5101Permit1991 - Batch No.___

10 Johnson Co. 51-01

1991

5101 1991

CF 51-01
Johnston Co. Permit File.

State of North Carolina
Department of Environment, Health, and Natural Resources
512 North Salisbury Street • Raleigh, North Carolina 27611

James G. Martin, Governor

William W. Cobey, Jr., Secretary

DIVISION OF LAND RESOURCES
August 13, 1991

County of Johnston
PO Box 1049
Smithfield, NC 27577
ATTN: Norman Denning, Chairman
Board of County Commissioners

RE: Letter of Approval
Project Name: Vertical Landfill Expansion
Location: Johnston County
Submitted by: McKim & Creed
Date Received: 7-30-91
Date Processing Initiated: 7-30-91
New Submittal ( ) Revised (X)

Dear Mr. Denning:

This office has reviewed the subject Erosion and Sedimentation Control Plan. We find the plan to be acceptable and hereby issue this letter of approval. If any modifications, performance reservations, or recommendations are applicable, a list is enclosed and is incorporated as a part of this letter of approval. If any modifications are not incorporated into the plan and implemented in the field, the site will be in violation of the Sedimentation Pollution Control Act of 1973 (NCGS 113A-61.1).

Please be advised that Title 15A, North Carolina Administrative Code, 4B.0018(a) requires that a copy of the approved plan be on file at the job site. Also, please consider this letter as notice in accordance with the requirements of North Carolina General Statute (hereinafter NCGS) 113A-61.1 concerning our right to perform periodic inspections to ensure compliance with the approved plan.

North Carolina's sedimentation pollution control program is performance oriented, requiring protection of the natural resources and adjoining properties. If at any time during this project it is determined that the Erosion and Sedimentation Control Plan is inadequate to meet the requirements of the Sedimentation Pollution Control Act of 1973 (NCGS 113A-51 through 66), this office may require revisions in the plan and its implementation to ensure compliance with the Act.

Please note that this approval is based in part on the accuracy of the information provided concerning financial responsibility. You are requested to file an amended Financial Responsibility Form if any changes become necessary. In addition, it would be helpful if you would notify this office of the proposed starting date for the activity at the subject site.

Your cooperation is appreciated and we look forward to working with you on this project. If there are any questions, please do not hesitate to contact this office at 919/733-2314.

Sincerely,

John L. Holley, Jr., P.E., CPESC
Regional Engineer
Land Quality Section
Raleigh Regional Office

JLH/ga

cc: Jerry C. Hodge
Suzanne Molloy

State of North Carolina
Department of Environment, Health, and Natural Resources
512 North Salisbury Street • Raleigh, North Carolina 27611

James G. Martin, Governor

William W. Cobey, Jr., Secretary

LAND WASTE SECTION
AUG 2

DIVISION OF LAND RESOURCES
July 31, 1991

County of Johnston
PO Box 1049
Smithfield, NC 27577
ATTN: Norman Denning, Chairman
Board of County Commissioners

RE: Letter of Receipt for Revised Plan
Project Name: Johnston Co. Vertical Landfill Exp.
Location: Johnston County
Submitted by: McKim & Creed
Date Received: 7-30-91
Date Processing Initiated: 7-30-91

Dear Mr. Denning:

This office has received a Revised Erosion and Sedimentation Control Plan for the subject project in accordance with the Sedimentation Pollution Control Act of 1973.

Please be advised that this Act requires that the approving authority must approve or disapprove a revised plan within 15 days of receipt of a complete application (Date Processing Initiated). Failure of the approving authority to approve or disapprove the submitted plan within the 15 day period will be deemed approval of the plan.

Pending approval, commencement or continuation of any land-disturbing activity associated with this project is subject to the conditions of our previous correspondence.

We will complete our review of the proposed plan as soon as possible and will notify you concerning approval or disapproval. If you have any questions or need additional information please do not hesitate to contact this office. Your cooperation in this matter is appreciated.

Sincerely,

John U. Holley, Jr., P.E., CPESC
Regional Engineer
Land Quality Section

cc: Jerry C. Hodge
Suzanne Molloy

JLH

CF
Permit 56-01
Johnston Co. LF

State of North Carolina
Department of Environment, Health, and Natural Resources
Division of Solid Waste Management
P.O. Box 27687 · Raleigh, North Carolina 27611-7687

James G. Martin, Governor
William W. Cobey, Jr., Secretary

William L. Meyer
Director

July 30, 1991

Mr. Haywood Phthisic
Johnston County Utility Department
P. O. Box 2263
Smithfield, North Carolina 27577

RE: Amendment to Permit #56-01, Vertical Expansion Johnston County Landfill, North Carolina

Dear Mr. Phthisic:

The enclosed Amendment to Permit for the referenced facility is approved in accordance with G.S. 130A-294, subject to the conditions of the Permit.

As requested by the applicant, the permit is amended to include a revised sediment and erosion control plan and deletes the usage of the proposed fill area between phase 3 and phase 4 of the original landfill plan. This permit is for a three year vertical expansion. The conditions of this permit supersede any permit conditions issued heretofore.

Please note General Condition No. 1 which states that modifications of this permit may be required in accordance with upcoming Subtitle D criteria. Modifications to the construction and operational plans or even closure of this landfill may be required before the permit period expires.

Please note Construction and Operational Condition No. 2 which states that all sedimentation/erosion control activities by conducted in accordance with the Sedimentation Control Act (15A NCAC 4). Enclosed is the letter of approval from the Land Quality Section with attached comments.

If you have any questions or comments, please contact our

office at (919)733-0692.

Sincerely,

Suzanne Molloy

Suzanne Molloy
Environmental Engineer
Solid Waste Section

ENCLOSURES

cc: Terry Dover
Fred Wood
Tim Broome

AMENDMENT TO PERMIT NO. 5~~5~~1-01
JULY 30, 1991

STATE OF NORTH CAROLINA

DEPARTMENT OF ENVIRONMENT, HEALTH AND NATURAL RESOURCES

DIVISION OF SOLID WASTE MANAGEMENT

P. O. BOX 27687 RALEIGH, NC 27611-7687

S O L I D W A S T E P E R M I T

Johnston County

is hereby issued a permit to operate a

SANITARY LANDFILL

located

S. R. 1503, Johnston County,
North Carolina

in accordance with Article 9, Chapter 130A, of the General Statutes of North Carolina and all rules promulgated thereunder and subject to the conditions set forth in this permit.

Dexter R. Matthews, Chief
Solid Waste Section
Solid Waste Management Division

PERMIT NO. 51-01
October 25, 1991

AMENDMENT TO SOLID WASTE PERMIT

Johnston County Landfill

CONDITIONS OF PERMIT:

1) This amendment to permit is issued for a period not to exceed three years from the date of issuance. Upcoming amendments to the Solid Waste Management Rules, in accordance with EPA Subtitle D revisions, may necessitate the modifications of the construction and operation plans or even closure of this facility prior to this date.

2. When this property is sold, leased, conveyed or transferred, the deed or other instrument of transfer shall contain in the description section in no smaller type than used in the body of the deed or instrument a statement that the property has been used as a sanitary landfill.

CONSTRUCTION AND OPERATION PLANS

1. This permit is for construction according to the attached plans. Additional conditions and revisions of the approved plan shall be approved by the North Carolina Solid Waste Section.

2. All sedimentation/erosion control activities will be conducted in accordance with the Sedimentation Control Act (15A NCAC 4).

3. This permit amends the "Amendment to Permit" issued on October 25, 1990 to include a revised sedimentation and erosion control plan and deletes the usage of the fill area between phase 3 and phase 4 of the original permit.

4. This facility shall conform to operating procedures in Rule .0505 of the Solid Waste Management Rules, and the conditions specified herein.

5. A closure and post-closure plan must be submitted for approval at least 90 days prior to closure or partial closure. The plan must include all steps and measures necessary to close and maintain the facility in accordance with all rules in effect at that time. The final cover will be evaluated based upon performance and upgraded if necessary.

MONITORING REQUIREMENTS

1. Johnston County shall sample monitoring wells and surface waters as per the North Carolina Water Quality Monitoring Guidance Document.

2. Ground water quality at this facility is subject to the classification and remedial action provision referenced in Rule .0503 (2)(d) of 15A NCAC 2L.

Johnston Co.
Haywood Pthsic'l
(919) 989-5075

PERMIT APPLICATION TRACKING SYSTEM
SOLID WASTE MANAGEMENT FACILITY

GENERAL INFORMATION

APPLICANT Johnston Co. TYPE OF FACILITY MSWLF

TYPE OF WASTE MSW TYPE OF APPLICATION Amend to Amend to Vert. Exp.

LOCATION OF FACILITY NO. 55-01

PERMITTING PROCESS

PRELIMINARY SITING ASSISTANCE, TYPE _____ DATE _____

APPLICATION	APPLICATION RECEIVED	COMPLETENESS REVIEW, LETTER SENT	ADDITIONAL INFORMATION RECEIVED	NRCD		TECHNICAL REVIEW LETTER SENT	ADDITIONAL INFORMATION RECEIVED
				SENT	COMMENTS RECEIVED		
SITE PLAN							
SITE SUITABILITY ACTION TAKEN: ACTIVITY _____ (DEM) DATE _____							
CONSTRUCTION PLAN	6/24/91			6/25 sent to LQ 7/15 Approval letter.			
PERMIT ACTION TAKEN: ACTIVITY 7/30/91 PERMIT NO. Amend issued. (LQ) DATE _____							

PERTINENT ACTIVITY

DATE	TYPE OF ACTIVITY	COMMENTS

July $4^{3}\ 39^{10}$ 30 3^{00}

$60\overline{)210}$ = 3, 180, 30

Aug. $1\ 7^{50}$ 8

$8\overline{)450}$

Sept. 7^{50} 8 $7^{50}\ 9$

Oct. 7^{50} 8 $60\overline{)450}$ = 7, 42

Nov. 7^{50} 8 7030 2430 300

63, 7

Dec 9^{10} 8 7940 3200

Temy

M.
A.
M.
J.
J.
A.
S
O
N

$8\overline{)70}$ = 8, 64, 6, 30

10 1/4 days!

7940
3^{00}
8240

$8\overline{)82^{40}}$ = 10, 8, 2

12 days!

70^{30}
24^{30}
3^{00}
98^{00}

$8\overline{)98}$ = 12, 8, 18, 16

$8\ 63^{30}$

9 DAYS.
3 SICK.

Permit 55-01

McKIM & CREED

LETTER OF TRANSMITTAL

DATE 7-30-91	PROJ. NO.
ATTENTION JOHN L. HOLLEY, JR., P.E.	
RE: JOHNSTON COUNTY VERTICAL LANDFILL EXPANSION	

SOLID WASTE SECTION

TO

N.C. D.E.H & N.R.
3800 BARRETT DR., SUITE 101
RALEIGH, N.C. 27609

GENTLEMEN:

WE ARE SENDING YOU ☒ Attached ☐ Under separate cover via _____ the following items:

☐ Shop drawings ☒ Prints ☐ Originals ☐ Samples ☐ Specifications

☒ Other CALCULATIONS

Quan.	Dwg. No.	Description	Status
2	N/A	REV. CALC. SHEETS	E
2	1,3,15 & 16	REV. PLAN DRAWINGS	E

Status Code:

A. Approved
B. Approved as noted
C. Rejected—Re-submit
D. Revise and Re-submit
E. For your information
F. Refer to remarks

REMARKS JOHN - ENCLOSED ARE THE REVISED CALC. & DRAWING THAT HAVE BEEN REVISED PER YOUR LETTER OF 7-12-91. IF I CAN BE OF FUTHER ASSISTANCE, PLEASE CONTACT ME.

5580 CENTERVIEW DRIVE, SUITE 100 RALEIGH, NC 27606 919/233-8091 FAX 919/233-8031

cc: HAYWOOD PHTHISK
SUZANNE MOLLOY

McKIM & CREED ENGINEERS, PA

SIGNED Jerry C. Holley

51-01

-Booklet-

Johnston County Landfill
Proposed Vertical Expansion
Calculations
June 1991

Approved 7/30/91

JOHNSTON COUNTY LANDFILL

PROPOSED VERTICAL EXPANSION

CALCULATIONS

SOLID WASTE SECTION
JUN 24 1991

7/30/91 Amendment to
Permit No. ~~55-01~~
51-01

June, 1991

McKIM&CREED

Construction Sequence

1. Install temporary diversions, silt fence, sediment basins, or other measure as shown on the approved plans. Clear as necessary to install these devices.

2. Call 733-2314 for onsite inspection by environmental inspector and obtain certification of compliance.

3. Begin land filling operations.

4. Landfill operations shall begin in Phase III, Section 1 and proceed to Section 5. After completion of Section 5 work will begin in Phase II, Section 7 and proceed to Section 10.

5. Begin work in Phase III, Section 1.

6. Install Slope Drains #1, #3, and #4 along with terraces to divert flow into Sediment Basins No. 4 and No. 3. Install rock check dam in existing channel down stream of slope drain #4.

7. Complete work in Section 1, stabilize Section 1 and remove stone check dam.

8. Begin work in Section 2.

9. Install slope drain No. 5 and stone check dam.

10. Complete work and stabilize Section No. 2.

11. Remove stone check dam and proceed to the next section.

12. The above sequence shall be repeated until completion of Section No. 5.

13. Upon completion of Section No. 5, begin work in Phase II.

14. Install Channel No. 4, 5, 6 and 7 to convey runoff to Sediment Basin No. 7, 8 and to drainage way. Install slope drain No. 9.

15. Commence work in Section No. 7.

16. Upon completion of work stabilize and seed Section No. 7.

17. Install slope drain No. 10.

18. Repeat this procedure for Section 8 through 10.

19. Upon completion of Phase II clean out Sediment Basin No. 7. Sediment Basin No. 7 shall remain in service to act as a retention basin.

20. Stabilize all areas in Phase III and Phase II and call for inspection.

JOHNSTON COUNTY LANDFILL

PROPOSED VERTICAL EXPANSION

CALCULATIONS

JUNE, 1991

NORTH CAROLINA PROFESSIONAL SEAL 6114 ENGINEER TIMOTHY G. BROOME

6/20/91

CALCULATION

PROJECT LANDFILL VERT. EXP.
CLIENT JOHNSTON CO.
SUBJECT INDEX / CALC.

PROJ. NO.
DATE 6/91
DES. BY JCH
CHK. BY

REMARKS

INDEX TO CALCULATIONS

1 - 1A PHASE III DESIGN PARAMETERS
2 - 7 AREAS, TC & C10 CALC'S.
8 - 17 SEDIMENTATION BASINS #1 THRU #6
18 - 29 SLOPE DRAINS #1 THRU #8
30 - 34 CHANNELS #1 THRU #3

35 - 36 PHASE II, DESIGN PARAMETERS
37 - 43 AREAS, TC & C10 CALC'S.
44 - 57 SEDIMENTATION BASIN #7 & #8
58 - 62 SLOPE DRAINS #9 THRU #12
63 - 70 CHANNELS #4 THRU #7
71 - 78 PIPES #1 THRU #3

79 LANDFILL LIFE EXPECTANCY
80 BORROW / FILL REQUIREMENTS

McKIM & CREED

CALCULATION

PROJECT _____ PROJ. NO. _____

CLIENT _____ DATE _____

SUBJECT _____ DES. BY _____

CHK. BY _____

1/

REMARKS

PHASE III

McKIM&CREED

DESIGN AND CONSTRUCTION PARAMETERS FOR PHASE III

1. Existing landfill is located adjacent to apparent wetlands.

2. Since the existing slopes are on such steep grades, the only areas available for a large sedimentation basin that would not require a dam safety permit are located in apparent wetlands.

3. The location of weathered rock at some of the other soil borings limits the depth of excavation to approximately 20 feet in the borrow site.

4. As a result of the Rock conditions and the live stream, it was decided to reuse the existing small sedimentation basin at the end of the existing drainage way and to install stone check dams downstream of the new slope drains to enhance the existing sedimentation basin No 3. for a more detailed explanation of the design in this area see sheet No. ___.

5. The existing Section III & IV have terraces across the tops to direct and control the point of discharge, along with slope drains to control the flow to the new basin.

6. Flow from Section IV will continue to function as originally designed. Section IV is already permitted and no new work in this section will be done.

7. Section III will be raised vertically 20'.

8. Section III will be sectioned off in approximately 3.0 acre tracts.

9. Upon completion of a section it will be stabilized, and seeded.

10. There will be a 20' wide bench between the exiting terrace and the toe of the new slope. This will be used to catch the flow coming off the new slopes and to direct the flow to a point of controlled discharge.

11. The flow into the basin from the 3.0 acre tracts in Section III will be controlled by slope drains discharging into a existing channel in the existing drainage way.

12. Section III will be worked first. The work will begin at the low end and proceed to the high end (Sections 1 through 5).

16. Upon completion and stabilization of Section III, work will begin in Phase II.

SECTION 1 (PHASE II)

AREA = 2.97 Ac.
ΔEL. = 206 - 190 = 16 FT.
L = 530 FT.
Tc = 5.0 min
i10 = 7.5 in./hr.
Q10 = 20.0 cfs
C = 0.9

SECTION 1A

AREA = 1.39 Ac.
ΔEL. = 190 - 180 = 10 FT.
L = 500 FT.
Tc = 5.0 min.
i10 = 7.5 in./hr.
Q10 = 9.4 cfs
C = 0.90

SECTION 1B

AREA = 0.64 Ac.
ΔEL. = 206 - 180 = 26 FT.
L = 300 FT.
Tc = 5 min.
i10 = 7.5 in/hr
C = 0.90
Q10 = 4.3 cfs

SECTION 2

AREA = 2.74 Ac.
ΔEL. = 220 - 204 = 16 FT.
L = 600 FT
Tc = 5 min.
i10 = 7.5 in/hr
C = 0.90
Q10 = 18.5 cfs

SECTION 2A

AREA = 0.81 Ac.
ΔEL = 218 - 186 = 32.0 FT.
L = 430 FT.
Tc = 5 min.
i10 = 7.5 in./hr
C = 0.90
Q10 = 5.5 cfs

SECTION 2B

AREA = 1.10 Ac.
ΔEL = 220 - 190 = 30 FT.
L = 450 FT.
Tc = 5 min.
i10 = 7.5 in/hr
C = 0.90
Q10 = 7.4 cfs

SECTION 3

AREA = 2.6
ΔEL = 230 - 218 = 12 FT.
L = 520 FT.
Tc = 5 min.
i10 = 7.5 in./hr.
C = 0.90
Q10 = 17.6 cfs

SECTION 3A

AREA = 0.68 Ac
ΔEL. = 228 - 198 = 30 FT.
L = 350 FT.
Tc = 5 min.
i10 = 7.5 in./hr.
C = 0.90
Q10 = 4.6 cfs

SECTION 3B

AREA = 0.64 Ac.
ΔEL = 210 - 198 = 12 FT.
L = 400 FT.
Tc = 5 min.
i10 = 7.5 in/hr
C = 0.90
Q10 = 4.3 cfs

SECTION 4

AREA = 2.87 Ac.
ΔEL = 240 - 228 = 12 FT.
L = 600 FT.
Tc = 5 min.
i10 = 7.5 in./hr.
C = 0.90
Q10 = 19.4 cfs

SECTION 4A

AREA = 0.605 Ac.
ΔEL. = 238 - 210 = 28 FT.
L = 400 FT.
Tc = 5 min.
i10 = 7.5 in./hr.
C = 0.90
Q10 = 4.4 cfs

SECTION 5

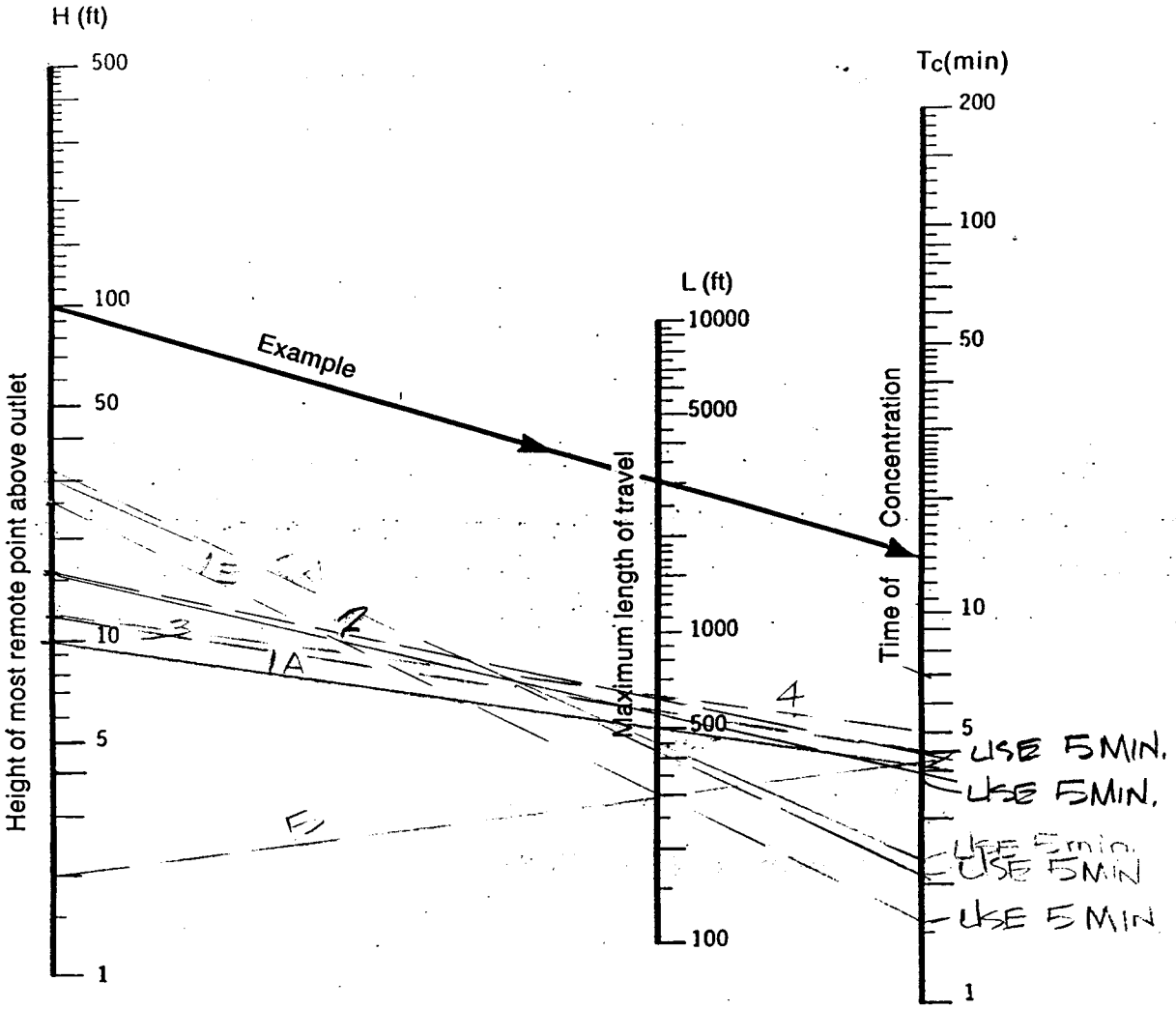
AREA = 1.44 Ac.
ΔEL. = 240 - 238 = 2 FT.
L = 320 FT.
Tc = 5 min.
i10 = 7.5 in./hr.
C = 0.90
Q10 = 9.7 cfs

SECTION 5A

AREA = 0.53 Ac.
ΔEL = 240 − 216 = 24 FT.
L = 410 FT.
Tc = 5 min.
i10 = 7.5 in./hr.
C = 0.90
Q10 = 3.6 cfs

SECTION 5B

AREA = 0.32 Ac.
ΔEL = 240 − 210 = 30 FT.
L = 300 FT.
Tc = 5 min.
i10 = 7.5 in./hr.
C = 0.90
Q10 = 2.2 cfs



Note:
Use nomograph Tc for natural basins with well-defined channels, for overland flow on bare earth, and for mowed-grass roadside channels.

For overland flow, grassed surfaces, multiply Tc by 2.

For overland flow, concrete or asphalt surfaces, multiply Tc by 0.4.

For concrete channels, multiply Tc by 0.2.

Figure 8.03a Time of concentration of small drainage basins.

6

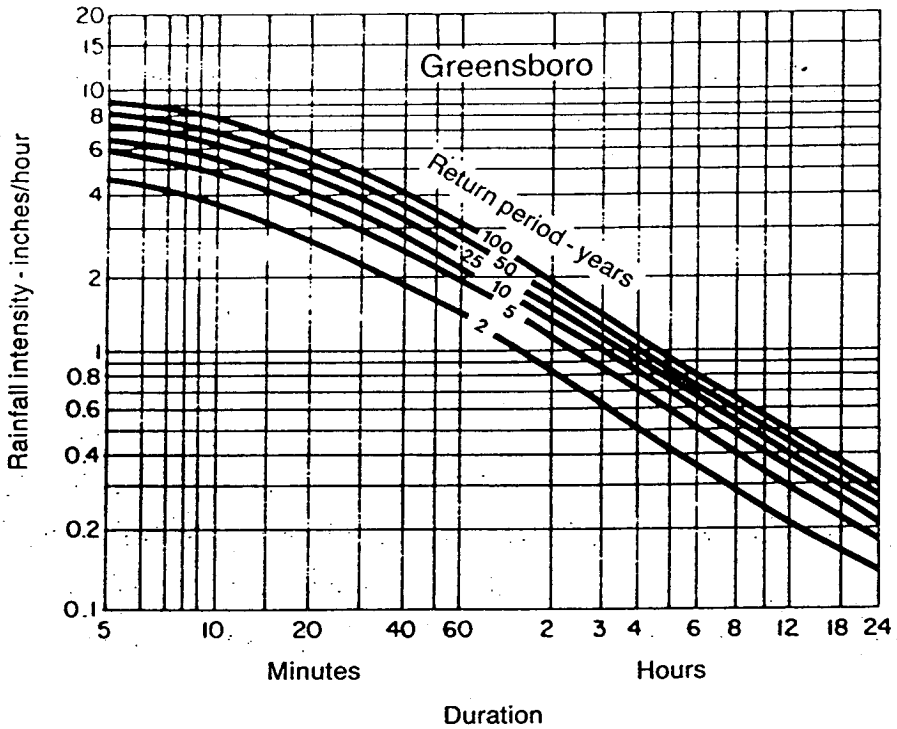


Figure 8.03d Rainfall intensity duration curves—Greensboro.

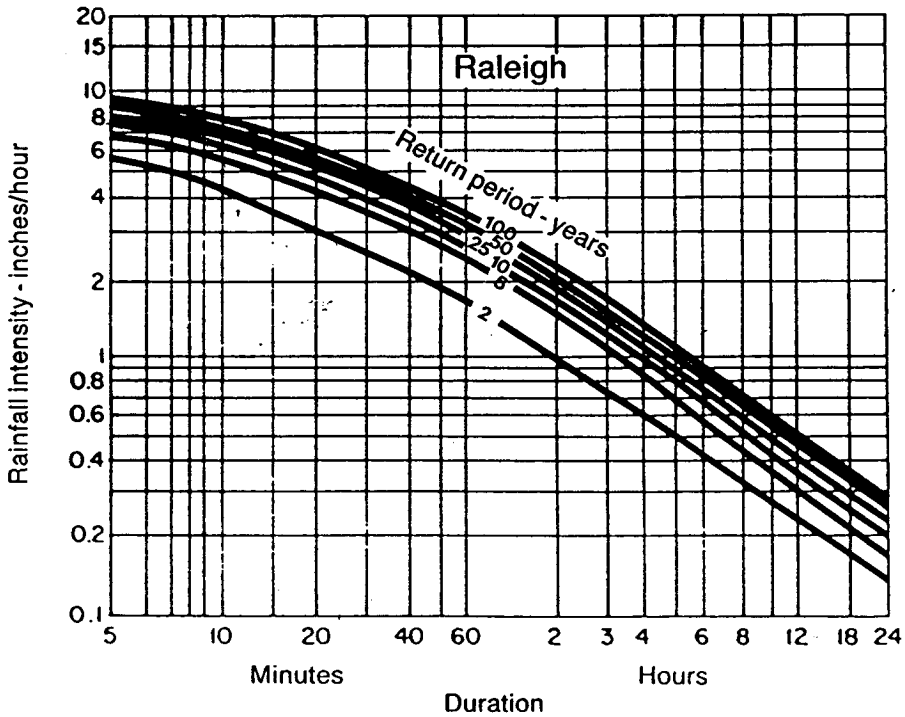


Figure 8.03e Rainfall intensity duration curves—Raleigh.

7

SED. BASIN #1

1. BASIN IS EXIST. & IN GOOD WORKING MODE
2. NO WORK IN THIS AREA & NO ADD. FLOW ∴ BASIN IS OK

SED. BASIN #2

1. SAME AS #1

SED. BASIN #3

1. BASIN IS EXIST. & IS TO BE REUSED - SEE SHEET 9A FOR EXPLANATION OF DESIGN.

SED. BASIN #4.

1. BASIN IS EXIST. & WILL BE CLEANED & REUSED
2. DIST. AREA = SECT. 1B THRU 5B = 3.91 Ac.
3. SEE SHEET NO. FOR FLOW CALC. INTO BASIN
4. APPROX SIZE = 70' (W) X 280' (L) X 6' (D) - TOP DIM.
5. SLOPES = 2:1
6. EXIST. 18" RISER & 12" BARREL (CMP)

S.S.R. = (1800)(3.91) = 5,238.0 C.FT.

