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NSWC INDIAN HEAD
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Erosion and Sediment Control Plan Report

for

Removal of Mercury-Contaminated Soil at Site 8 - Nitroglycerin Plant Office Indian Head Division Naval Surface Warfare Center

Indian Head, Maryland

Chesapeake Division
Naval Facilities Engineering Command
Contract Number N62472-90-D-1298
Contract Task Order 0099

August 1993

R-06-93-7

EROSION AND SEDIMENT CONTROL PLAN REPORT
FOR
REMOVAL OF MERCURY-CONTAMINATED SOIL AT
SITE 8 - NITROGLYCERIN PLANT OFFICE
INDIAN HEAD DIVISION, NAVAL SURFACE WARFARE CENTER
INDIAN HEAD, MARYLAND

COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT

Submitted to:
Chesapeake Division
Environmental Branch Code 405
Washington Navy Yard, Building 212
Washington, D.C. 20374-2121

Submitted by:
Halliburton NUS Corporation
993 Old Eagle School Road, Suite 415
Wayne, Pennsylvania 19087-1710

CONTRACT NUMBER N62472-90-D-1298
CONTRACT TASK ORDER 0099

AUGUST 1993

SUBMITTED BY:

ANTHONY P. KLIMEK, P.E.
PROJECT MANAGER
HALLIBURTON NUS CORPORATION
PITTSBURGH, PENNSYLVANIA

APPROVED FOR SUBMISSION BY:

for JOHN J. TREPANOWSKI, P.E.
PROGRAM MANAGER
HALLIBURTON NUS CORPORATION
WAYNE, PENNSYLVANIA

OWNER'S/DEVELOPER'S CERTIFICATION:

"I/We hereby certify that all clearing, grading, construction and or development will be done pursuant to this plan and that any responsible personnel involved in the construction project will have a certificate of attendance at a Maryland Department of the Environment approved training program for the control of sediment and erosion before beginning the project. I hereby authorize the right of entry for periodic on-site evaluation by State of Maryland, Department of the Environment, Compliance Inspectors."

Date	Owner/Developer Signature
Card No.	Printed Name and Title

STANDARD STABILIZATION NOTE:

"Following initial soil disturbance of redisturbance, permanent or temporary stabilization shall be completed within seven (7) calendar days as to the surface of all perimeter controls, dikes, swales, ditches, perimeter slopes, and all slopes greater than 3 horizontal to 1 vertical (3:1); and fourteen days (14) as to all other disturbed or graded areas on the project site."

DESIGN CERTIFICATION:

"I hereby certify that this plan has been designed in accordance with the 1983 Standards and Specifications for Soil Erosion and Sediment Control or current revisions thereof, and Department of the Environment Stormwater Management Regulations.

8/20/93	Anthony P. Klimek
Date	Designer's Signature
Md. Registration No. 16659	Anthony P. Klimek, P.E.
(P.E.), R.L.S. or R.L.A. (circle)	Printed Name

STATE OF MARYLAND
ANTHONY PAUL KLIMEK
No. 16659
REGISTERED
PROFESSIONAL ENGINEER

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1.0 INTRODUCTION

This Erosion and Sediment Control Plan Report is for removal of mercury contaminated sediment/soil from and existing stream and its subsequent placement in an earthen embankment. The sediment/soil to be removed is located at Site 8 - Nitroglycerin Plant Office (Installation Restoration Site 8), at the Indian Head Division, Naval Surface Warfare Center (NSWC) in Indian Head, Maryland. The contaminated soil will then be incorporated into the earthen soil cover at Magazine No. 606, also located at the NSWC. NSWC is in the Chesapeake Division (CHESDIV) of the Naval Facilities Engineering Command.

The Indian Head NSWC consists of the main area and the Stump Neck Annex. The main area of the NSWC contains approximately 2,500 acres. The Stump Neck Annex consists of slightly less than 1,000 additional acres located approximately 25 miles southwest of Washington, DC, in the northwestern section of Charles County, Maryland. The main area of the NSWC is located on a peninsula bounded by the Potomac River to the northwest and Mattawoman Creek to the south and southeast. As shown on Figure 1-1, Installation Restoration Site 8 (Site 8) is located in the central portion of the main area of Indian Head NSWC; water from Site 8 discharges into Mattawoman Creek. Magazine No. 606 is located approximately 1,000 feet northeast of Site 8.

Site 8 - Nitroglycerin Plant Office consists of the following: Building 766 - Former Nitroglycerin Plant Office Laboratory, a 3-inch drain pipe from Building 766 to a manhole (Manhole A), concrete pipe that conveys water from Manhole A under railroad tracks to a stream, approximately 1,300 feet of stream, and a tidal pond/marsh area. The tidal pond/marsh area is approximately 700 feet long and 200 feet wide; it includes both a marsh and open water area. The tidal pond outlets through a culvert under Noble Road and into Mattawoman Creek. The area of excavation at Site 8 will be the Upper Section of Stream.

Magazine No. 606 is located approximately 1,000 feet from Site 8. It is a concrete structure approximately 100 feet long, 50 feet wide, and 20 feet high. The front of Magazine No. 606 is a vertical concrete wall. The back and sides of the structure are covered with a soil cover that has 2H:1V (horizontal to vertical) side slopes. The area of work at Magazine No. 606 will be the back part of the soil cover.

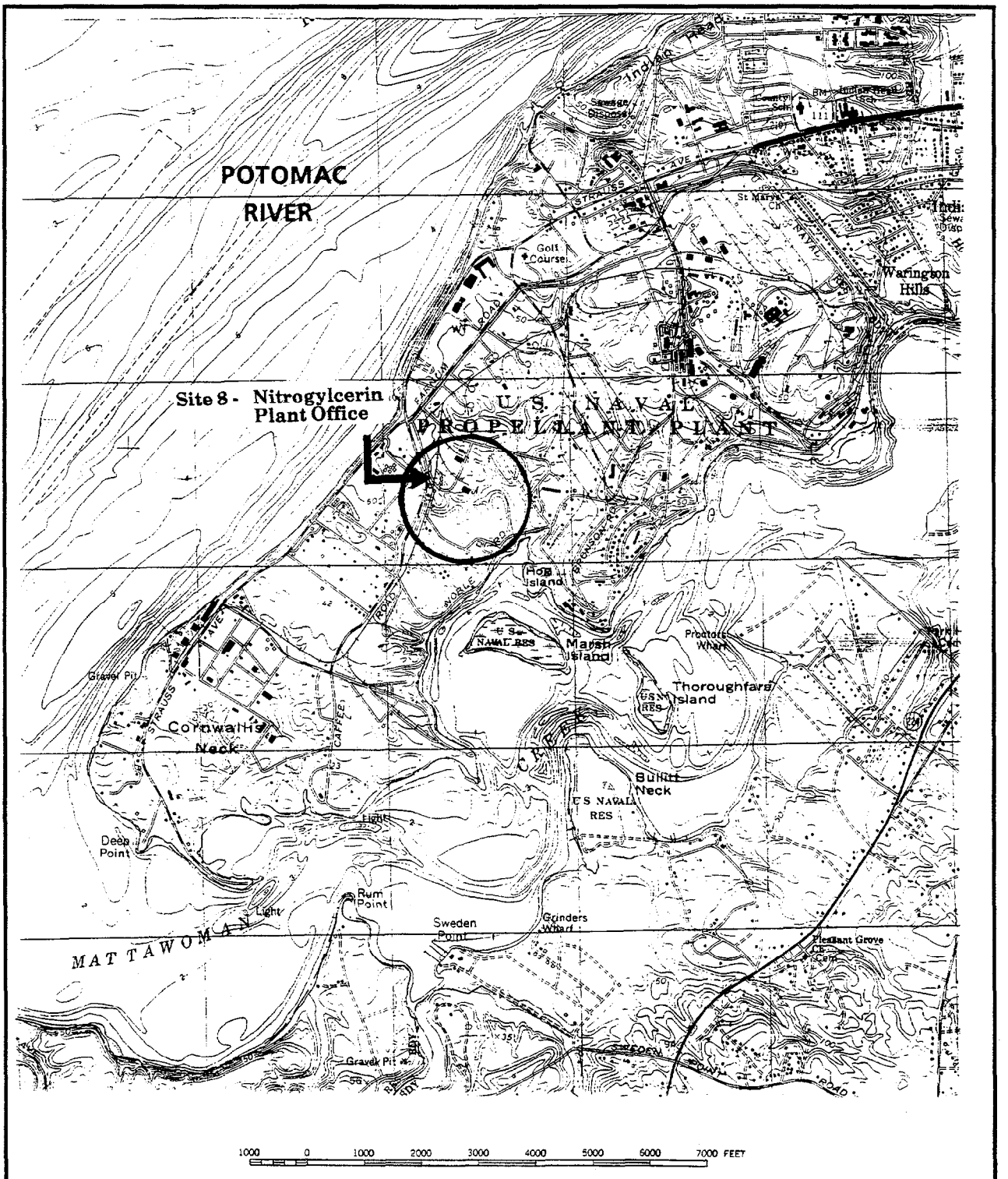


FIGURE 1-1
SITE LOCATION MAP
INSTALLATION RESTORATION PROGRAM
SITE 8 - NITROGLYCERIN PLANT OFFICE

HALLIBURTON NUS
Environmental Corporation

Source: 7.5 Minute USGS Quad Indian Head, MD-VA 1966 Photo Revised 1978

1.1 GENERAL PROJECT DESCRIPTION

The Upper Section of Stream is approximately 300 feet long. It begins at the pool located at the outlet of the pipe under the railroad tracks and extends in a southerly direction generally to the railroad tracks. The Upper Section of Stream flows through a moderately vegetated wooded area and drops approximately 6 feet in elevation. The stream bed varies from 1 to 2 feet wide and has steep overbanks.

