# MASTER DEVELOPMENT DRAINAGE PLAN

## INDUSTRIAL PARK SOUTH
## COLORADO SPRINGS, COLORADO

Prepared for:

# MASTER DEVELOPMENT DRAINAGE PLAN

## INDUSTRIAL PARK SOUTH
## COLORADO SPRINGS, COLORADO

Prepared for:

Reliable Sanitation
2239 Commercial Drive
Colorado Springs, Colorado 80906

Prepared by:

Kiowa Engineering Corporation
1011 North Weber Street Suite 200
Colorado Springs, Colorado 80903

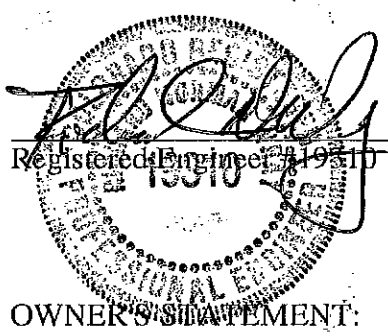
KIOWA Project No. 95.66
R414

SEPTEMBER, 1995
REVISED OCTOBER, 1995

**ENGINEER'S STATEMENT:**

The attached drainage plan and report was prepared under my direction and supervision and are correct to the best of my knowledge and belief. Said drainage report has been prepared according to the criteria established by the City for drainage reports and said report is in conformity with the master plan of the drainage basin. I accept responsibility for any liability caused by any negligent acts, errors and omissions on my part in preparing this report.

Kiowa Engineering Corporation, 1011 North Weber St., Suite 200, Colorado Springs, CO 80903



Registered Engineer, #19510

10-19-95
Date

OWNER'S STATEMENT:

The Owner and/or his representative has read and will comply with all of the requirements specified in this drainage report and plan.

BY: _____

10-23-95
Date

ADDRESS:

2239 Commercial Blvd

Colo Springs Colo 80906

CITY OF COLORADO SPRINGS

Filed in accordance with Section 15-3-906 of the Code of the City of Colorado Springs, 1980, as amended.

_____

for City Engineer

10-23-95
Dated

Conditions:

## PROJECT DESCRIPTION

The Industrial Park South Development is a nine lot, and 2 tract subdivision located in Colorado Springs, Colorado, near I-25 and Circle Drive. The development of the site will involved the platting and eventual construction of a light industrial subdivision(s). The development of the property will be phased, whereby individual filings will be proposed. The first phase of the project will involve the platting of Industrial Park South Filing No. 1, which will be a three lot subdivision. Individual filing drainage plans will be prepared in accordance with City policy and criteria. Tract B, which is owned by Waste Management, Inc., will remain in its current use as an outside storage facility.

The property is bounded on the north and northeast by Fountain Creek, on the east by unplatted and undeveloped commercially zoned property, on the south by developed planned business center property (i.e., the Sheraton Hotel, and on the west by Interstate 25 and developed industrial property. The property is bounded on the north and east by City of Colorado Springs corporate limits. The property covers approximately 29.7 acres, and is currently seventy five percent undeveloped with unplatted light to heavy industrial uses. The project site is shown on Figure 1.

The site presently drains in a sheet flow through the existing industrial areas to generally the east property line of the development. At this location the site runoff now collects in a low area which is drained by an existing 48-inch RCP culvert. The culvert is aligned along the west side of Janitell Road and outfalls to Fountain Creek. There are no existing stormwater facilities within the site. No offsite drainage facilities convey flow onto the property, with the exception of flow collected within the Janitell Road street section and conveyed to an unimproved channel along the site's east property line. The development is bounded by Janitell Road on the east, Four Seasons Drive on the south, and Commercial Boulevard on the west. The individual lots within the property will be drained to proposed local streets. Street flows will be intercepted by storm inlets and storm sewer which will outfall to the 48-inch RCP described above. Proposed drainage facilities to collect the site runoff have been detailed on the Master Development Drainage Plan enclosed with this report. The project site is located within a direct flow area of the Southwest Area Drainage Basin.

## PREVIOUS REPORTS

The following reports and plans were reviewed in the process of preparing this master development drainage plan:

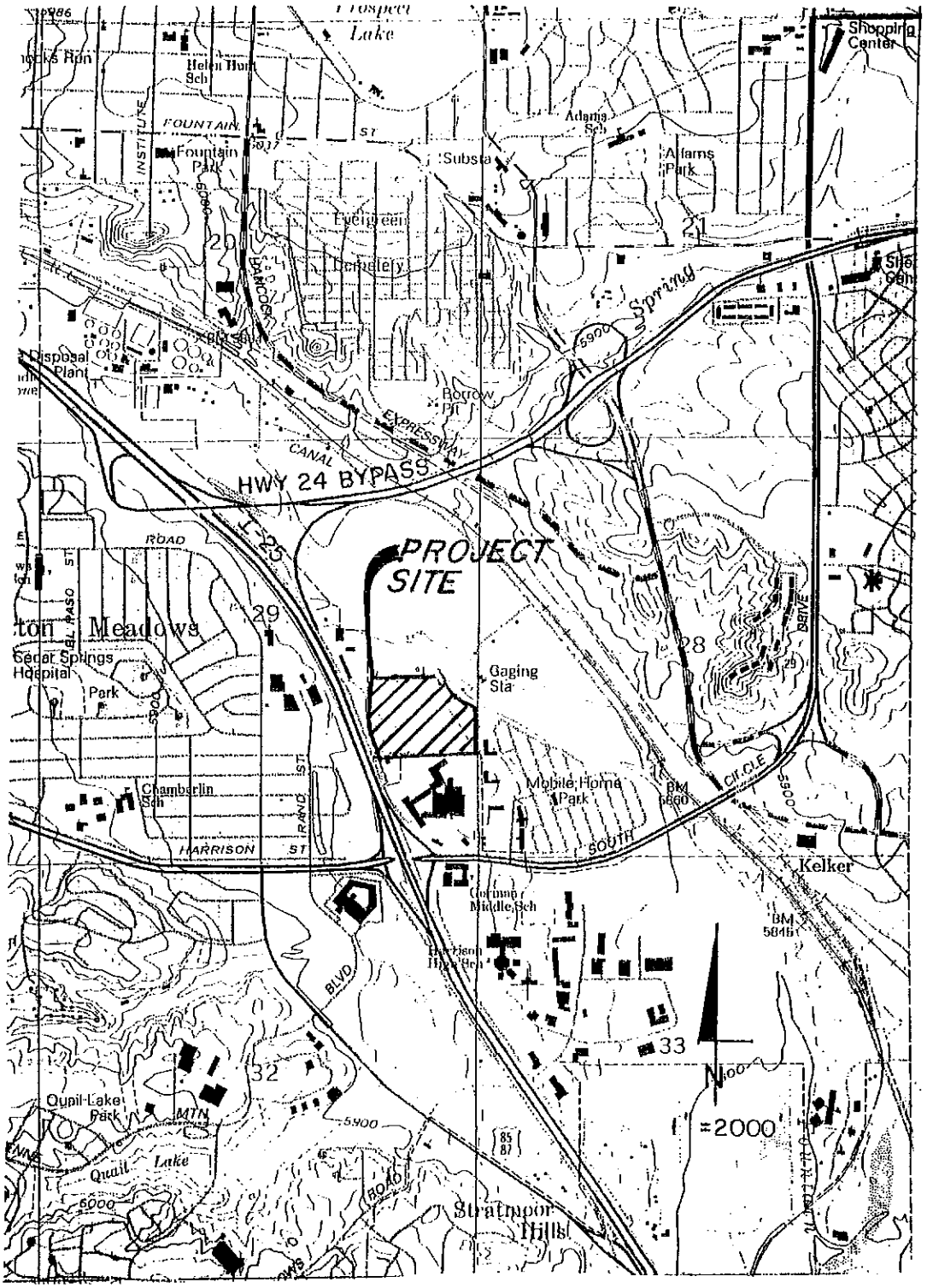



FIGURE I
VICINITY MAP

City of Colorado Springs and El Paso County Flood Insurance Study, prepared by the Federal Emergency Management Agency, dated September, 1992, with most current revisions.

City of Colorado Springs and El Paso County, Storm Drainage Criteria Manual, dated October, 1987.

Janitell Road Bridge Replacement Project Design Plans, prepared by the El Paso County Department of Transportation.

Southwest Area Drainage Basin Planning Study, prepared by Obering Wurth and Associates, Inc. dated September 1990.

## HYDROLOGY

The offsite and onsite hydrology for the site was estimated using the methods outlined in the City/County Storm Drainage Criteria Manual. Field surveyed topography and site utility investigations were prepared for individual filings. The topography compiled by the City of Colorado Springs Department of Utilities (i.e., the FIMS mapping), was used to verify the offsite and onsite sub-basin boundaries.

