FINAL DRAINAGE REPORT

Redevelopment of 2025 South College Avenue

(Total Petroleum, Inc.)

Donohue & Associates, Inc.
4710 South College Avenue
Fort Collins, Colorado 80525

February 1987

Introduction

This report describes the drainage characteristics for the Total Petroleum site (2025 S. College Avenue). The existing site (see Exhibit 1 - Grading Plan) is only half developed. The west half drains north into Spring Court, to Johnson Drive, and ultimately to Spring Creek. The east half drains to College Avenue and then to Spring Creek. This flow pattern will remain the same under the proposed development, however, on-site detention within the rear parking lot will be used to control storm water release to the 2-year, historic rate.

Design Flows and Subbasins

Flows were calculated using the Rational Formula for the 100-year and 2-year storm events. These are shown on the attached exhibit along with flow arrows and grading contours. The contribution of flow from the east side of the site to College Avenue is 1.37 cfs during the 100-year event and 0.4 cfs during the 2-year event. The flow off the back (west) side of the site is 2.6 cfs for the 100-year event and 0.86 cfs for the 2-year event (see exhibit). The two other subareas on the site are grassed areas comprising 0.12 acres located at the extreme west part of the site.

Storm Water Detention

Storm water will be held in the rear parking lot, bounded on the west by a retaining wall. The retained water amounts to approximately 1800 cubic feet. A release structure will be constructed to control flow west to Spring Court to 0.5 cfs. The flow control device consists of a manhole lid with drilled holes, and a drop structure.

Erosion Control

The erosion control plan for the construction phase of the off-site and site improvements includes the use of filter fence and filter berms to confine mud generated by construction activities to the construction area. Use of filter berms at the end of construction on Spring Court and at the site entrance to College Avenue will retain sediment carried by drainage flows. Filter fences will be used where grades will cause drainage from the construction area to leave the area. The site parking area will be paved and the landscaped areas sodded shortly after grading is completed. Offsite areas disturbed will be plowed and seeded. Erosion control measures will be removed after completion of site coverage.

The potential for erosion once the site is completed is minimized by the use of sod, gravel mulch and paving to cover the entire site. The drainage channel includes a concrete trickle channel for channel protection. All drainage flows are confined to paved areas or the paved trickle channel.

Impacts

The proposed improvement will not significantly impact downstream facilities during either major or minor storm events because storm water releases will not significantly exceed historical releases.

Revisions

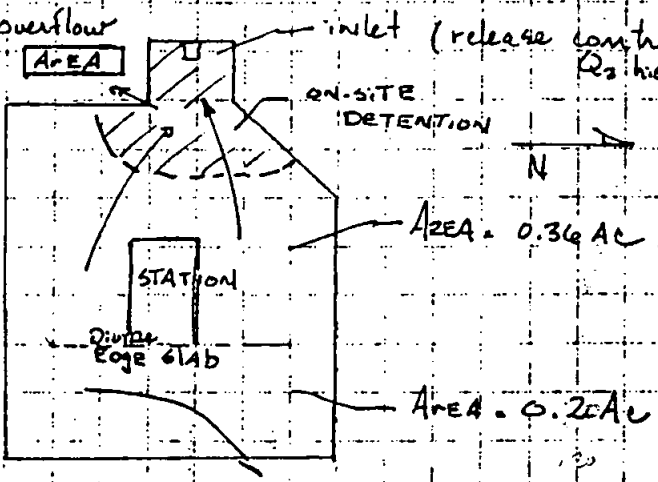
DONOHUE & ASSOCIATES, INC.

CONSULTING ENGINEERS

FORT COLLINS, COLORADO

CLIENT Total Petroleum — DATE 2-12-87
on-site improvements
PROJECT Vickers Site — BY MWK
PROJECT NO. 237.002 — PAGE NO. 1/7

GENERAL



College

Refer to grading plan. On-site detention provided for 0.36 acres, with a controlled release rate of 0.50 cfs. East 0.20 acres of site will be undetained and flow into College, releasing 1.37 cfs (Q_{100})

To Detention.	Q_{100} = 2.6 cfs max	$Q_{2\ hist}$ = 0.5 cfs
To College	Q_{100} = 1.37 cfs max	$Q_{2\ hist}$ = 0.4 cfs

(See detailed calcs. on sheet 2)

Required detention volume to maintain flood elevation is 1800 ft³, corresponding to an elevation of 90.0 ft.

