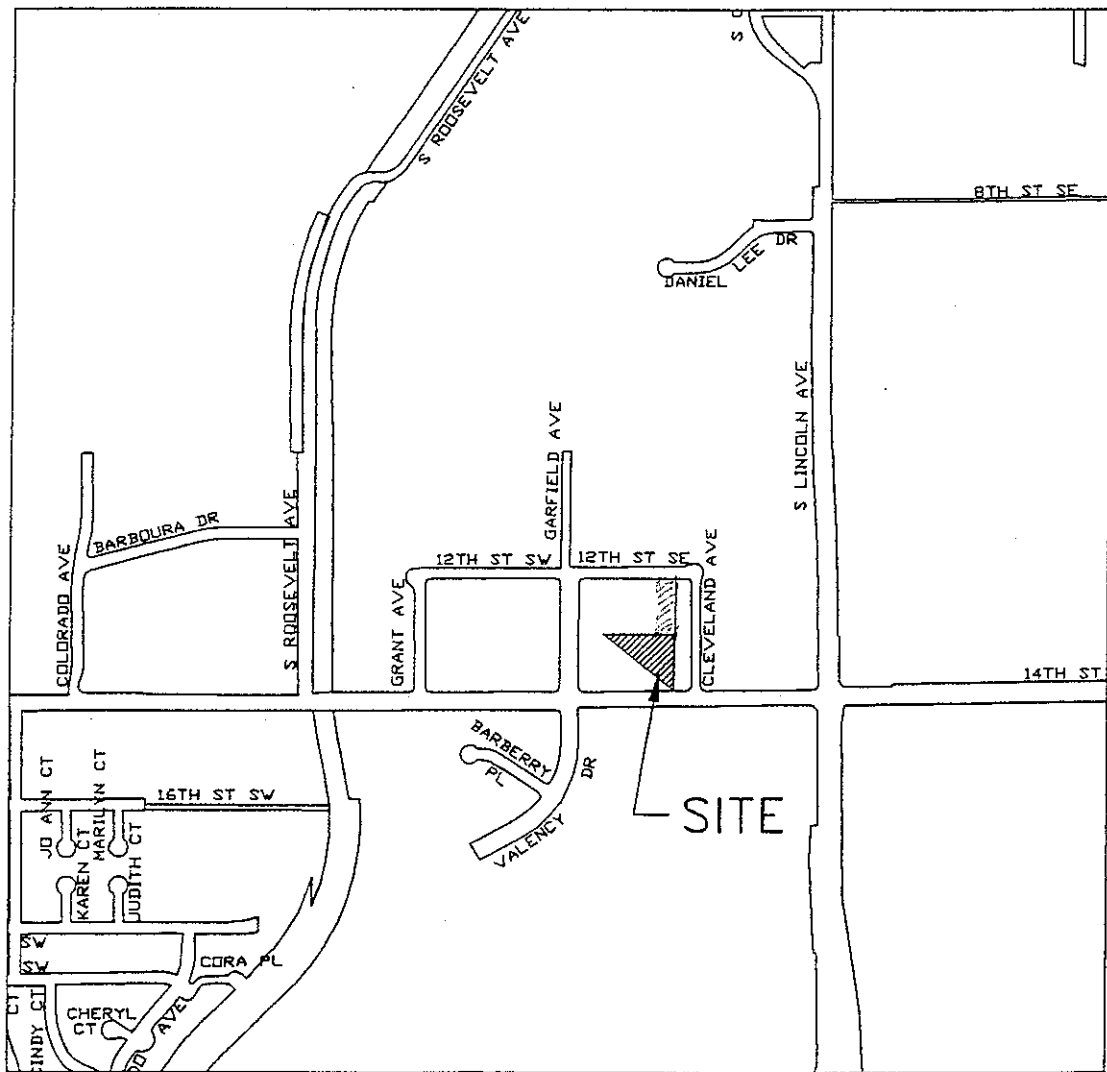
1. The analysis of the re-constructed paved area improvements at 204 12th Street S. E. is effective for the control of storm water runoff without negatively impacting adjacent properties or structures.

VII. References:

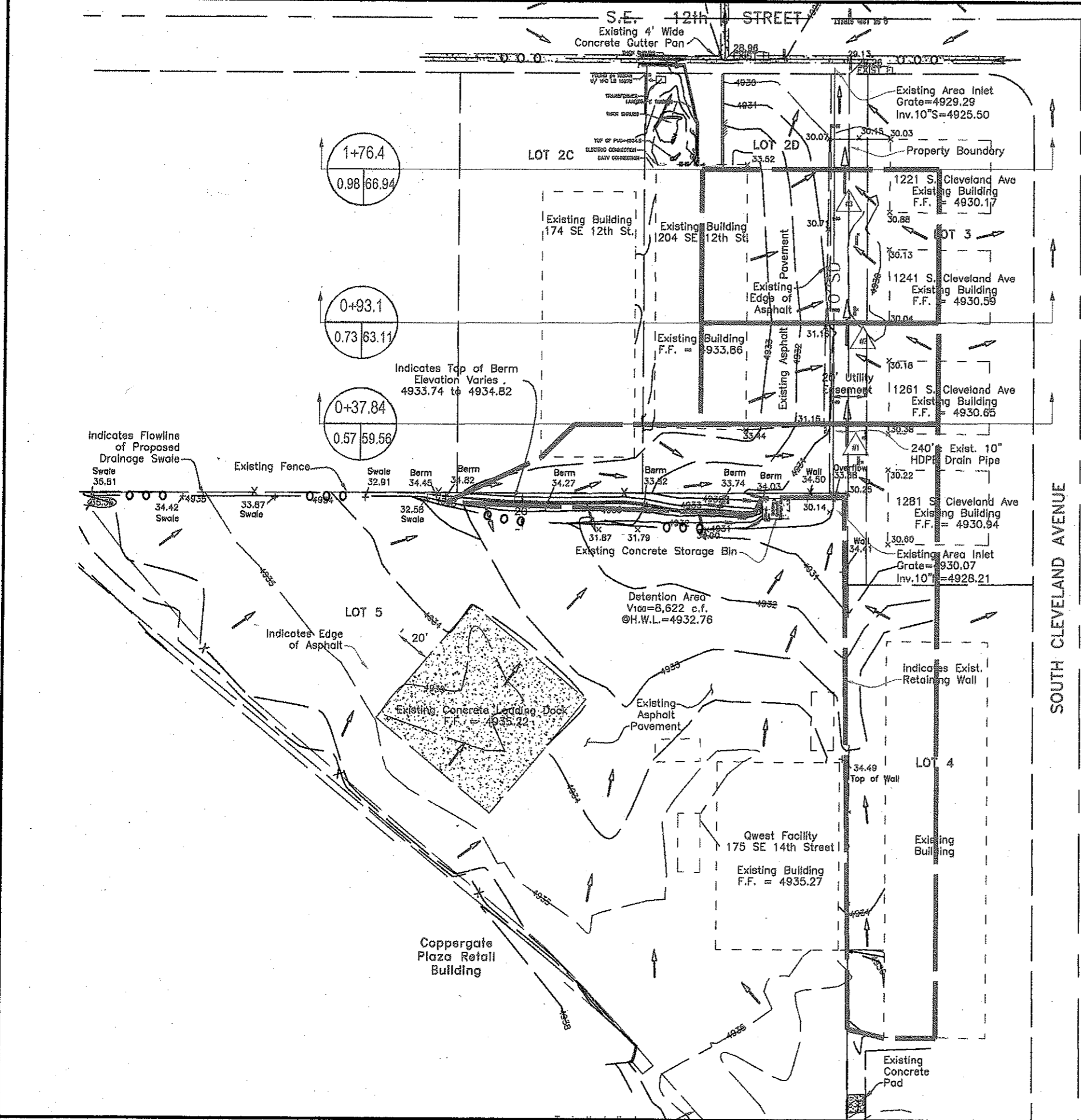
- A. **City of Loveland Storm Drainage Criteria (Addendum to the Urban Storm Drainage Criteria Manuals Volumes I, II, and III.)**
- B. **Urban Storm Drainage Criteria Manuals Volume I, II, and III**
- C. **City of Loveland Master Drainage Plan**
- D. **Soil Survey of Larimer County Area, Colorado**
- E. **Final Drainage Investigation & Erosion Control Report for Lot 5, Block 3 of South Loveland Industrial Park (Qwest Communications Construction & Maintenance Facility, 175 14th Street S. E., Loveland, Colorado 80537) prepared by: Messner Engineering, Inc., dated: November 2003.**

EXHIBITS

Vicinity Map



Scale: 1" = 1000'



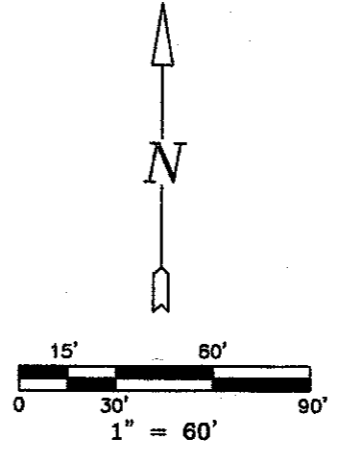
"PRIOR" SUMMARY RUNOFF TABLE

Design Point	Contributing Basin(s)	Contributing Area (acres)	Peak 10-Year (cfs)	Peak 100-Year (cfs)
#1	0+37.84	0.57	1.28	2.51
#2	0+93.10	0.73	1.63	3.14
#3	1+76.40	0.98	2.24	4.22

Dennis R. Messner, P.E.
 Consulting Civil Engineer
 114 East 5th Street
 Loveland, Colorado 80537
 Telephone: (970)663-2221

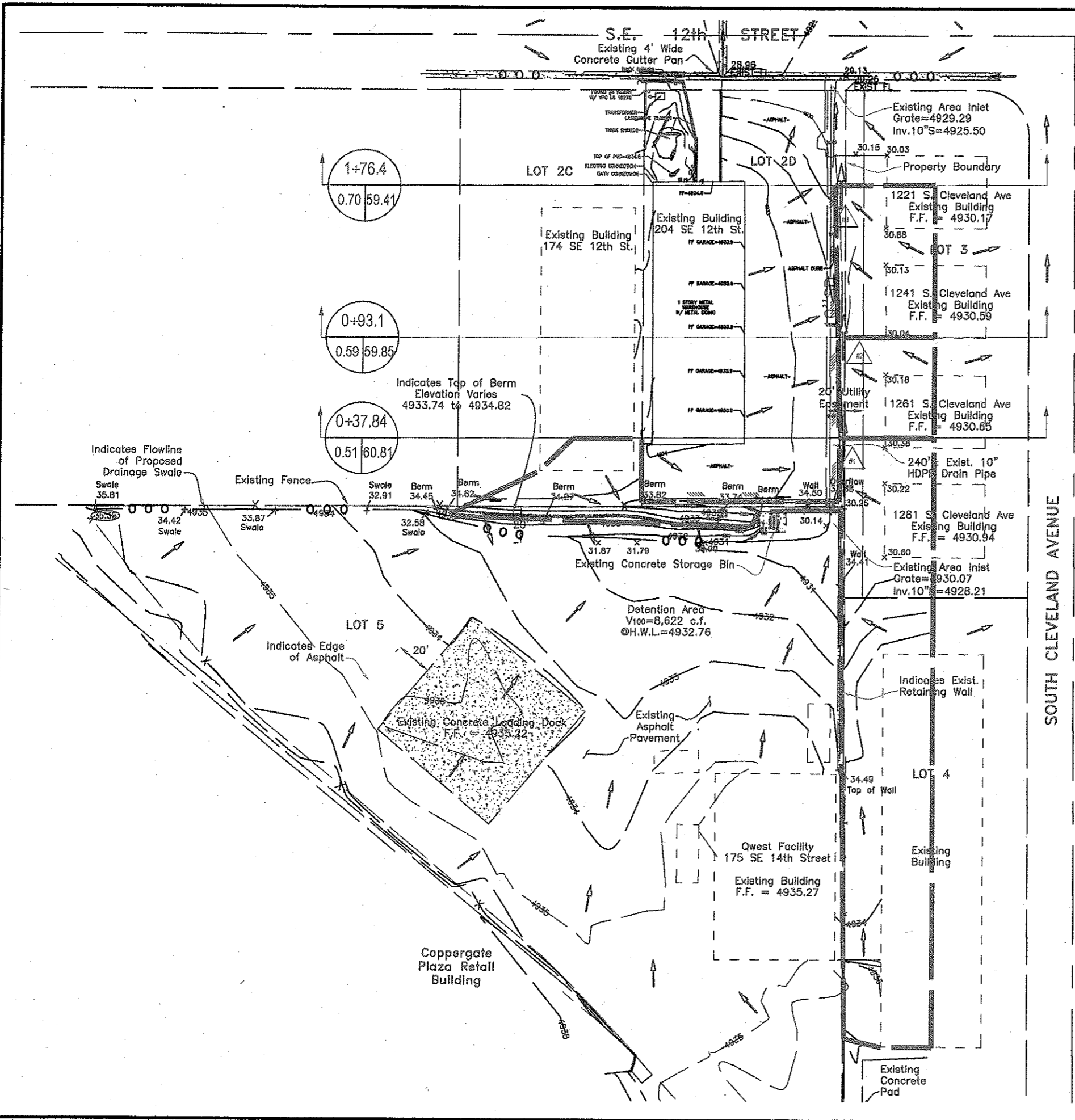
CLIENT: MASTER METAL WORKS
TITLE: Drainage Exhibit
 Condition PRIOR to Parking Area Reconstruction
 204 12th Street S.E.
 Loveland, Colorado

DATE: Aug. 6, 2012
SCALE: As Noted
DRAWN: D.A.R.
CHKD: D.R.M.
Project No. 1029-GRD-12
SHEET 1 of 2



LEGEND

	Typically Indicates Existing Ground Surface Contour
	Drainage Basin Limit Identifier
	Typically Indicates Drainage Flow Direction
	Concentration Point Identifier
	A = Basin Designation B = Area in Acres I = % Imperviousness
	D = Design Point Designation



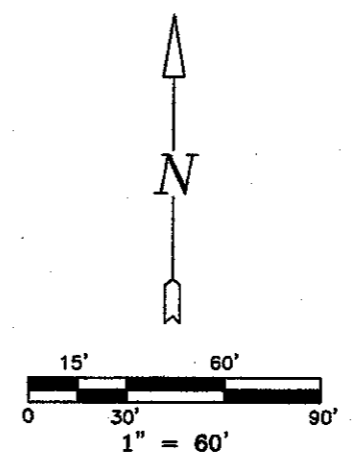
"EXISTING" SUMMARY RUNOFF TABLE

Design Point	Contributing Basin(s)	Contributing Area (acres)	Peak 10-Year (cfs)	Peak 100-Year (cfs)
#1	0+37.84	0.51	1.17	2.29
#1	0+93.10	0.59	1.27	2.48
#3	1+76.40	0.70	1.48	2.90

Dennis R. Messner, P.E.
 Consulting Civil Engineer
 114 East 5th Street
 Loveland, Colorado 80537
 Telephone: (970)663-2221

MASTER METAL WORKS
 Drainage Exhibit
 Condition After Parking Area Reconstruction
 204 12th Street S. E.
 Loveland, Colorado

CLIENT: MASTER METAL WORKS
 TITLE: Drainage Exhibit
 DATE: Aug. 6, 2012
 SCALE: As Noted
 DRAWN: D.A.R.
 CHKD: D.R.M.
 Project No. 1029-GRD-12
 SHEET 2 of 2



LEGEND

- 5012--- Typically Indicates Existing Ground Surface Contour
- Drainage Basin Limit Identifier
- Typically Indicates Drainage Flow Direction
- Concentration Point Identifier
- A = Basin Designation
- B = Area in Acres
- I = % Imperviousness
- #1 D = Design Point Designation

APPENDIX I

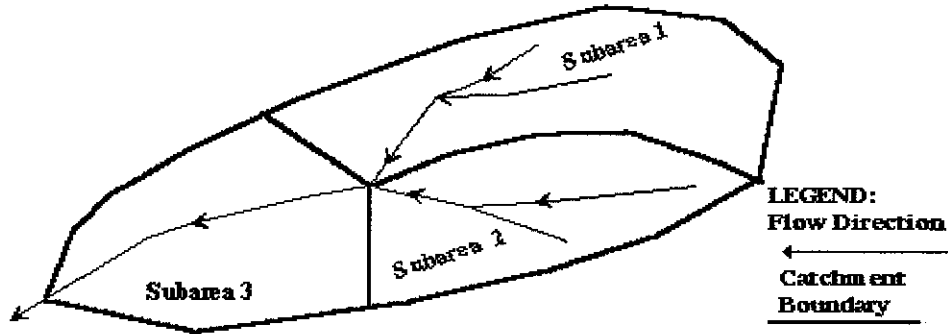
(CALCULATIONS)

CONDITION "PRIOR"
TO
RE-CONSTRUCTION

Area-Weighting for Runoff Coefficient Calculation

Project Title: MASTER METAL WORKS - 204 12th Street SE
 Catchment ID: 0+37.84 (Condition PRIOR to Re-Construction)

Illustration



Instructions: For each catchment subarea, enter values for A and C.

Subarea ID	Area acres	Runoff Coeff.	Product
	A	C*	CA
input	input	input	output
Roof	8431.00	90.00	758790.00
Pavement	1063.00	100.00	106300.00
Gravel	15317.00	40.00	612680.00
Sum:	24811.00	Sum:	#####

Area-Weighted Runoff Coefficient (sum CA/sum A) = 59.56

***See sheet "Design Info" for imperviousness-based runoff coefficient values.**
 For catchments larger than 50 acres, CUP hydrograph and routing are recommended.

