

9/4/14

Coran Chassey, What
1/5 DOG1
Fluoridation inlet not provided

Size of pipe across AC - inlet control device?

What about flow rate of University Blvd
0 cfs from B&E

✓ Showing HGL

✓ FP removed

19.80 + 5.3 = 25.1
24" DIA (87 ft) → 1/4" LT → 30" DIA (12 ft) → 36" (20 ft)

→ NOT capturing (a pass) AT NEW INLET, 6000 PSI AT 100'

0.81 + 5.2 = 1.33 cfs in ACC, NOT MUCH

But not provide piping for 30" + 36"
but larger than by planning + HGL OK

Thrust seems longer than necessary
but still bearing 1.33 cfs (not much)

ROAD PLANNING COMMIT APPROVED ✓

COA 5105.07

AVENIDA CEDAR CHAVEZ INLET REPORT 9/6/13 BY PB

DRAINAGE 810 → 40 CFS ←

NEED TO PROVIDE CALCS

25.1 CFS

REPLACE DECK

FOR THIS - EXHIBIT 1 PVD
BUT I HAVE SOME BASIN MAPS & NO
EXPLANATION OF ANALYSIS PD

ALT 8-WB

10' LONG x 4' WIDE INLET

ALT 1-EB

SERIES OF INLETS S SIDE TYPE B

GUARD RAIL

pl10 HYDROLOG

POND?

COST EST pl17

TYPE D SINGLE, TYPE D DOUBLE

pl10 3 TYPE B ?

$$\begin{aligned} L=45' Q_{\text{NORTH}} &= 19.80 \text{ CFS} \\ L=15' Q_{\text{SOUTH}} &= 5.3 \text{ CFS} \\ Q_T &= 25.1 \text{ CFS} \end{aligned}$$

COULDN'T HAVE GRATE

BIKES IN GUTTER PAN - GRATE IS RATED FOR BIKES

31 FT CURB OPENING LENGTH 48"

AMPCA - BIKES

JUST
THROAT
(NO GRATE)

$$L_N = \frac{19.8}{2.95 (.33)^{3/2}} = 35.41' \quad L_S = \frac{5.3}{2.95 (.33)^{3/2}} = 9.5'$$

.89C
541

$$L_N = \frac{Q}{2.95 H^{3/2}} = \frac{19.8}{2.95 (.79)^{3/2}} = 19.8 \quad 9.55 \text{ FT} \quad \text{DOUBLE A, SINGLE C, DOUBLE C}$$

$$L_S = \frac{5.3}{2.95 (.79)^{3/2}} = 2.56 \text{ FT} \quad \text{SINGLE A}$$

$$D = 1.33 \left(\frac{n Q}{\sqrt{S}} \right)^{3/8} = 1.33 \left(\frac{.013 (5.3)}{\sqrt{.005}} \right)^{3/8} = 1.32" = 15.8" \rightarrow 18"$$

$$D = 1.33 \left(\frac{.013 (25.1)}{\sqrt{.005}} \right)^{3/8} = 2.36' = 28.3" \rightarrow 30" \quad \checkmark$$

INLET
CANNOT
NEED
24"
NOT
24"

USO HYDRAFLOW FOR UNEVEN WATER SURFACE

ROAD WITH 1% GRADE
WITH 2% SLOPE IN DRAIN
DRAINAGE MANHOLE 10' TO
10' - 12' DEPTH



2. REPORT REVIEW AND FIELD INSPECTION

2.1 Drainage

Existing drainage reports were collected from the City of Albuquerque to determine the extent of the previously constructed Avenida Cesar Chavez storm drain improvements. In 1994, a report entitled "Stadium Boulevard Storm Drainage Improvements Engineering Analysis Report" (EAR) was prepared by Bohannon-Huston, Inc. for the City of Albuquerque and serves as a basis for this report. The EAR addressed flooding issues along Stadium Boulevard (currently known as Avenida Cesar Chavez), primarily at its intersection with University Boulevard. The report indicated that the Avenida Cesar Chavez storm drain improvements were intended to intercept flows from the planned Yale Boulevard storm drain, Buena Vista storm drain, overland and surcharged storm sewer flows from University Boulevard, overland flow from Santa Clara Avenue, and flows from Avenida Cesar Chavez east of the South Diversion channel. The report proposed the construction of an 84" diameter storm drain beginning at Yale Boulevard and extending west along Avenida Cesar Chavez increasing in size to an 108" diameter storm drain before it transitions into a trapezoidal channel at its confluence with the South Diversion Channel. The construction of this system was confirmed through as-built plans obtained from the City of Albuquerque.

Upon review of the post-project flow rates found in the EAR, a field review of the project site was performed to determine if any additional improvements had been made that would affect runoff patterns proposed in the original report. Storm drain as-built plans were also collected for the properties and storm drain networks contributing to the Avenida Cesar Chavez storm drain network to aid in developing a basin map for the project area. The following changes were noted from the EAR.

1. A total of 6 additional Type "A" inlets (3 northbound and 3 southbound) have been built as part of the Stadium Boulevard Improvements Project.)
2. Improvements to the Langham storm drain network (5 inlets) have been constructed to further reduce flows reaching the existing transverse drainage inlet.)

A map showing offsite and roadway basins contributing to the Avenida Cesar Chavez storm drain network can be seen in Exhibit 1 in Appendix A of this report.)

2.2 Crossing Structure

2.1.1 Description

The design plans for the existing Avenida Cesar Chavez structure over the South Diversion Channel were obtained from the Albuquerque Metropolitan Arroyo Flood Control Authority (AMAFCA). The existing structure plans are dated 1971. The structure consists of a reinforced concrete "U" channel, with a steel grate superstructure, and reinforced concrete sidewalk. The clear span between the channel walls is 11 feet 4 inches. The width perpendicular to the roadway is 100 feet 9 inches, which includes two 7-foot, 4-inch wide sidewalks. This width provides room for pipe railings along the outside of the structure.



The superstructure has 22 steel "I" girders, type 12 WF 27. The girders are approximately 12 inches deep at 4-foot spacing. The girders support a 5-inch thick steel grate deck, which allows for through drainage. The beams are



past repairs is visible, as described previously. In addition, a piece of steel plate from the past repairs was seen at the bottom of the channel.

While no immediate safety concerns were observed, the structure will require ongoing, frequent maintenance if no improvements are made. The noise from the deck indicates that significant grate movement is occurring under traffic loads, which may result in fatigue of the connections to the beams. With drainage through the deck, the beams and the concrete seats will continue to deteriorate.

3. HYDROLOGY

The design flood for this assessment is the 100-year recurrence interval storm based on the "City of Albuquerque's Development Process Manual" (DPM). ArcGIS, version 10.1 was used to prepare the drainage basin map for this assessment. Aerial photos along with City of Albuquerque 2-foot interval contours were used to delineate drainage basins contributing to the analysis area. Future developed land usage estimates are based on the current City of Albuquerque GIS Data Website. The 100-year rainfall data for the analysis area was obtained from the DPM. The Rational Method was used to perform peak flow calculation for this assessment based on the 6-hour storm duration per the DPM. Peak flow rate calculations can be found in **Appendix B**. The following land treatment assumptions were made:

- Areas that fell under the land use category "Vacant/Other" were analyzed as fully developed properties and were assumed to be 90% land treatment D and 10% land treatment C.
- Areas that fell under the land use category "Parks/Recreational" appeared to be paved parking areas, or sports complex buildings and were assumed to be primarily land treatment C and D. Aerial photos were used to determine percent impervious values.

See Exhibit 2 in Appendix A for a Land Use Map of the Project.

3.1 Flow Analysis

The EAR indicates that with the construction of the recommended drainage improvements, the overland flow reaching the transverse drainage inlet has decreased from 810 cfs to 40 cfs. In an effort to confirm the current amount of flow reaching the transverse drainage inlet, an analysis of the capacity of the existing inlets along Avenida Cesar Chavez from University Boulevard to Langham was performed.

According to the original EAR, inlets constructed along University Boulevard and Avenida Cesar Chavez, east of University Boulevard, intercept all overland flow. Therefore, analysis of the previously constructed Avenida Cesar Chavez storm drain system was limited to west of the University Boulevard/Avenida Cesar Chavez intersection. Analysis points AP1 and AP2 were defined for eastbound and westbound Avenida Cesar Chavez, and flows were computed and distributed to the existing inlets. As-built plans indicated that City of Albuquerque Type "A" inlets were used on Avenida Cesar Chavez and a combination of City of Albuquerque Type "A" and Type "Double C" inlets were used on Langham. Existing roadway slopes for Avenida Cesar Chavez and Langham were taken from as-built plans or calculated based on City of Albuquerque contours. Analysis indicates that a total of 25.1 cubic feet per second (cfs) currently reaches the transverse drainage inlet (19.8 cfs at AP1 and 5.3 cfs at AP2). The decrease in flow reaching the transverse inlet can be attributed to the construction of the Langham storm drain improvements as well as to the addition of the 6 inlets to the Avenida Cesar Chavez storm drain network. Drainage inlet analysis calculations can be found in **Appendix B**.

EAR

mentioned in the previous paragraph. An analysis was performed to determine what effect diverting this flow to the Stadium Boulevard storm drain project would have on drainage flows in University Boulevard. The Stadium Boulevard project has additional capacity at Buena Vista Drive.

The AHYMO model of the Stadium Boulevard project in-place was revised to include a 48" diversion pipe to Stadium Boulevard. Three different AHYMO models for three conditions were run in order to determine the effects of the diversion. Table 5 summarizes the modeling results for the three conditions analyzed.

TABLE 5
100-YEAR STORM PEAK DISCHARGES (IN CFS)
FOR THREE CONDITIONS

		Pre-Project Conditions	Post-Project With Diversion	Post-Project No Diversion
Coal & University	SD	127	66	127
	OL	213	0	41
Stadium & University	SD	127	127 ¹	127
	OL	625	240 ²	325 ²
Subbasin BB-2	OL	260	230	230
Residual flow from APBB4	OL	250	150	150
Stadium & SDC	SD	0	1,340	1,290
	OL	875	40	55
SDC just down- stream of Stadium	OL	1,570	2,090	2,050

SD = Storm drain flow; OL = Overland flow

¹Assumes that OL from Subbasin BB-2 enters the 48" SD in University Boulevard.

²Flow will be intercepted by the number of new catch basins constructed along University Boulevard and Stadium Boulevard.

Comparison of the results in the above table shows that the diversion does have a beneficial effect on flows into University Boulevard. The next step in the analysis was



The conveyance capacity of Avenida Cesar Chavez was checked based on the hydraulic design criteria found in the DPM. The DPM indicates that flow depths in the event of a 100-year design discharge may not exceed 0.2 feet above curb height and shall be contained within the right-of-way (ROW). It was determined that City of Albuquerque standards are met for the 100-year design discharge.

3.2 South Diversion Channel Analysis

The South Diversion Channel Hydrologic and Hydraulics Review (yet to be published) was completed by Easterling & Associates Inc. using the Hydrologic Engineering Center River Analysis System (HEC-RAS). A copy of the analysis was obtained from AMAFCA, and it indicated that the 100-year water surface elevation does not reach the low chord. Flows in the South Diversion Channel and the hydraulic capacity of the existing crossing structure will not be affected by replacement of the steel grate superstructure.

4. EXISTING STRUCTURE ANALYSIS

The existing crossing structure was analyzed to assess its suitability for rehabilitation and replacement of the existing steel deck. Based on the analysis, the existing structure can be modified to extend its service life and to address the current safety and maintenance issues associated with the steel deck.

The structure was analyzed per the AASHTO Standard Specifications for Highway Bridges, 17th Edition. Analysis assumptions were based on the design plans, obtained from AMAFCA, and engineering judgment. Assumptions included:

- Soils
 - Type: Medium-dense sand
 - Angle of Internal Friction: 34 degrees
 - Density: 120 pounds per cubic foot (pcf)
 - Horizontal Earth Pressure: Active case, Rankine formula
 - Allowable Bearing Pressure: 2,000 pounds per square foot (psf)
- Concrete
 - Compressive Strength (f_c): 3,000 pounds per square inch (psi)
- Reinforcing Steel
 - Yield Strength (f_y): 40,000 psi

The structure was analyzed as a simple frame using the STAAD.Pro V8i computer program, version 20.08.07.20. Moment and shear were checked at critical locations for two cases, with and without bracing of the vertical walls by the existing deck. The results are shown in **Table 1** on the following page.

PARSONS BRINCKERHOFF Computation Sheet

subject Arrenda Cesar Chavez DT Assessment

page 1 of 4 33677
made by KVC
date 6-5-13
checked by FHD
date 6-19-13

Basin A.

A=1.56 B=2.28 C=3.14 D=4.70
Rainfall Zone 2

Area = 0.97 acres

* Vacant land = 0.022 acres

D = 0.022 acres

Note: vacant land in Basin A appears to be a paved road + sidewalk.

* Commercial services = $0.97 - 0.022 = 0.95$

D = $0.90 (0.95 \text{ acres}) = 0.86 \text{ acres}$

C = $0.95 - 0.86 = 0.09 \text{ acres}$

Total D = $0.022 + 0.86 = 0.88 \text{ acres}$ Total C = 0.09 acres

$Q_p = 4.70(0.88) + 3.14(0.09) = \underline{\underline{4.42 \text{ cfs}}}$

Basin B

Area = 7.5 acres

* Commercial services = 5.1 acres

D = $0.90(5.1) = 4.59 \text{ acres}$

C = $5.1 - 4.59 = 0.51 \text{ acres}$

* Vacant land = 0.52 acres

D = 0.52 acres

* public / institutional = $7.5 - 5.1 - 0.52 = 1.88 \text{ acres}$

D = $0.90(1.88) = 1.69$

C = $1.88 - 1.69 = 0.19$

Note: lands that fall under the public/institution category were analyzed as commercial services.

Total D = $4.59 + 0.52 + 1.69 = 6.8$

Total C = $0.51 + 0.19 = 0.7$

$Q_p = 4.70(6.8) + 3.14(0.70) = \underline{\underline{34.16 \text{ cfs}}}$

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date

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subject

Basin C.

Area = 1.98 acres.

* Public / constitutional = 0.85 acres.

$$D = 0.90(0.85) = 0.77 \text{ acres.} \quad C = 0.85 - 0.77 = 0.085 \text{ acres.}$$

* Vacant land = 1.98 - 0.85 = 1.13 acres.

$$D = 1.13$$

$$\text{Total } D = 0.77 + 1.13 = 1.9 \text{ acres.} \quad \text{Total } C = 0.085 \text{ acres.}$$

$$Q_p = 4.70(1.9) + 3.14(0.085) = \underline{9.2 \text{ cfs.}}$$

Basin D

Area = 1.62 acres.

* Vacant land = 1.62 acres

$$D = 0.90(1.62) = 1.46 \quad C = 0.162$$

$$Q_p = 4.70(1.46) + 3.14(.162) = \underline{7.37 \text{ cfs.}}$$

Note: Vacant land in Basins D, E, + F was analyzed as fully developed Basin E per COP instruction.

Area = 5.25 acres.

* Vacant land = 5.25 acres

$$D = 0.9(5.25) = 4.73 \quad C = 0.525$$

$$Q_p = 4.7(5.25) + 3.14(.525) = \underline{26.32 \text{ cfs.}}$$

Basins I - Y

Note: all basins are treatment D = 4.70 in

	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
A	0.42	0.05	0.68	0.05	0.05	0.39	0.20	0.15	0.07	0.09	0.22	0.25	0.06	0.83
Qp	1.97	0.24	3.2	0.24	0.24	1.83	0.94	0.71	0.33	0.42	1.03	1.18	0.28	3.9

Basin Z

Area = 0.51

D = 0.36 acres.

$$C = 0.51 - 0.36 = 0.15$$

$$Q_p = 4.70(0.36) + 3.14(0.15) = \underline{2.14 \text{ cfs.}}$$

	W	X	Y
A	0.06	0.06	0.55
Qp	0.28	0.28	2.59

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subject

Basin AA

$$Area = 0.85 \text{ acrs.}$$

$$C = 0.85 \text{ acrs}$$

$$Q_p = 3.14(0.85) = \underline{\underline{2.67 \text{ cfs.}}}$$

Basin BB

$$Area = 0.83$$

* Multi Family (attached)

$$D = 0.70(0.83) = 0.58 \text{ acrs}$$

$$C = 0.83 - 0.58 = 0.25 \text{ acrs.}$$

$$Q_p = 4.70(0.58) + 3.14(0.25) = \underline{\underline{3.51 \text{ cfs}}}$$

Basin CC

$$Area = 0.04$$

* Multi Family (attached)

$$D = 0.70(0.04) = 0.03$$

$$C = 0.01$$

$$Q_p = 4.70(.03) + 3.14(0.01) = \underline{\underline{0.17 \text{ cfs.}}}$$

Basin DD

$$Area = 0.06$$

$$D = 0.7(0.06) = 0.04 \quad C = 0.02$$

$$Q_p = 4.7(0.04) + 3.14(0.02) = \underline{\underline{0.25 \text{ cfs.}}}$$

Basin EE

$$Area = 0.62 \text{ acres.}$$

$$D = 0.7(0.62) = 0.43$$

$$C = 0.19$$

$$Q_p = 4.7(0.43) + 3.14(0.19) = \underline{\underline{2.62 \text{ cfs.}}}$$

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subject _____

Basin H.

$$Area = 0.49 \text{ acrs}$$

$$D = 0.49 \text{ acrs}$$

$$Q_p = 4.70(0.49) = \underline{\underline{2.3 \text{ cfs.}}}$$

Basin G.

$$Area = 0.42 \text{ acrs}$$

$$D = 0.42 \text{ acrs}$$

$$Q_p = 4.70(0.42) = \underline{\underline{1.97 \text{ cfs}}}$$

Basin F

$$Area = 2.88 \text{ acrs}$$

$$* \text{ Vacant land} = 2.88 \text{ acrs}$$

$$D = 0.90(2.88) = 2.59 \quad C = 0.288$$

$$Q_p = 4.7(2.59) + 3.14(.288) = \underline{\underline{13.08 \text{ cfs.}}}$$

9.03602

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subject Avenida Cesar Chavez Outlet Assessment.
EB ACC

Outlet 8

Basin P = 0.71 cfs.

I = 0.71 cfs B = 0 cfs.

Outlet 9

Basin Q + Outlet 8 B = 0.33 + 0 = 0.33 cfs.