Contributing Area

Sub Area 1 = 0.36 Ac. (to detention)

$Q_{100} = (1.25)(0.95)(7.2)(0.36) = 2.6$ cfs (use 1.0, T = 10 min)

$Q_2 = (0.95)(2.5)(.36) = 0.86$ cfs (T = 30 min)

$Q_{2\,(HIST)} = (1)(0.85)(1.46)(0.36) = 0.45$ say 0.5 cfs

$Q_{2\,(HIST)}$ is the allowable release rate from the west inlet.

Subarea 2 0.20 Ac (to College)

$T = 10$ min $Q_{100} = (1.25)\,C\,(7.2)\,0.20 = 1.37$ cfs

$T = 10$ min $Q_2 = (0.76)(2.5)(.20) = 0.38$ cfs

$C = \dfrac{(0.05)(0.25) + (0.15)(0.95)}{.20} = 0.76$

$T_c = 30$ min Q_2 Hist $= (1)(.85)(2.5)(0.20) = 0.42$ say 0.4 cfs

For Subarea 1 detention

$Q_{100} = (.95)(1.25)(i)(0.36) = 0.36\ i\ \Delta T$ (use 1)

0.5 cfs

Time (min)	i 100 (in/hr)	Σ Runoff	Σ Discharge	Detention Vol.
10	7.2	1555	300	1255
15	6	1944	450	1494
20	5.19	2242	600	1642
30	4.17	2702	900	1802 ← max.
60	2.6	3370	1800	1570
90	1.87	3635	2700	935
120	1.44	3732	3600	
180	1.05	4082	5400	

Subarea 3 and 4 0.06 ac each $Q_{100} = (1.2)(1.25)(7.2)(.06) = .011$ cfs

$C = 0.20$ (grass) $Q_2 = (1.2)(2.5)(.06) = 0.03$

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PROJECT Vickers
PROJECT NO.

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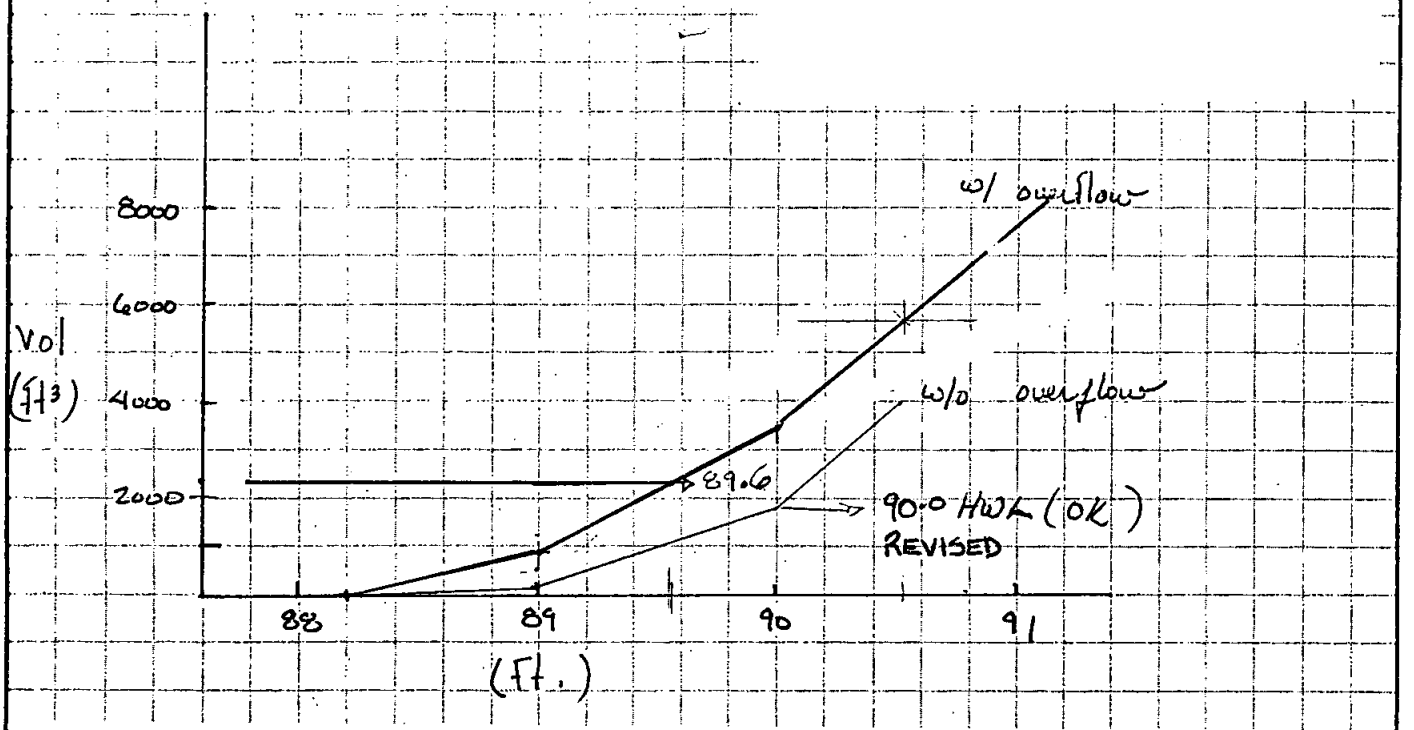
Incremental