S.S.A. = (USE 2' STORAGE DEPTH)

$A_1 = [70 - (6 \times 2 \times 2)]\,[280' - (6 \times 2 \times 2)] = 11,776.0$ FT.^{2}

$A_2 = [70 - (4 \times 2 \times 2)]\,[280 - (4 \times 2 \times 2)] = 14,256.0$ FT.^{2}

$V = \frac{2}{3}(11,776.0 + 14,256 + \sqrt{(11,776.0)(14,256)}$

$V = 25,993.8$ C.FT. > 5,238.0 C.FT. ∴ OK

CHECK TRAP EFF.

S.A. = .01 (Q10) = .01 (24) = 0.24 Ac. = 10,454.4 FT.^{2}

S.A. IN BASIN = $\frac{A_1 + A_2}{2}$ = 13,016.0 FT.^{2} > 10,454.4 FT.^{2} ∴ OK

BY _____ DATE _____ SUBJECT _____ SHEET NO. 8 OF _____
CHKD. BY _____ DATE _____ JOB NO. _____

RAGSDALE CONSULTANTS, P. A. | CONSULTING ENGINEERS | DESIGN SHEET

CHECK SPILLWAYS

150 - ELEV. / EMERG. SPILLWAY
135 - ELEV. / OUTLET
15' - AV. HEAD ON BARREL

CAP. / 12" BARREL = 6.7 cfs

$Q_{OUT} = Q_{IN} - Q_{PIPE} = 23.9 - 6.7 = 17.2$ cfs

EMERG. SPILLWAY IS 6' (W) & 3' (D)

$Q = 3.367 L H^{3/2}$ TRY $H = 0.75'$
$= 17.5$ cfs > 17.2 cfs ∴ OK

$H = 0.75' < 3.0'$ ∴ OK

EXIST. BASIN IS OK

SED. BASIN # 5

1. BASIN IS EXIST. & WILL BE ABAND.

BY _____ DATE _____ SUBJECT _____ SHEET NO. 9 OF _____
CHKD. BY _____ DATE _____ JOB NO. _____

RAGSDALE CONSULTANTS, P. A. | CONSULTING ENGINEERS | DESIGN SHEET

Existing Sedimentation Basin No. 3

1. It has come to our attention that there is a live stream in the location of this previously planned sedimentation basin No. 6.

2. Given the live stream and the location of the existing landfill toes there is not adequate space to locate a new sedimentation basin in this area.

3. The proposed vertical expansion will not increase the runoff to the existing channel, nor to the existing sedimentation basin No. 3.

4. Phase III vertical expansion will be worked in approximately 3 acre section with terraces and slope drain installed (with stone aprons) down to the existing channel.

5. The existing sedimentation basin No. 3 was excavated down to rock. Given that rock is present in this area, an expansion of this basin would be very difficult. I do not feel that we could install a basin of the appropriate size between the existing landfill toe and the live stream.

6. Given the above constraints, our proposal is to:

   a. Clean out the existing basin and reuse it as is.
   b. Install slope drains down to the existing channel with stone aprons at the outlet ends.
   c. Place stone check dams in the existing channel downstream of the new slope drains to enhance the operation of the existing sedimentation basin.

PIPE FLOW CHART (Full flow assumed)

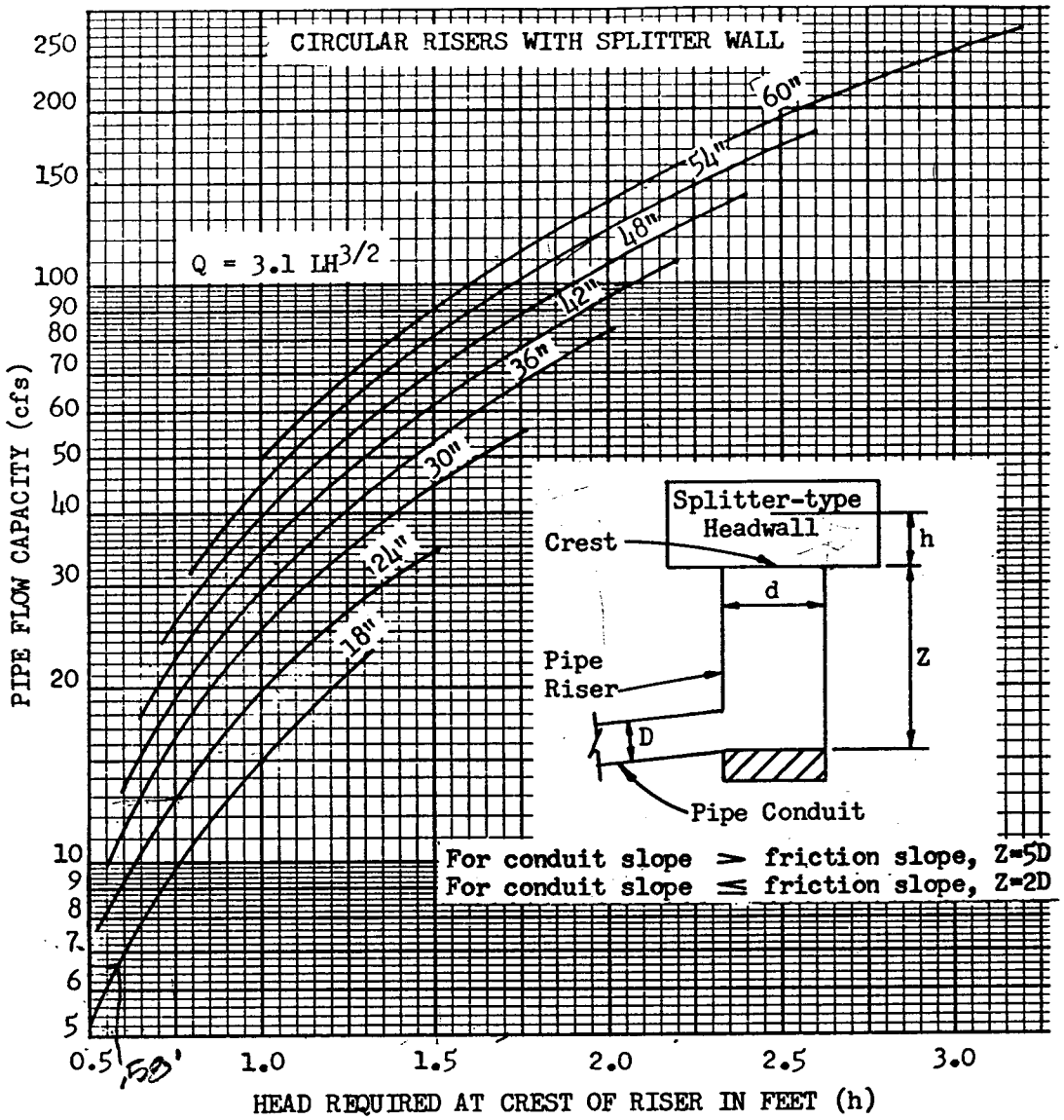
For Corrugated Metal Pipe Inlet $K_e + K_b = 1.0$ and 70 feet of Corrugated Metal Pipe Conduit n = 0.025. Note correction factors for other pipe lengths.

Dia. / H	12"	15"	18"	21"	24"	30"	36"	42"
2	2.84	4.92	7.73	11.30	15.60	26.60	40.77	58.12
3	3.48	6.03	9.47	13.84	19.10	32.58	49.93	71.19
4	4.02	6.96	10.94	15.98	22.06	37.62	57.66	82.20
5	4.49	7.78	12.23	17.87	24.66	42.06	64.46	91.90
6	4.92	8.52	13.40	19.57	27.01	46.07	70.60	100.65
7	5.32	9.21	14.47	21.14	29.19	49.77	76.28	108.75
8	5.68	9.84	15.47	22.60	31.19	53.19	81.53	116.23
9	6.03	10.44	16.41	23.97	33.09	56.43	86.49	123.30
10	6.36	11.00	17.30	25.26	34.88	59.48	91.16	129.96
11	6.67	11.54	18.14	26.50	36.59	62.39	95.63	136.33
12	6.96	12.05	18.95	27.68	38.21	65.16	99.87	142.37
13	7.25	12.55	19.72	28.81	39.77	67.83	103.96	148.21
14	7.52	13.02	20.47	29.90	41.27	70.39	107.88	153.80
15	7.78	13.48	21.19	30.95	42.72	72.85	111.66	159.18
16	8.04	13.92	21.88	31.96	44.12	75.24	115.32	164.40
17	8.29	14.35	22.55	32.94	45.48	77.55	118.87	169.46
18	8.53	14.77	23.21	33.90	46.80	79.81	122.33	174.39
19	8.76	15.17	23.84	34.83	48.08	81.99	125.67	179.15
20	8.99	15.56	24.46	35.73	49.33	84.12	128.93	183.80
21	9.21	15.95	25.07	36.62	50.55	86.21	132.13	188.36
22	9.43	16.32	25.65	37.47	51.73	88.22	135.21	192.76
23	9.64	16.69	26.23	38.32	52.90	90.21	138.27	197.12
24	9.85	17.05	26.80	39.14	54.04	92.15	141.24	201.35
25	10.05	17.40	27.35	39.95	55.15	94.05	144.15	205.50
L	Correction Factors For Other Pipe Lengths							
40	1.23	1.22	1.20	1.19	1.16	1.14	1.13	1.11
50	1.14	1.13	1.12	1.11	1.10	1.09	1.08	1.07
60	1.07	1.06	1.06	1.05	1.05	1.04	1.04	1.03
70	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
80	0.95	0.95	0.95	0.96	0.96	0.96	0.97	0.97
90	0.90	0.91	0.91	0.92	0.92	0.93	0.94	0.94
100	0.86	0.87	0.88	0.89	0.89	0.90	0.91	0.92

(7.78)(.80)
= 6.1 cfs

Figure 6-25 Pipe flow chart for corrugated metal pipe drop inlet spillway

10



Inlet Proportions	
Pipe Conduit (D)-in.	Pipe Riser (d)-in.
8	18
15	21
18	24
21	30
24	30
30	36
36	48
42	54
48	60

Pipe Drop Inlet Spillway Design:

For a given Q and H, refer to Figure 6-25 or 6-26 for conduit size. Then determine the riser diameter (d) from the Inlet Proportions table on this figure. Next, refer to the above curves, using the conduit capacity and riser diameter and find the head (h) required above the crest of the riser. The height of the riser should not be less than 5D - h, except as noted in the above sketch.

Example - Given: CMP; Q = 20 cfs; H = 14 ft., h max. 1.0 ft.; L = 70 ft. From Figure 6-25 find conduit size (D) = 18 inches. From Inlet Proportions table, riser size = 30 inches. Head (h) required for Q = 20 and d = 30 is 0.85 foot.

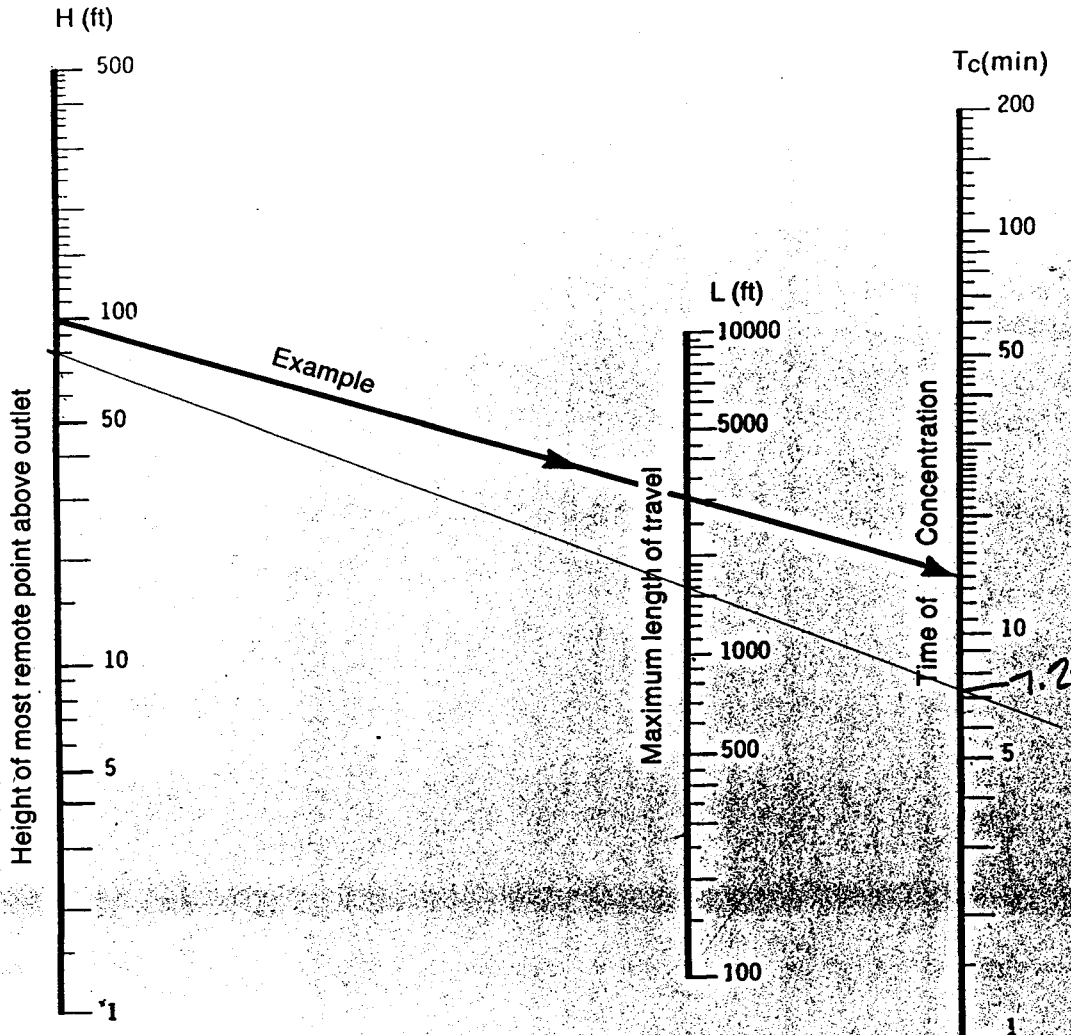
Figure 6-27 Chart for determining inlet proportions and required head over inlet.

BASIN #4

Location									Design							
From	To	Incremental Acres	C Runoff Coefficient	AXC	ΣAXC	Time Of Concentration tc	Intensity - I Inches/Hr. / Storm Frequency *	Q = IΣAXC (cfs)	Pipe Length (Ft.)	Pipe Scope (%)	Pipe Diameter (In.)	V Full (fps)	V Actual (fps)	Fall (Ft.)	Ground Slope (%)	Time of Travel (Min.)
5B	#4	.32	.9			5.0										
4B	#4	1.21	.9			5.0										
3B	#4	.64	.9			5.0										
2B	#4	1.10	.9			5.0										
1B	#4	.64	.9			5.0										
B	#4	3.91	.9	3.51	3.51	7.2	6.8	23.9								

1600'
240-160 =
80'

*Storm Frequency will be 10 yrs. unless otherwise noted.



Note:
Use nomograph Tc for natural basins with well-defined channels, for overland flow on bare earth, and for mowed-grass roadside channels.

For overland flow, grassed surfaces, multiply Tc by 2.

For overland flow, concrete or asphalt surfaces, multiply Tc by 0.4.

For concrete channels, multiply Tc by 0.2.

Figure 8.03a Time of concentration of small drainage basins.

13

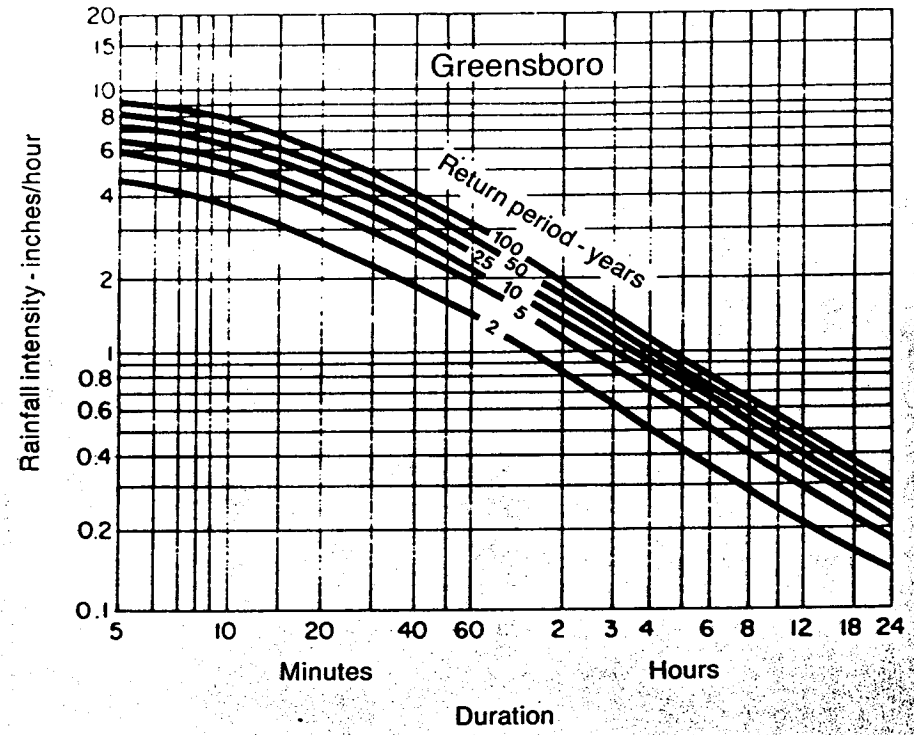


Figure 8.03d Rainfall intensity duration curves—Greensboro.

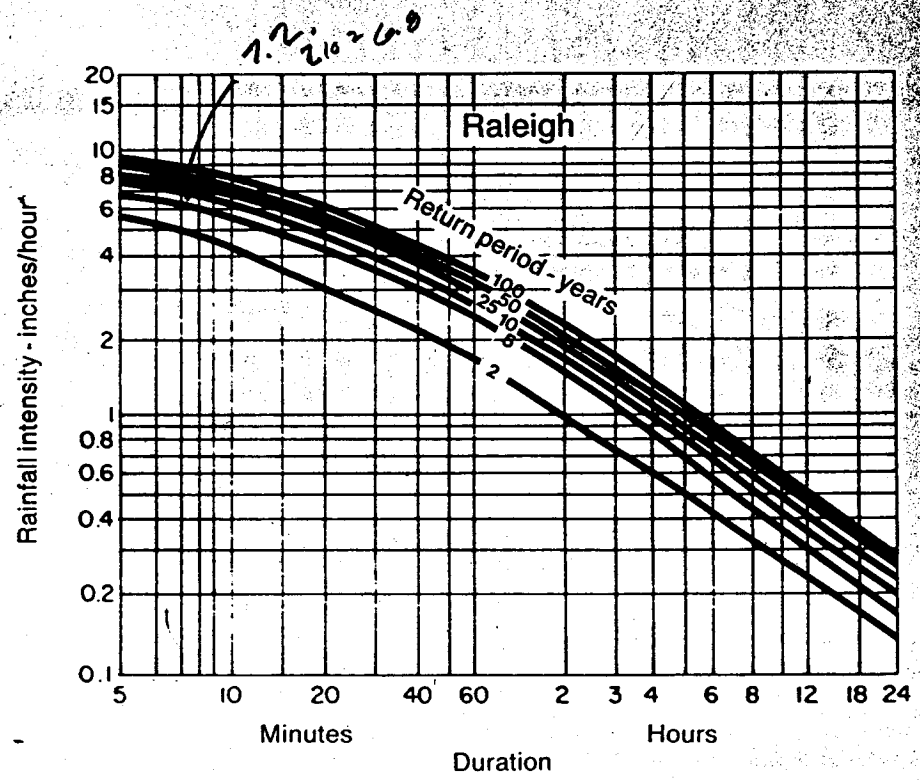


Figure 8.03e Rainfall intensity duration curves—Raleigh.

SED. BASIN # 6

DA = 31.35 AC Q_{10} = 105 CFS

BASIN AREA REQ'D = 0.01(105) = 1.05 AC·FT

AREA OF BASIN SHOWN = 2.0 AC = 87120 SF @ WATER SURF.

AREA OF BASIN BOTTOM 39680 SF

STORAGE VOL. REQ'D 1800 FT³/AC (31.35 AC) = 56430 FT³

AVAILABLE STORAGE VOL.

$$V = \frac{h}{3}(A_1 + A_2 + \sqrt{A_1 A_2}) = \frac{4}{3}(39680 + 87120 + \sqrt{39680(87120)})$$

$$= 247461 \text{ FT}^3$$

$T_c = 13$ MIN $T_p = T_c(60) = 780$ SEC

$$Q_o = Q_i - \frac{S}{T_c} = 105 - \frac{247461}{780} = -212$$ ∴ ADEQUATE STORAGE @ PEAK

$Q_o = 0.2(31.35) = 6.3$ CFS

P 8.07.6 USE 15" CONDUIT
USE 21" RISER

$$A_o = \frac{A_s\sqrt{2h}}{T\,C_d\,20428} = \frac{87120\sqrt{(2)4}}{10\,(0.6)20428} = 2.01 \text{ FT}^2$$

$2.01 \text{ FT}^2 / (.2 \text{ IN}^2/12) = 121$ HOLES

A OF ½" ϕ HOLE = $\pi \cdot .25^2 = 0.20$"

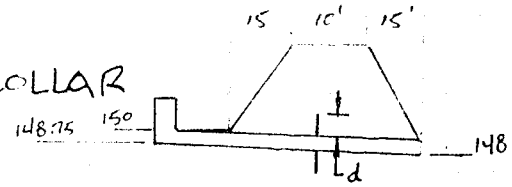
C OF 21" RISER = 66" / 3' = 22 HOLES PER RING

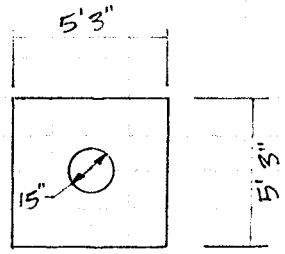
2.01/22(.2/12) = 5 ½ RINGS OF ½" ϕ HOLES 3" APART

BY LWH DATE 8.27.90 SUBJECT SEDIMENT BASIN @ BORROW PIT JOHNSTON CO. LANDFILL SHEET NO. 15 OF
CHKD. BY ____ DATE ____ JOB NO. ____

RAGSDALE CONSULTANTS, P. A. | CONSULTING ENGINEERS | DESIGN SHEET

ANTISEEP COLLAR





$1.1(40') = 40 + 2d$
$44 = 40 + 2d$
$d = 2'$

ANTIFLOTATION BLOCK

VOL OF RISER $\frac{\pi(1.75^2)}{4}(4.25) = 10.22\ FT^3$

REQ'D WEIGHT $= 10.22(62.4)1.1 = 700\#$

USE 2'6"x2'6"x9" WEIGHT = 703 #

OUTLET PROTECTION

FROM 806.3 $d_{50} = 3"$

$L_a = 33'$ $W = D_o + L_a = 34'3"$

USE 43 TONS CLASS "B" STONE AS SPEC. BY NCDOT W/ FILTER FABRIC

EMERGENCY SPILLWAY

$Q_e = Q_{10} - Q_p = 105 - 6.3 = 98.7$ CFS

$Q = 3.367 L H^{3/2} = 3.367(30)1^{3/2} = 101.01$ CFS

USE 30' SPILLWAY

SPILLWAY EXIT CHANNEL

30' BOTTOM 3:1 SIDE SLOPES
V = 4.7 F/S
VEGITATIVE COVER W/ JUTE MATTING OR FIBERGLAS ROVING

LWW DATE 8-27-90 SUBJECT SEDIMENT BASIN @ BORROW PIT JOHNSTON CO LANDFILL SHEET NO. 16 OF
CHKD. BY DATE JOB NO.

RAGSDALE CONSULTANTS, P. A. | CONSULTING ENGINEERS | DESIGN SHEET

****
***** CHANNEL LINING ANALYSIS *****
****

DESIGNER: DATE: 08-27-1990

PROJECT: PROJECT NO.:

STATION: TO STATION:

DRAINAGE AREA: 0.0 Acres DESIGN FREQUENCY: 0 Years

CHANNEL DESCRIPTION: CHANNEL SLOPE: 0.010 ft/ft

Bottom Width: 30.00 ft

Left Side Slope: 3.0

Right Side Slope: 3.0

Lining	Permissible Shear (lb/sf)	Discharge (cfs)	Hydraulic Radius (ft)	Manning Coefficient
Jute Net	0.45	100.0	0.62	0.023

Normal Depth (ft)	Area (sf)	Velocity (ft/sec)	Calculated Shear (lb/sf)	Remarks
0.66	21.27	4.70	0.41	Stable

(1) Check for channel bends

SHEET No. 17

SLOPE DRAINS #1 THRU #3

1. DESIGN SLOPE DRAIN #3 & USE THIS DESIGN FOR #1 & #2

AREA = 1.39 Ac.
Q10 = 9.4 cfs
L = 160 FT.
ΔEL. = 180 − 150 = 30 FT.
S = 18.75%

SLOPE DRAIN #4 THRU #8

1. DESIGN SLOPE DRAIN #4 & USE FOR #5 - #8

AREA = 2.97 Ac.
Q10 = 20.0 cfs
L = 130 FT.
ΔEL. 43.3 FT.
S = 33.33%

PROJECT: SLOPE DRAIN #3

DESIGNER: JCH

DATE: 9/90

HYDROLOGIC AND CHANNEL INFORMATION

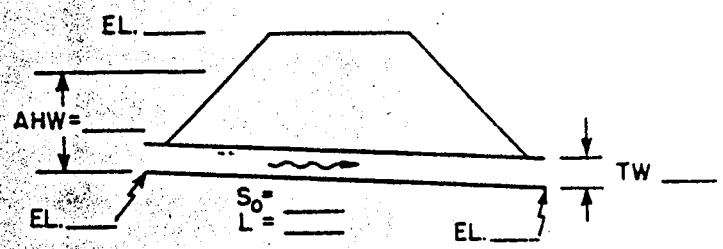
Q_1 = 9.4 TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION : _____



MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT.		OUTLET CONTROL HW=H + h_o − LS_o								CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
			$\frac{HW}{D}$	HW	K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW				
CMP PROJECT	9.4	24	0.9	1.8	.5	1.4	1.1	1.6		1.6	30	1.8		12.5		INLET CONTROL

SUMMARY & RECOMMENDATIONS:

sat[redacted]actory for the full 100-year
ead[redacted]ater is too high, a larger size
naximum permissible headwater.
ollows.

fo[redacted]nlet control enter Fig. 4-22,
ter depth in outlet control. If the
ntrol, the culvert is assumed to be
lies[redacted]

o[redacted]the flow charts. For other
gth, L′, calculated by the formula

. . . . . (14)

on chart.

ts, [redacted]djust the result for the Man-

r t[redacted] entrance condition desired.
9, p[redacted]e 156.

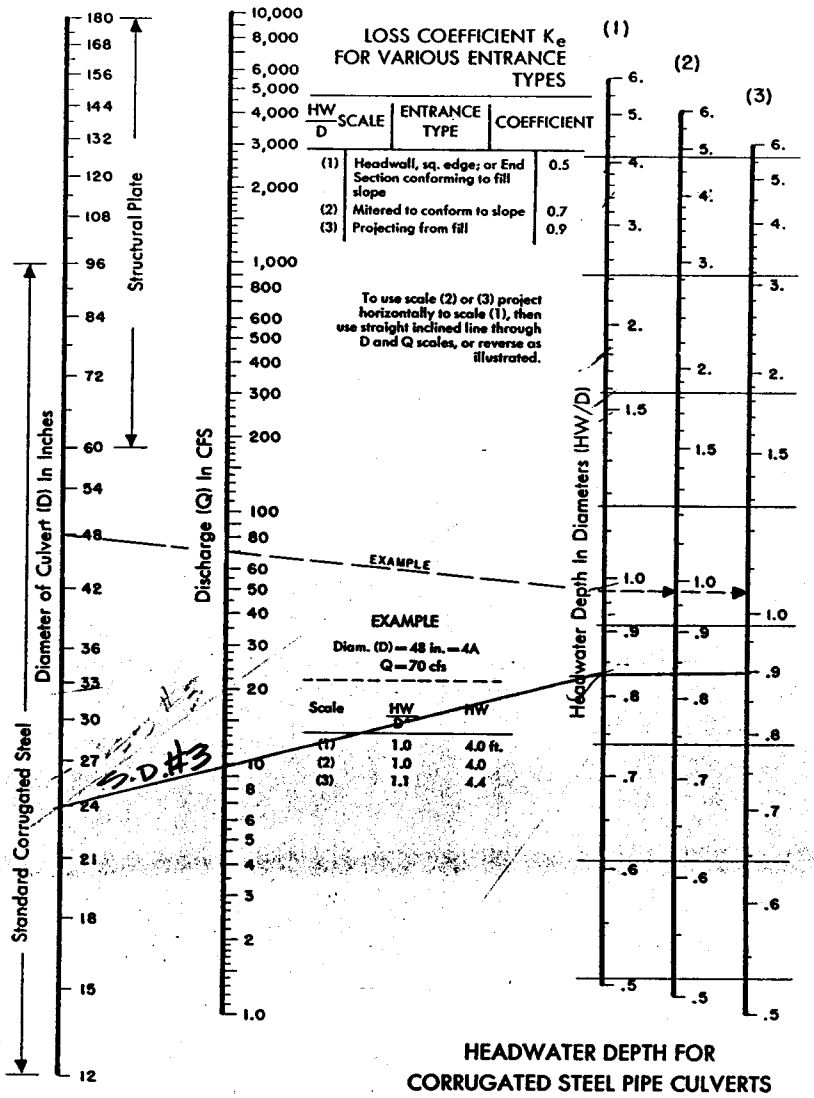
headwater exceeds the allowable,
g to acceptable headwater depth.
be [redacted]nsidered for corrugated steel
s. [redacted]e Table 4-10. A smaller size
factory.

sid[redacted]ed. It may be economical to
if [redacted]size difference results. Check

nning's *n* for Structural Plate Pipe
asu[redacted]ments reported in Table 4-11
an[redacted]4-25 together with the corre-
is data was not a part of the Fed-
ch were published in 1963.