The primary objectives of the proposed removal action are to remove mercury-contaminated sediment/soil from the Upper Section of Stream, place the removed sediment/soil from the Upper Section of Stream within the soil cover of Magazine No. 606, and then restore and revegetate the Upper Section of Stream and Magazine No. 606.

The removal action will consist of controlling water flow during construction, general site preparation work, excavation of mercury-contaminated sediment/soil, placement and disposal of the contaminated sediment/soil in the soil cover of Magazine No. 606, and restoration of all disturbed areas. The estimated construction period is expected to be approximately 2 weeks.

1.2 SEQUENCE OF CONSTRUCTION

The time to perform the required construction activities is estimated to be approximately 2 weeks. The major construction activities are as follows:

- **Step 1 - Install Water Diversion and Erosion and Sediment Control Devices.**

  The major stream diversion system (pump from Manhole A), tributary pumping system, silt fencing, sediment basin dike, and rock construction entrance will be installed.

- **Step 2 - Site Preparation.**

  During this task the contractor will construct an access road into the construction sites, perform clearing and grubbing at Site 8, remove topsoil from the area to be disturbed at Magazine No. 606, and excavate and stockpile the existing soil cover at Magazine No. 606 to make room for the excavated contaminated sediment/soil.

- **Step 3 - Excavate Contamination Sediment/Soil.**

  The mercury-contaminated soil from Site 8 will be excavated and securely placed in the soil cover of Magazine No. 606. Confirmatory sampling will be performed to determine and verify that the mercury-contaminated sediment/soil has been removed.

- **Step 4 - Reconstruct Stream Channel and Cover the Contaminated Sediment/Soil.**

  The stream channel at Site 8 will be regraded and reconstructed with a combination of Gabion, riprap, and vegetated channels. The contaminated sediment/soil at Magazine No. 606 will be covered with a clay cap, soil cover, and topsoil.

- **Step 5 - Revegetate Disturbed Areas**

  All areas disturbed by construction activities and not covered with riprap will be graded to drain and seeded.

- **Step 6 - Remove Water Diversion and Erosion and Sediment Control Devices**

  After construction activities are completed, the water diversion and erosion and sediment control devices will be removed and corresponding disturbed area revegetated.

2.0 ANALYSIS

Technical Release 55 (TR-55) Procedures were used to calculate storm runoff volumes and peak rates of discharge for the 24-hour - 2-, 10-, and 100-year storm events.

Runoff is determined primarily by the amount of precipitation and by infiltration characteristics related to soil type, soil moisture, antecedent rainfall, cover type, amount of impervious surfaces, and surface retention. Travel time is determined primarily by slope, length of flow path, depth of flow, and roughness of flow surface. Peak discharges are based on the relationship of these parameters and on the total drainage area of the watershed being considered.

Erosion and sediment control related construction drawings are provided separately.

Hydrological and hydraulic calculations for this project are presented in Appendix A of this report.

3.0 CONCLUSIONS

The entire project will disturb a relatively small area (0.25 acres at Site 8 and 0.25 acres at Magazine No. 606) and occur in a short time period approximately 2 weeks). Silt fence or sediment basins will be installed downgradient of all disturbed areas. In addition, where appropriate, steps will be implemented to divert runoff around the disturbed areas during construction. This diversion will cause a subsequent reduction in the erosion and sediment control potential.

APPENDIX A

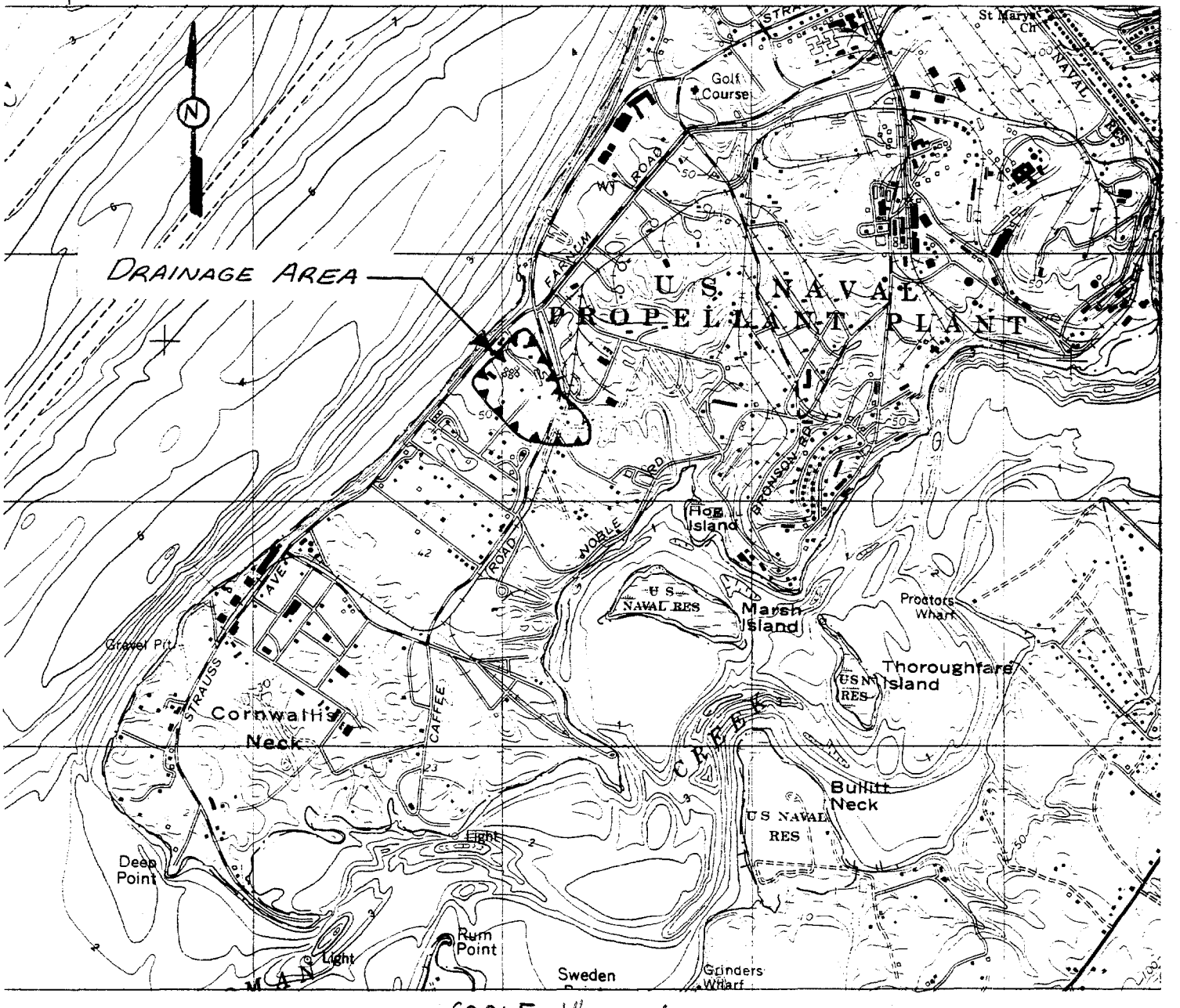
DESIGN CALCULATIONS

CALCULATION WORKSHEET Order No. 19116 (01-91)

CLIENT: NSWC - INDIAN HEAD	JOB NUMBER: 6190
SUBJECT: Hydrologic Calculations	
BASED ON: TR-55 Guidance	DRAWING NUMBER: I-11
BY: RFS / CHECKED BY: APK 8/19/93	APPROVED BY: / DATE: 5/23/93