CALCULATION OF A PEAK RUNOFF USING RATIONAL METHOD

Project Title: MASTER METAL WORKS - 204 12th Street SE
 Catchment ID: 0+37.84 (Condition PRIOR to Re-Construction) 2 Year Storm

I. Catchment Hydrologic Data

Catchment ID = 0+37.84
 Area = 0.57 Acres
 Percent Imperviousness = 59.56 %
 NRCS Soil Type = C A, B, C, or D

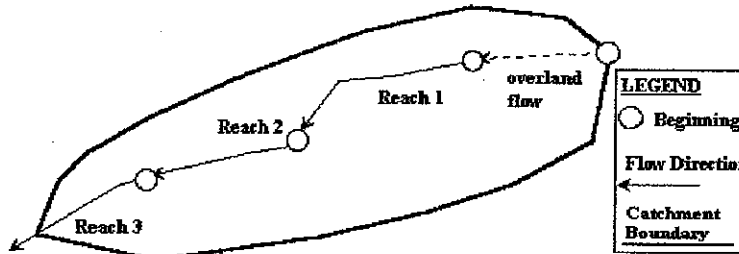
II. Rainfall Information I (inch/hr) = $C1 * P1 / (C2 + Td)^{C3}$

Design Storm Return Period, T_r = 2 years (input return period for design storm)
 $C1$ = 28.50 (input the value of $C1$)
 $C2$ = 10.00 (input the value of $C2$)
 $C3$ = 0.786 (input the value of $C3$)
 $P1$ = 1.00 inches (input one-hr precipitation—see Sheet "Design Info")

III. Analysis of Flow Time (Time of Concentration) for a Catchment

Runoff Coefficient, C = 0.40
 Override Runoff Coefficient, C = _____ (enter an override C value if desired, or leave blank to accept calculated C .)
 5-yr. Runoff Coefficient, $C-5$ = 0.45
 Override 5-yr. Runoff Coefficient, C = _____ (enter an override $C-5$ value if desired, or leave blank to accept calculated $C-5$.)

Illustration



NRCS Land Type	Heavy Meadow	Tillage/Field	Short Pasture/Lawns	Nearly Bare Ground	Grassed Swales/Waterways	Paved Areas & Shallow Paved Swales (Sheet Flow)
Conveyance	2.5	5	7	10	15	20

Calculations:

Reach ID	Slope S	Length L	5-yr Runoff Coeff $C-5$	NRCS Conveyance	Flow Velocity V	Flow Time T_f
	ft/ft	ft			fps	minutes
input	input	input	output	input	output	output
Overland	0.0195	51	0.45	N/A	0.13	6.68
1	0.0190	249		10.00	1.38	3.01
2	0.0034	38		10.00	0.59	1.08
3						
4						
5						
Sum		338				

Computed T_c = 10.77
 Regional T_c = 11.88
 User-Entered T_c = 10.77

IV. Peak Runoff Prediction

Rainfall Intensity at Computed T_c , I = 2.63 inch/hr
 Rainfall Intensity at Regional T_c , I = 2.52 inch/hr
 Rainfall Intensity at User-Defined T_c , I = 2.63 inch/hr

Peak Flowrate, Q_p = 0.60 cfs
 Peak Flowrate, Q_p = 0.58 cfs
 Peak Flowrate, Q_p = 0.60 cfs

CALCULATION OF A PEAK RUNOFF USING RATIONAL METHOD

Project Title: MASTER METAL WORKS - 204 12th Street SE
 Catchment ID: 0+37.84 (Condition PRIOR to Re-Construction) 10 Year storm

I. Catchment Hydrologic Data

Catchment ID = 0+37.84
 Area = 0.57 Acres
 Percent Imperviousness = 59.56 %
 NRCS Soil Type = C A, B, C, or D

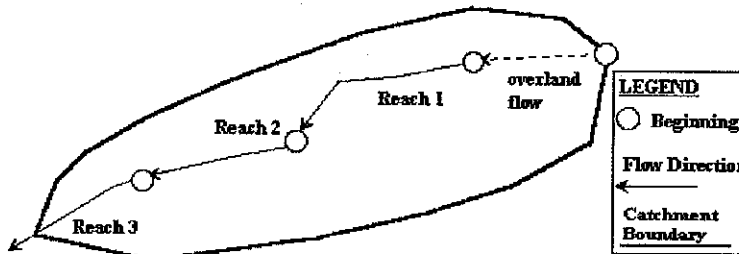
II. Rainfall Information I (inch/hr) = $C1 * P1 / (C2 + Td)^{C3}$

Design Storm Return Period, T_r = 10 years (input return period for design storm)
 $C1$ = 28.50 (input the value of $C1$)
 $C2$ = 10.00 (input the value of $C2$)
 $C3$ = 0.786 (input the value of $C3$)
 $P1$ = 1.69 inches (input one-hr precipitation--see Sheet "Design Info")

III. Analysis of Flow Time (Time of Concentration) for a Catchment

Runoff Coefficient, C = 0.51
 Override Runoff Coefficient, C = _____ (enter an override C value if desired, or leave blank to accept calculated C .)
 5-yr. Runoff Coefficient, $C-5$ = 0.45
 Override 5-yr. Runoff Coefficient, $C-5$ = _____ (enter an override $C-5$ value if desired, or leave blank to accept calculated $C-5$.)

Illustration



NRCS Land Type	Heavy Meadow	Tillage/Field	Short Pasture/Lawns	Nearly Bare Ground	Grassed Swales/Waterways	Paved Areas & Shallow Paved Swales (Sheet Flow)
Conveyance	2.5	5	7	10	15	20

Calculations:

Reach ID	Slope S	Length L	5-yr Runoff Coeff C-5	NRCS Conveyance	Flow Velocity V	Flow Time T _f
	ft/ft	ft			input	output
Overland	0.0195	51	0.45	N/A	0.13	6.68
1	0.0190	249		10.00	1.38	3.01
2	0.0034	38		10.00	0.59	1.08
3						
4						
5						
Sum		338				

Computed T_c = 10.77
 Regional T_c = 11.88
 User-Entered T_c = 10.77

IV. Peak Runoff Prediction

Rainfall Intensity at Computed T_c, I = 4.44 inch/hr
 Rainfall Intensity at Regional T_c, I = 4.26 inch/hr
 Rainfall Intensity at User-Defined T_c, I = 4.44 inch/hr

Peak Flowrate, Q_p = 1.28 cfs
 Peak Flowrate, Q_p = 1.23 cfs
 Peak Flowrate, Q_p = 1.28 cfs

CALCULATION OF A PEAK RUNOFF USING RATIONAL METHOD

Project Title: MASTER METAL WORKS - 204 12th Street SE
 Catchment ID: 0+37.84 (Condition PRIOR to Re-Construction) 100 Year Storm

I. Catchment Hydrologic Data

Catchment ID = 0+37.84
 Area = 0.57 Acres
 Percent Imperviousness = 59.56 %
 NRCS Soil Type = C A, B, C, or D

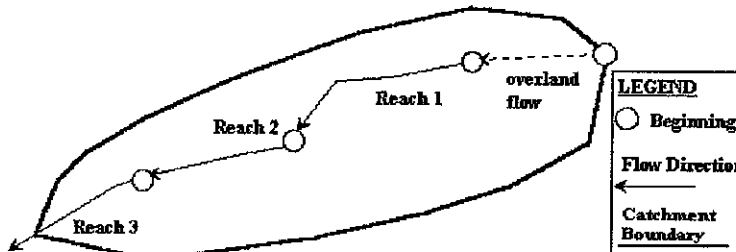
II. Rainfall Information I (inch/hr) = $C1 * P1 / (C2 + Td)^{C3}$

Design Storm Return Period, T_r = 100 years (input return period for design storm)
 $C1$ = 28.50 (input the value of $C1$)
 $C2$ = 10.00 (input the value of $C2$)
 $C3$ = 0.786 (input the value of $C3$)
 $P1$ = 2.66 inches (input one-hr precipitation--see Sheet "Design Info")

III. Analysis of Flow Time (Time of Concentration) for a Catchment

Runoff Coefficient, C = 0.63
 Override Runoff Coefficient, C = _____ (enter an override C value if desired, or leave blank to accept calculated C .)
 5-yr. Runoff Coefficient, $C-5$ = 0.45
 Override 5-yr. Runoff Coefficient, $C-5$ = _____ (enter an override $C-5$ value if desired, or leave blank to accept calculated $C-5$.)

Illustration



NRCS Land Type	Heavy Meadow	Tillage/Field	Short Pasture/Lawns	Nearly Bare Ground	Grassed Swales/Waterways	Paved Areas & Shallow Paved Swales (Sheet Flow)
Conveyance	2.5	5	7	10	15	20

Calculations:

Reach ID	Slope S	Length L	5-yr Runoff Coeff C-5	NRCS Conveyance	Flow Velocity V	Flow Time T _f
	ft/ft input	ft input			fps output	minutes output
Overland	0.0195	51	0.45	N/A	0.13	6.68
1	0.0190	249		10.00	1.38	3.01
2	0.0034	38		10.00	0.59	1.08
3						
4						
5						
Sum		338				

Computed T_c = 10.77
 Regional T_c = 11.88
 User-Entered T_c = 10.77

IV. Peak Runoff Prediction

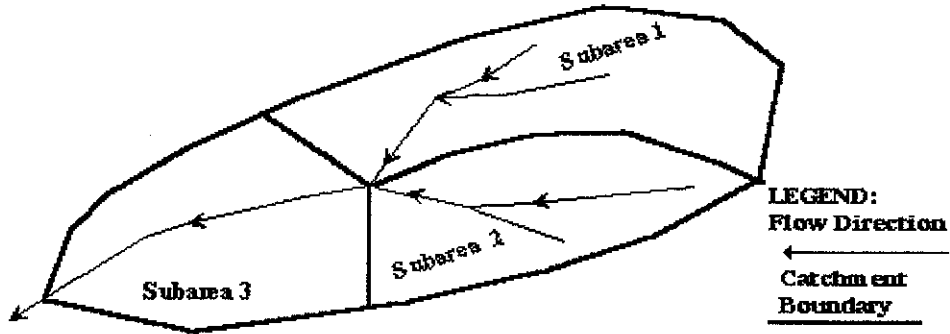
Rainfall Intensity at Computed T_c, I = 6.99 inch/hr
 Rainfall Intensity at Regional T_c, I = 6.71 inch/hr
 Rainfall Intensity at User-Defined T_c, I = 6.99 inch/hr

Peak Flowrate, Q_p = 2.51 cfs
 Peak Flowrate, Q_p = 2.41 cfs
 Peak Flowrate, Q_p = 2.51 cfs

Area-Weighting for Runoff Coefficient Calculation

Project Title: MASTER METAL WORKS - 204 12th Street SE
 Catchment ID: 0+93.1 (Condition PRIOR to Re-Construction)

Illustration



Instructions: For each catchment subarea, enter values for A and C.

Subarea ID	Area acres	Runoff Coeff.	Product
	A	C*	CA
input	input	input	output
Roof	10629.00	90.00	956610.00
Pavement	3398.00	100.00	339800.00
Gravel	17794.00	40.00	711760.00
Sum:	31821.00	Sum:	#####

Area-Weighted Runoff Coefficient (sum CA/sum A) = 63.11

***See sheet "Design Info" for imperviousness-based runoff coefficient values.**

For catchments larger than 50 acres, CNP hydrograph and routing are recommended.

CALCULATION OF A PEAK RUNOFF USING RATIONAL METHOD

Project Title: MASTER METAL WORKS - 204 12th Street SE
 Catchment ID: 0+93.1 (Condition PRIOR to Re-Construction) 2 Year Storm

I. Catchment Hydrologic Data

Catchment ID = 0+93.1
 Area = 0.73 Acres
 Percent Imperviousness = 63.11 %
 NRCS Soil Type = C A, B, C, or D

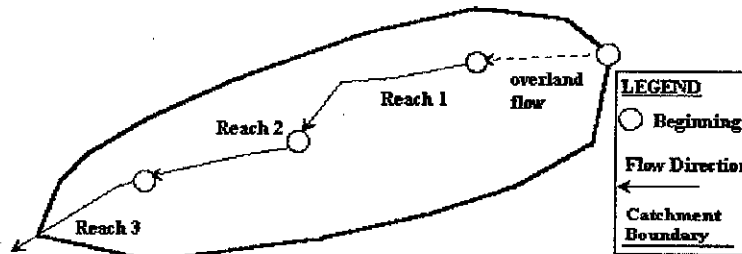
II. Rainfall Information I (inch/hr) = $C1 * P1 / (C2 + Td)^{C3}$

Design Storm Return Period, T_r = 2 years (input return period for design storm)
 $C1$ = 28.50 (input the value of $C1$)
 $C2$ = 10.00 (input the value of $C2$)
 $C3$ = 0.786 (input the value of $C3$)
 $P1$ = 1.00 inches (input one-hr precipitation—see Sheet "Design Info")

III. Analysis of Flow Time (Time of Concentration) for a Catchment

Runoff Coefficient, C = 0.43
 Override Runoff Coefficient, C = _____ (enter an override C value if desired, or leave blank to accept calculated C .)
 5-yr. Runoff Coefficient, $C-5$ = 0.48
 Override 5-yr. Runoff Coefficient, $C-5$ = _____ (enter an override $C-5$ value if desired, or leave blank to accept calculated $C-5$.)

Illustration



NRCS Land Type	Heavy Meadow	Tillage/Field	Short Pasture/Lawns	Nearly Bare Ground	Grassed Swales/Waterways	Paved Areas & Shallow Paved Swales (Sheet Flow)
Conveyance	2.5	5	7	10	15	20

Calculations:

Reach ID	Slope S	Length L	5-yr Runoff Coeff C-5	NRCS Conveyance	Flow Velocity V	Flow Time T _f
	ft/ft input	ft input			fps output	minutes output
Overland	0.0195	51	0.48	N/A	0.13	6.43
1	0.0190	249		10.00	1.38	3.01
2	0.0034	93		10.00	0.59	2.64
3						
4						
5						
Sum		393				

Computed T_c = 12.09
 Regional T_c = 12.18
 User-Entered T_c = 12.09

IV. Peak Runoff Prediction

Rainfall Intensity at Computed T_c , I = 2.50 inch/hr
 Rainfall Intensity at Regional T_c , I = 2.49 inch/hr
 Rainfall Intensity at User-Defined T_c , I = 2.50 inch/hr

Peak Flowrate, Q_p = 0.79 cfs
 Peak Flowrate, Q_p = 0.79 cfs
 Peak Flowrate, Q_p = 0.79 cfs

CALCULATION OF A PEAK RUNOFF USING RATIONAL METHOD

Project Title: MASTER METAL WORKS - 204 12th Street SE
 Catchment ID: 0+93.1 (Condition PRIOR to Re-Construction) 10 Year Storm

I. Catchment Hydrologic Data

Catchment ID = 0+93.1
 Area = 0.73 Acres
 Percent Imperviousness = 63.11 %
 NRCS Soil Type = C A, B, C, or D

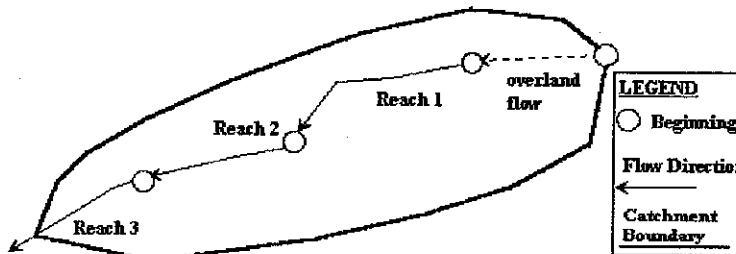
II. Rainfall Information I (inch/hr) = $C1 * P1 / (C2 + Td)^{C3}$

Design Storm Return Period, T_r = 10 years (input return period for design storm)
 $C1$ = 28.50 (input the value of $C1$)
 $C2$ = 10.00 (input the value of $C2$)
 $C3$ = 0.786 (input the value of $C3$)
 $P1$ = 1.69 inches (input one-hr precipitation—see Sheet "Design Info")

III. Analysis of Flow Time (Time of Concentration) for a Catchment

Runoff Coefficient, C = 0.53
 Override Runoff Coefficient, C = _____ (enter an override C value if desired, or leave blank to accept calculated C .)
 5-yr. Runoff Coefficient, $C-5$ = 0.48
 Override 5-yr. Runoff Coefficient, $C-5$ = _____ (enter an override $C-5$ value if desired, or leave blank to accept calculated $C-5$.)

