

CITY OF ALBUQUERQUE

Planning Department
Brennon Williams, Director



Mayor Timothy M. Keller

May 19, 2021

Sara Lavy, PE
Parametrix
9600 San Mateo Blvd. NE
Albuquerque, NM, 87113

**RE: Atrisco Vista Blvd NW
Final Drainage Report
Engineer's Stamp Date: 05/11/21
Hydrology File: C06D001**

Dear Ms. Lavy:

Based upon the information provided in your submittal received 02/22/2021 and 05/19/2021 along with AMAFCA's approval email on 04/01/2021, the Drainage Report is approved for DRC Work Order.

If you have any questions, please contact me at 924-3995 or rbrissette@cabq.gov.

Sincerely,

Renée C. Brissette, P.E. CFM
Senior Engineer, Hydrology
Planning Department

PO Box 1293

Albuquerque

NM 87103

www.cabq.gov



City of Albuquerque

Planning Department
Development & Building Services Division

DRAINAGE AND TRANSPORTATION INFORMATION SHEET (REV 10/2018)

Project Title: Atrisco Vista Boulevard **Building Permit #:** _____ **Hydrology File #:** C06D001

DRB#: _____ **EPC#:** _____ **Work Order#:** 656192

Legal Description: _____

City Address: Atrisco Vista Blvd from Double Eagle Road to Paseo del Norte

Applicant: Parametrix **Contact:** Sara Lavy

Address: 9600 San Mateo Blvd, NE

Phone#: 505-998-5581 **Fax#:** _____ **E-mail:** slavy@parametrix.com

Other Contact: Bernalillo County Public Works **Contact:** Leila Momenzadeh

Address: 2400 Broadway Blvd, SE

Phone#: 505-224-2124 **Fax#:** _____ **E-mail:** lmomenzadeh@bernco.gov

TYPE OF DEVELOPMENT: _____ PLAT (# of lots) _____ RESIDENCE _____ DRB SITE _____ ADMIN SITE

IS THIS A RESUBMITTAL? ☒ Yes _____ No

DEPARTMENT: _____ TRAFFIC/TRANSPORTATION ☒ HYDROLOGY/DRAINAGE

Check all that Apply:

TYPE OF SUBMITTAL:

- ☐ ENGINEER/ARCHITECT CERTIFICATION
- ☐ PAD CERTIFICATION
- ☐ CONCEPTUAL G & D PLAN
- ☐ GRADING PLAN
- ☐ DRAINAGE MASTER PLAN
- ☒ DRAINAGE REPORT
- ☐ FLOODPLAIN DEVELOPMENT PERMIT APPLIC
- ☐ ELEVATION CERTIFICATE
- ☐ CLOMR/LOMR
- ☐ TRAFFIC CIRCULATION LAYOUT (TCL)
- ☐ TRAFFIC IMPACT STUDY (TIS)
- ☐ OTHER (SPECIFY) _____
- ☐ PRE-DESIGN MEETING?

TYPE OF APPROVAL/ACCEPTANCE SOUGHT:

- ☐ BUILDING PERMIT APPROVAL
- ☐ CERTIFICATE OF OCCUPANCY
- ☐ PRELIMINARY PLAT APPROVAL
- ☐ SITE PLAN FOR SUB'D APPROVAL
- ☐ SITE PLAN FOR BLDG. PERMIT APPROVAL
- ☐ FINAL PLAT APPROVAL
- ☐ SIA/ RELEASE OF FINANCIAL GUARANTEE
- ☐ FOUNDATION PERMIT APPROVAL
- ☐ GRADING PERMIT APPROVAL
- ☐ SO-19 APPROVAL
- ☐ PAVING PERMIT APPROVAL
- ☐ GRADING/ PAD CERTIFICATION
- ☒ WORK ORDER APPROVAL
- ☐ CLOMR/LOMR
- ☐ FLOODPLAIN DEVELOPMENT PERMIT
- ☐ OTHER (SPECIFY) _____

DATE SUBMITTED: 2-17-2021 **By:** Sara Lavy, PE

COA STAFF:

ELECTRONIC SUBMITTAL RECEIVED: _____

FEE PAID: _____

Brissette, Renee C.

From: Nicole Friedt <nfriedt@amafca.org>
Sent: Thursday, April 1, 2021 8:07 AM
To: Sara Lavy
Cc: Brissette, Renee C.; Leila Momenzadeh; Brad Bingham; Nancie Adams
Subject: RE: Atrisco Vista Drainage Report - AMAFCA Comments

Follow Up Flag: Follow up
Flag Status: Completed

External

Good morning Sara,
Sounds good. I have no further comments.

Thanks,
Nicole

Nicole M. Friedt, P.E., CFM
Development Review Engineer
Main: (505) 884-2215
Cell: (505) 362-1272

From: Sara Lavy <SLavy@parametrix.com>
Sent: Tuesday, March 30, 2021 1:57 PM
To: Nicole Friedt <nfriedt@amafca.org>
Cc: Brissette, Renee C. <rbrissette@cabq.gov>; Leila Momenzadeh <lmomenzadeh@bernco.gov>; Brad Bingham <bbingham@amafca.org>; Nancie Adams <NAdams@parametrix.com>
Subject: RE: Atrisco Vista Drainage Report - AMAFCA Comments

Hi Nicole,

Here are answers to your questions:

1. I agree that DS-7 would benefit from moving further up station to align with the existing contours. This will be shown on the next plan submittal and I've attached a draft version of Sheet 3-5 showing the new location.
2. I calculated 48 feet, but there is 17' of concrete for the apron of the CBC so I subtracted that out to get 31 feet. There is 30 feet from the end of the apron to the edge of the ROW. The plans will be updated for the next submittal with the new erosion control pad lengths.
3. The water quality pond has been moved off the hill crest to the location of DS-8. I've attached draft versions of Sheets 3-6 and 8-3 showing the new pond location. The pond will capture offsite flows before they enter DS-8.