SITE 8 - DRAINAG AREA MAP

SOURCE: U.S. DEPT. OF THE INTERIOR
GEOLOGICAL SURVEY (USGS)
INDIAN HEAD QUADRANGLE
MARYLAND-VIRGINIA; 1978

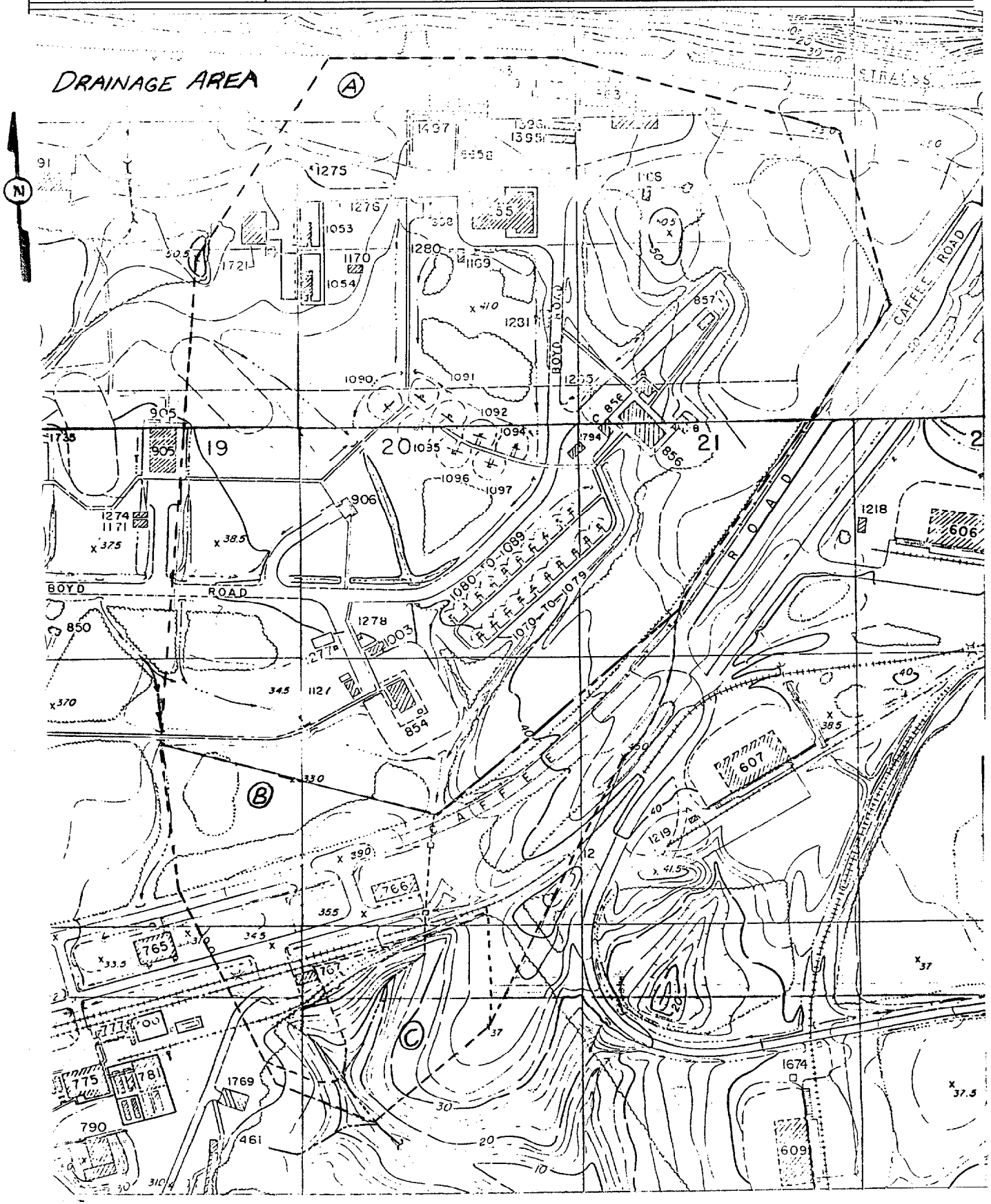


SCALE: 1" = 2000'

CALCULATION WORKSHEET

Order No. 19116 (01-91)

CLIENT: NSWC - INDIAN HEAD	JOB NUMBER: 6190
SUBJECT: Hydrologic Calculations (SCALE 1" = 200'	
BASED ON: TR-55 Guidance	DRAWING NUMBER: I-12
BY: RFS / CHECKED BY: APK 8/11/93	APPROVED BY: / DATE: 6/11/93

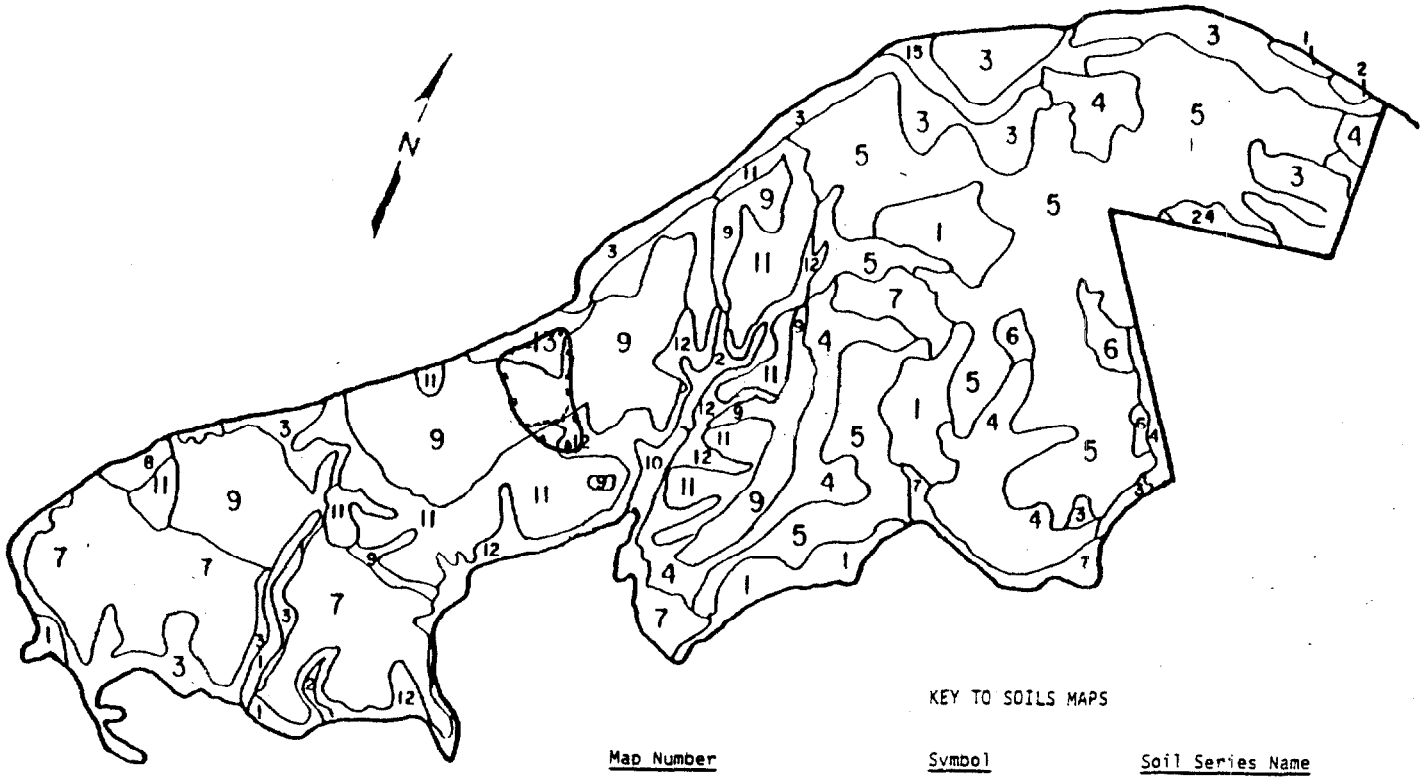


CALCULATION WORKSHEET

Order No. 19116 (01-91)

CLIENT: NSWC - INDIAN HEAD	JOB NUMBER: 6190
SUBJECT: Hydrologic Calculations	
BASED ON: TR-55 Guidance	DRAWING NUMBER: I-13
BY: RFS / CHECKED BY: AOK 8/11/93	APPROVED BY: / DATE: 5/26/93

SITE 8 - Soils Delineation Map



KEY TO SOILS MAPS

Map Number	Symbol	Soil Series Name
1	Cu	Cut-and-Fill Land
2	Bo	Bibb Silt Loam
3	GvE	Gravelly Land; Steep
4	Au	Aura Gravelly Sandy Loam
5	Bl	Beltsville Silt Loam
7	Kp	Keyport Silt Loam
8	Gp	Gravell and Borrow Pits
9	Ek	Elkton Silt Loam
10	Tm	Tidal Marsh
11	Ms	Matawan Loamy Sand
12	Sa	Sandy Land; Steep
13	Rd	Rumford Loamy Sand
15	Sh	Sassafras Sandy Loam
17	Ga	Galestown Loamy Sand
18	Ot	Otbelto Silt Loam
19	Wo	Woodstown Sandy Loam
20	Ex	Exum Silt Loam
21	Mn	Matapeake Silt Loam
22	Mu	Mattapex Silt Loam

SCALE (FT)

0 1000 2000 3000

REF: INITIAL ASSESSMENT STUDY
NEESA 13-021
Fred C. Hart Associates, Inc.
MAY, 1993.

ORIGIONAL SOURCE:

USDA Soil Conservation Service
Soil Survey of Charles County, Maryland

CLIENT NSWC - INDIAN HEAD		JOB NUMBER 6190	
SUBJECT Hydrologic Calculations			
BASED ON TR-55 Guidance		DRAWING NUMBER	
BY RFS	CHECKED BY APK 8/11/93	APPROVED BY	DATE 6/1/93

I. STREAM DIVERSION CALCULATIONS

• DRAINAGE AREA (AREA "A" ONLY)

D.A. = 18 ACRES ✓

REF. Geological Survey, INDIAN HEAD Quadrangle
1" = 2000' page 1 DWG. NO. I-11
Public Works Office, Base Maps
1" = 200' page 2 DWG. NO. I-12

• SOIL CLASSIFICATIONS

Soil Type	Hydrologic Soil Group	% of Total
Rumford Loamy Sand (13)	B ✓	40% ✓
Elkton Silt Loam (9)	D (C/D) ✓	60% ✓

REF: USDA Soil Conservation Service, Page 3
Soil Group Class, Exhibit A-1 ~ TR-55

Cover Description:

Soil Area No.	Cover Type	% of Total
Rumford (13)	Woods, Fair Condition	50% ✓
(13)	72% C.I. URBAN, Industrial	50% ✓
Elkton (9)	Woods, Fair Condition	50% ✓
(9)	72% C.I. Urban, Industrial	50% ✓

CLIENT NSWC - INDIAN HEAD		JOB NUMBER 6190	
SUBJECT Hydrologic Calculations			
BASED ON TR-55 Guidance		DRAWING NUMBER	
BY RFS	CHECKED BY APK 8/19/93	APPROVED BY A	DATE 6/1/93

- RUNOFF CURVE NUMBER

  Use Table 2-2c ~ Woods Fair Condition
  Use Table 2-2a ~ Urban district - Industrial

  SEE ATTACHED WORKSHEET 2 : Runoff Curve Number and Runoff. Weighted CN.