Illustration



NRCS Land Type	Heavy Meadow	Tillage/Field	Short Pasture/Lawns	Nearly Bare Ground	Grassed Swales/Waterways	Paved Areas & Shallow Paved Swales (Sheet Flow)
Conveyance	2.5	5	7	10	15	20

Calculations:

Reach ID	Slope S	Length L	5-yr Runoff Coeff C-5	NRCS Conveyance	Flow Velocity V	Flow Time T _f
	ft/ft input	ft input			fps output	minutes output
Overland	0.0195	51	0.48	N/A	0.13	6.43
1	0.0190	249		10.00	1.38	3.01
2	0.0034	93		10.00	0.59	2.64
3						
4						
5						
Sum		393				

Computed T_c = 12.09
 Regional T_c = 12.18
 User-Entered T_c = 12.09

IV. Peak Runoff Prediction

Rainfall Intensity at Computed T_c, I = 4.23 inch/hr
 Rainfall Intensity at Regional T_c, I = 4.22 inch/hr
 Rainfall Intensity at User-Defined T_c, I = 4.23 inch/hr

Peak Flowrate, Q_p = 1.63 cfs
 Peak Flowrate, Q_p = 1.62 cfs
 Peak Flowrate, Q_p = 1.63 cfs

CALCULATION OF A PEAK RUNOFF USING RATIONAL METHOD

Project Title: MASTER METAL WORKS - 204 12th Street SE
 Catchment ID: 0+93.1 (Condition PRIOR to Re-Construction) 100 Year Storm

I. Catchment Hydrologic Data

Catchment ID = 0+93.1
 Area = 0.73 Acres
 Percent Imperviousness = 63.11 %
 NRCS Soil Type = C A, B, C, or D

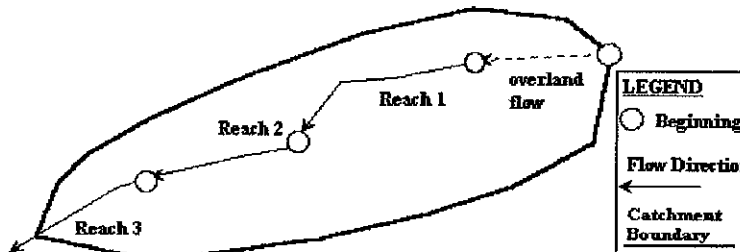
II. Rainfall Information I (inch/hr) = $C1 * P1 / (C2 + Td)^{C3}$

Design Storm Return Period, T_r = 100 years (input return period for design storm)
 $C1$ = 28.50 (input the value of $C1$)
 $C2$ = 10.00 (input the value of $C2$)
 $C3$ = 0.786 (input the value of $C3$)
 $P1$ = 2.66 inches (input one-hr precipitation—see Sheet "Design Info")

III. Analysis of Flow Time (Time of Concentration) for a Catchment

Runoff Coefficient, C = 0.64
 Override Runoff Coefficient, C = _____ (enter an override C value if desired, or leave blank to accept calculated C)
 5-yr. Runoff Coefficient, $C-5$ = 0.48
 Override 5-yr. Runoff Coefficient, $C-5$ = _____ (enter an override $C-5$ value if desired, or leave blank to accept calculated $C-5$.)

Illustration



NRCS Land Type	Heavy Meadow	Tillage/Field	Short Pasture/Lawns	Nearly Bare Ground	Grassed Swales/Waterways	Paved Areas & Shallow Paved Swales (Sheet Flow)
Conveyance	2.5	5	7	10	15	20

Calculations:

Reach ID	Slope S	Length L	5-yr Runoff Coeff $C-5$	NRCS Conveyance	Flow Velocity V	Flow Time T_f
	ft/ft input	ft input			fps output	minutes output
Overland	0.0195	51	0.48	N/A	0.13	6.43
1	0.0190	249		10.00	1.38	3.01
2	0.0034	93		10.00	0.59	2.64
3						
4						
5						
Sum		393				

Computed T_c = 12.09
 Regional T_c = 12.18
 User-Entered T_c = 12.09

IV. Peak Runoff Prediction

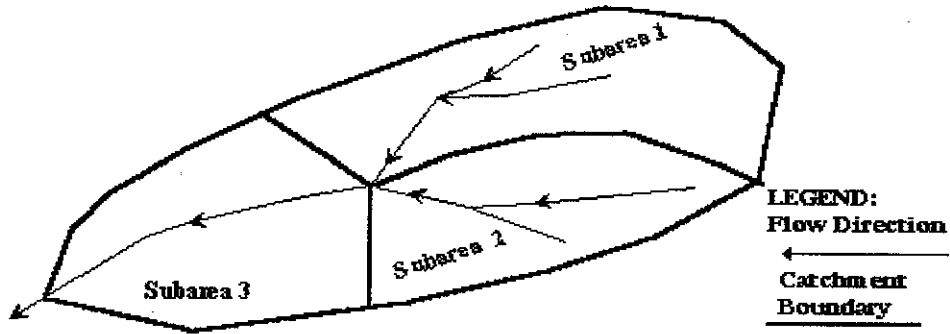
Rainfall Intensity at Computed T_c , I = 6.66 inch/hr
 Rainfall Intensity at Regional T_c , I = 6.63 inch/hr
 Rainfall Intensity at User-Defined T_c , I = 6.66 inch/hr

Peak Flowrate, Q_p = 3.14 cfs
 Peak Flowrate, Q_p = 3.13 cfs
 Peak Flowrate, Q_p = 3.14 cfs

Area-Weighting for Runoff Coefficient Calculation

Project Title: MASTER METAL WORKS - 204 12th Street SE
 Catchment ID: 1+76.4 (Condition PRIOR to Re-Construction)

Illustration



Instructions: For each catchment subarea, enter values for A and C.

Subarea ID	Area acres	Runoff Coeff.	Product
	A	C*	CA
input	input	input	output
Roof	14414.00	90.00	#####
Pavement	7077.00	100.00	707700.00
Gravel	21025.00	40.00	841000.00
Sum:	42516.00	Sum:	#####

Area-Weighted Runoff Coefficient (sum CA/sum A) = 66.94

***See sheet "Design Info" for imperviousness-based runoff coefficient values.**
 For catchments larger than 90 acres, CUPP hydrograph and routing are recommended.

CALCULATION OF A PEAK RUNOFF USING RATIONAL METHOD

Project Title: MASTER METAL WORKS - 204 12th Street SE
 Catchment ID: 1+76.4 (Condition PRIOR to Re-Construction) 2 Year Storm

I. Catchment Hydrologic Data

Catchment ID = 1+76.4
 Area = 0.98 Acres
 Percent Imperviousness = 66.94 %
 NRCS Soil Type = C A, B, C, or D

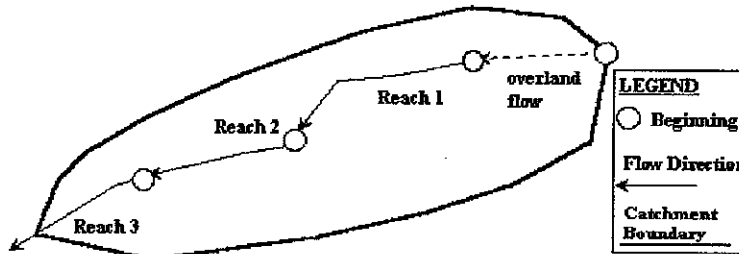
II. Rainfall Information I (inch/hr) = $C1 * P1 / (C2 + Td)^{C3}$

Design Storm Return Period, T_r = 2 years (input return period for design storm)
 $C1$ = 28.50 (input the value of $C1$)
 $C2$ = 10.00 (input the value of $C2$)
 $C3$ = 0.786 (input the value of $C3$)
 $P1$ = 1.00 inches (input one-hr precipitation--see Sheet "Design Info")

III. Analysis of Flow Time (Time of Concentration) for a Catchment

Runoff Coefficient, C = 0.46
 Override Runoff Coefficient, C = _____ (enter an override C value if desired, or leave blank to accept calculated C .)
 5-yr. Runoff Coefficient, $C-5$ = 0.51
 Override 5-yr. Runoff Coefficient, $C-5$ = _____ (enter an override $C-5$ value if desired, or leave blank to accept calculated $C-5$.)

Illustration



NRCS Land Type	Heavy Meadow	Tillage/Field	Short Pasture/Lawns	Nearly Bare Ground	Grassed Swales/Waterways	Paved Areas & Shallow Paved Swales (Sheet Flow)
Conveyance	2.5	5	7	10	15	20

Calculations:

Reach ID	Slope S	Length L	5-yr Runoff Coeff $C-5$	NRCS Conveyance	Flow Velocity V	Flow Time T_f
	ft/ft input	ft input			fps output	minutes output
Overland	0.0195	51	0.51	N/A	0.14	6.14
1	0.0190	249		10.00	1.38	3.01
2	0.0034	93		10.00	0.59	2.64
3	0.0045	83		10.00	0.67	2.06
4						
5						
Sum		476				

Computed T_c = 13.86
 Regional T_c = 12.64
 User-Entered T_c = 12.64

IV. Peak Runoff Prediction

Rainfall Intensity at Computed T_c , I = 2.36 inch/hr
 Rainfall Intensity at Regional T_c , I = 2.45 inch/hr
 Rainfall Intensity at User-Defined T_c , I = 2.45 inch/hr

Peak Flowrate, Q_p = 1.06 cfs
 Peak Flowrate, Q_p = 1.11 cfs
 Peak Flowrate, Q_p = 1.11 cfs

CALCULATION OF A PEAK RUNOFF USING RATIONAL METHOD

Project Title: MASTER METAL WORKS - 204 12th Street SE
 Catchment ID: 1+76.4 (Condition PRIOR to Re-Construction) 10 Year Storm

I. Catchment Hydrologic Data

Catchment ID = 1+76.4
 Area = 0.98 Acres
 Percent Imperviousness = 66.94 %
 NRCS Soil Type = C A, B, C, or D

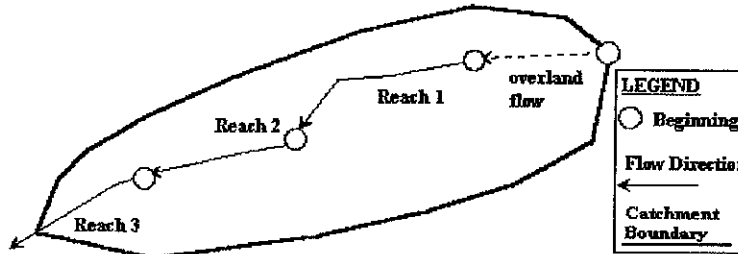
II. Rainfall Information I (inch/hr) = $C1 * P1 / (C2 + Td)^{C3}$

Design Storm Return Period, T_r = 10 years (input return period for design storm)
 $C1$ = 28.50 (input the value of $C1$)
 $C2$ = 10.00 (input the value of $C2$)
 $C3$ = 0.786 (input the value of $C3$)
 $P1$ = 1.69 inches (input one-hr precipitation--see Sheet "Design info")

III. Analysis of Flow Time (Time of Concentration) for a Catchment

Runoff Coefficient, C = 0.55
 Override Runoff Coefficient, C = _____ (enter an override C value if desired, or leave blank to accept calculated C .)
 5-yr. Runoff Coefficient, $C-5$ = 0.51
 Override 5-yr. Runoff Coefficient, C = _____ (enter an override $C-5$ value if desired, or leave blank to accept calculated $C-5$.)

Illustration



NRCS Land Type	Heavy Meadow	Tillage/Field	Short Pasture/Lawns	Nearly Bare Ground	Grassed Swales/Waterways	Paved Areas & Shallow Paved Swales (Sheet Flow)
Conveyance	2.5	5	7	10	15	20

Calculations:

Reach ID	Slope S ft/ft input	Length L ft input	5-yr Runoff Coeff C-5 output	NRCS Conveyance input	Flow Velocity V	Flow Time T _f
					fps output	minutes output
Overland	0.0195	51	0.51	N/A	0.14	6.14
1	0.0190	249		10.00	1.38	3.01
2	0.0034	93		10.00	0.59	2.64
3	0.0045	83		10.00	0.67	2.06
4						
5						
Sum		476				
					Computed T _c =	13.86
					Regional T _c =	12.64
					User-Entered T _c =	12.64

IV. Peak Runoff Prediction

Rainfall Intensity at Computed T_c, I = 3.98 inch/hr
 Rainfall Intensity at Regional T_c, I = 4.15 inch/hr
 Rainfall Intensity at User-Defined T_c, I = 4.15 inch/hr

Peak Flowrate, Q_p = 2.15 cfs
 Peak Flowrate, Q_p = 2.24 cfs
 Peak Flowrate, Q_p = 2.24 cfs

CALCULATION OF A PEAK RUNOFF USING RATIONAL METHOD

Project Title: MASTER METAL WORKS - 204 12th Street SE
 Catchment ID: 1+76.4 (Condition PRIOR to Re-Construction) 100 Year Storm

I. Catchment Hydrologic Data

Catchment ID = 1+76.4
 Area = 0.98 Acres
 Percent Imperviousness = 66.94 %
 NRCS Soil Type = C A, B, C, or D

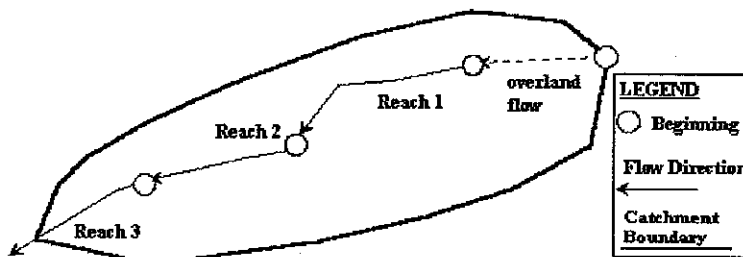
II. Rainfall Information I (inch/hr) = $C1 * P1 / (C2 + Td)^{C3}$

Design Storm Return Period, T_r = 100 years (input return period for design storm)
 $C1$ = 28.50 (input the value of $C1$)
 $C2$ = 10.00 (input the value of $C2$)
 $C3$ = 0.786 (input the value of $C3$)
 $P1$ = 2.66 inches (input one-hr precipitation--see Sheet "Design Info")

III. Analysis of Flow Time (Time of Concentration) for a Catchment

Runoff Coefficient, C = 0.66
 Override Runoff Coefficient, C = _____ (enter an override C value if desired, or leave blank to accept calculated C).
 5-yr. Runoff Coefficient, $C-5$ = 0.51
 Override 5-yr. Runoff Coefficient, C = _____ (enter an override $C-5$ value if desired, or leave blank to accept calculated $C-5$).

Illustration



NRCS Land Type	Heavy Meadow	Tillage/Field	Short Pasture/Lawns	Nearly Bare Ground	Grassed Swales/Waterways	Paved Areas & Shallow Paved Swales (Sheet Flow)
Conveyance	2.5	5	7	10	15	20

Calculations:

Reach ID	Slope S ft/ft input	Length L ft input	5-yr Runoff Coeff C-5 output	NRCS Convey- ance input	Flow Velocity V	Flow Time Tf
					fps output	minutes output
Overland	0.0195	51	0.51	N/A	0.14	6.14
1	0.0190	249		10.00	1.38	3.01
2	0.0034	93		10.00	0.59	2.64
3	0.0045	83		10.00	0.67	2.06
4						
5						
Sum		476				

Computed T_c = 13.86
 Regional T_c = 12.64
 User-Entered T_c = 12.64

IV. Peak Runoff Prediction

Rainfall Intensity at Computed T_c , I = 6.26 inch/hr
 Rainfall Intensity at Regional T_c , I = 6.53 inch/hr
 Rainfall Intensity at User-Defined T_c , I = 6.53 inch/hr

Peak Flowrate, Q_p = 4.05 cfs
 Peak Flowrate, Q_p = 4.22 cfs
 Peak Flowrate, Q_p = 4.22 cfs

0+37.84 PRIOR to Reconstruction
Worksheet for Irregular Channel

Project Description	
Project File	c:\program files\haestad\academic\fmw\mmw.fm2
Worksheet	0+37.84 PRIOR Condition
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

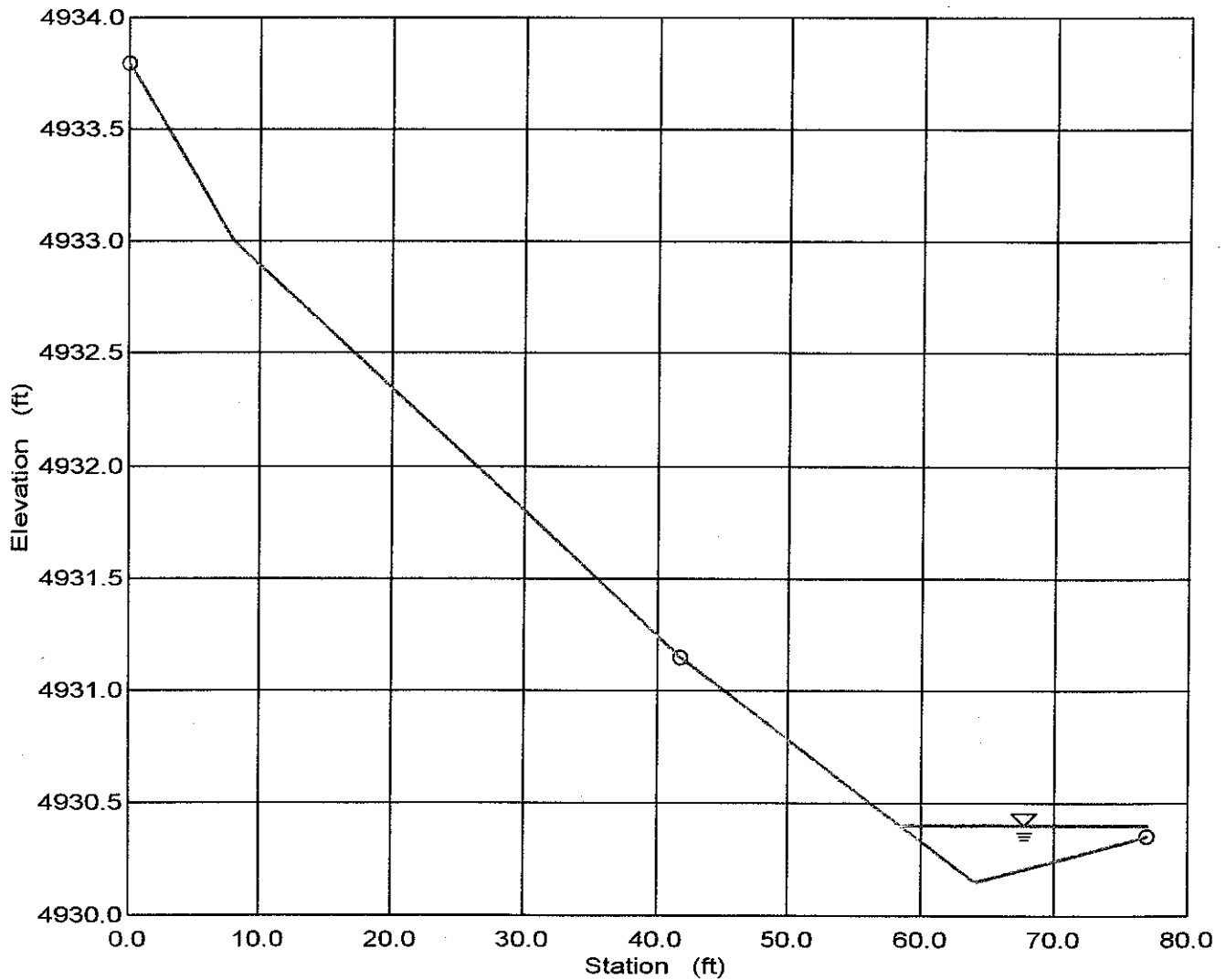
Input Data					
Channel Slope	0.004000 ft/ft				
Elevation range: 4,930.15 ft to 4,933.80 ft.					
Station (ft)	Elevation (ft)	Start Station	End Station	Roughness	
0.00	4,933.80	0.00	41.80	0.015	
8.00	4,933.00	41.80	77.00	0.027	
26.45	4,932.00				
41.80	4,931.15				
64.00	4,930.15				
77.00	4,930.35				
Discharge	2.51	cfs			

Results		
Wtd. Mannings Coefficient	0.027	
Water Surface Elevation	4,930.40	ft
Flow Area	2.65	ft ²
Wetted Perimeter	18.61	ft
Top Width	18.55	ft
Height	0.25	ft
Critical Depth	4,930.33	ft
Critical Slope	0.023579	ft/ft
Velocity	0.95	ft/s
Velocity Head	0.01	ft
Specific Energy	4,930.41	ft
Froude Number	0.44	
Flow is subcritical.		
Water elevation exceeds lowest end station by 0.05 ft.		