I = 0.33 cfs B = 0 cfs

Outlet 10

Basin R = 0.42 cfs.

I = 0.42 cfs B = 0 cfs.

Outlet 11

Basin S = 1.03 cfs.

I = 1.03 cfs B = 0 cfs.

Outlet 12

Basin T = 1.18 cfs

I = 1.18 cfs. B = 0 cfs.

Outlet 13.

Basin U = 0.28 cfs.

I = 0.28 cfs B = 0 cfs.

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Outlet 14

$$\text{Basin V} + \text{Basin Z} + \text{Basin AA} + \text{Basin BB} = 3.9 + 2.16 + 2.67 + 3.51 = \underline{\underline{12.24 \text{ cfs}}}$$

$$I = 7.01 \text{ cfs} \quad B = 5.23 \text{ cfs}$$

Outlet 15

$$\text{Basin W} + \text{Basin CC} + \text{Outlet 14 B} = 0.28 + 0.17 + 5.23 = \underline{\underline{5.68 \text{ cfs}}}$$

$$I = 4.22 \text{ cfs} \quad B = 1.46 \text{ cfs}$$

Inlet 16

$$\text{Basin X} + \text{Basin DD} + \text{Inlet 15 B} = 0.28 + 0.25 + 1.46 = \underline{\underline{1.99 \text{ cfs}}}$$

$$I = 1.91 \text{ cfs} \quad B = 0.08 \text{ cfs}$$

EB ACC @ South Diversion Channel

$$\text{Basin Y} + \text{Basin EE} + \text{Inlet 16 B} = 2.59 + 2.62 + 0.08 = \underline{\underline{5.29 \text{ cfs}}}$$

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WB ACC

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checked by FHO
date 6-19-13

Inlet 1

$$\text{Basin A} + \text{Basin I} = 4.42 + 1.97 = \underline{\underline{6.39 \text{ cfs}}}$$

$$I = 4.53 \text{ cfs}$$

$$B = 1.86 \text{ cfs}$$

I = intercepted

B = bypass.

Inlet 2

$$\text{Basin J} + \text{Inlet 1 B} = 0.24 + 1.86 = \underline{\underline{2.1 \text{ cfs}}}$$

$$I = 1.98$$

$$B = 0.12 \text{ cfs}$$

Inlet 3

$$\text{Basin C} + \text{Inlet 2 B} = 9.2 + 0.12 = \underline{\underline{9.32 \text{ cfs}}}$$

$$I = 5.82 \text{ cfs} \quad B = 3.50 \text{ cfs}$$

Inlet 4

$$\text{Basin K} + \text{Basin D} + \text{Inlet 3 B} = 3.2 + 7.37 + 3.50 = \underline{\underline{14.07 \text{ cfs}}}$$

$$I = 7.65 \text{ cfs}$$

$$B = 6.42 \text{ cfs}$$

Inlet 5

$$\text{Basin L} + \text{Inlet 4 B} = 0.24 + 6.42 = \underline{\underline{6.66 \text{ cfs}}}$$

$$I = 4.70 \text{ cfs}$$

$$B = 1.96 \text{ cfs}$$

Inlet 6

$$\text{Basin M} + \text{Inlet 5 B} = 0.24 + 1.96 = \underline{\underline{2.2 \text{ cfs}}}$$

$$I = 2.08 \text{ cfs}$$

$$B = 0.12 \text{ cfs}$$

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date

subject

Orbit 7.

$$\text{Basin N} + \text{Basin E} + \text{Orbit 4 B} = 1.83 + 26.32 + 0.12 = \underline{\underline{28.27 \text{ cfs}}}$$

$$I = 11.33 \text{ cfs}$$

$$B = 16.94 \text{ cfs}$$

Orbit 17

$$\text{Basin F} + \text{Basin G} = 13.08 + 1.97 = \underline{\underline{15.05 \text{ cfs}}}$$

$$I = 8.05 \text{ cfs}$$

$$B = 7.00 \text{ cfs}$$

Orbit 18

$$\text{Bypass Orbit 17} = 7.00 \text{ cfs}$$

$$I = 5.05 \text{ cfs} \quad B = 1.95 \text{ cfs}$$

Orbit 19

$$\text{Basin H} = \underline{\underline{2.3 \text{ cfs}}}$$

$$I = 2.13 \text{ cfs} \quad B = 0.17 \text{ cfs}$$

Orbit 20

$$\text{Orbit 19 Bypass} = \underline{\underline{0.17 \text{ cfs}}}$$

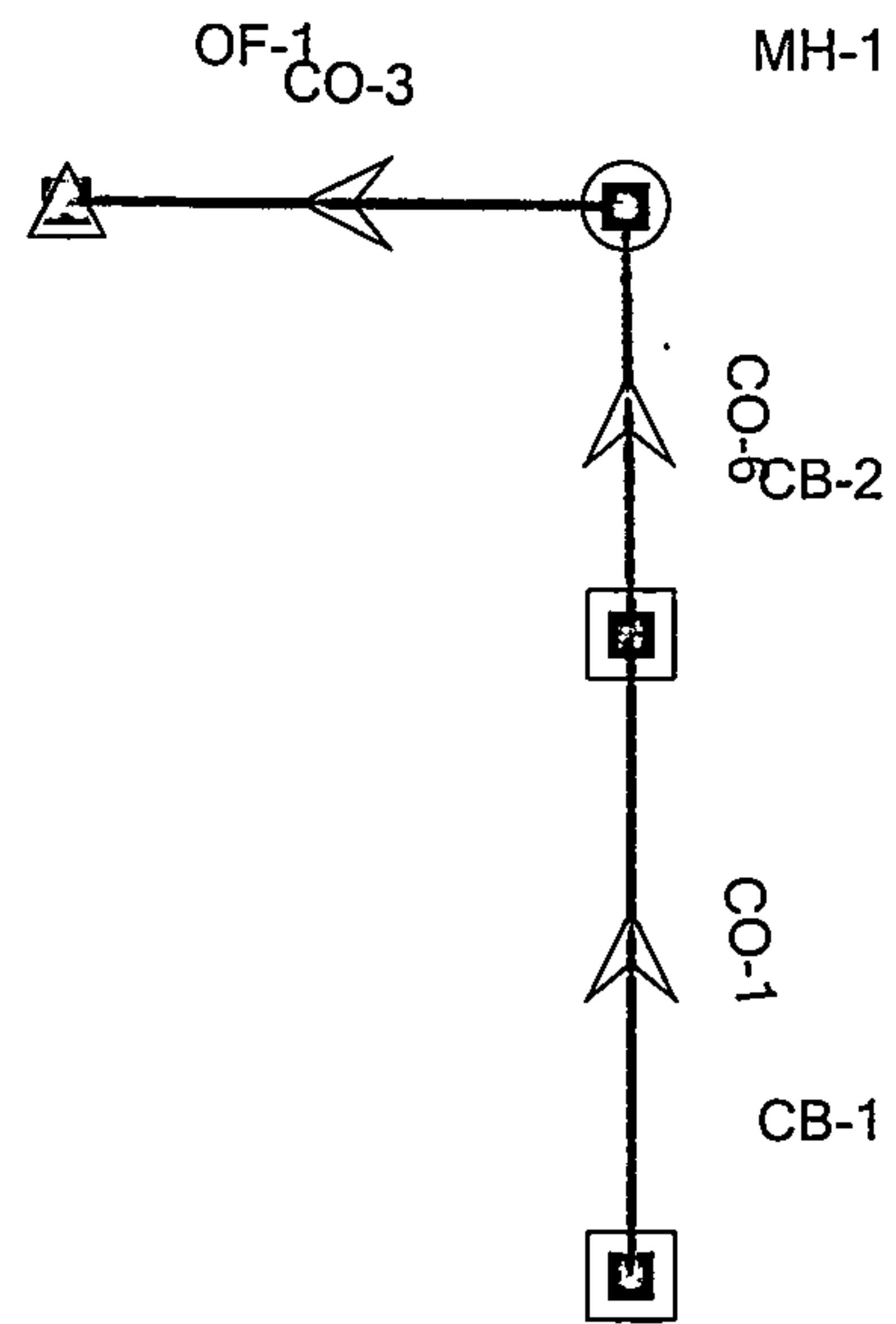
$$I = 0.17 \text{ cfs} \quad B = 0 \text{ cfs}$$

WB-ACC-@-South-Diversion-Channel

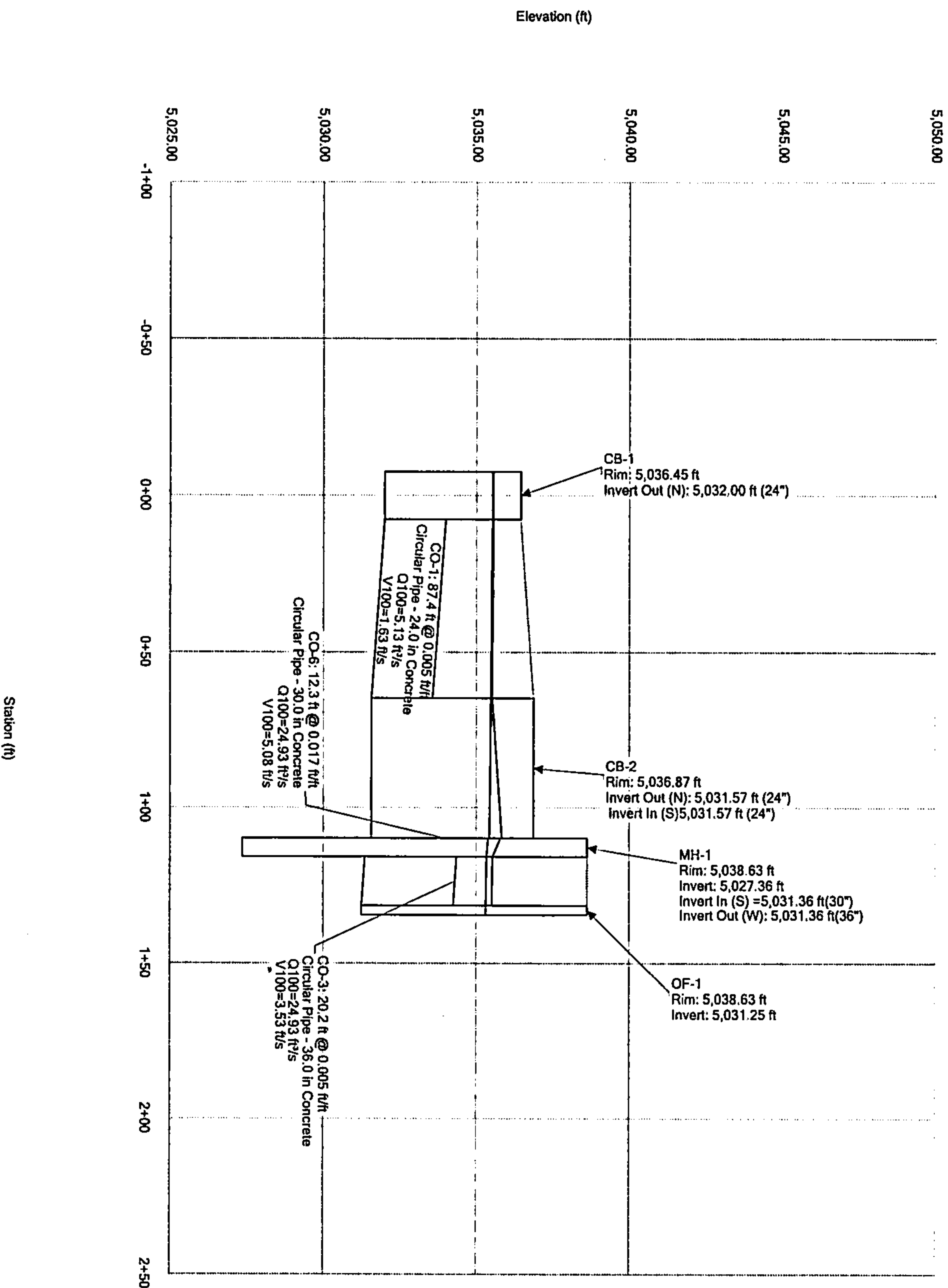
$$\text{Basin O} + \text{Orbit 7 B} + \text{Langham Bypass}$$

$$0.94 + 16.94 + 1.95 = \underline{\underline{19.82 \text{ cfs}}}$$

Scenario: Base



Profile Report
Engineering Profile - Profile - 1 (ACC.stc)



**CITY OF ALBUQUERQUE
CITY WIDE-ON CALL ENGINEERING SERVICES
(TRANSPORTATION & STORM DRAINAGE)
5015.03**

**TASK 1
AVENIDA CESAR CHAVEZ
DRAINAGE INLET ASSESSMENT
FINAL**

Prepared For:



Prepared By:

**PARSONS
BRINCKERHOFF**

September 6, 2013

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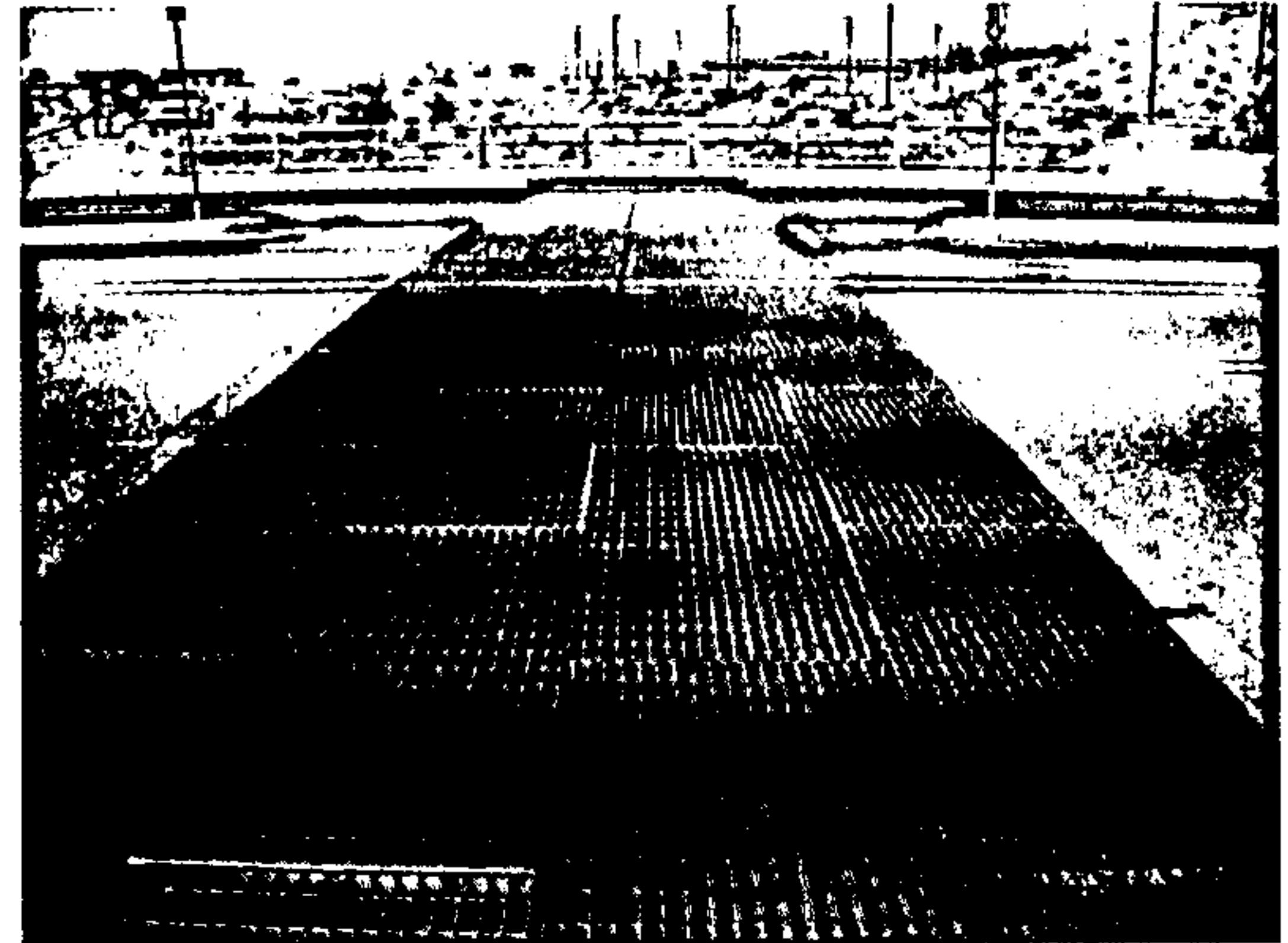
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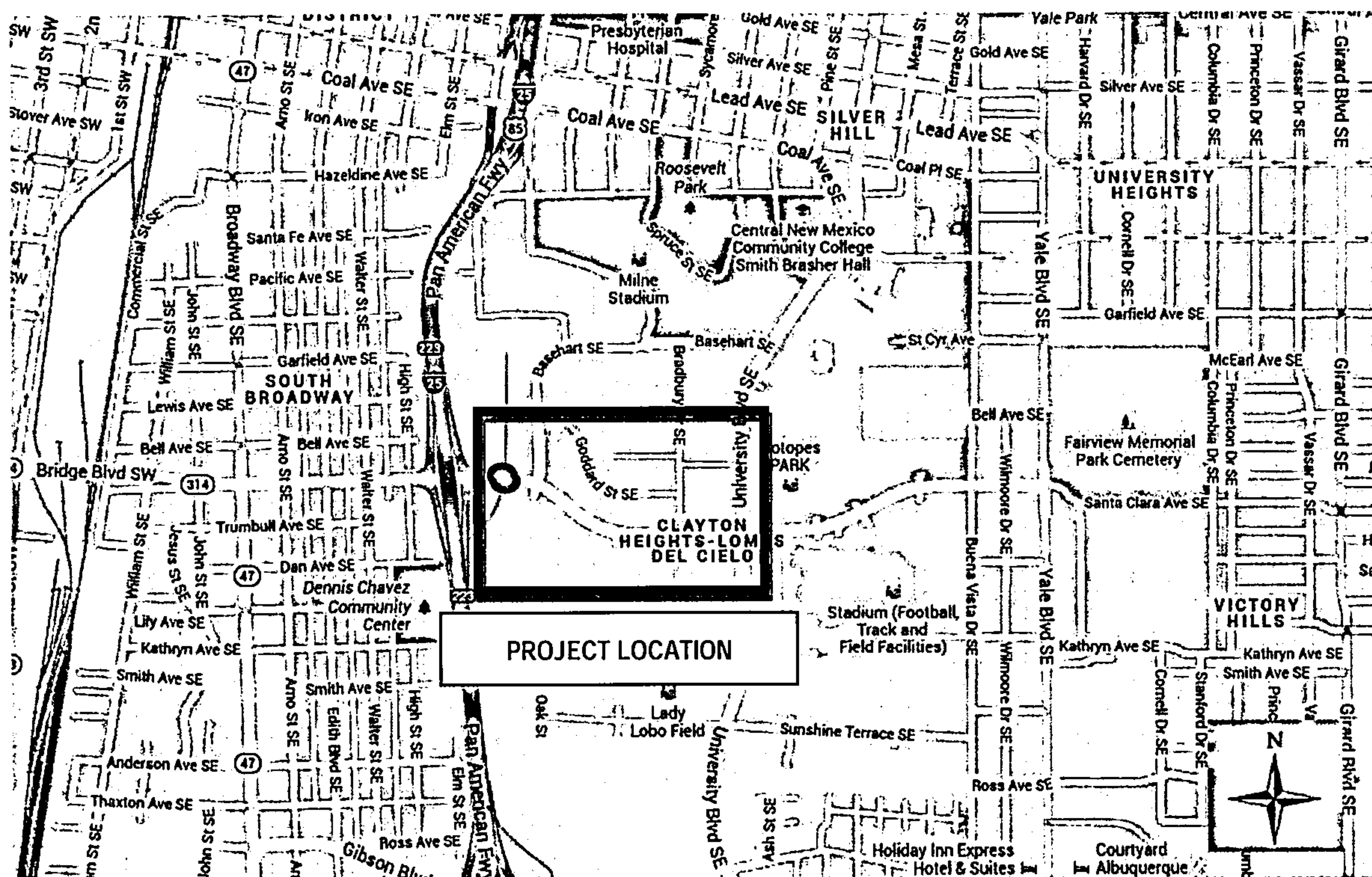
1. INTRODUCTION

The City of Albuquerque (COA) has expressed concern over the existing transverse drainage inlet located over the South Diversion Channel just east of I-25 and west of the Avenida Cesar Chavez/Langham intersection. The inlet poses both safety concerns, as well as maintenance issues due to the deficient condition of the steel deck and structure. The COA has requested that Parsons Brinckerhoff assess the structure and recommend feasible alternatives that will address the drainage structure deficiencies and verify the impacts of the drainage improvements upstream.