Area 88.2 =	0 ft²		+ overflow*		
Area 89 =	483 ft²	V_{89} = 129	+ 758	= 887	∀ 89
Area 90 =	3210 ft²	+ V_{90} = 1775	+ 1664	3439	∀ 90
Area 90.5 =	5695 ft²	+ $V_{90.5}$ = 3967	+ 1664	5631	∀ 90.5



Existing Site Hydrology:

Total Area: 0.72 ac.
Rational "C": 0.72
Onsite runoff: Q_2: 1.3 cfs Q_{100} = 4.7 cfs

Developed Site Hydrology:

Design Point	Basin	Area	C	Q_2 (cfs)	Q_{100} (cfs)
1	1	0.36	0.95	0.86	2.6
2	2	0.20	0.76	0.40	1.4
3	3	0.06	0.20	0.03	0.11
4	4	0.06	0.20	0.03	0.11

Detention Summary:

Ponding Area at Back of paved Area drains 0.36 Ac. (Area 1)
Max. release is 0.5 cfs
Volume is 1800 cubic feet

Drainage Basin Characteristics:

Gross platted and Not Area: 0.717 ac.
Gross and Not Area C: 0.77
Onsite detention: 2510 cf/ac.

Composite 'C' factor (Existing)

LOT 12 0.357 ac. bare dirt @ 2-10% slope say C = 0.50

LOT 8 0.360 ac. highway, business C = 0.95*

* from C. of F.C. drainage criteria manual

$$\frac{0.357(0.50) + 0.360(0.95)}{0.717} = 0.72 \rightarrow \text{current 'C' value}$$

T_c: 10 min. $Q_{100} = (1.25)(0.72)(7.2)(.72) = 4.7$ cfs

" $Q_2 = (1)(.72)(2.5)(.72) = 1.3$ cfs

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on-site improvements
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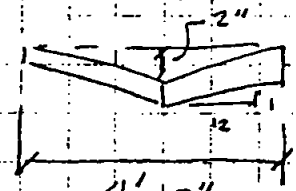
gross Area C - (proposed development)

$$= \frac{(.36)(.95) + (.20)(.76) + (.12)(.20) + (.04)(.95)}{.72} = 0.77$$

.95 pvmt, roof
.76 (from p. 2)
.20 grass

Design cut kit (channel/pan)

For Q = 0.5 cfs, all flow w/in Valley pan.



use a 4' pan
w/ 12:1 ss
S = 1%
n = 0.016
$AR^{2/3}$ = 0.0537
y = 0.46' 0.0564 ok
y = 5.5 in ok

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PROJECT 2029 S. College BY R. Tenney
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REVISED 3-11-87 RDT

Storm drainage outlet design

Release rate 0.5 CFS
approx. ponding depth 1.8'

use orifice equation $Q = C_o \sqrt{2gh}$ - full contraction

C = ?

TABLE 21-9
Std. Handbook for C.E., Merritt

C ranges from
0.644 @ 0.07' dia. to
0.608 @ 0.1" dia

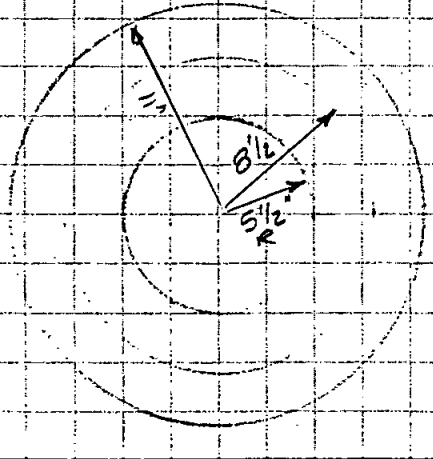
use C = 0.60 (0.08" ϕ holes), (0.005 SF/ea)

$0.5 = (0.6) A \sqrt{2gH}$ $A = 0.0774$ SF $\simeq 11$ in²

15.4 holes

in symatrical pattern

22" O.D. r = 11" 2 rows 1 @ 5.5" radius C = 34.6" 7.86
1 @ 8.5" radius c = 53.4" 12.14



15 - 1" ϕ holes
5 1/2" R → 5 @ 6 15/16" O.C.
8 1/2 R → 10 @ 5 5/16 O.C.