Please contact me if you have any comments or questions.

Thanks,

Parametrix

ENGINEERING . PLANNING . ENVIRONMENTAL SCIENCES

Sara Lavy, PE

505.821.4700 | desk
505.998.5581 | direct
505.710.4925 | cell



From: Nicole Friedt <nfriedt@amafca.org>
Sent: Tuesday, March 16, 2021 2:32 PM
To: Sara Lavy <SLavy@parametrix.com>
Cc: Brissette, Renee C. <rbrissette@cabq.gov>; Leila Momenzadeh <lmomenzadeh@bernco.gov>; Brad Bingham <bbingham@amafca.org>
Subject: RE: Atrisco Vista Drainage Report - AMAFCA Comments

Hey Sara –

A few quick questions/comments:

- Since the existing structure at DS-7 is being removed, is the proposed aligned in the right spot? Contours look like it should be further up station by 50 ft.
- For structure DS-11, why are you using 31 ft of riprap if you calculated that the need is 48 ft of riprap? The plans don't appear to reflect either dimension
- Why is the water quality pond on the top of the hill with the roadway sloped away from it? Is it even going to be able to collect the water that it is 'computed' to collect?

Thanks,
Nicole

Nicole M. Friedt, P.E., CFM
Development Review Engineer
Main: (505) 884-2215
Cell: (505) 362-1272

From: Brissette, Renee C. <rbrissette@cabq.gov>
Sent: Wednesday, March 3, 2021 2:10 PM
To: Nicole Friedt <nfriedt@amafca.org>
Subject: FW: Atrisco Vista Drainage Report
Importance: High

Nicole,

Have you reviewed this final DR? They answered my questions and all that I need is an email from you stating that you have no objection to the report and I can issue them an approval letter for work order. Please just let me know. Thanks.



RENÉE CHRISTINA BRISSETTE, PE CFM

senior engineer, hydrology

o 505.924.3995

e rbrissette@cabq.gov

cabq.gov/planning

Atrisco Vista Boulevard Drainage Report

Prepared for

Bernalillo County Public Works Division



City of Albuquerque
Planning Department
Development Review Services
HYDROLOGY SECTION

APPROVED

DATE: 05/19/21
BY: Renee C. Brissette
HydroTrans # C06D001

THE APPROVAL OF THESE PLANS/REPORT SHALL NOT BE
CONSTRUED TO PERMIT VIOLATIONS OF ANY CITY
ORDINANCE OR STATE LAW, AND SHALL NOT PREVENT
THE CITY OF ALBUQUERQUE FROM REQUIRING
CORRECTION, OR ERROR OR DIMENSIONS IN PLANS,
SPECIFICATIONS, OR CONSTRUCTIONS, SUCH APPROVED PLANS
SHALL NOT BE CHANGED, MODIFIED OR ALTERED WITHOUT
AUTHORIZATION.

Prepared by

Parametrix

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February 2021

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APPENDICES

Appendix D1 – FIRM Maps

Appendix D2 – Hydrology - Developed Condition Flows

Appendix D3 – Hydraulic Calculations

Appendix D4 – Atrisco Vista Draft Preliminary Report Excerpts

1. INTRODUCTION

Atrisco Vista Boulevard is a principal arterial located in the northwest quadrant of the Albuquerque urban area. It provides direct access to several regional facilities including an employment center just north of I-40, a regional general aviation airport, several large tracts of lands master planned for development, and several recreational destinations.

