

**Final Drainage Plan,
Cherry Creek Crossing Filing No. 1 Lot 111
El Paso County, Colorado**

Prepared for:
Colorado Highway 382 Limited Partnership
6070 North Camino Almonte
Tucson, Arizona 85718

Prepared by:
Kiowa
Engineering Corporation

1604 South 21st Street
Colorado Springs, Colorado 80904
(719) 630-7342

Kiowa Project No. 14028
August 3, 2017
Revised September 20, 2017

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Engineer's Statement:

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

Kiowa Engineering Corporation, 1604 South 21st Street, Colorado Springs, Colorado 80904

Richard N. Wray
Registered Engineer #19310
For and on Behalf of Kiowa Engineering Corporation

Date

Developer's Statement:

I, the Developer, have read and will comply with all of the requirements specified in this drainage report and plan.

BY: _____

Date

Printed

ADDRESS: Colorado Highway 382 Limited Partnership
6070 North Camino Almonte
Tucson, Arizona 85718

El Paso County:

Filed in accordance with the requirements of the Drainage Criteria Manual Volumes 1 and 2, El Paso County Engineering Criteria Manual and Land Development Code, as amended.

Jennifer Irvine, P.E.
County Engineer/ECM Administrator

Date

I. General Location and Description of Project

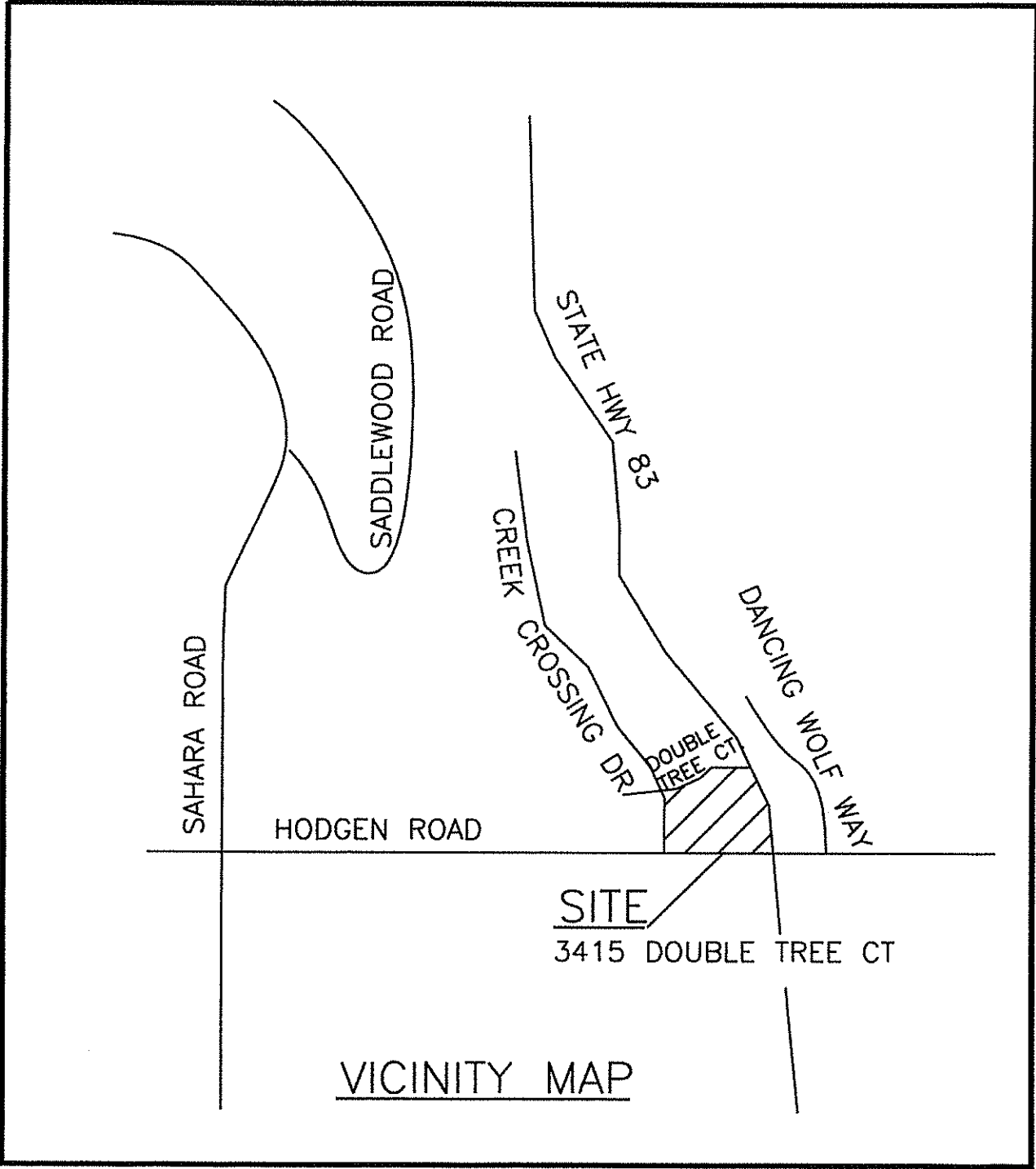
Cherry Creek Crossing Filing No. 1 is a platted subdivision in northern El Paso County that consists of 53 single family lots ranging in size from 2.5 to 5 acres, and one 8-acre commercial lot. The commercial lot, Lot 111, is located at the northwest corner of State Highway 83 and Hodgen Road. The owner of Lot 111 is proposing to carry out overlot grading in anticipation of a commercial use being established on the lot. The location of Lot 111 is shown on Figure 1.

The final drainage report for Filing No. 1 was approved by the County in 1998. Since that time the single-family lots have all been developed while Lot 111 has remains undeveloped. The public roadways that serve the subdivision have all been built and are currently maintained by the County. An overlot grading and erosion control plan has been prepared to show the extent of grading that is proposed for Lot 111. In addition to the overlot grading operations, the existing 54-inch reinforced concrete pipe presently maintained by the County that conveys runoff from offsite watersheds into Lot 111 is proposed for extension approximately 200 feet to the north. The proposed extension to this culvert is shown on Figure 2. When Filing 1 was platted, a drainage, floodplain and no-build easement was shown. This easement was created for access to the drainageway for the purposes of maintenance by the individual property owner. The County has a dedicated permanent easement that extends into the property 95-feet from the Hodgen Road right-of-way for the purposes of mainatence acces to the 54-inch RCP that was extended when Hodgen Road was widened. These easements are shown on Figure 2.