Neenah R-4055 Med. Duty Cover
w/ 20 1" ϕ holes drilled thru

1 extra hole due to 1" ϕ lifting hole in center

DRAINAGE GRATES

R-4030 Series Heavy Duty Grates

R-4040 Series Light Duty Grates

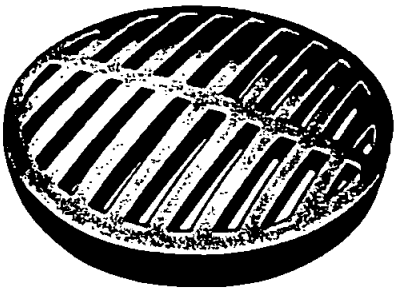
Designed to fit in bell end of standard sewer pipe.

Bell and spigot vitrified clay and concrete pipe are made under many specifications and dimensions vary. Check the grate sizes in the table to be sure they will fit the pipe you are using.

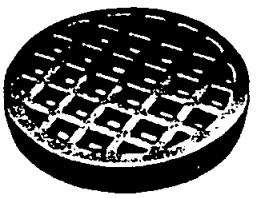
If specified, special lug arrangement is available on R-4040 series which modifies grate to fit corrugated metal pipe in sizes indicated.

Weight in Pounds		Dimensions in inches		
Heavy Duty	Light Duty			
R-4030	R-4040	Pipe Size	Grate Dia.	Grate Thickness*
6‡	4	4	5¾	1½
13‡	8	6	8	2
25‡	11	8	10⅜	2¼
25‡	14	10	12⅜	2½
38‡	32	12	14¾	2½
70‡	55	15	18¼	2¾
115†**⊗	75	18	22	2¾
200†**⊗	100	21	25½	3
210†**	140	24	29	3¼
290**	155	27	32¾	3½
300**⊗	180⊗	30	36	3¾
525**	300⊗	36	42	4

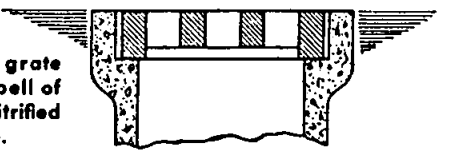
*For light duty series this figure includes legs. **Slotted openings.
†Slight Crown. ‡Square openings. ⊗Not recommended for bicycle traffic.
For safety standards see pages 94 to 99.



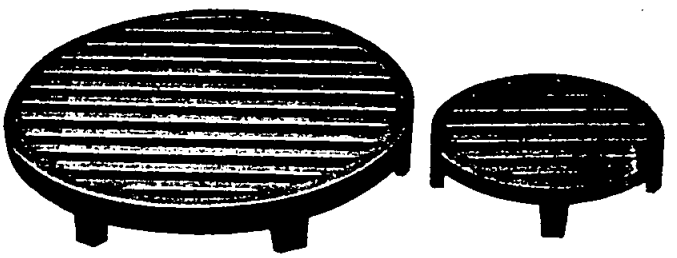
R-4030 Type Grate**



R-4030 Type Grate‡



Showing grate placed in bell of standard vitrified sewer pipe.



R-4040 Type Grate with Legs

Specify:

1. Catalog number.
2. Pipe size.
3. Lugs on R-4040 for corrugated pipe if required.

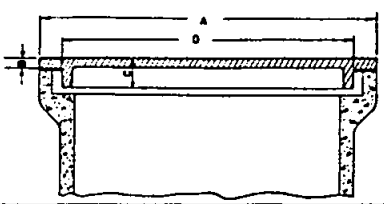
R-4044 Series Manhole Lids to Fit Over Pipe Bell

Medium Duty

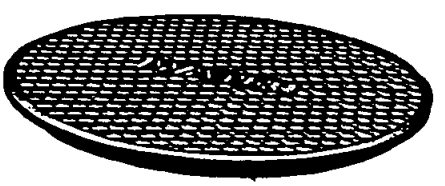
Bell and spigot vitrified clay and concrete pipe is made under many specifications and dimensions vary. Check the lid size in the table to be sure they will fit the pipe you are using.