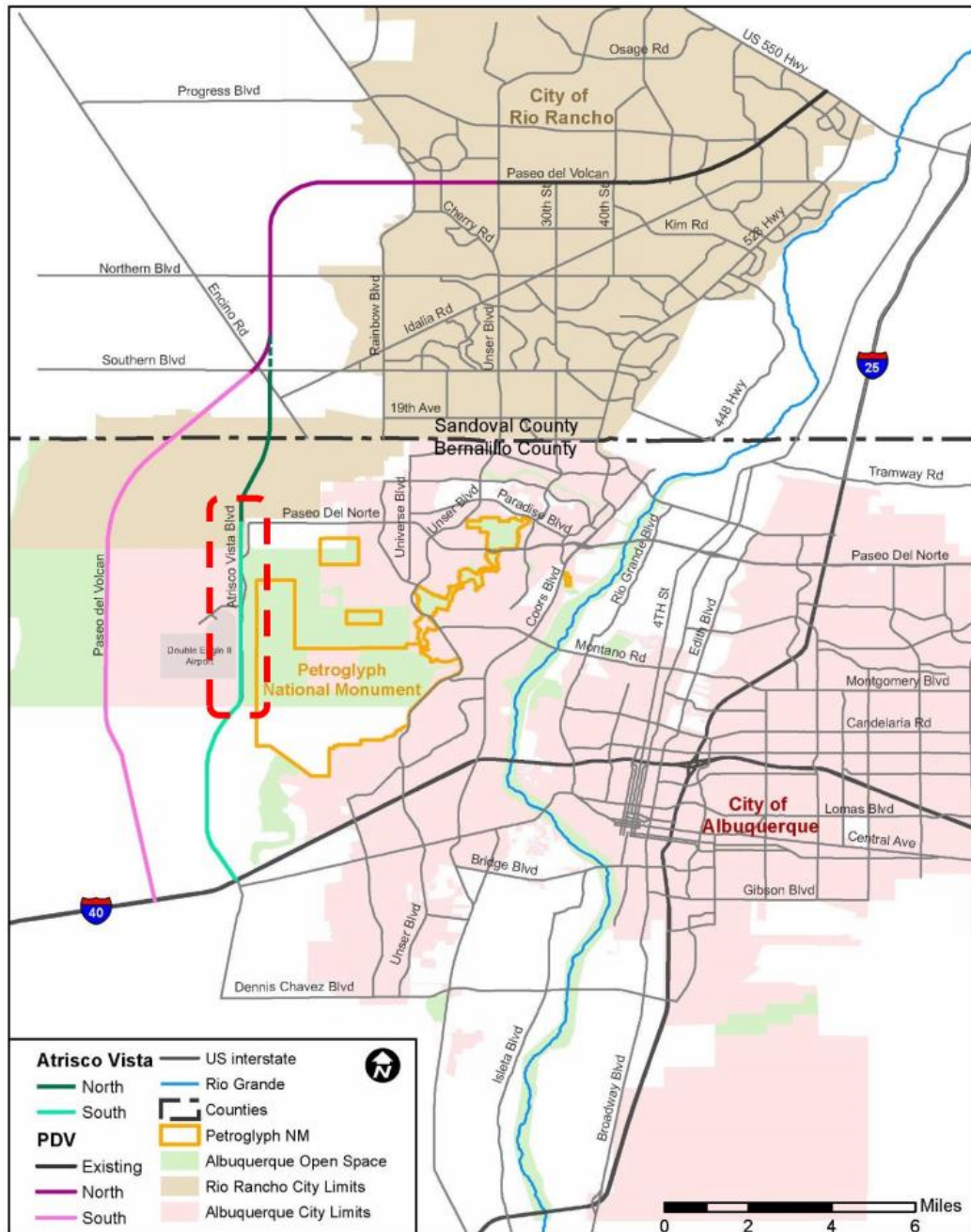
Parametrix worked with Bernalillo County to identify and evaluate route alignment alternatives to improve the existing roadway from Double Eagle Road to Paseo del Norte Boulevard. Based on the previous evaluation, Alternative 2 is being advanced as the recommended alternative for implementation. Alternative 2 generally follows the existing Atrisco Vista alignment from Double Eagle Road north to Paseo del Norte Boulevard. The current project also includes about 700 feet of reconstruction of Paseo Del Norte Boulevard east of Atrisco Vista. The total route length is approximately 2.3 miles. The Project Location Map is shown in **Figure 1-1**.

The purpose of this Drainage Report is to recommend improvements consistent with the goals of minimizing flooding, conveying stormwater runoff safely, and maintaining the proposed facilities. This report summarizes previous drainage master plans for the area. Based on those plans, the report provides recommendations for drainage improvements.

1.1 Jurisdiction

Existing watersheds within the project area are within the jurisdictions of the City of Albuquerque and Bernalillo County. The Albuquerque Metropolitan Arroyo Flood Control Authority (AMAFCA) has jurisdiction over portions of the drainageways within Bernalillo County. AMAFCA will work cooperatively with the agencies within their jurisdiction: Bernalillo County and the City of Albuquerque. These three agencies will be responsible for regulating, approving, and maintaining the drainage infrastructure within the project area.

Figure 1-1. Project Location



1.2 Existing Drainage Plans and Reports

Existing drainage plans and reports reviewed for the project are listed below:

- Double Eagle II Municipal Airport Storm Drainage Masterplan (May 2010) – This report by Molzen-Corbin & Associates summarizes the hydrologic and hydraulic studies and drainage recommendations for the Double Eagle II Airport.
- Paradise West Master Plan (June 2004) – This plan, prepared by Consensus Planning and D. Mark Goodwin & Associates, describes the development scenario and proposed peak flow rates for the Middle and West Branches of the Calabacillas Arroyo through the subdivision. It also discusses treatment of arroyos for developed conditions.
- Drainage Management Plan Update for Boca Negra Arroyo, Draft (August 2018) – This plan (referred to in this report as the Boca Negra DMP) by Bohannon Huston, Inc analyzes the Boca Negra Arroyo, which crosses Atrisco Vista Boulevard south of Paseo del Norte. The report analyzes developed conditions and proposed detention basins, including the Double Eagle II pond, located directly east of Atrisco Vista Boulevard.
- Calabacillas West Branch Arroyo Drainage and Storm Water Quality Management Plan, Final (August 2018) – This plan, prepared by BHI and Tetra Tech, (referred to in this report as the Calabacillas West Branch DMP) analyzes developed condition scenarios for the Calabacillas West Branch Arroyo. It identifies two scenarios that maintain flows at or below the capacity of the existing crossing and grade control structures along the Arroyo. One scenario, DCIM #3, proposes construction of the Quail Ranch Pond west of the Atrisco Vista corridor and the Paradise West Pond east of the corridor. Another scenario, DCIM #4, proposes many smaller ponds throughout the watershed. Based on discussions with AMAFCA, this scenario is unlikely, and DCIM #3 should be used.