0+37.84 PRIOR 100 Year
Cross Section for Irregular Channel

Project Description	
Project File	c:\program files\haestad\academic\fmw\lmmw.fm2
Worksheet	0+37.84 PRIOR Condition
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Section Data	
Wtd. Mannings Coefficient	0.027
Channel Slope	0.004000 ft/ft
Water Surface Elevation	4,930.40 ft
Discharge	2.51 cfs



0+93.1 PRIOR to Reconstruction
Worksheet for Irregular Channel

Project Description

Project File c:\program files\haestad\academic\fmw\mmw.fm2
Worksheet 0+93.1 PRIOR Condition
Flow Element Irregular Channel
Method Manning's Formula
Solve For Water Elevation

Input Data

Channel Slope 0.004000 ft/ft
Elevation range: 4,929.75 ft to 4,933.80 ft.

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
0.00	4,933.80	0.00	42.50	0.015
13.35	4,933.00	42.50	77.20	0.027
29.10	4,932.00			
42.50	4,931.15			
44.15	4,931.00			
59.50	4,930.00			
60.75	4,929.75			
75.30	4,930.00			
77.20	4,930.05			
Discharge	3.14	cfs		

Results

Wtd. Mannings Coefficient 0.027
Water Surface Elevation 4,930.06 ft
Flow Area 3.03 ft²
Wetted Perimeter 18.67 ft
Top Width 18.63 ft
Height 0.31 ft
Critical Depth 4,929.98 ft
Critical Slope 0.021964 ft/ft
Velocity 1.04 ft/s
Velocity Head 0.02 ft
Specific Energy 4,930.08 ft
Froude Number 0.45

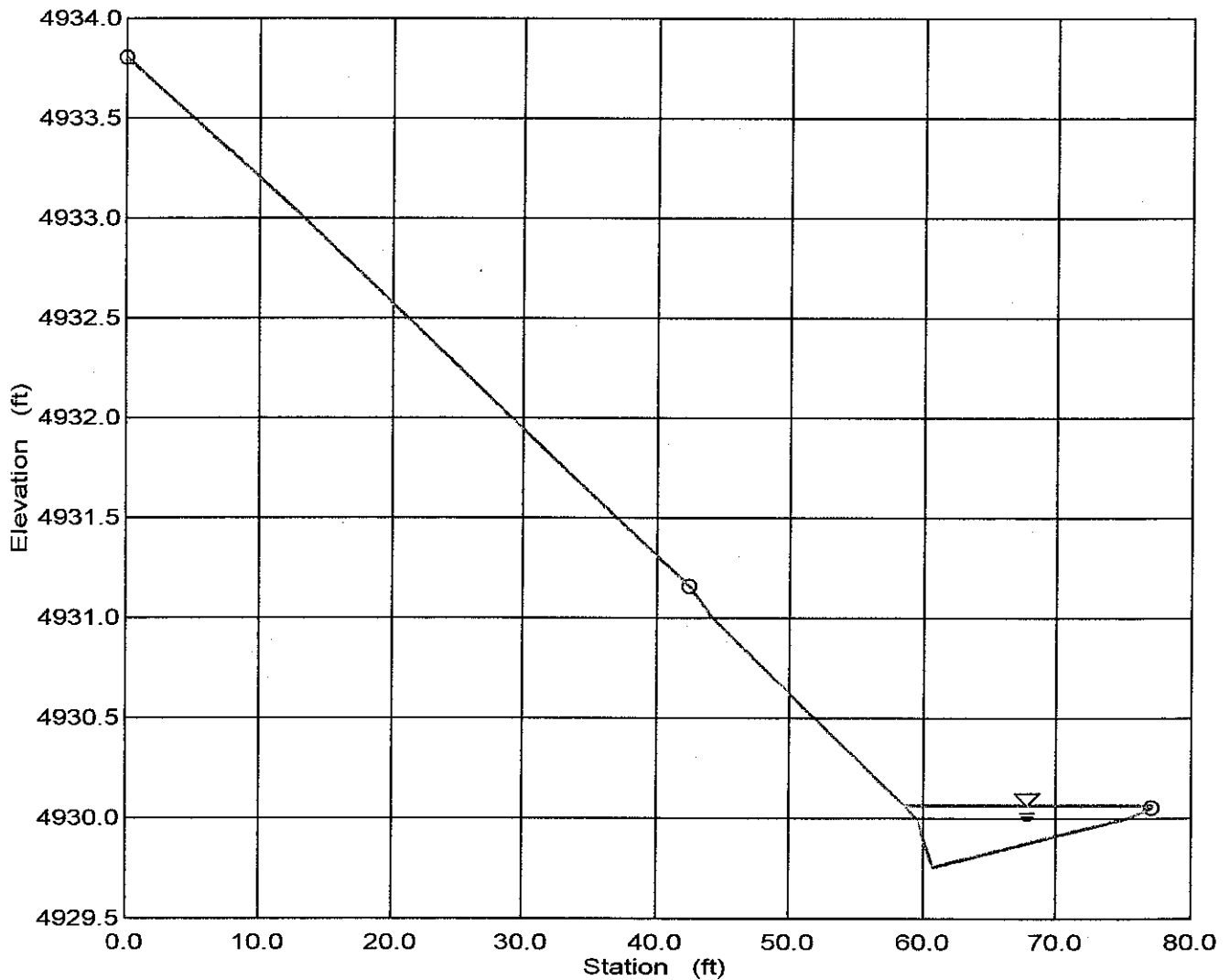
Flow is subcritical.

Water elevation exceeds lowest end station by 0.01 ft.

0+93.1 PRIOR 100 Year
Cross Section for Irregular Channel

Project Description	
Project File	c:\program files\haestad\academic\fmw\mmw.fm2
Worksheet	0+93.1 PRIOR Condition
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Section Data	
Wtd. Mannings Coefficient	0.027
Channel Slope	0.004000 ft/ft
Water Surface Elevation	4,930.06 ft
Discharge	3.14 cfs



1+76.4 PRIOR to Reconstruction
Worksheet for Irregular Channel

Project Description	
Project File	c:\program files\haestad\academic\fmw\mmw.fm2
Worksheet	1+76.4 PRIOR Condition
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

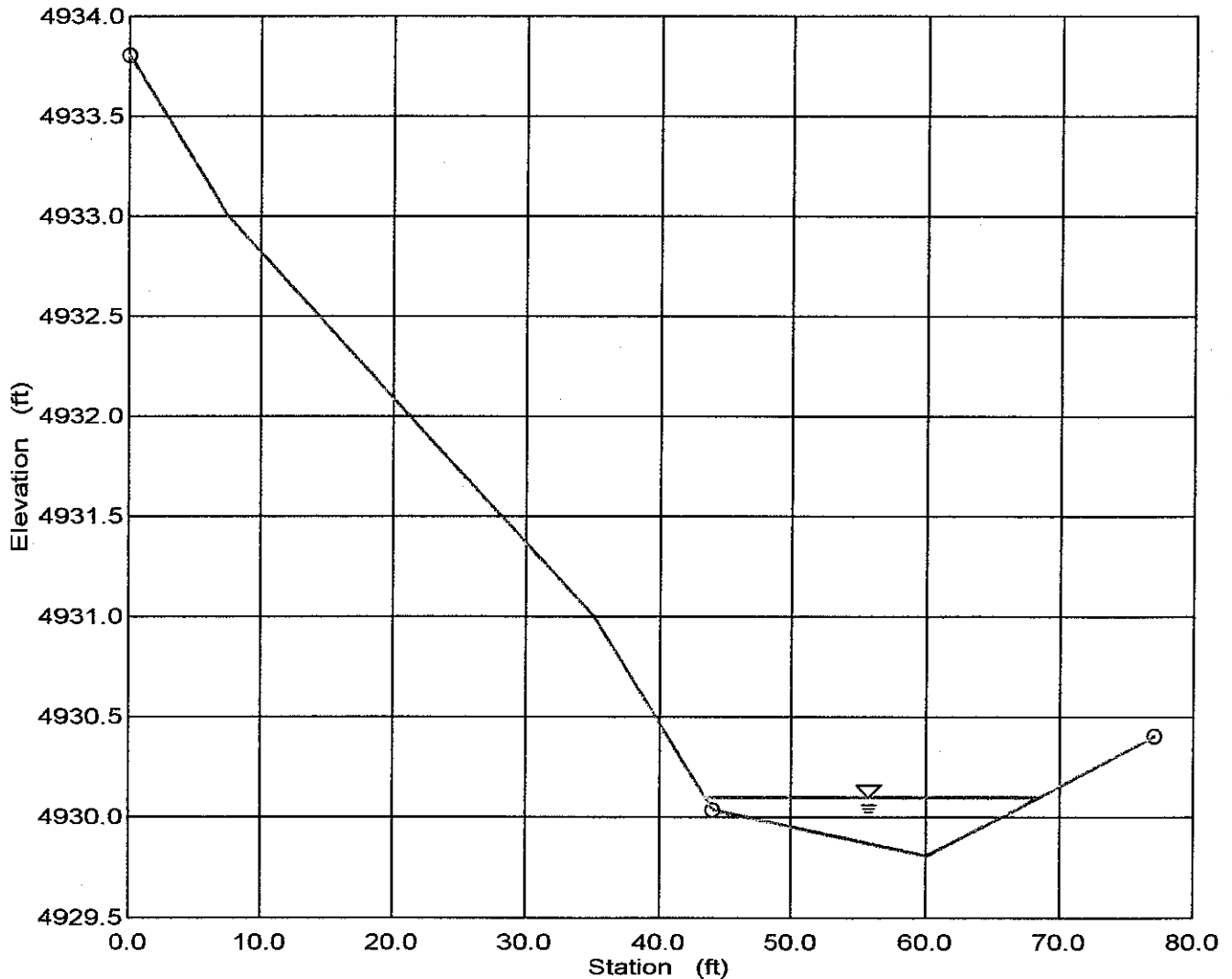
Input Data					
Channel Slope	0.004000 ft/ft				
Elevation range:	4,929.80 ft to 4,933.80 ft.				
Station (ft)	Elevation (ft)	Start Station	End Station	Roughness	
0.00	4,933.80	0.00	44.00	0.015	
7.45	4,933.00	44.00	77.10	0.027	
21.20	4,932.00				
35.00	4,931.00				
44.00	4,930.03				
60.00	4,929.80				
77.10	4,930.40				
Discharge	4.22	cfs			

Results		
Wtd. Mannings Coefficient	0.027	
Water Surface Elevation	4,930.09	ft
Flow Area	4.03	ft ²
Wetted Perimeter	24.86	ft
Top Width	24.85	ft
Height	0.29	ft
Critical Depth	4,930.02	ft
Critical Slope	0.022345	ft/ft
Velocity	1.05	ft/s
Velocity Head	0.02	ft
Specific Energy	4,930.11	ft
Froude Number	0.46	
Flow is subcritical.		

**1+76.4 PRIOR 100 Year
Cross Section for Irregular Channel**

Project Description	
Project File	c:\program files\haestad\academic\fmw\mmw.fm2
Worksheet	1+76.4 PRIOR Condition
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Section Data	
Wtd. Mannings Coefficient	0.027
Channel Slope	0.004000 ft/ft
Water Surface Elevation	4,930.09 ft
Discharge	4.22 cfs

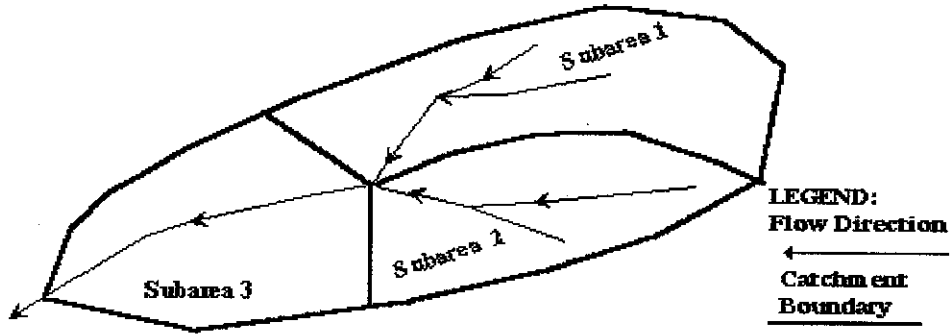


***CONDITION “EXISTING”
AFTER
RE-CONSTRUCTION***

Area-Weighting for Runoff Coefficient Calculation

Project Title: MASTER METAL WORKS - 204 12th Street SE
 Catchment ID: 0+37.84 (Condition EXISTING after Re-Construction)

Illustration



Instructions: For each catchment subarea, enter values for A and C.

Subarea ID	Area acres	Runoff Coeff.	Product
	A	C*	CA
input	input	input	output
Roof	8104.00	90.00	729360.00
Pavement	994.00	100.00	99400.00
Gravel	13244.00	40.00	529760.00
Sum:	22342.00	Sum:	#####

Area-Weighted Runoff Coefficient (sum CA/sum A) = 60.81

***See sheet "Design Info" for imperviousness-based runoff coefficient values.**

For catchments larger than 60 acres, CUPP hydrograph and routing are recommended.

CALCULATION OF A PEAK RUNOFF USING RATIONAL METHOD

Project Title: MASTER METAL WORKS - 204 12th Street SE
 Catchment ID: 0+37.84 (Condition EXISTING after Re-Construction) 2 Year Storm

I. Catchment Hydrologic Data

Catchment ID = 0+37.84
 Area = 0.51 Acres
 Percent Imperviousness = 60.81 %
 NRCS Soil Type = C A, B, C, or D

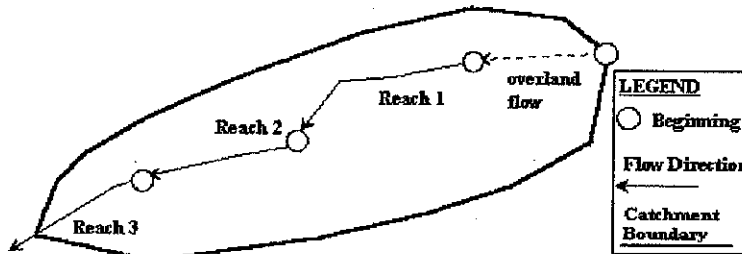
II. Rainfall Information I (inch/hr) = $C1 * P1 / (C2 + Td)^{C3}$

Design Storm Return Period, T_r = 2 years (input return period for design storm)
 $C1$ = 28.50 (input the value of $C1$)
 $C2$ = 10.00 (input the value of $C2$)
 $C3$ = 0.786 (input the value of $C3$)
 $P1$ = 1.00 inches (input one-hr precipitation—see Sheet "Design Info")

III. Analysis of Flow Time (Time of Concentration) for a Catchment

Runoff Coefficient, C = 0.41
 Override Runoff Coefficient, C = _____ (enter an override C value if desired, or leave blank to accept calculated C .)
 5-yr. Runoff Coefficient, $C-5$ = 0.46
 Override 5-yr. Runoff Coefficient, $C-5$ = _____ (enter an override $C-5$ value if desired, or leave blank to accept calculated $C-5$.)