Prior to the final development of Lot 111 a site plan will have to be provided to the County for review and approval per the requirements of the approved development plan for Cherry Creek Crossing. A specific use has not been identified for Lot 111. It is anticipated that onsite drainage facilities as well as water quality storage will be installed at that time. There are no stormwater detention or water quality facilities proposed for construction as part of the overlot grading. Permanent water quality measures will be installed when the site is developed into its final use. Permanent water quality measures such as water quality storage basins will not be placed in the area bounded by Double Tree Court, Cherry Crossing Road and the future access drives shown on Figure 2. A temporary sediment basin will be installed as part of the overlot grading work.

II. Hydrology

Onsite and offsite hydrology for Cherry Creek Crossing Filing 1 used to size the drainage facilities within the subdivision is summarized in the Filing 1 final drainage report. The hydrology work map from the Filing 1 final drainage plan showing the location of Lot 111 has been included within Appendix A. The overlot grading and eventual revegetation efforts will cause no change in the existing condition rates of runoff for Lot 111. The peak flow rates that are carried into the site by the existing 54-inch RCP under Hodgen Road are shown on Figure 2.



SAHARA ROAD

SADDLEWOOD ROAD

STATE HWY 83

CREEK CROSSING DR

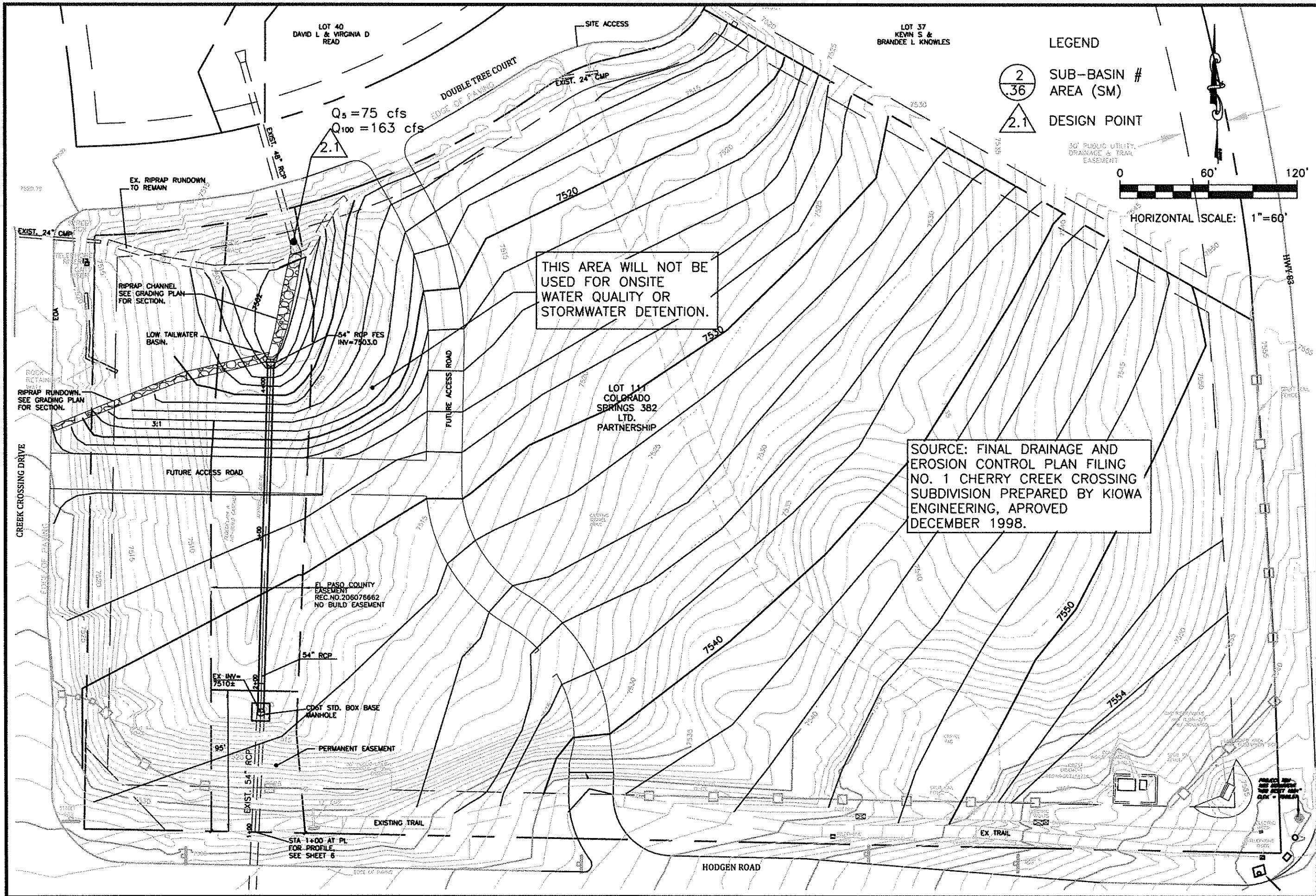
DOUBLE TREE CT

DANCING WOLF WAY

HODGEN ROAD

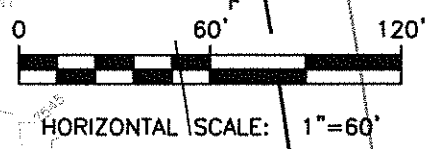
SITE
3415 DOUBLE TREE CT

VICINITY MAP



LEGEND

- 2
36 SUB-BASIN #
AREA (SM)
- 2.1 DESIGN POINT



THIS AREA WILL NOT BE USED FOR ONSITE WATER QUALITY OR STORMWATER DETENTION.