Pertinent excerpts from these reports are included in **Appendix D4**.

1.3 Watershed Characteristics

The western boundary of the watershed follows the Rio Puerco escarpment west of the study area. The terrain slopes east toward the Rio Grande at slopes between 1 and 3 percent. Grades steepen and become hilly west of the proposed corridor, with slopes approaching 10 percent.

Soils in the study area consist of alluvium, eolian, and colluvium deposits comprised of sand, silt, clay, and gravel. These soils generally have moderate to high infiltration rates. Areas of loamy soil and shallow bedrock exist in the southeastern corner of the study area.

The watershed is generally undeveloped, except for the Double Eagle II Airport. Vegetation consists of a mix of shrubs and native grasses. The only major arroyo crossing this portion of the Atrisco Vista corridor is the North Fork Boca Negra.

1.4 FIRM Maps

The site is located on FIRM Maps 35001C0085H and 35001C0095H. The maps show the Atrisco Vista Boulevard corridor crosses two mapped flood plains created by a tributary and the main channel of the North Fork Boca Negra Arroyo. The northern floodplain is classified as Zone AO, flood elevations determined to be 2 feet and the southern tributary floodplain as Zone A, no base flood determined. The area outside the floodplains is shown as Zone X, “other areas,” which are outside the 100 and 500-year

floodplains. These floodplains will not be affected by this project. Flows will be allowed to pass under the new roadway similar to the current drainage patterns. See **Appendix D1**.

1.5 Existing Structures

Existing small-diameter culverts cross under Atrisco Vista Boulevard from Double Eagle Road north to Paseo del Norte Boulevard. Culverts range in size from 24" to 42" diameter, with concrete blankets or end sections.

The North Fork Boca Negra arroyo crosses under Atrisco Vista through an approximately 20' span by 6' rise structure. No as-built information is available for this structure. The structure is referred to as a concrete box culvert in the Boca Negra DMP; however, the invert appears to be lined with loose boulders, and no concrete bottom is visible, so it is referred to as a bridge for the purposes of this report.



Atrisco Vista Boulevard Crossing at the North Fork Boca Negra Arroyo

2. PROPOSED CONDITIONS

2.1 Roadway Improvements

The proposed roadway typical section has a 2-lane roadway, 10-foot multi-purpose pedestrian and bicycle facility, and 186-foot right-of-way width (**Figure 2-1**). The right-of-way width is proposed to accommodate additional lanes in the future, if needed.

2.1.1 Atrisco Vista Boulevard

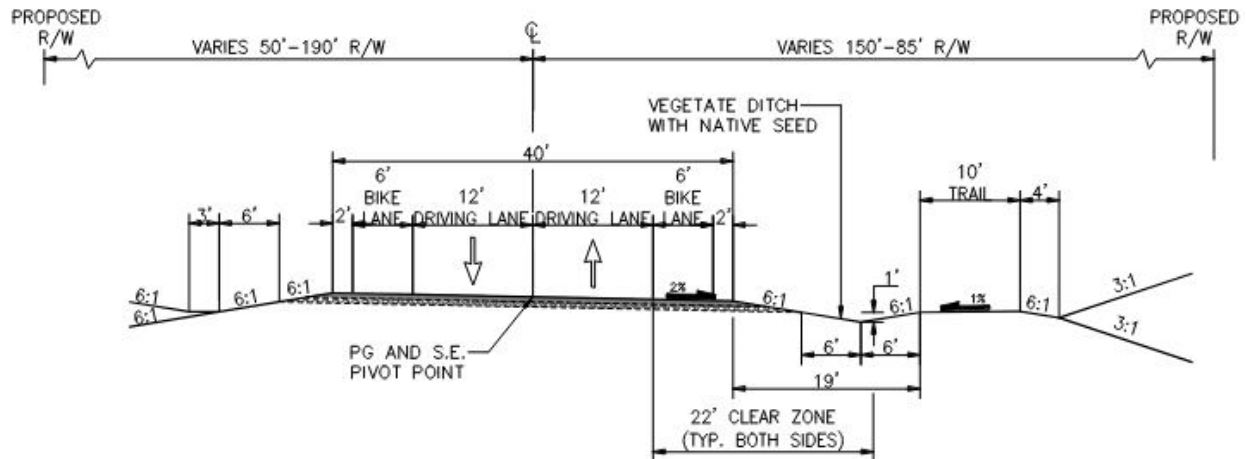


Figure 2-1. Proposed Atrisco Vista Typical Section

2.2 Drainage Criteria

Hydrologic criteria for off-site flows were previously defined by the appropriate drainage master plans. Hydraulic criteria for rural highway design from local agencies are limited, so the NMDOT Drainage Design Manual (July 2018) design criteria were adapted for this report. The criteria address bridges, crossing culverts, and roadside ditches. In the event of discrepancies between NMDOT and local agency criteria, the local criteria will govern.