Illustration



NRCS Land Type	Heavy Meadow	Tillage/Field	Short Pasture/Lawns	Nearly Bare Ground	Grassed Swales/Waterways	Paved Areas & Shallow Paved Swales (Sheet Flow)
Conveyance	2.5	5	7	10	15	20

Calculations:

Reach ID	Slope S	Length L	5-yr Runoff Coeff C-5	NRCS Conveyance	Flow Velocity V	Flow Time Tt
	ft/ft input	ft input			fps output	minutes output
Overland	0.0195	51	0.46	N/A	0.13	6.60
1	0.0190	249		10.00	1.38	3.01
2	0.0034	38		10.00	0.59	1.08
3						
4						
5						
Sum		338				

Computed T_c = 10.69
 Regional T_c = 11.88
 User-Entered T_c = 10.69

IV. Peak Runoff Prediction

Rainfall Intensity at Computed T_c , I = 2.63 inch/hr
 Rainfall Intensity at Regional T_c , I = 2.52 inch/hr
 Rainfall Intensity at User-Defined T_c , I = 2.63 inch/hr

Peak Flowrate, Q_p = 0.56 cfs
 Peak Flowrate, Q_p = 0.53 cfs
 Peak Flowrate, Q_p = 0.56 cfs

CALCULATION OF A PEAK RUNOFF USING RATIONAL METHOD

Project Title: MASTER METAL WORKS - 204 12th Street SE
 Catchment ID: 0+37.84 (Condition EXISTING after Re-Construction) 10 Year Storm

I. Catchment Hydrologic Data

Catchment ID = 0+37.84
 Area = 28.51 Acres
 Percent Imperviousness = 60.81 %
 NRCS Soil Type = C A, B, C, or D

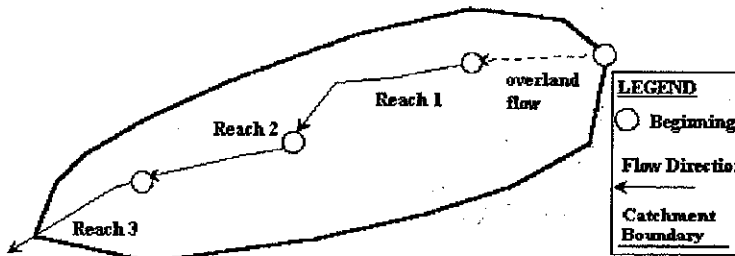
II. Rainfall Information I (inch/hr) = $C1 * P1 / (C2 + Td)^{C3}$

Design Storm Return Period, T_r = 10 years (input return period for design storm)
 $C1$ = 28.50 (input the value of $C1$)
 $C2$ = 10.00 (input the value of $C2$)
 $C3$ = 0.786 (input the value of $C3$)
 $P1$ = 1.69 inches (input one-hr precipitation--see Sheet "Design Info")

III. Analysis of Flow Time (Time of Concentration) for a Catchment

Runoff Coefficient, C = 0.51
 Override Runoff Coefficient, C = _____ (enter an override C value if desired, or leave blank to accept calculated C .)
 5-yr. Runoff Coefficient, $C-5$ = 0.46
 Override 5-yr. Runoff Coefficient, $C-5$ = _____ (enter an override $C-5$ value if desired, or leave blank to accept calculated $C-5$.)

Illustration



NRCS Land Type	Heavy Meadow	Tillage/Field	Short Pasture/Lawns	Nearly Bare Ground	Grassed Swales/Waterways	Paved Areas & Shallow Paved Swales (Sheet Flow)
Conveyance	2.5	5	7	10	15	20

Calculations:

Reach ID	Slope S	Length L	5-yr Runoff Coeff $C-5$ output	NRCS Conveyance input	Flow Velocity V	Flow Time T_f	
	ft/ft input	ft input			fps output	minutes output	
Overland	0.0195	51	0.46	N/A	0.13	6.60	
1	0.0190	249			10.00	1.38	3.01
2	0.0034	38			10.00	0.59	1.08
3							
4							
5							
Sum		338					

Computed T_c = 10.69
 Regional T_c = 11.88
 User-Entered T_c = 10.69

IV. Peak Runoff Prediction

Rainfall Intensity at Computed T_c , I = 4.45 inch/hr
 Rainfall Intensity at Regional T_c , I = 4.26 inch/hr
 Rainfall Intensity at User-Defined T_c , I = 4.45 inch/hr

Peak Flowrate, Q_p = 1.17 cfs
 Peak Flowrate, Q_p = 1.12 cfs
 Peak Flowrate, Q_p = 1.17 cfs

CALCULATION OF A PEAK RUNOFF USING RATIONAL METHOD

Project Title: MASTER METAL WORKS - 204 12th Street SE
 Catchment ID: 0+37.84 (Condition EXISTING after Re-Construction) 100 Year Storm

I. Catchment Hydrologic Data

Catchment ID = 0+37.84
 Area = 0.51 Acres
 Percent Imperviousness = 60.81 %
 NRCS Soil Type = C A, B, C, or D

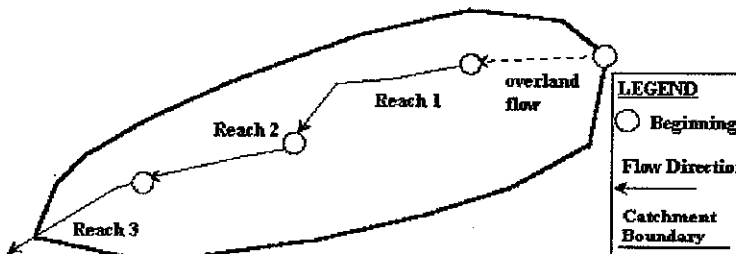
II. Rainfall Information I (inch/hr) = $C1 * P1 / (C2 + Td)^{C3}$

Design Storm Return Period, T_r = 100 years (input return period for design storm)
 $C1$ = 28.50 (input the value of $C1$)
 $C2$ = 10.00 (input the value of $C2$)
 $C3$ = 0.786 (input the value of $C3$)
 $P1$ = 2.66 inches (input one-hr precipitation--see Sheet "Design Info")

III. Analysis of Flow Time (Time of Concentration) for a Catchment

Runoff Coefficient, C = 0.64
 Override Runoff Coefficient, C = _____ (enter an override C value if desired, or leave blank to accept calculated C .)
 5-yr. Runoff Coefficient, $C-5$ = 0.46
 Override 5-yr. Runoff Coefficient, $C-5$ = _____ (enter an override $C-5$ value if desired, or leave blank to accept calculated $C-5$.)

Illustration



NRCS Land Type	Heavy Meadow	Tillage/Field	Short Pasture/Lawns	Nearly Bare Ground	Grassed Swales/Waterways	Paved Areas & Shallow Paved Swales (Sheet Flow)
Conveyance	2.5	5	7	10	15	20

Calculations:

Reach ID	Slope S	Length L	5-yr Runoff Coeff C-5	NRCS Conveyance	Flow Velocity V	Flow Time T _f
	ft/ft input	ft input			output	minutes output
Overland	0.0195	51	0.46	N/A	0.13	6.60
1	0.0190	249		10.00	1.38	3.01
2	0.0034	38		10.00	0.59	1.08
3						
4						
5						
Sum		338				

Computed T_c = 10.69
 Regional T_c = 11.88
 User-Entered T_c = 10.69

IV. Peak Runoff Prediction

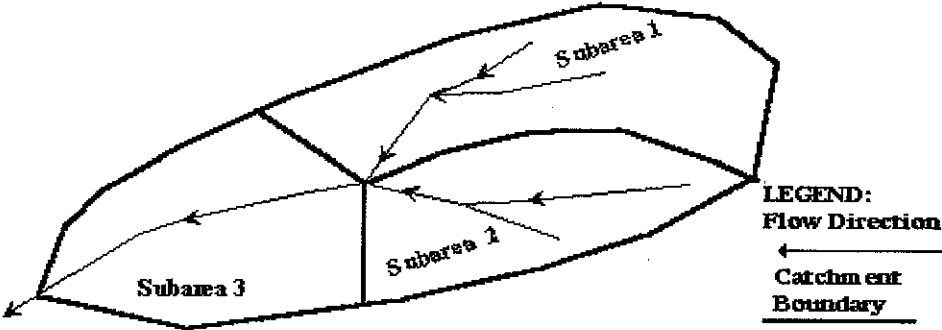
Rainfall Intensity at Computed T_c , I = 7.01 inch/hr
 Rainfall Intensity at Regional T_c , I = 6.71 inch/hr
 Rainfall Intensity at User-Defined T_c , I = 7.01 inch/hr

Peak Flowrate, Q_p = 2.29 cfs
 Peak Flowrate, Q_p = 2.19 cfs
 Peak Flowrate, Q_p = 2.29 cfs

Area-Weighting for Runoff Coefficient Calculation

Project Title: MASTER METAL WORKS - 204 12th Street SE
 Catchment ID: 0+93.1 (Condition EXISTING after Re-Construction)

Illustration



Instructions: For each catchment subarea, enter values for A and C.

Subarea ID	Area acres	Runoff Coeff.	Product
	A	C*	CA
input	input	input	output
Roof	9024.00	90.00	812160.00
Pavement	994.00	100.00	99400.00
Gravel	15721.00	40.00	628840.00
Sum:	25739.00	Sum:	#####

Area-Weighted Runoff Coefficient (sum CA/sum A) = 59.85

***See sheet "Design Info" for imperviousness-based runoff coefficient values.**
 For catchments larger than 60 acres, CUPP hydrograph and routing are recommended.

CALCULATION OF A PEAK RUNOFF USING RATIONAL METHOD

Project Title: MASTER METAL WORKS - 204 12th Street SE
 Catchment ID: 0+93.1 (Condition EXISTING after Re-Construction) 2 Year Storm

I. Catchment Hydrologic Data

Catchment ID = 0+93.1
 Area = 0.59 Acres
 Percent Imperviousness = 59.85 %
 NRCS Soil Type = C A, B, C, or D

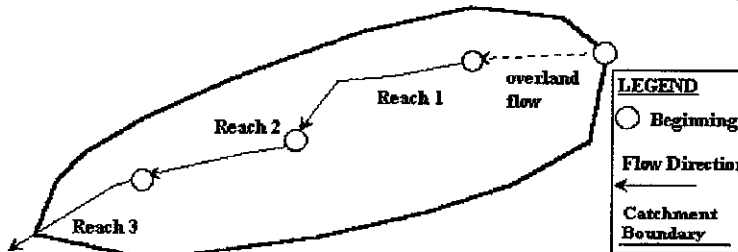
II. Rainfall Information I (inch/hr) = $C1 * P1 / (C2 + Td)^{C3}$

Design Storm Return Period, T_r = 2 years (input return period for design storm)
 $C1$ = 28.50 (input the value of $C1$)
 $C2$ = 10.00 (input the value of $C2$)
 $C3$ = 0.786 (input the value of $C3$)
 $P1$ = 1.00 inches (input one-hr precipitation—see Sheet "Design Info")

III. Analysis of Flow Time (Time of Concentration) for a Catchment

Runoff Coefficient, C = 0.41
 Override Runoff Coefficient, C = _____ (enter an override C value if desired, or leave blank to accept calculated C .)
 5-yr. Runoff Coefficient, $C-5$ = 0.46
 Override 5-yr. Runoff Coefficient, $C-5$ = _____ (enter an override $C-5$ value if desired, or leave blank to accept calculated $C-5$.)

Illustration



NRCS Land Type	Heavy Meadow	Tillage/Field	Short Pasture/Lawns	Nearly Bare Ground	Grassed Swales/Waterways	Paved Areas & Shallow Paved Swales (Sheet Flow)
Conveyance	2.5	5	7	10	15	20

Calculations:

Reach ID	Slope S	Length L	5-yr Runoff Coeff $C-5$ output	NRCS Conveyance input	Flow Velocity V	Flow Time T_f
	ft/ft input	ft input			fps output	minutes output
Overland	0.0195	51	0.46	N/A	0.13	6.66
1	0.0190	249		10.00	1.38	3.01
2	0.0034	93		10.00	0.59	2.64
3						
4						
5						
Sum		393				

Computed T_c = 12.32
 Regional T_c = 12.18
 User-Entered T_c = 12.18

IV. Peak Runoff Prediction

Rainfall Intensity at Computed T_c , I = 2.48 inch/hr
 Rainfall Intensity at Regional T_c , I = 2.49 inch/hr
 Rainfall Intensity at User-Defined T_c , I = 2.49 inch/hr

Peak Flowrate, Q_p = 0.59 cfs
 Peak Flowrate, Q_p = 0.60 cfs
 Peak Flowrate, Q_p = 0.60 cfs

CALCULATION OF A PEAK RUNOFF USING RATIONAL METHOD

Project Title: MASTER METAL WORKS - 204 12th Street SE
 Catchment ID: 0+93.1 (Condition EXISTING after Re-Construction) 10 Year Storm

I. Catchment Hydrologic Data

Catchment ID = 0+93.1
 Area = 0.59 Acres
 Percent Imperviousness = 59.85 %
 NRCS Soil Type = C A, B, C, or D

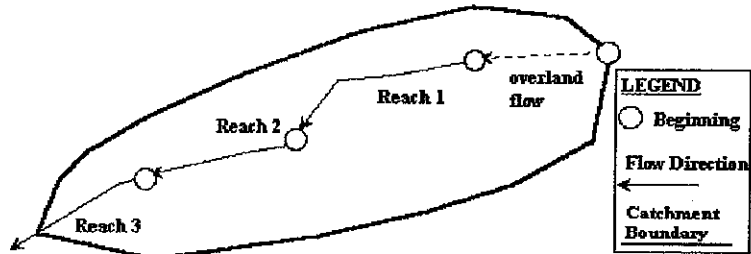
II. Rainfall Information $I \text{ (inch/hr)} = C1 * P1 / (C2 + Td)^{C3}$

Design Storm Return Period, $T_r =$ 10 years (input return period for design storm)
 $C1 =$ 28.50 (input the value of C1)
 $C2 =$ 10.00 (input the value of C2)
 $C3 =$ 0.786 (input the value of C3)
 $P1 =$ 1.69 inches (input one-hr precipitation--see Sheet "Design Info")

III. Analysis of Flow Time (Time of Concentration) for a Catchment

Runoff Coefficient, $C =$ 0.51
 Override Runoff Coefficient, $C =$ _____ (enter an override C value if desired, or leave blank to accept calculated C.)
 5-yr. Runoff Coefficient, $C-5 =$ 0.46
 Override 5-yr. Runoff Coefficient, $C =$ _____ (enter an override C-5 value if desired, or leave blank to accept calculated C-5.)

Illustration



NRCS Land Type	Heavy Meadow	Tillage/Field	Short Pasture/Lawns	Nearly Bare Ground	Grassed Swales/Waterways	Paved Areas & Shallow Paved Swales (Sheet Flow)
Conveyance	2.5	5	7	10	15	20

Calculations:

Reach ID	Slope S	Length L	5-yr Runoff Coeff C-5 output	NRCS Conveyance input	Flow Velocity V fps output	Flow Time T _f minutes output
	ft/ft input	ft input				
Overland	0.0195	51	0.46	N/A	0.13	6.66
1	0.0190	249		10.00	1.38	3.01
2	0.0034	93		10.00	0.59	2.64
3						
4						
5						
Sum		393				

Computed T_c = 12.32
 Regional T_c = 12.18
 User-Entered T_c = 12.18

IV. Peak Runoff Prediction

Rainfall Intensity at Computed T_c, $I =$ 4.19 inch/hr
 Rainfall Intensity at Regional T_c, $I =$ 4.22 inch/hr
 Rainfall Intensity at User-Defined T_c, $I =$ 4.22 inch/hr

Peak Flowrate, $Q_p =$ 1.26 cfs
 Peak Flowrate, $Q_p =$ 1.27 cfs
 Peak Flowrate, $Q_p =$ 1.27 cfs

CALCULATION OF A PEAK RUNOFF USING RATIONAL METHOD

Project Title: MASTER METAL WORKS - 204 12th Street SE
 Catchment ID: 0+93.1 (Condition EXISTING after Re-Construction) 100 Year Storm

I. Catchment Hydrologic Data

Catchment ID = 0+93.1
 Area = 0.59 Acres
 Percent Imperviousness = 59.85 %
 NRCS Soil Type = C A, B, C, or D

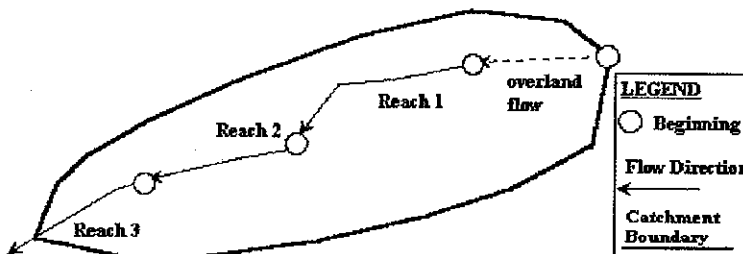
II. Rainfall Information $I \text{ (inch/hr)} = C1 * P1 / (C2 + Td)^{C3}$

Design Storm Return Period, T_r = 100 years (input return period for design storm)
 $C1$ = 28.50 (input the value of C1)
 $C2$ = 10.00 (input the value of C2)
 $C3$ = 0.786 (input the value of C3)
 $P1$ = 2.66 inches (input one-hr precipitation--see Sheet "Design Info")

III. Analysis of Flow Time (Time of Concentration) for a Catchment

Runoff Coefficient, C = 0.63
 Override Runoff Coefficient, C = _____ (enter an override C value if desired, or leave blank to accept calculated C.)
 5-yr. Runoff Coefficient, $C-5$ = 0.46
 Override 5-yr. Runoff Coefficient, C = _____ (enter an override C-5 value if desired, or leave blank to accept calculated C-5.)