SOURCE: FINAL DRAINAGE AND EROSION CONTROL PLAN FILING NO. 1 CHERRY CREEK CROSSING SUBDIVISION PREPARED BY KIOWA ENGINEERING, APPROVED DECEMBER 1998.

**CHERRY CREEK CROSSING, FILING NO. 1 LOT 111
AMENDED FINAL DRAINAGE PLAN**

EL PASO COUNTY, COLORADO

Project No.:	14028
Date:	SEPT. 20, 2017
Design:	RNW
Drawn:	EAK
Check:	RNW
Revisions:	

FIG.2

III. Hydraulic Calculations

The hydraulic capacity of the existing 48-inch CMP under Hodgen Road has been verified in its as-built condition. A field survey was conducted in 2014 whereby the as-built invert of the 54-inch RCP under Hodgen Road as well as for the 48-inch CMP culvert under Double Tree Court were confirmed. The overlot grading as proposed would not affect the culvert under Double Tree Court. The hydraulic capacity of the 54-inch RCP under Hodgen Road extended as shown on Figure 2 was reverified. Based upon the hydraulic calculations, extending the 54-inch into the site will not affect the hydraulic capacity of the culvert. The headwater-to-depth ratio is unchanged between the existing and extended condition. The culvert calculations have been included in Appendix A.

IV. Floodplain Statement

The Floodplain Insurance Rate Map (FIRM) for El Paso County Flood Insurance Study (FIS) panel 285 was reviewed to determine any potential regulatory floodplains within Lot 111. There is no land within the Filing 1 subdivision that is located within a 100-year floodplain as delineated in the FIS. A copy of the relevant portion of FIRM panel 285F is shown on Figure 3.

V. Drainage and Bridge Fees

Drainage and bridge fees for Filing No.1 were determined in the Filing No. 1 final drainage report. The drainage and bridge fees were paid with the development of Filing 1. Therefore, there are no fees due for Lot 111.

VI. Economic Analysis

Summarized on Table 1 is the cost estimate for the extension of the 54-inch culvert through Lot 111.



NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP
EL PASO COUNTY,
COLORADO AND
INCORPORATED AREAS

PANEL 285 OF 1300
(SEE MAP INDEX FOR PANELS NOT PRINTED)

CONTAINS:	COMMUNITY	NUMBER	PANEL	SUFFIX
EL PASO COUNTY, UNINCORPORATED AREAS		080059	0285	F

MAP NUMBER
08041C0285 F
EFFECTIVE DATE:
MARCH 17, 1997



Federal Emergency Management Agency

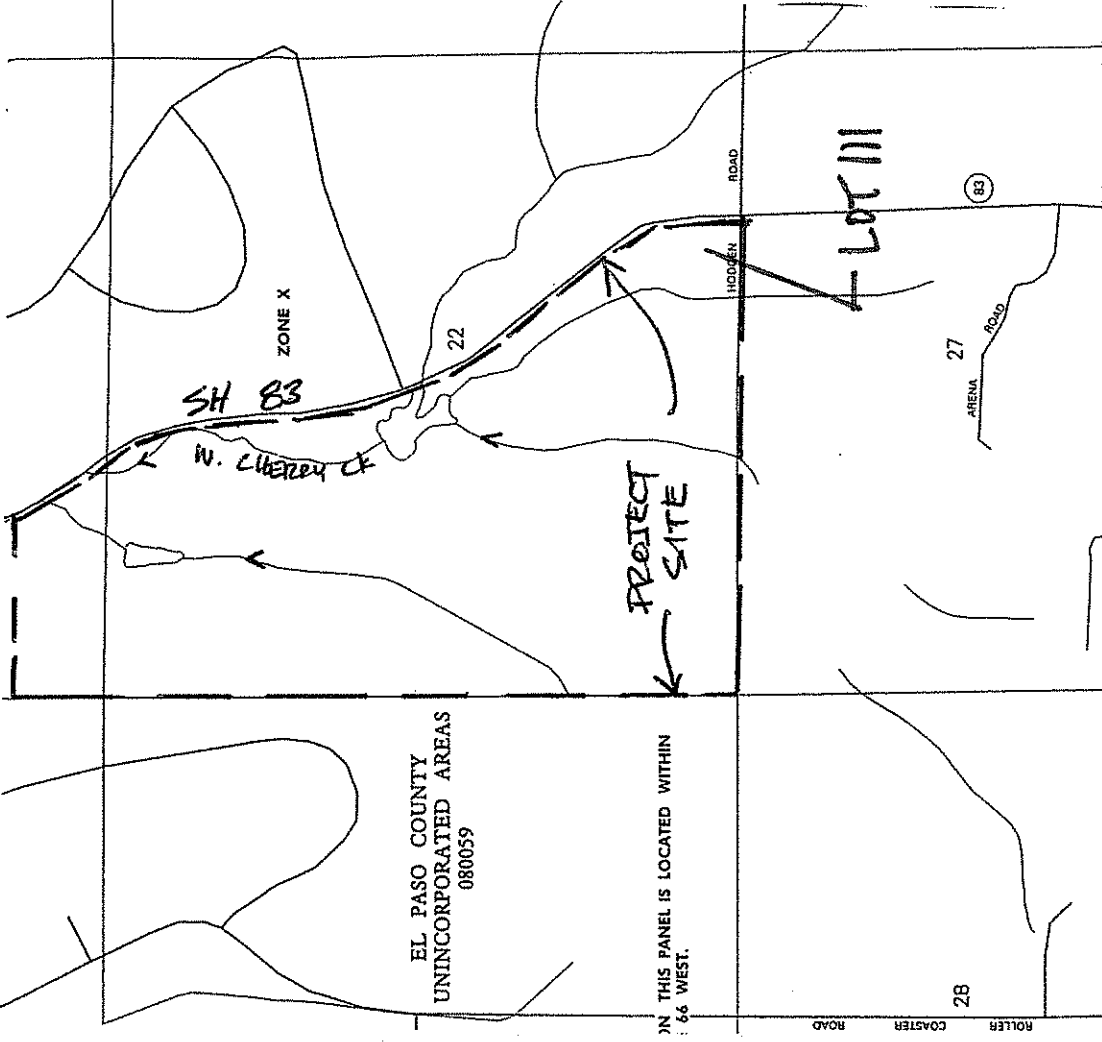


FIGURE 3
NO SCALE

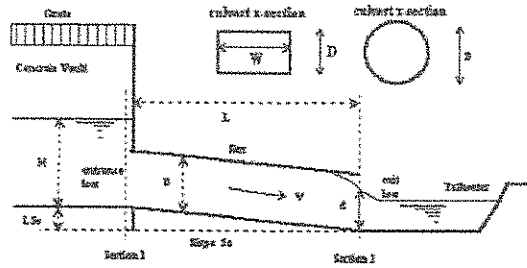
**TABLE 1: CHERRY CREEK CROSSING FILING 1 LOT 111
DRAINAGE IMPROVEMENT COST ESTIMATE
KIOWA PROJECT NUMBER 14028**