The following criteria were used:

- Design storm: 100-year
- Culverts
 - Limit headwater spread to half of a driving lane
 - Headwater to depth ratio (HW/D) < 1.5 for new culverts
 - Maintain existing flow depth at the upstream property line
 - For box culverts, provide 6' to 7' minimum vertical clearance for maintenance where practical
- Roadside Ditches:
 - Limit spread to half of driving lane
 - Limit flow to inside/low edge of trail during 10-year storm

2.3 Peak Flows

Peak drainage flows for the 100-year storm were calculated using the appropriate drainage management plans for the area and the City of Albuquerque DPM, (see **Appendix D2**). Note that the hydrologic methods used for these plans may be different from the current methodology and the results were incorporated as discussed below.

In general, the developed condition flows were used for structure sizing, as calculated in the various drainage management plans for the area.

Developed condition flows assume one existing City of Albuquerque detention pond and one AMAFCA regional detention facility west of Atrisco Vista: the Double Eagle II Airport Detention Pond "A," (located in Basin 2) and the Quail Ranch Pond on the Boca Negra Arroyo. The undeveloped flow for Basin 11 (see Figure 2-2 on Page 10 for Basin Map) was used to analyze the proposed CBC structure as it is larger than the developed flow due to the proposed Quail Ranch Pond that will be constructed in the future. Also, a second Double Eagle II Pond is proposed to be on the east side of Atrisco Vista Boulevard northeast of the airport and will not be affected by the proposed roadway improvements.

The developed upland basin flows were calculated using the flows from the various DMP's or the City of Albuquerque's Weighted E method for smaller basins (less than 40 acres). Larger basins from the Boca Negra DMP and Calabacillas West DMP basins were adjusted and/or subdivided based on 2' contour data from the Middle Rio Grande Council of Governments (2010). With the modified boundaries, the master plan basin flows were prorated based on the new sub-basin areas to calculate preliminary design flows or recalculated using Weighted E due to small sizes.

Table 1. Drainage Basin Summary

Basins	Area (acre)	Area (sq. mile)	Hydrology Method	Developed 100-year Storm (cfs)	Developed 10-year Storm (cfs)
1	294	0.459	Q from Double Eagle II DMP	84.40	N/A
2	890	1.391	Q from Double Eagle II DMP	340.00	N/A
3	21.8	0.034	Weighted E	47.88	9.58
5	341.46	0.534	Q from Boca Negra DMP	83.03	36.92
6	16.25	0.025	Weighted E	43.12	24.08
7	894.42	1.398	Q from Boca Negra DMP	200.09	81.65
8	4.80	0.008	Weighted E	12.75	7.12
9	63.49	0.099	Q from Boca Negra DMP	23.83	9.86
10	136.33	0.213	Q from Boca Negra DMP	51.17	21.17
11	3855	6.023	Q from Boca Negra DMP	327.00	239.00
12	12.65	0.020	Calabacillas W. Branch DMP	33.11	18.66
13	15.87	0.025	Calabacillas W. Branch DMP	41.54	23.41
14	40.64	0.063	Calabacillas W. Branch DMP	106.35	59.93

2.3.1 Weighted E

Basins 3, 6, and 8 were calculated using the Weighted E method. These basins are all smaller than 40 acres. Basin 3 was formerly part of the Double Eagle II DMP. Basins 6 and 8 are part of the Boca Negra DMP. These basins are part of the larger Basin 33 from the Boca Negra report. They are calculated with Weighted E rather than prorating the flows due to their small size. Prorating the flows did not account for the smaller time of concentration these basins have compared to the larger basin they were

originally part of. Therefore, Weighted E was used to calculate the flows to get a more accurate developed flow rate.

2.4 Crossing Structures

Crossing structures were sized using the 100-year peak flows. Pipe culverts were assumed for the smaller basins. Box culverts were sized for the Boca Negra arroyo. Erosion protection at the culvert ends will consist of the riprap erosion control pads. The pads will be constructed using wire tied riprap and will be a minimum of 10' in length. DS-1, DS-2, DS-10, DS-11, and DS-14 require pad lengths longer than 10 feet due to higher flows and velocities at those locations. Erosion control calculations are located in Appendix D3.