Illustration



NRCS Land Type	Heavy Meadow	Tillage/Field	Short Pasture/Lawns	Nearly Bare Ground	Grassed Swales/Waterways	Paved Areas & Shallow Paved Swales (Sheet Flow)
Conveyance	2.5	5	7	10	15	20

Calculations:

Reach ID	Slope S	Length L	5-yr Runoff Coeff C-5	NRCS Conveyance	Flow Velocity V	Flow Time T _f
	ft/ft	ft			fps	minutes
Overland	0.0195	51	0.46	N/A	0.13	6.66
1	0.0190	249		10.00	1.38	3.01
2	0.0034	93		10.00	0.59	2.64
3						
4						
5						
Sum		393				

Computed T_c = 12.32
 Regional T_c = 12.18
 User-Entered T_c = 12.18

IV. Peak Runoff Prediction

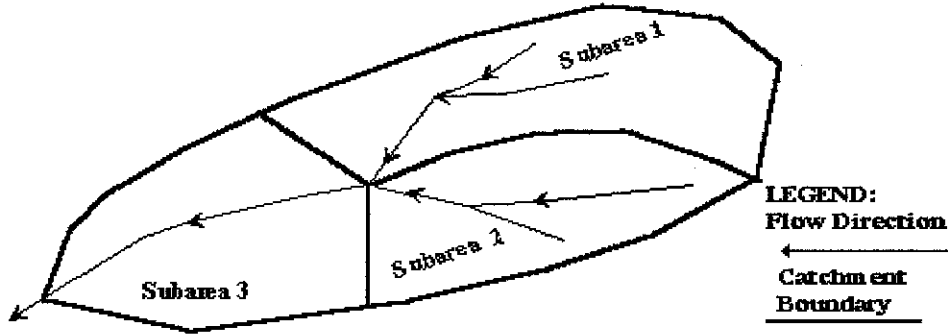
Rainfall Intensity at Computed T_c, I = 6.60 inch/hr
 Rainfall Intensity at Regional T_c, I = 6.63 inch/hr
 Rainfall Intensity at User-Defined T_c, I = 6.63 inch/hr

Peak Flowrate, Q_p = 2.47 cfs
 Peak Flowrate, Q_p = 2.48 cfs
 Peak Flowrate, Q_p = 2.48 cfs

Area-Weighting for Runoff Coefficient Calculation

Project Title: MASTER METAL WORKS - 204 12th Street SE
 Catchment ID: 1+76.4 (Condition EXISTING after Re-Construction)

Illustration



Instructions: For each catchment subarea, enter values for A and C.

Subarea ID	Area acres	Runoff Coeff.	Product
	A	C*	CA
input	input	input	output
Roof	10709.00	90.00	963810.00
Pavement	994.00	100.00	99400.00
Gravel	18952.00	40.00	758080.00
Sum:	30655.00	Sum:	#####

Area-Weighted Runoff Coefficient (sum CA/sum A) = 59.41

***See sheet "Design Info" for imperviousness-based runoff coefficient values.**

For catchments larger than 10 acres, CUP hydrograph and routing are recommended.

CALCULATION OF A PEAK RUNOFF USING RATIONAL METHOD

Project Title: MASTER METAL WORKS - 204 12th Street SE
 Catchment ID: 1+76.4 (Condition EXISTING after Re-Construction) 2 Year Storm

I. Catchment Hydrologic Data

Catchment ID = 1+76.4
 Area = 0.70 Acres
 Percent Imperviousness = 59.41 %
 NRCS Soil Type = C A, B, C, or D

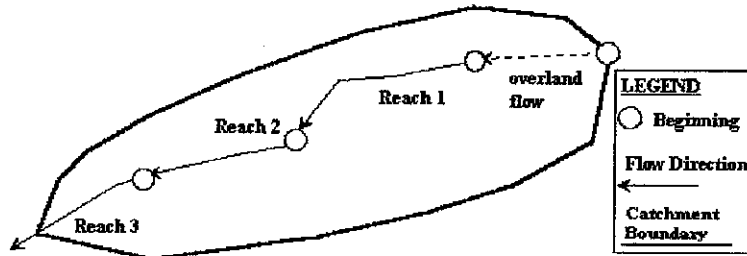
II. Rainfall Information $I (\text{inch/hr}) = C1 * P1 / (C2 + Td)^{C3}$

Design Storm Return Period, T_r = 2 years (input return period for design storm)
 $C1$ = 28.50 (input the value of $C1$)
 $C2$ = 10.00 (input the value of $C2$)
 $C3$ = 0.786 (input the value of $C3$)
 $P1$ = 1.00 inches (input one-hr precipitation—see Sheet "Design Info")

III. Analysis of Flow Time (Time of Concentration) for a Catchment

Runoff Coefficient, C = 0.40
 Override Runoff Coefficient, C = _____ (enter an override C value if desired, or leave blank to accept calculated C .)
 5-yr. Runoff Coefficient, $C-5$ = 0.45
 Override 5-yr. Runoff Coefficient, $C-5$ = _____ (enter an override $C-5$ value if desired, or leave blank to accept calculated $C-5$.)

Illustration



NRCS Land Type	Heavy Meadow	Tillage/Field	Short Pasture/Lawns	Nearly Bare Ground	Grassed Swales/Waterways	Paved Areas & Shallow Paved Swales (Sheet Flow)
Conveyance	2.5	5	7	10	15	20

Calculations:

Reach ID	Slope S	Length L	5-yr Runoff Coeff C-5	NRCS Conveyance	Flow Velocity V	Flow Time T _f
	ft/ft	ft			fps	minutes
Overland	0.0195	51	0.45	N/A	0.13	6.69
1	0.0190	249		10.00	1.38	3.01
2	0.0034	93		10.00	0.59	2.64
3	0.0045	83		10.00	0.67	2.06
4						
5						
Sum		476				
Computed T _c =						14.41
Regional T _c =						12.64
User-Entered T _c =						12.64

IV. Peak Runoff Prediction

Rainfall Intensity at Computed T_c, I = 2.31 inch/hr
 Rainfall Intensity at Regional T_c, I = 2.45 inch/hr
 Rainfall Intensity at User-Defined T_c, I = 2.45 inch/hr

Peak Flowrate, Q_p = 0.65 cfs
 Peak Flowrate, Q_p = 0.69 cfs
 Peak Flowrate, Q_p = 0.69 cfs

CALCULATION OF A PEAK RUNOFF USING RATIONAL METHOD

Project Title: MASTER METAL WORKS - 204 12th Street SE
 Catchment ID: 1+76.4 (Condition EXISTING after Re-Construction) 10 Year Storm

I. Catchment Hydrologic Data

Catchment ID = 1+76.4
 Area = 0.70 Acres
 Percent Imperviousness = 59.41 %
 NRCS Soil Type = C A, B, C, or D

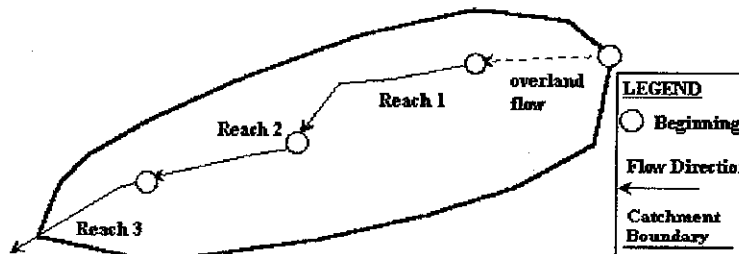
II. Rainfall Information I (inch/hr) = $C1 * P1 / (C2 + Td)^{C3}$

Design Storm Return Period, T_r = 10 years (input return period for design storm)
 $C1$ = 28.50 (input the value of $C1$)
 $C2$ = 10.00 (input the value of $C2$)
 $C3$ = 0.786 (input the value of $C3$)
 $P1$ = 1.69 inches (input one-hr precipitation--see Sheet "Design Info")

III. Analysis of Flow Time (Time of Concentration) for a Catchment

Runoff Coefficient, C = 0.51
 Override Runoff Coefficient, C = _____ (enter an override C value if desired, or leave blank to accept calculated C .)
 5-yr. Runoff Coefficient, $C-5$ = 0.45
 Override 5-yr. Runoff Coefficient, C = _____ (enter an override $C-5$ value if desired, or leave blank to accept calculated $C-5$.)

Illustration



NRCS Land Type	Heavy Meadow	Tillage/Field	Short Pasture/Lawns	Nearly Bare Ground	Grassed Swales/Waterways	Paved Areas & Shallow Paved Swales (Sheet Flow)
Conveyance	2.5	5	7	10	15	20

Calculations:

Reach ID	Slope S	Length L	5-yr Runoff Coeff C-5	NRCS Conveyance	Flow Velocity V	Flow Time T _f
	ft/ft input	ft input	output		fps output	minutes output
Overland	0.0195	51	0.45	N/A	0.13	6.69
1	0.0190	249		10.00	1.38	3.01
2	0.0034	93		10.00	0.59	2.64
3	0.0045	83		10.00	0.67	2.06
4						
5						
Sum		476				
Computed T _c =						14.41
Regional T _c =						12.64
User-Entered T _c =						12.64

IV. Peak Runoff Prediction

Rainfall Intensity at Computed T_c, I = 3.91 inch/hr
 Rainfall Intensity at Regional T_c, I = 4.15 inch/hr
 Rainfall Intensity at User-Defined T_c, I = 4.15 inch/hr

Peak Flowrate, Q_p = 1.39 cfs
 Peak Flowrate, Q_p = 1.48 cfs
 Peak Flowrate, Q_p = 1.48 cfs

CALCULATION OF A PEAK RUNOFF USING RATIONAL METHOD

Project Title: MASTER METAL WORKS - 204 12th Street SE
 Catchment ID: 1+76.4 (Condition EXISTING after Re-Construction) 100 Year Storm

I. Catchment Hydrologic Data

Catchment ID = 1+76.4
 Area = 0.70 Acres
 Percent Imperviousness = 59.41 %
 NRCS Soil Type = C A, B, C, or D

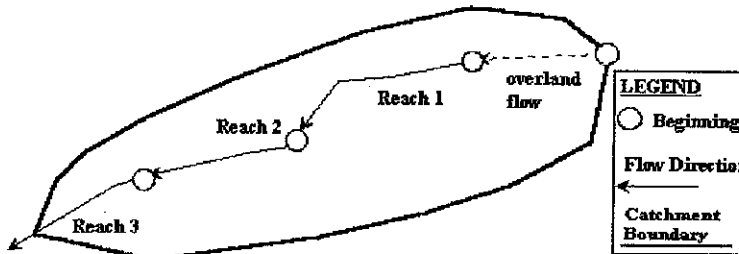
II. Rainfall Information I (inch/hr) = $C1 * P1 / (C2 + Td)^{C3}$

Design Storm Return Period, T_r = 100 years (input return period for design storm)
 $C1$ = 28.50 (input the value of $C1$)
 $C2$ = 10.00 (input the value of $C2$)
 $C3$ = 0.786 (input the value of $C3$)
 $P1$ = 2.66 inches (input one-hr precipitation—see Sheet "Design Info")

III. Analysis of Flow Time (Time of Concentration) for a Catchment

Runoff Coefficient, C = 0.63
 Override Runoff Coefficient, C = _____ (enter an override C value if desired, or leave blank to accept calculated C .)
 5-yr. Runoff Coefficient, $C-5$ = 0.45
 Override 5-yr. Runoff Coefficient, $C-5$ = _____ (enter an override $C-5$ value if desired, or leave blank to accept calculated $C-5$.)

Illustration



NRCS Land Type	Heavy Meadow	Tillage/Field	Short Pasture/Lawns	Nearly Bare Ground	Grassed Swales/Waterways	Paved Areas & Shallow Paved Swales (Sheet Flow)
Conveyance	2.5	5	7	10	15	20

Calculations:

Reach ID	Slope S	Length L	5-yr Runoff Coeff C-5	NRCS Conveyance	Flow Velocity V	Flow Time T _f
	ft/ft	ft			input	output
Overland	0.0195	51	0.45	N/A	0.13	6.69
1	0.0190	249		10.00	1.38	3.01
2	0.0034	93		10.00	0.59	2.64
3	0.0045	83		10.00	0.67	2.06
4						
5						
Sum		476				

Computed T_c = 14.41
 Regional T_c = 12.64
 User-Entered T_c = 12.64

IV. Peak Runoff Prediction

Rainfall Intensity at Computed T_c, I = 6.15 inch/hr
 Rainfall Intensity at Regional T_c, I = 6.53 inch/hr
 Rainfall Intensity at User-Defined T_c, I = 6.53 inch/hr

Peak Flowrate, Q_p = 2.73 cfs
 Peak Flowrate, Q_p = 2.90 cfs
 Peak Flowrate, Q_p = 2.90 cfs

0+37.84 EXISTING after Reconstruction
Worksheet for Irregular Channel

Project Description	
Project File	c:\program files\haestad\academic\fmw\master m.fm2
Worksheet	Sta. 0+37.84 EXISTING Condition
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

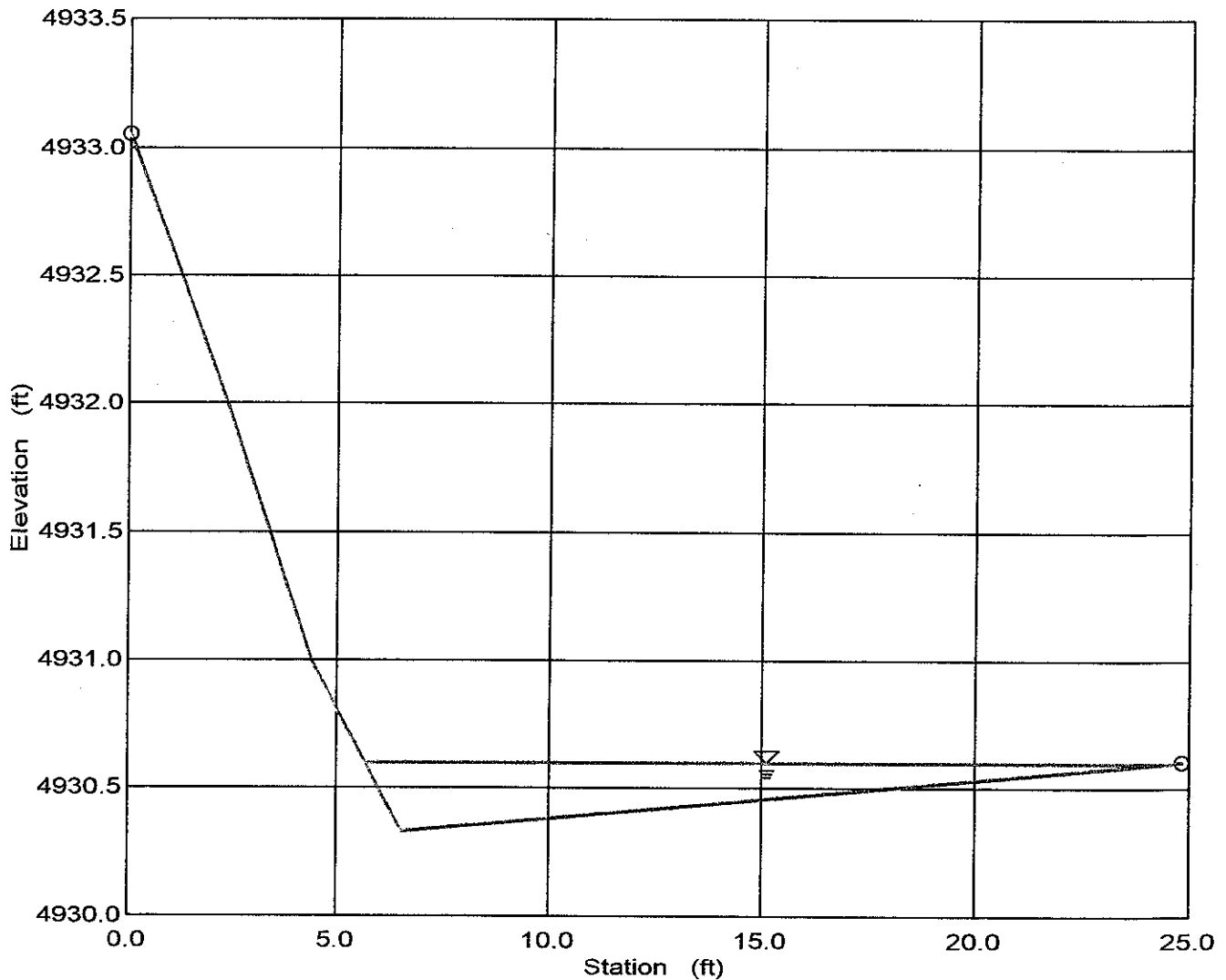
Input Data				
Channel Slope	0.004000 ft/ft			
Elevation range: 4,930.33 ft to 4,933.05 ft.				
Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
0.00	4,933.05	0.00	24.85	0.027
2.35	4,932.00			
4.35	4,931.00			
6.50	4,930.33			
24.85	4,930.60			
Discharge	2.29	cfs		

Results		
Wtd. Mannings Coefficient	0.027	
Water Surface Elevation	4,930.60	ft
Flow Area	2.53	ft ²
Wetted Perimeter	19.00	ft
Top Width	18.96	ft
Height	0.27	ft
Critical Depth	4,930.52	ft
Critical Slope	0.023287	ft/ft
Velocity	0.91	ft/s
Velocity Head	0.01	ft
Specific Energy	4,930.61	ft
Froude Number	0.44	
Flow is subcritical.		