S

nd [redacted]0-year flood discharge. Ob-
less [redacted]nportance which do not war-
design discharges for less critical
0-yea[redacted] floods. This is a matter of
on [redacted] of this chapter. But, whatever
n di[redacted]harge, the rationale presented
y be balanced by requiring no static
ood discharge than the design dis-



HEADWATER DEPTH FOR CORRUGATED STEEL PIPE CULVERTS WITH INLET CONTROL

Fig. 4-18. *Inlet control* nomograph for corrugated steel *pipe* culverts. The manufacturers recommend keeping *HW/D* to a maximum of 1.5 and preferably to no more than 1.0.

20

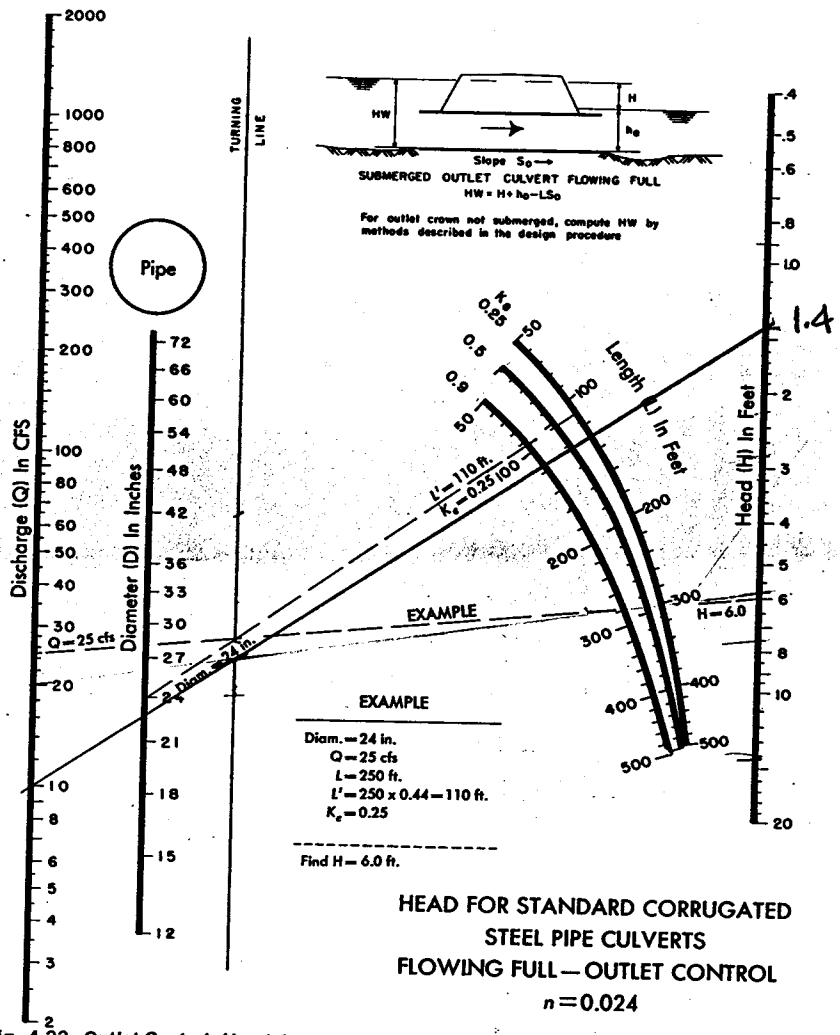


Fig. 4-22. *Outlet Control.* Head for corrugated steel *pipe* culvert with submerged outlet and culvert flowing full. See note under sketch at top.

Length Adjustment for Improved Hydraulics

Pipe Diameter in Inches	Roughness Factor n' for Helical Corr.*	Length Adjustment Factor $\left(\frac{n'}{n}\right)^2$
12	.011	.21
24	.016	.44
36	.019	.61
48	.020	.70

*Other values of roughness, n, are applicable to paved pipe, lined pipe and pipe with 3 x 1 in. corrugations. See Table 4-10. To use the above chart for these types of pipe and pipe-arches, use "adjusted length factors" computed per equation 14, page 160.

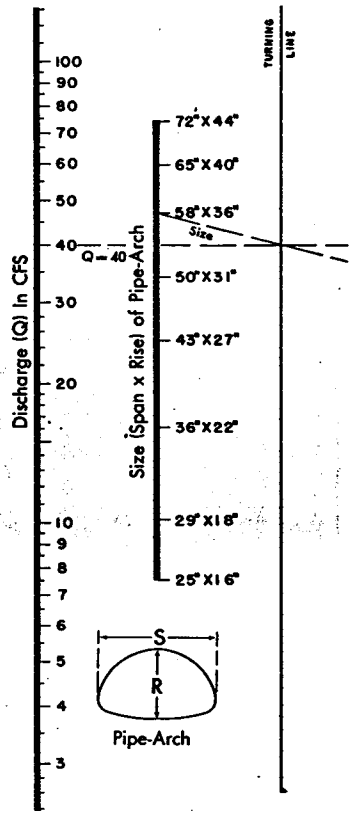
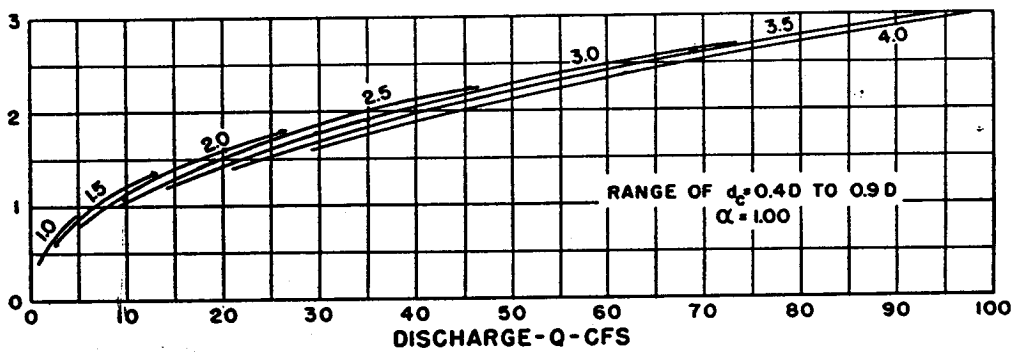
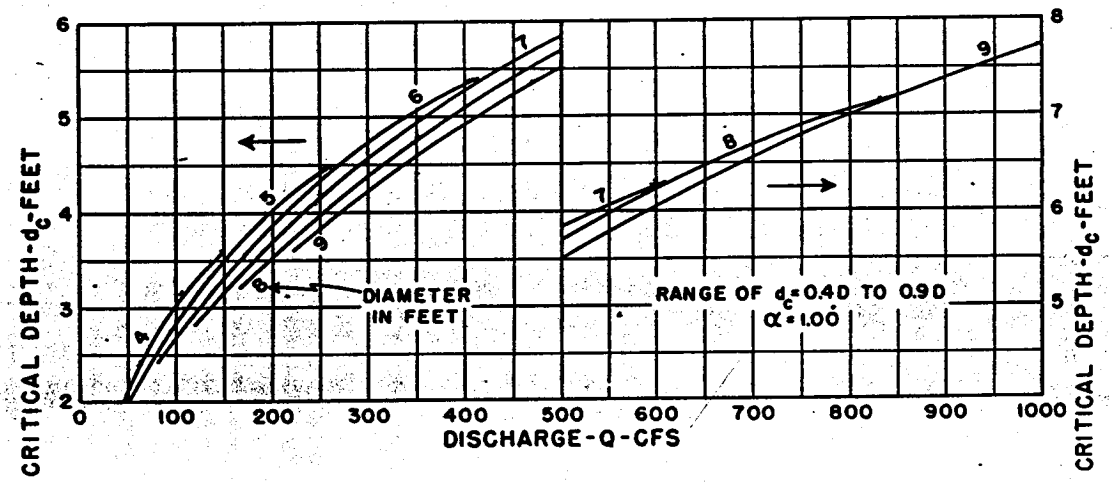


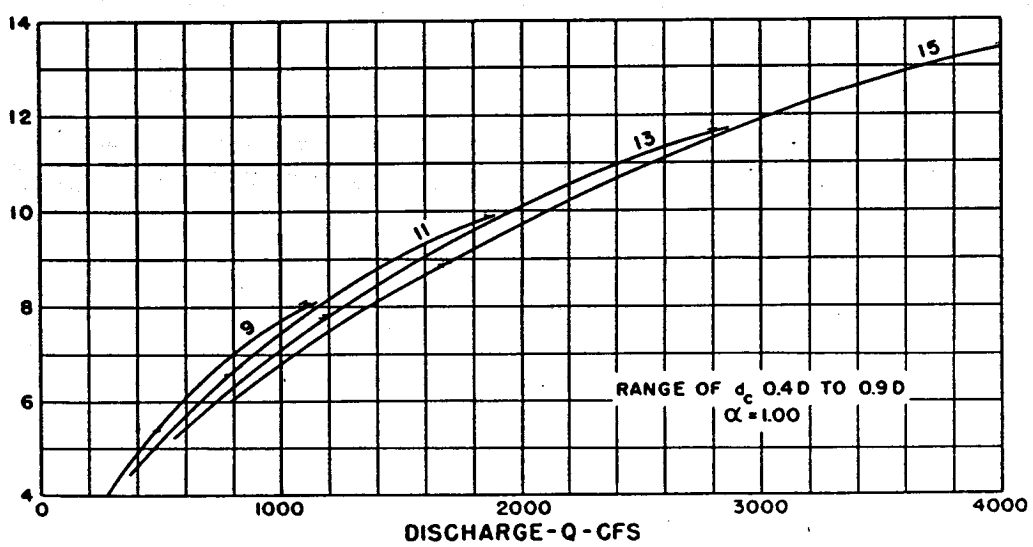
Fig. 4-23. *Outlet Control.* Head for c outlet and flowing full.

Fig. 4-23a. Pipe-arch culvert under l

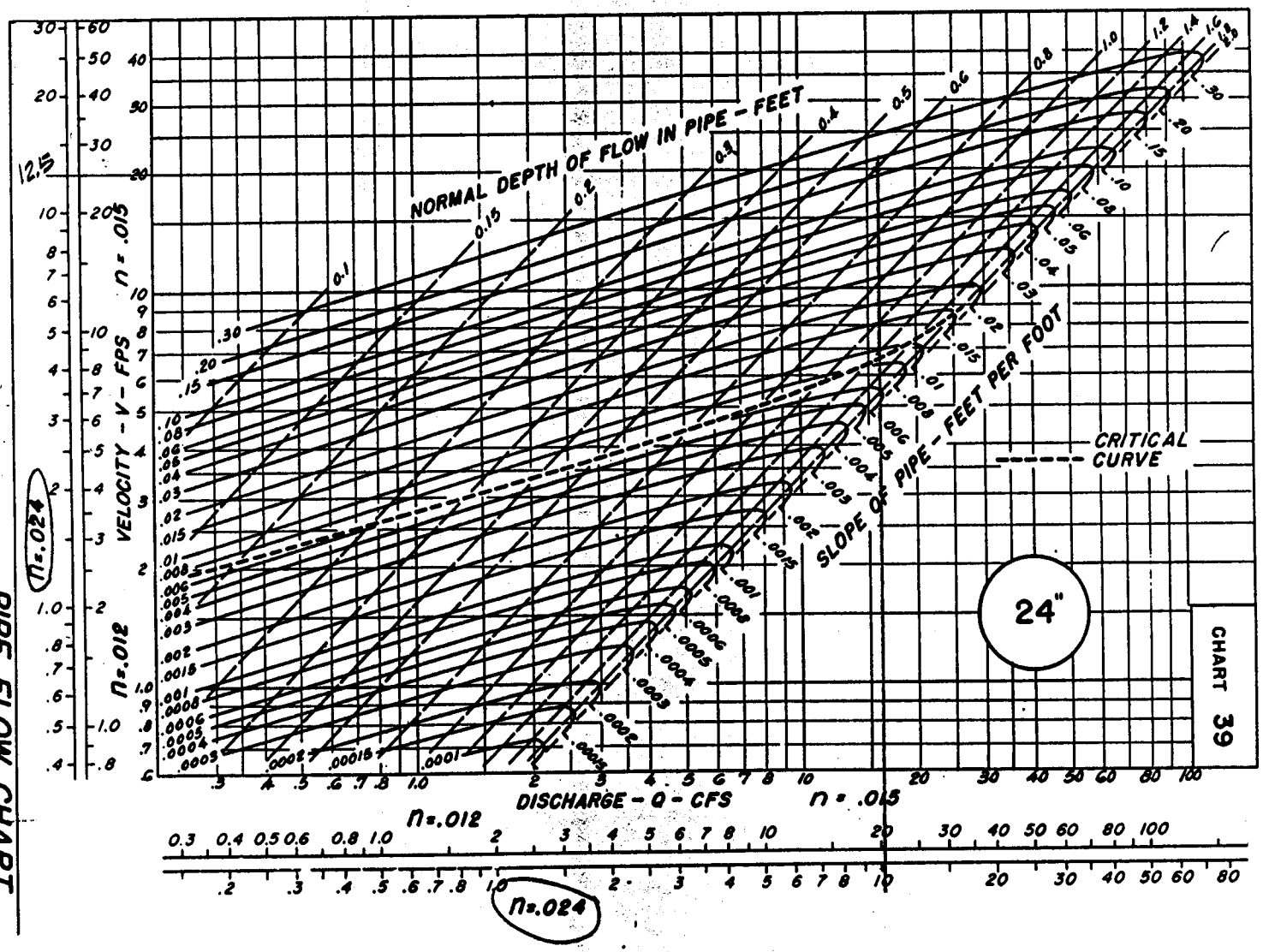
CHART 56







CIRCULAR PIPE
CRITICAL DEPTH



PIPE FLOW CHART
24-INCH DIAMETER

Stone Sizes For Culvert Aprons

ESTIMATION OF STONE SIZE AND DIMENSIONS FOR CULVERT APRONS

Step i) Estimate flow velocity V_0 at culvert or paved channel outlet.

Step ii) For pipe culverts D_0 is diameter.

For pipe arch, arch, and box culverts, and paved channel outlets, $D_0 = A_0$, where A_0 = cross sectional area of flow at outlet.

For multiple culverts, use $D_0 = 1.25 \times D_0$ of single culvert.

Step iii) For apron grades of 10% or steeper, use recommendation ' higher zone (zones 1 through 6).

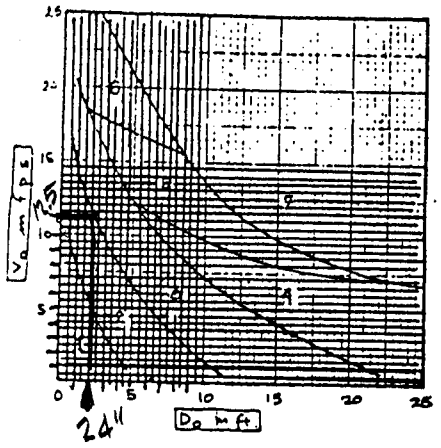


FIGURE 7

ZONE	APRON MATERIAL	LENGTH OF APRON: TO PROTECT CULVERT L_1	LENGTH OF APRON: TO PREVENT SCOUR HOLE L_2
1	Stone Filling (Fine)	$3 \times D_0$	$4 \times D_0$
2	" " (Light)	$3 \times D_0$	$6 \times D_0$
3	" " (Medium)	$4 \times D_0$	$8 \times D_0$
4	" " (Heavy)	$4 \times D_0$	$8 \times D_0$
5	" " "	$5 \times D_0$	$10 \times D_0$
6	" " "	$6 \times D_0$	$12 \times D_0$
7	Special study required (energy dissipators, stilling basin, or larger size stone)		

FIGURE 8

(6)(2) = 12.0'

Source: "Bank and Channel Lining Procedures," New York Department of Transportation, Division of Design and Construction, 1971.

Determination of Stone Sizes for Dumped Stone Channel Linings and Revetments

Step 1) Use Fig. 9 to determine maximum stone size (e.g., for 12 fps = 20" or 550 lbs.).

Step 11) Use Fig. 10 to determine acceptable size range for stone (for 12 fps it is 125-500 lbs. for 75% of stone, and the maximum and minimum range in weight should be 25-500 lbs.)

Note: In determining channel velocities for stone linings and revetments, use the following coefficients of roughness:

	Diameter (inches)	Manning's 'n'	Min. Thickness of Lining (inches)
Fine	3	0.031	9
Light	6	0.035	12 CLASS A
Medium	13	0.040	18
Heavy	23	0.044	30

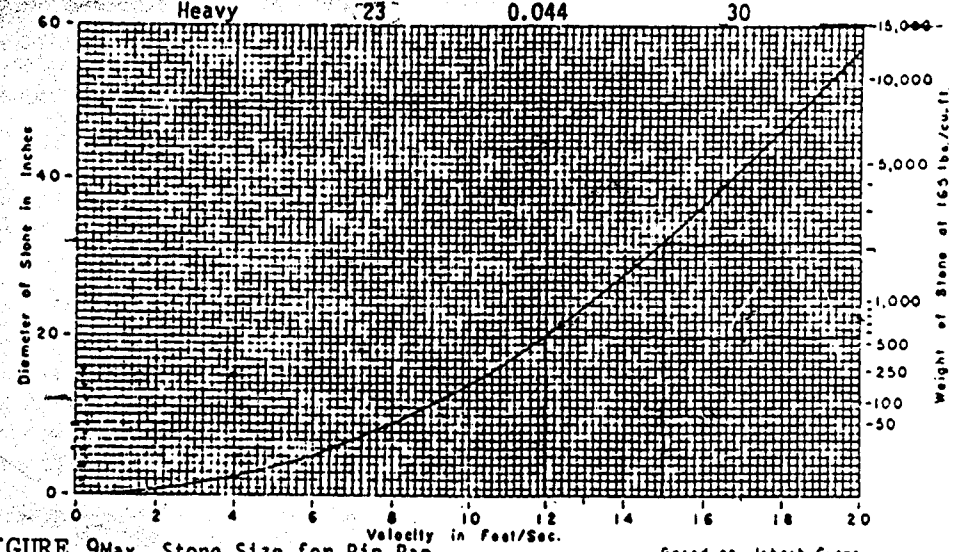


FIGURE 9 Max. Stone Size for Rip Rap

Based on Isbash Curve

Maximum weight of stone required	Minimum and maximum range in weight of stones	Weight range of 75% of stones
(lbs.)	(lbs.)	(lbs.)
150	25 - 150	50 - 150
200	25 - 200	50 - 200
250	25 - 250	50 - 250
400	25 - 400	100 - 400
600	25 - 600	150 - 600
800	25 - 800	200 - 800
1,000	50 - 1,000	250 - 1,000
1,300	50 - 1,300	325 - 1,300
1,600	50 - 1,600	400 - 1,600
2,000	75 - 2,000	600 - 2,000
2,700	100 - 2,700	800 - 2,700

FIGURE 10 Gradation of Rip Rap

PROJECT: SLOPE DRAIN #4

DESIGNER: JCH

DATE: 9/90

HYDROLOGIC AND CHANNEL INFORMATION

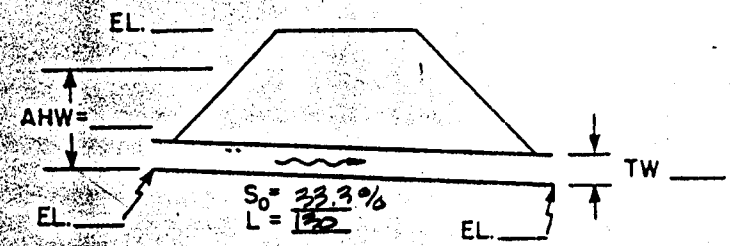
Q_1 = 20.0 TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION : _____



MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. $\frac{HW}{D}$	HW	OUTLET CONTROL $HW=H+h_o-LS_o$: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
CMP PROJECT	20.0	24	1.65	3.3	.5	4.75	1.6	1.8		1.8	43.3		3.3	18.0		INLET CONTROL

SUMMARY & RECOMMENDATIONS:

USE A NHDOT APRON

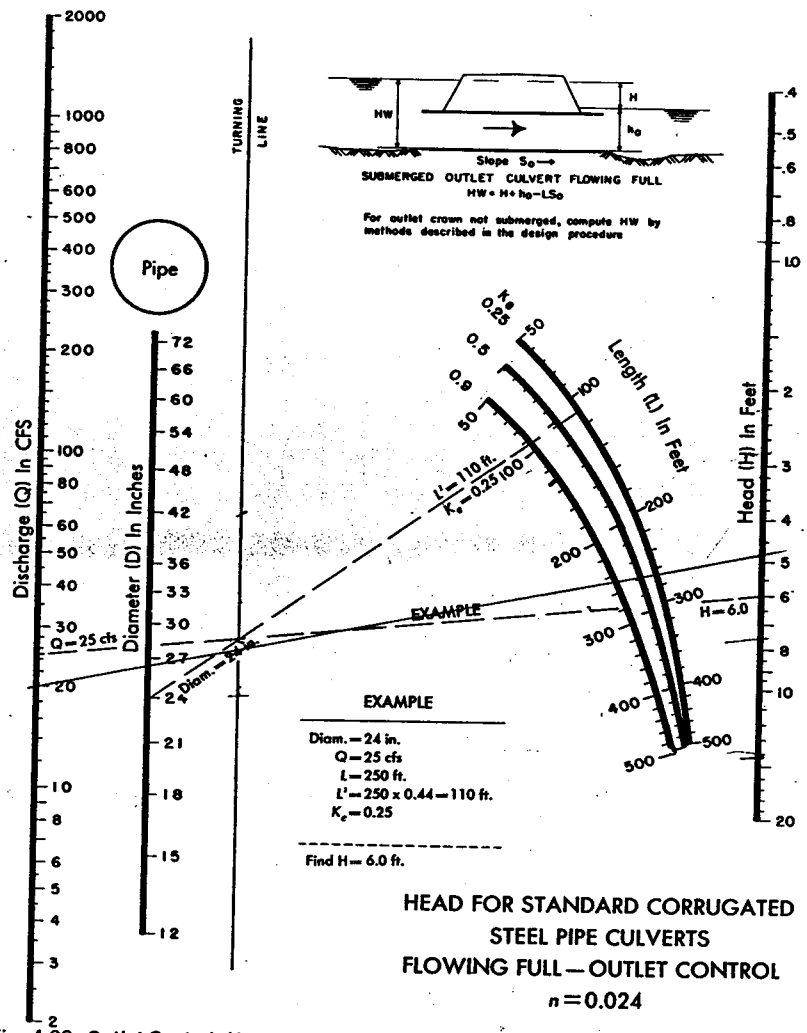


Fig. 4-22. *Outlet Control.* Head for corrugated steel *pipe* culvert with submerged outlet and culvert flowing full. See note under sketch at top.

Length Adjustment for Improved Hydraulics

Pipe Diameter in Inches	Roughness Factor n' for Helical Corr.*	Length Adjustment Factor $\left(\frac{n'}{n}\right)^2$
12	.011	.21
24	.016	.44
36	.019	.61
48	.020	.70

*Other values of roughness, n, are applicable to paved pipe, lined pipe and pipe with 3 x 1 in. corrugations. See Table 4-10. To use the above chart for these types of pipe and pipe-arches, use "adjusted length factors" computed per equation 14, page 160.

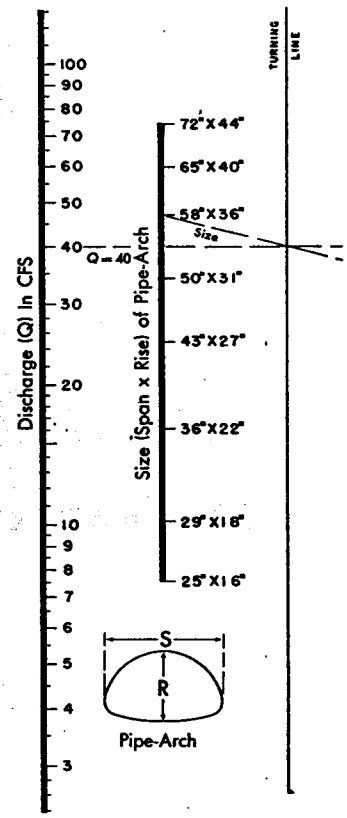


Fig. 4-23. *Outlet Control.* Head for outlet and flowing full.

Fig. 4-23a. Pipe-arch culvert under

sati ctory for the full 100-year
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d 0-year flood discharge. Ob-
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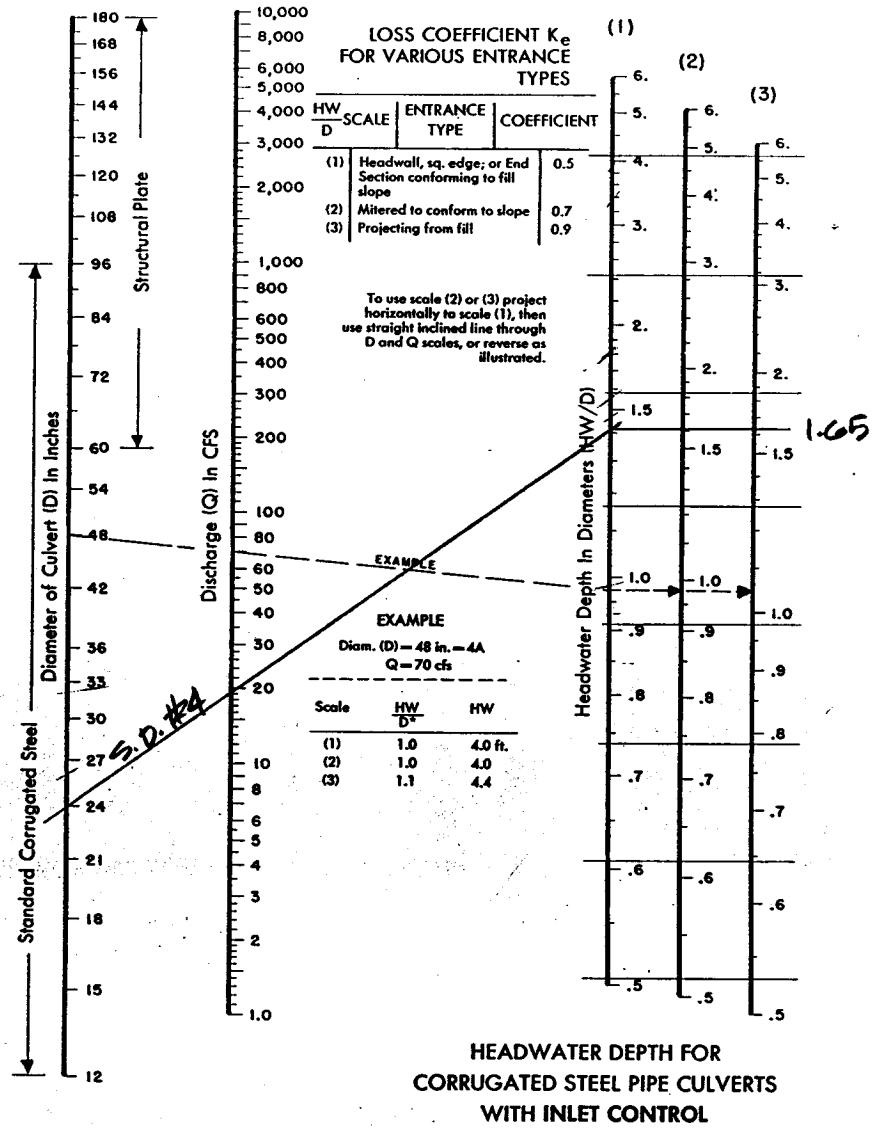
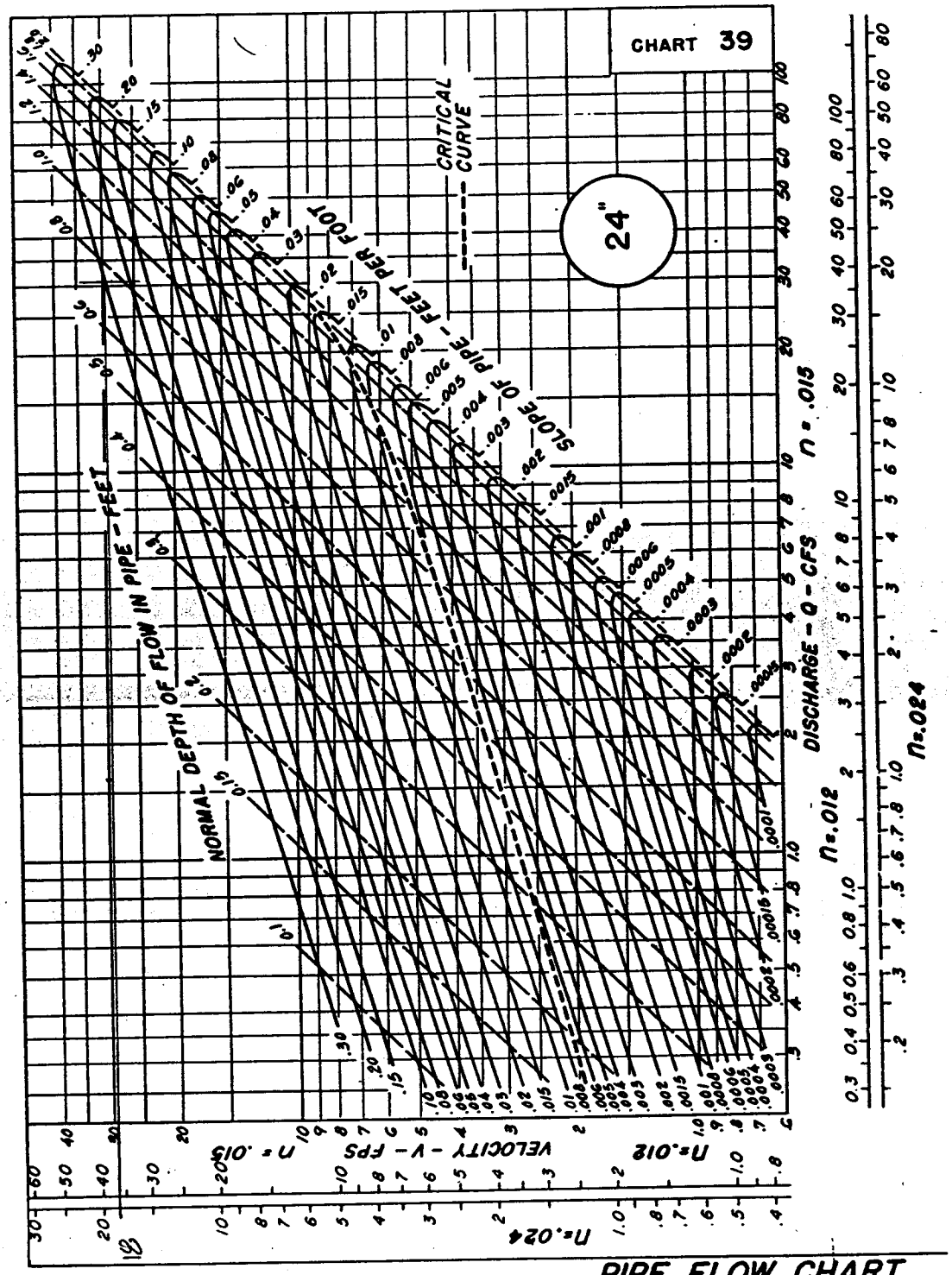


HEADWATER DEPTH FOR CORRUGATED STEEL PIPE CULVERTS WITH INLET CONTROL

Fig. 4-18. *Inlet control* nomograph for corrugated steel *pipe* culverts. The manufacturers recommend keeping *HW/D* to a maximum of 1.5 and preferably to no more than 1.0.