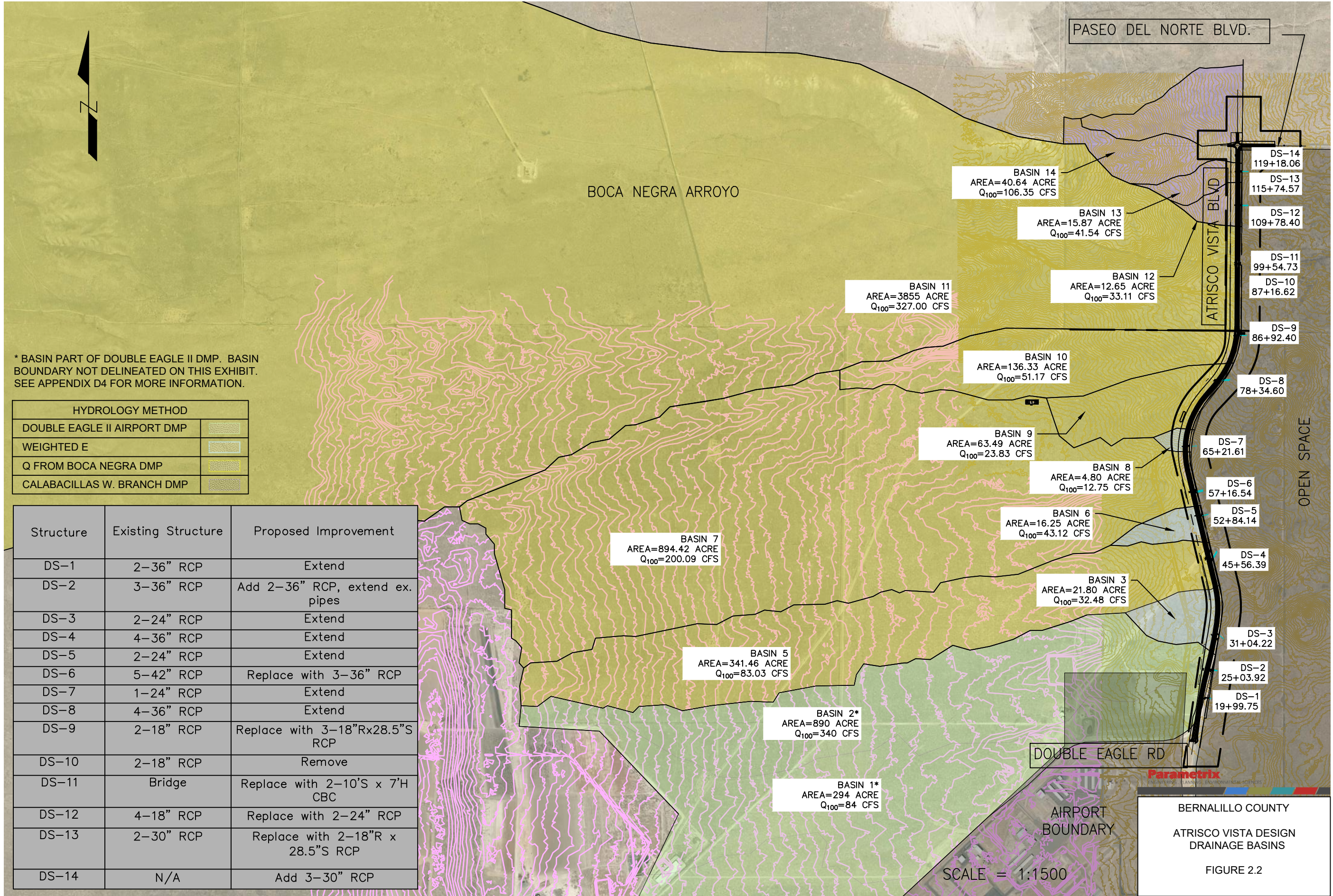
The roadway has been designed to maintain existing drainage patterns to the extent practicable. In general, flow changes due to the proposed roadway improvements will be minor relative to the size of the overall watershed. Also, drainage ditches and structures are designed to help minimize erosion and sedimentation. Storm water quality is discussed in Section 2.6.

The proposed crossing structure at the Boca Negra Arroyo is a two-barrel, 10' span by 7' rise concrete box culvert with wingwalls. This will match the opening of the existing bridge upstream. The 100-year design flow is 595 cfs, and the proposed headwater depth is approximately 5 feet. The existing bridge and roadway will be removed after construction of the new roadway and CBC structure is complete.

Crossing structure recommendations are shown in **Figure 2-3** and **Table 2**.

Table 2. Culvert Summary

Structure	Station	Basins	Existing Culvert Size	Existing Culvert Capacity Y/N	Proposed Improvement
DS-1	19+99.75	1	2-36" RCP	Yes	Extend
DS-2	25+03.92	2	3-36" RCP	No	Add 2-36", extend ex. pipes
DS-3	31+04.22	3	2-24" RCP	Yes	Extend
DS-4	45+56.39	5	4-36" RCP	Yes	Extend
DS-5	52+84.14	6	2-24" RCP	No	Extend
DS-6	57+16.54	7	5-42" RCP	Yes	Replace with 3-36" pipes
DS-7	65+21.61	8	1-24" RCP	Yes	Extend
DS-8	78+34.60	9	4-36" RCP	Yes	Extend
DS-9	86+92.40	10	2-18" RCP	No	Replace with 3-18"R x 26.5"S RCP
DS-10	87+16.62	10	2-18" RCP (under turnout rt.)	No	Remove
DS-11	100+00.00	11	Bridge	Yes	Replace with 2-10'S x 7'H CBC
DS-12	109+78.40	12	4-18" RCP	No	Replace with 2-24"
DS-13	115+74.58	13	2-30" RCP	No	Replace with 2-18"R x 26.5S RCP
DS-14	119+00	14	N/A	Yes	Construct 3-30" pipes



2.5 Roadside Ditches and Drop Inlets

A drainage ditch will be located between the roadway and the trail. The purpose of the ditch will be to collect flows from the new pavement and carry them to the nearest existing drainage channel. The ditch will be designed so the 10-year storm flows do not exceed the inside/low edge of the multi-use path. The 100-year flows may flood the path but will be confined to the right-of-way. The roadway ditch has 6:1 slopes, is one foot deep, and is unlined.