0+37.84 EXISTING 100 YEAR
Cross Section for Irregular Channel

Project Description	
Project File	c:\program files\haestad\academic\fmw\master m.fm2
Worksheet	Sta. 0+37.84 EXISTING Condition
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Section Data	
Wtd. Mannings Coefficient	0.027
Channel Slope	0.004000 ft/ft
Water Surface Elevation	4,930.60 ft
Discharge	2.29 cfs



0+37.84 EXISTING w/ Freeboard
Worksheet for Irregular Channel

Project Description	
Project File	c:\program files\haestad\academic\fmw\master m.fm2
Worksheet	Sta. 0+37.84 EXISTING w/ freeboard
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

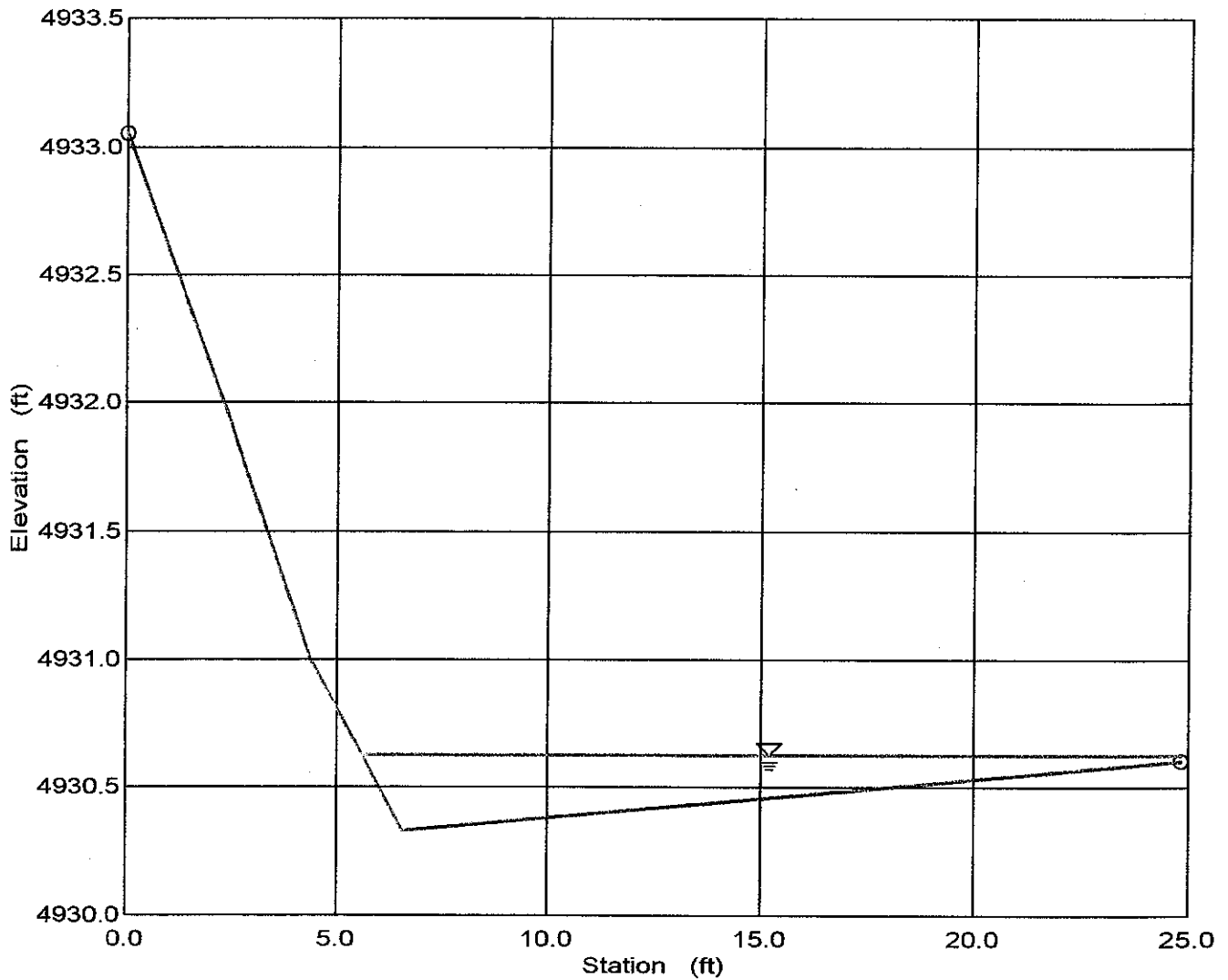
Input Data					
Channel Slope	0.004000 ft/ft				
Elevation range:	4,930.33 ft to 4,933.05 ft.				
Station (ft)	Elevation (ft)	Start Station	End Station	Roughness	
0.00	4,933.05	0.00	24.85	0.027	
2.35	4,932.00				
4.35	4,931.00				
6.50	4,930.33				
24.85	4,930.60				
Discharge	3.05	cfs			

Results		
Wtd. Mannings Coefficient	0.027	
Water Surface Elevation	4,930.62	ft
Flow Area	3.02	ft ²
Wetted Perimeter	19.36	ft
Top Width	19.29	ft
Height	0.29	ft
Critical Depth	4,930.54	ft
Critical Slope	0.022417	ft/ft
Velocity	1.01	ft/s
Velocity Head	0.02	ft
Specific Energy	4,930.64	ft
Froude Number	0.45	
Flow is subcritical.		
Water elevation exceeds lowest end station by 0.02 ft.		

0+37.84 EXISTING 100 x 1.33
Cross Section for Irregular Channel

Project Description	
Project File	c:\program files\haestad\academic\fmw\master m.fm2
Worksheet	Sta. 0+37.84 EXISTING w/ freeboard
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Section Data	
Wtd. Mannings Coefficient	0.027
Channel Slope	0.004000 ft/ft
Water Surface Elevation	4,930.62 ft
Discharge	3.05 cfs



0+93.1 EXISTING after Reconstruction
Worksheet for Irregular Channel

Project Description	
Project File	c:\program files\haestad\academic\fmw\master m.fm2
Worksheet	0+93.1 EXISTING Condition
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

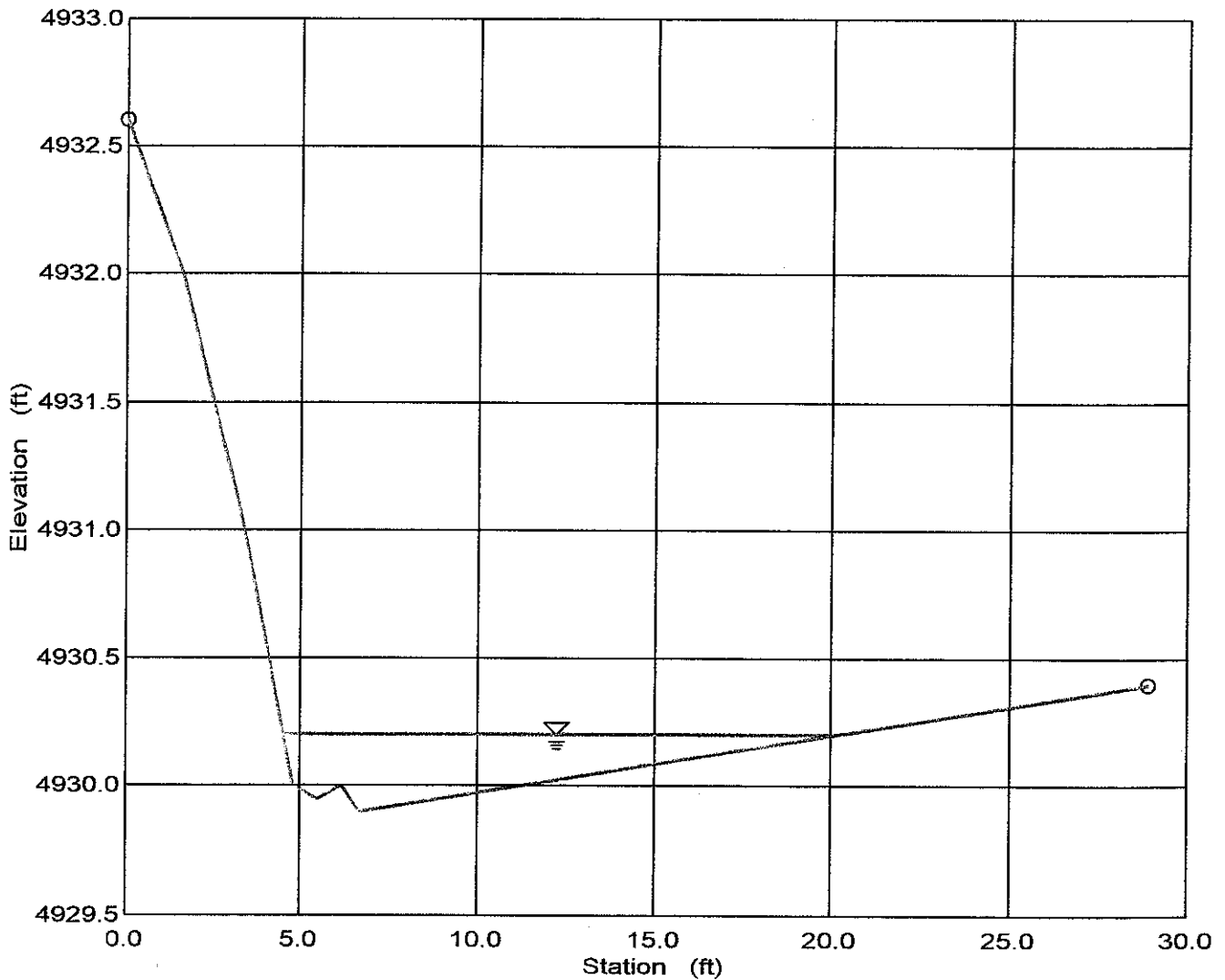
Input Data				
Channel Slope	0.004000 ft/ft			
Elevation range:	4,929.90 ft to 4,932.60 ft.			
Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
0.00	4,932.60	0.00	28.95	0.027
1.60	4,932.00			
3.40	4,931.00			
4.80	4,930.00			
5.50	4,929.95			
6.20	4,930.00			
6.70	4,929.90			
28.95	4,930.40			
Discharge	2.48	cfs		

Results		
Wtd. Mannings Coefficient	0.027	
Water Surface Elevation	4,930.20	ft
Flow Area	2.44	ft ²
Wetted Perimeter	15.53	ft
Top Width	15.45	ft
Height	0.30	ft
Critical Depth	4,930.11	ft
Critical Slope	0.022131	ft/ft
Velocity	1.01	ft/s
Velocity Head	0.02	ft
Specific Energy	4,930.21	ft
Froude Number	0.45	
Flow is subcritical.		

**0+93.1 EXISTING 100 Year
Cross Section for Irregular Channel**

Project Description	
Project File	c:\program files\haestad\academic\fmw\master m.fm2
Worksheet	0+93.1 EXISTING Condition
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Section Data	
Wtd. Mannings Coefficient	0.027
Channel Slope	0.004000 ft/ft
Water Surface Elevation	4,930.20 ft
Discharge	2.48 cfs



0+93.1 EXISTING w/ Freeboard
Worksheet for Irregular Channel

Project Description	
Project File	c:\program files\haestad\academic\fmw\master m.fm2
Worksheet	0+93.1 EXISTING w/ freeboard
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

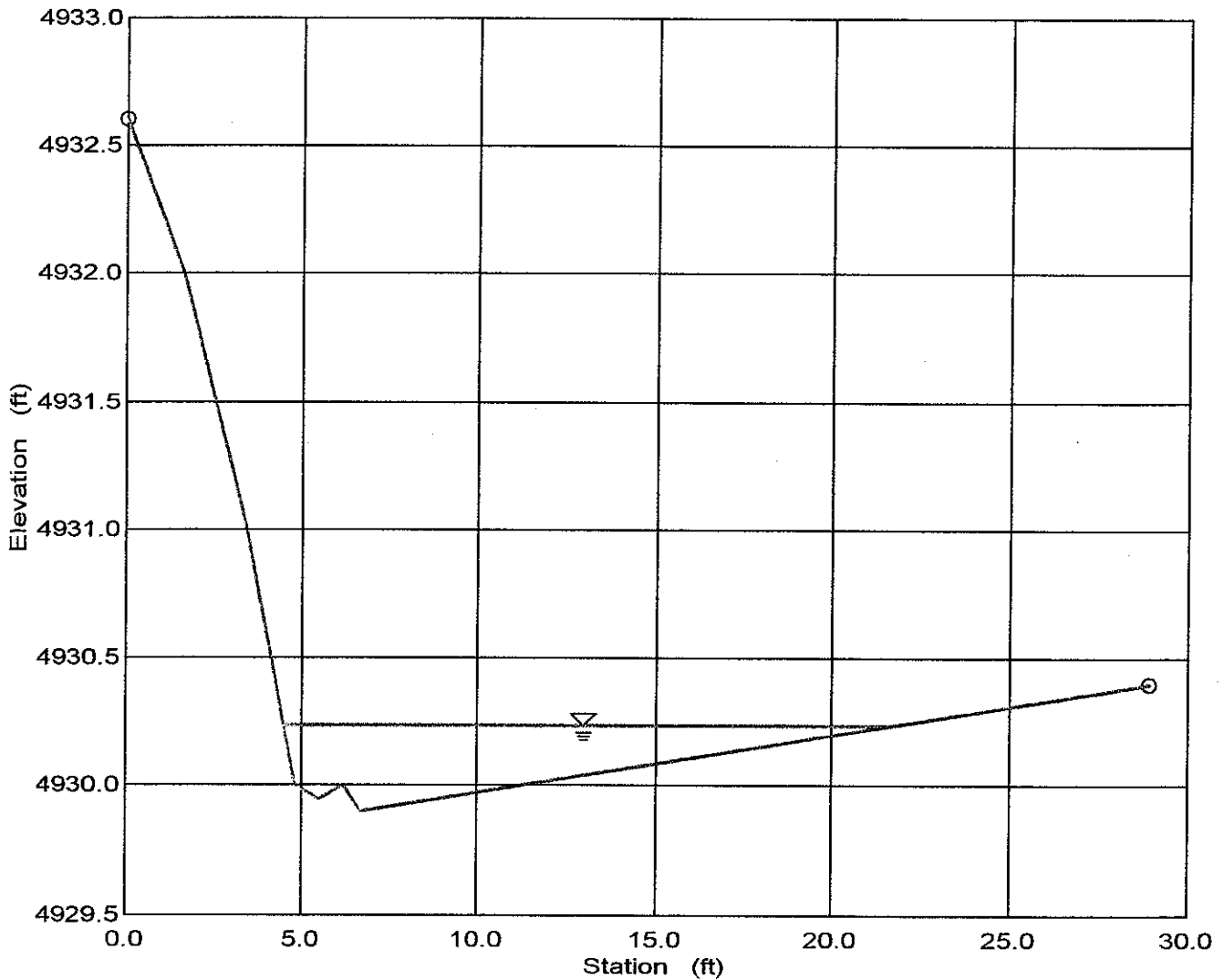
Input Data					
Channel Slope	0.004000 ft/ft				
Elevation range: 4,929.90 ft to 4,932.60 ft.					
Station (ft)	Elevation (ft)	Start Station	End Station	Roughness	
0.00	4,932.60	0.00	28.95	0.027	
1.60	4,932.00				
3.40	4,931.00				
4.80	4,930.00				
5.50	4,929.95				
6.20	4,930.00				
6.70	4,929.90				
28.95	4,930.40				
Discharge	3.30	cfs			

Results		
Wtd. Mannings Coefficient	0.027	
Water Surface Elevation	4,930.23	ft
Flow Area	3.02	ft ²
Wetted Perimeter	17.17	ft
Top Width	17.08	ft
Height	0.33	ft
Critical Depth	4,930.14	ft
Critical Slope	0.021250	ft/ft
Velocity	1.09	ft/s
Velocity Head	0.02	ft
Specific Energy	4,930.25	ft
Froude Number	0.46	
Flow is subcritical.		