27



PIPE FLOW CHART
24-INCH DIAMETER

28

Stone Sizes For Culvert Aprons

ESTIMATION OF STONE SIZE AND DIMENSIONS FOR CULVERT APRONS

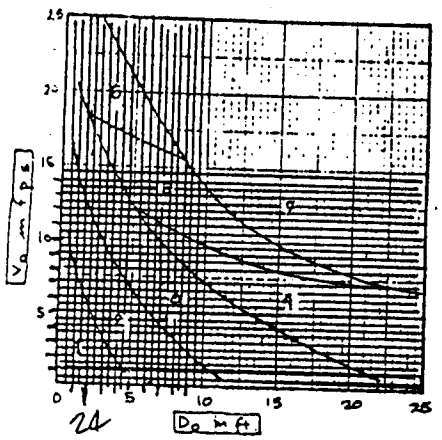
Step i) Estimate flow velocity V_0 at culvert or paved channel outlet.

Step ii) For pipe culverts D_0 is diameter.

For pipe arch, arch, and box culverts, and paved channel outlets, $D_0 = A_0$, where A_0 = cross sectional area of flow at outlet.

For multiple culverts, use $D_0 = 1.25 \times D_0$ of single culvert.

Step iii) For apron grades of 10% or steeper, use recommendation [illegible] higher zone (zones 1 through 6).



ZONE 6

FIGURE 7

ZONE	APRON MATERIAL	LENGTH OF APRON: TO PROTECT CULVERT L_1	LENGTH OF APRON: TO PREVENT SCOUR HOLE L_2
1	Stone Filling (Fine)	$3 \times D_0$	$4 \times D_0$
2	" " (Light)	$3 \times D_0$	$6 \times D_0$
3	" " (Medium)	$4 \times D_0$	$8 \times D_0$
4	" " (Heavy)	$4 \times D_0$	$8 \times D_0$
5	" " "	$5 \times D_0$	$10 \times D_0$
6	" " "	$6 \times D_0$	$12 \times D_0$
7	Special study required (energy dissipators, stilling basin, or larger size stone.)		

(12)(2) = 24

FIGURE 8

Source: "Bank and Channel Lining Procedures," New York Department of Transportation, Division of Design and Construction, 1971.

Determination of Stone Sizes for Dumped Stone Channel Linings and Revetments

Step i) Use Fig. 9 to determine maximum stone size (e.g., for 12 fps = 20" or 550 lbs.).

Step ii) Use Fig. 10 to determine acceptable size range for stone (for 12 fps it is 125-500 lbs. for 75% of stone, and the maximum and minimum range in weight should be 25-500 lbs.)

Note: In determining channel velocities for stone linings and revetments, use the following coefficients of roughness:

	Diameter (inches)	Manning's 'n'	Min. Thickness of Lining (inches)
Fine	3	0.031	9
Light	6	0.035	12
Medium	13	0.040	18
Heavy	23	0.044	30

USE CLASS B W/ 6" STONE BLANKET (FS-2) #100 TO 2" STONE

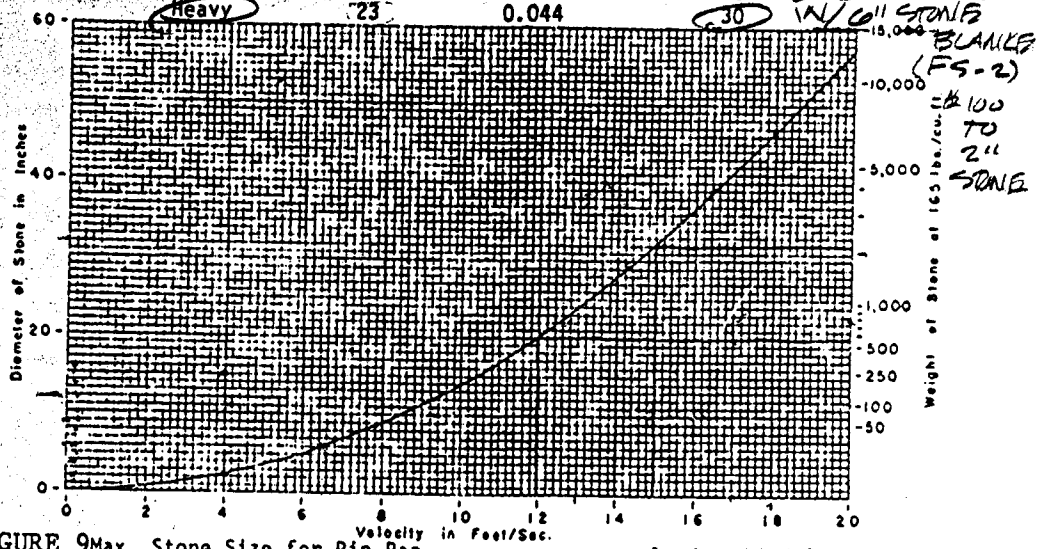


FIGURE 9 Max. Stone Size for Rip Rap

Based on Isbash Curve

Maximum weight of stone required	Minimum and maximum range in weight of stones	Weight range of 75% of stones
(lbs.)	(lbs.)	(lbs.)
150	25 - 150	50 - 150
200	25 - 200	50 - 200
250	25 - 250	50 - 250
400	25 - 400	100 - 400
600	25 - 600	150 - 600
800	25 - 800	200 - 800
1,000	50 - 1,000	250 - 1,000
1,300	50 - 1,300	325 - 1,300
1,600	50 - 1,600	400 - 1,600
2,000	75 - 2,000	600 - 2,000
2,700	100 - 2,700	800 - 2,700

FIGURE 10 Gradation of Rip Rap

29

CHANNEL #1

L = 280 FT
ΔEL. = 216 - 211 = 5 FT.
S = 1.8%
Z = 2:1
W = 4'
Q10 = 2.2 cfs

CHANNEL #2

L = 570 FT.
ΔEL. = 211 - 205 = 6 FT.
S = 1.05%
Z = 2:1
W = 4'
Q10 = 9.4 cfs

CHANNEL #3

L = 400 FT.
ΔEL = 205 - 192 = 13 FT.
S = 3.25%
Z = 2:1
W = 4'
Q10 = 12.7 cfs

BASIN _____

	Location									Design							
	From	To	Incremental Acres	C Runoff Coefficient	AXC	ΣAXC	Time Of Concentration tc	Intensity - I Inches/Hr. / Storm Frequency*	Q = IΣAXC (cfs)	Pipe Length (Ft.)	Pipe Scope (%)	Pipe Diameter (In.)	V Full (fps)	V Actual (fps)	Fall (Ft.)	Ground Slope (%)	Time of Travel (Min.)
	5B	CH. 1	.32	.9	.29	.29	5.0	7.5	2.2	500			4				2.4
	4B	CH 2	1.21	.9	1.09	1.09	5.0	7.5	8.2								
E	CH. 2	CH. 3	/	/	/	1.38	7.4	6.8	9.4	400			4				1.6
	3B	CH 3	.64	.9	.58	.58	5.0	7.5	4.4								
E	CH 3	FED BAS.	/	/	/	1.96	9.0	6.5	12.7								

*Storm Frequency will be 10 yrs. unless otherwise noted.

JO CO LANDFILL PHASE 3
09-07-1990

CHANNEL NUMBER:# 1 BEFOR GRASS
LEFT SIDESLOPE= 2 :1
RIGHT SIDESLOPE= 2 :1
BOTTOM WIDTH= 4 FT
FRICTION FACTOR N= .02
% LONG. SLOPE= 1.8
TRIAL DEPTH= .18 FT

WETTED AREA IS .7848001 SF
WETTED PERIMETER IS 4.804985 FT
HYD. RADIUS IS .1633304 FT
FLOW VELOCITY IS 2.978537 FPS > 2.0 fps ∴ NEED TEMP. LINING TRY STRAW & NET
FLOW RATE IS 2.337556 CFS

JO CO LANDFILL PHASE 3
09-07-1990

CHANNEL NUMBER:# 1 TEMP. LINING
LEFT SIDESLOPE= 2 :1
RIGHT SIDESLOPE= 2 :1
BOTTOM WIDTH= 4 FT
FRICTION FACTOR N= .065
% LONG. SLOPE= 1.8
TRIAL DEPTH= .35 FT

n = .065 (d = 0.0' TO .5')
0 < .35' < .5' ∴ n ok
T = (62.4)(.35)(.018)
= 0.39 psf < 1.45 psf
∴ ok

WETTED AREA IS 1.645 SF
WETTED PERIMETER IS 5.565248 FT
HYD. RADIUS IS .2955843 FT
FLOW VELOCITY IS 1.361014 FPS
FLOW RATE IS 2.238868 CFS

JO CO LANDFILL PHASE 3
09-07-1990

CHANNEL NUMBER:# 1 AFTER GRASS
LEFT SIDESLOPE= 2 :1
RIGHT SIDESLOPE= 2 :1
BOTTOM WIDTH= 4 FT
FRICTION FACTOR N= .12
% LONG. SLOPE= 1.8
TRIAL DEPTH= .5 FT

WETTED AREA IS 2.5 SF
WETTED PERIMETER IS 6.236068 FT
HYD. RADIUS IS .4008937 FT
FLOW VELOCITY IS .9032888 FPS < 4.5 fps
FLOW RATE IS 2.258222 CFS

JO CO LANDFILL PHASE 3
09-06-1990

CHANNEL NUMBER:# 2 BEFORE GRASS
LEFT SIDESLOPE= 2 :1
RIGHT SIDESLOPE= 2 :1
BOTTOM WIDTH= 4 FT
FRICTION FACTOR N= .02
% LONG. SLOPE= 1.05
TRIAL DEPTH= .48 FT

WETTED AREA IS 2.3808 SF
WETTED PERIMETER IS 6.146626 FT
HYD. RADIUS IS .3873345 FT
FLOW VELOCITY IS 4.045519 FPS > 2.5 fps ∴ NEED TEMP. LINING
FLOW RATE IS 9.631572 CFS
TRY STRAW & NET

JO CO LANDFILL PHASE 3
09-06-1990

CHANNEL NUMBER:# 2 TEMP. GRASS
LEFT SIDESLOPE= 2 :1
RIGHT SIDESLOPE= 2 :1
BOTTOM WIDTH= 4 FT
FRICTION FACTOR N= .033
% LONG. SLOPE= 1.05
TRIAL DEPTH= .65 FT

n = .033 (d = .5' TO 2.0')
.5' < .65 < 2.0 ∴ n OK

T = (62.4)(.65)(.0105)
= 0.43 psf < 1.45 psf
∴ OK

WETTED AREA IS 3.445 SF
WETTED PERIMETER IS 6.906888 FT
HYD. RADIUS IS .4987774 FT
FLOW VELOCITY IS 2.902045 FPS
FLOW RATE IS 9.997542 CFS

JO CO LANDFILL PHASE 3
09-06-1990

JO CO LANDFILL PHASE 3
09-06-1990

CHANNEL NUMBER:# 2 AFTER GRASS
LEFT SIDESLOPE= 2 :1
RIGHT SIDESLOPE= 2 :1
BOTTOM WIDTH= 4 FT
FRICTION FACTOR N= .12
% LONG. SLOPE= 1.05
TRIAL DEPTH= 1.28 FT

WETTED AREA IS 8.3968 SF
WETTED PERIMETER IS 9.724334 FT
HYD. RADIUS IS .8634833 FT
FLOW VELOCITY IS 1.150628 FPS < 4.5 fps ∴ OK
FLOW RATE IS 9.661591 CFS

JO CO LANDFILL PHASE 3
09-06-1990

JO CO LANDFILL PHASE 3
09-06-1990

CHANNEL NUMBER:# 3 BEFORE GRASS
LEFT SIDESLOPE= 2 :1
RIGHT SIDESLOPE= 2 :1
BOTTOM WIDTH= 4 FT
FRICTION FACTOR N= .02
% LONG. SLOPE= 3.25
TRIAL DEPTH= .41 FT

WETTED AREA IS 1.9762 SF
WETTED PERIMETER IS 5.833576 FT
HYD. RADIUS IS .3387631 FT
FLOW VELOCITY IS 6.509203 FPS > 2.5 fps ∴ NEED TEMP. LINING
FLOW RATE IS 12.86349 CFS
TRY STRAW & NET

JO CO LANDFILL PHASE 3
09-06-1990

CHANNEL NUMBER:# 3 TEMP. LINING
LEFT SIDESLOPE= 2 :1
RIGHT SIDESLOPE= 2 :1
BOTTOM WIDTH= 4 FT
FRICTION FACTOR N= .033
% LONG. SLOPE= 3.25
TRIAL DEPTH= .55 FT

n = .033 (d = .5 TO 2.0')
.5' < .55' < 2.0'
T = (62.4)(.55)(.0325)
= 1.12 psf < 1.45 psf
∴ OK

WETTED AREA IS 2.805 SF
WETTED PERIMETER IS 6.459675 FT
HYD. RADIUS IS .4342324 FT
FLOW VELOCITY IS 4.655089 FPS
FLOW RATE IS 13.05752 CFS

JO CO LANDFILL PHASE 3
09-06-1990

CHANNEL NUMBER:# 3 AFTER GRASS
LEFT SIDESLOPE= 2 :1
RIGHT SIDESLOPE= 2 :1
BOTTOM WIDTH= 4 FT
FRICTION FACTOR N= .12
% LONG. SLOPE= 3.25
TRIAL DEPTH= 1.1 FT

WETTED AREA IS 6.82 SF
WETTED PERIMETER IS 8.919349 FT
HYD. RADIUS IS .7646298 FT
FLOW VELOCITY IS 1.866724 FPS < 4.5 fps ∴ OK
FLOW RATE IS 12.73106 CFS

CALCULATION

PROJECT _____ PROJ. NO. _____

CLIENT _____ DATE _____

SUBJECT _____ DES. BY _____

CHK. BY _____

REMARKS

PHASE II

McKIM&CREED

DESIGN AND CONSTRUCTION PARAMETERS FOR PHASE II

1. Existing Phase II is completed and is stabilized with a good stand of grass.

2. Due to site conditions (a live stream and toe/existing landfill), there is not room to build the sediment basin and channels as previously designed.

3. Due to the above constraint, it was decided to build basin #7 and 8. Reuse the existing channels along the existing road, to revise terrace and slope drain locations, to place silt fence along toe/new slopes at the south and east sides of phase II where the channels can not be installed.

4. The flow to the basins will be controlled by the use of channels, and slope drain.

5. Prior to commencement of work in Phase II, sedimentation basins No. 7 and No. 8 will be constructed and channels No. 4 through 7 will be installed and stabilized.

6. Work will be started in Section No. 7 and proceed to Section No. 10.

7. Upon completion of Section 7, a terrace will be constructed between Section 7 and Section 8 and slope drain installed.

8. Stabilize Section 7 and proceed to section 8.

9. This procedure will be repeated for Section 8 through 10.

PHASE II

SECTION 6

AREA = 1.99 Ac.
ΔEL. = 244 - 186 = 58 FT.
L = 710 FT.
TC = 5 min.
i10 = 7.5 in./hr.
C = 0.90
Q10 = 13.4 cfs

SECTION 7

AREA = 1.55 Ac.
ΔEL = 246 - 242 = 4 FT.
L = 450 FT.
TC = 5 min.
i10 = 7.5 in./hr.
C = 0.90
Q10 = 10.5 cfs

SECTION 8

AREA = 5.06 Ac.
ΔEL = 244 - 236 = 8 FT.
L = 900 FT.
TC = 8.7 min.
i10 = 6.5 in./hr.
C = 0.90
Q10 = 29.6 cfs

SECTION 9

AREA = 4.80 Ac.
ΔEL = 238 - 230 = 8 FT.
L = 900 FT.
TC = 8.7 min.
i10 = 6.5 in./h.
C = 0.90
Q10 = 28.1 cfs

CALCULATION

PROJECT _____ PROJ. NO. _____

CLIENT _____ DATE _____

SUBJECT _____ DES. BY _____

CHK. BY _____

REMARKS

SECTION 10

AREA = 1.89 Ac.

ΔEL. = 232 - 228 = 4 FT.

L = 450 FT.

Tc = 5 min.

i10 = 7.5 in./hr.

C = 0.90

Q10 = 12.8 cfs

SECTION 11

AREA = 2.36 Ac

ΔEL. = 242 - 208 = 34 FT.

L = 700 FT.

Tc = 5 min.

i10 = 7.5 in./hr.

C = 0.90

Q10 = 15.9 cfs

SECTION 12

AREA = 0.87 Ac.

ΔEL = 232 - 211 = 21 FT.

L = 630 FT.

Tc = 5 min.

i10 = 7.5 in./hr.

C = 0.90

Q10 = 5.9 cfs

McKIM&CREED

CALCULATION

PROJECT _____ PROJ. NO. _____

CLIENT _____ DATE _____

SUBJECT _____ DES. BY _____

CHK. BY _____

REMARKS

SECTION 13

AREA = 0.69 AC.

ΔEL. = 190 − 166 = 24 FT.

L = 680 FT.

TC = 5 min.

i10 = 7.5 in./hr.

C = 0.90

Q10 = 4.7 cfs

SECTION 14

AREA = 3.88 AC.

ΔEL. = 238 − 216 = 22 FT.

L = 800 FT.

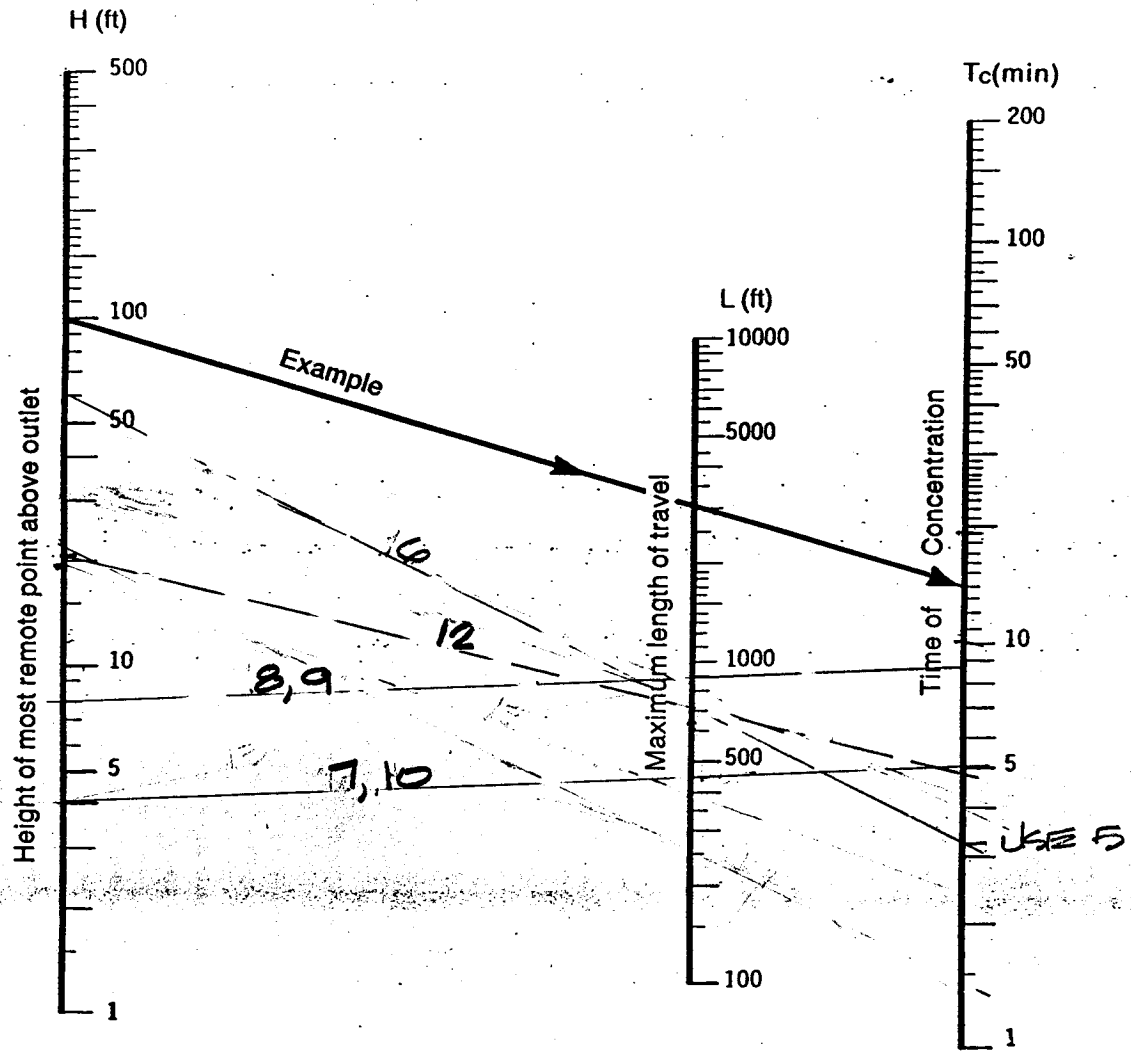
TC = 5 min.

i10 = 7.5 in./hr.

C = 0.5

Q10 = 14.6 cfs

McKIM&CREED



Note:
Use nomograph Tc for natural basins with well-defined channels, for overland flow on bare earth, and for mowed-grass roadside channels.

For overland flow, grassed surfaces, multiply Tc by 2.

For overland flow, concrete or asphalt surfaces, multiply Tc by 0.4.

For concrete channels, multiply Tc by 0.2.

Figure 8.03a Time of concentration of small drainage basins.

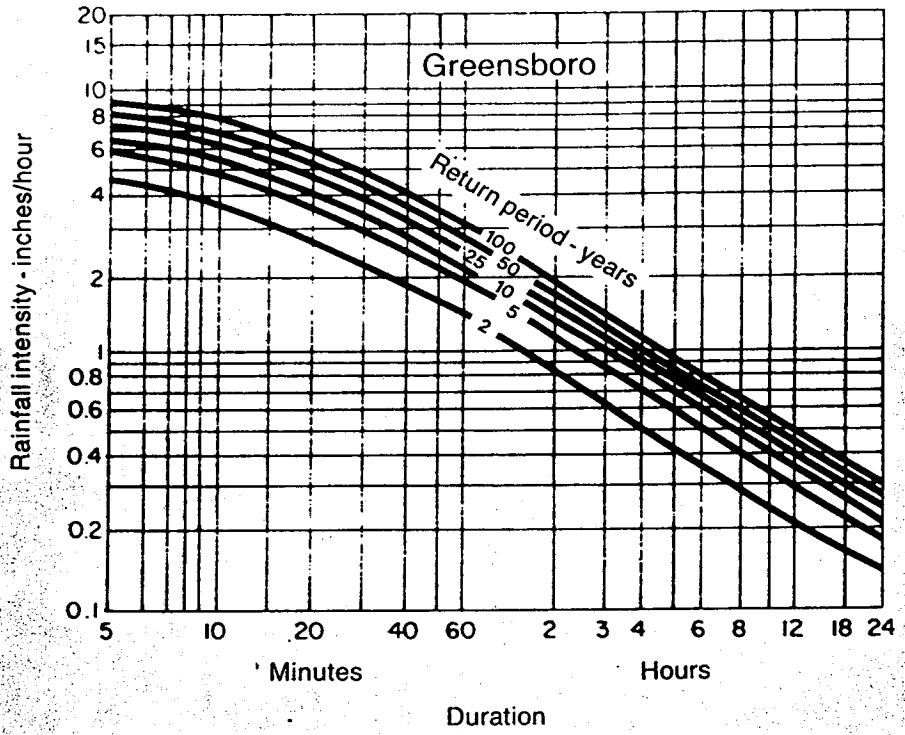


Figure 8.03d Rainfall intensity duration curves—Greensboro.

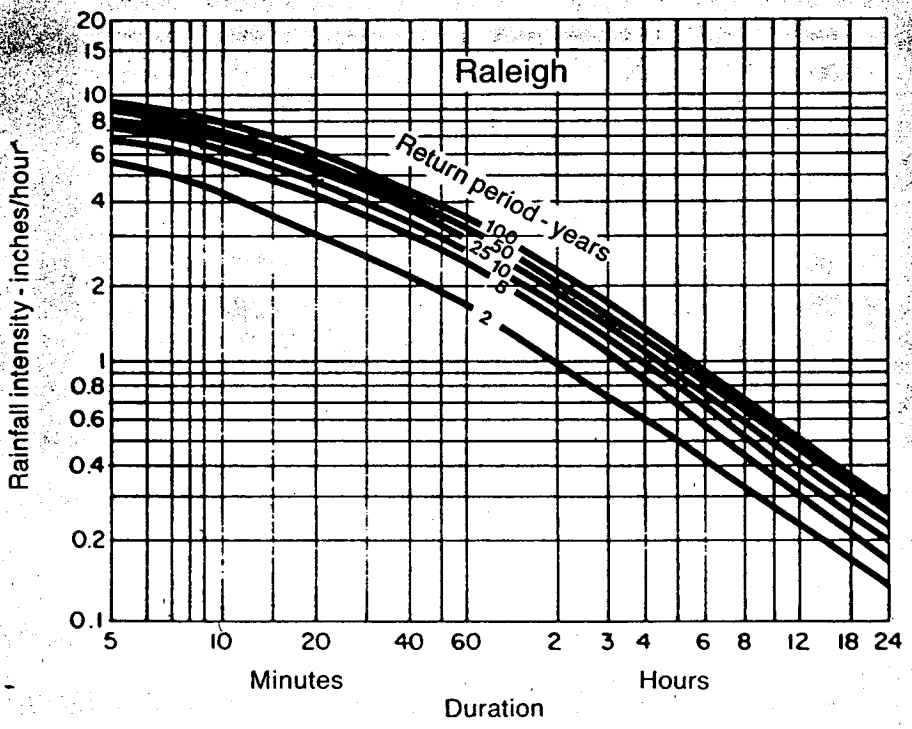


Figure 8.03e Rainfall intensity duration curves—Raleigh.