Presented on Figure 2 is the existing condition sub-basin boundaries and data relevant to the project site. It was assumed in this report that the developed runoff from offsite areas would not enter the property, similar to the existing basin conditions. Future onsite sub-basin were assumed to be collected along common lot lines and within the street right-of-ways. The sub-basin boundaries for the developed condition are shown of Figure 3. The analysis and calculations summarized herein applied this same assumption.

## HYDROLOGY ANALYSIS

Summarized on Figures 2 and 3 are the hydrology data and summary of runoff rates for the frequencies specified in the City/County Storm Drainage Criteria Manual. Hydrology calculations were performed in order to verify the offsite drainage facility capacity, and to check the capacity of proposed stormwater facilities to receive the developed runoff from the site.

The rational method was used to determine peak discharges for the 5-year and 100-year frequencies. The basin area, time of concentration and rainfall intensity were determined for each of the sub-basins. Because of the size of the sub-basins, a minimum time of concentration of 5 minutes was assumed for most of the sub-basins. Presented on Figure 2 are the existing condition peak discharges for each sub-basin and design point. Presented on Figure 3 are the developed condition peak discharges for each sub-basin

and design point. The hydrology calculations are presented in Appendix A of this Report.

## HYDRAULICS

The sizing of the required onsite drainage improvements were carried out in accordance with the City/County Storm Drainage Criteria Manual. The capacity of the proposed offsite facilities were verified.

The capacity of the existing 48-inch storm sewer which currently drains the site was estimated using the elevations and slopes given on the Janitell Road Bridge Replacement Plans. An existing capacity of 150 cubic feet per second was estimated for the 48-inch RCP. The existing 48-inch lies within the backwater of the Fountain Creek floodplain. The capacity of the 48-inch was calculated assuming that it was freely discharging to Fountain Creek, in the absence of a 100-year flow along Fountain Creek.

The maximum flow capacity of the inlets within Janitell Road, also installed as part of the bridge replacement project, was determined. The developed flow at design point 9, plus the flow from the inlets described above gives a total flow of 210 cfs. The capacity of the existing 48-inch culvert is not sufficient to pass the 210 cfs without overtopping the roadway. The alternative of a detention basin at this location was invesigated versus improving the inlet condition to the 48-inch RCP. An improved slope tapered inlet will provide a total capacity of 215 cfs.

Tract B which is currently developed as an outside storage yard, drains to an existing unimproved swale to Fountain Creek. A portion of this Tract also has a portion of Fountain Creek within its boundary. Improvements to the existing outfall swale at design point 1 and possibly bank lining improvements along Fountain Creek within the Tract B will be required by the City if the Tract is developed and replatted.

## FLOODPLAIN STATEMENT

A portion of this site is located in an area presently mapped as a 100-year floodplain in the City of Colorado Springs Flood Insurance Study, prepared by the Federal Emergency Management Agency (FEMA). All development such as grading and building construction will occur outside of the floodplain limits. The 100-year FIS flood boundary is shown on Figures 2 and 3.

## STORM ROUTING AND PROPOSED FACILITIES

Presented on Figure 3, contained within the map pocket of this report, are the proposed onsite facilities which will be required for the development of this site. The site

will be drained by a series of privately owned and maintained grasslined swales which will convey flow to the proposed street section via sheet flow and/or curb chases. Sub-basins 5 and 7 will be conveyed to the proposed public storm sewer by a private inlet and storm sewer. Once the street flow capacity is reached, a five-year capacity storm sewer system has been sized. A 100-year capacity grass swale will carry the developed runoff from the roadway section and storm sewer through sub-basins 8 and 9 to the existing 48-inch culvert described above. An improved inlet will need to be constructed at the inlet to the existing 48-inch RCP. Calculations show that either a slope tapered or a side tapered inlet will be sufficient to convey the design discharge to the 48-inch RCP outfall storm sewer.

Tract B will need a rock outfall channel constructed from design point 1 to Fountain Creek should the Tract ever be replatted. Bank lining improvements for the portion of Fountain Creek within the Tract may also be required by the City should Tract B ever be replatted or redeveloped. The bank improvements for this segment of Fountain Creek have been identified in the Fountain Creek Corridor Plan prepared by the City of Colorado Springs.

**DRAINAGE FACILITY COSTS**

Summarized on Table 1 are the estimated costs of the public and private drainage facilities required for the development of the property. The public drainage facility costs include the inlets and storm sewers within Reliable Circle, and the 100-year outfall channel to the existing 48-inch culvert.

Bank improvements for the portion of Fountain Creek within Tract B may also be required by the City should Tract B be redeveloped or platted.

**DRAINAGE FEES**

Drainage fees for this MDDP have been based upon the total plattable acreage and the Southwest Area drainage basin fee. The fees are as follows:

Drainage fee:

29.68 acres at $5,904 per acre = $175,230.72

Financial assurances for the construction of the public and private systems shown herein will be required. Fees will be paid as individual lot filings are developed.

TABLE 1:
PUBLIC DRAINAGE IMPROVEMENTS
INDUSTRIAL PARK SOUTH

| ITEM | UNIT COST | UNIT | QUANTITY | TOTAL CONSTRUCTION |
|---|---|---|---|---|
| 18" RCP | $28 | LF | 165 | $4,620 |
| 24" RCP | $35 | LF | 210 | $7,350 |
| 30" RCP | $42 | LF | 40 | $1,680 |
| 30" RCP FES | $300 | EA | 1 | $300 |
| 5' BW GRASS SWALE | $60 | LF | 300 | $18,000 |
| 4' CO INLET | $2,400 | EA | 2 | $4,800 |
| 8' CO INLET | $2,800 | EA | 1 | $2,800 |
| TYPE M RIPRAP | $100 | CY | 28 | $2,800 |
| TAPERED INLET | $10,000 | EA | 1 | $10,000 |
| STD MANHOLE | $2,500 | EA | 3 | $7,500 |
| SUBTOTAL | | | | $59,850.00 |
| 10% ENGINEERING | | | | $3,440.00 |
| 5% CONTINGENCY | | | | $1,720.00 |
| TOTAL PUBLIC COSTS | | | | $65,010.00 |

PRIVATE DRAINAGE IMPROVEMENTS
INDUSTRIAL PARK SOUTH

| ITEM | UNIT COST | UNIT | QUANTITY | TOTAL CONSTRUCTION |
|---|---|---|---|---|
| 18" RCP | $28 | LF | 60 | $1,680 |
| 5' BW GRASS SWALE | $60 | LF | 440 | $26,400 |
| 5' CO INLET | $2,500 | EA | 1 | $2,500 |
| 7' CO INLET | $3,200 | EA | 2 | $6,400 |
| SUBTOTAL | | | | $36,980.00 |
| 10% ENGINEERING | | | | $3,440.00 |
| 5% CONTINGENCY | | | | $1,720.00 |
| TOTAL PRIVATE COSTS | | | | $42,140.00 |

# APPENDIX A: HYDROLOGIC AND HYDRAULIC CALCULATIONS

# Hydrology - Existing

- Basin Areas;

| Basin # | Acreage |
|---|---|
| 1 | ~~11.9~~ 5.0 Δ |
| 2 | 9.7 |
| 3 | 10.6 |
| 4 | 6.9 Δ |

- Runoff Coefficients - Hydrologic Soils Group B
Bresser Series.

Basin # 1 - Undeveloped. $C_{10} = .15$

$C_{100} = .20$

Basin # 2 -

| | $C_{10}$ |
|---|---|
| (4.2 Ac) Undeveloped | $C_{10} = .15$ |
| | $C_{100} = .20$ |
| (5.5 Ac) Light ~~Comm~~ Industry | $C_{10} = 0.70$ |
| | $C_{100} = 0.80$ |

$$Wtd_{10} \Rightarrow \frac{4.2(.15) + 5.5(.70)}{9.7} = .46$$

$$Wtd_{100} \Rightarrow \frac{4.2(.20) + 5.5(.80)}{9.7} = .54$$

Rev. 7/30/95

Basin #3

Undeveloped: $C_{10} = .15$
$C_{100} = .20$

Basin #4 Undeveloped: $C_{10} = .15$ $C_{100} = .20$

- Time of Concentration

Sub-basin #1: * Overland $\frac{280'}{3/ps} = 1.6$ min

* Grassed Swale = $\frac{810}{3} = 4.5$

* Overland Flow: $140'/3 = 0.8$ min

* Grassed Swale $650/3 = 3.6$ min Total 4.4 min 6.1 min

use 5.0 min minimum

Sub-basin # 2 Overland $\frac{350'}{3} = 1.9$ min

Grass Swale

$\frac{350}{3} = \frac{1.9}{3.8}$

use min. 5 min

Sub-basin #3: Overland $\frac{500'}{3} = 2.8$ min

Grass Swale $\frac{380}{4} = \frac{1.6}{4.4}$

use 5' min

Sub-basin #4: Use 5' Min.