- STORM EVENT ~ 24 hour Rainfall in inches

  TABLES Appendix B 2yrs - 3.2 in ✓
  10 yrs - 5.2 in ✓
  TYPE II Distribution 100 yrs - 7.6 in ✓

TWO YEAR STORM EVENT

$$S = \frac{1000}{81.20} - 10 = 2.31$$

$$P_2 = 3.2$$

$$I_a = 0.2S = 0.46$$

$$Q_2 = \frac{(P_2 - I_a)^2}{(P_2 - I_a) + S} = \frac{(3.2 - 0.46)^2}{(3.2 - 0.46) + 2.31} = 1.49$$

$Q_2 =$ 1.5 inches ✓

(FIGURE 2-1, TR 55)

Worksheet 2: Runoff curve number and runoff

Project NSWC - INDIAN HEAD By RFS Date 5/26/93

Location SITE 8 - INDIAN HEAD, MARYLAND Checked _____ Date _____

Circle one: Present Developed Temporary Stream Diversion

1. Runoff curve number (CN)

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN 1/ Table 2-2	CN 1/ Fig. 2-3	CN 1/ Fig. 2-4	Area ☐ acres ☐ mi² ☑ %	Product of CN x area
13 Rumford, B	Woods, Fair Condition	60			20	1200
13 Rumford, B	Urban, Industrial	88			20	1760
9 Elkton, D	Woods, Fair Condition	79			30	2370
9 Elkton, D	Urban, Industrial	93			30	2790
				Totals =	100	8120

1/ Use only one CN source per line.

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{8120}{100} = 81.20$; Use CN = 81

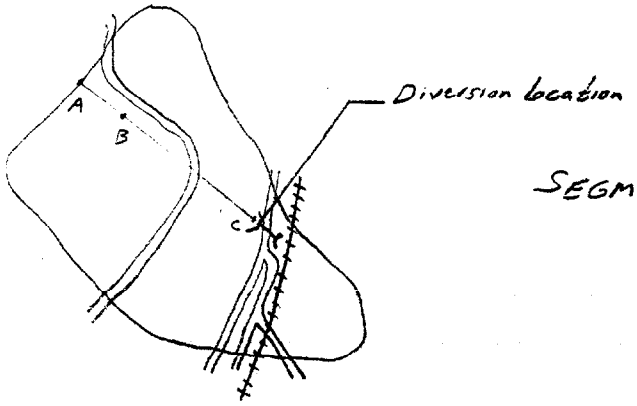
2. Runoff

	Storm #1	Storm #2	Storm #3
Frequency ..... yr	2 yrs		
Rainfall, P (24-hour) ..... in	3.2 in		
Runoff, Q ..... in (Use P and CN with table 2-1, fig. 2-1, or eqs. 2-3 and 2-4.)	1.5 in		

CLIENT NSWC - INDIAN HEAD	JOB NUMBER 6190
SUBJECT Hydrologic Calculations	
BASED ON TR-55 Guidance	DRAWING NUMBER
BY RFS / CHECKED BY	APPROVED BY / DATE 6/1/93

- TIME OF CONCENTRATION AND TRAVEL TIME

- Watershed Sketch



SEGMENT

AB: Woods, Lt brush - 150'

BC: Woods, Drainage Area - 850' (Ditch)

AB: Slope approx 1' drop over 100' run = 0.01 ✓ 1'

Use table 3-1 $n = 0.40$ ✓ Sheet flow

BC: Slope approx 1.5' over 100' run = 0.015 ✓

Use figure 3-1 $V = 2.0$ ✓ Shallow Concentrated flow

SEE WORKSHEET 3 FOR TIME CALCULATION

Tc (Time of concentration for two segments) = 0.77 hours ✓

- PEAK DISCHARGE

SEE WORKSHEET 4 "Graphical Peak Discharge Method"

$q_p = 16.8$ cfs

Worksheet 3: Time of concentration (T_c) or travel time (T_t)

Project NSWC - INDIAN HEAD By RFS Date _____

Location SITE 8 - INDIAN HEAD, MD Checked AOL Date 8/19/93

Circle one: (Present) Developed TEMPORARY STREAM DIVERSION

Circle one: (T_c) T_t through subarea

NOTES: Space for as many as two segments per flow type can be used for each worksheet.

Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T_c only)		Segment ID			
		AB			
1. Surface description (table 3-1)		Woods			
2. Manning's roughness coeff., n (table 3-1) ..		0.40			
3. Flow length, L (total L $\leq$ 300 ft)	ft	150			
4. Two-yr 24-hr rainfall, P_2	in	3.2			
5. Land slope, s	ft/ft	0.01			
6. $T_t = \frac{0.007\ (nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$ Compute T_t	hr	0.65	+	=	0.65 ✓

Shallow concentrated flow		Segment ID			
		BC			
7. Surface description (paved or unpaved)		unpaved			
8. Flow length, L	ft	850			
9. Watercourse slope, s	ft/ft	0.015			
10. Average velocity, V (figure 3-1)	ft/s	2.0			
11. $T_t = \frac{L}{3600\ V}$ Compute T_t	hr	0.12	+	=	0.12 ✓

Channel flow		Segment ID			
12. Cross sectional flow area, a	ft^2				
13. Wetted perimeter, p_w	ft				
14. Hydraulic radius, $r = \frac{a}{p_w}$ Compute r	ft				
15. Channel slope, s	ft/ft				
16. Manning's roughness coeff., n					
17. $V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$ Compute V	ft/s				
18. Flow length, L	ft				
19. $T_t = \frac{L}{3600\ V}$ Compute T_t	hr		+	=	

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19) ..... hr 0.77 ✓

Worksheet 4: Graphical Peak Discharge method

Project NSWC - INDIAN HEAD By RFS Date 6/1/93

Location SITE 8 - INDIAN HEAD, MARYLAND Checked MPK Date 8/19/93

Circle one: (Present) Developed

1. Data:

Drainage area ..... A_m = 0.028 mi^2 (acres/640)

Runoff curve number .... CN = 81 (From worksheet 2)

Time of concentration .. T_c = 0.77 hr (From worksheet 3)

Rainfall distribution type = II (I, IA, (II), III) From Appendix B

Pond and swamp areas spread throughout watershed ..... = --- percent of A_m (--- acres or mi^2 covered)

		Storm #1	Storm #2	Storm #3
2. Frequency	yr	2 yrs		
3. Rainfall, P (24-hour)	in	3.2 in		
4. Initial abstraction, I_a ..... (Use CN with table 4-1.)	in	0.469		
5. Compute I_a/P		0.146		
6. Unit peak discharge, q_u ..... (Use T_c and I_a/P with exhibit 4- II)	csm/in	400		
7. Runoff, Q ..... (From worksheet 2).	in	1.5		
8. Pond and swamp adjustment factor, F_p .... (Use percent pond and swamp area with table 4-2. Factor is 1.0 for zero percent pond and swamp area.)		1.0		
9. Peak discharge, q_p ..... (Where $q_p = q_u A_m Q F_p$)	cfs	16.8		

CLIENT NSWC - INDIAN HEAD		JOB NUMBER	
SUBJECT Hydrologic Calculations			
BASED ON TR-55 Guidance		DRAWING NUMBER	
BY RFS	CHECKED BY	APPROVED BY	DATE 6/1/93

II. STREAM CHANNEL DESIGN CALCULATIONS

- DRAINAGE AREA (Areas "A" and "B")

D.A. = 25 ACRES ✓

- SOIL CLASSIFICATIONS

SOIL TYPE	Soil Area	Hydro Soil Group	% of Total
Rumford Loamy Sand	13	B ✓	30%
Elkton Silt Loam	9	D ✓ (C/D)	47%
Matawam Loamy Sand	11 ✓	C ✓	23%
Sandy Land; steep	12	N/A	—

Cover Discription:

Soil Area	Cover type	% of Total
13	Woods, Fair	50%
13	Urban, Industrial	50%
9	Woods, Fair	50%
9	Urban, Industrial	50%
11	Urban, Industrial	100%

- RUNOFF CURVE NUMBER

TABLES 2-2a & 2-2c

SEE WORKSHEET 2

CLIENT	JOB NUMBER
NSWC - INDIAN HEAD	6190
SUBJECT: Hydrologic Calculations	
BASED ON: TR-55 Guidance	DRAWING NUMBER
BY: RFS	CHECKED BY	APPROVED BY	DATE: 6/1/93

10 YEAR STORM EVENT

$$S = \frac{1000}{83.55} - 10 = 1.97$$

$$P_{10} = 5.2 \text{ in}$$

$$I_a = 0.2S = 0.394$$

$$Q_{10} = \frac{(P_{10} - I_a)^2}{(P_{10} - I_a) + S} = \frac{(5.2 - 0.394)^2}{(5.2 - 0.394) + 1.97} = 3.41$$

$Q_{10} = 3.4$ inches

100 YEAR STORM EVENT

$$P_{100} = 7.6 \text{ in}$$

$$Q_{100} = \frac{(P_{100} - I_a)^2}{(P_{100} - I_a) + S} = \frac{(7.6 - 0.394)^2}{(7.6 - 0.394) + 1.97} = 5.66$$

$Q_{100} = 5.7$ inches

Worksheet 2: Runoff curve number and runoff

Project NSWC - INDIAN HEAD By RFS Date 6/1/93

Location SITE 8 - INDIAN HEAD, MD Checked ADK Date 8/19/93

Circle one: (Present) Developed RipRap stream project

1. Runoff curve number (CN)

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN 1/ Table 2-2	CN 1/ Fig. 2-3	CN 1/ Fig. 2-4	Area ☐ acres ☐ mi² ☑ %	Product of CN x area
13 Rumford, B	Woods, Fair Condition	60			15	900
13 Rumford, B	Urban, Industrial	88			15	1320
9 Elkton, D	Woods, Fair Condition	79			23.5	1856.5
9 Elkton, D	Urban, Industrial	93			23.5	2185.5
11 Matawan, C	Urban, Industrial	91			23	2093
				Totals =	100	8355

1/ Use only one CN source per line.