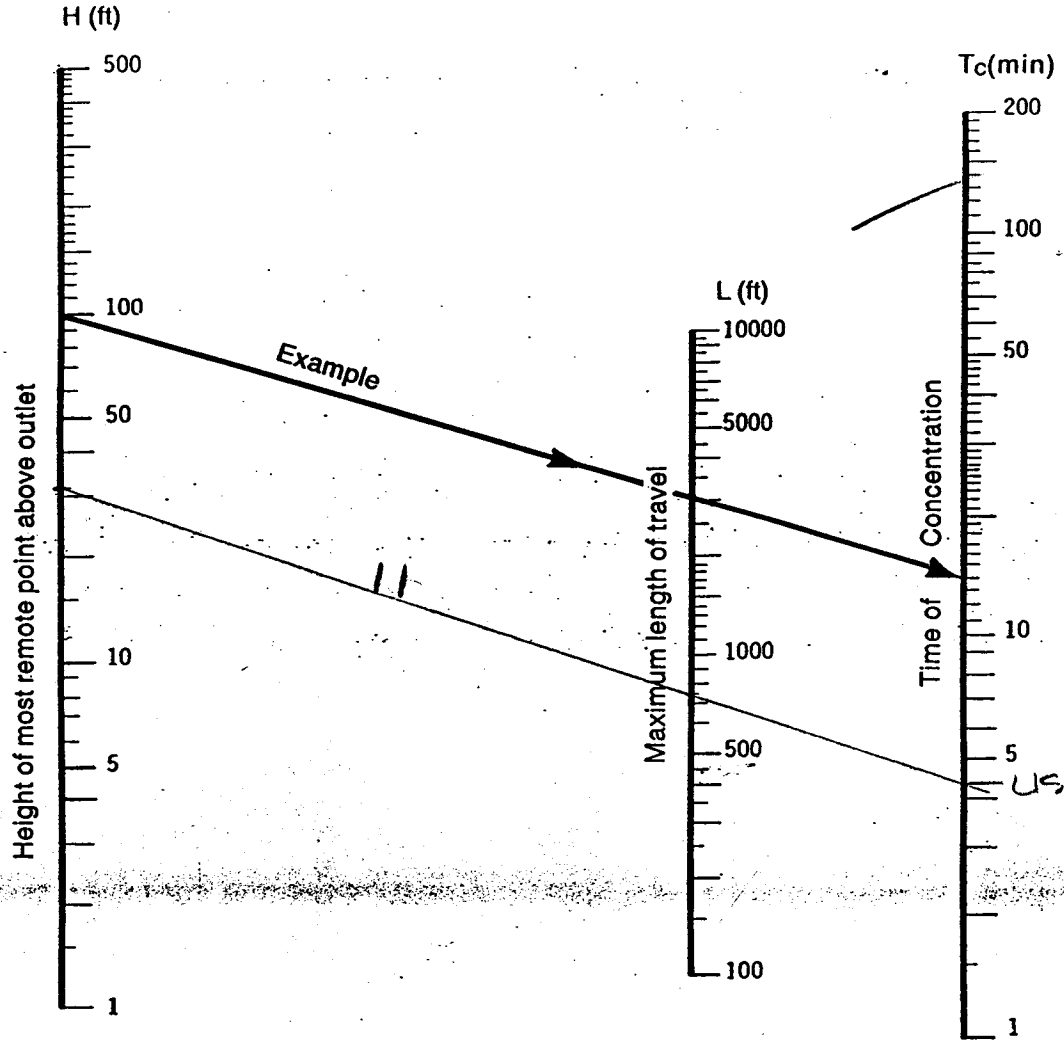


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Figure 8.03a Time of concentration of small drainage basins.

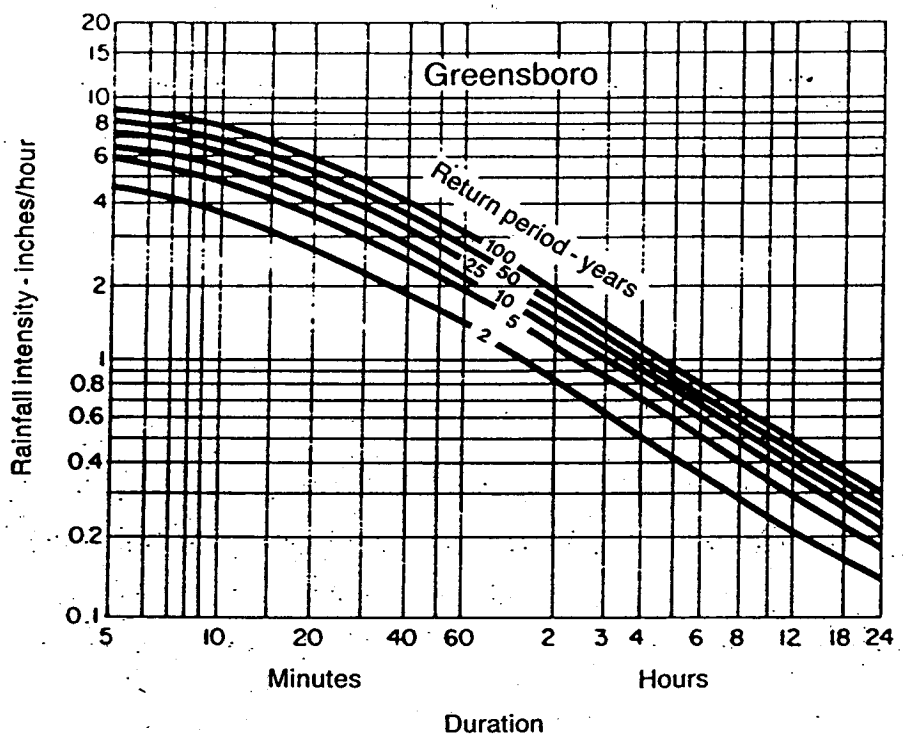

Figure 8.03d Rainfall intensity duration curves—Greensboro.

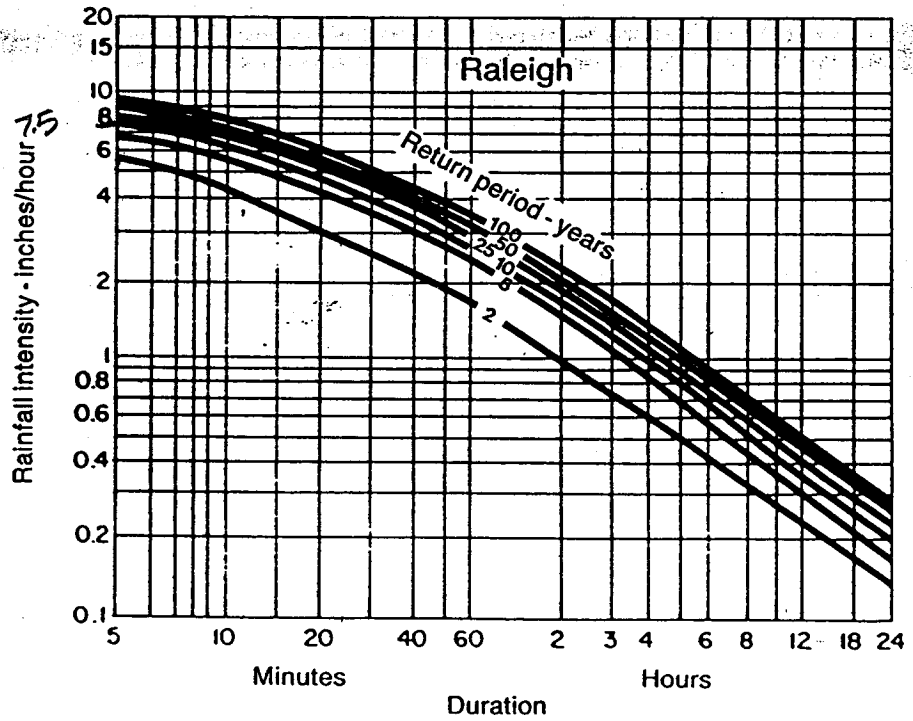

Figure 8.03e Rainfall intensity duration curves—Raleigh.

CALCULATION

PROJECT _____ PROJ. NO. _____

CLIENT _____ DATE 6/91

SUBJECT _____ DES. BY JCH

CHK. BY _____

REMARKS

SED. BASIN NO. 7

DISTURB. AREA = 6 + 7 = 1.99 + 2.64 = 4.63 Ac.

DRAINAGE AREA = 6 + 7 + 13 = 13.4 + 10.5 + 4.7 = 28.6 Ac

SED. STORAGE REQ'D. = (1800)(4.63) = 8,334 C.FT.

SURFACE AREA REQ'D. = (.01)(28.6) = 0.29 Ac

= 12,458 FT.^{2}

CHECK SURFACE AREA @ CREST / EMERG. SPILLWAY

(TRY 60' x 270' - TOP DIM.)

AREA = (60 - 2x2x2)(270 - 2x2x2) = 13,624 > 12,458 ∴ OK

STORAGE VOL. @ 2' STORAGE DEPTH

$V = \frac{h}{3}(A_1 + A_2 + \sqrt{A_1 A_2})$ h = 2'

A_1 = (60-24)(270-24) = 8,856

A_2 = (60-16)(270-16) = 11,176

V = 19,987 FT.^{3} > 11,448 FT.^{3} ∴ OK

USE BASIN SIZE = 60' x 270' x 6' DEPTH (TOP DIM.)

McKIM & CREED

RISER & BARREL DESIGN

$Q_{10} = 28.6$ cfs

USE A 18" BARREL & 24" RISER
REMAINING FLOW WILL GO THRU EMERG. SPILLWAY

1666.0 - TOP/SED. BASIN
− 1.0 - FREEBOARD
1665.0 - MAX. W.S. EL.
1658.0 - INV./OUT 18" BARREL
7.0 FT. HEAD

FROM TABLE 8.07a FLOW = 14.47 cfs

BARREL IS 100 FT. ∴ CORRECTION FACTOR = 0.88

$Q_{OUT} = (14.47)(.88) = 12.73$ cfs

CHECK HEAD ON 24" RISER FOR 12.7 cfs
FROM CHART HEAD = 0.75 FT. < 2.0 FT. ∴ OK

EMERG. SPILLWAY FLOW

$Q_{OUT} = Q_{IN} - Q_{PIPE} = 28.6$ cfs − 12.7 cfs = 15.9 cfs

FROM PAGE 8.07.11
Q = 15 cfs
SLOPE = 3.3%
W = 12 FT.
STAGE = 0.7 FT. < 1.0 FT.

DEWATERING HOLES

$$A_o = \frac{A_s 2h}{T\, C_d\, 20{,}428} = \frac{(\quad)(2 \times 2)}{(10)(.6)(20{,}428)}$$
$$= 0.47 \text{ FT.}^2$$

AREA / ½ HOLE = 0.005 FT.²
/ ROW W/ 3" MIN. SPA. = $\frac{\pi d}{3} = \frac{(\pi)(24)}{3} = 25$ HOLES

AREA / ROW = (25)(.005) = 0.13 FT.²/ROW
/ ROWS = $\frac{.47}{.13} = 3.6$ SAY 4 ROWS

BY _____ DATE _____ SUBJECT _____ SHEET NO. 45 OF _____
CHKD. BY _____ DATE _____ JOB NO. _____

RAGSDALE CONSULTANTS, P. A. | CONSULTING ENGINEERS | _____ DESIGN SHEET

APRON FOR OUTLET PIPE

$V_o = 7.2$ fps.

USE A N4 DOT APRON

BY _____ DATE _____ SUBJECT _____ SHEET NO. 46 OF _____

CHKD. BY _____ DATE _____ JOB NO. _____

RAGSDALE CONSULTANTS, P. A. | CONSULTING ENGINEERS | _____ DESIGN SHEET

Stone Sizes For Culvert Aprons

ESTIMATION OF STONE SIZE AND DIMENSIONS FOR CULVERT APRONS

Step i) Estimate flow velocity V_0 at culvert or paved channel outlet.

Step ii) For pipe culverts D_0 is diameter.

For pipe arch, arch, and box culverts, and paved channel outlets, $D_0 = A_0$, where A_0 = cross sectional area of flow at outlet.

For multiple culverts, use $D_0 = 1.25 \times D_0$ of single culvert.

Step iii) For apron grades of 10% or steeper, use recommendation ' higher zone (zones 1 through 6).

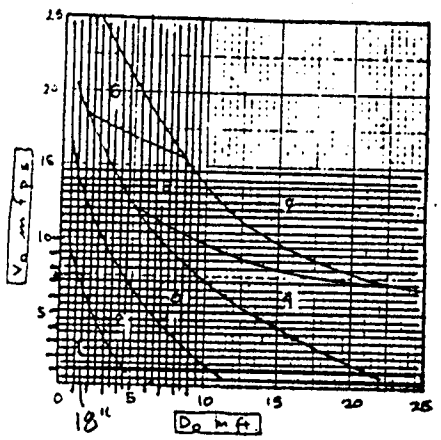

FIGURE 7

ZONE	APRON MATERIAL	LENGTH OF APRON: TO PROTECT CULVERT L_1	LENGTH OF APRON: TO PREVENT SCOUR HOLE L_2
1	Stone Filling (Fine)	$3 \times D_0$	$4 \times D_0$
2	" " (Light)	$3 \times D_0$	$6 \times D_0$ (Cd)(1.5) = 9'
3	" " (Medium)	$4 \times D_0$	$8 \times D_0$
4	" " (Heavy)	$4 \times D_0$	$8 \times D_0$
5	" " "	$5 \times D_0$	$10 \times D_0$
6	" " "	$6 \times D_0$	$12 \times D_0$
7	Special study required (energy dissipators, stilling basin, or larger size stone)		

FIGURE 8

Source: "Bank and Channel Lining Procedures," New York Department of Transportation, Division of Design and Construction, 1971.

Determination of Stone Sizes for Dumped Stone Channel Linings and Revetments

Step i) Use Fig. 9 to determine maximum stone size (e.g., for 12 fps = 20" or 550 lbs.).

Step ii) Use Fig. 10 to determine acceptable size range for stone (for 12 fps it is 125-500 lbs. for 75% of stone, and the maximum and minimum range in weight should be 25-500 lbs.)

Note: In determining channel velocities for stone linings and revetments, use the following coefficients of roughness:

	Diameter (inches)	Manning's 'n'	Min. Thickness of Lining (inches)
Fine	3	0.031	9
Light	6	0.035	12 USE NCDOT CLASS A STONE
Medium	13	0.040	18
Heavy	23	0.044	30

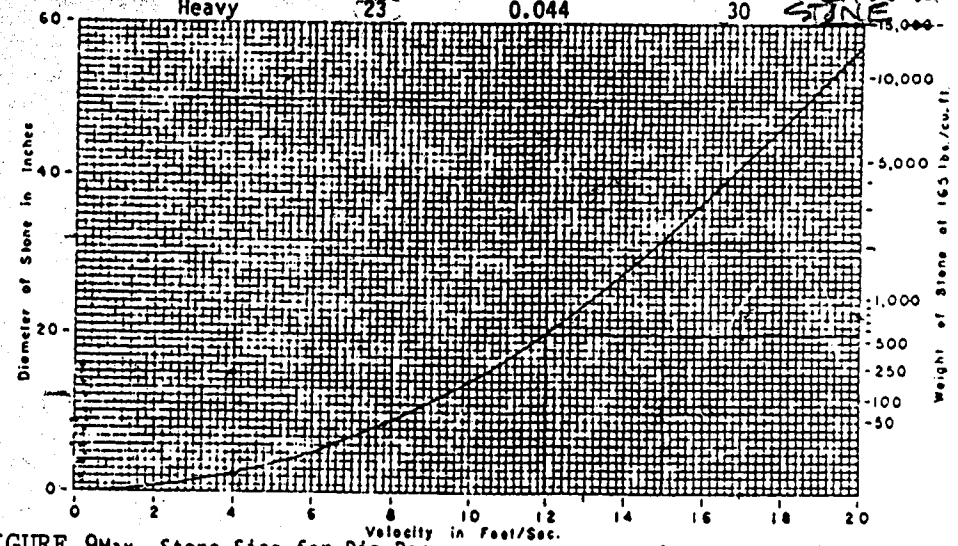

FIGURE 9 Max. Stone Size for Rip Rap

Based on Isbash Curve

Maximum weight of stone required	Minimum and maximum range in weight of stones	Weight range of 75% of stones
(lbs.)	(lbs.)	(lbs.)
150	25 - 150	50 - 150
200	25 - 200	50 - 200
250	25 - 250	50 - 250
400	25 - 400	100 - 400
600	25 - 600	150 - 600
800	25 - 800	200 - 800
1,000	50 - 1,000	250 - 1,000
1,300	50 - 1,300	325 - 1,300
1,600	50 - 1,600	400 - 1,600
2,000	75 - 2,000	600 - 2,000
2,700	100 - 2,700	800 - 2,700

FIGURE 10 Gradation of Rip Rap

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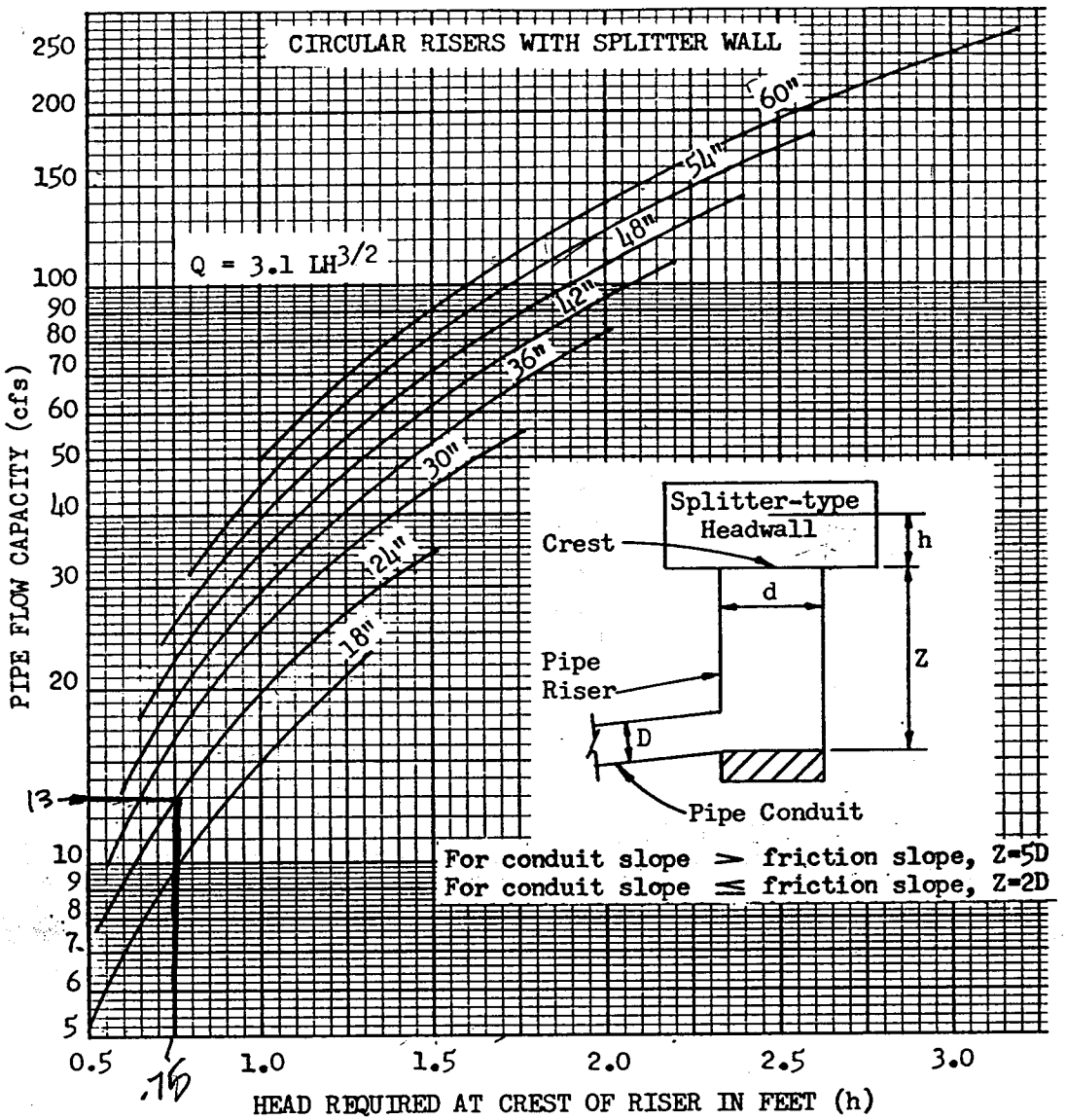
Table 8.07a
Pipe Flow Chart for Design of Corrugated Metal Outlet Conduit
(Q in cubic ft/sec)

For Corrugated Metal Pipe Inlet $K_e + K_b = 1.0$ and 70 feet of Corrugated Metal Pipe Conduit n = 0.025. Note correction factors for other pipe lengths.

Dia. / H	12"	15"	18"	21"	24"	30"	36"	42"
2	2.84	4.92	7.73	11.30	15.60	26.60	40.77	58.12
3	3.48	6.03	9.47	13.84	19.10	32.58	49.93	71.19
4	4.02	6.96	10.94	15.98	22.06	37.62	57.66	82.20
5	4.49	7.78	12.23	17.87	24.66	42.06	64.46	91.90
6	4.92	8.52	13.40	19.57	27.01	46.07	70.60	100.65
7	5.32	9.21	14.47	21.14	29.19	49.77	76.28	108.75
8	5.68	9.84	15.47	22.60	31.19	53.19	81.53	116.23
9	6.03	10.44	16.41	23.97	33.09	56.43	86.49	123.30
10	6.36	11.00	17.30	25.26	34.88	59.48	91.16	129.96
11	6.67	11.54	18.14	26.50	36.59	62.39	95.63	136.33
12	6.96	12.05	18.95	27.68	38.21	65.16	99.87	142.37
13	7.25	12.55	19.72	28.81	39.77	67.83	103.96	148.21
14	7.52	13.02	20.47	29.90	41.27	70.39	107.88	153.80
15	7.78	13.48	21.19	30.95	42.72	72.85	111.66	159.18
16	8.04	13.92	21.88	31.96	44.12	75.24	115.32	164.40
17	8.29	14.35	22.55	32.94	45.48	77.55	118.87	169.46
18	8.53	14.77	23.21	33.90	46.80	79.81	122.33	174.39
19	8.76	15.17	23.84	34.83	48.08	81.99	125.67	179.15
20	8.99	15.56	24.46	35.73	49.33	84.12	128.93	183.80
21	9.21	15.95	25.07	36.62	50.55	86.21	132.13	188.36
22	9.43	16.32	25.65	37.47	51.73	88.22	135.21	192.76
23	9.64	16.69	26.23	38.32	52.90	90.21	138.27	197.12
24	9.85	17.05	26.80	39.14	54.04	92.15	141.24	201.35
25	10.05	17.40	27.35	39.95	55.15	94.05	144.15	205.50
L	Correction Factors For Other Pipe Lengths							
40	1.23	1.22	1.20	1.19	1.16	1.14	1.13	1.11
50	1.14	1.13	1.12	1.11	1.10	1.09	1.08	1.07
60	1.07	1.06	1.06	1.05	1.05	1.04	1.04	1.03
70	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
80	0.95	0.95	0.95	0.96	0.96	0.96	0.97	0.97
90	0.90	0.91	0.91	0.92	0.92	0.93	0.94	0.94
100	0.86	0.87	0.88	0.89	0.89	0.90	0.91	0.92



Inlet Proportions	
Pipe Conduit (D)-in.	Pipe Riser (d)-in.
8-12	18
15	21
18	24
21	30
24	30
30	36
36	48
42	54
48	60

Pipe Drop Inlet Spillway Design:

For a given Q and H, refer to Figure 6-25 or 6-26 for conduit size. Then determine the riser diameter (d) from the Inlet Proportions table on this figure. Next, refer to the above curves, using the conduit capacity and riser diameter and find the head (h) required above the crest of the riser. The height of the riser should not be less than 5D - h, except as noted in the above sketch.

Example - Given: CMP; Q = 20 cfs; H = 14 ft., h max. 1.0 ft.; L = 70 ft. From Figure 6-25 find conduit size (D) = 18 inches. From Inlet Proportions table, riser size = 30 inches. Head (h) required for Q = 20 and d = 30 is 0.85 foot.

Figure 6-27 Chart for determining inlet proportions and required head over inlet.

Table 8.07d
Design Table for Vegetated Spillways Excavated in Very Erodible Soils
(side slopes–3 horizontal:1 vertical)

Discharge Q CFS	Slope Range Minimum Percent	Slope Range Maximum Percent	Bottom Width Feet	Stage Feet
10	3.5	4.7	8	.68
15	3.4	4.4	12	.69
	3.4	5.9	16	.60
20	3.3	3.3	12	.80
	3.3	4.1	16	.70
	3.5	5.3	20	.62
25	3.3	3.3	16	.79
	3.3	4.0	20	.70
	3.5	4.9	24	.64
30	3.3	3.3	20	.78
	3.3	4.0	24	.71
	3.4	4.7	28	.65
	3.4	5.5	32	.61
35	3.2	3.2	24	.77
	3.3	3.9	28	.71
	3.5	4.6	32	.66
	3.5	5.2	36	.62
40	3.3	3.3	28	.76
	3.4	3.8	32	.71
	3.4	4.4	36	.67
	3.4	5.0	40	.64
45	3.3	3.3	32	.76
	3.4	3.8	36	.71
	3.4	4.3	40	.67
	3.4	4.8	44	.64
50	3.3	3.3	36	.75
	3.3	3.8	40	.71
	3.3	4.3	44	.68
60	3.2	3.2	44	.75
	3.2	3.7	48	.72
70	3.3	3.3	52	.75
80	3.1	3.1	56	.78

Example of Use

Given: Discharge, Q = 38 c.f.s. Spillway slope, Exit section (from profile) = 4%.

Find: Bottom Width and Stage in Reservoir.

Procedure: Enter table from left at 40 c.f.s. Note that spillway slope (4.0%) falls within slope ranges corresponding to bottom widths of 36 and 40 ft. Use wider bottom width, 40 ft, to minimize velocity. Stage in Reservoir will be 0.64 ft.

Note: Computations based on: Roughness coefficient, n = .040
Maximum velocity = 3.50 ft per sec.

CALCULATION

PROJECT LANDFILL EXPANSION
CLIENT JOHNSTON CO.
SUBJECT REV. - CALC.

PROJ. NO. ____
DATE 5/91
DES. BY JCH
CHK. BY ____

REMARKS

SED. BASIN #8

1. DRAINAGE AREA = SECTIONS 15, 16, 17, 18 & 23
2. JUST ADD Q'S FOR DESIGN
3. SURFACE AREA WILL CONTROL (.01 Ac./cfs)
4. Q10 = 28.1 + 12.8 + 5.9 + 3.1 + 14.6 = 64.5 cfs

REQ'D. SURFACE AREA = (.01)(64.5) = 0.65 = 28,096 FT.^{2}
BASIN RATIO = 2:1 ∴ AREA = (2X)(X) ∴
$X = \sqrt{\frac{AREA}{2}} = \sqrt{\frac{28096}{2}}$ = 118.5 FT. SAY 120 FT.

TRY BASIN SIZE 120'(W) x 240' (L) (@ WATER LEVEL)
CHECK VOL. REQ'D. (ASSUME 6' TOTAL DEPTH) W/ 2:1 SLOPES
DISTUR. AREAS = 15 THRU 18
AREA = 4.8 + 1.9 + 0.9 + 0.5 = 8.1 Ac.
V REQ'D. = (1800 FT.^{3})(8.1) = 14,580 C. FT.
BOTT. AREA (A1) = [120 - (3 x 2 x 2)] [240' - 12'] = 24,624 FT.^{2}
TOP AREA (A2) = (120)(240) = 28,800 FT.^{2}
$V = \frac{h}{3}(A_1 + A_2 + \sqrt{A_1 A_2})$ = 80,054 FT.^{3} > 14,580 ∴ OK

BASIN SIZE
TOP - 134' (W) x 254' (L)
BOTT. - 110' (W) x 230' (L)
} RECT. BASIN WILL NOT FIT SITE - SEE PLAN. READINGS
TOTAL DEPTH - 6 FT.

PLAINMETER AREAS
TOP AREA = 0.82 Ac. = 35,719 FT.^{2}
BOTT. AREA = 0.63 Ac. = 27,443 FT.^{2}
AV. AREA = 0.73 = 31,581 FT.^{2} > 28,096 ∴ OK

CALCULATION

PROJECT _____ PROJ. NO. _____

CLIENT _____ DATE 6/91

SUBJECT _____ DES. BY JCH

CHK. BY _____

REMARKS

RISER & BARREL

$Q_{out} = Q_{in} - \text{STORAGE}$

$Q_{in} = (Q_{10})(T_p)$

$Q_{10} = 64.5$ cfs

$T_p = (T_c)(2)(60)$

$Q_{in} = (64.5)(10 \times 2 \times 60)$

$= 77,400$ C.FT.

WATER STORAGE = TOTAL STOR. - SED. STOR.

USE 1 FT. SED. STORAGE & 2' WATER STORAGE

CHANGE/AREA PER FT. $= \frac{35,719 - 27,443}{6} = 1,379.33$ FT^2

TOTAL STORAGE $= \frac{3}{3}\left(27,443 + (27,443 + 1379.3 \times 3) + \sqrt{A_1 A_2}\right)$

$= 88,463.4$ C.FT.

SED. STORAGE $= \frac{1}{3}\left(27,443 + (27,443 + 1379.3) + \sqrt{A_1 A_2}\right)$

$= 28,129.9$ C.FT.

$W_s = 88,463.4 - 28,129.9 = 60,333.6$ C.FT.

$Q_{out} = 77,400 - 60,333.6 = 17,066.4$ C.FT.

DISCHARGE $Q = \frac{17,066.4}{(20)(60)} = 14.2$ cfs

TRY A 30" RISER & 24" BARREL (CMP)

SEE FIG. 6-25 & FIG 6-27

h @ RISER = 0.70 FT. < 1.0 FT.

∴ OK

EMERG. SPILLWAY DESIGN

$Q_{out} = Q_{in} - Q_{PIPE}$

Q/BARREL @ 4' Head = 22 cfs

Q/RISER @ 1' Head = 30 cfs

FIG. 6-25

FIG 6-27

BARREL CONTROLS – MAX. DISCHARGE @ RISER = 22 cfs

McKIM & CREED

CALCULATION

PROJECT _____ PROJ. NO. _____

CLIENT _____ DATE 6/91

SUBJECT _____ DES. BY JCH

CHK. BY _____

REMARKS

$Q_{OUT} = 65 - 22 = 43$ cfs

TRY 20' WIDTH & $h = 1.18$ FT. x .75

$Q = 3.367\, L\, H^{1.5}$

$Q = 43.2$ cfs < 43 cfs 43.14 — ∴ OK

$h = 1.18$ FT. < 2.0 FT. (0.75) — ∴ OK

CHECK OUTLET VEL. – ASSUME FULL FLOW

$V = \frac{Q}{A} = \frac{22}{(.7854)(2^2)} = 7.0$ fps

USE NCDOT CLASS A STONE (2" TO 6")

$T = (1.5)(6) = 9$ in., USE 12" THICK

USE A NYDOT APRON – SEE SHT. NO. ___

DEWATERING HOLES

$A_o = \frac{A_s \sqrt{2h}}{T\, C_d\, 20{,}428}$ — $A_s = 31{,}581$ FT.^{2}, $h = 2$ FT., $T = 10$ hrs., $C_d = .6$

$= \frac{(31{,}581)(\sqrt{(2)(2)})}{(10)(.6)(20{,}428)}$

$= 0.52$ FT.^{2}

AREA / ½" HOLE $= (.7854)(.04^2) = 0.0014$ FT.^{2}

CIRC. / RISER $= (\pi)(30") = 94.25$ in.