ITEM	UNIT COST	UNIT	QUANTITY	TOTAL
PUBLIC DRAINAGE FACILITIES				
54-INCH RCP	\$182	LF	215	\$39,130
54-INCH RCP FES	-	EA	1	\$0
BOX BASE MANHOLE	\$4,575	EA	1	\$4,575
TYPE M SOIL/RIPRAP	\$98	CY	50	\$4,900
LOW TAILWATER OUTLET PROTECTION	\$6,000	EA	1	\$6,000
SUBTOTAL				\$54,605.00
CONTINGENCY (5 %)				\$2,730.25
ENGINEERING (10 %)				\$5,460.50
TOTAL				\$62,795.75

Appendix A
Hydraulic Calculations

CULVERT STAGE-DISCHARGE SIZING (INLET vs. OUTLET CONTROL WITH TAILWATER EFFECTS)

Project: 14028 Cherry Creek Crossing Filing No. 1, Lot 111
 Basin ID: Hodgen Road culvert existing conditions
 Status: _____



Design Information (Input):

Circular Culvert: Barrel Diameter in Inches D = inches
 Inlet Edge Type (choose from pull-down list)

OR:

Box Culvert: Barrel Height (Rise) in Feet Height (Rise) = ft.
 Barrel Width (Span) in Feet Width (Span) = ft.
 Inlet Edge Type (choose from pull-down list)

Number of Barrels No. =

Inlet Elevation at Culvert Invert Inlet Elev. = ft. elev.
 Outlet Elevation at Culvert Invert OR Slope of Culvert (ft v./ft h.) Outlet Elev. = ft. elev.
 Culvert Length in Feet L = ft.
 Manning's Roughness n =
 Bend Loss Coefficient K_b =
 Exit Loss Coefficient K_e =

Design Information (calculated):

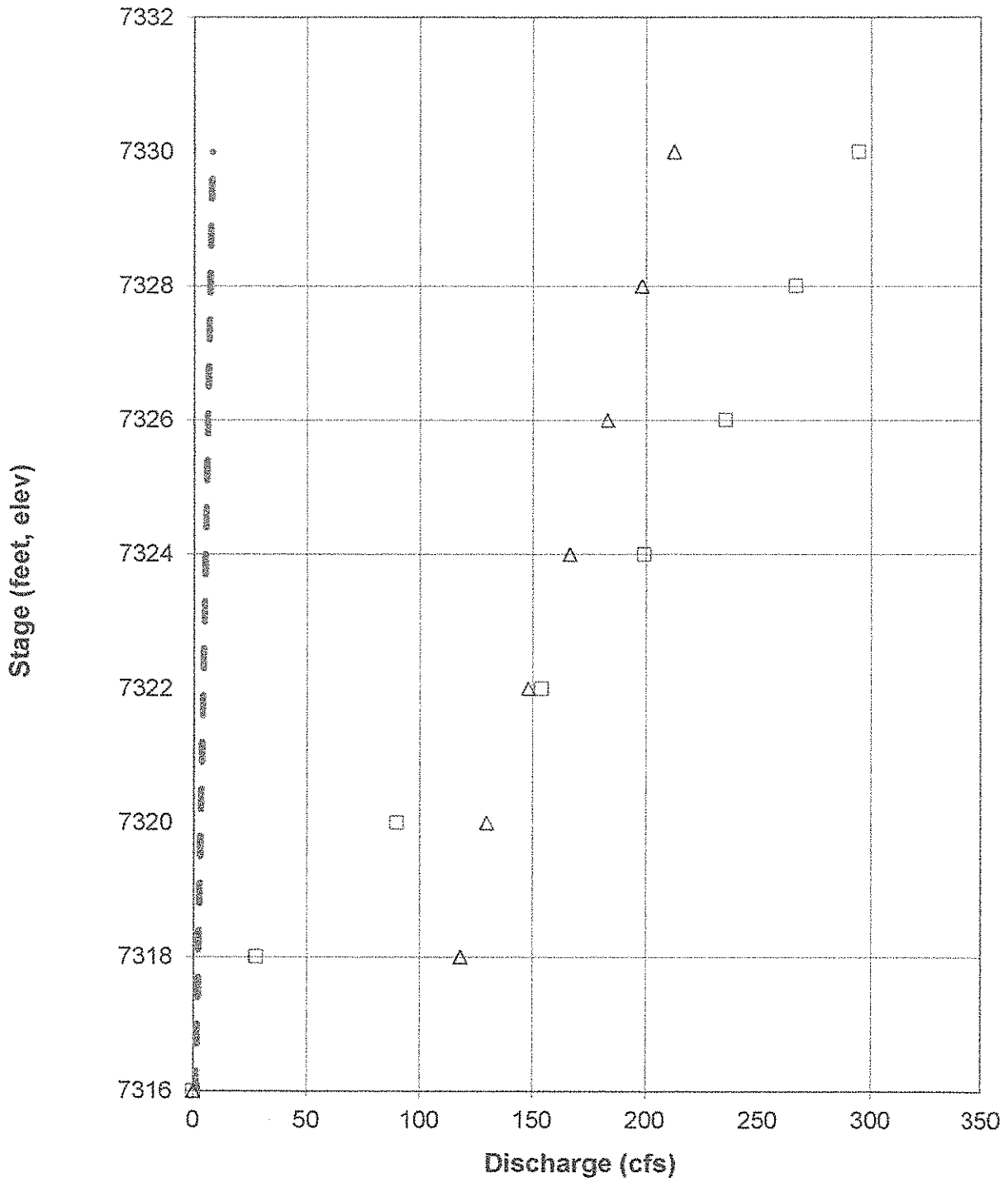
Entrance Loss Coefficient K_e =
 Friction Loss Coefficient K_f =
 Sum of All Loss Coefficients K_s =
 Orifice Inlet Condition Coefficient C_d =
 Minimum Energy Condition Coefficient K_{E_{min}} =