This report presents the findings of the feasibility assessment performed that evaluated and has identified alternatives for the drainage inlet replacement/removal. This report documents the engineering analyses conducted, alternatives considered, the evaluation of each alternative, and recommends a course of action to implement a project. The location of the project is shown in Figure 1.

Figure 1: Project Location





2. REPORT REVIEW AND FIELD INSPECTION

2.1 Drainage

Existing drainage reports were collected from the City of Albuquerque to determine the extent of the previously constructed Avenida Cesar Chavez storm drain improvements. In 1994, a report entitled "Stadium Boulevard Storm Drainage Improvements Engineering Analysis Report" (EAR) was prepared by Bohannon-Huston, Inc. for the City of Albuquerque and serves as a basis for this report. The EAR addressed flooding issues along Stadium Boulevard (currently known as Avenida Cesar Chavez), primarily at its intersection with University Boulevard. The report indicated that the Avenida Cesar Chavez storm drain improvements were intended to intercept flows from the planned Yale Boulevard storm drain, Buena Vista storm drain, overland and surcharged storm sewer flows from University Boulevard, overland flow from Santa Clara Avenue, and flows from Avenida Cesar Chavez east of the South Diversion channel. The report proposed the construction of an 84" diameter storm drain beginning at Yale Boulevard and extending west along Avenida Cesar Chavez increasing in size to an 108" diameter storm drain before it transitions into a trapezoidal channel at its confluence with the South Diversion Channel. The construction of this system was confirmed through as-built plans obtained from the City of Albuquerque.

Upon review of the post-project flow rates found in the EAR, a field review of the project site was performed to determine if any additional improvements had been made that would affect runoff patterns proposed in the original report. Storm drain as-built plans were also collected for the properties and storm drain networks contributing to the Avenida Cesar Chavez storm drain network to aid in developing a basin map for the project area. The following changes were noted from the EAR.

1. A total of 6 additional Type "A" inlets (3 northbound and 3 southbound) have been built as part of the Stadium Boulevard Improvements Project.
2. Improvements to the Langham storm drain network (5 inlets) have been constructed to further reduce flows reaching the existing transverse drainage inlet.

A map showing offsite and roadway basins contributing to the Avenida Cesar Chavez storm drain network can be seen in Exhibit 1 in Appendix A of this report.

2.2 Crossing Structure

2.1.1 Description

The design plans for the existing Avenida Cesar Chavez structure over the South Diversion Channel were obtained from the Albuquerque Metropolitan Arroyo Flood Control Authority (AMAFCA). The existing structure plans are dated 1971. The structure consists of a reinforced concrete "U" channel, with a steel grate superstructure, and reinforced concrete sidewalk. The clear span between the channel walls is 11 feet 4 inches. The width perpendicular to the roadway is 100 feet 9 inches, which includes two 7-foot, 4-inch wide sidewalks. This width provides room for pipe railings along the outside of the structure.



The superstructure has 22 steel "I" girders, type 12 WF 27. The girders are approximately 12 inches deep at 4-foot spacing. The girders support a 5-inch thick steel grate deck, which allows for through drainage. The girders are



supported on ledge seats on the channel walls. The girders rest on lead plates and are attached to the concrete seats with anchor bolts.

The channel has 90 degree wingwalls at each end. The wingwalls extend 25-feet, 9-inches from the outside of the channel walls. Steel pipe railings are located along the top of the wingwalls and across the channel on each side of the roadway.

2.1.2 Field Inspection

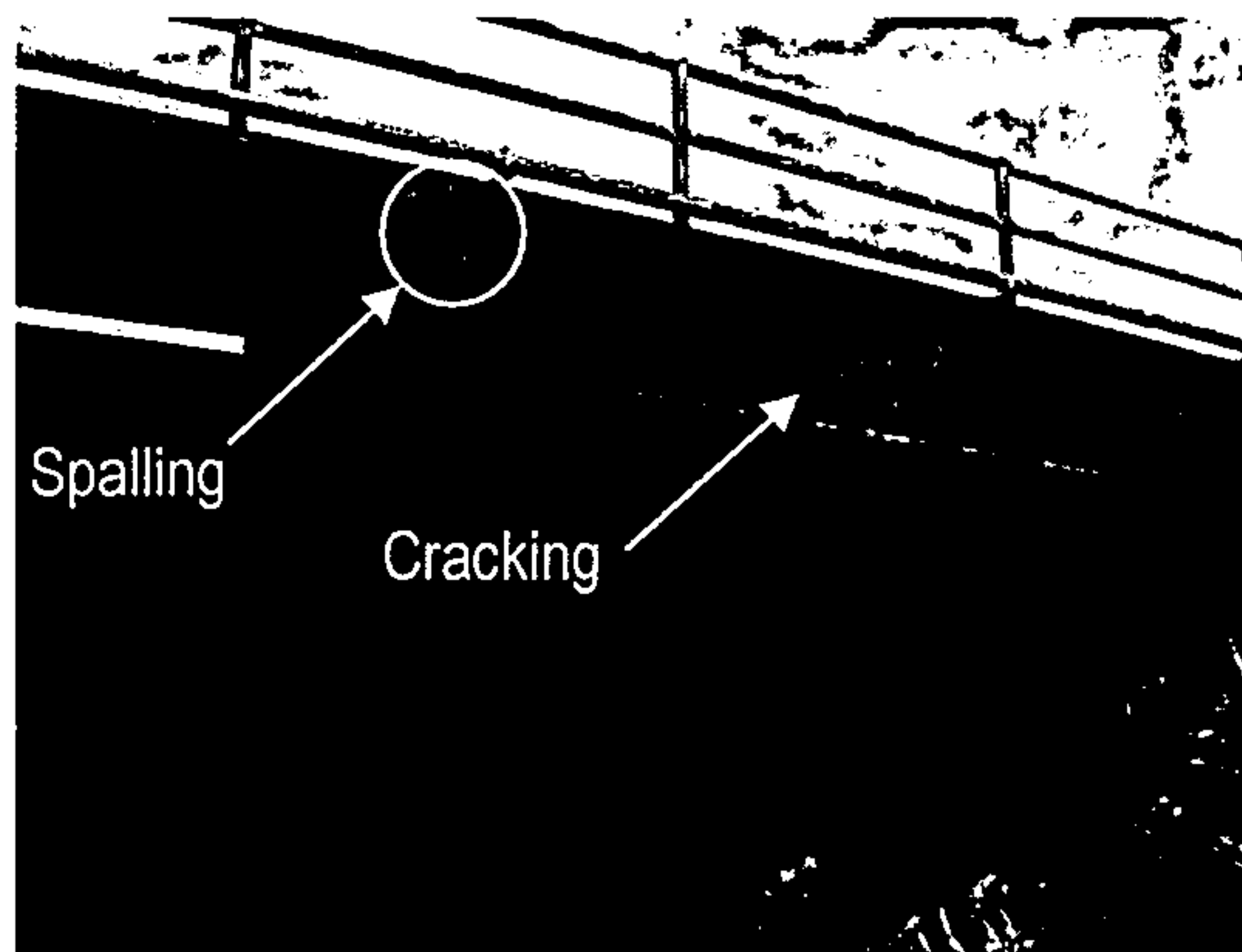
The structure was visually inspected on May 29, 2013. The steel grate deck has numerous large gaps between the grates, and the steel clangs loudly when vehicles drive over it. Many of the steel girders have visible rust at the west ends on the bottom corners. The bottom flanges of two of the girders at the west end have been retrofitted with steel plates. Some of the concrete under the girder seats at the west end is damaged and missing. An area of spalled concrete is visible near the abutment seat in the southwest corner. On the east side opposite, the seat appears to have been patched.



Steel plates were used to repair two girders at the west abutment

The walls of the "U" channel have a number of visible hairline cracks. Most of these are short, although several vertical full-height cracks were observed on the west wall. The channel floor was covered with dirt and was not visible.

The wingwalls have significant map cracking visible on the faces and tops of the walls. This probably indicates the presence of reactive aggregate in the concrete, known as alkali-silica reactive (ASR) concrete. Spalling is visible at the south end near the top upper right (east) corner of the opening. Large cracks, approximately 1/8-inch wide or more, extend vertically along the joint between the channel walls and the wingwalls. The wall corners are chipped. The steel railing at the southeast corner of the structure is bent and damaged.



The wingwalls have map cracking and spalling, visible at the southwest corner

Several utilities in galvanized metal conduits are attached to the wingwalls at both ends of the structure. The two conduits at the south wingwall have outside diameters (O.D.) of approximately 2-1/2 inch and 1-1/4 inch. The two conduits at the north wingwall are 3-3/8 inch and 2-1/2 inch O.D.

2.1.3 Maintenance and Safety Issues

Based on discussions with City staff, the structure has had a long history of maintenance and safety issues. Repairs were made to the deck after some of the grates came loose under traffic. The roadway had to be closed, and some grates reportedly fell into the channel before they could be secured, which was a major safety concern. Evidence of



past repairs is visible, as described previously. In addition, a piece of steel plate from the past repairs was seen at the bottom of the channel.

While no immediate safety concerns were observed, the structure will require ongoing, frequent maintenance if no improvements are made. The noise from the deck indicates that significant grate movement is occurring under traffic loads, which may result in fatigue of the connections to the girders. With drainage through the deck, the girders and the concrete seats will continue to deteriorate.

3. HYDROLOGY

The design flood for this assessment is the 100-year recurrence interval storm based on the "City of Albuquerque's Development Process Manual" (DPM). ArcGIS, version 10.1 was used to prepare the drainage basin map for this assessment. Aerial photos along with City of Albuquerque 2-foot interval contours were used to delineate drainage basins contributing to the analysis area. Future developed land usage estimates are based on the current City of Albuquerque GIS Data Website. The 100-year rainfall data for the analysis area was obtained from the DPM. The Rational Method was used to perform peak flow calculation for this assessment based on the 6-hour storm duration per the DPM. Peak flow rate calculations can be found in Appendix B. The following land treatment assumptions were made:

- Areas that fell under the land use category "Vacant/Other" were analyzed as fully developed properties and were assumed to be 90% land treatment D and 10% land treatment C.
- Areas that fell under the land use category "Parks/Recreational" appeared to be paved parking areas, or sports complex buildings and were assumed to be primarily land treatment C and D. Aerial photos were used to determine percent impervious values.

See Exhibit 2 in Appendix A for a Land Use Map of the Project.

3.1 Flow Analysis

The EAR indicates that with the construction of the recommended drainage improvements, the overland flow reaching the transverse drainage inlet has decreased from 810 cfs to 40 cfs. In an effort to confirm the current amount of flow reaching the transverse drainage inlet, an analysis of the capacity of the existing inlets along Avenida Cesar Chavez from University Boulevard to Langham was performed.

According to the original EAR, inlets constructed along University Boulevard, near the University Boulevard/Avenida Cesar Chavez Intersection, as well as inlets constructed along Avenida Cesar Chavez, east of the University Boulevard/Avenida Cesar Chavez Intersection, intercept all overland flow. Therefore, analysis of the previously constructed Avenida Cesar Chavez storm drain system was limited to west of the University Boulevard/Avenida Cesar Chavez intersection. Analysis points AP1 and AP2 were defined for eastbound and westbound Avenida Cesar Chavez (see **Exhibit 1**), and flows were computed and distributed to the existing inlets. As-built plans indicated that City of Albuquerque Type "A" inlets were used on Avenida Cesar Chavez and a combination of City of Albuquerque Type "A" and Type "Double C" inlets were used on Langham. Existing roadway slopes for Avenida Cesar Chavez and Langham were taken from as-built plans or calculated based on City of Albuquerque contours. Analysis indicates that a total of 25.1 cubic feet per second (cfs) currently reaches the transverse drainage inlet (19.8 cfs along the north side at AP1 and 5.3 cfs along the south side at AP2). The decrease in flow reaching the transverse inlet can be attributed to the construction of the Langham storm drain improvements as well as to the addition of the



6 inlets to the Avenida Cesar Chavez storm drain network. Drainage inlet analysis calculations can be found in Appendix B.

The conveyance capacity of Avenida Cesar Chavez was checked based on the hydraulic design criteria found in the DPM. The DPM indicates that flow depths in the event of a 100-year design discharge may not exceed 0.2 feet above curb height and shall be contained within the right-of-way (ROW). It was determined that City of Albuquerque standards are met for the 100-year design discharge.

3.2 South Diversion Channel Analysis

The South Diversion Channel Hydrologic and Hydraulics Review (yet to be published) was completed by Easterling & Associates Inc. using the Hydrologic Engineering Center River Analysis System (HEC-RAS). A copy of the analysis was obtained from AMAFCA, and it indicated that the 100-year water surface elevation does not reach the low chord. Flows in the South Diversion Channel and the hydraulic capacity of the existing crossing structure will not be affected by replacement of the steel grate superstructure.

4. EXISTING STRUCTURE ANALYSIS

The existing crossing structure was analyzed to assess its suitability for rehabilitation and replacement of the existing steel deck. Based on the analysis, the existing structure can be modified to extend its service life and to address the current safety and maintenance issues associated with the steel deck.

The structure was analyzed per the AASHTO Standard Specifications for Highway Bridges, 17th Edition. Analysis assumptions were based on the design plans, obtained from AMAFCA, and engineering judgment. Assumptions included:

- Soils
 - Type: Medium-dense sand
 - Angle of Internal Friction: 34 degrees
 - Density: 120 pounds per cubic foot (pcf)
 - Horizontal Earth Pressure: Active case, Rankine formula
 - Allowable Bearing Pressure: 2,000 pounds per square foot (psf)
- Concrete
 - Compressive Strength (f'_c): 3,000 pounds per square inch (psi)
- Reinforcing Steel
 - Yield Strength (f_y): 40,000 psi

The structure was analyzed as a simple frame using the STAAD.Pro V8i computer program, version 20.08.07.20. Moment and shear were checked at critical locations for two cases, with and without bracing of the vertical walls by the existing deck. The results are shown in Table 1 on the following page.



Table 1: Structure Analysis Results

Capacity Check	Location	Factored Load*	Strength*	Assessment
Moment in Wall - No Bracing	Base of wall	47.1 ft-kip	57.0 ft-kip	OK
Moment in Wall - Braced by Deck	Mid-height (8.7' above the base slab)	6.9 ft-kip	7.0 ft-kip	OK
Shear in Wall	Base of wall	8.2 kips	12.8 kips (concrete only)	OK

* Note: The loads and strengths were calculated using factors that result in factors of safety in accordance with AASHTO standards.

The soil bearing pressure was also checked and was within an acceptable range.

5. CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

The following general conclusions can be drawn from the assessment.

- The existing transverse drainage inlet is not required based on an assessment of the existing Avenida Cesar Chavez and Langham storm drain improvements west of University Boulevard.
- Analysis indicates that 19.8 cfs reach the South Diversion Channel from westbound Avenida Cesar Chavez and 5.3 cfs reach the South Diversion Channel from eastbound Avenida Cesar Chavez.
- The existing steel superstructure (deck) is in poor condition and should be replaced. The existing substructure appears structurally adequate and can be rehabilitated.
- Flows in the South Diversion Channel and the hydraulic capacity of the existing crossing structure will not be affected.

5.2 Alternatives and Recommendations

5.2.1 Drainage Alternatives

Based upon the results of this analysis, the existing transverse drainage inlet is not required and can be replaced with a smaller drainage structure. Several alternatives for improving the structure have been considered and are summarized in Table 2 on the following page. Alternatives for eastbound and westbound drainage improvements were considered separately, as flows remain split due to a normally crowned roadway section. A requirement was the ability to accommodate a water quality feature. This requirement has been taken into consideration in each of the following alternatives.