Specify:

1. Catalog number.
2. Lettered as shown or without lettering.



Catalog No.	For Pipe Size	Dimensions in inches A	B	C	D	Wt. Lbs.
R-4044-A	4	7⅛	½	1¼	5⅜	7
R-4044-B	6	9½	½	1½	7¾	13
R-4044-C	8	12¼	½	2	10¼	20
R-4044-D	10	14¾	½	2¼	12¾	30
R-4044-E	12	17¼	⅝	2¼	14½	50
R-4044-F	15	21¼	⅝	2¼	17	53
R-4044-G	18	25½	⅝	2½	21¾	111
R-4044-J	21	29½	¾	2½	24⅞	150
R-4044-K	24	33¼	¾	2½	29¼	185
R-4044-L	30	42	⅞	2¾	35¾	340
R-4044-M	36	49¼	⅞	2¾	42½	435



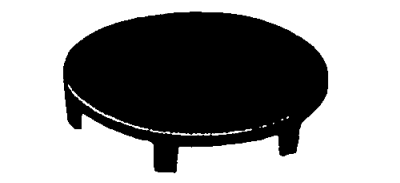
R-4055 Series Covers to Fit in Sewer Pipe Bell

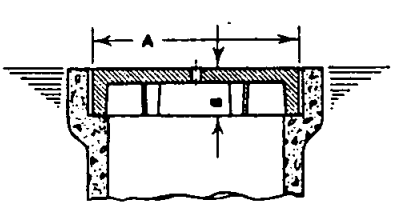
Medium Duty

Supplied with 1" lift hole as standard. Available without lift hole if so specified.

When ordering, advise pipe size. Remember, bell and spigot vitrified clay and concrete pipe is made under many specifications and dimensions vary. Check the cover size in the table to be sure they will fit the pipe you are using.

Catalog No.	Pipe Size	Dimensions in inches A	B	Wt. Lbs.
R-4055-4	4	5¾	1½	5
R-4055-6	6	8	2	8
R-4055-8	8	10⅜	2¼	15
R-4055-10	10	12⅜	2½	22
R-4055-12	12	14¾	2½	30
R-4055-15	15	18¼	2¾	45
R-4055-18	18	22	2¾	50
R-4055-21	21	25½	3	110
R-4055-24	24	29	3¼	140
R-4055-27	27	32¾	3½	170
R-4055-30	30	36	3¾	240
R-4055-36	36	42	4	365





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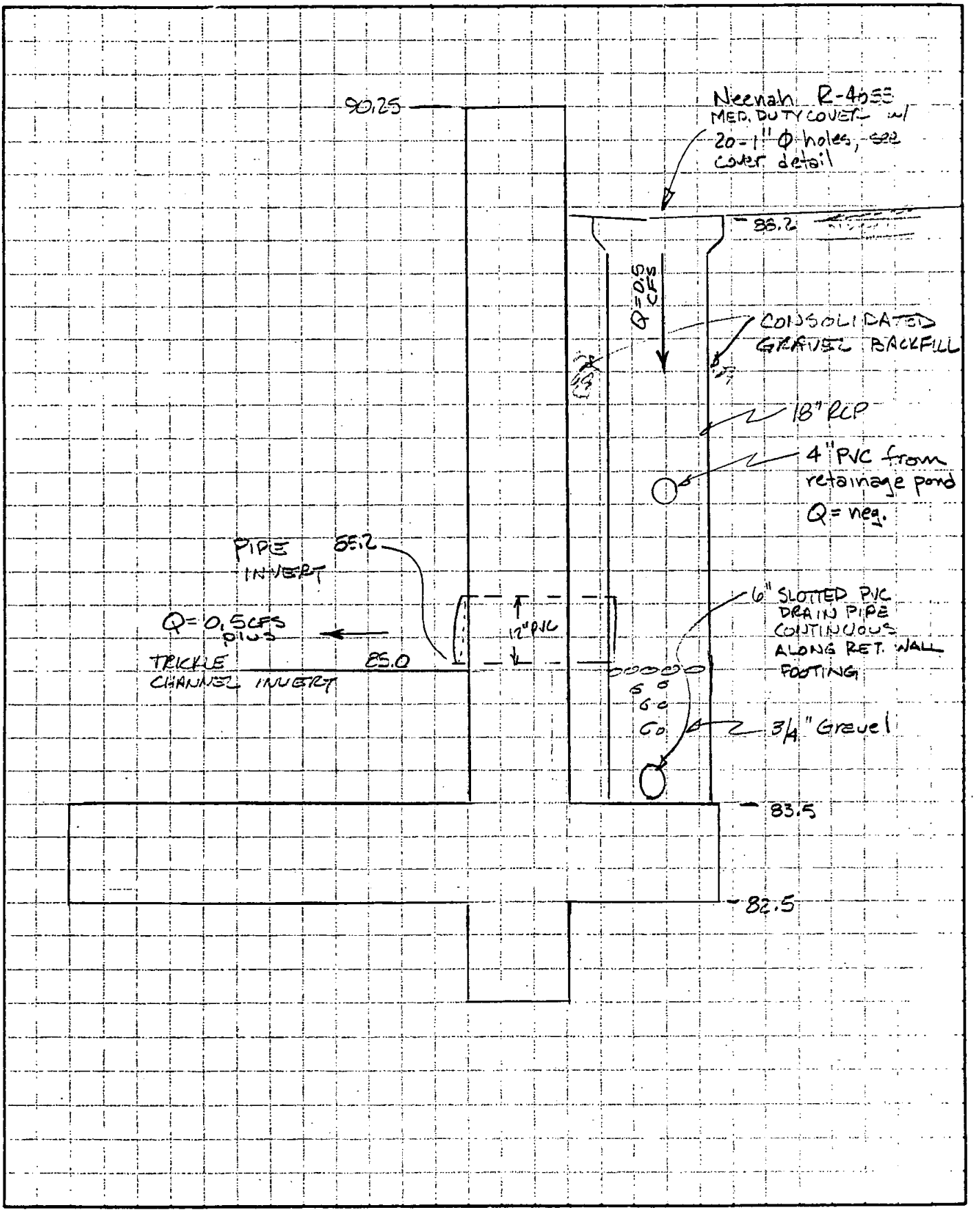