0+93.1 EXISTING 100 Year x 1.33
 Cross Section for Irregular Channel

Project Description	
Project File	c:\program files\haestad\academic\fmw\master m.fm2
Worksheet	0+93.1 EXISTING w/ freeboard
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Section Data	
Wtd. Mannings Coefficient	0.027
Channel Slope	0.004000 ft/ft
Water Surface Elevation	4,930.23 ft
Discharge	3.30 cfs



1+76.4 EXISTING after Reconstruction
Worksheet for Irregular Channel

Project Description	
Project File	c:\program files\haestad\academic\fmw\master m.fm2
Worksheet	1+76.4 EXISTING Condition
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

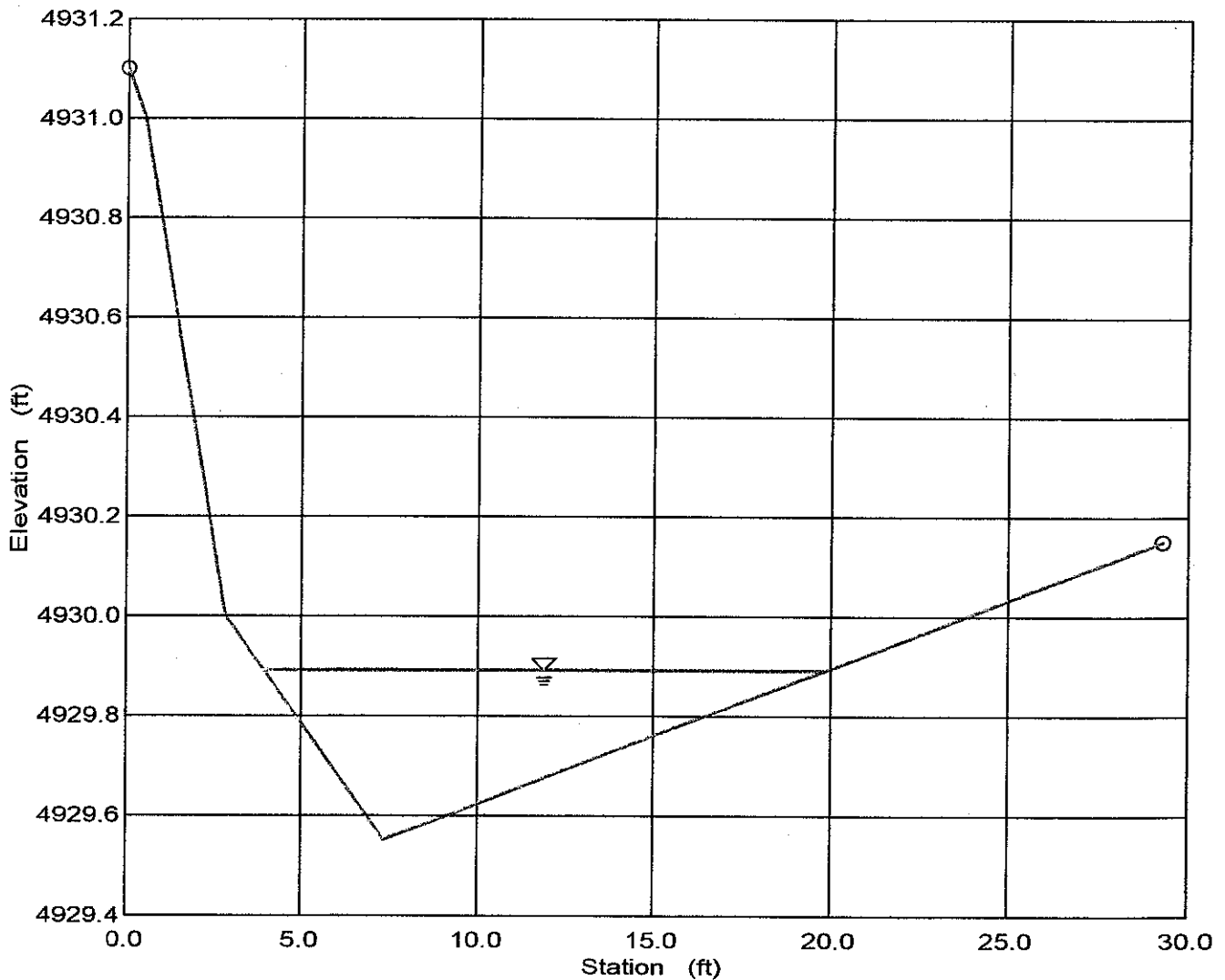
Input Data					
Channel Slope	0.004000 ft/ft				
Elevation range: 4,929.55 ft to 4,931.10 ft.					
Station (ft)	Elevation (ft)	Start Station	End Station	Roughness	
0.00	4,931.10	0.00	29.35	0.027	
0.50	4,931.00				
2.85	4,930.00				
7.35	4,929.55				
29.35	4,930.15				
Discharge	2.90	cfs			

Results		
Wtd. Mannings Coefficient	0.027	
Water Surface Elevation	4,929.89	ft
Flow Area	2.71	ft ²
Wetted Perimeter	15.93	ft
Top Width	15.91	ft
Height	0.34	ft
Critical Depth	4,929.80	ft
Critical Slope	0.021308	ft/ft
Velocity	1.07	ft/s
Velocity Head	0.02	ft
Specific Energy	4,929.91	ft
Froude Number	0.46	
Flow is subcritical.		

1+76.4 EXISTING 100 Year
Cross Section for Irregular Channel

Project Description	
Project File	c:\program files\haestad\academic\fmw\master m.fm2
Worksheet	1+76.4 EXISTING Condition
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Section Data	
Wtd. Mannings Coefficient	0.027
Channel Slope	0.004000 ft/ft
Water Surface Elevation	4,929.89 ft
Discharge	2.90 cfs



1+76.4 EXISTING w/ Freeboard
Worksheet for Irregular Channel

Project Description	
Project File	c:\program files\haestad\academic\fmw\master m.fm2
Worksheet	1+76.4 EXISTING w/ freeboard
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

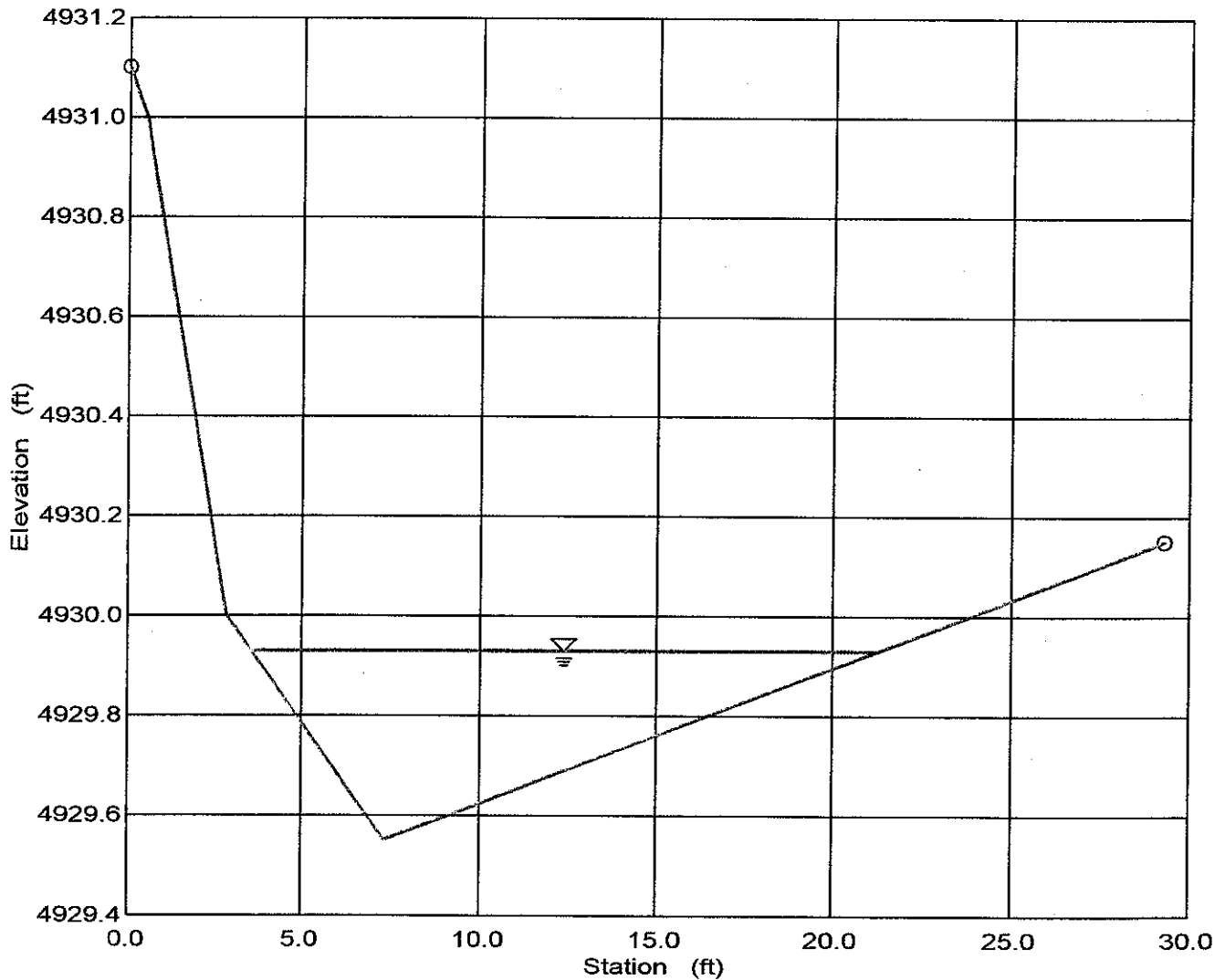
Input Data					
Channel Slope	0.004000 ft/ft				
Elevation range: 4,929.55 ft to 4,931.10 ft.					
Station (ft)	Elevation (ft)	Start Station	End Station	Roughness	
0.00	4,931.10	0.00	29.35	0.027	
0.50	4,931.00				
2.85	4,930.00				
7.35	4,929.55				
29.35	4,930.15				
Discharge	3.85	cfs			

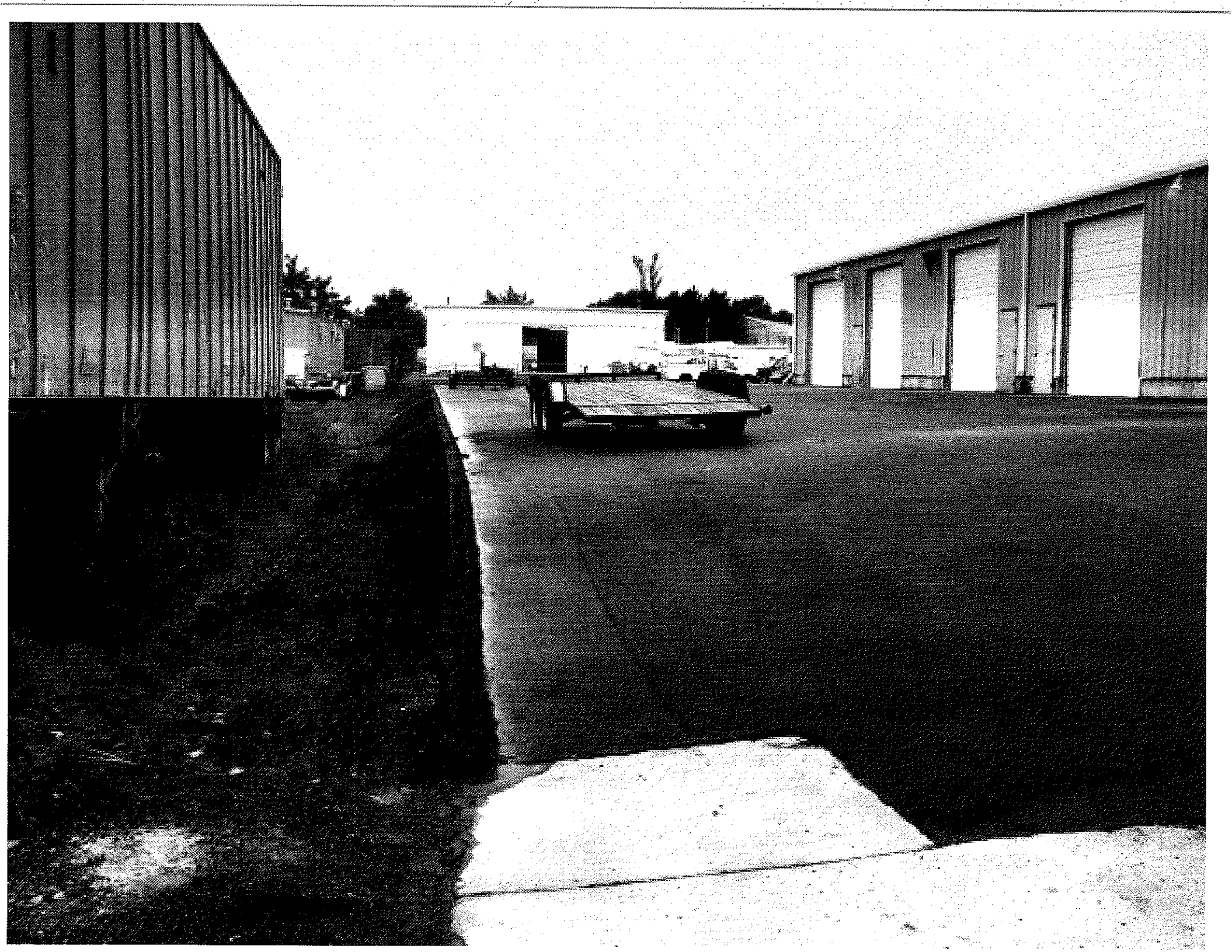
Results		
Wtd. Mannings Coefficient	0.027	
Water Surface Elevation	4,929.93	ft
Flow Area	3.35	ft ²
Wetted Perimeter	17.72	ft
Top Width	17.69	ft
Height	0.38	ft
Critical Depth	4,929.83	ft
Critical Slope	0.020518	ft/ft
Velocity	1.15	ft/s
Velocity Head	0.02	ft
Specific Energy	4,929.95	ft
Froude Number	0.46	
Flow is subcritical.		

**1+76.4 EXISTING 100 x 1.33
Cross Section for Irregular Channel**

Project Description	
Project File	c:\program files\haestad\academic\fmw\master m.fm2
Worksheet	1+76.4 EXISTING w/ freeboard
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Section Data	
Wtd. Mannings Coefficient	0.027
Channel Slope	0.004000 ft/ft
Water Surface Elevation	4,929.93 ft
Discharge	3.85 cfs





Google Maps - Street View Panorama

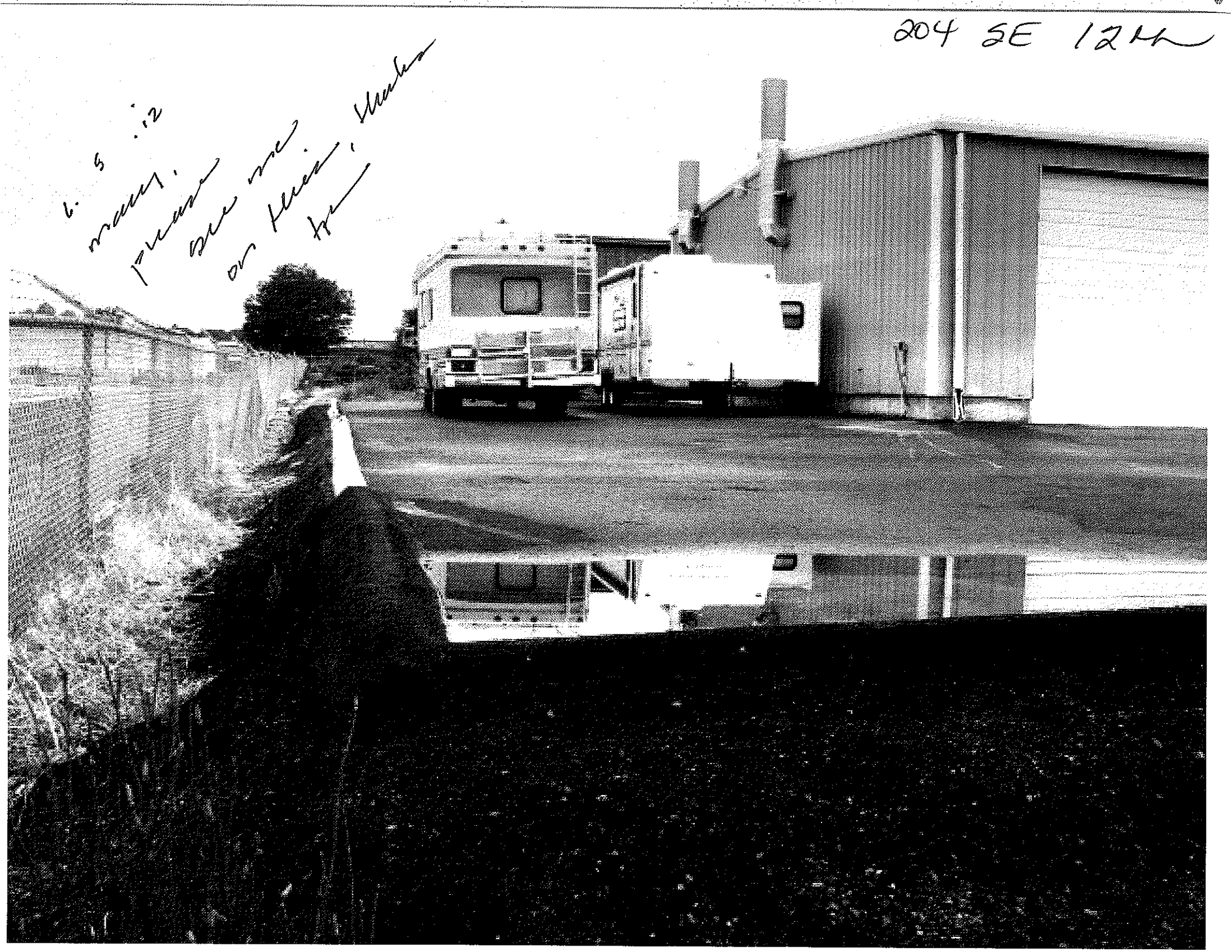


Current View Direction: **South**



204 SE 12th

6. 5. 12
marty,
Please see me
on floor, thanks
for



Inspection Ticket

Address	204 12TH ST SE	Subdivision	S LVLD IND PARK ADDN	
Tenant, Nbr	Rock Troll, LLC			
Contractor	Owner/Builder - Same	Phone		
Primary		Phone		
Parcel	378-03-02D-95243-14-004			
Permit	BP-12-01467: Grading Modification Permit, Non-Res			
Order	Description	Inspector	Requested	Notes to Inspector
	Completed	Result	Comments	
30	6651 Final PW-Site Cert/Gradng #1	Krehbiel , Dan	09/11/2012 08:00:00 AM	IVR Conf No: 020055-01 Voice Message: No -
	09/12/2012 12:00:00 AM	Approved		
30	6668 Final PW-Erosion Control #1	Krehbiel , Dan	09/11/2012 08:00:00 AM	IVR Conf No: 020055-02 Voice Message: No -
	09/12/2012 12:00:00 AM	Approved		
30	6692 Permit Completion #1	Dwight , Amanda	09/13/2012 08:00:00 AM	
	09/12/2012 12:00:00 AM	Approved		
30	8851 Final PW-Grading/Backfill #1	Krehbiel , Dan	09/11/2012 08:00:00 AM	IVR Conf No: 020055-03 Voice Message: No -
	09/12/2012 12:00:00 AM	Approved		