Table 2: Drainage Structure Replacement Alternatives

Westbound Alternatives		Potential Issues/Concerns	
*1-WB	Cap the existing transverse drainage inlet and construct a new drainage ditch to capture runoff from Basin E and carry it to a new 5'x5' water quality median drop inlet at the northeast corner of the Avenida Cesar Chavez/Langham intersection. A new 24" diameter storm drain would carry the flow from the inlet to the South Diversion Channel.	- New ditch and inlet would require ROW acquisition or developer cooperation. - New storm drain network would need to be constructed to outlet the new MDI. - Coordination with the U.S. Army Corps of Engineers would be required to construct a new outlet into the South Diversion Channel.	
*2-WB	Cap the existing transverse drainage inlet and construct a new curb opening inlet starting approximately 31' east of the channel and outletting within the limits of the deck.	- Water quality feature could be an issue. - Structure would not fit within the limits of the existing crossing structure, requiring additional curb/pavement replacement.	
3-WB	Cap the existing transverse drainage inlet and construct a new 22' wide transverse drop inlet over the channel.	- Structure would extend into Avenida Cesar Chavez lanes of traffic. - Inlet grates in the driving lanes are not recommended due to maintenance concerns.	
4-WB	Cap the existing transverse drainage inlet and construct a series of 10 COA standard grates along the north curb line.	Structure would not fit within the limits of the existing crossing structure, requiring additional curb/pavement replacement.	
5-WB	Cap the existing transverse drainage inlet and construct a new roadside rundown immediately upstream of the South Diversion Channel.	- Water quality feature could be an issue. - Coordination with the U.S. Army Corps of Engineers would be required.	
6-WB	Cap the existing transverse drainage inlet and construct a 28' long curb opening inlet along the north curb line immediately upstream of the South Diversion Channel to drain into the existing ditch/pond in the northwest quadrant of the Avenida Cesar Chavez/Langham intersection via a roadside rundown. Flow bypassing the grates/sidewalk culverts would be captured in a series of 3 COA standard grates built along the north curb line, within the limits of the deck.	- The existing ditch/pond would have to be modified to accommodate the additional volume of water. - An easement may have to be acquired to complete modifications to the existing ditch/pond.	
7-WB	Cap the existing transverse drainage inlet and construct slotted drain inlets/grates within the deck.	- Slotted drain inlets have limited capacity and are prone to clogging. - Inlets in driving lanes are not recommended due to maintenance concerns.	
8-WB	Cap the existing transverse drainage inlet and construct a large grate inlet, 10' long by 4' wide (similar to three COA Type "B" inlets in series) along the north curb line, within the limits of the existing deck.	Grates are wider than the existing gutter section.	
Eastbound Alternatives		Potential Issues/Concerns	
1-EB	Cap the existing transverse drainage inlet and construct 3 new COA standard grates along the south curb line, within the limits of the deck.		
*2-EB	Cap the existing transverse drainage inlet and construct a new curb opening inlet starting approximately 4' east of the channel and outletting within the limits of the deck.	- Water quality feature could be an issue. - Structure would not fit within the limits of the existing crossing structure.	
3-EB	Cap the existing transverse drainage inlet and construct a new roadside rundown immediately upstream of the South Diversion Channel.	- No water quality feature - Coordination with the U.S. Army Corps of Engineers would be required.	

*Option requires existing curb opening at the existing transverse drainage inlet to remain.



5.2.2 Drainage Recommendations

The south Diversion Channel falls under the jurisdiction of the U.S Army Corps of Engineers, and AMAFCA. Any work that affects the Channel will require review and approval by AMAFCA and possibly the Corps, depending on the improvements being proposed. As described previously, the existing inlet configuration has surface flow into the channel through the grates. Based on the input provided by AMAFCA and the Corps, maintaining the existing drainage configuration would not require Corps review. A change from the existing configuration could trigger the review process. Therefore, to expedite the project schedule and reduce the review requirements, changes to the existing drainage configuration should be minimized.

Based upon a review of the proposed alternatives, alternative 8-WB (construction of a 10 foot long by 4 foot wide grate inlet, within the limits of the deck) and alternative 1-EB (construction of a series of new City of Albuquerque grate inlets along the south curb line, within the limits of the deck) are recommended. These alternatives would alleviate many of the existing maintenance issues, as grates would no longer be located within Avenida Cesar Chavez lanes of traffic.

The inlet capacity of alternative 8-WB was analyzed using two methods. First, Bentley FlowMaster V8i was used. It was determined that preferred alternative 8-WB would bypass 5.22 cfs (26% of the total) in the event of a 100-year storm under fully developed conditions. An investigation of the downstream drainage system capacity was beyond the scope of this study. However, the risk of flooding is low, because the design flows are conservative. The flows were calculated assuming full build-out of several properties that would be very difficult and expensive to develop. As a second method of analysis, preferred alternative 8-WB was re-analyzed based on the City of Albuquerque DPM inlet charts for Type "B" storm inlets. According to the inlet charts, 3-Type "B" storm inlets would capture 100% of the flow for a 100-year storm under fully developed land treatment conditions. At the City's direction, the effects of placing the inlets adjacent to each other were neglected for the analysis. The inlet hydraulics analysis for preferred alternative 8-WB can be found in **Appendix B**.

5.2.3 Roadway Recommendations

The existing pedestrian railings along the ends of the crossing structure are located within the roadway clear zone. A roadway clear zone is defined as the unobstructed, traversable area provided beyond the edge of the traveled way for the recovery of errant vehicles. The AASHTO "Roadside Design Guide" (2011) gives a clear zone runoff of 14 to 16 feet for this situation, assuming a design speed of 40 miles per hour (mph) or less. Although existing barrier curb exists along Avenida Cesar Chavez over the crossing structure, it is still possible for an errant vehicle to go over the curb and fall into the existing channel below. The roadway clear zone requirement cannot be met at this location by eliminating the hazard. Therefore, it is recommended that guard rail or metal barrier be installed, with end treatments. The existing railings could be removed and the holes patched, and new barrier railings could be attached to the wingwalls. Barriers would need to be designed to maintain access to the South Diversion Channel through existing access driveways along Avenida Cesar Chavez.

5.2.4 Structure Alternatives

The goal of the structure alternatives is to replace the existing deck with a structurally sound, durable and low-maintenance deck.

*Materials*

While replacement of the steel girders could be considered, concrete will be more economical given the short span length. Reinforced concrete offers suitable strength, good durability, minimal maintenance, economical construction, and is available locally. Reinforced concrete alternatives include precast deck panels or a cast-in-place deck.

Precast deck panels can be fabricated off-site at a supplier yard and trucked to the site. The panels are usually post-tensioned together laterally, with grouted joints. An epoxy-polymer overlay is placed to seal the deck. The advantages of precast panels include rapid construction and less formwork in the channel. The disadvantages include increased cost, complexity of construction, grade control difficulty, and additional joints compared to a cast-in-place structure.

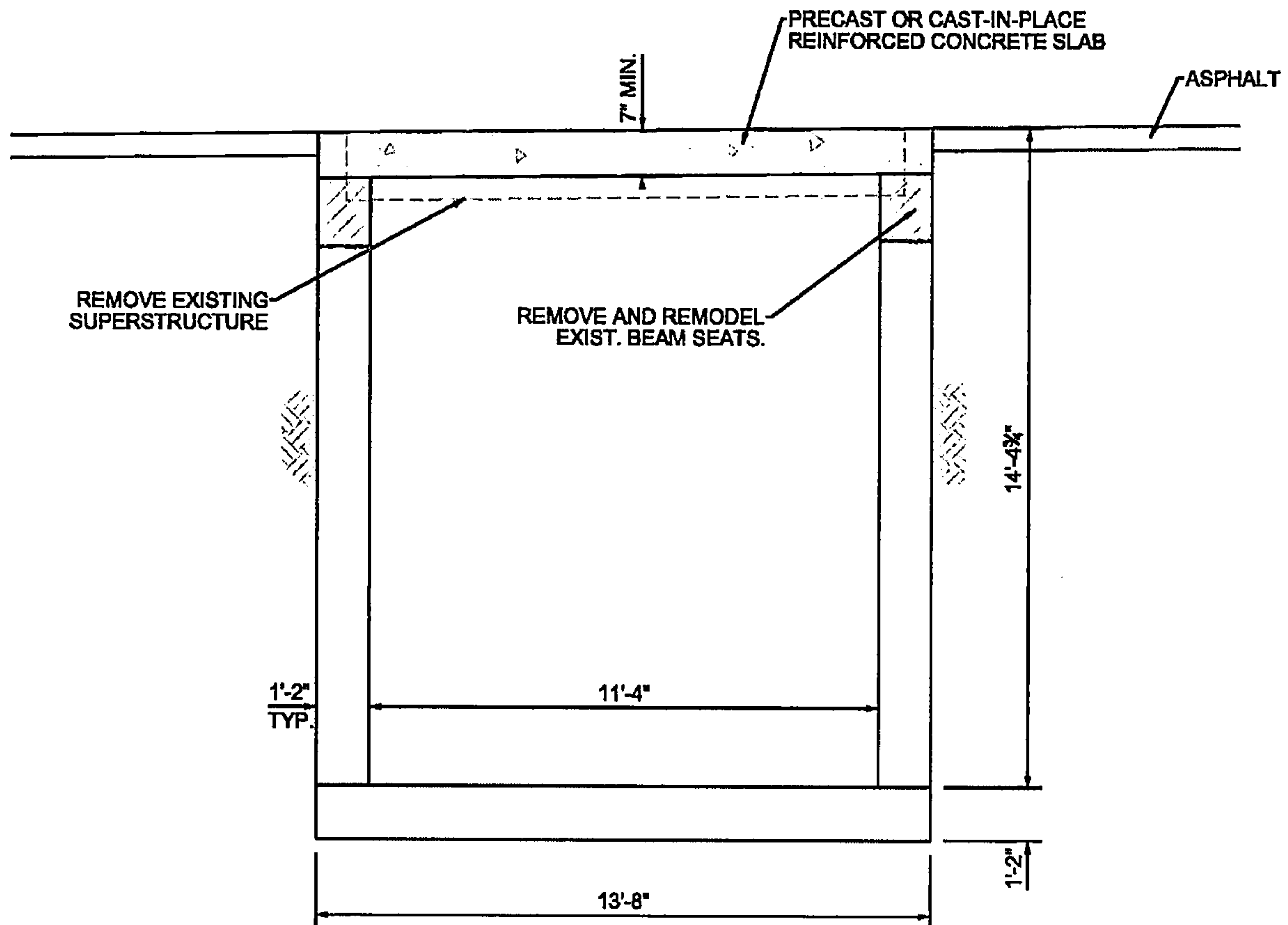
A cast-in-place deck can be constructed reliably and for lower cost than a precast deck. The structure would have fewer joints, so the potential for the associated maintenance issues is reduced. Disadvantages include increased time for forming and placing rebar and concrete, and the need to construct shoring in the channel to support the concrete forms.

5.2.5 Structure Recommendations

Because of schedule concerns with closing lanes of Avenida Cesar Chavez, construction of a precast deck is recommended. The conceptual structure profile is shown in Figure 2.



Figure 2: Conceptual Structure Profile



Inlets could be constructed in the new concrete deck, if necessary. The inlets should be located out of the wheel path, adjacent to the curb, to reduce potential maintenance issues.

Recommended work:

- Remove existing steel deck
- Remove and remodel existing abutment seats to accommodate new concrete deck
- Construct reinforced concrete or precast slab
- Replace pedestrian railing with traffic railing (NMDOT metal railing type "D" for bridges)
- Epoxy-inject cracks in existing structure and wingwalls
- Repair spalled concrete at the structure headwalls
- Apply water repellant treatment to all exposed concrete surfaces

5.2.6 Traffic Control and Schedule Recommendations

Avenida Cesar Chavez is a 6-lane urban minor arterial roadway that serves as the main access to the University of New Mexico (UNM) Sports Complexes, Albuquerque Isotopes Baseball Park, and Central New Mexico University. Avenida Cesar Chavez has an average daily traffic (ADT) volume of 26,100 vehicles per day with traffic volumes

Exhibit 1: Drainage Basin Map



Exhibit 2: Land Use Map



Exhibit 2: Land Use Map



Appendix B: Calculations

PARSONS BRINCKERHOFF Computation Sheet

page 1 of 5 33677
made by KVC
date 7-10-13
checked by
date

subject Avenida Cesar Chavez Arid Assessment
Pond Volume Calculations

WB.

$$\text{Clear span} = 11' 4" = 136"$$

$$\text{grate length} = 40" = 3 \text{ grates } 19.8 \text{ cfs} - 11.71 \text{ cfs} = \underline{8.11 \text{ cfs}} \text{ bypass}$$

* see attached
flowmaster output.

Storm Volume

$$t_p = (0.7 * t_c) + ((1.6 - (A_D / A_T)) / 12)$$

Note: assume this is
the flow to the pond
from A.C.C (100-year
storm)

$$t_p = (0.7 * 0.2 \text{ hr}) + ((1.6 - (21.11 \text{ acres} / 22.95 \text{ acres})) / 12) \\ (0.14) + (0.057) = \underline{0.197 \text{ hrs}}$$

$$A_D = A + B + C + D + E + F + G + H + I + J + K + L + M + N + O$$

$$A_D = 0.88 + 6.8 + 1.9 + 1.4 + 4.73 + 2.59 + 0.42 + 0.49 + 0.42 + 0.05 + 0.68 \\ A \quad B \quad C \quad D \quad E \quad F \quad G \quad H \quad I \quad J \quad K \\ + 0.05 + 0.05 + 0.39 + 0.20 = \underline{21.11 \text{ acres}} \\ L \quad M \quad N \quad O$$

$$A_T = 0.97 + 7.5 + 1.98 + 1.62 + 5.25 + 2.88 + 0.42 + 0.49 + 0.42 + 0.05 + 0.68 \\ A \quad B \quad C \quad D \quad E \quad F \quad G \quad H \quad I \quad J \quad K \\ + 0.05 + 0.05 + 0.39 + 0.20 = \underline{22.95 \text{ acres}} \\ L \quad M \quad N \quad O$$

$$t_B = (2.107 * E * A_T / Q_p) - ((0.25 * A_D / A_T)$$

$$t_B = \left(2.107 * 2.12 \text{ inches} * \frac{22.95 \text{ acres}}{107.48 \text{ cfs}} \right) - \left((0.25 * \frac{21.11 \text{ acres}}{22.95 \text{ cfs}}) \right) \\ t_B = \underline{0.72 \text{ hrs}}$$

$$Q_p = 4.42 + 34.16 + 9.2 + 7.37 + 26.32 + 13.08 + 2.3 + 1.97 + 1.97 + 0.24 + 3.2 \\ + 0.24 + 0.24 + 1.83 + 0.94 = 107.48 \text{ cfs}$$

PARSONS BRINCKERHOFF Computation Sheet

page 2 of 5

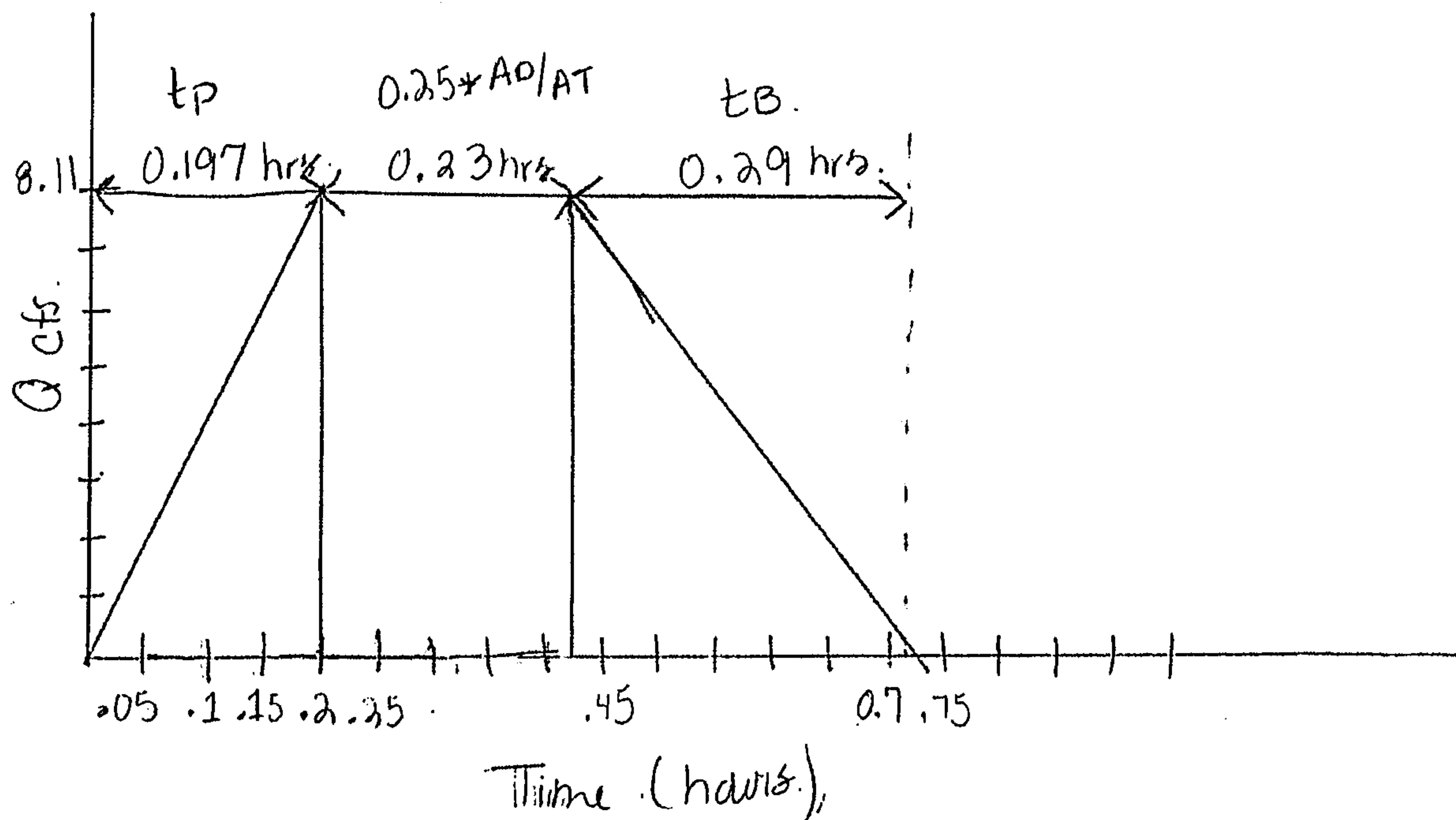
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$$\begin{aligned}
 V_T &= \left(\frac{8.11 \text{ ft}^3}{\text{s}} * \frac{0.197 \text{ hrs}}{1 \text{ hr}} * \frac{3600 \text{ s}}{\text{hr}} \right) + \left(\frac{8.11 \text{ ft}^3}{\text{s}} * \frac{0.23 \text{ hrs}}{1 \text{ hr}} * \frac{3600 \text{ s}}{\text{hr}} \right) \\
 &+ \left(\frac{8.11 \text{ ft}^3}{\text{s}} * \frac{0.29 \text{ hrs}}{1 \text{ hr}} * \frac{3600 \text{ s}}{\text{hr}} \right) = \frac{13824.2 \text{ ft}^3}{43560 \text{ ft}^2} = 0.32 \text{ ave-ft}
 \end{aligned}$$