△1 Rev. 9/30/15

- Rainfall Intensity — Use interim reference Int Curve.

| | $I_5$ | $I_{100}$ |
|---|---|---|
| Sub #1 - | △1 ~~5.0~~ 5.2 | △1 ~~8.5~~ 9.0 |
| Sub #2 - | 5.2 | 9.0 |
| Sub #3 - | 5.2 | 9.0 |
| Sub #4 | 5.2 | 9.0 |

- Runoff.

SB #1 $Q_5 = .15(\overset{5}{\cancel{11.9}})(5.2) = \overset{39}{15.1}$ △1

$Q_{100} = .20(\overset{5}{\cancel{11.9}})(9.0) = \cancel{8.5}\ 9.0$

$\cancel{20.2}$ △1

SB # 2 $Q_5 = .46(9.7)(9) = 40.1$

$Q_{100} = .54(9.7)(9) = 47.1$

SB # 3 $Q_5 = .15(10.6)(9) = 14.3$

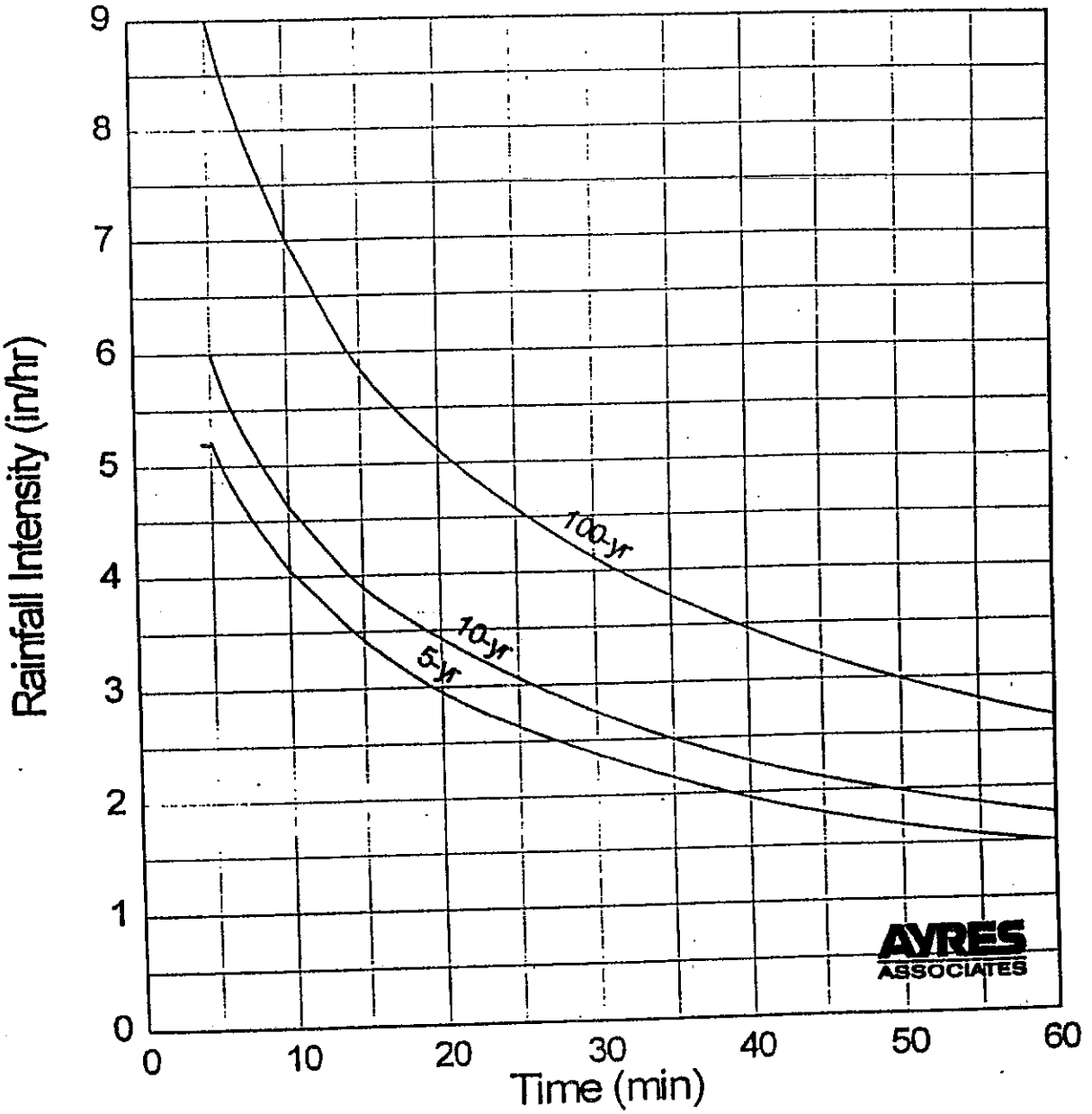
$Q_{100} = .20(10.6)(9) = 19.1$

SB # 4 $Q_5 = .15(5.2)(6.9) = 5.4$ cfs △1

$Q_{100} = .20(9.0)(6.9) = 12.4$ cfs △1

- Design Point △1

| | | $Q_5$ | $Q_{100}$ |
|---|---|---|---|
| △1 = SB1 = | | 39 ~~15.1~~ | 9.0 ~~20.2~~ |
| △2 = SB1 + SB2 | | 44.0 ~~55.2~~ | 56.1 ~~67.3~~ |
| △3 = △2 + SB3 | | ~~56.2~~ ~~46.5~~ | 75.2 ~~80.4~~ |
| △4 = SB 4 | | 5.4 | 12.4 |