CONTROL TECHNIQUE F

FILTER FENCE

DEFINITION

A low fence made of filter cloth and fencing material.

PURPOSE

To filter runoff water prior to discharge.

APPLICABILITY

Any construction site or other site of disturbance where the danger of discharge of sediment-laden water exists. This is a temporary measure and should be removed when no longer needed.

PLANNING CRITERIA

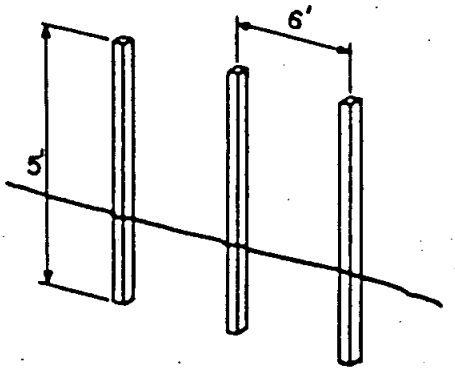
A filter fence can be substituted for a filter berm at approximately equal cost, but the filter fence is easier to maintain and remove. Care must be taken to insure that all runoff water must pass through, not over, under or around, the filter cloth. This only applies to sites which will not be subjected to significant hydrostatic pressure or to vehicular traffic.

METHODS AND MATERIALS

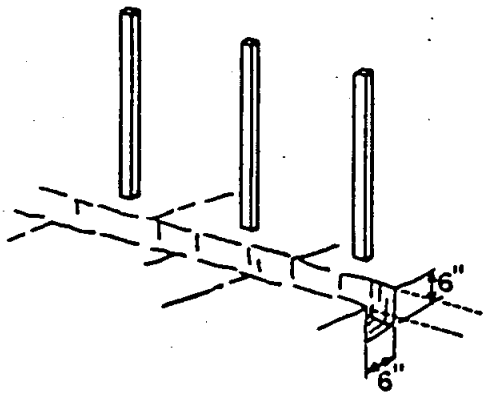
- The filter fence shall be designed to filter the design storm without overtopping, collapsing, becoming sedimented in, or being skirted by runoff flows.
- The fence shall be constructed with fence posts and "hog-wire" (4"x4" or 6"x6" wire mesh) or "chicken-wire" of #14 or heavier gauge wire. The fence shall be constructed as shown in Figure F-1.
- A trench shall be excavated at the uphill base of the fence to a depth of at least 6 inches.
- Filter cloth (Mirafi 140 or equivalent) shall be draped over the wire fencing material and lowered into the trench.
- The trench shall be backfilled to grade and compacted.