The drainage ditch on the east side of the roadway will be located between the roadway and the proposed trail. This will necessitate drop inlets to be placed within the ditch at the locations of culvert crossings to convey flows from the roadside ditch into the new culverts. All inlets are assumed to be Type D inlets using the COA standard drawings. Also, inlets in sag were analyzed with a 50% clogging factor. Drop inlet and ditch calculations are included in Appendix D3 along with an exhibit showing the roadway basins. Roadway basins were analyzed using the Rational Method.

Table 3. Drop Inlet Summary

Station	Analysis Point	100-year Ditch Flow (cfs)	Ditch Flow Depth (ft)	Drop Inlet Depth (Inlets in Sag) (ft)	Bypass (Inlets on Grade) (cfs)	Max. Allowable Depth (ft)	Capacity
31+43.12	AP-1	15.69	1.07	0.98		1.1	Yes
45+50.44	AP-2	6.79	0.84	0.57		1.1	Yes
56+69.37	AP-3	11.96	0.96	0.82		1.1	Yes
78+50	AP-4	7.53	0.62		3.1	1.1	Yes
87+15	AP-5	10.08	0.74		4.85	1.1	Yes
100+26.50	AP-6	16.23	0.88	1.02		1.1	Yes
111+50	AP-7	1.76	0.50	0.23		1.1	Yes
111+50	AP-8	10.85	0.98	0.77		1.1	Yes
119+18.06	AP-9	2.85	0.56	0.28		1.1	Yes

2.6 Stormwater Quality

Atrisco Vista Boulevard is within the EPA Middle Rio Grande Watershed Municipal Separate Storm Sewer System (MS4) Permit area. This permit is intended to help protect water resources, and it is a cooperative effort between the agencies in the watershed responsible for storm water management. In general, the MS4 Permit requires on-site retention of the runoff from a small, relatively frequent storm. In statistical terms, this is the 80th percentile rainfall event (for re-development), which produces approximately 0.48 inches of precipitation in the study area. Note this is the requirement for the permanent facility. Other EPA requirements are in place to help protect water quality during construction.

The proposed Atrisco Vista roadway has approximately 700,710 SF of impervious area. The old roadway had approximately 342,000 SF of impervious area. This is a difference of 358,710 of increased impervious area. Per the MS4 permit, the project is required to treat runoff resulting from 0.48 inches

of rainfall on this increased impervious area. This results in approximately 14,348 cubic feet or 0.33 acre-ft. A small pond will be graded at approximately station 77+00 and will overflow to DS-8.

3. SUMMARY

Improvements to Atrisco Vista Boulevard are proposed to extend from Double Eagle Road in Albuquerque to Paseo del Norte Boulevard. It is a principal arterial roadway with a length of 2.3 miles.

This Drainage Report recommends improvements consistent with the goals of minimizing flooding, conveying stormwater runoff safely, and maintaining the proposed facilities. The Double Eagle II Airport DMP, Boca Negra DMP Update, and Calabacillas West Branch DMP were sources for drainage information and flow rates used for this report. Recommendations for drainage improvements are as follows:

- Upgrade or extend existing culverts as described in Section 2.4
- Provide drainage ditch located between the roadway and trail to convey roadway flows to outfall locations.
- Provide Type D drop inlets as described in Section 2.5 to convey flows from the proposed drainage ditch to the new culverts.
- Remove existing bridge structure at Station 99+73 and replace with two 10'S x 7'H concrete box culverts.
- Provide MS4 pond with a minimum volume of 14,348 cubic feet or 0.33 acre-ft.

Appendix D1

FIRM Maps

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The community map repository should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **Floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Floodway Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only to landward of 0.0' North American Vertical Datum of 1988 (NAVD 88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Floodway Elevations table in the Flood Insurance Study Report for this jurisdiction. Elevations shown in the Summary of Floodway Elevations table should be used for construction, and/or floodplain management purposes when they are higher than the elevations shown on the FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for the jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures in this jurisdiction.

The projection used in the preparation of this map was New Mexico State Plane, Central Zone (NAD 83). The horizontal datum was NAD 83. Users of this FIRM should be aware that, in addition, projection or State Plane zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same vertical datum. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at <http://www.ngs.noaa.gov> or contact the National Geodetic Survey at the following address:

NGS Information Services
NGAA, NNGS12
National Geodetic Survey, SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 715-3242

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at (301) 715-3242, or visit their website at <http://www.ngs.noaa.gov/>

Base map information shown on this FIRM was provided in digital format by City of Albuquerque, 2010; Bernalillo County, 2004, and 2010; Bureau of Land Management, 2003; National Geodetic Survey, 2003; and United States Geological Survey (USGS), 1999. Additional information was photogrammetrically compiled at a scale of 1:12,000 from U.S. Department of Agriculture aerial photography dated 2009.