**Interim Release October 12, 1994 , Rainfall Intensity Curves**
**City Of Colorado Springs Drainage Criteria Manual**

# Hydrology - Developed. (Revised 10-10-95)

Basin Areas: See Rational Method Calcs

Runoff Coefficients: Assume Light Industrial

$C_5 = .70$ $C_{100} = .80$

T/C : use minimum $T_c = 5$ min

Rainfall Intensity $I_5 = 5.2$"/hr

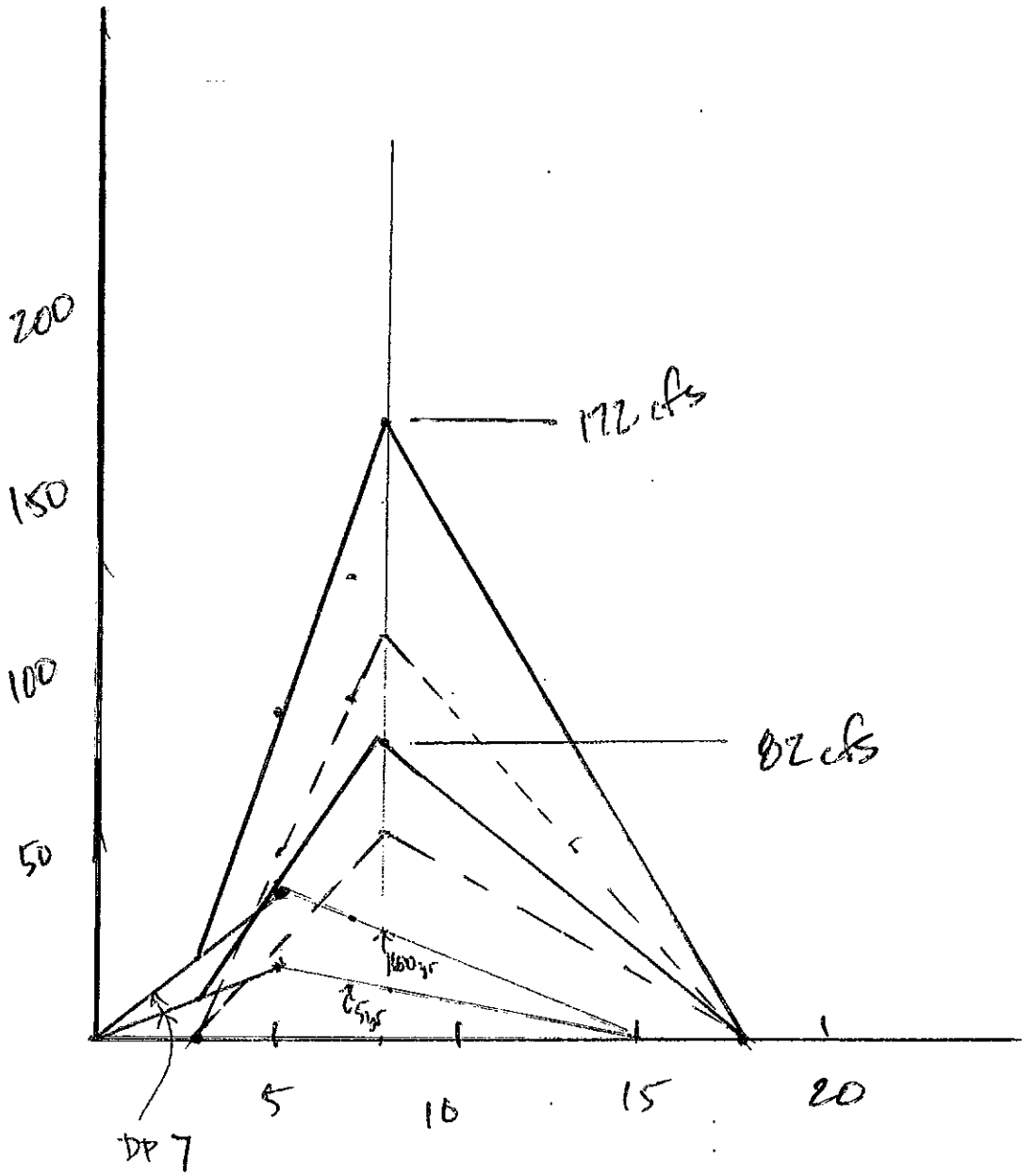
$I_{100} = 9.0$"/hr

Runoff - See Calcs.

RATIONAL METHOD CALCULATIONS (DEVELOPED)
PROJECT: SOUTH INDUSTRIAL PARK MDDP
DATE: SEPTEMBER 1995, REVISED OCTOBER 1995

| SUB BASIN # | AREA (AC) | RUNOFF COEFFICIENT C5 | C100 | RAINFALL INTENSITY I5 | I100 | DISCHARGE Q5 CFS | Q100 CFS |
|---|---|---|---|---|---|---|---|
| 1 | 6.9 | 0.7 | 0.8 | 5.2 | 9.0 | 25.1 | 49.7 |
| 2 | 3.5 | 0.7 | 0.8 | 5.2 | 9.0 | 12.7 | 25.2 |
| 3 | 5.2 | 0.7 | 0.8 | 5.2 | 9.0 | 18.9 | 37.4 |
| 4 | 4.0 | 0.7 | 0.8 | 5.2 | 9.0 | 14.6 | 28.8 |
| 5 | 3.1 | 0.7 | 0.8 | 5.2 | 9.0 | 11.3 | 22.3 |
| 6 | 3.4 | 0.7 | 0.8 | 5.2 | 9.0 | 12.4 | 24.5 |
| 7 | 2.1 | 0.7 | 0.8 | 5.2 | 9.0 | 7.6 | 15.1 |
| 8 | 2.1 | 0.7 | 0.8 | 5.2 | 9.0 | 7.6 | 15.1 |
| 9 | 2.7 | 0.7 | 0.8 | 5.2 | 9.0 | 9.8 | 19.4 |

Flow Hydrograph to DP 7.1 (Revised 10-10-95)




Hydrographs 8 + 9 would not be additive

CARDER CONCRETE PRODUCTS
8311 West Carder Court
Littleton, Colorado 80125
303-791-1600
Fax: 303-791-1710
1-800-365-3096

| | |
|---|---|
| Project: Hydraulics/Hydrology | Page: 3A |
| Location: | Date: 9/10/95 |
| Product: | By: Rev 10-10-95 |
| Client: | Checked: |

Travel Time Estimate:

To DP 1:

Overland flow 300' t = 300/3 = 1.7 min

Grassswale 240' t = 240/4 = 1.0 min

(To Trautman Creek) 2.7 min ←

To DP-2

Grassswale 320'/4 = 80/60 1.3 min

4.0 min

To DP-2.1

340 Street/pipe 340/5 = 1.1 min

2.4 5.4 min

To DP 5

Street flow 140'/5 .5 min

2.9 5.9

To DP 7.1

Street/flow 150'/5 .5 min

3.4 6.4 min

Kiowa Engineering Corporation

CLIENT Telluride Sanitation JOB NO. 95.66 PAGE 9-15-95
PROJECT ? DATE CHECKED DATE
DETAIL Existing Systems CHECKED BY COMPUTED BY [illegible]

Capacity check: 48" RCP West of Imitation Rd.

from design plans: Imitation Road Bridge Repl.

Seg 1 Slope = $3.3/120' = .0275'/'$

Seg 2 Slope = $2.1/71' = .029'/'$

using 1st Segment $Q_{FULL}$ = 240 cfs

Check with Inlet control / outlet control (Chart 14)

Capacity Check of 15' Type R CO INLET on Imitation Rd

assume SUMP (conservative)

$Q_i = 3.0 L_i d_i^{1.5}$

$Q_i = 3.0(15)(.67)^{1.5} = 24.6$ cfs

Say 25 cfs.

Capacity of 5' Type R.

$Q_i = 3.0(5)(.67)^{1.5} = 8.2$ cfs

Total 33 cfs.

Assume full 33 passes to 48" RCP (Conservative).

EXISTING 48" w/o IMP. INLET (1A)

CURRENT DATE: 10-13-1995
CURRENT TIME: 13:29:52

FILE DATE: 10-13-1995
FILE NAME: IND48

**********
FHWA CULVERT ANALYSIS
HY-8, VERSION 3.2
**********

| CULV # | SITE DATA: INLET ELEV. (FT) | SITE DATA: OUTLET ELEV. (FT) | SITE DATA: CULVERT LENGTH (FT) | CULVERT SHAPE, MATERIAL, INLET: BARRELS SHAPE MATERIAL | SPAN (FT) | RISE (FT) | MANNING n | INLET TYPE |
|---|---|---|---|---|---|---|---|---|
| 1 | 39.00 | 33.60 | 200.07 | 1 RCP | 4.00 | 4.00 | .012 | CONVENTIONAL |
| 2 | | | | | | | | |
| 3 | | | | | | | | |
| 4 | | | | | | | | |
| 5 | | | | | | | | |
| 6 | | | | | | | | |

**********

SUMMARY OF CULVERT FLOWS (CFS) FILE: IND48 DATE: 10-13-1995

| ELEV (FT) | TOTAL | 1 | 2 | 3 | 4 | 5 | 6 | ROADWAY | ITR |
|---|---|---|---|---|---|---|---|---|---|
| 39.00 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 40.78 | 20 | 20 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 41.71 | 40 | 40 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 42.49 | 60 | 60 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 43.26 | 80 | 80 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 44.15 | 100 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 45.23 | 120 | 120 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 46.52 | 140 | 140 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 47.12 | 160 | 148 | 0 | 0 | 0 | 0 | 0 | 10 | 8 |
| 47.23 | 180 | 150 | 0 | 0 | 0 | 0 | 0 | 29 | 5 |
| 47.32 | 200 | 151 | 0 | 0 | 0 | 0 | 0 | 48 | 4 |
| 47.00 | 147 | 147 | 0 | 0 | 0 | 0 | 0 | OVERTOPPING | |

**********

SUMMARY OF ITERATIVE SOLUTION ERRORS FILE: IND48 DATE: 10-13-1995

| HEAD ELEV(FT) | HEAD ERROR(FT) | TOTAL FLOW(CFS) | FLOW ERROR(CFS) | % FLOW ERROR |
|---|---|---|---|---|
| 39.00 | 0.00 | 0 | 0 | 0.00 |
| 40.78 | 0.00 | 20 | 0 | 0.00 |
| 41.71 | 0.00 | 40 | 0 | 0.00 |
| 42.49 | 0.00 | 60 | 0 | 0.00 |
| 43.26 | 0.00 | 80 | 0 | 0.00 |
| 44.15 | 0.00 | 100 | 0 | 0.00 |
| 45.23 | 0.00 | 120 | 0 | 0.00 |
| 46.52 | 0.00 | 140 | 0 | 0.00 |
| 47.12 | -0.01 | 160 | 1 | 0.92 |
| 47.23 | -0.01 | 180 | 1 | 0.56 |
| 47.32 | -0.01 | 200 | 1 | 0.70 |