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{8355}{100} = 83.55$; Use CN = 84

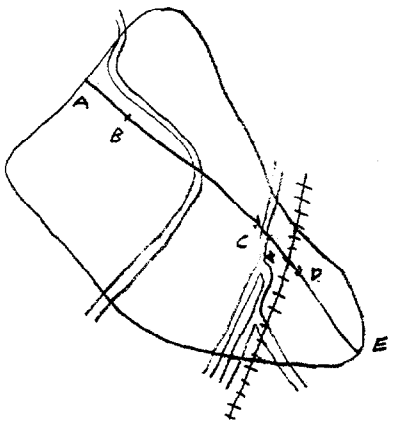
2. Runoff

	Storm #1	Storm #2	Storm #3
Frequency ..... yr	10 yrs	100 yrs	
Rainfall, P (24-hour) ..... in	5.2 in	7.6 in	
Runoff, Q ..... in (Use P and CN with table 2-1, fig. 2-1, or eqs. 2-3 and 2-4.)	3.4 in	5.7 in	

CLIENT	JOB NUMBER
NSWC - INDIAN HEAD	6190
SUBJECT: Hydrologic Calculations	
BASED ON: TR-55 Guidance	DRAWING NUMBER
BY: RFS	CHECKED BY:	APPROVED BY:	DATE: 6/1/93

SITE 8: Time of Concentration and travel time

• WATERSHED SKETCH



SEGMENT

AB: Woods, light under brush - 150 ft
BC: Woods & drainage area - 850 ft
CD: Culvert - 36" - 210 ft
DE: Open Channel - 400 ft

AB: Slope approx. 1' drop over 100' run = 0.01
Use table 3-1 for $n = 0.40$

BC: Slope approx. 1.5' drop over 100' run = 0.015
Use figure 3-1 for $V = 2.0$

CD: Hydraulic Radius 36" pipe filled ½ full flow
Lindeburg: 16-6

$$\frac{d}{D} = 0.50 \qquad \frac{r_h}{D} = 0.2500 = r_h = 0.75$$

DE: Channel ~ Upper Section of Stream
NATURAL FORMED CHANNEL

SEE WORKSHEET 3

T_c (Time of Concentration for two segments) = 0.81 hrs

SEE WORKSHEET 4

$q_{10} = 55.8$ cfs
$q_{100} = 102.5$ cfs

Worksheet 3: Time of concentration (T_c) or travel time (T_t)

Project NSWC - INDIAN HEAD By RFS Date 6/1/93

Location SITE 8 - Nitro Plant Checked MOK Date 8/19/93

Circle one: (Present) Developed

Circle one: (T_c) T_t through subarea

NOTES: Space for as many as two segments per flow type can be used for each worksheet.

Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T_c only)		Segment ID	AB			
1. Surface description (table 3-1)			Woods			
2. Manning's roughness coeff., n (table 3-1) ..			0.40			
3. Flow length, L (total L $\leq$ 300 ft)	ft		150			
4. Two-yr 24-hr rainfall, P_2	in		3.2			
5. Land slope, s	ft/ft		0.01			
6. $T_t = \frac{0.007\ (nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$ Compute T_t	hr		0.65	+	=	0.65 ✓

Shallow concentrated flow		Segment ID	BC			
7. Surface description (paved or unpaved)			Unpaved			
8. Flow length, L	ft		850			
9. Watercourse slope, s	ft/ft		0.015			
10. Average velocity, V (figure 3-1)	ft/s		2.0			
11. $T_t = \frac{L}{3600\ V}$ Compute T_t	hr		0.12	+	=	0.12 ✓

Channel flow		Segment ID	CD	DE
12. Cross sectional flow area, a	ft^2		3.53	6.0
13. Wetted perimeter, p_w	ft		4.71	7.0
14. Hydraulic radius, $r = \frac{a}{p_w}$ Compute r	ft		0.75	0.86
15. Channel slope, s	ft/ft		0.025	0.012
16. Manning's roughness coeff., n			0.011	0.05
17. $V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$ Compute V	ft/s		17.68	2.95
18. Flow length, L	ft		210	400
19. $T_t = \frac{L}{3600\ V}$ Compute T_t	hr		0.003	+ 0.04	=	0.04
20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19)	hr					0.81 ✓

Worksheet 4: Graphical Peak Discharge method

Project NSWC - INDIAN HEAD By RFS Date 6/1/93

Location SITE 8 - INDIAN HEAD MD Checked ____ Date ____

Circle one: (Present) Developed

1. Data:

Drainage area ..... A_m = 0.0391 mi^2 (acres/640)

Runoff curve number .... CN = 84 (From worksheet 2)

Time of concentration .. T_c = 0.81 hr (From worksheet 3)

Rainfall distribution type = II (I, IA, II, III) From Appendix B: TR55

Pond and swamp areas spread throughout watershed ..... = --- percent of A_m (--- acres or mi^2 covered)

		Storm #1	Storm #2	Storm #3
2. Frequency	yr	10 yrs	100 yrs	
3. Rainfall, P (24-hour)	in	5.2 in	7.6 in	
4. Initial abstraction, I_a ..... (Use CN with table 4-1.)	in	0.381	0.381	
5. Compute I_a/P		0.073	0.050	
6. Unit peak discharge, q_u ..... (Use T_c and I_a/P with exhibit 4-II)	csm/in	420	460	
7. Runoff, Q ..... (From worksheet 2).	in	3.4	5.7	
8. Pond and swamp adjustment factor, F_p .... (Use percent pond and swamp area with table 4-2. Factor is 1.0 for zero percent pond and swamp area.)		1.0	1.0	
9. Peak discharge, q_p ..... (Where $q_p = q_u A_m Q F_p$)	cfs	55.8	102.5	

CLIENT NSWC - INDIAN HEAD		JOB NUMBER 6190	
SUBJECT Hydrologic Calculations			
BASED ON TR-55 Guidance		DRAWING NUMBER	
BY RFS	CHECKED BY AOK	APPROVED BY	DATE 6/1/93

III. PROPOSED DEVELOPED CONDITIONS

Conditions after construction will be basically the same as before the construction except the stream will be LINED rather than an unlined channel.

IV TEMPORARY STREAM DIVERSION DESIGN

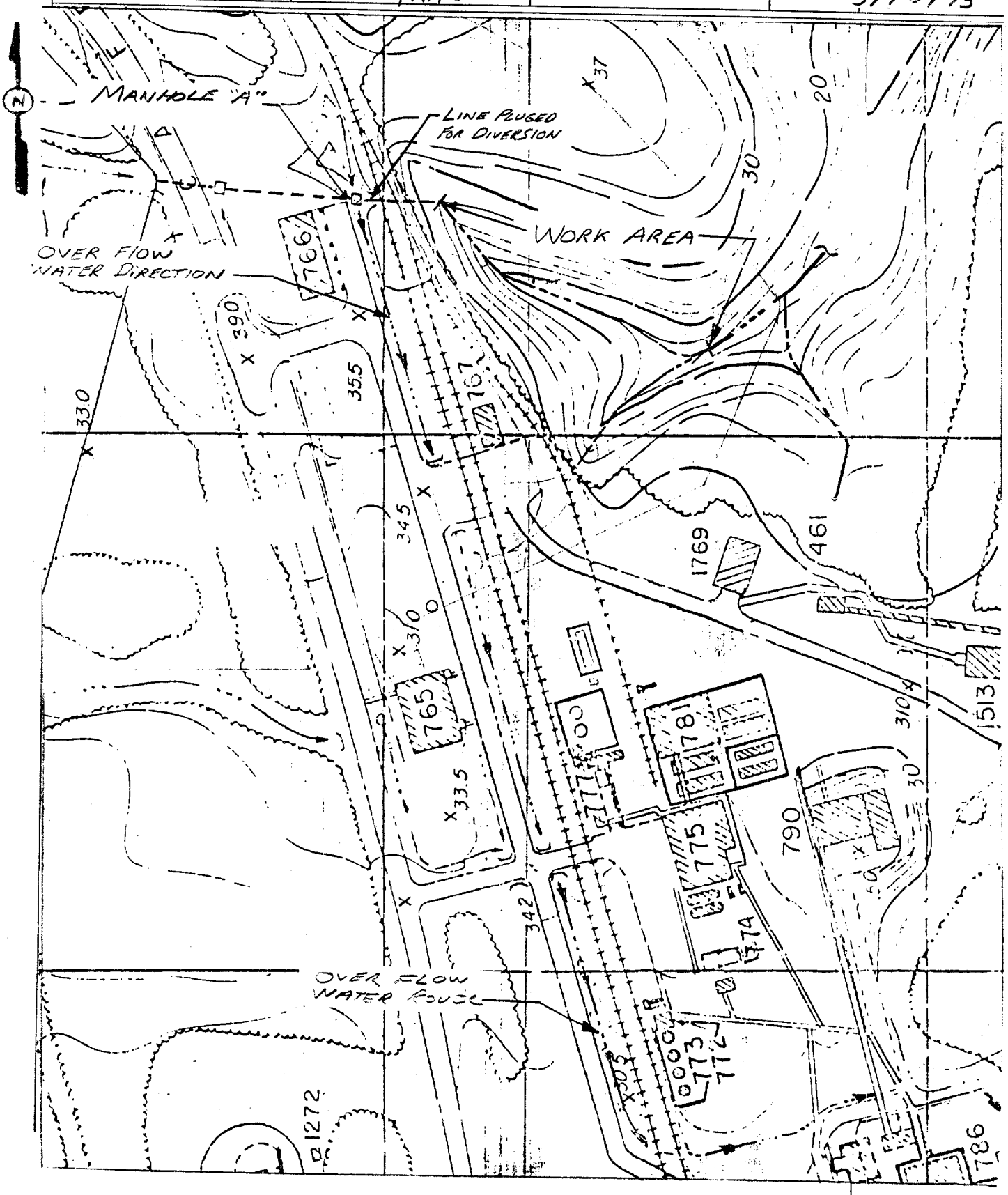
- DESIGN THE PRIMARY STREAM DIVERSION TO HANDLE A BASE FLOW. MEASURED FLOW RATES FOR THE STREAM WERE APPROX 40 gpm. USE A 100 gpm PUMP. OVERFLOWS WILL BE CONVEYED AROUND THE SITE ALONG AN EXISTING DITCH / PIPE SYSTEM