MAINTENANCE

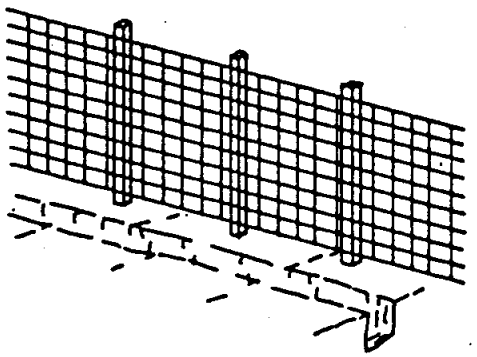
Inspect periodically and after each storm for damage and repair or replace damaged sections. Remove sediment accumulations when the capacity of the filter is impaired.



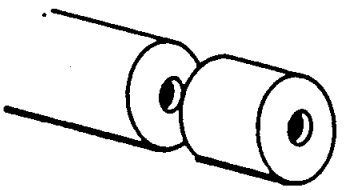
1. Drive wooden or metal posts.



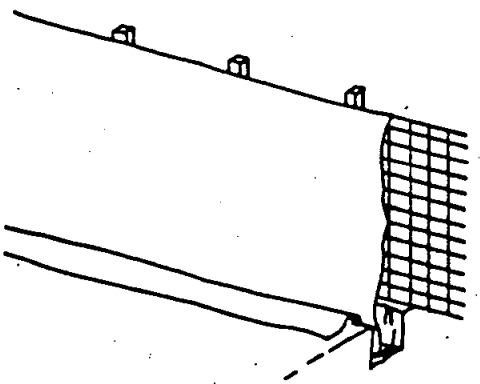
2. Dig toe trench.



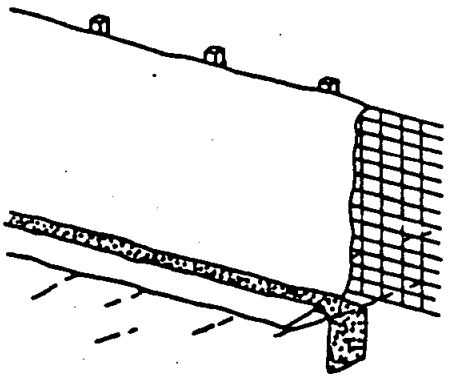
3. Attach wire mesh.



4. Cut length of filter fabric.



5. Attach filter fabric.



6. Backfill trench.

FILTER FENCE

FIGURE F-1

CONTROL TECHNIQUE E

FILTER BERM

DEFINITION

A filter berm is a temporary ridge of gravel or crushed rock.

PURPOSE

To retain sediment on-site by retarding and filtering runoff while allowing water to be discharged from the site.

APPLICABILITY

Filter berms may be used as outlets for sediment barriers around construction sites, where graded areas meet paved roadways, in uncompleted drainage facilities, or any other location requiring detention and filtration of runoff water.

PLANNING CRITERIA

Filter berms are used to filter runoff water for discharge from the site. Continuous filter berms may be used around construction sites or individual berms may be located at discharge points in impermeable barriers such as shown in CT G&H.