**********

<1> TOLERANCE (FT) = 0.010 <2> TOLERANCE (%) = 1.000

**********

CURRENT DATE: 10-13-1995
CURRENT TIME: 13:29:52

FILE DATE: 10-13-1995
FILE NAME: IND48

**********
********** CULVERT # 1 **********
**********

PERFORMANCE CURVE FOR 1 BARREL(S)

| Q (cfs) | HWE (ft) | TWE (ft) | ICH (ft) | OCH (ft) | FLOW TYPE | CCE (ft) | FCE (ft) | TCE (ft) | VO (fps) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 39.00 | 33.60 | 0.00 | -5.40 | 0-NF | 0.00 | 39.00 | 0.00 | 0.00 |
| 20 | 40.78 | 34.04 | 1.78 | -2.66 | 6-FF | 0.00 | 0.00 | 0.00 | 11.36 |
| 40 | 41.71 | 34.24 | 2.71 | -2.10 | 6-FF | 0.00 | 0.00 | 0.00 | 14.59 |
| 60 | 42.49 | 34.40 | 3.49 | -1.41 | 6-FF | 0.00 | 0.00 | 0.00 | 15.69 |
| 80 | 43.26 | 34.54 | 4.26 | -0.58 | 6-FF | 0.00 | 0.00 | 0.00 | 16.95 |
| 100 | 44.15 | 34.65 | 5.15 | 0.40 | 6-FF | 0.00 | 0.00 | 0.00 | 17.68 |
| 120 | 45.23 | 34.76 | 6.23 | 1.55 | 6-FF | 0.00 | 0.00 | 0.00 | 18.36 |
| 140 | 46.52 | 34.86 | 7.52 | 2.84 | 6-FF | 0.00 | 0.00 | 0.00 | 19.00 |
| 148 | 47.12 | 34.95 | 8.12 | 3.43 | 6-FF | 0.00 | 0.00 | 0.00 | 19.24 |
| 150 | 47.23 | 35.03 | 8.23 | 3.54 | 6-FF | 0.00 | 0.00 | 0.00 | 19.28 |
| 151 | 47.32 | 35.11 | 8.32 | 3.63 | 6-FF | 0.00 | 0.00 | 0.00 | 19.32 |

El. inlet face invert 39.00 ft El. outlet invert 33.60 ft
El. inlet throat invert 0.00 ft El. inlet crest 0.00 ft

**********

**** SITE DATA ***** CULVERT INVERT **********

| | |
|---|---|
| INLET STATION (FT) | 0.00 |
| INLET ELEVATION (FT) | 39.00 |
| OUTLET STATION (FT) | 200.00 |
| OUTLET ELEVATION (FT) | 33.60 |
| NUMBER OF BARRELS | 1.00 |
| SLOPE (V-FT/H-FT) | 0.0270 |
| CULVERT LENGTH ALONG SLOPE (FT) | 200.07 |

***** CULVERT DATA SUMMARY **********

| | |
|---|---|
| BARREL SHAPE | CIRCULAR |
| BARREL DIAMETER | 4.00 FT |
| BARREL MATERIAL | CONCRETE |
| BARREL MANNING'S N | 0.012 |
| INLET TYPE | CONVENTIONAL |
| INLET EDGE AND WALL | SQUARE EDGE WITH HEADWALL |
| INLET DEPRESSION | NONE |

**********

CURRENT DATE: 10-13-1995 FILE DATE: 10-13-1995
CURRENT TIME: 13:29:52 FILE NAME: IND48

**********
********** TAILWATER **********
**********

***** REGULAR CHANNEL CROSS SECTION *****

| | |
|---|---|
| BOTTOM WIDTH (FT) | 10.00 |
| SIDE SLOPE H/V (X:1) | 5.0 |
| CHANNEL SLOPE V/H (FT/FT) | 0.030 |
| MANNING'S N (.01-0.1) | 0.035 |
| CHANNEL INVERT ELEVATION (FT) | 33.60 |
| CULVERT NO.1 OUTLET INVERT ELEVATION | 33.60 FT |

******* UNIFORM FLOW RATING CURVE FOR DOWNSTREAM CHANNEL

| FLOW (CFS) | W.S.E. (FT) | FROUDE NUMBER | VEL. (FPS) | SHEAR (PSF) |
|---|---|---|---|---|
| 0.00 | 33.60 | 0.000 | 0.00 | 0.00 |
| 20.00 | 34.04 | 1.007 | 3.77 | 0.82 |
| 40.00 | 34.24 | 1.036 | 4.71 | 1.20 |
| 60.00 | 34.40 | 1.050 | 5.34 | 1.50 |
| 80.00 | 34.54 | 1.059 | 5.82 | 1.75 |
| 100.00 | 34.65 | 1.066 | 6.21 | 1.97 |
| 120.00 | 34.76 | 1.071 | 6.54 | 2.17 |
| 140.00 | 34.86 | 1.075 | 6.84 | 2.35 |
| 160.00 | 34.95 | 1.079 | 7.10 | 2.52 |
| 180.00 | 35.03 | 1.082 | 7.34 | 2.68 |
| 200.00 | 35.11 | 1.084 | 7.56 | 2.82 |

**********
********** ROADWAY OVERTOPPING DATA **********
**********

| | |
|---|---|
| ROADWAY SURFACE | GRAVEL |
| EMBANKMENT TOP WIDTH (FT) | 40.00 |
| CREST LENGTH (FT) | 100.00 |
| OVERTOPPING CREST ELEVATION (FT) | 47.00 |

**********

SLOPE TAPERED INLET



CURRENT DATE: 10-16-1995
CURRENT TIME: 11:47:09

FILE DATE: 10-13-1995
FILE NAME: IND48

FHWA CULVERT ANALYSIS
HY-8, VERSION 3.2

| CULV # | SITE DATA | | | CULVERT SHAPE, MATERIAL, INLET | | | | |
|---|---|---|---|---|---|---|---|---|
| | INLET ELEV. (FT) | OUTLET ELEV. (FT) | CULVERT LENGTH (FT) | BARRELS SHAPE MATERIAL | SPAN (FT) | RISE (FT) | MANNING n | INLET TYPE |
| 1 | 39.00 | 33.60 | 200.07 | 1 RCP | 4.00 | 4.00 | .012 | IMPR SLT |
| 2 | | | | | | | | |
| 3 | | | | | | | | |
| 4 | | | | | | | | |
| 5 | | | | | | | | |
| 6 | | | | | | | | |

SUMMARY OF CULVERT FLOWS (CFS) FILE: IND48 DATE: 10-13-1995

| ELEV (FT) | TOTAL | 1 | 2 | 3 | 4 | 5 | 6 | ROADWAY | ITR |
|---|---|---|---|---|---|---|---|---|---|
| 39.00 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 40.26 | 20 | 20 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 41.00 | 40 | 40 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 41.62 | 60 | 60 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 42.17 | 80 | 80 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 42.68 | 100 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 43.16 | 120 | 120 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 43.65 | 140 | 140 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 44.22 | 160 | 160 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 44.86 | 180 | 180 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 45.58 | 200 | 200 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 46.00 | 211 | 211 | 0 | 0 | 0 | 0 | 0 | OVERTOPPING | |

SUMMARY OF ITERATIVE SOLUTION ERRORS FILE: IND48 DATE: 10-13-1995

| HEAD ELEV(FT) | HEAD ERROR(FT) | TOTAL FLOW(CFS) | FLOW ERROR(CFS) | % FLOW ERROR |
|---|---|---|---|---|
| 39.00 | 0.00 | 0 | 0 | 0.00 |
| 40.26 | 0.00 | 20 | 0 | 0.00 |
| 41.00 | 0.00 | 40 | 0 | 0.00 |
| 41.62 | 0.00 | 60 | 0 | 0.00 |
| 42.17 | 0.00 | 80 | 0 | 0.00 |
| 42.68 | 0.00 | 100 | 0 | 0.00 |
| 43.16 | 0.00 | 120 | 0 | 0.00 |
| 43.65 | 0.00 | 140 | 0 | 0.00 |
| 44.22 | 0.00 | 160 | 0 | 0.00 |
| 44.86 | 0.00 | 180 | 0 | 0.00 |
| 45.58 | 0.00 | 200 | 0 | 0.00 |