Existing Pond Flow

$$Area = 0.58 \text{ acrs}$$

* Vacant land = 0.58 acrs - assumed land trust murt 13

$$Q = 0.58 (2.28) = 1.32 \text{ cfs.}$$
$$Vol. = (0.58 \text{ acrs}) (0.79 \text{ ft} / 12 \text{ in}) = 0.038 \text{ acre ft}$$

Pond Volume Required = 0.21 acre-ft

Existing Pond Volume (from record drawing) 1.9:1

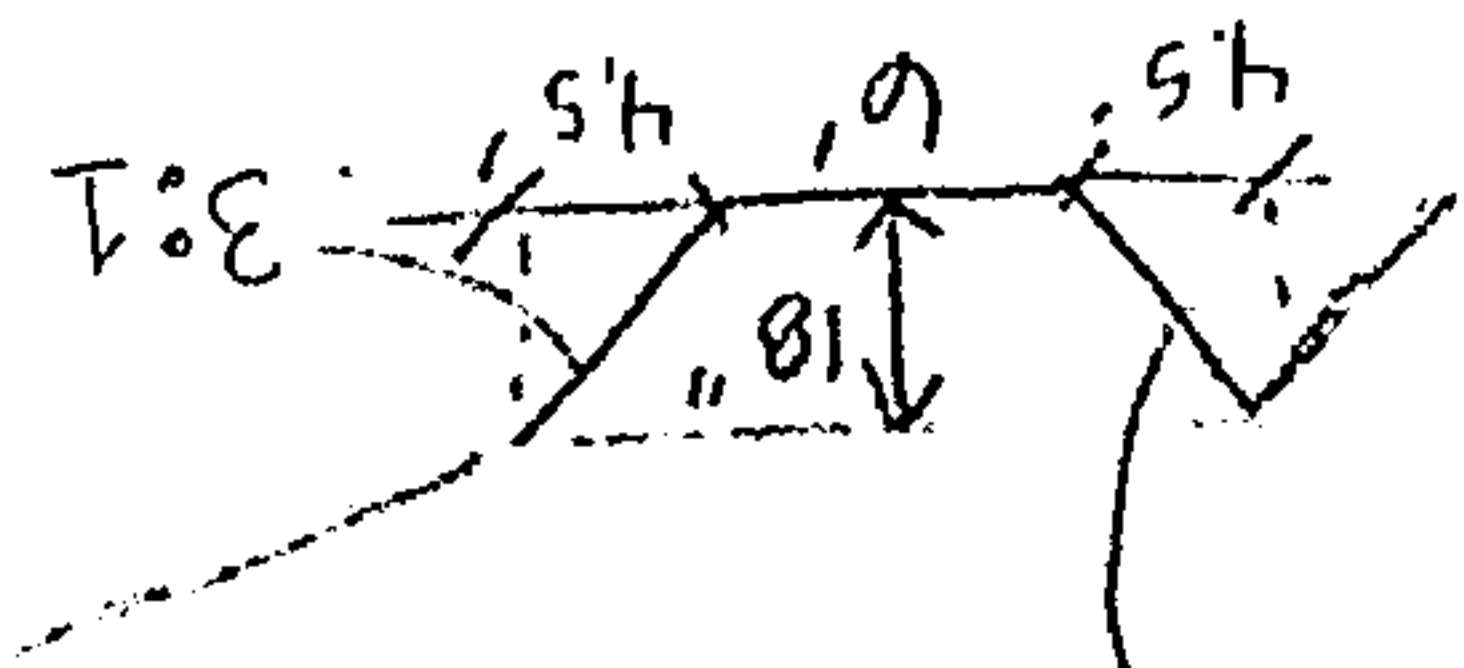
$$L = 15 + 32 - 11 + 00 = 432 \text{ ft}$$

$$A = 6' (1.5) + 4.5 (1.5) = 15.9 \text{ ft}$$

$$V = 15.9 (432) = 6868.8 \text{ ft}^3 \approx 0.16 \text{ acre-ft}$$

Additional Volume Required

$$0.21 \text{ acre-ft} - 0.16 \text{ acre-ft} = 0.05 \text{ acre-ft}$$



see attached sheet
for pond volume
calculations.

$$A = 1.56 \quad B = 2.28 \quad C = 3.14 \quad D = 4.70$$

subject

date

checked by

date

made by

page

3 of 5

DETENTION POND VOLUME USING THE RATIONAL METHOD

PROJECT: Avenida Cesar Chavez Drainage Inlet Assessment

LOCATION: Avenida Cesar Chavez/Langham Intersection

BY: KVC

DATE: 7/10/2013

INPUT PEAK FLOW: 8.11 cfs 100 YR

INPUT STORM VOLUME: 0.317361 ac.-ft. = 2.4
13824.245 cu. ft.

DURATION T (CALCULATED)= 56.8 min.

INPUT TIME TO PEAK: 12 min.

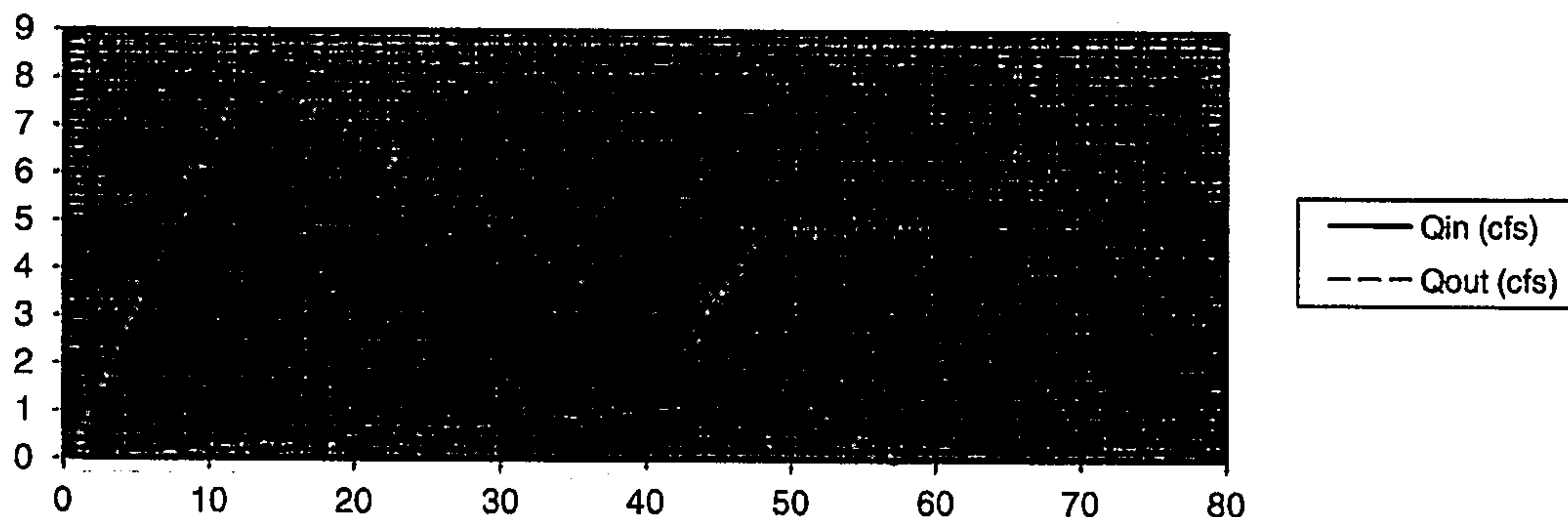
INPUT MAX. OUTFLOW RATE: 1.32 cfs

INPUT TIME WHEN Qin=Qout: 49.5 min.

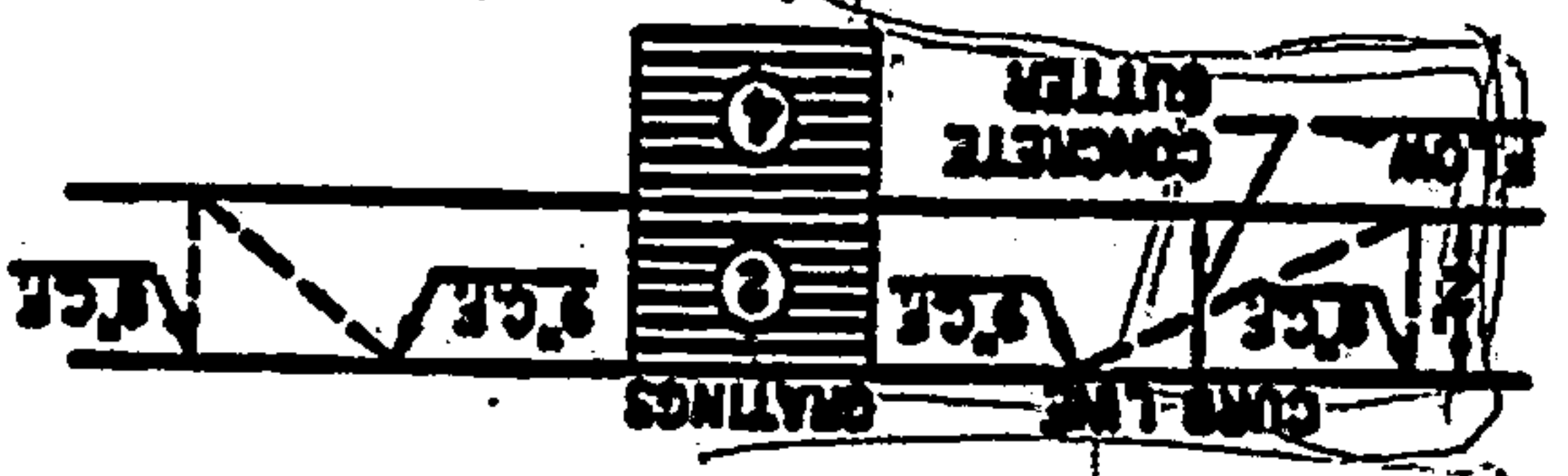
MAXIMUM STORAGE VOLUME = 0.26 ac.-ft.

t (min)	Qin (cfs)	Qout (cfs)	Vin (cu ft)	Vout (cu ft)	Vstore (cu ft)	(ac ft)	TIME INCREMENT=
0	0	0	0	0	0	0.00	2.84 min 170.4592 sec
2.8	1.92	0.08	164	6	157	0.00	
5.7	3.84	0.15	655	26	629	0.01	
8.5	5.76	0.23	1473	58	1415	0.03	
11.4	7.68	0.30	2618	103	2515	0.06	
14.2	7.71	0.38	3930	161	3769	0.09	
17.0	7.20	0.45	5201	232	4968	0.11	
19.9	6.68	0.53	6384	316	6067	0.14	
22.7	6.17	0.61	7479	413	7066	0.16	
25.6	5.65	0.68	8487	523	7964	0.18	
28.4	5.14	0.76	9407	646	8761	0.20	
31.3	4.63	0.83	10239	781	9458	0.22	
34.1	4.11	0.91	10984	930	10054	0.23	
36.9	3.60	0.98	11641	1091	10550	0.24	
39.8	3.08	1.06	12211	1266	10945	0.25	
42.6	2.57	1.14	12693	1453	11240	0.26	
45.5	2.06	1.21	13087	1653	11434	0.26	
48.3	1.54	1.29	13394	1866	11528	0.26	
51.1	1.03	1.32	13613	2088	11525	0.26	
54.0	0.51	1.32	13744	2313	11431	0.26	
56.8	0.00	1.32	13788	2538	11250	0.26	
59.7	-0.51	1.32	13744	2763	10981	0.25	
62.5	-1.03	1.32	13613	2988	10625	0.24	
65.3	-1.54	1.32	13394	3213	10181	0.23	
68.2	-2.06	1.32	13087	3438	9649	0.22	

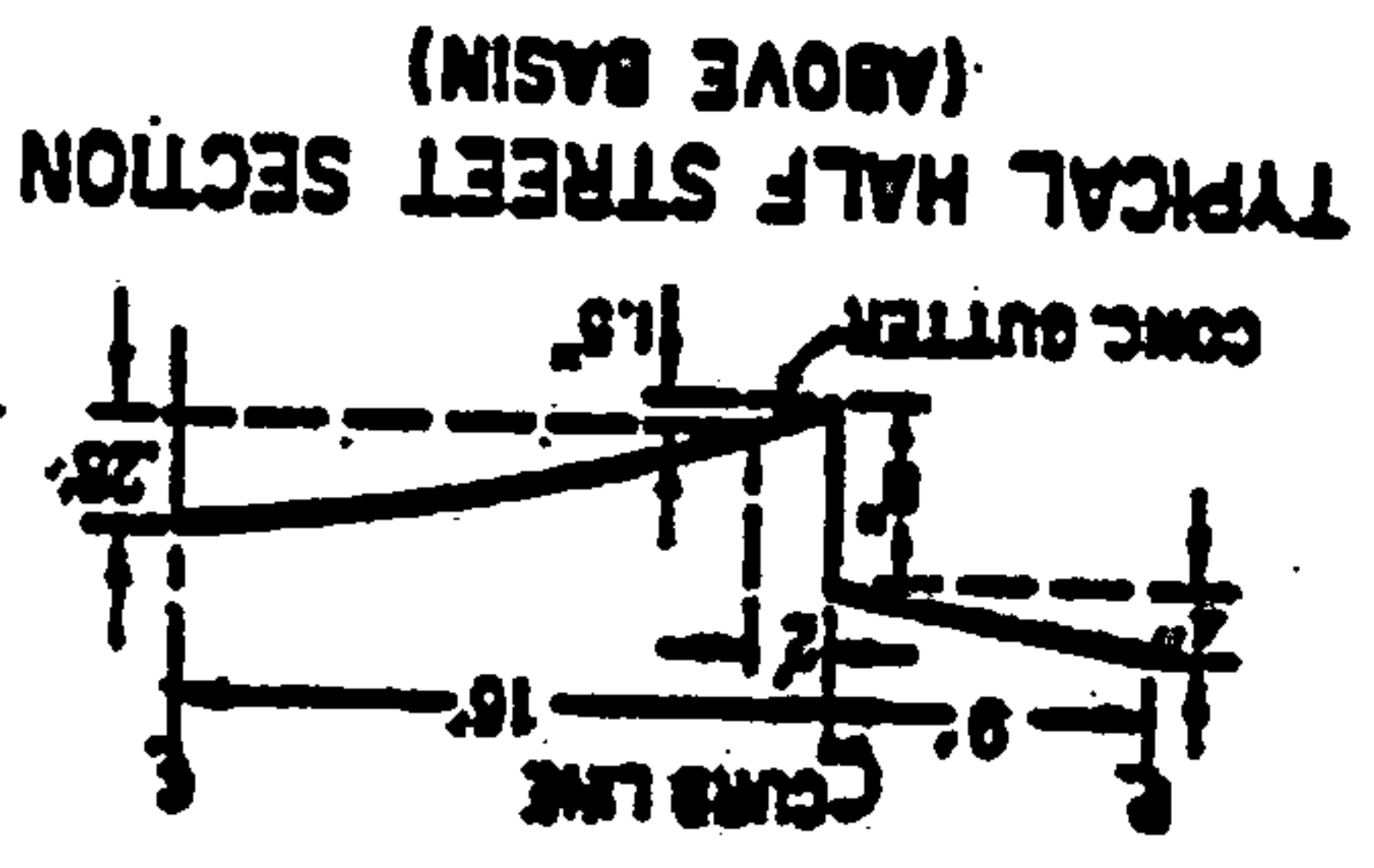
Hydrograph



- developed.