Calculations of Culvert Capacity (output):

$Q_{100} = 163 \text{ cfs}$
 $H_w/D = \frac{7.5}{4.5} = 1.67$

Water Surface Elevation (ft., linked)	Tailwater Surface Elevation ft	Culvert Inlet-Control Flowrate cfs	Culvert Outlet-Control Flowrate cfs	Controlling Culvert Flowrate cfs (output)	Inlet Equation Used:	Flow Control Used
7316.00	7310.00	0.00	0.00	0.00	No Flow (WS < inlet)	N/A
7318.00	7310.50	27.40	117.96	27.40	Min. Energy Eqn.	INLET
7320.00	7311.00	89.80	129.53	89.80	Regression Eqn.	INLET
7322.00	7311.50	153.80	147.76	147.76	Regression Eqn.	OUTLET
7324.00	7312.00	199.20	166.26	166.26	Regression Eqn.	OUTLET
7326.00	7312.50	235.50	182.89	182.89	Regression Eqn.	OUTLET
7328.00	7313.00	266.60	198.09	198.09	Regression Eqn.	OUTLET
7330.00	7313.50	294.50	212.27	212.27	Orifice Eqn.	OUTLET
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STAGE-DISCHARGE CURVE FOR THE CULVERT



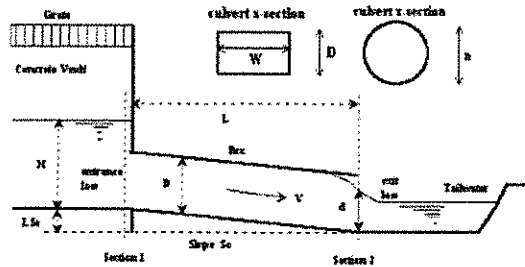
○ Stage-Discharge □ Inlet Control △ Outlet Control

CULVERT STAGE-DISCHARGE SIZING (INLET vs. OUTLET CONTROL WITH TAILWATER EFFECTS)

Project: 14028 Cherry Creek Crossing Filing No. 1, Lot 111

Basin ID: Hodgen Road Culvert- Extended Condition

Status:



Provide the culvert analysis of the 48" RCP which includes the head water calculation.

Design Information (Input):

Circular Culvert: Barrel Diameter in Inches
Inlet Edge Type (choose from pull-down list)

OR:

Box Culvert: Barrel Height (Rise) in Feet
Barrel Width (Span) in Feet
Inlet Edge Type (choose from pull-down list)

Number of Barrels
Inlet Elevation at Culvert Invert
Outlet Elevation at Culvert Invert OR Slope of Culvert (ft v./fl h.)
Culvert Length in Feet
Manning's Roughness
Bend Loss Coefficient
Exit Loss Coefficient

D =	54	inches
Grooved End Projection		
Height (Rise) =		ft.
Width (Span) =		ft.
Square Edge w/ 90-15 Deg. Headwall		
No =	1	
Inlet Elev =	7316	ft. elev.
Outlet Elev =	7303	ft. elev.
L =	430	ft.
n =	0.025	
K _b =	0	
K _e =	1	

Design Information (calculated):

Entrance Loss Coefficient
Friction Loss Coefficient
Sum of All Loss Coefficients
Orifice Inlet Condition Coefficient
Minimum Energy Condition Coefficient

K _e =	0.20
K _f =	6.66
K _s =	7.86
C _d =	0.95
KE _{low} =	-0.0856

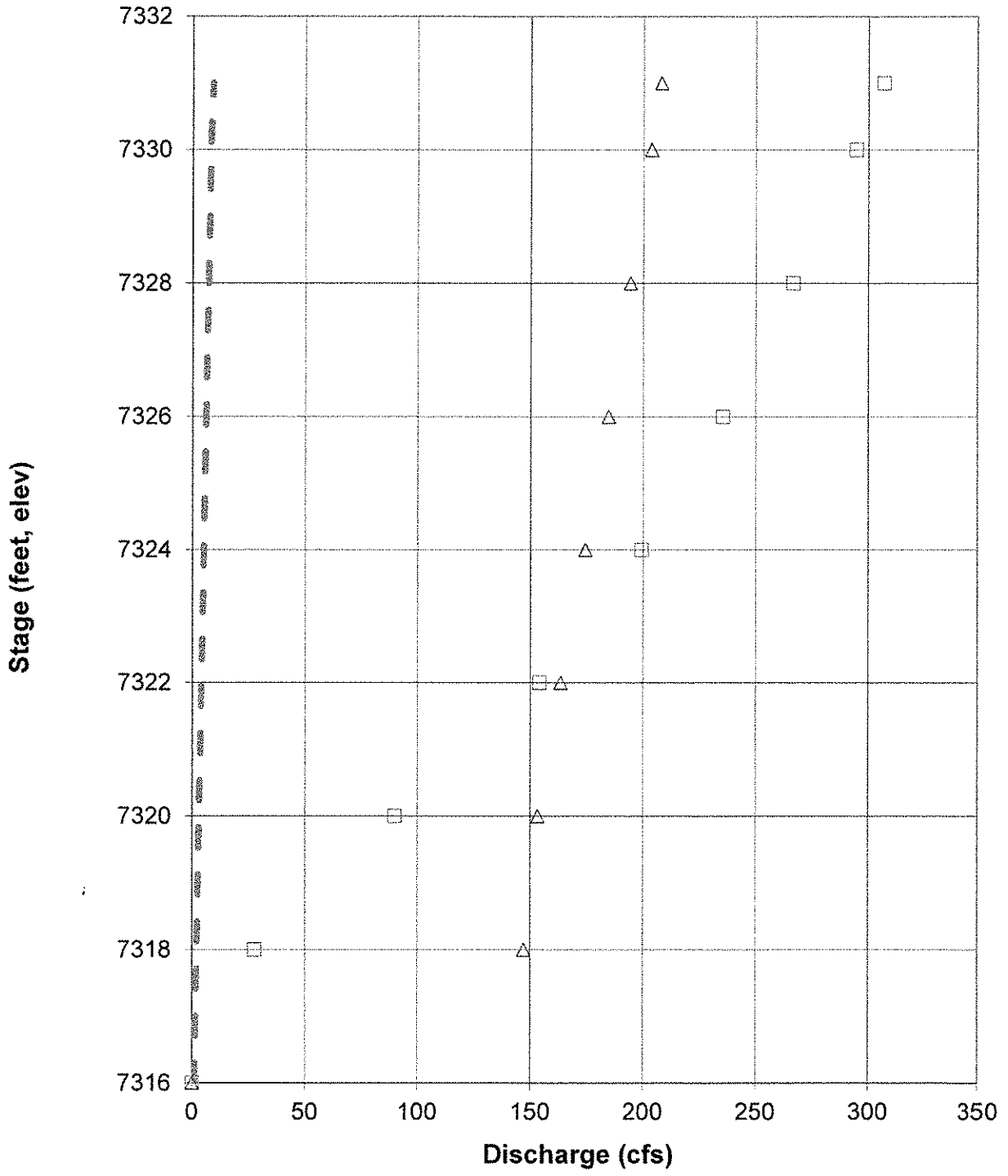
Calculations of Culvert Capacity (output):