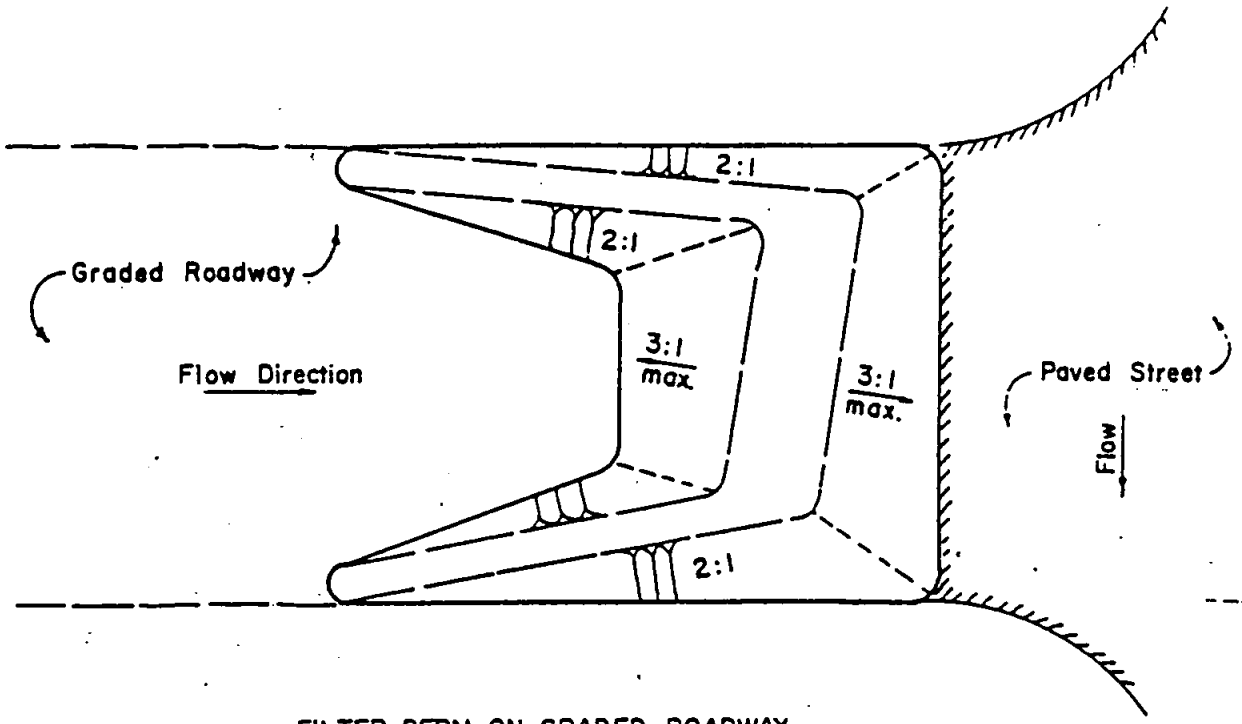
- If continuous filter berms are used, discharge through shall be to a stable area such that no erosion occurs.
- Detailed design is not required. Figures E-1 and E-2 provide general design criteria. Minimum requirements for use on graded rights-of-way are as follows:
  - Height - 1.5 feet to 3 feet.
  - Top Width - 1 to 1.5 feet.
  - Side Slopes - 2:1 or flatter
  - Material - Coarse (3/4" to 1-1/2"), well-graded gravel or crushed rock. Fines less than 5 percent.
  - Filter Cloth - As specified in CT F.

MAINTENANCE

Remove all trapped sediment and clean out or replace clogged filter material after each storm. Repair as damaged by traffic.

COST

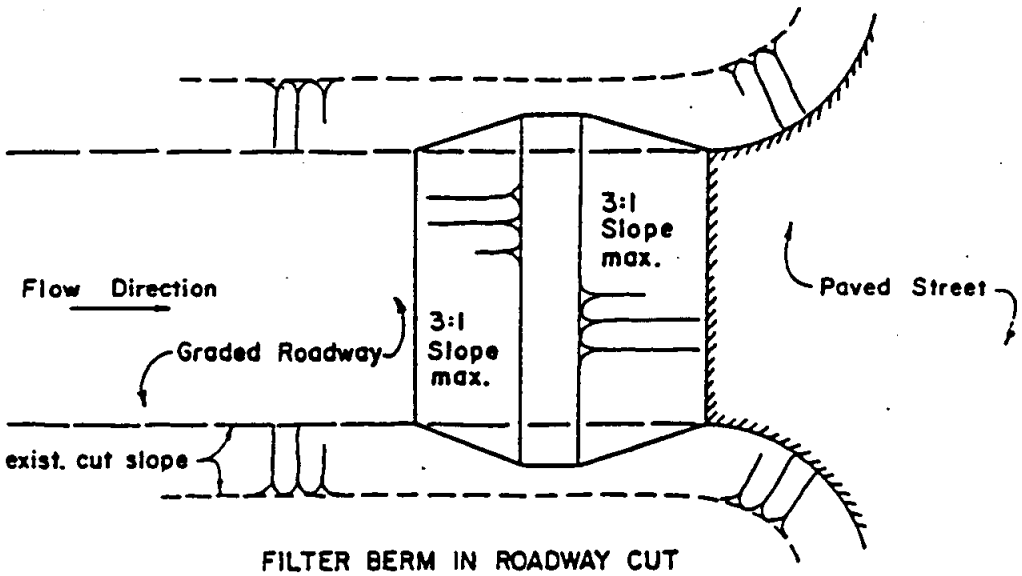
The unit cost for filter berms is $6.00 - $7.00 per lineal foot.



FILTER BERM ON GRADED ROADWAY

PLAN

no scale



FILTER BERM IN ROADWAY CUT

PLAN

no scale

FILTER BERMS CON: RCA [illegible]

FIGURE E-2