HOLES/ROW $= \frac{94.25}{3} = 31.4$ SAY 30/ROW

AREA/ROW $= (30)(.0014) = 0.04$ FT.^{2}/ROW

#/ROW $= \frac{.52}{.04} = 12.4$ SAY 13 ROWS — TO MANY ROWS – USE 1"Φ HOLES

AREA/HOLE $= (.7854)(.08^2) = 0.0050$ FT.^{2}

AREA/ROW $= (.0050)(30) = 0.15$ FT.^{2}

#/ROWS $= \frac{.52}{.15} = 3.4$, SAY 4 ROWS

CALCULATION

PROJECT _____ PROJ. NO. _____

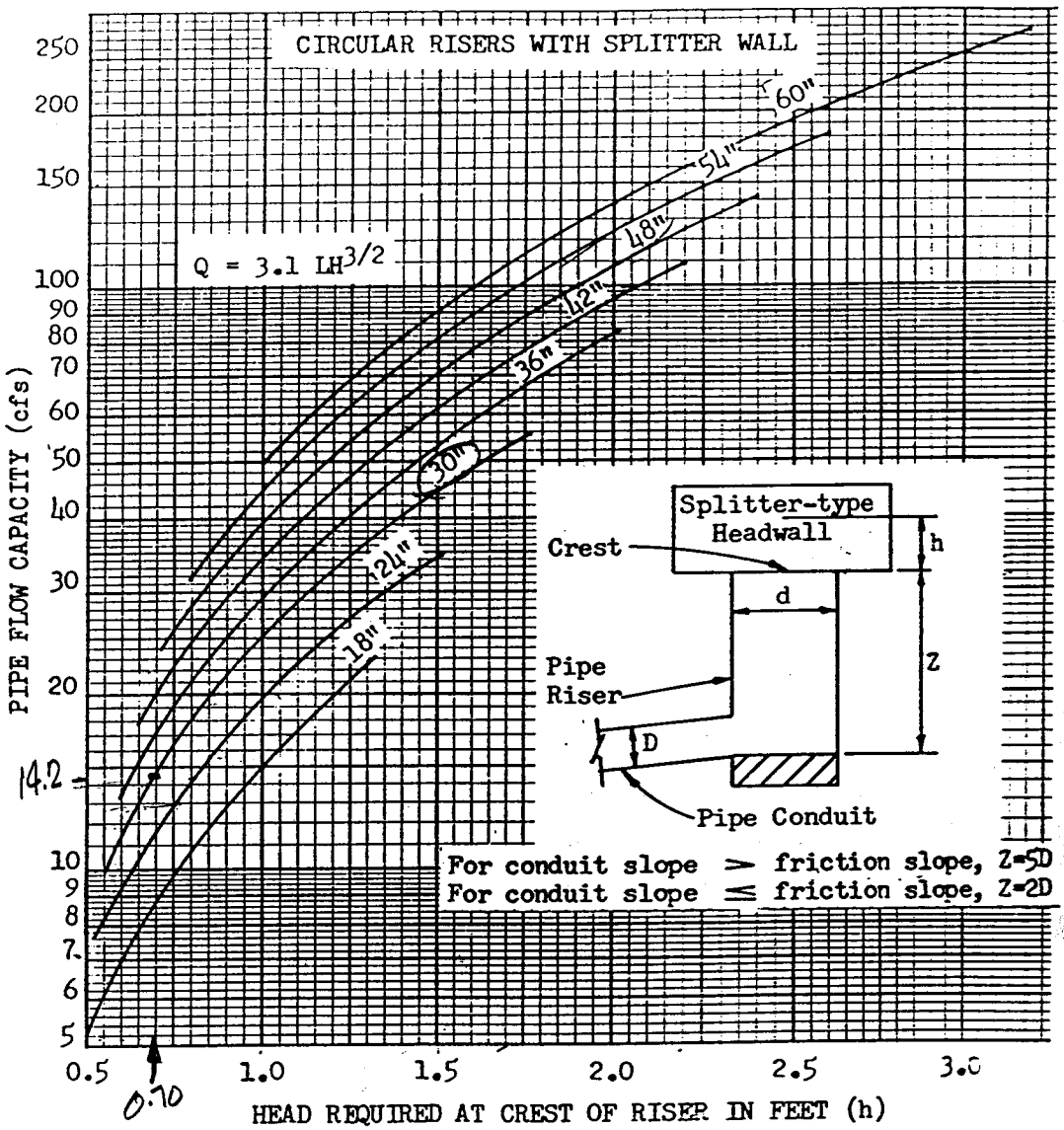
CLIENT _____ DATE 6/91

SUBJECT _____ DES. BY JCH

CHK. BY _____

	REMARKS
CHECK FLOATATION	
V/REPLACED = (.7854)(2.5²)(3) = 14.73 FT.³	
↑ UPWARD FORCE = (14.73)(62.4) = 918.9 Lbs.	
REQ'D. WEIGHT = (1.1)(918.9) = 1,010.8 Lbs.	
TRY 3.5' SQ. × 1 FT. THICK	
↓ W = ((3.5)² − 4.91)(150)	
= 1,101.2 Lbs > 1,010.8 Lbs.	∴ OK

McKIM&CREED



Inlet Proportions	
Pipe Conduit (D)-in.	Pipe Riser (d)-in.
8-12	18
15	21
18	24
21	30
24	30
30	36
36	48
42	54
48	60

Pipe Drop Inlet Spillway Design:

For a given Q and H, refer to Figure 6-25 or 6-26 for conduit size. Then determine the riser diameter (d) from the Inlet Proportions table on this figure. Next, refer to the above curves, using the conduit capacity and riser diameter and find the head (h) required above the crest of the riser. The height of the riser should not be less than 5D - h, except as noted in the above sketch.

Example - Given: CMP; Q = 20 cfs; H = 14 ft., h max. 1.0 ft.; L = 70 ft. From Figure 6-25 find conduit size (D) = 18 inches. From Inlet Proportions table, riser size = 30 inches. Head (h) required for Q = 20 and d = 30 is 0.85 foot.

Figure 6-27 Chart for determining inlet proportions and required head over inlet.

PIPE FLOW CHART (Full flow assumed)

For Corrugated Metal Pipe Inlet $K_e + K_b = 1.0$ and 70 feet of Corrugated Metal Pipe Conduit n = 0.025. Note correction factors for other pipe lengths.

Dia. / H	12"	15"	18"	21"	24"	30"	36"	42"
2	2.84	4.92	7.73	11.30	15.60	26.60	40.77	58.12
3	3.48	6.03	9.47	13.84	19.10	32.58	49.93	71.19
4	4.02	6.96	10.94	15.98	22.06	37.62	57.66	82.20
5	4.49	7.78	12.23	17.87	24.66	42.06	64.46	91.90
6	4.92	8.52	13.40	19.57	27.01	46.07	70.60	100.65
7	5.32	9.21	14.47	21.14	29.19	49.77	76.28	108.75
8	5.68	9.84	15.47	22.60	31.19	53.19	81.53	116.23
9	6.03	10.44	16.41	23.97	33.09	56.43	86.49	123.30
10	6.36	11.00	17.30	25.26	34.88	59.48	91.16	129.96
11	6.67	11.54	18.14	26.50	36.59	62.39	95.63	136.33
12	6.96	12.05	18.95	27.68	38.21	65.16	99.87	142.37
13	7.25	12.55	19.72	28.81	39.77	67.83	103.96	148.21
14	7.52	13.02	20.47	29.90	41.27	70.39	107.88	153.80
15	7.78	13.48	21.19	30.95	42.72	72.85	111.66	159.18
16	8.04	13.92	21.88	31.96	44.12	75.24	115.32	164.40
17	8.29	14.35	22.55	32.94	45.48	77.55	118.87	169.46
18	8.53	14.77	23.21	33.90	46.80	79.81	122.33	174.39
19	8.76	15.17	23.84	34.83	48.08	81.99	125.67	179.15
20	8.99	15.56	24.46	35.73	49.33	84.12	128.93	183.80
21	9.21	15.95	25.07	36.62	50.55	86.21	132.13	188.36
22	9.43	16.32	25.65	37.47	51.73	88.22	135.21	192.76
23	9.64	16.69	26.23	38.32	52.90	90.21	138.27	197.12
24	9.85	17.05	26.80	39.14	54.04	92.15	141.24	201.35
25	10.05	17.40	27.35	39.95	55.15	94.05	144.15	205.50
L	Correction Factors For Other Pipe Lengths							
40	1.23	1.22	1.20	1.19	1.16	1.14	1.13	1.11
50	1.14	1.13	1.12	1.11	1.10	1.09	1.08	1.07
60	1.07	1.06	1.06	1.05	1.05	1.04	1.04	1.03
70	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
80	0.95	0.95	0.95	0.96	0.96	0.96	0.97	0.97
90	0.90	0.91	0.91	0.92	0.92	0.93	0.94	0.94
100	0.86	0.87	0.88	0.89	0.89	0.90	0.91	0.92

Figure 6-25 Pipe flow chart for corrugated metal pipe drop inlet spillway

ESTIMATION OF STONE SIZE AND DIMENSIONS FOR CULVERT APRONS

Step i) Estimate flow velocity V_o at culvert or paved channel outlet.

Step ii) For pipe culverts D_o is diameter.

For pipe arch, arch, and box culverts, and paved channel outlets, $D_o = A_o$, where A_o = cross sectional area of flow at outlet.

For multiple culverts, use $D_o = 1.25 \times D_o$ of single culvert.

Step iii) For apron grades of 10% or steeper, use recommendation higher zone (zones 1 through 6).

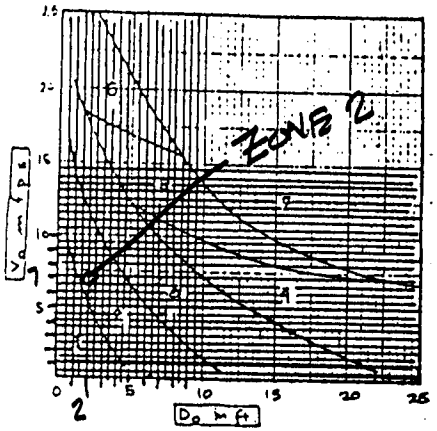


FIGURE 7

ZONE	APRON MATERIAL	LENGTH OF APRON: TO PROTECT CULVERT L_1	LENGTH OF APRON: TO PREVENT SCOUR HOLE L_2
①	Stone Filling (Fine)	$3 \times D_o$	$4 \times D_o$
②	" " (Light)	$3 \times D_o$	$6 \times D_o$
③	" " (Medium)	$4 \times D_o$	$8 \times D_o$
④	" " (Heavy)	$4 \times D_o$	$8 \times D_o$
⑤	" " "	$5 \times D_o$	$10 \times D_o$
⑥	" " "	$6 \times D_o$	$12 \times D_o$
⑦	Special study required (energy dissipators, stilling basin, or larger size stone)		

FIGURE 8

(6)(2) = 12'

Source: "Bank and Channel Lining Procedures," New York Department of Transportation, Division of Design and Construction, 1971.

Determination of Stone Sizes for Dumped Stone Channel Linings and Revetments

Step i) Use Fig. 9 to determine maximum stone size (e.g., for 12 fps = 20" or 550 lbs.).

Step ii) Use Fig. 10 to determine acceptable size range for stone (for 12 fps it is 125-500 lbs. for 75% of stone, and the maximum and minimum range in weight should be 25-500 lbs.)

Note: In determining channel velocities for stone linings and revetments, use the following coefficients of roughness:

	Diameter (inches)	Manning's 'n'	Min. Thickness of Lining (inches)
Fine	3	0.031	9
Light	6	0.035	12
Medium	13	0.040	18
Heavy	23	0.044	30

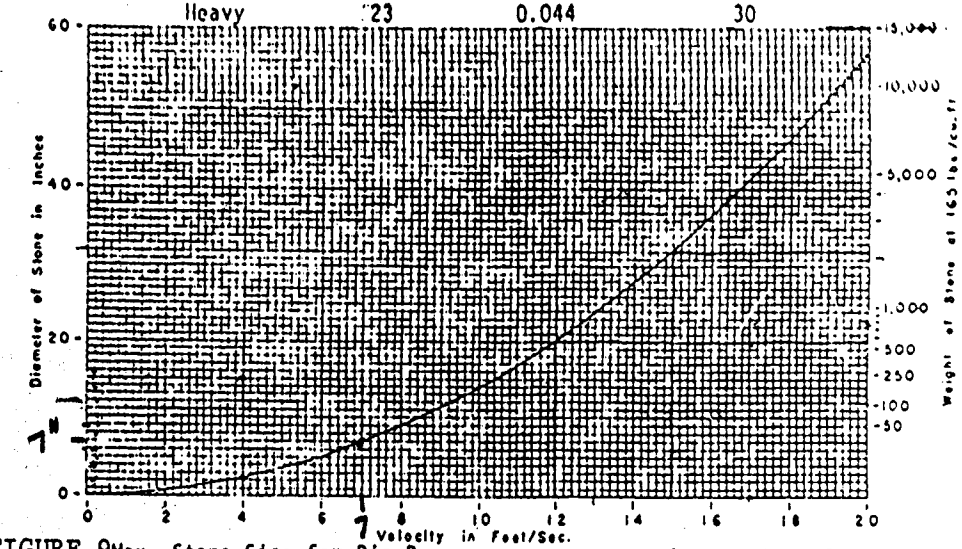


FIGURE 9 Max. Stone Size for Rip Rap

Based on Isbash Curve

Maximum weight of stone required	Minimum and maximum range in weight of stones	Weight range of 75% of stones
(lbs.)	(lbs.)	(lbs.)
150	25 - 150	50 - 150
200	25 - 200	50 - 200
250	25 - 250	50 - 250
400	25 - 400	100 - 400
600	25 - 600	150 - 600
800	25 - 800	200 - 800
1,000	50 - 1,000	250 - 1,000
1,300	50 - 1,300	325 - 1,300
1,600	50 - 1,600	400 - 1,600
2,000	75 - 2,000	600 - 2,000
2,700	100 - 2,700	800 - 2,700

FIGURE 10 Gradation of Rip Rap

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SLOPE DRAIN #9

DRAINAGE AREA = SECTION 7
Q10 = 10.5 CFS
SLOPE = 3:1

SLOPE DRAIN #10

DRAINAGE AREA = SECTION 8
Q10 = 34.1 CFS
SLOPE = 3:1

SLOPE DRAIN #11

DRAINAGE AREA = SECTION 9
Q10 = 32.4 CFS
SLOPE = 3:1

SLOPE DRAIN #12

DRAINAGE AREA = SECTION 10
Q10 = 12.8 CFS

DESIGN PIPE #12 & USE FOR #9 & DESIGN PIPE #10 & USE FOR #11

USE 24" CMP & USE 2-24" CMP FOR #10 & #11

USE A NYDOT STONE APRON @ ENDS/PIPES

BY JCH DATE 9/90 SUBJECT SHEET NO. 58 OF
CHKD. BY DATE JOB NO.

RAGSDALE CONSULTANTS, P. A. | CONSULTING ENGINEERS | DESIGN SHEET

PROJECT: Jo. Co. LANDFILL

DESIGNER: JCH

SLOPE DRAIN #10 & #12

DATE: 9/90

HYDROLOGIC AND CHANNEL INFORMATION

NOTE: PIPES ARE ON 3:1 SLOPES & WILL BE INLET CONTROL

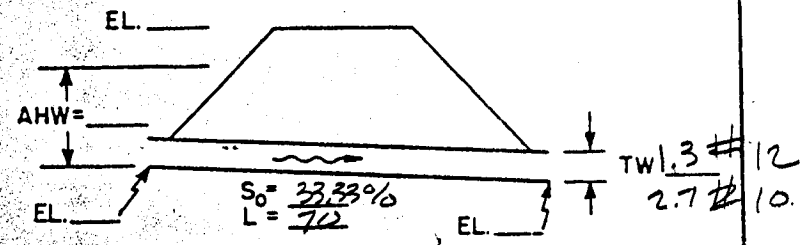
Q_1 = 12.8 cfs (#12) TW_1 = 1.3

Q_2 = 34.1 cfs (#10) TW_2 = 2.7

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
~~Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100}~~)

SKETCH

STATION: PHASE II



MEAN STREAM VELOCITY = ____

MAX. STREAM VELOCITY = ____

	CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL HW=H+h_o−LS_o: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
#12	CMP PROJECTING	12.8	24	1.05	2.10										17.0		
#10	do.	17.1	24	1.36	2.72										18.0		

SUMMARY & RECOMMENDATIONS:

sati ctory for the full 100-year ad ter is too high, a larger size aximum permissible headwater. ollows.

for let control enter Fig. 4-22, er depth in outlet control. If the trol, the culvert is assumed to be ies.

on he flow charts. For other gth, L′, calculated by the formula

. . . . . (14)

on chart.

s, adjust the result for the Man-

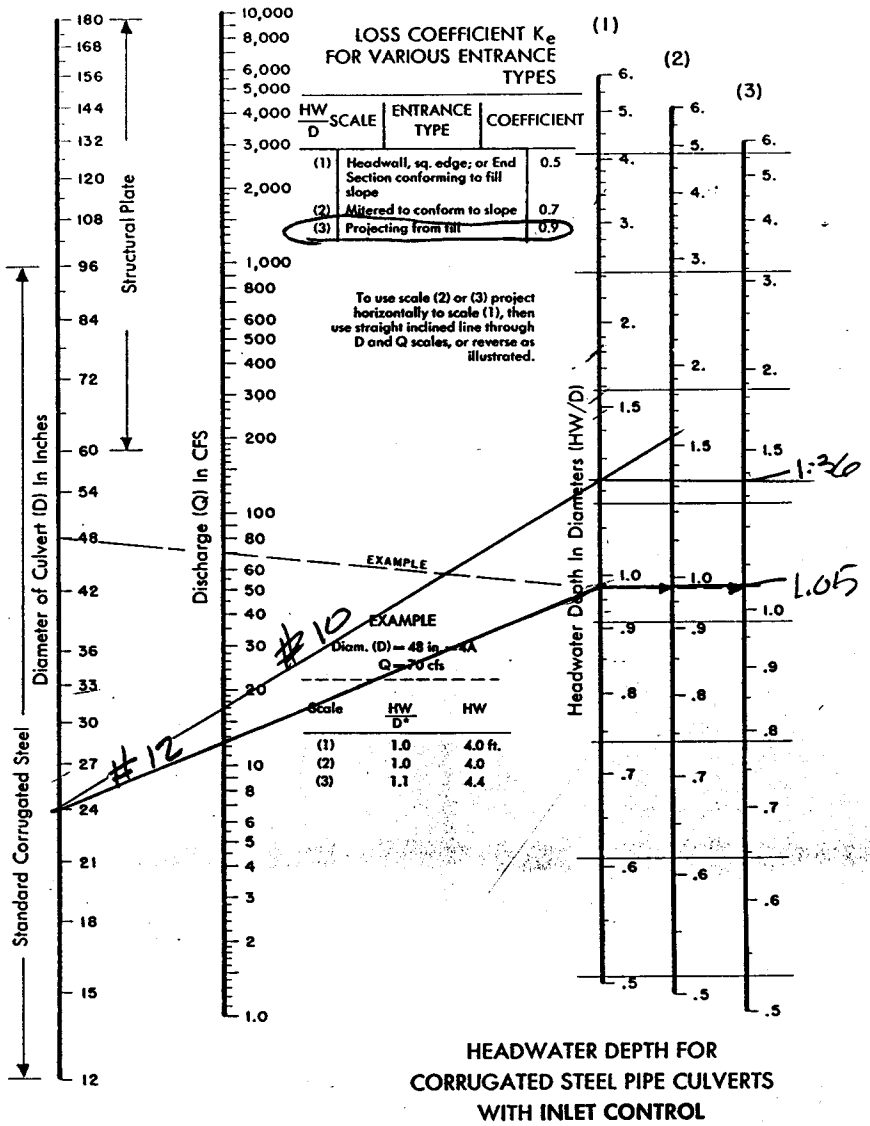
th entrance condition desired. , pa 156.

headwater exceeds the allowable, g to cceptable headwater depth. e c sidered for corrugated steel . S Table 4-10. A smaller size ctory.

ide l. It may be economical to if a ze difference results. Check

nning's *n* for Structural Plate Pipe sur ents reported in Table 4-11 and 25 together with the corre- s data was not a part of the Fed- n were published in 1963.

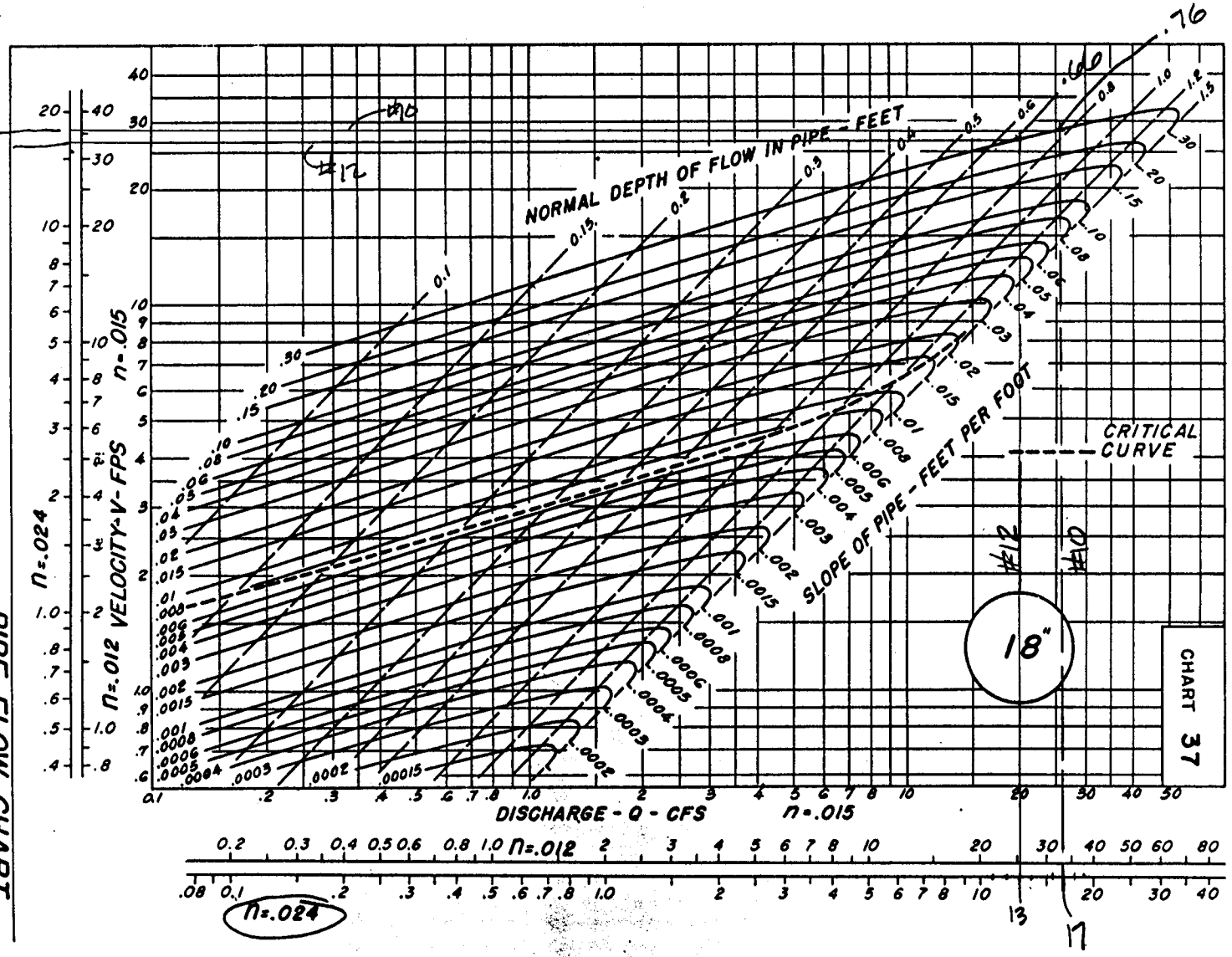
d 1 -year flood discharge. Ob- ss importance which do not war- esign discharges for less critical yea loods. This is a matter of n A f this chapter. But, whatever discharge, the rationale presented be balanced by requiring no static od scharge than the design dis-



HEADWATER DEPTH FOR CORRUGATED STEEL PIPE CULVERTS WITH INLET CONTROL

Fig. 4-18. *Inlet control* nomograph for corrugated steel *pipe* culverts. The manufacturers recommend keeping *HW/D* to a maximum of 1.5 and preferably to no more than 1.0.

60



PIPE FLOW CHART
18-INCH DIAMETER

Stone Sizes For Culvert Aprons

ESTIMATION OF STONE SIZE AND DIMENSIONS FOR CULVERT APRONS

Step i) Estimate flow velocity V_0 at culvert or paved channel outlet.

Step ii) For pipe culverts D_0 is diameter.

For pipe arch, arch, and box culverts, and paved channel outlets, $D_0 = A_0$, where A_0 = cross sectional area of flow at outlet.

For multiple culverts, use $D_0 = 1.25 \times D_0$ of single culvert.

Step iii) For apron grades of 10% or steeper, use recommendation ' higher zone (zones 1 through 6).

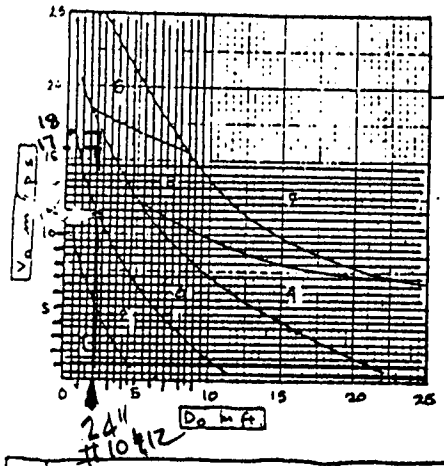


FIGURE 7

BOTH #10 & 12
ZONE 3

ZONE	APRON MATERIAL	LENGTH OF APRON: TO PROTECT CULVERT L_1	LENGTH OF APRON: TO PREVENT SCOUR HOLE L_2
1	Stone Filling (Fine)	$3 \times D_0$	$4 \times D_0$
2	" " (Light)	$3 \times D_0$	$8 \times D_0$
3	" " (Medium)	$4 \times D_0$	$8 \times D_0$
4	" " (Heavy)	$4 \times D_0$	$8 \times D_0$
5	" " "	$5 \times D_0$	$10 \times D_0$
6	" " "	$6 \times D_0$	$12 \times D_0$
7	Special study required (energy dissipators, stilling basin, or larger size stone)		

FIGURE 8

(8)(2) = 16'

Source: "Bank and Channel Lining Procedures," New York Department of Transportation, Division of Design and Construction, 1971.

Determination of Stone Sizes for Dumped Stone Channel Linings and Revetments

Step i) Use Fig. 9 to determine maximum stone size (e.g., for 12 fps = 20" or 550 lbs.).

Step ii) Use Fig. 10 to determine acceptable size range for stone (for 12 fps it is 125-500 lbs. for 75% of stone, and the maximum and minimum range in weight should be 25-500 lbs.)

Note: In determining channel velocities for stone linings and revetments, use the following coefficients of roughness:

	Diameter (inches)	Manning's 'n'	Min. Thickness of Lining (inches)
Fine	3	0.031	9
Light	6	0.035	12
Medium	13	0.040	18
Heavy	23	0.044	30

CLASS B
1/6" FS-2

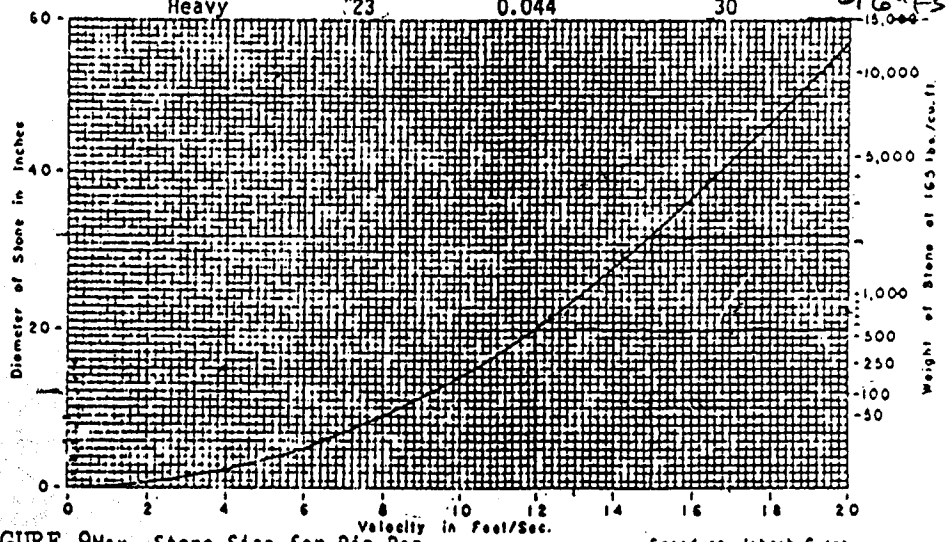


FIGURE 9 Max. Stone Size for Rip Rap

Based on Isbash Curve

Maximum weight of stone required	Minimum and maximum range in weight of stones	Weight range of 75% of stones
(lbs.)	(lbs.)	(lbs.)
150	25 - 150	50 - 150
200	25 - 200	50 - 200
250	25 - 250	50 - 250
400	25 - 400	100 - 400
600	25 - 600	150 - 600
800	25 - 800	200 - 800
1,000	50 - 1,000	250 - 1,000
1,300	50 - 1,300	325 - 1,300
1,600	50 - 1,600	400 - 1,600
2,000	75 - 2,000	600 - 2,000
2,700	100 - 2,700	800 - 2,700

FIGURE 10 Gradation of Rip Rap

CHANNEL NOTES.