<1> TOLERANCE (FT) = 0.010 <2> TOLERANCE (%) = 1.000

URRENT DATE: 10-16-1995
URRENT TIME: 11:47:09

FILE DATE: 10-13-1995
FILE NAME: IND48

CULVERT # 1

PERFORMANCE CURVE FOR 1 BARREL(S)

| Q (cfs) | HWE (ft) | TWE (ft) | ICH (ft) | OCH (ft) | FLOW TYPE | CCE (ft) | FCE (ft) | TCE (ft) | VO (fps) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 39.00 | 33.60 | 0.00 | -5.40 | 0-NF | 39.00 | 39.00 | 36.00 | 0.00 |
| 20 | 40.26 | 34.04 | 1.26 | -2.68 | 6-FF | 40.26 | 40.26 | 37.40 | 11.36 |
| 40 | 41.00 | 34.24 | 2.00 | -2.18 | 6-FF | 41.00 | 41.00 | 38.17 | 14.59 |
| 60 | 41.62 | 34.40 | 2.62 | -1.59 | 6-FF | 41.62 | 41.62 | 38.85 | 15.69 |
| 80 | 42.17 | 34.54 | 3.17 | -0.90 | 6-FF | 42.17 | 42.17 | 39.46 | 16.95 |
| 100 | 42.68 | 34.65 | 3.68 | -0.09 | 6-FF | 42.68 | 42.68 | 40.03 | 17.68 |
| 120 | 43.16 | 34.76 | 4.16 | 0.84 | 6-FF | 43.16 | 43.16 | 40.56 | 18.36 |
| 140 | 43.65 | 34.86 | 4.65 | 1.88 | 6-FF | 43.61 | 43.65 | 41.07 | 19.00 |
| 160 | 44.22 | 34.95 | 5.22 | 3.07 | 6-FF | 44.04 | 44.22 | 41.59 | 19.59 |
| 180 | 44.86 | 35.03 | 5.86 | 4.40 | 6-FF | 44.45 | 44.86 | 42.11 | 20.17 |
| 200 | 45.58 | 35.11 | 6.58 | 5.82 | 6-FF | 44.85 | 45.58 | 42.67 | 20.71 |

El. inlet face invert 39.00 ft El. outlet invert 33.60 ft
El. inlet throat invert 36.00 ft El. inlet crest 39.00 ft

*: ***** SITE DATA ***** CULVERT INVERT **********

| | |
|---|---|
| INLET STATION (FT) | 0.00 |
| INLET ELEVATION (FT) | 39.00 |
| OUTLET STATION (FT) | 200.00 |
| OUTLET ELEVATION (FT) | 33.60 |
| NUMBER OF BARRELS | 1.00 |
| SLOPE (V-FT/H-FT) | 0.0270 |
| CULVERT LENGTH ALONG SLOPE (FT) | 200.07 |

***** CULVERT DATA SUMMARY **********

| | |
|---|---|
| BARREL SHAPE | CIRCULAR |
| BARREL DIAMETER | 4.00 FT |
| BARREL MATERIAL | CONCRETE |
| BARREL MANNING'S N | 0.012 |
| INLET TYPE | IMPR SLT |
| INLET EDGE AND WALL | BEVELED EDGE TOP (26-45 DEG WINGWALL) |
| INLET DEPRESSION | FALL INCLUDED |

** ** SLOPE-TAPERED IMPROVED INLET **********

| | | |
|---|---|---|
| FACE WIDTH | | 5.00 FT |
| SIDE TAPER (4:1 TO 6:1) | (X:1) | 4.00 |
| FALL SLOPE (2:1 TO 3:1) | (X:1) | 2.00 |
| FALL | | 3.00 FT |
| MITERED FACE | (Y/N) | N |
| FACE-CREST LENGTH IF MITERED | | 5.00 FT |

JRRENT DATE: 10-16-1995
CURRENT TIME: 11:47:09

FILE DATE: 10-13-1995
FILE NAME: IND48

## TAILWATER

****** REGULAR CHANNEL CROSS SECTION **********

| | |
|---|---|
| BOTTOM WIDTH (FT) | 10.00 |
| SIDE SLOPE H/V (X:1) | 5.0 |
| CHANNEL SLOPE V/H (FT/FT) | 0.030 |
| MANNING'S N (.01-0.1) | 0.035 |
| CHANNEL INVERT ELEVATION (FT) | 33.60 |
| CULVERT NO.1 OUTLET INVERT ELEVATION | 33.60 FT |

******* UNIFORM FLOW RATING CURVE FOR DOWNSTREAM CHANNEL

| FLOW (CFS) | W.S.E. (FT) | FROUDE NUMBER | VEL. (FPS) | SHEAR (PSF) |
|---|---|---|---|---|
| 0.00 | 33.60 | 0.000 | 0.00 | 0.00 |
| 20.00 | 34.04 | 1.007 | 3.77 | 0.81 |
| 40.00 | 34.24 | 1.036 | 4.71 | 1.20 |
| 60.00 | 34.40 | 1.050 | 5.34 | 1.50 |
| 80.00 | 34.54 | 1.059 | 5.82 | 1.75 |
| 100.00 | 34.65 | 1.066 | 6.21 | 1.97 |
| 120.00 | 34.76 | 1.071 | 6.55 | 2.17 |
| 140.00 | 34.86 | 1.075 | 6.84 | 2.35 |
| 160.00 | 34.95 | 1.079 | 7.10 | 2.52 |
| 180.00 | 35.03 | 1.082 | 7.34 | 2.68 |
| 200.00 | 35.11 | 1.084 | 7.56 | 2.82 |

## ROADWAY OVERTOPPING DATA

| | |
|---|---|
| ROADWAY SURFACE | GRAVEL |
| EMBANKMENT TOP WIDTH (FT) | 40.00 |
| CREST LENGTH (FT) | 100.00 |
| OVERTOPPING CREST ELEVATION (FT) | 46.00 |

SIDE TAPERED CIRC. INLET



CURRENT DATE: 10-16-1995
CURRENT TIME: 11:54:34

FILE DATE: 10-13-1995
FILE NAME: IND48

FHWA CULVERT ANALYSIS
HY-8, VERSION 3.2

| CULV # | SITE DATA: INLET ELEV. (FT) | SITE DATA: OUTLET ELEV. (FT) | SITE DATA: CULVERT LENGTH (FT) | CULVERT SHAPE, MATERIAL, INLET: BARRELS SHAPE MATERIAL | SPAN (FT) | RISE (FT) | MANNING n | INLET TYPE |
|---|---|---|---|---|---|---|---|---|
| 1 | 38.04 | 33.60 | 196.05 | 1 RCP | 4.00 | 4.00 | .012 | IMPR SDT CIR |
| 2 | | | | | | | | |
| 3 | | | | | | | | |
| 4 | | | | | | | | |
| 5 | | | | | | | | |
| 6 | | | | | | | | |

SUMMARY OF CULVERT FLOWS (CFS) FILE: IND48 DATE: 10-13-1995

| ELEV (FT) | TOTAL | 1 | 2 | 3 | 4 | 5 | 6 | ROADWAY | ITR |
|---|---|---|---|---|---|---|---|---|---|
| 38.04 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 39.83 | 20 | 20 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 40.49 | 40 | 40 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 41.17 | 60 | 60 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 41.87 | 80 | 80 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 42.56 | 100 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 43.25 | 120 | 120 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 43.98 | 140 | 140 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 44.77 | 160 | 160 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 45.63 | 180 | 180 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 46.10 | 200 | 190 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 46.00 | 188 | 188 | 0 | 0 | 0 | 0 | 0 | 9 | 8 |
| | | | | | | | 0 | OVERTOPPING | |

SUMMARY OF ITERATIVE SOLUTION ERRORS FILE: IND48 DATE: 10-13-1995

| HEAD ELEV(FT) | HEAD ERROR(FT) | TOTAL FLOW(CFS) | FLOW ERROR(CFS) | % FLOW ERROR |
|---|---|---|---|---|
| 38.04 | 0.00 | 0 | 0 | 0.00 |
| 39.83 | 0.00 | 20 | 0 | 0.00 |
| 40.49 | 0.00 | 40 | 0 | 0.00 |
| 41.17 | 0.00 | 60 | 0 | 0.00 |
| 41.87 | 0.00 | 80 | 0 | 0.00 |
| 42.56 | 0.00 | 100 | 0 | 0.00 |
| 43.25 | 0.00 | 120 | 0 | 0.00 |
| 43.98 | 0.00 | 140 | 0 | 0.00 |
| 44.77 | 0.00 | 160 | 0 | 0.00 |
| 45.63 | 0.00 | 180 | 0 | 0.00 |
| 46.10 | -0.00 | 200 | 1 | 0.54 |