Water Surface Elevation (ft., linked)	Tailwater Surface Elevation ft	Culvert Inlet-Control Flowrate cfs	Culvert Outlet-Control Flowrate cfs	Controlling Culvert Flowrate cfs (output)	Inlet Equation Used:	Flow Control Used
7316.00	7303.00	0.00	0.00	0.00	No Flow (WS < inlet)	N/A
7318.00	7303.50	27.60	147.13	27.60	Min. Energy Eqn.	INLET
7320.00	7304.00	90.00	153.26	90.00	Regression Eqn.	INLET
7322.00	7305.00	154.00	163.40	154.00	Regression Eqn.	INLET
7324.00	7305.50	199.30	174.24	174.24	Regression Eqn.	OUTLET
7326.00	7306.00	235.40	184.47	184.47	Regression Eqn.	OUTLET
7328.00	7306.50	266.70	194.25	194.25	Regression Eqn.	OUTLET
7330.00	7307.00	294.60	203.49	203.49	Orifice Eqn.	OUTLET
7331.00	7307.20	306.90	207.94	207.94	Orifice Eqn.	OUTLET
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Q₁₀₀ = 163 cfs
→
H_w/_D = 7 / 4.5 = 1.6
=

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STAGE-DISCHARGE CURVE FOR THE CULVERT



◆ Stage-Discharge □ Inlet Control △ Outlet Control

KIOWA ENGINEERING CORPORATION

JOB Cherry Creek Xstg Lot III
 SHEET NO. 1402B OF 1 of 2
 CALCULATED BY _____ DATE 9-13-17
 CHECKED BY _____ DATE FAW
 SCALE Hydraulics

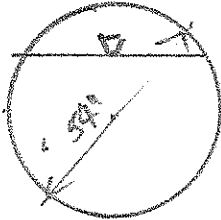
Outlet Velocity @ 54" RCP

$$Q_{100} = 163 \text{ cfs}$$

54" RCP free area = 15.9 a'

Flow full @ 3.2% = 340 cfs $V = 21.4 \text{ fps}$

Check @ 2/3 Full: Area = 10.3 a'



$$Q = \frac{1.49}{n} S^{1/2} A R^{2/3}$$

$$A = 10.3 \quad R \approx .90$$

$$Q = \frac{1.49}{.013} \sqrt{.032} (10.3)(.9)^{2/3}$$

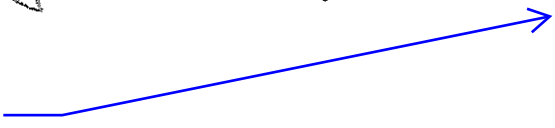
$Q = 198 \text{ cfs}$; check 1/2 full

$Q @ 1/2 \text{ full: } A = 7.7 \text{ a'} \quad R = \frac{7.7}{7.1} = 1.08$

$$Q = \frac{1.49}{.013} \sqrt{.032} (7.7)(1.08)^{2/3} = 166 \text{ cfs} \checkmark$$

$$\text{Velocity} = 166 / 7.7 = 21.6 \text{ fps}$$

Revise to provide a maximum velocity of 18 fps per ECM 3.3.1.J.8



Pipe Sizing

Slope outlet of 54 to 48" under Double Tree
 $S = .028' / f'$

$$\frac{V S^{.17}}{(S_s - 1)^{.66}} = \frac{21.6 (.028)^{.17}}{(2.6 - 1)^{.66}} = \frac{11.8}{1.32} = 8.6$$

Per Table 10-6 DCM
 Rock Size > V_H 24" D₅₀

probably super critical e outlet ∴ 10-6 does not apply:

With a supercritical condition at the outlet
 A stilling basin appears to be required.
 Provide calculations for the plunge pool design. See DCM Section 10.8.3.

Due to inlet control condition e outlet
 Double Tree, in 100-year flow would be still-d, ∴ 21 fps e outlet of 54" is not reasonable. Continuous layer of Type M should suffice e this location as velocity would be < 10 fps. warranty Type M.

How was this derived?