GRATING & GUTTER PLAN



TYPICAL HALF STREET SECTION
 (ABOVE BASIN)

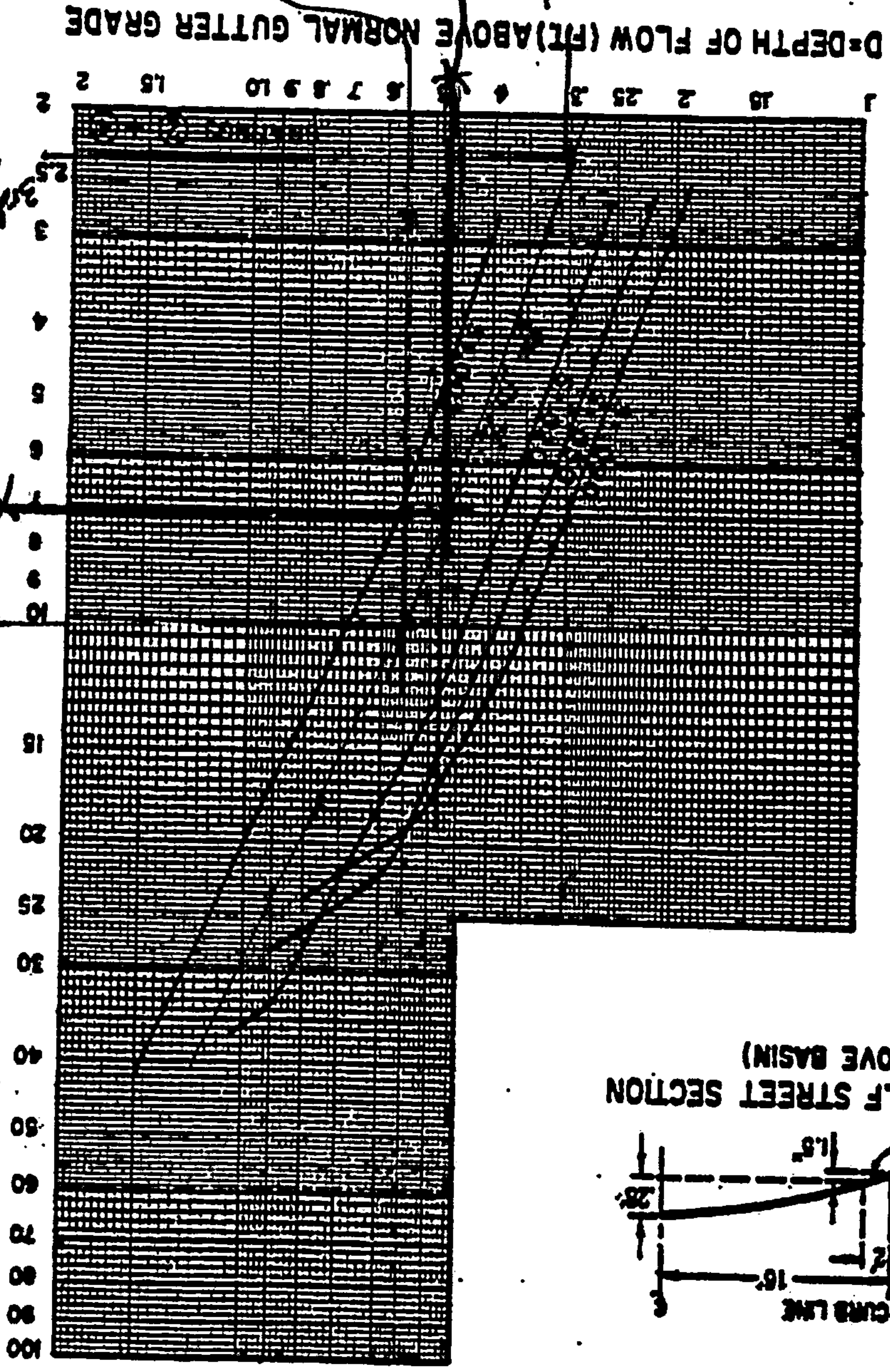


PLATE 22.3 D-7

June 1997

22-146

Depth @ 2.3 cfs.
 Depth @ 9.3 cfs
 Depth @ 19.8 cfs
 0.31'
 0.47'
 0.56'

1st 10.5 cfs
 2nd 7 cfs
 3rd 2.4 cfs

Worksheet for Alternative 8-WB

Project Description

Solve For

Efficiency

Input Data

Discharge	19.80	ft ³ /s	
Slope	0.00915	ft/ft	.0074
Gutter Width	4.17	ft	2.0 FT
Gutter Cross Slope	0.063	ft/ft	
Road Cross Slope	0.012	ft/ft	
Roughness Coefficient	0.016		
Grate Width	4.17	ft	2
Grate Length	10.00	ft	
Grate Type	P-50 mm x 100 mm (P-1-7/8"-4")		
Clogging	15.00	%	NOT IF USE TYPEA

Options

Grate Flow Option

Exclude None

Results

Efficiency	73.70	%
Intercepted Flow	14.59	ft ³ /s
Bypass Flow	5.21	ft ³ /s
Spread	28.74	ft
Depth	0.56	ft
Flow Area	5.40	ft ²
Gutter Depression	0.21	ft
Total Depression	0.21	ft
Velocity	3.67	ft/s
Splash Over Velocity	13.24	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.51	
Grate Flow Ratio	0.46	
Active Grate Length	8.50	ft

Messages

Messages

Grate Length should be within the defined range of HEC-22's Chart 5 (approx. 0.5-4.5 ft / 0.15-1.35 m).

OTHER?
SIDE?
5.3 CFS

Worksheet for INLET1_TYPEA

Project Description

Solve For

Efficiency

Input Data

Discharge	6.39	ft ³ /s
Slope	0.02760	ft/ft
Gutter Width	2.08	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.016	
Local Depression	2.77	in
Local Depression Width	2.08	ft
Grate Width	2.08	ft
Grate Length	3.33	ft
Grate Type	P-50 mm x 100 mm (P-1-7/8"-4")	
Clogging	0.00	%
Curb Opening Length	6.45	ft

Options

Calculation Option

Use Both

Grate Flow Option

Exclude None

Results

Efficiency	70.85	%
Intercepted Flow	4.53	ft ³ /s
Bypass Flow	1.86	ft ³ /s
Spread	11.29	ft
Depth	0.31	ft
Flow Area	1.37	ft ²
Gutter Depression	0.09	ft
Total Depression	0.32	ft
Velocity	4.67	ft/s
Splash Over Velocity	6.57	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.12	
Grate Flow Ratio	0.50	
Equivalent Cross Slope	0.09708	ft/ft
Active Grate Length	3.33	ft
Length Factor	0.14	
Total Interception Length	21.58	ft

Worksheet for INLET2_TYPEA

Project Description

Solve For

Efficiency

Input Data

Discharge	2.10	ft³/s
Slope	0.02760	ft/ft
Gutter Width	2.08	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.016	
Local Depression	2.77	in
Local Depression Width	2.08	ft
Grate Width	2.08	ft
Grate Length	3.33	ft
Grate Type	P-50 mm x 100 mm (P-1-7/8"-4")	
Clogging	0.00	%
Curb Opening Length	6.45	ft

Options

Calculation Option

Use Both

Grate Flow Option

Exclude None

Results

Efficiency	94.47	%
Intercepted Flow	1.98	ft³/s
Bypass Flow	0.12	ft³/s
Spread	6.83	ft
Depth	0.22	ft
Flow Area	0.56	ft²
Gutter Depression	0.09	ft
Total Depression	0.32	ft
Velocity	3.76	ft/s
Splash Over Velocity	6.57	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.16	
Grate Flow Ratio	0.74	
Equivalent Cross Slope	0.13385	ft/ft
Active Grate Length	3.33	ft
Length Factor	0.28	
Total Interception Length	11.15	ft

Worksheet for INLET3_TYPEA

Project Description

Solve For

Efficiency

Input Data

Discharge	9.32	ft³/s
Slope	0.02760	ft/ft
Gutter Width	2.08	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.016	
Local Depression	2.77	in
Local Depression Width	2.08	ft
Grate Width	2.08	ft
Grate Length	3.33	ft
Grate Type	P-50 mm x 100 mm (P-1-7/8"-4")	
Clogging	0.00	%
Curb Opening Length	6.45	ft

Options

Calculation Option

Use Both

Grate Flow Option

Exclude None

Results

Efficiency	62.45	%
Intercepted Flow	5.82	ft³/s
Bypass Flow	3.50	ft³/s
Spread	13.20	ft
Depth	0.35	ft
Flow Area	1.83	ft²
Gutter Depression	0.09	ft
Total Depression	0.32	ft
Velocity	5.08	ft/s
Splash Over Velocity	6.57	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.10	
Grate Flow Ratio	0.44	
Equivalent Cross Slope	0.08685	ft/ft
Active Grate Length	3.33	ft
Length Factor	0.12	
Total Interception Length	27.03	ft

Worksheet for INLET4_TYPEA

Project Description

Solve For

Efficiency

Input Data

Discharge	14.07	ft ³ /s
Slope	0.04000	ft/ft
Gutter Width	2.08	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.016	
Local Depression	2.77	in
Local Depression Width	2.08	ft
Grate Width	2.08	ft
Grate Length	3.33	ft
Grate Type	P-50 mm x 100 mm (P-1-7/8"-4")	
Clogging	0.00	%
Curb Opening Length	6.45	ft

Options

Calculation Option

Use Both

Grate Flow Option

Exclude None

Results

Efficiency	54.40	%
Intercepted Flow	7.65	ft ³ /s
Bypass Flow	6.42	ft ³ /s
Spread	14.47	ft
Depth	0.38	ft
Flow Area	2.19	ft ²
Gutter Depression	0.09	ft
Total Depression	0.32	ft
Velocity	6.44	ft/s
Splash Over Velocity	6.57	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.07	
Grate Flow Ratio	0.40	
Equivalent Cross Slope	0.08131	ft/ft
Active Grate Length	3.33	ft
Length Factor	0.08	
Total Interception Length	37.37	ft

Worksheet for INLET6_TYPEA

Project Description

Solve For

Efficiency

Input Data

Discharge	2.20	ft³/s
Slope	0.04000	ft/ft
Gutter Width	2.08	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.016	
Local Depression	2.77	in
Local Depression Width	2.08	ft
Grate Width	2.08	ft
Grate Length	3.33	ft
Grate Type	P-50 mm x 100 mm (P-1-7/8"-4")	
Clogging	0.00	%
Curb Opening Length	6.45	ft

Options

Calculation Option

Use Both

Grate Flow Option

Exclude None

Results

Efficiency	94.48	%
Intercepted Flow	2.08	ft³/s
Bypass Flow	0.12	ft³/s
Spread	6.36	ft
Depth	0.22	ft
Flow Area	0.50	ft²
Gutter Depression	0.09	ft
Total Depression	0.32	ft
Velocity	4.43	ft/s
Splash Over Velocity	6.57	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.13	
Grate Flow Ratio	0.77	
Equivalent Cross Slope	0.13887	ft/ft
Active Grate Length	3.33	ft
Length Factor	0.25	
Total Interception Length	12.43	ft

Worksheet for INLET5_TYPEA

Project Description

Solve For

Efficiency

Input Data

Discharge	6.66	ft ³ /s
Slope	0.04000	ft/ft
Gutter Width	2.08	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.016	
Local Depression	2.77	in
Local Depression Width	2.08	ft
Grate Width	2.08	ft
Grate Length	3.33	ft
Grate Type	P-50 mm x 100 mm (P-1-7/8"-4")	
Clogging	0.00	%
Curb Opening Length	6.45	ft

Options

Calculation Option

Use Both

Grate Flow Option

Exclude None

Results

Efficiency	70.63	%
Intercepted Flow	4.70	ft ³ /s
Bypass Flow	1.96	ft ³ /s
Spread	10.62	ft
Depth	0.30	ft
Flow Area	1.22	ft ²
Gutter Depression	0.09	ft
Total Depression	0.32	ft
Velocity	5.46	ft/s
Splash Over Velocity	6.57	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.09	
Grate Flow Ratio	0.53	
Equivalent Cross Slope	0.10132	ft/ft
Active Grate Length	3.33	ft
Length Factor	0.13	
Total Interception Length	23.92	ft

Worksheet for INLET7_TYPEA

Project Description

Solve For

Efficiency

Input Data

Discharge	28.27	ft³/s
Slope	0.03720	ft/ft
Gutter Width	2.08	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.016	
Local Depression	2.77	in
Local Depression Width	2.08	ft
Grate Width	2.08	ft
Grate Length	3.33	ft
Grate Type	P-50 mm x 100 mm (P-1-7/8"-4")	
Clogging	0.00	%
Curb Opening Length	6.45	ft

Options

Calculation Option

Use Both

Grate Flow Option

Exclude None

Results

Efficiency	40.09	%
Intercepted Flow	11.33	ft³/s
Bypass Flow	16.94	ft³/s
Spread	19.35	ft
Depth	0.48	ft
Flow Area	3.84	ft²
Gutter Depression	0.09	ft
Total Depression	0.32	ft
Velocity	7.37	ft/s
Splash Over Velocity	6.57	ft/s
Frontal Flow Factor	0.93	
Side Flow Factor	0.06	
Grate Flow Ratio	0.30	
Equivalent Cross Slope	0.06615	ft/ft
Active Grate Length	3.33	ft
Length Factor	0.06	
Total Interception Length	55.47	ft

Worksheet for INLET8_TYPEA

Project Description

Solve For Efficiency

Input Data

Discharge	0.71	ft ³ /s
Slope	0.02680	ft/ft
Gutter Width	2.08	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.016	
Local Depression	2.77	in
Local Depression Width	2.08	ft
Grate Width	2.08	ft
Grate Length	3.33	ft
Grate Type	P-50 mm x 100 mm (P-1-7/8"-4")	
Clogging	0.00	%
Curb Opening Length	6.45	ft

Options

Calculation Option	Use Both
Grate Flow Option	Exclude None

Results

Efficiency	100.00	%
Intercepted Flow	0.71	ft ³ /s
Bypass Flow	0.00	ft ³ /s
Spread	3.60	ft
Depth	0.16	ft
Flow Area	0.22	ft ²
Gutter Depression	0.09	ft
Total Depression	0.32	ft
Velocity	3.20	ft/s
Splash Over Velocity	6.57	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.21	
Grate Flow Ratio	0.96	
Equivalent Cross Slope	0.16792	ft/ft
Active Grate Length	3.33	ft
Length Factor	0.51	
Total Interception Length	6.12	ft

Worksheet for INLET9_TYPEA

Project Description

Solve For Efficiency

Input Data

Discharge	0.33	ft³/s
Slope	0.02680	ft/ft
Gutter Width	2.08	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.016	
Local Depression	2.77	in
Local Depression Width	2.08	ft
Grate Width	2.08	ft
Grate Length	3.33	ft
Grate Type	P-50 mm x 100 mm (P-1-7/8"-4")	
Clogging	0.00	%
Curb Opening Length	6.45	ft

Options

Calculation Option	Use Both
Grate Flow Option	Exclude None

Results

Efficiency	100.00	%
Intercepted Flow	0.33	ft³/s
Bypass Flow	0.00	ft³/s
Spread	1.94	ft
Depth	0.12	ft
Flow Area	0.12	ft²
Gutter Depression	0.09	ft
Total Depression	0.32	ft
Velocity	2.79	ft/s
Splash Over Velocity	6.57	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.25	
Grate Flow Ratio	1.00	
Equivalent Cross Slope	0.17348	ft/ft
Active Grate Length	3.33	ft
Length Factor	0.72	
Total Interception Length	4.35	ft

Worksheet for INLET10_TYPEA

Project Description

Solve For

Efficiency

Input Data

Discharge	0.42	ft ³ /s
Slope	0.02680	ft/ft
Gutter Width	2.08	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.016	
Local Depression	2.77	in
Local Depression Width	2.08	ft
Grate Width	2.08	ft
Grate Length	3.33	ft
Grate Type	P-50 mm x 100 mm (P-1-7/8"-4")	
Clogging	0.00	%
Curb Opening Length	6.45	ft

Options

Calculation Option

Use Both

Grate Flow Option

Exclude None

Results

Efficiency	100.00	%
Intercepted Flow	0.42	ft ³ /s
Bypass Flow	0.00	ft ³ /s
Spread	2.23	ft
Depth	0.13	ft
Flow Area	0.14	ft ²
Gutter Depression	0.09	ft
Total Depression	0.32	ft
Velocity	2.96	ft/s
Splash Over Velocity	6.57	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.23	
Grate Flow Ratio	1.00	
Equivalent Cross Slope	0.17346	ft/ft
Active Grate Length	3.33	ft
Length Factor	0.65	
Total Interception Length	4.81	ft

Worksheet for INLET11_TYPEA

Project Description

Solve For Efficiency

Input Data

Discharge	1.03	ft ³ /s
Slope	0.02760	ft/ft
Gutter Width	2.08	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.016	
Local Depression	2.77	in
Local Depression Width	2.08	ft
Grate Width	2.08	ft
Grate Length	3.33	ft
Grate Type	P-50 mm x 100 mm (P-1-7/8"-4")	
Clogging	0.00	%
Curb Opening Length	6.45	ft

Options

Calculation Option	Use Both
Grate Flow Option	Exclude None

Results

Efficiency	100.00	%
Intercepted Flow	1.03	ft ³ /s
Bypass Flow	0.00	ft ³ /s
Spread	4.60	ft
Depth	0.18	ft
Flow Area	0.30	ft ²
Gutter Depression	0.09	ft
Total Depression	0.32	ft
Velocity	3.39	ft/s
Splash Over Velocity	6.57	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.19	
Grate Flow Ratio	0.90	
Equivalent Cross Slope	0.15851	ft/ft
Active Grate Length	3.33	ft
Length Factor	0.42	
Total Interception Length	7.47	ft

Worksheet for INLET12_TYPEA

Project Description

Solve For

Efficiency

Input Data

Discharge	1.18	ft ³ /s
Slope	0.02760	ft/ft
Gutter Width	2.08	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.016	
Local Depression	2.77	in
Local Depression Width	2.08	ft
Grate Width	2.08	ft
Grate Length	3.33	ft
Grate Type	P-50 mm x 100 mm (P-1-7/8"-4")	
Clogging	0.00	%
Curb Opening Length	6.45	ft

Options

Calculation Option

Use Both

Grate Flow Option

Exclude None

Results

Efficiency	99.92	%
Intercepted Flow	1.18	ft ³ /s
Bypass Flow	0.00	ft ³ /s
Spread	5.00	ft
Depth	0.19	ft
Flow Area	0.34	ft ²
Gutter Depression	0.09	ft
Total Depression	0.32	ft
Velocity	3.45	ft/s
Splash Over Velocity	6.57	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.19	
Grate Flow Ratio	0.87	
Equivalent Cross Slope	0.15417	ft/ft
Active Grate Length	3.33	ft
Length Factor	0.39	
Total Interception Length	8.04	ft

Worksheet for INLET13_TYPEA

Project Description

Solve For

Efficiency

Input Data

Discharge	0.28	ft³/s
Slope	0.02760	ft/ft
Gutter Width	2.08	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.016	
Local Depression	2.77	in
Local Depression Width	2.08	ft
Grate Width	2.08	ft
Grate Length	3.33	ft
Grate Type	P-50 mm x 100 mm (P-1-7/8"-4")	
Clogging	0.00	%
Curb Opening Length	6.45	ft

Options

Calculation Option

Use Both

Grate Flow Option

Exclude None

Results

Efficiency	100.00	%
Intercepted Flow	0.28	ft³/s
Bypass Flow	0.00	ft³/s
Spread	1.82	ft
Depth	0.11	ft
Flow Area	0.10	ft²
Gutter Depression	0.09	ft
Total Depression	0.32	ft
Velocity	2.71	ft/s
Splash Over Velocity	6.57	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.26	
Grate Flow Ratio	1.00	
Equivalent Cross Slope	0.17348	ft/ft
Active Grate Length	3.33	ft
Length Factor	0.76	
Total Interception Length	4.09	ft

Worksheet for INLET14_TYPEA

Project Description

Solve For Efficiency

Input Data

Discharge	12.24	ft ³ /s
Slope	0.04000	ft/ft
Gutter Width	2.08	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.016	
Local Depression	2.77	in
Local Depression Width	2.08	ft
Grate Width	2.08	ft
Grate Length	3.33	ft
Grate Type	P-50 mm x 100 mm (P-1-7/8"-4")	
Clogging	0.00	%
Curb Opening Length	6.45	ft