1. SEE SHEET NO. FOR FLOW CALC. FOR CHANNELS
2. SEE SHEET NOS. __ THRU __ FOR CHANNEL CALC.
3. CHANNEL CALC. FOR GRASS CHANNELS ARE CALC. FOR RET. CLASS B. (TALL FESCUE UNCUT)
4. MAX. CHANNEL VEL. AFTER GRASS SHALL BE LESS THAN 4.5 FPS.
5. FROM SHEET NO. __, USE "n" VALUE OF 0.12 FOR THE GRASS CHANNELS.
6. USE FLOW DEPTH & VEL. FOR TEMP. LINING TO CHECK VEL. WHEN GRASS FIRST COMES UP.

Appendix A.—TABLES

Table 1.—Manning roughness coefficients, n [1]

	Manning's n range [2]
I. Closed conduits:	
A. Concrete pipe	0.011–0.013
B. Corrugated-metal pipe or pipe-arch:	
1. 2⅔ by ½-in. corrugation (riveted pipe): [3]	
a. Plain or fully coated	0.024
b. Paved invert (range values are for 25 and 50 percent of circumference paved):	
(1) Flow full depth	0.021–0.018
(2) Flow 0.8 depth	0.021–0.016
(3) Flow 0.6 depth	0.019–0.013
2. 6 by 2-in. corrugation (field bolted)	0.03
C. Vitrified clay pipe	0.012–0.014
D. Cast-iron pipe, uncoated	0.013
E. Steel pipe	0.009–0.011
F. Brick	0.014–0.017
G. Monolithic concrete:	
1. Wood forms, rough	0.015–0.017
2. Wood forms, smooth	0.012–0.014
3. Steel forms	0.012–0.013
H. Cemented rubble masonry walls:	
1. Concrete floor and top	0.017–0.022
2. Natural floor	0.019–0.025
I. Laminated treated wood	0.015–0.017
J. Vitrified clay liner plates	0.015
II. Open channels, lined [4] (straight alinement): [5]	
A. Concrete, with surfaces as indicated:	
1. Formed, no finish	0.013–0.017
2. Trowel finish	0.012–0.014
3. Float finish	0.013–0.015
4. Float finish, some gravel on bottom	0.015–0.017
5. Gunite, good section	0.016–0.019
6. Gunite, wavy section	0.018–0.022
B. Concrete, bottom float finished, sides as indicated:	
1. Dressed stone in mortar	0.015–0.017
2. Random stone in mortar	0.017–0.020
3. Cement rubble masonry	0.020–0.025
4. Cement rubble masonry, plastered	0.016–0.020
5. Dry rubble (riprap)	0.020–0.030
C. Gravel bottom, sides as indicated:	
1. Formed concrete	0.017–0.020
2. Random stone in mortar	0.020–0.023
3. Dry rubble (riprap)	0.023–0.033
D. Brick	0.014–0.017
E. Asphalt:	
1. Smooth	0.013
2. Rough	0.016
F. Wood, planed, clean	0.011–0.013
G. Concrete-lined excavated rock:	
1. Good section	0.017–0.020
2. Irregular section	0.022–0.027
III. Open channels, excavated [4] (straight alinement,[5] natural lining):	
A. Earth, uniform section:	
1. Clean, recently completed	0.016–0.018
2. Clean, after weathering	0.018–0.020
3. With short grass, few weeds	0.022–0.027
4. In gravelly soil, uniform section, clean	0.022–0.025
B. Earth, fairly uniform section:	
1. No vegetation	0.022–0.025
2. Grass, some weeds	0.025–0.030
3. Dense weeds or aquatic plants in deep channels	0.030–0.035
4. Sides clean, gravel bottom	0.025–0.030
5. Sides clean, cobble bottom	0.030–0.040
C. Dragline excavated or dredged:	
1. No vegetation	0.028–0.033
2. Light brush on banks	0.035–0.050
D. Rock:	
1. Based on design section	0.035
2. Based on actual mean section:	
a. Smooth and uniform	0.035–0.040
b. Jagged and irregular	0.040–0.045
E. Channels not maintained, weeds and brush uncut:	
1. Dense weeds, high as flow depth	0.08–0.12
2. Clean bottom, brush on sides	0.05–0.08
3. Clean bottom, brush on sides, highest stage of flow	0.07–0.11
4. Dense brush, high stage	0.10–0.14
IV. Highway channels and swales with maintained vegetation [6 7] (values shown are for velocities of 2 and 6 f.p.s.):	
A. Depth of flow up to 0.7 foot:	
1. Bermudagrass, Kentucky bluegrass, buffalograss:	
a. Mowed to 2 inches	0.07–0.045
b. Length 4–6 inches	0.09–0.05
2. Good stand, any grass:	
a. Length about 12 inches	0.18–0.09
b. Length about 24 inches	0.30–0.15
3. Fair stand, any grass:	
a. Length about 12 inches	0.14–0.08
b. Length about 24 inches	0.25–0.13
B. Depth of flow 0.7–1.5 feet:	
1. Bermudagrass, Kentucky bluegrass, buffalograss:	
a. Mowed to 2 inches	0.05–0.035
b. Length 4 to 6 inches	0.06–0.04
2. Good stand, any grass:	
a. Length about 12 inches	0.12–0.07
b. Length about 24 inches	0.20–0.10
3. Fair stand, any grass:	
a. Length about 12 inches	0.10–0.06
b. Length about 24 inches	0.17–0.09
V. Street and expressway gutters:	
A. Concrete gutter, troweled finish	0.012
B. Asphalt pavement:	
1. Smooth texture	0.013
2. Rough texture	0.016
C. Concrete gutter with asphalt pavement:	
1. Smooth	0.013
2. Rough	0.015
D. Concrete pavement:	
1. Float finish	0.014
2. Broom finish	0.016
E. For gutters with small slope, where sediment may accumulate, increase above values of n by	*0.002*
VI. Natural stream channels:[5]	
A. Minor streams [8] (surface width at flood stage less than 100 ft.):	
1. Fairly regular section:	
a. Some grass and weeds, little or no brush	0.030–0.035
b. Dense growth of weeds, depth of flow materially greater than weed height	0.035–0.05
c. Some weeds, light brush on banks	0.035–0.05
d. Some weeds, heavy brush on banks	0.05–0.07
e. Some weeds, dense willows on banks	0.06–0.08
f. For trees within channel, with branches submerged at high stage, increase all above values by	*0.01–0.02*
2. Irregular sections, with pools, slight channel meander; increase values given in 1a–e about	*0.01–0.02*
3. Mountain streams, no vegetation in channel, banks usually steep, trees and brush along banks submerged at high stage:	
a. Bottom of gravel, cobbles, and few boulders	0.04–0.05
b. Bottom of cobbles, with large boulders	0.05–0.07
B. Flood plains (adjacent to natural streams):	
1. Pasture, no brush:	
a. Short grass	0.030–0.035
b. High grass	0.035–0.05
2. Cultivated areas:	
a. No crop	0.03–0.04
b. Mature row crops	0.035–0.045
c. Mature field crops	0.04–0.05
3. Heavy weeds, scattered brush	0.05–0.07
4. Light brush and trees: [10]	
a. Winter	0.05–0.06
b. Summer	0.06–0.08
5. Medium to dense brush: [10]	
a. Winter	0.07–0.11
b. Summer	0.10–0.16
6. Dense willows, summer, not bent over by current	0.15–0.20
7. Cleared land with tree stumps, 100–150 per acre:	
a. No sprouts	0.04–0.05
b. With heavy growth of sprouts	0.06–0.08
8. Heavy stand of timber, a few down trees, little undergrowth:	
a. Flood depth below branches	0.10–0.12
b. Flood depth reaches branches	0.12–0.16
C. Major streams (surface width at flood stage more than 100 ft.): Roughness coefficient is usually less than for minor streams of similar description on account of less effective resistance offered by irregular banks or vegetation on banks. Values of n may be somewhat reduced. Follow recommendation in publication cited [8] if possible. The value of n for larger streams of most regular section, with no boulders or brush, may be in the range of	0.028–0.033

Footnotes to table 1 appear at the top of page 101.

FHA PB 86-179249

SHT. 64

CALCULATION

PROJECT _____ PROJ. NO. _____

CLIENT _____ DATE 6/91

SUBJECT _____ DES. BY JCH

CHK. BY _____

REMARKS

CHANNEL 4

Q10 = 41 cfs (AREAS 6 & 11)

L = 6050 FT.

ΔEL. = 10'

SLOPE = 1.54%

W = 12 FT.

Z = 2:1

CHANNEL 5

Q10 = 44 cfs (AREAS 9, 10 & 12)

L = 6050 FT.

ΔEL. = 3 FT.

SLOPE = 0.46%

W = 12 FT.

Z = 2:1

CHANNEL 6

Q10 = 43 cfs (DISCHARGE FROM EMERG. SPILLWAY)

L = 210 FT.

ΔEL. = 3 FT.

SLOPE = 1.43%

W = 12 FT.

Z = 2:1

McKIM & CREED

JO CO LANDFILL
06-14-1991

CHANNEL NUMBER:4 BEFORE GRASS
LEFT SIDESLOPE= 2 :1
RIGHT SIDESLOPE= 2 :1
BOTTOM WIDTH= 12 FT
FRICTION FACTOR N= .02
% LONG. SLOPE= 1.54
TRIAL DEPTH= .55 FT

WETTED AREA IS 7.205001 SF
WETTED PERIMETER IS 14.45968 FT
HYD. RADIUS IS .4982823 FT
FLOW VELOCITY IS 5.795169 FPS > 2.5 FPS ∴ NEED LINING
FLOW RATE IS 41.75419 CFS

JO CO LANDFILL
06-14-1991

CHANNEL NUMBER:4 TEMP. LINING
LEFT SIDESLOPE= 2 :1
RIGHT SIDESLOPE= 2 :1
BOTTOM WIDTH= 12 FT
FRICTION FACTOR N= .033
% LONG. SLOPE= 1.54
TRIAL DEPTH= .73 FT

WETTED AREA IS 9.8258 SF
WETTED PERIMETER IS 15.26466 FT
HYD. RADIUS IS .643696 FT
FLOW VELOCITY IS 4.165997 FPS
FLOW RATE IS 40.93425 CFS

T= (62.4)(.73)(.0154)
= 0.70 < 1.45 ∴ OK

JO CO LANDFILL
06-14-1991

CHANNEL NUMBER:4 AFTER GRASS
LEFT SIDESLOPE= 2 :1
RIGHT SIDESLOPE= 2 :1
BOTTOM WIDTH= 12 FT
FRICTION FACTOR N= .12
% LONG. SLOPE= 1.54
TRIAL DEPTH= 1.55 FT

WETTED AREA IS 23.405 SF
WETTED PERIMETER IS 18.93181 FT
HYD. RADIUS IS 1.236279 FT
FLOW VELOCITY IS 1.770145 FPS < 4.0 FPS ∴ OK
FLOW RATE IS 41.43025 CFS

SOLUTION OF MANNING'S EQN. FOR PRISMATIC CHANNELS
RAGSDALE CONSULTANTS, P.A., RALEIGH, N.C.

JO CO LANDFILL
06-14-1991

CHANNEL NUMBER:5 BEFORE GRASS
LEFT SIDESLOPE= 2 :1
RIGHT SIDESLOPE= 2 :1
BOTTOM WIDTH= 12 FT
FRICTION FACTOR N= .02
% LONG. SLOPE= .46
TRIAL DEPTH= .82 FT

WETTED AREA IS 11.1848 SF
WETTED PERIMETER IS 15.66715 FT
HYD. RADIUS IS .7139013 FT
FLOW VELOCITY IS 4.025253 FPS > 2.5 FPS ∴ NEED LINING
FLOW RATE IS 45.02165 CFS

JO CO LANDFILL
06-14-1991

JO CO LANDFILL
06-14-1991

CHANNEL NUMBER:5 TEMP. LINING
LEFT SIDESLOPE= 2 :1
RIGHT SIDESLOPE= 2 :1
BOTTOM WIDTH= 12 FT
FRICTION FACTOR N= .033
% LONG. SLOPE= .46
TRIAL DEPTH= 1.1 FT

WETTED AREA IS 15.62 SF
WETTED PERIMETER IS 16.91935 FT
HYD. RADIUS IS .9232034 FT
FLOW VELOCITY IS 2.895668 FPS
FLOW RATE IS 45.23033 CFS

$T = (62.4)(1.1)(.0046)$
$= 0.32 < 1.45$ ∴ OK

JO CO LANDFILL
06-14-1991

CHANNEL NUMBER:5 AFTER GRASS
LEFT SIDESLOPE= 2 :1
RIGHT SIDESLOPE= 2 :1
BOTTOM WIDTH= 12 FT
FRICTION FACTOR N= .12
% LONG. SLOPE= .46
TRIAL DEPTH= 2.3 FT

WETTED AREA IS 38.18 SF
WETTED PERIMETER IS 22.28591 FT
HYD. RADIUS IS 1.71319 FT
FLOW VELOCITY IS 1.202505 FPS < 4.0 FPS ∴ OK
FLOW RATE IS 45.91164 CFS

SOLUTION OF MANNING'S EQN. FOR PRISMATIC CHANNELS
RAGSDALE CONSULTANTS, P.A., RALEIGH, N.C.

JO CO LANDFILL
06-14-1991

CHANNEL NUMBER:6 BEFORE GRASS
LEFT SIDESLOPE= 2 :1
RIGHT SIDESLOPE= 2 :1
BOTTOM WIDTH= 12 FT
FRICTION FACTOR N= .02
% LONG. SLOPE= 1.43
TRIAL DEPTH= .58 FT

WETTED AREA IS 7.6328 SF
WETTED PERIMETER IS 14.59384 FT
HYD. RADIUS IS .5230153 FT
FLOW VELOCITY IS 5.767661 FPS > 2.5 FPS ∴ NEED LINING
FLOW RATE IS 44.02341 CFS

JO CO LANDFILL
06-14-1991

CHANNEL NUMBER:6 TEMP. LINING
LEFT SIDESLOPE= 2 :1
RIGHT SIDESLOPE= 2 :1
BOTTOM WIDTH= 12 FT
FRICTION FACTOR N= .033
% LONG. SLOPE= 1.43
TRIAL DEPTH= .78 FT

WETTED AREA IS 10.5768 SF
WETTED PERIMETER IS 15.48827 FT
HYD. RADIUS IS .6828911 FT
FLOW VELOCITY IS 4.175808 FPS
FLOW RATE IS 44.16668 CFS

T= (62.4)(.78)(.0143)
=

JO CO LANDFILL
06-14-1991

CHANNEL NUMBER:6 AFTER GRASS
LEFT SIDESLOPE= 2 :1
RIGHT SIDESLOPE= 2 :1
BOTTOM WIDTH= 12 FT
FRICTION FACTOR N= .12
% LONG. SLOPE= 1.43
TRIAL DEPTH= 1.63 FT

WETTED AREA IS 24.8738 SF
WETTED PERIMETER IS 19.28958 FT
HYD. RADIUS IS 1.289494 FT
FLOW VELOCITY IS 1.754359 FPS < 4.0 FPS ∴ OK
FLOW RATE IS 43.62757 CFS

CALCULATION

PROJECT _____ PROJ. NO. _____

CLIENT _____ DATE 6/91

SUBJECT _____ DES. BY JCH

CHK. BY _____

REMARKS

CHANNEL 7

L = 850 FT.

ΔEL. = 184 - 166 = 18 FT.

S = 2.12 %

Z = 2:1

W = 12 FT.

Q10 = 28.6 CFS (SEE SED. BASIN 7 DESIGN)

McKIM&CREED

SOLUTION OF MANNING'S EQN. FOR PRISMATIC CHANNELS
RAGSDALE CONSULTANTS, P.A., RALEIGH, N.C.

JO CO LANDFILL
06-17-1991

CHANNEL NUMBER:7 BEFORE GRASS
LEFT SIDESLOPE= 2 :1
RIGHT SIDESLOPE= 2 :1
BOTTOM WIDTH= 12 FT
FRICTION FACTOR N= .02
% LONG. SLOPE= 2.12
TRIAL DEPTH= .4 FT

WETTED AREA IS 5.120001 SF
WETTED PERIMETER IS 13.78886 FT
HYD. RADIUS IS .3713144 FT
FLOW VELOCITY IS 5.588792 FPS > 2.5 FPS ∴ NEED LINING
FLOW RATE IS 28.61462 CFS

JO CO LANDFILL
06-17-1991

CHANNEL NUMBER:7 TEMP LINING
LEFT SIDESLOPE= 2 :1
RIGHT SIDESLOPE= 2 :1
BOTTOM WIDTH= 12 FT
FRICTION FACTOR N= .033
% LONG. SLOPE= 2.12
TRIAL DEPTH= .54 FT

WETTED AREA IS 7.063201 SF
WETTED PERIMETER IS 14.41495 FT T = (02.4)(.54)(.0212)
HYD. RADIUS IS .4899912 FT
FLOW VELOCITY IS 4.075039 FPS = 0.71 < 1.45 ∴ OK
FLOW RATE IS 28.78282 CFS

JO CO LANDFILL
06-17-1991

CHANNEL NUMBER:7 AFTER GRASS
LEFT SIDESLOPE= 2 :1
RIGHT SIDESLOPE= 2 :1
BOTTOM WIDTH= 12 FT
FRICTION FACTOR N= .12
% LONG. SLOPE= 2.12
TRIAL DEPTH= 1.15 FT

WETTED AREA IS 16.445 SF
WETTED PERIMETER IS 17.14296 FT
HYD. RADIUS IS .9592861 FT
FLOW VELOCITY IS 1.753763 FPS < 4.0 ∴ OK
FLOW RATE IS 28.84064 CFS

PROJECT: JO. CO. LANDFILL

DESIGNER: JCH

PIPES #1 THRU #3

DATE: 6/91

*HYDROLOGIC AND CHANNEL INFORMATION

*MAX. FLOW FROM CHANNEL CALS.

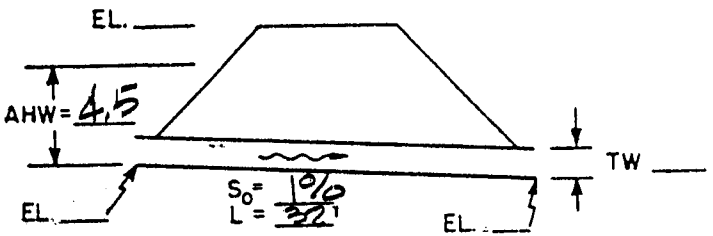
Q_1 = *44 CFS TW_1 = *2.3

Q_2 = ____ TW_2 = ____

(Q_1 = DESIGN DISCHARGE, SAY ~~Q25~~ Q10
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION: ____



MEAN STREAM VELOCITY = ____

MAX. STREAM VELOCITY = ____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL HW=H+h_o−LS_o: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
RCP PROJ.	44	30"	1.75	4.4	.2	2.1	2.25	2.4	2.3	2.4	.32	4.2	4.4	9.4		SEE APRON DESIGN

SUMMARY & RECOMMENDATIONS:

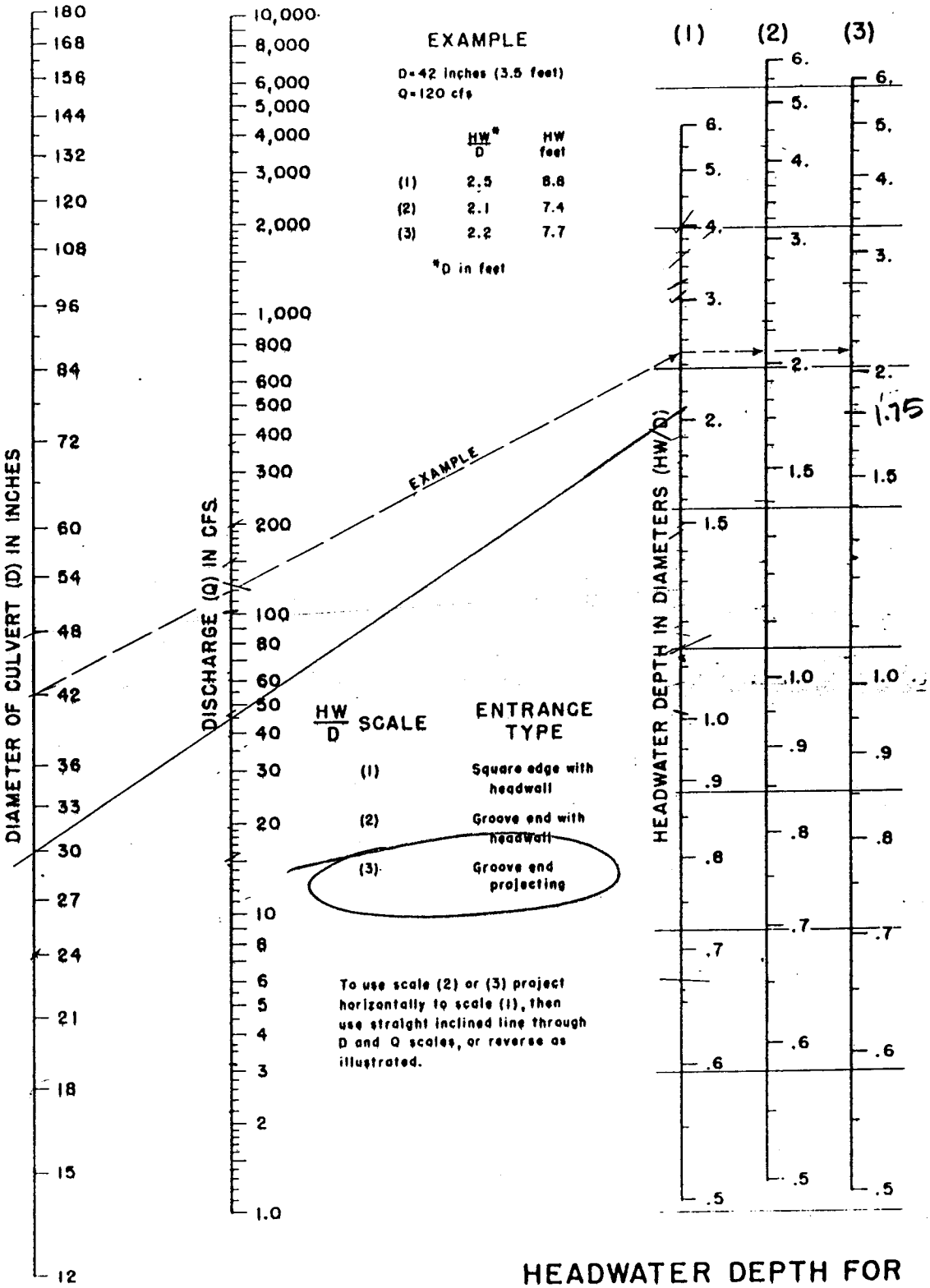
$\frac{Q_{10}}{Q_{FULL}} = \frac{44}{46} = 0.96$

$V = \frac{Q}{A} = \frac{44}{4.7} = 9.4$ fps

$A_{FULL} = (.7854)2.5^2 = 4.91$ FT.^{2}

$A_{10} = (4.91)(.96) = 4.70$

FIGURE 7

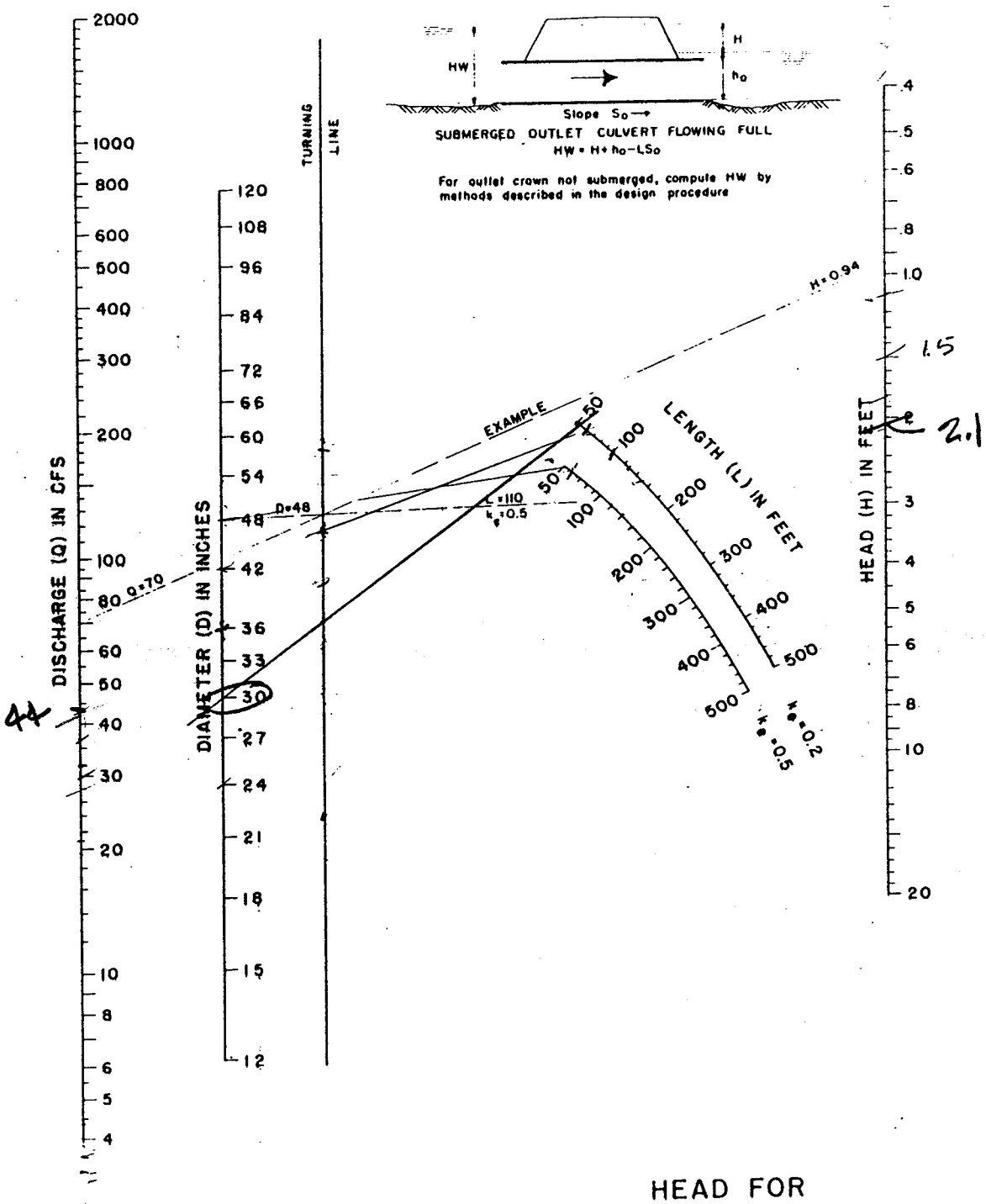


HEADWATER DEPTH FOR CONCRETE PIPE CULVERTS WITH INLET CONTROL

HEADWATER SCALES 283
REVISED MAY 1964

BUREAU OF PUBLIC ROADS JAN 1963

FIGURE 8



HEAD FOR
CONCRETE PIPE CULVERTS
FLOWING FULL
n = 0.012

BUREAU OF PUBLIC ROADS JAN 1963

TABLE 1 - ENTRANCE LOSS COEFFICIENTS

Outlet Control, Full or Partly Full

Entrance head loss $H_e = k_e \frac{V^2}{2g}$

Type of Structure and Design of Entrance	Coefficient k_e
Pipe, Concrete	
Projecting from fill, socket end (groove-end) . . .	0.2
Projecting from fill, sq. cut end	0.5
Headwall or headwall and wingwalls	
Socket end of pipe (groove-end)	0.2
Square-edge	0.5
Rounded (radius = 1/12D)	0.2
Mitered to conform to fill slope	0.7
*End-Section conforming to fill slope	0.5
Beveled edges, 33.7° or 45° bevels	0.2
Side-or slope-tapered inlet	0.2
Pipe, or Pipe-Arch, Corrugated Metal	
Projecting from fill (no headwall)	0.9
Headwall or headwall and wingwalls square-edge . .	0.5
Mitered to conform to fill slope, paved or unpaved slope	0.7
*End-Section conforming to fill slope	0.5
Beveled edges, 33.7° or 45° bevels	0.2
Side-or slope-tapered inlet	0.2
Box, Reinforced Concrete	
Headwall parallel to embankment (no wingwalls)	
Square-edged on 3 edges	0.5
Rounded on 3 edges to radius of 1/12 barrel dimension, or beveled edges on 3 sides . . .	0.2
Wingwalls at 30° to 75° to barrel	
Square-edged at crown	0.4
Crown edge rounded to radius of 1/12 barrel dimension, or beveled top edge	0.2
Wingwall at 10° to 25° to barrel	
Square-edged at crown	0.5
Wingwalls parallel (extension of sides)	
Square-edged at crown	0.7
Side-or slope-tapered inlet	0.2

*Note: "End Section conforming to fill slope," made of either metal or concrete, are the sections commonly available from manufacturers. From limited hydraulic tests they are equivalent in operation to a headwall in both inlet and outlet control. Some end sections, incorporating a closed taper in their design have a superior hydraulic performance. These latter sections can be designed using the information given for the beveled inlet.