Size e 10 fps $\frac{V S^{.17}}{(S_s - 1)^{.66}} = 4.0 \therefore$ Type M

STA 32+75.24 RT
BEGIN DRAINAGE RUNDOWN
SECTION BB, SEE PG. 11
END @ STA 34+75, 85' RT

STA 33+41.03, END PAINTED
MEDIAN, RAD. 6' LT (R=2)

STA 33+80.99
CL-CL INTERSECTION
CHERRY CROSSING DRIVE

STA 34+21.04, BEGIN PAINTED
MEDIAN, 16' WIDE (0 RT)
STA 22+41.92,

BEGIN STA 35+33.03,
40.12' RT
INSTALL 5'1" x 9'w x 1'1"
RIP RAP PAD D50=6"
ON 6" THICK TYPE II
GRANULAR BEDDING
STA 35+50, 85' RT
BEGIN DRAINAGE RUNDOWN
SECTION BB, SEE PG. 11
END @ STA 37+50, 62' RT

EXIST. 54" CMP CULVERT
BEGIN STA 35+33.03, 40.12'
END STA 35+35.57, 50.92' L
EXTEND CULVERT BY ±80' NORTH
OF HODGEN & ±60' SOUTH OF
HODGEN, FIELD VERIFY EXTENSK
LENGTHS, USE CMP TO MATCH
EXISTING CULVERT
INSTALL 201 x 21
RIP RAP PAD D50=12"
PAD IS 10' W @ SOUTH END
INCREASING TO 20' W @ NORTH E
ON 6" THICK TYPE II
GRANULAR BEDDING

STA 36+26.81, BEGIN
180° TAPER INTO LEFT
AND RIGHT TURN LANES
(8' LFT & RT)

CROSSHATCHING LINES
YELLOW, 8" WIDE @
45' TO PROJECTED CL
& SPACED @ 10'

LANE LINE
WHITE, 4" WIDE
CENTER LINES
YELLOW, 4" WIDE (TYP.)

STA 38+06.81, END
TAPER (4' LT)
BEGIN LEFT TURN LANE
(8' RT)

CHANNELIZING LINES
WHITE, 8" WIDE

36" x 36"
RIGHT LANE MUST TURN
RIGHT SIGN (R3-7)

STA 35+50, 85' RT
BEGIN DRAINAGE RUNDOWN
SECTION BB, SEE PG. 11
END @ STA 37+50, 62' RT

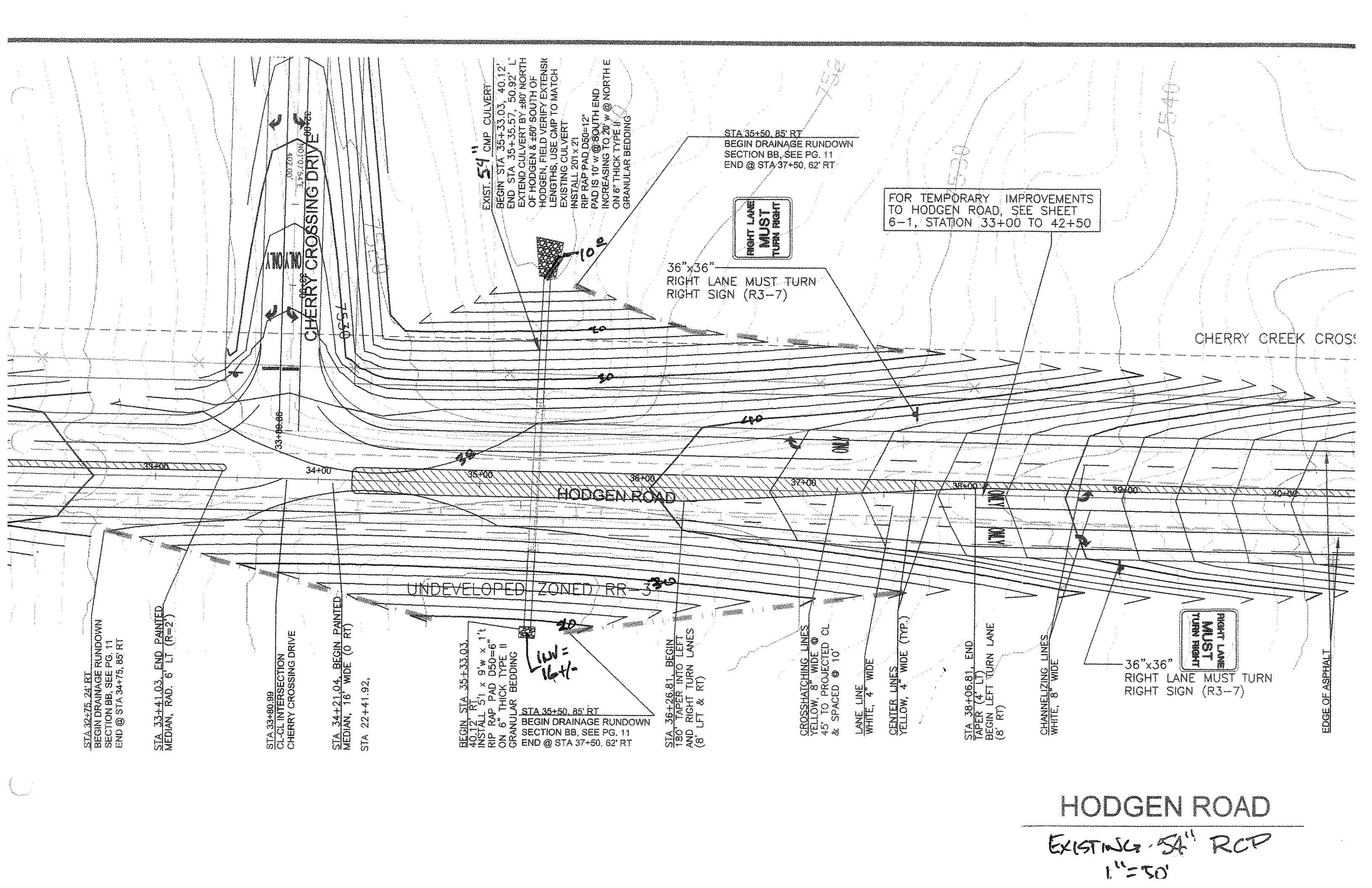
36" x 36"
RIGHT LANE MUST TURN
RIGHT SIGN (R3-7)