Options

Calculation Option	Use Both
Grate Flow Option	Exclude None

Results

Efficiency	57.24	%
Intercepted Flow	7.01	ft ³ /s
Bypass Flow	5.23	ft ³ /s
Spread	13.68	ft
Depth	0.36	ft
Flow Area	1.96	ft ²
Gutter Depression	0.09	ft
Total Depression	0.32	ft
Velocity	6.24	ft/s
Splash Over Velocity	6.57	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.07	
Grate Flow Ratio	0.42	
Equivalent Cross Slope	0.08467	ft/ft
Active Grate Length	3.33	ft
Length Factor	0.09	
Total Interception Length	34.40	ft

Worksheet for INLET15_TYPEA

Project Description

Solve For

Efficiency

Input Data

Discharge	5.68	ft ³ /s
Slope	0.04000	ft/ft
Gutter Width	2.08	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.016	
Local Depression	2.77	in
Local Depression Width	2.08	ft
Grate Width	2.08	ft
Grate Length	3.33	ft
Grate Type	P-50 mm x 100 mm (P-1-7/8"-4")	
Clogging	0.00	%
Curb Opening Length	6.45	ft

Options

Calculation Option

Use Both

Grate Flow Option

Exclude None

Results

Efficiency	74.31	%
Intercepted Flow	4.22	ft ³ /s
Bypass Flow	1.46	ft ³ /s
Spread	9.92	ft
Depth	0.29	ft
Flow Area	1.08	ft ²
Gutter Depression	0.09	ft
Total Depression	0.32	ft
Velocity	5.28	ft/s
Splash Over Velocity	6.57	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.10	
Grate Flow Ratio	0.56	
Equivalent Cross Slope	0.10620	ft/ft
Active Grate Length	3.33	ft
Length Factor	0.14	
Total Interception Length	21.75	ft

Worksheet for INLET16_TYPEA

Project Description

Solve For

Efficiency

Input Data

Discharge	1.99	ft ³ /s
Slope	0.04000	ft/ft
Gutter Width	2.08	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.016	
Local Depression	2.77	in
Local Depression Width	2.08	ft
Grate Width	2.08	ft
Grate Length	3.33	ft
Grate Type	P-50 mm x 100 mm (P-1-7/8"-4")	
Clogging	0.00	%
Curb Opening Length	6.45	ft

Options

Calculation Option

Use Both

Grate Flow Option

Exclude None

Results

Efficiency	96.02	%
Intercepted Flow	1.91	ft ³ /s
Bypass Flow	0.08	ft ³ /s
Spread	6.04	ft
Depth	0.21	ft
Flow Area	0.46	ft ²
Gutter Depression	0.09	ft
Total Depression	0.32	ft
Velocity	4.36	ft/s
Splash Over Velocity	6.57	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.13	
Grate Flow Ratio	0.80	
Equivalent Cross Slope	0.14247	ft/ft
Active Grate Length	3.33	ft
Length Factor	0.27	
Total Interception Length	11.74	ft

Worksheet for INLET17_TYPEA

Project Description

Solve For

Efficiency

Input Data

Discharge	15.05	ft³/s
Slope	0.01245	ft/ft
Gutter Width	2.08	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.016	
Local Depression	2.77	in
Local Depression Width	2.08	ft
Grate Width	2.08	ft
Grate Length	3.33	ft
Grate Type	P-50 mm x 100 mm (P-1-7/8"-4")	
Clogging	0.00	%
Curb Opening Length	6.45	ft

Options

Calculation Option

Use Both

Grate Flow Option

Exclude None

Results

Efficiency	53.52	%
Intercepted Flow	8.05	ft³/s
Bypass Flow	7.00	ft³/s
Spread	18.73	ft
Depth	0.46	ft
Flow Area	3.60	ft²
Gutter Depression	0.09	ft
Total Depression	0.32	ft
Velocity	4.18	ft/s
Splash Over Velocity	6.57	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.14	
Grate Flow Ratio	0.31	
Equivalent Cross Slope	0.06767	ft/ft
Active Grate Length	3.33	ft
Length Factor	0.10	
Total Interception Length	30.24	ft

Worksheet for INLET18_TYPE_DBLC

Project Description

Solve For Efficiency

Input Data

Discharge	7.00	ft ³ /s
Slope	0.01245	ft/ft
Gutter Width	2.08	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.016	
Grate Width	2.08	ft
Grate Length	6.67	ft
Grate Type	P-50 mm x 100 mm (P-1-7/8"-4")	
Clogging	0.00	%

Options

Grate Flow Option Exclude None

Results

Efficiency	72.10	%
Intercepted Flow	5.05	ft ³ /s
Bypass Flow	1.95	ft ³ /s
Spread	13.85	ft
Depth	0.36	ft
Flow Area	2.01	ft ²
Gutter Depression	0.08	ft
Total Depression	0.08	ft
Velocity	3.49	ft/s
Splash Over Velocity	10.48	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.52	
Grate Flow Ratio	0.41	
Active Grate Length	6.67	ft

Messages

Messages Grate Length should be within the defined range of HEC-22's Chart 5 (approx. 0.5-4.5 ft / 0.15-1.35 m).

Worksheet for INLET19_TYPEA

Project Description

Solve For

Efficiency

Input Data

Discharge	2.30	ft³/s
Slope	0.01245	ft/ft
Gutter Width	2.08	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.016	
Local Depression	2.77	in
Local Depression Width	2.08	ft
Grate Width	2.08	ft
Grate Length	3.33	ft
Grate Type	P-50 mm x 100 mm (P-1-7/8"-4")	
Clogging	0.00	%
Curb Opening Length	6.45	ft

Options

Calculation Option

Use Both

Grate Flow Option

Exclude None

Results

Efficiency	92.42	%
Intercepted Flow	2.13	ft³/s
Bypass Flow	0.17	ft³/s
Spread	8.61	ft
Depth	0.26	ft
Flow Area	0.83	ft²
Gutter Depression	0.09	ft
Total Depression	0.32	ft
Velocity	2.76	ft/s
Splash Over Velocity	6.57	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.25	
Grate Flow Ratio	0.63	
Equivalent Cross Slope	0.11666	ft/ft
Active Grate Length	3.33	ft
Length Factor	0.31	
Total Interception Length	9.91	ft

Worksheet for INLET20_TYPE_DBLC

Project Description

Solve For Efficiency

Input Data

Discharge	0.17	ft ³ /s
Slope	0.01245	ft/ft
Gutter Width	2.08	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.016	
Grate Width	2.08	ft
Grate Length	6.67	ft
Grate Type	P-50 mm x 100 mm (P-1-7/8"-4")	
Clogging	0.00	%

Options

Grate Flow Option Exclude None

Results

Efficiency	100.00	%
Intercepted Flow	0.17	ft ³ /s
Bypass Flow	0.00	ft ³ /s
Spread	1.80	ft
Depth	0.11	ft
Flow Area	0.10	ft ²
Gutter Depression	0.08	ft
Total Depression	0.08	ft
Velocity	1.76	ft/s
Splash Over Velocity	10.48	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.79	
Grate Flow Ratio	1.00	
Active Grate Length	6.67	ft

Messages

Messages Grate Length should be within the defined range of HEC-22's Chart 5 (approx. 0.5-4.5 ft / 0.15-1.35 m).

Worksheet for Option 1 EB- 2-TYPE DBL D

Project Description

Solve For

Efficiency

Input Data

Discharge	5.29	ft³/s
Slope	0.00915	ft/ft
Gutter Width	2.08	ft
Gutter Cross Slope	0.02	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.016	
Grate Width	2.08	ft
Grate Length	13.32	ft
Grate Type	P-50 mm x 100 mm (P-1-7/8"-4")	
Clogging	15.00	%

Options

Grate Flow Option

Exclude None

Results

Efficiency	88.93	%
Intercepted Flow	4.70	ft³/s
Bypass Flow	0.59	ft³/s
Spread	14.96	ft
Depth	0.26	ft
Flow Area	1.94	ft²
Gutter Depression	0.00	ft
Total Depression	0.00	ft
Velocity	2.72	ft/s
Splash Over Velocity	20.20	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.83	
Grate Flow Ratio	0.33	
Active Grate Length	11.32	ft

Messages

Messages

Grate Length should be within the defined range of HEC-22's Chart 5 (approx. 0.5-4.5 ft / 0.15-1.35 m).

Worksheet for Options 2 & 3 EB - Curb Opening

Project Description

Solve For

Efficiency

Input Data

Discharge	5.29	ft ³ /s
Slope	0.00915	ft/ft
Gutter Width	1.00	ft
Gutter Cross Slope	0.02	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.016	
Curb Opening Length	15.00	ft
Local Depression	3.00	in
Local Depression Width	0.83	ft

Results

Efficiency	96.60	%
Intercepted Flow	5.11	ft ³ /s
Bypass Flow	0.18	ft ³ /s
Spread	14.96	ft
Depth	0.26	ft
Flow Area	1.94	ft ²
Gutter Depression	0.00	ft
Total Depression	0.25	ft
Velocity	2.72	ft/s
Equivalent Cross Slope	0.06810	ft/ft
Length Factor	0.85	
Total Interception Length	17.70	ft

Worksheet for Option 1 WB - Triangular Ditch

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Roughness Coefficient 0.035
Channel Slope 0.02670 ft/ft
Left Side Slope 3.00 ft/ft (H:V)
Right Side Slope 3.00 ft/ft (H:V)
Discharge 26.32 ft³/s

Results

Normal Depth 1.32 ft
Flow Area 5.19 ft²
Wetted Perimeter 8.32 ft
Hydraulic Radius 0.62 ft
Top Width 7.89 ft
Critical Depth 1.37 ft
Critical Slope 0.02174 ft/ft
Velocity 5.07 ft/s
Velocity Head 0.40 ft
Specific Energy 1.71 ft
Froude Number 1.10
Flow Type Supercritical

GVF Input Data

Downstream Depth 0.00 ft
Length 0.00 ft
Number Of Steps 0

GVF Output Data

Upstream Depth 0.00 ft
Profile Description
Profile Headloss 0.00 ft
Downstream Velocity Infinity ft/s
Upstream Velocity Infinity ft/s
Normal Depth 1.32 ft
Critical Depth 1.37 ft
Channel Slope 0.02670 ft/ft
Critical Slope 0.02174 ft/ft

Worksheet for Option 1 WB - 5'x5' W.Q. Inlet

Project Description

Solve For Spread

Input Data

Discharge	26.32	ft ³ /s	Basin E runoff
Left Side Slope	3.00	ft/ft (H:V)	
Right Side Slope	3.00	ft/ft (H:V)	
Bottom Width	0.00	ft	
Grate Width	5.00	ft	
Grate Length	5.00	ft	
Local Depression	0.00	in	
Local Depression Width	0.00	ft	
Grate Type	P-50 mm x 100 mm (P-1-7/8"-4")		
Clogging	50.00	%	

Results

Spread	4.20	ft
Depth	0.70	ft
Wetted Perimeter	4.42	ft
Top Width	4.20	ft
Open Grate Area	10.00	ft ²
Active Grate Weir Length	15.00	ft

Worksheet for Option 1 WB - 24" SDCP

Project Description

Friction Method Manning Formula
Solve For Full Flow Capacity

Input Data

Roughness Coefficient 0.013
Channel Slope 0.02000 ft/ft
Normal Depth 2.00 ft
Diameter 2.00 ft
Discharge 31.99 ft³/s 25.1

Results

Discharge 31.99 ft³/s
Normal Depth 2.00 ft
Flow Area 3.14 ft²
Wetted Perimeter 6.28 ft
Hydraulic Radius 0.50 ft
Top Width 0.00 ft
Critical Depth 1.89 ft
Percent Full 100.0 %
Critical Slope 0.01730 ft/ft
Velocity 10.18 ft/s
Velocity Head 1.61 ft
Specific Energy 3.61 ft
Froude Number 0.00
Maximum Discharge 34.41 ft³/s
Discharge Full 31.99 ft³/s
Slope Full 0.02000 ft/ft
Flow Type SubCritical

GVF Input Data

Downstream Depth 0.00 ft
Length 0.00 ft
Number Of Steps 0

GVF Output Data

Upstream Depth 0.00 ft
Profile Description
Profile Headloss 0.00 ft
Average End Depth Over Rise 0.00 %

Worksheet for Option 1 WB - 24" SDCP

GVF Output Data

Normal Depth Over Rise	100.00	%
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	2.00	ft
Critical Depth	1.89	ft
Channel Slope	0.02000	ft/ft
Critical Slope	0.01730	ft/ft

Worksheet for Option 1 WB - INLET7_TYPEA

Project Description

Solve For

Efficiency

Input Data

Discharge	1.95	ft³/s
Slope	0.03720	ft/ft
Gutter Width	2.08	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.016	
Local Depression	2.77	in
Local Depression Width	2.08	ft
Grate Width	2.08	ft
Grate Length	3.33	ft
Grate Type	P-50 mm x 100 mm (P-1-7/8"-4")	
Clogging	0.00	%
Curb Opening Length	6.45	ft

Options

Calculation Option

Use Both

Grate Flow Option

Exclude None

Results

Efficiency	95.53	%
Intercepted Flow	1.86	ft³/s
Bypass Flow	0.09	ft³/s
Spread	6.17	ft
Depth	0.21	ft
Flow Area	0.47	ft²
Gutter Depression	0.08	ft
Total Depression	0.31	ft
Velocity	4.18	ft/s
Splash Over Velocity	6.57	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.14	
Grate Flow Ratio	0.78	
Equivalent Cross Slope	0.13825	ft/ft
Active Grate Length	3.33	ft
Length Factor	0.27	
Total Interception Length	11.59	ft

Worksheet for Option 1 WB - Curb Opening

Project Description

Solve For

Efficiency

Input Data

Discharge	2.98	ft ³ /s	Basin O + Langham Bypass + Inlet 7 bypass
Slope	0.00915	ft/ft	
Gutter Width	1.00	ft	
Gutter Cross Slope	0.01	ft/ft	
Road Cross Slope	0.01	ft/ft	
Roughness Coefficient	0.016		
Curb Opening Length	11.00	ft	
Local Depression	3.00	in	
Local Depression Width	1.00	ft	

Results

Efficiency	87.05	%
Intercepted Flow	2.59	ft ³ /s
Bypass Flow	0.39	ft ³ /s
Spread	15.38	ft
Depth	0.18	ft
Flow Area	1.39	ft ²
Gutter Depression	0.00	ft
Total Depression	0.25	ft
Velocity	2.14	ft/s
Equivalent Cross Slope	0.05280	ft/ft
Length Factor	0.68	
Total Interception Length	16.21	ft

Worksheet for Options 2 & 5 WB - Curb Opening

Project Description

Solve For

Efficiency

Input Data

Discharge	19.82	ft³/s
Slope	0.00915	ft/ft
Gutter Width	1.00	ft
Gutter Cross Slope	0.01	ft/ft
Road Cross Slope	0.01	ft/ft
Roughness Coefficient	0.016	
Curb Opening Length	42.00	ft
Local Depression	3.00	in
Local Depression Width	1.00	ft

Results

Efficiency	97.60	%
Intercepted Flow	19.34	ft³/s
Bypass Flow	0.48	ft³/s
Spread	31.30	ft
Depth	0.37	ft
Flow Area	5.76	ft²
Gutter Depression	0.00	ft
Total Depression	0.25	ft
Velocity	3.44	ft/s
Equivalent Cross Slope	0.03250	ft/ft
Length Factor	0.87	
Total Interception Length	48.05	ft

Worksheet for Option 3 WB - COA Cattle Guard Inlet

Project Description

Solve For

Efficiency

Input Data

Discharge	19.82	ft ³ /s
Slope	0.00915	ft/ft
Gutter Width	22.00	ft
Gutter Cross Slope	0.01	ft/ft
Road Cross Slope	0.01	ft/ft
Roughness Coefficient	0.016	
Local Depression	0.00	in
Local Depression Width	0.00	ft
Grate Width	22.00	ft
Grate Length	3.33	ft
Grate Type	P-50 mm x 100 mm (P-1-7/8"-4")	
Clogging	0.00	%
Curb Opening Length	6.61	ft

Options

Calculation Option

Use Both

Grate Flow Option

Exclude None

Results

Efficiency	97.28	%
Intercepted Flow	19.28	ft ³ /s
Bypass Flow	0.54	ft ³ /s
Spread	31.30	ft
Depth	0.37	ft
Flow Area	5.76	ft ²
Gutter Depression	0.00	ft
Total Depression	0.00	ft
Velocity	3.44	ft/s
Splash Over Velocity	6.57	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.12	
Grate Flow Ratio	0.96	
Equivalent Cross Slope	0.01177	ft/ft
Active Grate Length	3.33	ft
Length Factor	0.04	
Total Interception Length	88.42	ft

Worksheet for Option 3 WB - COA Cattle Guard Inlet

Messages

Messages Grate Length should be within the
defined range of HEC-22's Chart 5
(approx. 0.5-4.5 ft / 0.15-1.35 m).

Worksheet for Option 4 WB -5-TYPE DBL D Inlets

Project Description

Solve For Efficiency

Input Data

Discharge	19.82	ft ³ /s
Slope	0.00915	ft/ft
Gutter Width	2.08	ft
Gutter Cross Slope	0.01	ft/ft
Road Cross Slope	0.01	ft/ft
Roughness Coefficient	0.016	
Grate Width	2.08	ft
Grate Length	33.30	ft
Grate Type	P-50 mm x 100 mm (P-1-7/8"-4")	
Clogging	15.00	%

Options

Grate Flow Option Exclude None

Results

Efficiency	95.30	%
Intercepted Flow	18.89	ft ³ /s
Bypass Flow	0.93	ft ³ /s
Spread	34.67	ft
Depth	0.35	ft
Flow Area	6.01	ft ²
Gutter Depression	0.00	ft
Total Depression	0.00	ft
Velocity	3.30	ft/s
Splash Over Velocity	261.13	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.94	
Grate Flow Ratio	0.15	
Active Grate Length	28.31	ft

Messages

Messages Grate Length should be within the defined range of HEC-22's Chart 5 (approx. 0.5-4.5 ft / 0.15-1.35 m).