FLOW FOR CIRCULAR PIPE FLOWING FULL

BASED ON MANNING'S EQUATION n=0.012

USE THIS FOR INLET CONTROL ONLY

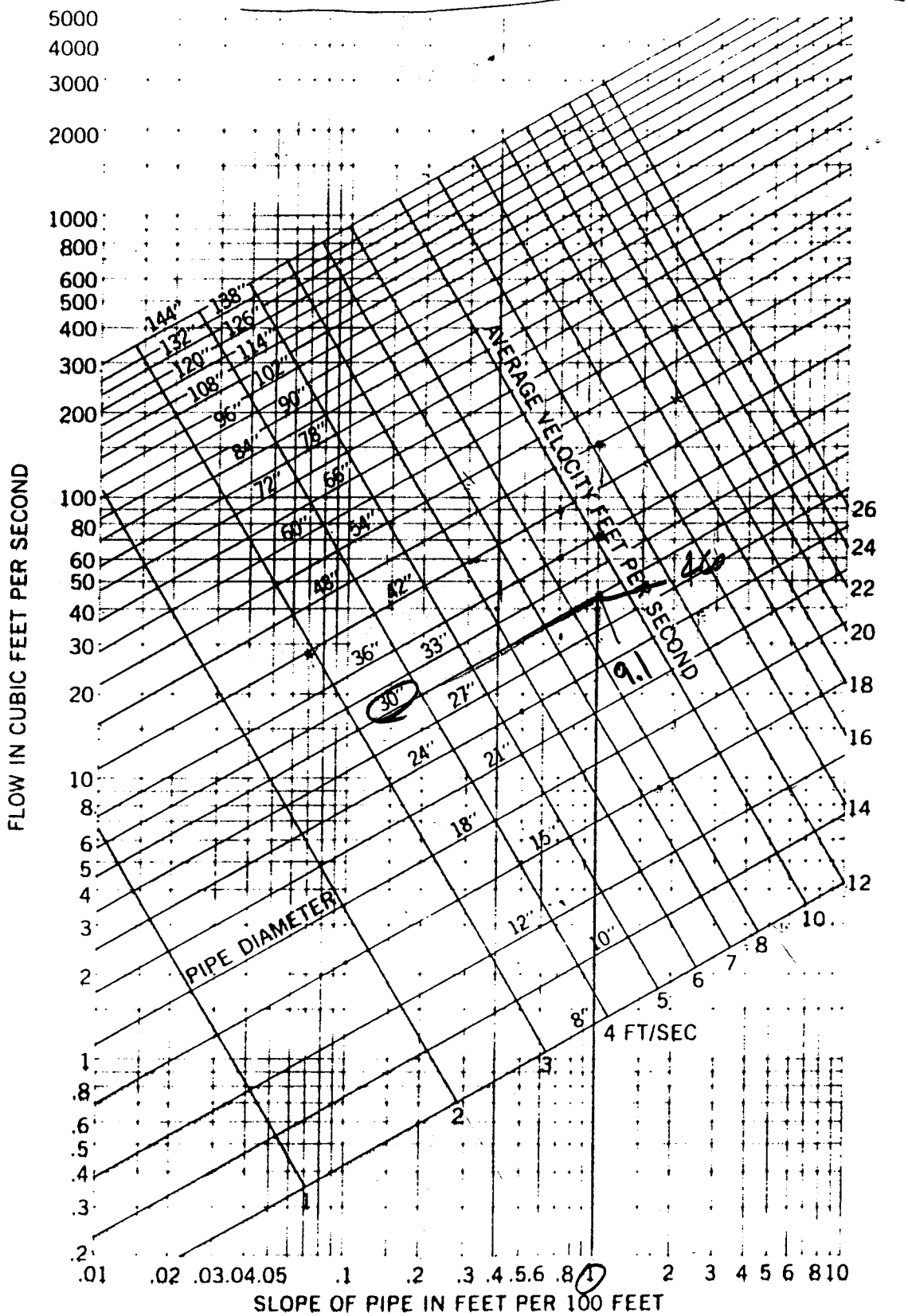
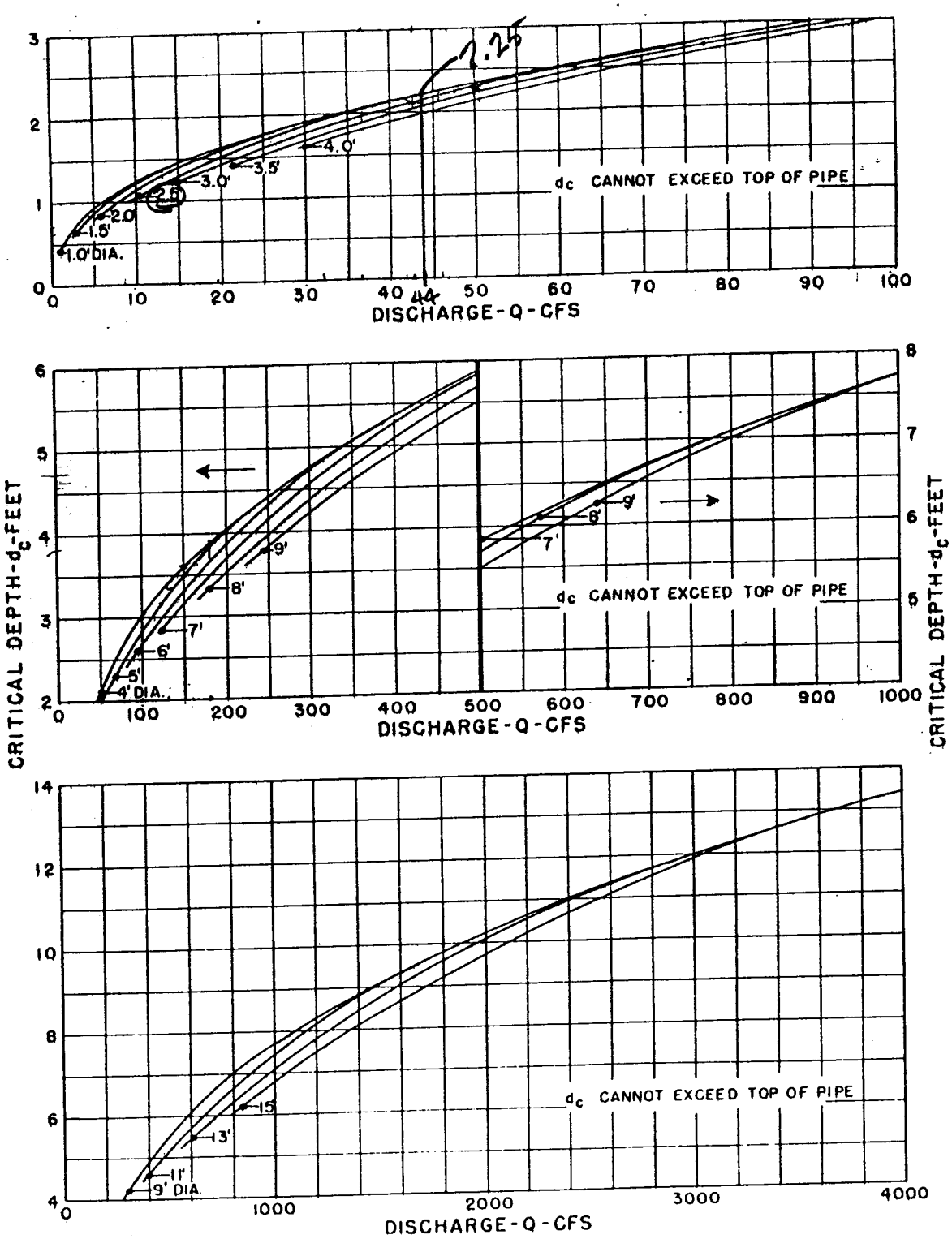


FIGURE 9



BUREAU OF PUBLIC ROADS

JAN. 1964

CRITICAL DEPTH
CIRCULAR PIPE

Stone Sizes For Culvert Aprons

ESTIMATION OF STONE SIZE AND DIMENSIONS FOR CULVERT APRONS

Step i) Estimate flow velocity V_0 at culvert or paved channel outlet.

Step ii) For pipe culverts D_0 is diameter.

For pipe arch, arch, and box culverts, and paved channel outlets, $D_0 = A_0$, where A_0 = cross sectional area of flow at outlet.

For multiple culverts, use $D_0 = 1.25 \times D_0$ of single culvert.

Step iii) For apron grades of 10% or steeper, use recommendation ' higher zone (zones 1 through 6).

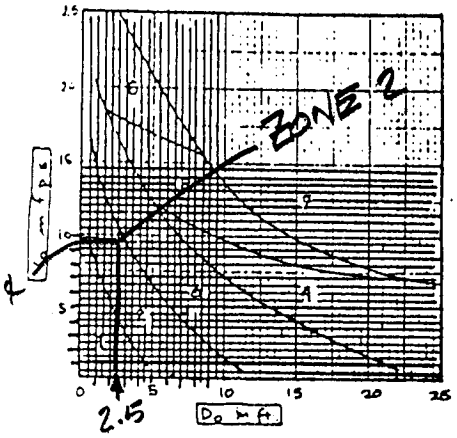


FIGURE 7

ZONE	APRON MATERIAL	LENGTH OF APRON: TO PROTECT CULVERT L_1	LENGTH OF APRON: TO PREVENT SCOUR HOLE L_2
1	Stone Filling (Fine)	$3 \times D_0$	$4 \times D_0$
2	" " (Light)	$3 \times D_0$	$6 \times D_0$
3	" " (Medium)	$4 \times D_0$	$8 \times D_0$
4	" " (Heavy)	$4 \times D_0$	$8 \times D_0$
5	" " "	$5 \times D_0$	$10 \times D_0$
6	" " "	$6 \times D_0$	$12 \times D_0$
7	Special study required (energy dissipators, stilling basin, or larger size stone)		

FIGURE 8

(6)(2.5) = 15 FT.

Source: "Bank and Channel Lining Procedures," New York Department of Transportation, Division of Design and Construction, 1971.

Determination of Stone Sizes for Dumped Stone Channel Linings and Revetments

Step i) Use Fig. 9 to determine maximum stone size (e.g., for 12 fps = 20" or 550 lbs.).

Step ii) Use Fig. 10 to determine acceptable size range for stone (for 12 fps it is 125-500 lbs. for 75% of stone, and the maximum and minimum range in weight should be 25-500 lbs.)

Note: In determining channel velocities for stone linings and revetments, use the following coefficients of roughness:

	Diameter (inches)	Manning's 'n'	Min. Thickness of Lining (inches)
Fine	3	0.031	9
Light	6	0.035	12
Medium	13	0.040	18
Heavy	23	0.044	30

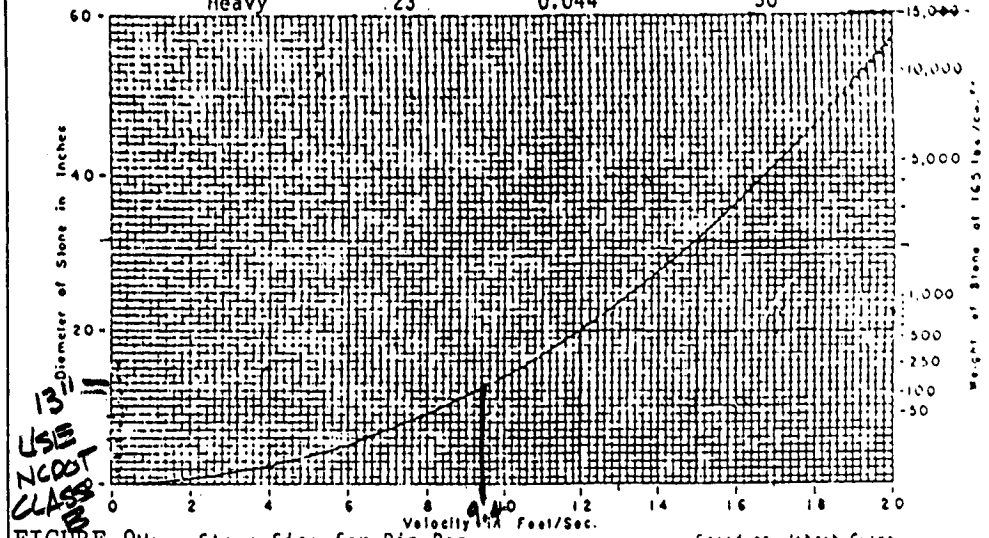


FIGURE 9 Max. Stone Size for Rip Rap

Maximum weight of stone required	Minimum and maximum range in weight of stones	Weight range of 75% of stones
(lbs.)	(lbs.)	(lbs.)
150	25 - 150	50 - 150
200	25 - 200	50 - 200
250	25 - 250	50 - 250
400	25 - 400	100 - 400
600	25 - 600	150 - 600
800	25 - 800	200 - 800
1,000	50 - 1,000	250 - 1,000
1,300	50 - 1,300	325 - 1,300
1,600	50 - 1,600	400 - 1,600
2,000	75 - 2,000	600 - 2,000
2,700	100 - 2,700	800 - 2,700

FIGURE 10 Gradation of Rip Rap

CALCULATION

PROJECT _____ PROJ. NO. _____

CLIENT _____ DATE _____

SUBJECT _____ DES. BY _____

CHK. BY _____

	REMARKS
APRON / PIPES 1 - 3 L = 15 FT. STONE SIZE = NCDOT CLASS "B" W/ 6" FILTER THICKNESS = (15") (1.5) = 22.5", USE 24"	(F.S. 2)

McKIM & CREED

CALCULATION

PROJECT _____ PROJ. NO. _____

CLIENT _____ DATE 6/91

SUBJECT _____ DES. BY JCH

CHK. BY _____

	REMARKS	
TOTAL VOLUME / FILL		
PHASE II	329,593	C.Y.
PHASE III	400,131	C.Y.
TOTAL	729,724	C.Y.
VOLUME AVAIL. / SOLID WASTE		
TOTAL	729,724	C.Y.
LESS FINAL COVER (33.6 AC. X 2' D)	- 108,416	C.Y.
SUBTOTAL	621,308	C.Y.
LESS WORKING COVER (2.7 : 1 RATIO)	- 230,114	C.Y.
TOTAL AVAILABLE	391,194	C.Y.
LIFESPAN		
PHASE II & III @ 244,186 C.Y. / YR.	1.6 YRS.	
REMAINING PHASE IV	1.5 YRS.	
TOTAL LIFE REMAINING	3.1 YRS.	

McKIM & CREED

CALCULATION

PROJECT _____ PROJ. NO. _____

CLIENT _____ DATE 6/91

SUBJECT _____ DES. BY JCH

CHK. BY _____

		REMARKS
CHECK BORROW VOL.		
VOL. REQ'D.		
FINIAL COVER	108,416 C.Y.	
WORKING COVER	230,114 C.Y.	
TERRACES	14,311 C.Y.	
FILL @ BORROW SITE	2,344 C.Y.	
TOTAL REQ'D.	355,185 C.Y.	
VOL. AVAILABLE	566,146 C.Y.	∴ OK

McKIM & CREED

State of North Carolina
Department of Environment, Health, and Natural Resources
Raleigh Regional Office

James G. Martin, Governor
William W. Cobey, Jr., Secretary

Edmond John Maguire
Regional Manager

JUL 15 1991

DIVISION OF LAND RESOURCES
July 12, 1991

County of Johnston
PO Box 1049
Smithfield, NC 27577
ATTN: Norman Denning, Chairman
Board of County Commissioners

RE: Letter of Approval
Project Name: Vertical Landfill Expansion
Location: Johnston County
Submitted by: Division of Solid Waste Management
Date Received: 6-28-91
Date Processing Initiated: 6-28-91
New Submittal ( ) Revised (X)

Dear Mr. Denning:

This office has reviewed the subject Erosion and Sedimentation Control Plan. We find the plan to be acceptable and hereby issue this letter of approval. If any modifications, performance reservations, or recommendations are applicable, a list is enclosed and is incorporated as a part of this letter of approval. If any modifications are not incorporated into the plan and implemented in the field, the site will be in violation of the Sedimentation Pollution Control Act of 1973 (NCGS 113A-61.1).

Please be advised that Title 15A, North Carolina Administrative Code, 4B.0018(a) requires that a copy of the approved plan be on file at the job site. Also, please consider this letter as notice in accordance with the requirements of North Carolina General Statute (hereinafter NCGS) 113A-61.1 concerning our right to perform periodic inspections to ensure compliance with the approved plan.

North Carolina's sedimentation pollution control program is performance oriented, requiring protection of the natural resources and adjoining properties. If at any time during this project it is determined that the Erosion and Sedimentation Control Plan is inadequate to meet the requirements of the Sedimentation Pollution Control Act of 1973 (NCGS 113A-51 through 66), this office may require revisions in the plan and its implementation to ensure compliance with the Act.

3800 Barrett Drive, Suite 101 • Raleigh, N.C. 27609
Telephone (919) 733-2314 • FAX Number (919) 733-7072

An Equal Opportunity Affirmative Action Employer

Please note that this approval is based in part on the accuracy of the information provided concerning financial responsibility. You are requested to file an amended Financial Responsibility Form if any changes become necessary. In addition, it would be helpful if you would notify this office of the proposed starting date for the activity at the subject site.

Your cooperation is appreciated and we look forward to working with you on this project. If there are any questions, please do not hesitate to contact this office.

Sincerely,

John L. Holley, ~~Jr., P.E.,~~ CPESC
Regional Engineer
Land Quality Section
Raleigh Regional Office

JLH/ga

cc: Suzanne Molloy
McKim & Creed

PLAN REVIEW COMMENTS

Project Name: Vertical Landfill Expansion

Date Received: 6-28-91

Date Processing Initiated: 6-28-91

Location: Johnston County Reviewed By: JLH

New Submittal ( ) Revised (X) Approved (X) Disapproved ( )

Reasons for Disapproval ( ) Modifications (X) Performance Reservations ( )

1. Based on the submitted data, at least 2.7 cubic feet of concrete must be added to the anti-flotation block at basin #7 before it is put into service. This is because the buoyant weight (87.6 pcf) of the concrete must be considered. The other basins appear to be adequate with respect to this issue.

2. Based on the anticipated outlet velocities, the outlet aprons for slope drains 1-3 must be constructed with Class B stone, at least 22" deep.

3. Where fill is placed around the entrance to the slope drains, it must have a top elevation at least 1' above the top of the pipe to ensure that adequate freeboard is generally provided. For slope drain #4, the top of the fill must extend sufficient to provide for the 3.3' required headwater.

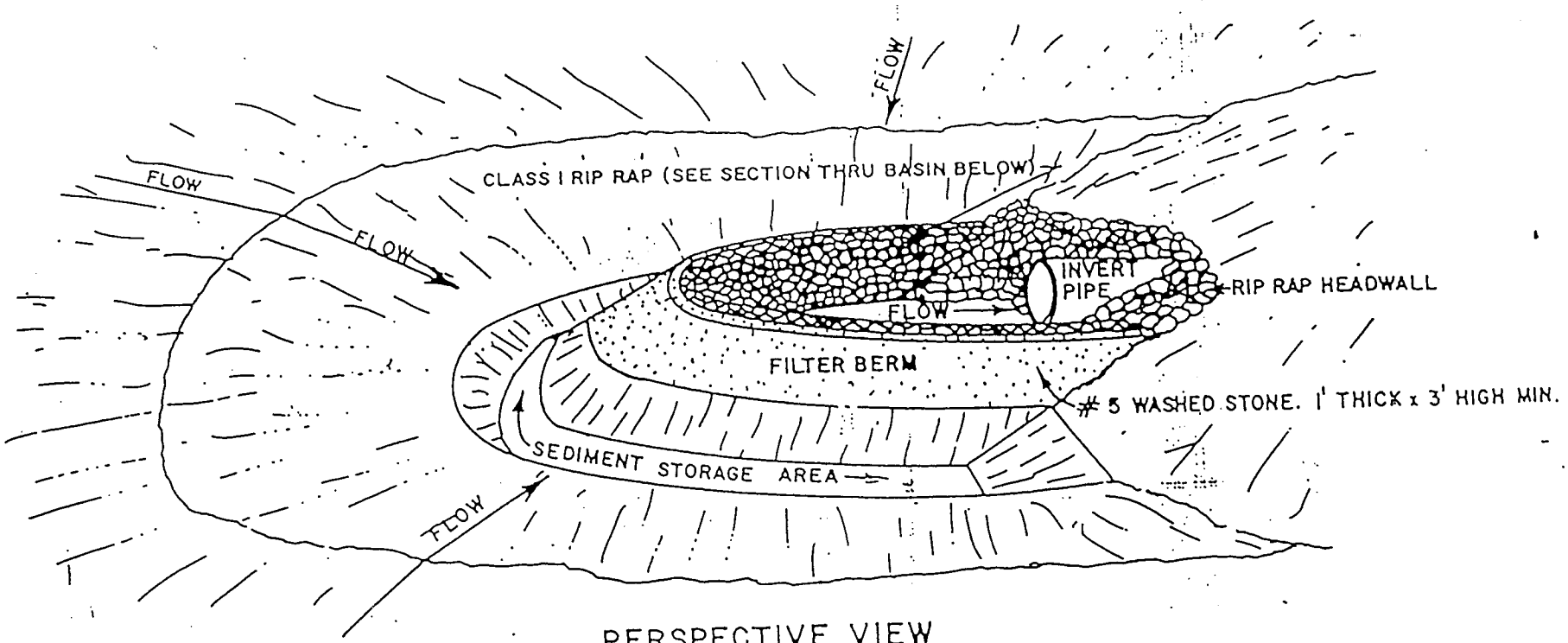
4. The silt fence proposed below basin 6 must be replaced with a stone check dam in the receiving channel.

5. The check dam at the existing 30" RCP below basin 8 must be constructed in accordance with the enclosed detail.

General Recommendations and/or Comments:

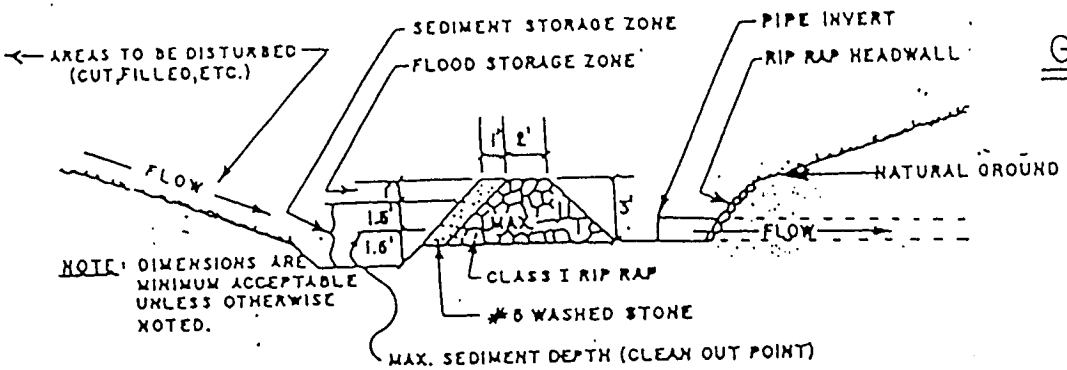
This site was inspected on 7-10-91, and it was discovered that the ridge beyond (north of) basin 7 and the channel below basin 7 have been disturbed to accommodate borrow activities. A revised plan must be provided to address this area. It must include close out of the unauthorized borrow activity and incorporation of the affected area into this plan. It must also include a stone check dam at the ditch outlet below basin 7 as well as a properly designed permanent outlet channel through this area.

This revised plan as well as revised record drawings addressing the above modifications must be received in this office by July 30, 1991.



PERSPECTIVE VIEW

NO SCALE



SECTION THRU BASIN, FILTER AND CULVERT PIPE

NO SCALE

GRAVEL & RIP RAP FILTER BERM BASIN DETAIL

TO PROTECT EXISTING PIPE INVERTS THAT DRAIN 10 ACRES OR LESS

PREPARED BY: WAKE COUNTY COMMUNITY DEVEL[illegible]MENT SERVIC
P.O. BOX 550 RALEIGH N.C. 27602 [illegible] 755-6[illegible]

State of North Carolina
Department of Environment, Health, and Natural Resources
512 North Salisbury Street • Raleigh, North Carolina 27611

James G. Martin, Governor

DIVISION OF LAND RESOURCES

William W. Cobey, Jr., Secretary

July 2, 1991

SOLID WASTE SECTION
JUL 02 1991

County of Durham
PO Box 1049
Smithfield, NC 27577
ATTN: Norman Denning, Chairman
Board of County Commissioners

RE: Letter of Receipt for Revised Plan
Project Name: Vertical Landfill Expansion
Location: Johnston County
Submitted by: Div. of Solid Waste Management
Date Received: 6-28-91
Date Processing Initiated: 6-28-91

Dear Mr. Denning:

This office has received a Revised Erosion and Sedimentation Control Plan for the subject project in accordance with the Sedimentation Pollution Control Act of 1973.

Please be advised that this Act requires that the approving authority must approve or disapprove a revised plan within 15 days of receipt of a complete application (Date Processing Initiated). Failure of the approving authority to approve or disapprove the submitted plan within the 15 day period will be deemed approval of the plan.

Pending approval, commencement or continuation of any land-disturbing activity associated with this project is subject to the conditions of our previous correspondence.

We will complete our review of the proposed plan as soon as possible and will notify you concerning approval or disapproval. If you have any questions or need additional information please do not hesitate to contact this office. Your cooperation in this matter is appreciated.

Sincerely,

John L. Holley, Jr., P.E., CPESC
Regional Engineer
Land Quality Section

cc: Suzanne Malloy
McKim & Creed
JLH

State of North Carolina
Department of Environment, Health, and Natural Resources
Division of Solid Waste Management
P.O. Box 27687 · Raleigh, North Carolina 27611-7687

James G. Martin, Governor
William W. Cobey, Jr., Secretary

William L. Meyer
Director

June 25, 1991

Mr. John Holley
Raleigh Regional Office
Land Quality Section
3800 Barrett Drive
P. O. Box 27687
Raleigh, North Carolina 27611

RE: Soil Erosion and Sedimentation Control Plan, Johnston County Landfill, Amendment to Permit No. 55-01

Dear Mr. Holley:

Please review the enclosed construction plans for the referenced facility to determine if the proposed land disturbing activities are in compliance with NCAC Title 15 Chapter 4.

All comments from your review will be incorporated into the conditions of the solid waste permit.

If there are any questions, please call me at (919)733-0692.

Sincerely,

Suzanne Molloy

Suzanne Molloy
Environmental Engineer
Solid Waste Section

ENCLOSURE

cc: McKim & Creed
Fred Wood
Terry Dover
Haywood Phthisic

McKIM & CREED

SOLID WASTE SECTION
JUN 24 1991

June 20, 1991

M&C00010.43

ENGINEERS

PLANNERS

SURVEYORS

Ms. Suzanne Molloy
Environmental Engineer
Solid Waste Section
Division of Solid Waste Management
P. O. Box 27687
Raleigh, North Carolina 27611-7687

RE: Amendment To Permit No. 55-01, Vertical Expansion of Johnston County Landfill, North Carolina

Dear Ms. Molloy:

On behalf of Johnston County, we are submitting herewith four (4) copies of plans and applicable calculations for an amendment to Permit No. 55-01 for the Johnston County Landfill. As we have discussed previously with you, the proposed amendment is for deletion of the proposed fill area between phases 3 and 4 of the original landfill plan. We trust you will find the proposed revisions in order and approvable.

Please note that we have modified the sedimentation and soil erosion control facilities in accordance with the change in scope.

The drawings now accurately show the location of all monitoring wells. All wells are in place and complete with the exception of wells no. 1 and 10 which have been installed but are in the process of being developed. Well logs have been submitted on all wells except nos. 1 and 10. Logs on these units will be forwarded within the next few days.

5580 CENTERVIEW DRIVE, SUITE 100

RALEIGH, NC 27606

919/233-8091

919/233-8031

Haywood Phillips
Johnston Co. Utility Dept.
P.O. Box 2263
Smithfield, N.C. 27577

We trust you will find this submittal complete. Please do not hesitate to call me or Mr. Jerry Hodge if you have any questions, or require any additional information.

Very truly yours,

McKIM & CREED ENGINEERS, P.A.

Timothy G. Broome

Timothy H. Broome, P.E.
Senior Project Manager

TGB/nh

CC: Mr. Haywood Phthisic
Mr. Richard Self
Mr. John Holly

P. S. We have conferred with Mr. John Holly of the Land Quality Division and Mr. Holly has advised that no further permit fee or responsibility form are required for these revisions.

McKIM&CREED

Johnston Co. May 29, 1991

Tim Broome, Haywood Lathrie, Jerry Hodge

Talked to Fred Wood.

That LF is one of the best operated sites.

Is it a violation under construction. (Jim says field staff).

Will issue N.O.V.
Fred is pleased w/ operation, but technically GW falls under

R.B. Howell finally

Want to revise plans for less life because have new LF sited & are encroaching on Wetlands.

- Hit rock below new well # 1 (ABANDONED) so didn't get new well
- Stick 1 well beside # 1 (of hole)
- " " " NW of well # Downgradient of Phase III
- Sample wells ensemble. Get wells w/in month. Sample 2 weeks later.
- Haywood is contact

Johnston County wants to make changes to reduce fill area. Changes to change direction of water flow. Have put in some of wells, but not all. Have failed to meet their deadline for ground water.