FOR TEMPORARY IMPROVEMENTS
TO HODGEN ROAD, SEE SHEET
6-1, STATION 33+00 TO 42+50

CHERRY CREEK CROSSING

HODGEN ROAD

EXISTING 54" RCP
1" = 50'



NORTH
1" = 1000'

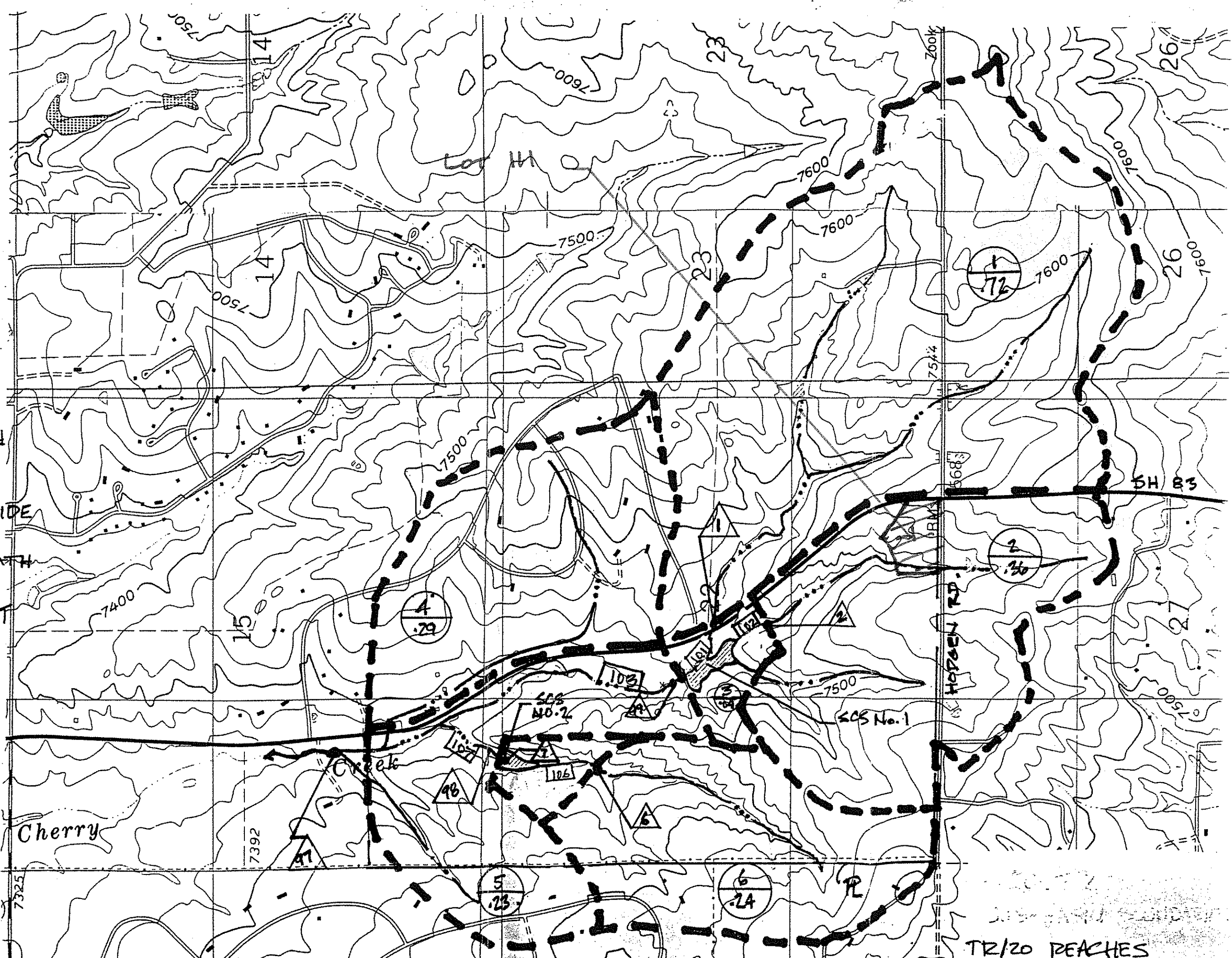
1
--- GUB-BASIN #
.72
--- AREA (SM)

--- BASIN DIVIDE

103
--- Tc FLOWPATH

7
--- DESIGN POINT

TR20 REACH
ELEMENT



TR/20 REACHES

Markup Summary

Callout (1)

$Q = \frac{1.48}{0.02} \sqrt{0.02} (77)(800)^{3/2} = 166416.6$
 $V_{velocity} = \frac{166416.6}{77} = 2161.9$

Revise to provide a maximum velocity of 18 fps per ECM 3.3.1.J.8

Subject: Callout
Page Label: 15
Lock: Unlocked
Author: dsdlaforce
Date: 10/9/2017 7:54:46 AM

Revise to provide a maximum velocity of 18 fps per ECM 3.3.1.J.8

Cloud+ (2)

critical outlet is 10-16 days
With a supercritical condition at the outlet, a stilling basin appears to be required. Provide calculations for the plunge pool design. See DCM Section 10.8.3.
100-year return period would be
for a outlet of 50 ft out minimum length of Type III
is the location as velocity would vary Type III
= 10 ft (Type III) = 4.0 : Type III

Subject: Cloud+
Page Label: 16
Lock: Unlocked
Author: dsdlaforce
Date: 10/9/2017 9:08:53 AM

With a supercritical condition at the outlet. A stilling basin appears to be required. Provide calculations for the plunge pool design. See DCM Section 10.8.3.

consideration continues
should surface at this
be < 10 fps. war
Sign @ 10 ft

How was this derived?

Subject: Cloud+
Page Label: 16
Lock: Unlocked
Author: dsdlaforce
Date: 10/9/2017 9:08:50 AM

How was this derived?

Text Box (1)

Provide the culvert analysis of the 48" RCP which includes the head water calculation.

1 inches
Projection

Subject: Text Box
Page Label: 13
Lock: Unlocked
Author: dsdlaforce
Date: 10/9/2017 9:54:30 AM

Provide the culvert analysis of the 48" RCP which includes the head water calculation.