Appendix C: Cost Estimates

Estimate of Probable Project Costs
Avenida Cesar Chavez Drainage Inlet Improvements
City of Albuquerque Project 5015.03
Alternative - Cast-in-Place Concrete Deck, Including Drainage Structure
Alternative(1-Lane Open Each Way)
9/6/2013

ITEM NUMBER	LONG DESCRIPTION	UNIT	UNIT PRICE	QUANTITY	TOTAL COST
Construction					
4.010	Construction Staking, compl.	%	1.40	1	\$2,810.31
4.01x	Material Testing	%	1.50	1	\$3,011.04
4.020	Construction Surveying, compl.	%	1.31	1	\$2,629.64
6.050	Construction Mobilization, compl.	%	4.77	1	\$9,575.11
6.060	Construction Demobilization, compl.	%	0.30	1	\$602.21
19.010	Construction Traffic Control & Barricading, compl.	%	7.00	1	\$14,051.53
30.010	Flood Protection, compl.	%	1.00	1	\$2,007.36
Subtotal of Construction Items					\$34,687.20
Roadway					
301.020	Subgrade Prep. 12" at 95% compaction, cip.	SY	2.00	656	\$1,312.00
302.01X	Aggregate Base Course, crushed. 8" at 95% compaction, cip. SD 2408	SY	8.00	656	\$5,248.00
336.010	Prime Coat, emulsified asphalt, cip.	SY	0.42	656	\$275.52
336.120	Tack Coat, cationic emulsified asphalt, cip.	SY	0.37	656	\$242.72
336.024	Asphalt Concrete, 3 inch thick, superpave	SY	13.00	1,312	\$17,056.00
340.050	Curb & Gutter, Standard, Portland Cement Concrete, incl. subgrade preparation, cip. SD 2415	LF	20.31	30	\$609.30
340.060	Curb & Gutter, Median, Portland Cement Concrete, cip. SD 2408	LF	19.49	800	\$15,592.00
340.300	4" Median Pavement, Portland Cement Concrete, incl. subgrade compaction. cip.	SY	40.08	250	\$10,020.00
606010	Metal Barrier Thrie Beam	LF	41.38	170	\$7,034.60
606010	Metal Barrier End Treatment (ANCHRG) Type B	EA	1,300.00	4	\$5,200.00
Subtotal of Roadway Items					\$62,590.14
Removals					
343.030	Existing Pavement, Asphalt Concrete, more than 4" thick, sawcut, remove & dispose, compl.	SY	9.51	617	\$5,867.67
343.080	Existing Curb & Gutter or Valley Gutter, PC Concrete, remove & dispose, compl.	LF	6.42	830	\$5,328.60
343.085	Existing Sidewalk, 4" PC Concrete, remove & dispose	SY	9.34	250	\$2,335.00
Subtotal of Removals Items					\$13,531.27
Signing and Striping					
441.001	Reflectorized Plastic Pavement Markings, 4" width, cip.	LF	0.46	3,500	\$1,610.00
441.007	Temporary Reflectorized Plastic Pavement Markings, 4" width, incl. remove & dispose, cip.	LF	1.17	3,500	\$4,095.00
Subtotal of Signing and Striping Items					\$5,705.00
Structures					
511XXX	Reinforced Concrete Deck, C.I.P.	SF	35.00	1,176	\$41,160.00
532000	Penetrating Water Repellent Treatment	SY	4.00	455	\$1,820.00
53300X	Remove Existing Deck and Remodel Abutments	LS	17,000.00	1	\$17,000.00
534000	Epoxy Injection, Type I	GAL	975.00	20	\$19,500.00
543030	Metal Railing, Type D	LF	220.00	126	\$27,720.00
601XXX	Remove Existing Metal Railing	LF	34.00	126	\$4,284.00
Subtotal of Structures Items					\$111,484.00
Drainage					
915.050	Catch Basin, Type "D", Single Grate, cip. SD 2206	EA	2,475.23	3	\$7,425.69
915.060	Catch Basin, Type "D", Double Grate, cip. SD 2206	EA	4,338.76	3	\$13,016.28
Subtotal of Drainage Items					\$7,425.69

Subtotal of Construction Items	\$235,423.30
Construction Management (6.6%)	\$15,537.94
Contingencies (30%)	\$70,626.99
NMGRT (7.0%)	\$21,423.52

TOTAL Estimate of Probable Project Cost	\$343,011.75
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Estimate of Probable Project Costs
Avenida Cesar Chavez Drainage Inlet Improvements
City of Albuquerque Project 5015.03
Alternative - Cast-in-Place Concrete Deck, Including Drainage Structure
Alternative (Full Closure)
9/6/2013

ITEM NUMBER	LONG DESCRIPTION	UNIT	UNIT PRICE	QUANTITY	TOTAL COST
Construction					
4.010	Construction Staking, compl.	%	1.40	1	\$1,978.18
4.01x	Material Testing	%	1.50	1	\$2,119.48
4.020	Construction Surveying, compl.	%	1.31	1	\$1,851.01
6.050	Construction Mobilization, compl.	%	4.77	1	\$6,739.94
6.060	Construction Demobilization, compl.	%	0.30	1	\$423.90
19.010	Construction Traffic Control & Barricading, compl.	%	6.00	1	\$8,477.91
30.010	Flood Protection, compl.	%	1.00	1	\$1,412.98
Subtotal of Construction Items					\$23,003.39
Roadway					
301.020	Subgrade Prep. 12" at 95% compaction, cip.	SY	2.00	201	\$402.00
302.01X	Aggregate Base Course, crushed. 8" at 95% compaction, cip. SD 2408	SY	8.00	201	\$1,608.00
336.010	Prime Coat, emulsified asphalt, cip.	SY	0.42	201	\$84.42
336.120	Tack Coat, cationic emulsified asphalt, cip.	SY	0.37	201	\$74.37
336.024	Asphalt Concrete, 3 inch thick, superpave	SY	13.00	402	\$5,226.00
340.050	Curb & Gutter, Standard, Portland Cement Concrete, incl. subgrade preparation, cip. SD 2415	LF	20.31	30	\$609.30
606010	Metal Barrier Thrie Beam	LF	41.38	170	\$7,034.60
606010	Metal Barrier End Treatment (ANCHRG) Type B	EA	1,300.00	4	\$5,200.00
Subtotal of Roadway Items					\$20,238.69
Removals					
343.030	Existing Pavement, Asphalt Concrete, more than 4" thick, sawcut, remove & dispose, compl.	SY	9.51	201	\$1,911.51
343.080	Existing Curb & Gutter or Valley Gutter, PC Concrete, remove & dispose, compl.	LF	6.42	30	\$192.60
Subtotal of Removals Items					\$2,104.11
Signing and Striping					
441.001	Reflectorized Plastic Pavement Markings, 4" width, cip.	LF	0.46	100	\$46.00
Subtotal of Signing and Striping Items					\$46.00
Structures					
511XXX	Reinforced Concrete Deck, C.I.P.	SF	35.00	1,176	\$41,160.00
532000	Penetrating Water Repellent Treatment	SY	4.00	455	\$1,820.00
53300X	Remove Existing Deck and Remodel Abutments	LS	17,000.00	1	\$17,000.00
534000	Epoxy Injection, Type I	GAL	975.00	20	\$19,500.00
543030	Metal Railing, Type D	LF	220.00	126	\$27,720.00
601XXX	Remove Existing Metal Railing	LF	34.00	126	\$4,284.00
Subtotal of Structures Items					\$111,484.00
Drainage					
915.050	Catch Basin, Type "D", Single Grate, cip. SD 2206	EA	2,475.23	3	\$7,425.69
915.060	Catch Basin, Type "D", Double Grate, cip. SD 2206	EA	4,338.76	3	\$13,016.28
Subtotal of Drainage Items					\$7,425.69

Subtotal of Construction Items	\$164,301.88
Construction Management (6.6%)	\$10,843.92
Contingencies (30%)	\$49,290.57
NMGRT (7.0%)	\$14,951.47
TOTAL Estimate of Probable Project Cost	\$239,387.85

Estimate of Probable Project Costs
Avenida Cesar Chavez Drainage Inlet Improvements
City of Albuquerque Project 5015.03
Alternative - Precast Deck, Including Drainage Structure
Alternative (1-Lane Open Each Way)
9/6/2013

ITEM NUMBER	LONG DESCRIPTION	UNIT	UNIT PRICE	QUANTITY	TOTAL COST
Construction					
4.010	Construction Staking, compl.	%	1.40	1	\$3,163.32
4.01x	Material Testing	%	1.50	1	\$3,389.28
4.020	Construction Surveying, compl.	%	1.31	1	\$2,959.97
6.050	Construction Mobilization, compl.	%	4.77	1	\$10,777.90
6.060	Construction Demobilization, compl.	%	0.30	1	\$677.86
19.010	Construction Traffic Control & Barricading, compl.	%	7.00	1	\$15,816.62
30.010	Flood Protection, compl.	%	1.00	1	\$2,259.52
Subtotal of Construction Items					\$39,044.45
Roadway					
301.020	Subgrade Prep. 12" at 95% compaction, cip.	SY	2.00	656	\$1,312.00
302.01X	Aggregate Base Course, crushed. 8" at 95% compaction, cip. SD 2408	SY	8.00	656	\$5,248.00
336.010	Prime Coat, emulsified asphalt, cip.	SY	0.42	656	\$275.52
336.120	Tack Coat, cationic emulsified asphalt, cip.	SY	0.37	656	\$242.72
336.024	Asphalt Concrete, 3 inch thick, superpave	SY	13.00	1,312	\$17,056.00
340.050	Curb & Gutter, Standard, Portland Cement Concrete, incl. subgrade preparation, cip. SD 2415	LF	20.31	30	\$609.30
340.060	Curb & Gutter, Median, Portland Cement Concrete, cip. SD 2408	LF	19.49	800	\$15,592.00
340.300	4" Median Pavement, Portland Cement Concrete, incl. subgrade compaction, cip.	SY	40.08	250	\$10,020.00
606010	Metal Barrier Thrie Beam	LF	41.38	170	\$7,034.60
606010	Metal Barrier End Treatment (ANCHRG) Type B	EA	1,300.00	2	\$2,600.00
Subtotal of Roadway Items					\$59,990.14
Removals					
343.030	Existing Pavement, Asphalt Concrete, more than 4" thick, sawcut, remove & dispose, compl.	SY	9.51	617	\$5,867.67
343.080	Existing Curb & Gutter or Valley Gutter, PC Concrete, remove & dispose, compl.	LF	6.42	830	\$5,328.60
343.085	Existing Sidewalk, 4" PC Concrete, remove & dispose	SY	9.34	250	\$2,335.00
Subtotal of Removals Items					\$13,531.27
Signing and Striping					
441.001	Reflectorized Plastic Pavement Markings, 4" width, cip.	LF	0.46	3,500	\$1,610.00
441.007	Temporary Reflectorized Plastic Pavement Markings, 4" width, incl. remove & dispose, cip.	LF	1.17	3,500	\$4,095.00
Subtotal of Signing and Striping Items					\$5,705.00
Structures					
511XXX	Reinforced Concrete Deck, Precast	SF	50.00	1,176	\$58,800.00
532000	Penetrating Water Repellent Treatment	SY	4.00	455	\$1,820.00
53300X	Remove Existing Deck and Remodel Abutments	LS	17,000.00	1	\$17,000.00
534000	Epoxy Injection, Type I	GAL	975.00	20	\$19,500.00
536000	Epoxy Polymer Bridge Deck Overlay	SY	35.00	131	\$4,585.00
543030	Metal Railing, Type D	LF	220.00	126	\$27,720.00
601XXX	Remove Existing Metal Railing	LF	34.00	126	\$4,284.00
Subtotal of Structures Items					\$133,709.00
Drainage					
915.050	Catch Basin, Type "D", Single Grate, cip. SD 2206	EA	2,475.23	3	\$7,425.69
915.060	Catch Basin, Type "D", Double Grate, cip. SD 2206	EA	4,338.76	3	\$13,016.28
Subtotal of Drainage Items					\$13,016.28

Subtotal of Construction Items	\$264,996.14
Construction Management (6.6%)	\$17,489.75
Contingencies (30%)	\$79,498.84
NMGRT (7.0%)	\$24,114.65
TOTAL Estimate of Probable Project Cost	\$386,099.38

Estimate of Probable Project Costs
Avenida Cesar Chavez Drainage Inlet Improvements
City of Albuquerque Project 5015.03
Alternative - Precast Deck, Including Drainage Structure
Alternative (Full Closure)
9/6/2013

ITEM NUMBER	LONG DESCRIPTION	UNIT	UNIT PRICE	QUANTITY	TOTAL COST
Construction					
4.010	Construction Staking, compl.	%	1.40	1	\$2,289.33
4.01x	Material Testing	%	1.50	1	\$2,452.85
4.020	Construction Surveying, compl.	%	1.31	1	\$2,142.16
6.050	Construction Mobilization, compl.	%	4.77	1	\$7,800.07
6.060	Construction Demobilization, compl.	%	0.30	1	\$490.57
19.010	Construction Traffic Control & Barricading, compl.	%	6.00	1	\$9,811.41
30.010	Flood Protection, compl.	%	1.00	1	\$1,635.23
Subtotal of Construction Items					\$26,621.62
Roadway					
301.020	Subgrade Prep. 12" at 95% compaction, cip.	SY	2.00	201	\$402.00
302.01X	Aggregate Base Course, crushed. 8" at 95% compaction, cip. SD 2408	SY	8.00	201	\$1,608.00
336.010	Prime Coat, emulsified asphalt, cip.	SY	0.42	201	\$84.42
336.120	Tack Coat, cationic emulsified asphalt, cip.	SY	0.37	201	\$74.37
336.024	Asphalt Concrete, 3 inch thick, superpave	SY	13.00	402	\$5,226.00
340.050	Curb & Gutter, Standard, Portland Cement Concrete, incl. subgrade preparation, cip. SD 2415	LF	20.31	30	\$609.30
606010	Metal Barrier Thrie Beam	LF	41.38	170	\$7,034.60
606010	Metal Barrier End Treatment (ANCHRG) Type B	EA	1,300.00	4	\$5,200.00
Subtotal of Roadway Items					\$20,238.69
Removals					
343.030	Existing Pavement, Asphalt Concrete, more than 4" thick, sawcut, remove & dispose, compl.	SY	9.51	201	\$1,911.51
343.080	Existing Curb & Gutter or Valley Gutter, PC Concrete, remove & dispose, compl.	LF	6.42	30	\$192.60
Subtotal of Removals Items					\$2,104.11
Signing and Striping					
441.001	Reflectorized Plastic Pavement Markings, 4" width, cip.	LF	0.46	100	\$46.00
Subtotal of Signing and Striping Items					\$46.00
Structures					
511XXX	Reinforced Concrete Deck, Precast	SF	50.00	1,176	\$58,800.00
532000	Penetrating Water Repellent Treatment	SY	4.00	455	\$1,820.00
53300X	Remove Existing Deck and Remodel Abutments	LS	17,000.00	1	\$17,000.00
534000	Epoxy Injection, Type I	GAL	975.00	20	\$19,500.00
536000	Epoxy Polymer Bridge Deck Overlay	SY	35.00	131	\$4,585.00
543030	Metal Railing, Type D	LF	220.00	126	\$27,720.00
601XXX	Remove Existing Metal Railing	LF	34.00	126	\$4,284.00
Subtotal of Structures Items					\$133,709.00
Drainage					
915.050	Catch Basin, Type "D", Single Grate, cip. SD 2206	EA	2,475.23	3	\$7,425.69
915.060	Catch Basin, Type "D", Double Grate, cip. SD 2206	EA	4,338.76	3	\$13,016.28
Subtotal of Drainage Items					\$7,425.69

Subtotal of Construction Items	\$190,145.11
Construction Management (6.6%)	\$12,549.58
Contingencies (30%)	\$57,043.53
NMGRT (7.0%)	\$17,303.21

TOTAL Estimate of Probable Project Cost	\$277,041.43
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SENT 7/27/14

Worksheet for Options 2 & 5 WB - Curb Opening

NORTH

Project Description

Solve For

Efficiency

Input Data

Discharge	19.82	ft ³ /s	✓
Slope	0.00740	ft/ft	✓
Gutter Width	2.00	ft	
Gutter Cross Slope	0.009	ft/ft	
Road Cross Slope	0.009	ft/ft	
Roughness Coefficient	0.016		
Curb Opening Length	48.00	ft	
Local Depression	2.00	in	
Local Depression Width	2.00	ft	

Results

Efficiency	94.72	%	
Intercepted Flow	18.77	ft ³ /s	NOT 19.8
Bypass Flow	1.05	ft ³ /s	
Spread	37.98	ft	
Depth	0.35	ft	
Flow Area	6.63	ft ²	
Gutter Depression	0.00	ft	
Total Depression	0.17	ft	
Velocity	2.99	ft/s	
Equivalent Cross Slope	0.02040	ft/ft	
Length Factor	0.80		
Total Interception Length	59.64	ft	

MCT 8/18/14

Worksheet for Options 2 & 5 WB - Curb Opening

Project Description

Solve For

Efficiency

Input Data

Discharge	19.82	ft ³ /s	
Slope	0.01240	ft/ft	✓
Gutter Width	2.00	ft	✓
Gutter Cross Slope	0.063	ft/ft	
Road Cross Slope	0.009	ft/ft	✓
Roughness Coefficient	0.016		✓
Curb Opening Length	45.00	ft	
Local Depression	1.50	in	✓ 4"?
Local Depression Width	2.00	ft	✓

Results

Efficiency	95.91	%
Intercepted Flow	19.01	ft ³ /s
Bypass Flow	0.81	ft ³ /s
Spread	33.93	ft
Depth	0.42	ft
Flow Area	5.40	ft ²
Gutter Depression	0.11	ft
Total Depression	0.23	ft
Velocity	3.67	ft/s
Equivalent Cross Slope	0.03098	ft/ft
Length Factor	0.83	
Total Interception Length	54.18	ft

MBT 8/18/14

Worksheet for Options 2 & 3 EB - Curb Opening

Project Description

Solve For Efficiency

Input Data

Discharge	5.29 ft ³ /s
Slope	0.01240 ft/ft
Gutter Width	2.00 ft
Gutter Cross Slope	0.063 ft/ft
Road Cross Slope	0.016 ft/ft
Roughness Coefficient	0.016
Curb Opening Length	15.00 ft
Local Depression	1.50 in
Local Depression Width	2.00 ft

Results

Efficiency	90.13 %
Intercepted Flow	4.77 ft ³ /s
Bypass Flow	0.52 ft ³ /s
Spread	14.20 ft
Depth	0.32 ft
Flow Area	1.71 ft ²
Gutter Depression	0.09 ft
Total Depression	0.22 ft
Velocity	3.10 ft/s
Equivalent Cross Slope	0.06097 ft/ft
Length Factor	0.72
Total Interception Length	20.72 ft