A well vegitated drainage ditch is located between Manhole "A" and the Soil Removal Construction Project along the Unused Rail Road Tracks as show on Drw. No. I-14, page 18.

CALCULATION WORKSHEET

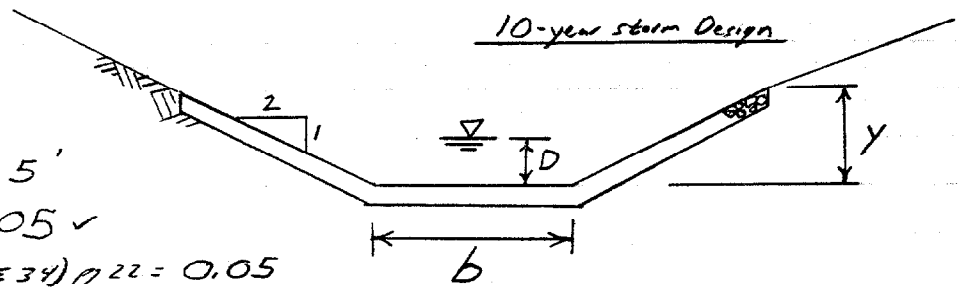
Order No. 19116 (01-91)

CLIENT: NSWC - INDIAN HEAD	JOB NUMBER: 6190
SUBJECT: Hydrologic Calculations	
BASED ON: TR-55 Guidance	DRAWING NUMBER: I-14
BY: RFS / CHECKED BY: AMK	APPROVED BY: / DATE: 5/16/93



CLIENT NSWC – INDIAN HEAD		JOB NUMBER 6190	
SUBJECT Hydrologic Calculations			
BASED ON SECTION 28 "Lined Waterways"		DRAWING NUMBER	
BY RFS	CHECKED BY APK	APPROVED BY	DATE 6/17/93

V STREAM CHANNEL STORM EVENT DESIGN



CHANNEL CROSS SECTION

• Upper section

FLOW DEPTH (D) = 1.5'
SLOPE (S) = 0.05 ✓
MANNINGS "n" (TABLE 34) pg 22 = 0.05
SIDE SLOPE = 2-1
BOTTOM WIDTH (b) = 4' ✓
CHANNEL DEPTH (Y) = 2' ✓
FREEBOARD = 0.5' ✓

REF: HANDBOOK OF HYDRAULICS BY BRATER AND KING, SIXTH EDITION McGRAW-HILL BOOK COMPANY

$D/b = 0.375$
K' (TABLE 7-11) = ~~0.387~~ 0.382 APK

$$Q = \frac{K'}{n} b^{8/3} S^{1/2} = \left(\frac{0.387}{0.05}\right) 4^{8/3} 0.05^{1/2} = 69.8 \text{ cfs}$$ USE 70 cfs

$$A = D(b + 2(D)) = 10.5 \text{ ft}^2 \checkmark$$

$$V = Q/A = 63 \text{ cfs}/10.5 \text{ ft}^2 = 6.6 \text{ ft/sec} \quad (6.7)$$

10 year storm = 55.8 cfs < 69.0 cfs OK ✓

RIP-RAP MAX Velocity = 9.0 > 6.0 OK ✓
(Riprap Stone ≃ NSA No. R-4 stone) (pg 23 & 24)
(TYPE A)

CLIENT NSWC - INDIAN HEAD	JOB NUMBER 6190
SUBJECT Hydrologic Calculations	
BASED ON SECTION 28 "Lined waterways"	DRAWING NUMBER
BY RFS / CHECKED BY MOK	APPROVED BY / DATE 6/17/93

100-year storm check

GIVEN: $b = 4'$ Avg. Slope (S) = 0.05

$D = 2'$ No FREE BOARD

$D/b = 0.5$

$K' = 0.679$ ✓ ($n = 0.44$ pg 22)

$$Q = \frac{K'}{n} b^{8/3} S^{1/2} = \left(\frac{0.679}{0.046}\right)(4)^{8/3}(0.05)^{1/2} = 133 \text{ cfs}$$ ✓ (139)

$$A = D(b + 2(D)) = 16 \text{ sq ft}$$ ✓

$$V = Q/A = 133 \text{ cfs}/16 \text{ ft}^2 = 8.3 \text{ ft/sec}$$ (8.7)

100 year storm = 102.5 cfs < 133 cfs OK ✓

Rip-RAP max velocity = 9.0 > 8.3 OK ✓

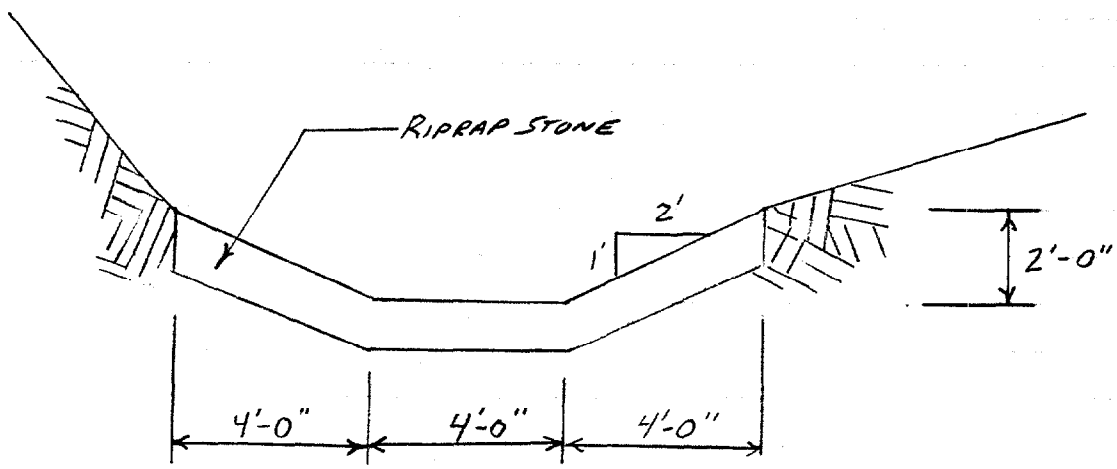
9.0 > 8.7 ok

USING: D_{50} = 6" Riprap Stone R-4 (pg 23)

" " " " " "

Maximum velocity 9 ft/sec OK

ACCEPTABLE STORM DESIGN:



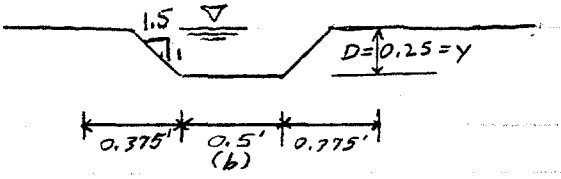
CLIENT NSWC - INDIAN HEAD	JOB NUMBER 6190
SUBJECT Hydrologic Calculations	
BASED ON 7/15/93 Flow Sample EVENT	DRAWING NUMBER
BY RFS / CHECKED BY APK	APPROVED BY / DATE 7/22/93

Lower Section in Veg. Channel

VI TYPICAL DAILY FLOW DESIGN

- Out of 36" RCP : 40 gpm OR 0.09 cfs

Flow Depth (D) = 0.25'
Slope (S) = 0.02
Manning's "n": Choked = 0.02 ✓
Side Slope = 1.5 : 1
Bottom Width (b) = 0.5'
Channel depth = 0.25
Avalible Free board = 0 ~ Not Required



$D/b = 0.5$
$k' = 0.598$ ✓

0.02 APK

$Q = \frac{k'}{n} b^{8/3} S^{1/2} = \left(\frac{0.598}{0.02}\right)(0.5)^{2.666}(.05)^{.5} = 1.05$ cfs [0.67 CF

$A = D(b + 2(0)) = 0.25(0.5 + 2(.25)) = 0.25\ ft^2$ ✓

$V = Q/A = 1.05\ cfs / 0.25\ ft^2 = 4.2$ ft/sec. [2.7 ft/sec

OK

NSA No.
R-2 Max 3 D_{50} = 1.5 min 1 = Max Velocity 4.5
MOE
Number I max 3 min 2 check 4.2 < 4.5
ok