<1> TOLERANCE (FT) = 0.010

<2> TOLERANCE (%) = 1.000

CURRENT DATE: 10-16-1995
CURRENT TIME: 11:54:34

FILE DATE: 10-13-1995
FILE NAME: IND48

CULVERT # 1

PERFORMANCE CURVE FOR 1 BARREL(S)

| Q (cfs) | HWE (ft) | TWE (ft) | ICH (ft) | OCH (ft) | FLOW TYPE | CCE (ft) | FCE (ft) | TCE (ft) | VO (fps) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 38.04 | 33.60 | 0.00 | -4.44 | 0-NF | 0.00 | 38.04 | 38.00 | 0.00 |
| 20 | 39.83 | 34.04 | 1.79 | -1.63 | 6-FF | 0.50 | 38.66 | 39.83 | 11.34 |
| 40 | 40.49 | 34.24 | 2.45 | -1.13 | 6-FF | 0.00 | 38.04 | 40.49 | 13.05 |
| 60 | 41.17 | 34.40 | 3.12 | -0.55 | 6-FF | 0.00 | 38.04 | 41.17 | 15.61 |
| 80 | 41.87 | 34.54 | 3.83 | 0.14 | 6-FF | 0.00 | 38.04 | 41.87 | 15.73 |
| 100 | 42.56 | 34.65 | 4.51 | 0.94 | 6-FF | 0.00 | 38.04 | 42.56 | 16.51 |
| 120 | 43.25 | 34.76 | 5.21 | 1.86 | 6-FF | 0.00 | 38.04 | 43.25 | 17.19 |
| 140 | 43.98 | 34.86 | 5.94 | 2.89 | 6-FF | 0.00 | 38.04 | 43.98 | 17.82 |
| 160 | 44.77 | 34.95 | 6.72 | 4.07 | 6-FF | 0.00 | 38.04 | 44.77 | 18.36 |
| 180 | 45.63 | 35.03 | 7.58 | 5.39 | 6-FF | 0.00 | 38.04 | 45.63 | 18.91 |
| 190 | 46.10 | 35.11 | 8.06 | 6.13 | 6-FF | 0.00 | 38.04 | 46.10 | 19.17 |

El. inlet face invert 38.04 ft El. outlet invert 33.60 ft
El. inlet throat invert 38.00 ft El. inlet crest 0.00 ft

* *** SITE DATA ***** CULVERT INVERT **********

| | |
|---|---|
| INLET STATION (FT) | 0.00 |
| INLET ELEVATION (FT) | 39.00 |
| OUTLET STATION (FT) | 200.00 |
| OUTLET ELEVATION (FT) | 33.60 |
| NUMBER OF BARRELS | 1.00 |
| SLOPE (V-FT/H-FT) | 0.0222 |
| CULVERT LENGTH ALONG SLOPE (FT) | 196.05 |

*'*** CULVERT DATA SUMMARY **********

| | |
|---|---|
| BARREL SHAPE | CIRCULAR |
| BARREL DIAMETER | 4.00 FT |
| BARREL MATERIAL | CONCRETE |
| BARREL MANNING'S N | 0.012 |
| INLET TYPE | IMPR SDT CIRC |
| INLET EDGE AND WALL | BEVELED EDGE TOP (26-45 DEG WINGWALL) |
| INLET DEPRESSION | YES |

***** FALL SUMMARY **********

| | |
|---|---|
| MAXIMUM ALLOWABLE FALL | 4.44 FT |
| INLET DEPRESSION | 1.00 FT |
| FALL SLOPE (X:1) | 1.00 |
| CREST WIDTH | 5.00 FT |

* *** SIDE-TAPERED CIRCULAR IMPROVED INLET *******

| | |
|---|---|
| FACE WIDTH | 5.00 FT |
| SIDE TAPER (4:1 TO 6:1) (X:1) | 4.00 |
| FACE HEIGHT | 4.40 FT |

CURRENT DATE: 10-16-1995
CURRENT TIME: 11:54:34

FILE DATE: 10-13-1995
FILE NAME: IND48

## TAILWATER

******* REGULAR CHANNEL CROSS SECTION **********

| | |
|---|---|
| BOTTOM WIDTH (FT) | 10.00 |
| SIDE SLOPE H/V (X:1) | 5.0 |
| CHANNEL SLOPE V/H (FT/FT) | 0.030 |
| MANNING'S N (.01-0.1) | 0.035 |
| CHANNEL INVERT ELEVATION (FT) | 33.60 |
| CULVERT NO.1 OUTLET INVERT ELEVATION | 33.60 FT |

******* UNIFORM FLOW RATING CURVE FOR DOWNSTREAM CHANNEL

| FLOW (CFS) | W.S.E. (FT) | FROUDE NUMBER | VEL. (FPS) | SHEAR (PSF) |
|---|---|---|---|---|
| 0.00 | 33.60 | 0.000 | 0.00 | 0.00 |
| 20.00 | 34.04 | 1.007 | 3.77 | 0.81 |
| 40.00 | 34.24 | 1.036 | 4.71 | 1.20 |
| 60.00 | 34.40 | 1.050 | 5.34 | 1.50 |
| 80.00 | 34.54 | 1.059 | 5.82 | 1.75 |
| 100.00 | 34.65 | 1.066 | 6.21 | 1.97 |
| 120.00 | 34.76 | 1.071 | 6.55 | 2.17 |
| 140.00 | 34.86 | 1.075 | 6.84 | 2.35 |
| 160.00 | 34.95 | 1.079 | 7.10 | 2.52 |
| 180.00 | 35.03 | 1.082 | 7.34 | 2.68 |
| 200.00 | 35.11 | 1.084 | 7.56 | 2.82 |

## ROADWAY OVERTOPPING DATA

| | |
|---|---|
| ROADWAY SURFACE | GRAVEL |
| EMBANKMENT TOP WIDTH (FT) | 40.00 |
| CREST LENGTH (FT) | 100.00 |
| OVERTOPPING CREST ELEVATION (FT) | 46.00 |

Hydraulic Calculation for 48" RCP

from Jamtell Road design plans:

Inlet elevation = 39.0
outlet elevation = 33.6
100-Year WS w/s of Jamtell Rd
41.0

- Outlet Control Results Q = 150 cfs
- Inlet Control (From Nomographs)

HW/D = 8/4 = 2.0

Q = 155 cfs (From Nomograph.

Developed flow @ DP # 9 ⇒ 180 cfs + 33 = 210 cfs

Will need to provide onsite detention storage. (Private maintenance). OK

Improved Inlet to 48"
See Improved Inlet Analysis worksheet, (Sheet 2A ⇒)

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1-800-365-3096

| | | | |
|---|---|---|---|
| Project: | Reliable Sam | Page: | 1 |
| Location: | | Date: | 9/15/95 |
| Product: | 95-66 | By: | RAW |
| Client: | | Checked: | |

Proposed improvements -

Segment 1: DP1 to DP 2

Use open grassline swale: 5' min BW S = .005'/'

$Q_5$ = 18.6 cfs $Q_{100}$ = 36.7 cfs

from worksheet d = 2.25' SS = 4:1

Area = $\frac{1}{2}(2.25)(23+5)$ = 31.5

V = 36.7/31.5 = 1.2 fps ∴ ok

REVISED

Segment 2: DP3 to DP4

Use open swale -

$Q_5$ = 18.4 $Q_{100}$ = 37.4

Approx Slope = 2/300 = .0067

From worksheet d = 1.95 SS = 4:1

A = $\frac{1}{2}(1.95)(20.6+5)$ = 25.0

V = 37.4/25 = 1.5 ∴ ok

Netting not required

Netting not required.

## Segment ~~1~~ 2 : DP-2 to DP 4.1

Street Capacity = 13.6 cfs/side 27.2 total

$Q_5$ = 12.7 $Q_{100}$ = 25.2

Total Flow can fit within Street Section : no initial systems needed.

## Segment ~~4~~ : DP ~~4~~ to DP - 4.1

Street Capacity = 40.5 cfs

$Q_5$ = 33.5 cfs $Q_{100}$ = 66.2 cfs

∴ adequate Street capacity exists.

## Segment 4.1 DP 4.1 to DP-5

$Q_5$ = 46.2 $Q_{100}$ = 91.4

Street cap. exceeded:

$Q_5$ Residual = ~~46.2~~ - 40.5 = 5.7 cfs

Need Inlet $5.7 \text{ cfs} = 3.0(L_i)(d_i)^{1.5}$

$$L_i = \frac{5.7}{3.0(d_i)^{1.5}} = \frac{1.9}{.548} = 3.5$$

use 4' DIOR (one each side)

w/ 18" RCP out @ 1.0%.

Segment 5 DP 5 to DP 7-1

Street Cap = 40.5 cfs

$Q_5$ = 57.4 cfs $Q_{100}$ = 113.7 cfs

| | | |
|---|---|---|
| Flow in 18" | 5.7 cfs | 5.7 |
| Street Flow | 40.5 | 40.5 |
| Residual | 11.2 cfs | 67.5 cfs |

Flow required in Pipe = 11.2 + 5.7 = 16.9 cfs

Need 24" RCP $Q_{full}$ = 21 cfs ∴ ok

Inlets:

$$11.2 = \frac{3.0 (L_i)(d_i)^{1.5}}{}$$

$$L_i = \frac{11.2}{3.0 (.67)^{1.5}} = 6.8 \text{ say } 7' \text{ DIOR}$$

Flow enters from DP 5

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| Project: | Page: 4 |
|---|---|
| Location: | Date: |
| Product: | By: |
| Client: | Checked: |

Segment 5 DP 5 to 7.1

Street Capacity 41.0 cfs

$Q_5$ = 82.6 cfs $Q_{100}$ = 163.4 cfs

| | | |
|---|---|---|
| Planter 24" | 28.9 cfs | 28.9 cfs |
| Street Flow | 41.0 | 41.0 |
| | 12.7 REVISED | 93.5 |

Required $Q_5$ in Pipe = 28.9 + 12.7 = 41.6 cfs

Need 30" RCP $Q_{full}$ = 42 cfs ∴ ok

Inflow to 30" Assumed to be from Onsite Strm Sewer.