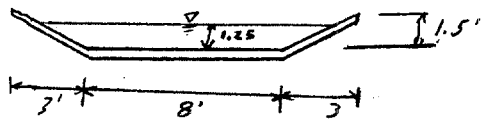
Thickness = Max (S) x 1.25 = 3.75" use 6" min

CLIENT NSWC - INDIAN HEAD	JOB NUMBER 6190
SUBJECT Hydrologic Calculations	
BASED ON TR55 RESULTS	DRAWING NUMBER
BY RFS / CHECKED BY AOK	APPROVED BY / DATE 7/21/93

VEGATATED CHANNEL

VII BIOENGINEERED SECTION DESIGN

• Lower Section



Flow Depth (D) = 1.25
Slope (S) = 0.02
Mannings "n" = 0.05
Side Slopes = 2:1
Bottom width (b) = 8'
Channel Depth (Y) = 1.5'
Freeboard = 0.25

$D/b = 0.16$ ✓
$K' = 0.0777$ ✓

$$Q = \frac{K'}{n} b^{8/3} S^{1/2} = \left(\frac{0.0777}{.05}\right)(8)^{2.666}(.02)^{.5} = 56.25 \text{ cfs} ✓$$

$$A = D(b + 2(D)) = 1.25(8 + 2(1.25)) = 13 \text{ ft}^2$$

$$V = Q/A = 56.25/13 = 4.32 \text{ ft/sec.}$$

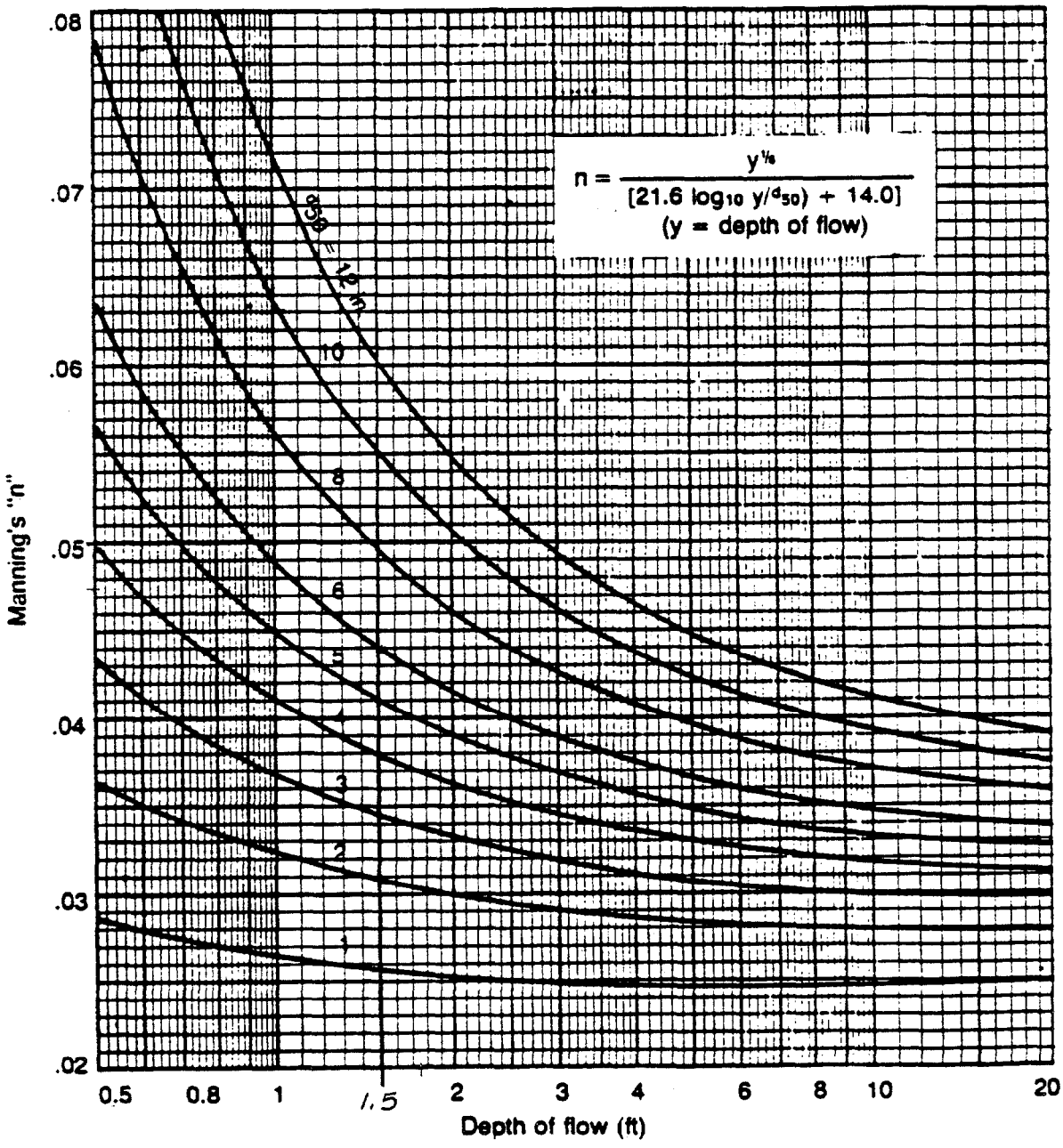
CHECK

JUTE MAT : 5 ft/sec > 4.32 ft/sec. OK

10 year Storm = 55.8 cfs < 56.25 OK ✓

Table 34

DETERMINING "n" FOR RIPRAP LINED CHANNEL USING DEPTH OF FLOW



Values of n for riprap-lined channels, d_{50} size vs depth of flow.

1991 MD STANDARDS & SPEC.

TABLE 4.7c Maximum Permissible Velocities for Rock Lined Channels and Riprap

NSA No.	Graded Rock Size (In.) Max.	D_{50}	Min.	Permissible velocity fps*	
R-1	1.5	.75	NO. 8	2.5	
R-2	3	1.50	1	4.5	⇐ TYPE B
R-3	6	3	2	6.5	
R-4	12	6	3	9.0 ✓	⇐ TYPE A
R-5	18	9	5	11.5	
R-6	24	12	7	13.0	
R-7	30	15	12	14.5	

* Permissible velocities based on rock at 165 lbs. per cubic foot. Adjust velocities for other rock weights used. See Figure 4.6

TABLE 4.7d Maximum Permissible Velocities for Reno Mattress and Gabions

Type	n	Thickness inches	Rock fill Gradation-in.	Permissible* Velocity-fps	
Reno Mattress	.025	6	3 - 6	13.5	
	.025	9	3 - 6	16.0	
	.025	12	4 - 6	18.0	✓
Gabion	.027	18 +	5 - 9	22.0	

* Permissible velocities may be increased by the introduction of sand mastic grout. Refer to manufacturers recommendations/specifications for permissible velocities.

EROSION & SEDIMENT CONTROL
DER Bureau of Soil & Water Conservation. April, 1990

Table 28 Stone Size

	SIZE RANGE	D_{50}	D_{100}	AASHTO	WEIGHT
NUMBER 57*	3/4" - 1 1/2"	1/2"	1 1/2"	M-43	N/A
NUMBER 1	2" TO 3"	2 1/2"	3"	M-43	N/A
RIP-RAP**	4" to 12"	8"	12"	N/A	N/A
CLASS I	N/A	9.5"	15"	N/A	150lb max
CLASS II	N/A	16"	24"	N/A	700lb max
CLASS III	N/A	23"	34"	N/A	2000lb max

* This classification is to be used on the inside face of stone outlets and check dams.

** This classification is to be used when ever rip-rap is required. The State Highway Administration designation for this stone is placed rip-rap for sediment control.

NOTE: Recycled concrete equivalent may be substituted for all stone classifications. Recycled concrete equivalent shall be concrete broken into the sizes meeting the appropriate classification, shall contain no steel reinforcement, and shall have a density of 150 pounds per cubic foot.

Stone For Gabion Baskets

BASKET THICKNESS		SIZE OF INDIVIDUAL STONES	
INCHES	MM	INCHES	MM
6	150	3 - 5	75 - 125
9	225	4 - 7	100 - 175
12	300	4 - 7	100 - 175
18	460	4 - 7	100 - 175
36	910	4 - 12	100 - 300

1991 MARYLAND
STANDARDS AND SPECS.
SOIL AND EROSION CONTROL

24.0 MATERIALS SPECIFICATIONS

Table 27 Geotextile Fabrics

CLASS	APPARENT OPENING SIZE MM. MAX.	GRAB TENSILE STRENGTH LB. MIN.	BURST STRENGTH PSI. MIN.
A	0.30	250	500
B	0.60	200	320
C	0.30	200	320
D	0.60	90	145
E	0.30	90	145
F (SILT FENCE)	0.40-0.80*	90	190

* US Std Sieve CW-02215

The properties shall be determined in accordance with the following procedures:

-Apparent opening size MSMT 323

-Grab tensile strength ASTM D 1682: 4x8" specimen, 1x2" clamps, 12"/min. strain rate in both principal directions of geotextile fabric.

-Burst strength ASTM D 3786

The fabric shall be inert to commonly encountered chemicals and hydrocarbons, and will be rot and mildew resistant. It shall be manufactured from fibers consisting of long chain synthetic polymers, and composed of a minimum of 85% by weight of polyolephins, polyesters, or polyamides. The geotextile fabric shall resist deterioration from ultraviolet exposure.

In addition, Classes A through E shall have a 0.01 cm./sec. minimum permeability when tested in accordance with MSMT 507, and an apparent minimum elongation of 20 percent (20%) when tested in accordance with the grab tensile strength requirements listed above.

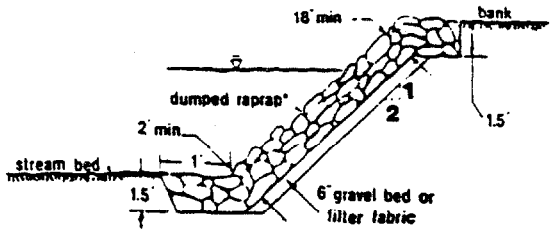
Silt Fence

Class F geotextile fabrics for silt fence shall have a 50 lb./in. minimum tensile strength and a 20 lb./in. minimum tensile modules when tested in accordance with MSMT 509. The material shall also have a 0.3 gal./ft.^{2}/min. flow rate and seventy-five percent (75%) minimum filtering efficiency when tested in accordance with MSMT 322.

Geotextile fabrics used in the construction of silt fence shall resist deterioration from ultraviolet exposure. The fabric shall contain sufficient amounts of ultraviolet ray inhibitors and stabilizers to provide a minimum of 12 months of expected usable construction life at a temperature range of 0 to 120 degrees F.

1991 MARYLAND STANDARDS AND SPECS. SOIL AND EROSION CONTROL

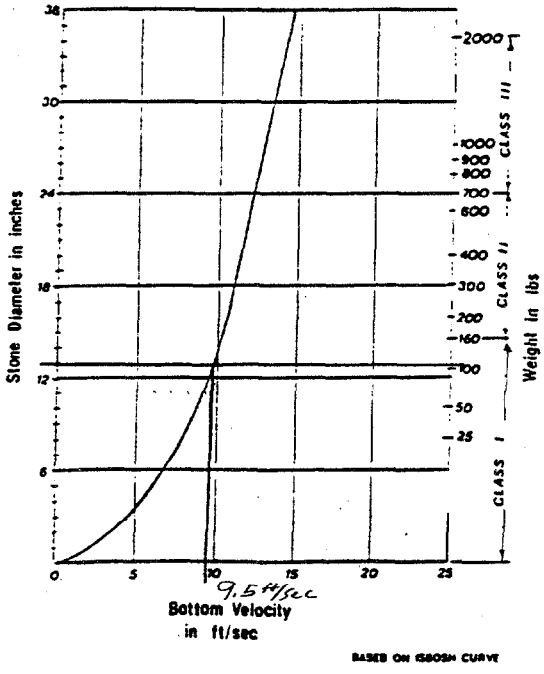
32



* size based on bankfull velocity

CROSS SECTION

SIZING RIPRAP PER STREAM VELOCITY



RIPRAP GRADATION

	Size	Percent of Total Weight Smaller than the Given Size
Class I	150 lb (70 kg) 2 lb (1 kg)	100 10 max
Class II	700 lb (320 kg) 20 lb (10 kg)	100 10 max
Class III	2000 lb (910 kg) 40 lb (20 kg)	100 10 max

I. Description

This work shall consist of protecting slopes and channels from erosion with coverings of stone in accordance with the plans and specifications shown on this drawing.

II. Material Specifications

1. Bedding:

A. Bank run gravel shall meet the following requirements:

% less than	U.S. Standard selve size
100	2 1/2 in
85 - 100	1 in
60 - 100	1/2 in
35 - 70	No. 10
20 - 50	No. 40
3 - 20	No. 200

B. Geotextile filter fabric shall meet the following requirements:

Tensile Strength	200 lbs.
Burst Strength	350 lbs.
Puncture Strength	70 lbs.
Permeability	.02 cm/sec
Elongation at Failure	30%
Minimum Lap Length	24 in

2. Riprap:

The maximum weight of stone shall be based upon the bankfull stream channel velocity, using the given chart. The gradation of the stone shall be as indicated.

III. Construction Requirements

1. The contractor shall install all sediment and erosion control devices as a first order of business.

2. Provisions must be made to anchor the riprap at the stream bed so as to provide protection against undermining. If this cannot be accomplished by extending the toe trench as indicated in Cross Section, an alternative method of protection must received prior written approval of the Administration.

3. Excavation for riprap shall be made in reasonably close conformity with the existing stream slope and bed.

4. A filter bedding is required under all riprap. Bedding material shall consist of either a bank run gravel or a geotextile filter fabric meeting the specifications of II. 1B above.

5. The placement of riprap shall begin with the toe. The larger stones shall be placed in the toe and along the outside edges of the limits of the slope and channel protection. The riprap shall be placed with suitable equipment in such a manner as to produce a reasonably graded mass of stones with zero drop height. The placing of stones that cause extensive segregation is not allowed.

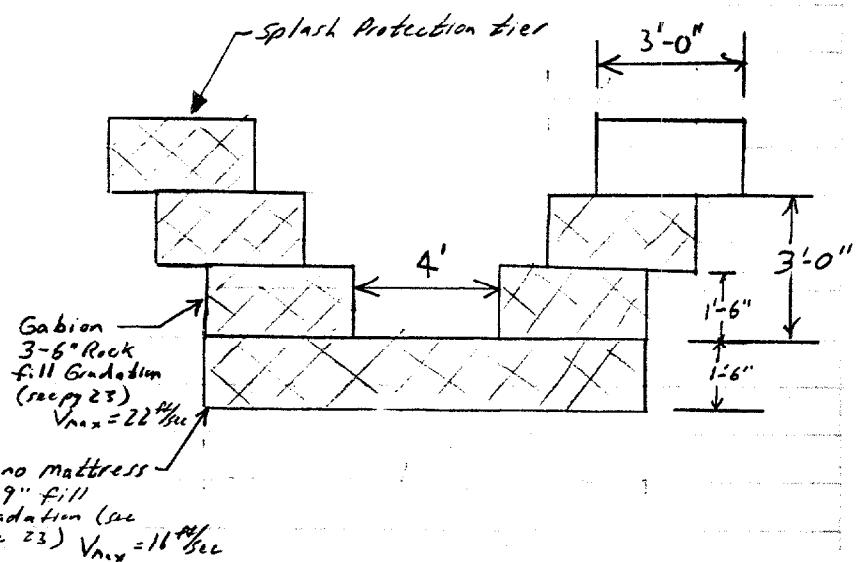
6. Any excavation voids existing along the edges of the completed slope and channel protection shall be backfilled.

7. All disturbed areas shall be permanently stabilized in accordance with an approved sediment and erosion control plan.

WATER RESOURCES ADMINISTRATION	Riprap	Approved On 1-24-86 Chief, Waterway Permits	WPD 3.1

CLIENT NSWC - INDIAN HEAD		JOB NUMBER 6190	
SUBJECT Hydrologic Calculations			
BASED ON TR-55 Results		DRAWING NUMBER	
BY RFS	CHECKED BY	APPROVED BY MK	DATE 8/5/93

VIII GABION ; PIPE OUTLET AREA



Flow Depth (D) = 1.5
Slope (S) = 0.05
Mannings 'n' = 0.025
Bottom Width (b) = 4'
Assume Vert. walls.
Set back for Freeboard

1125

$D/b = 0.375$
$k' = 0.200$

$$Q = \frac{k'}{n} b^{8/3} S^{1/2} = \left(\frac{0.200}{0.025}\right) 4^{8/3}\, 0.05^{1/2} = 72 \text{ CFS}$$

$A = 6 \text{ ft}^2$ (+ freeboard)

$V = Q/A = 72/6 = 12$ FPS

10 year Storm event 55.8 cfs < 72 cfs OK

MAX V = 16 ft/s > 12 ft/s OK

CLIENT NSWC - INDIAN HEAD		JOB NUMBER 6190	
SUBJECT Hydrologic Calculations			
BASED ON Dike Design "USGS map"		DRAWING NUMBER	
BY RFS	CHECKED BY	APPROVED BY APK	DATE 8/6/93

IX CONSTRUCTION AREA DRAINAGE

DIKE DESIGN

- Area to be considered is area not to be collected by:
  1) Diversion System
     a) Manhole "A"
     b) Tributary Collection pump.
  2) Over flow area North of RR Tracks

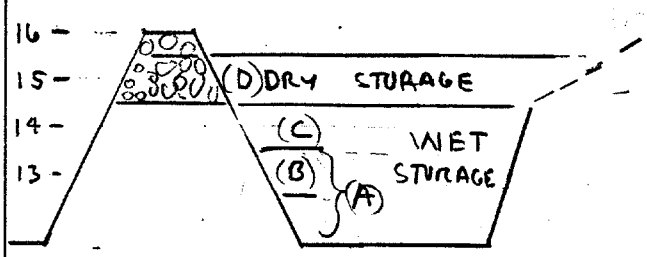
SEE sheet 2 of 28 Drawing

- Scaled Area = 1.1 ACRES

Required Storage: 1800 cf/Acre wet storage = 1980 cf ✓
1800 cf/ACRE Dry storage = 1980 cf ✓

Construction: Required Contaminated soil will be removed at end of Stream excuvation area as shown on drawings to create required area for storage.

VOLUME



WS = 11' x 20' x 2' = 220 (A)
= 39' x 20' x 1' = 780 (B)
= 50 x 20 x 1 = 1000 (C)
TOTAL 2000 CF

DS = 48' x 20' x 1 = 960
45 x 24 x 1 = 1080 } (D)
2040 CF

OK