Segment 6: DP 6 to DP 7.0

Street Capacity 41.0 cfs

$Q_5$ 12.4 cfs $Q_{100}$ = 24.5 cfs ∴ No system

Need: Pickup flow with inlet @ DP 7.1

$12.4 \text{ cfs} = 3.0 L_i (d_i)^{1.5}$

$L_i = \frac{12.4}{3.0(d_i)^{1.5}} = \frac{12.4}{1.64} = 7.56$

Say 8' & 10 FT.

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| Project: | Page: 5 |
|---|---|
| Location: | Date: |
| Product: | By: |
| Client: | Checked: |

## Segment 7 DP 7 to 7.1

Street Capacity = 41.0 cfs

$Q_5$ = 20.0 cfs $Q_{100}$ = 39.6 cfs

| | | | |
|---|---|---|---|
| Flowin 18" | = | 12.7 | 12.7 |
| Street flow | | N/A | N/A |
| | | 7.3 | 26.3 |

Required Qs from SB 7 = 7.6

∴ Assume SB will be conveyed to Storm Sewer via an onsite system.

Total Flow required = 12.7 + 7.6 = 20.3 cfs

∴ Need 24" @ 1.0%

Inlet For SB 7 Qs = 7.6

$7.6 = 3.0(L_i)(d_i)^{1.5}$

$L_i = \frac{7.6}{3.0(d_i)^{1.5}} = 4.6$ Say 5' DIOR

SHEAR STRESS CALCULATIONS
GRASSLINED SWALES AND EROSION CONTROL DESIGN

DESIGN FREQUENCY 100-YR

CHANNEL LINING TY GRASSLINED WITH EROSION M

BOTTOM WIDTH = 5.0 FEET

PERMISSABLE SHEAR STRESS 2.100

| SEGMENT # | MANNING "N" | Q (CFS) | SLOPE | D/B FACTOR | D/B RATIO | D (FT) | SHEAR STRESS (PSF) | COMMENTS |
|---|---|---|---|---|---|---|---|---|
| 1 | 0.030 | 36.7 | 0.005 | 0.143 | 0.45 | 2.25 | 0.70 | |
| 3 | 0.030 | 37.4 | 0.007 | 0.126 | 0.390 | 1.950 | 0.82 | |
| 7.100 | 0.030 | 182.0 | 0.015 | 0.410 | 0.380 | 1.900 | 1.78 | |

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1-800-365-3096

| | | | |
|---|---|---|---|
| Project: | Reliable San. | Page: | 6 |
| Location: | | Date: | 9/15/95 |
| Product: | 95-64 | By: | RAW |
| Client: | | Checked: | RAW 10-10-95 |

Segment 7-1 Outfall to DP 9 (48" RCP)

Piped System

Total Flow (100-year) 210 cfs

Flow in initial system:

DP 5 ~~24~~ 30" RCP = ~~42~~ 116.9 cfs

24" RCP = 20.3 cfs

Total ~~62.3~~ 137.2 cfs

Assume S = 1.0% Need ~~36~~ 30" RCP w/FES

$Q_{full}$ = ~~67~~ 91 cfs.

Grass lined Swale

Slope 5/300' = ~~1.67~~ 0.015' %

from worksheet 5' BW

depth = 1.9'

Area = ½(1.9)(20.2+5) = ~~23.9~~ 24.2 sf

V = ~~190~~ 210/24.2 = ~~6.6~~ 7.4 fps.

Needs erosion Matting

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Fax: 303-791-1710
1-800-365-3096

| Project: Reliable Sun. | Page: |
|---|---|
| Location: | Date: 9/15/95 |
| Product: | By: Paul |
| Client: | Checked: |

Street Capacities:

① Ringler Ct.:

Approx Slope: 2/320' = .00625'/'

using interim criteria:

Minor Residential (Collector)

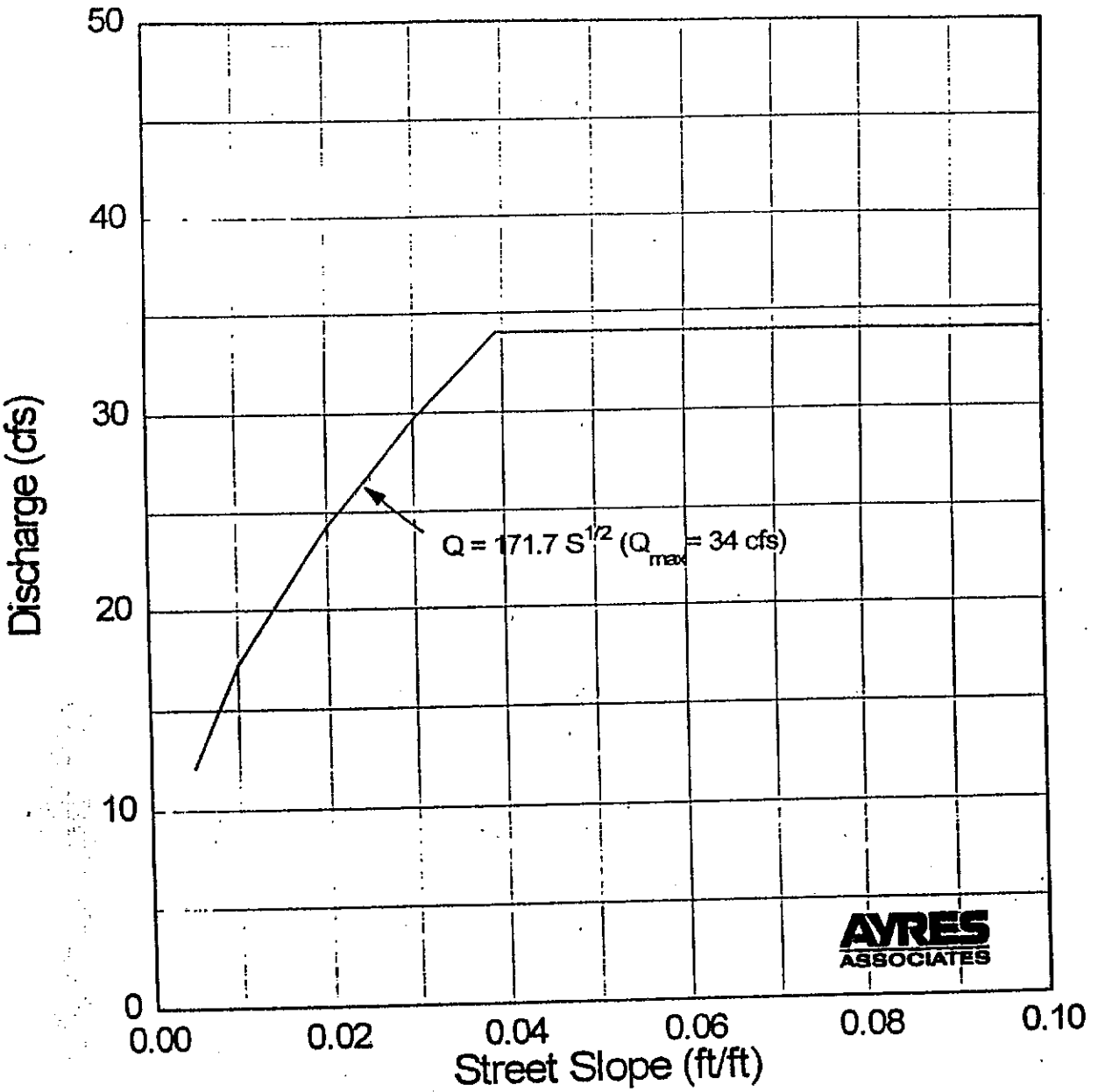
$Q = 171.7 S^{1/2} = 171.7(.00625)^{1/2} = 13.6$ cfs

② Reliable Ct.

Approx Slope = 2/140' = .014'/'

$Q = 171.7(.014)^{1/2} = 20.5$ cfs

## COLLECTOR STREETS (Major and Minor)

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**City of Colorado Springs**

Use this graph to determine the allowable street capacity per side, initial storm, for the typical street section using a 2% crown. No flow may cross the crown.