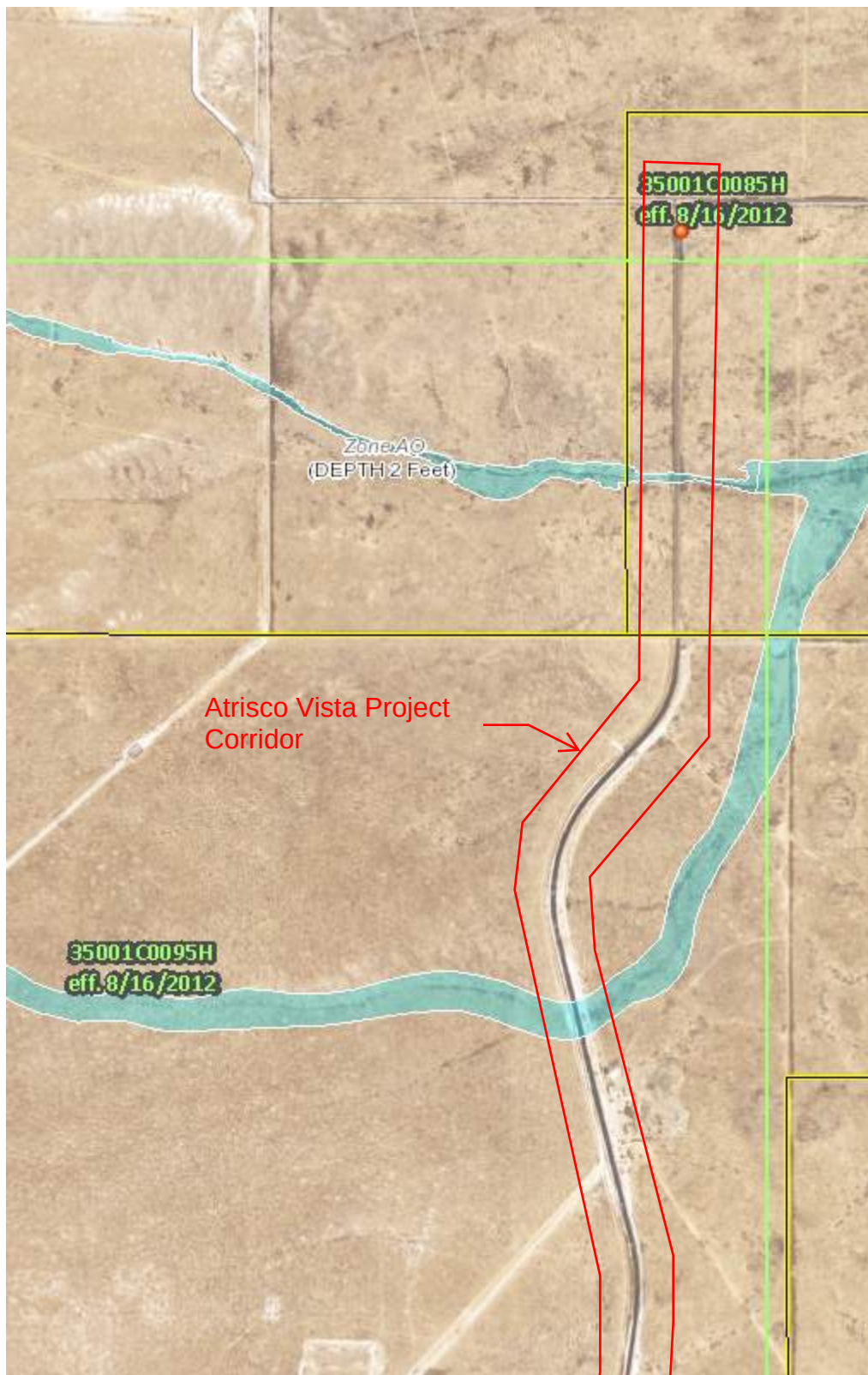
This map reflects more detailed and up-to-date stream channel configurations than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables in the Flood Insurance Study report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on this map.

Corporate limits shown on the map are based on the best data available at the time of publication. Boundary changes due to annexations or dis-annexations may have occurred after this map was published; map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels, community map repository addresses, and a listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

For information on available products associated with this FIRM visit the **Map Service Center (MSC)** website at <http://msc.fema.gov>. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the MSC website.

If you have questions about this map, how to order products or the National Flood Insurance Program in general, please call the **FEMA Map Information exchange (FMIX)** at 1-877-FEMA-MAP (1-877-336-2627) or visit the FEMA website at <http://www.fema.gov/business/fmip>.



Appendix D2

Hydrology - Developed Condition Flows

Basin Summary

Basin	Area (sf)	Area (acres)	Area (Sq. Miles)	Hydrology Method	Ex. 100-year Q (cfs)	Dev. 100-year Q (cfs)	Dev. 10-year Q (cfs)
1	12,806,640	294.00	0.459	Q from Double Eagle II Airport DMP		84.40	N/A
2	38,768,400	890.00	1.391	Q from Double Eagle II Airport DMP		340.00	N/A
3	949,566	21.80	0.034	Weighted E		32.48	6.58
4	Not Used						
5	14,873,994	341.46	0.534	Q from Boca Negra DMP		83.03	36.92
6	707,729	16.25	0.025	Weighted E		43.12	24.08
7	38,960,798	894.42	1.398	Q from Boca Negra DMP		200.09	81.65
8	209,230	4.80	0.008	Weighted E		12.75	7.12
9	2,765,437	63.49	0.099	Q from Boca Negra DMP		23.83	9.86
10	5,938,454	136.33	0.213	Q from Boca Negra DMP		51.17	21.17
11	167,923,800	3855.00	6.023	Q from Boca Negra DMP	595	327.00	239.00
12	551,112.54	12.65	0.020	Calabacillas W. Branch DMP		33.11	18.66
13	691,368.72	15.87	0.025	Calabacillas W. Branch DMP		41.54	23.41
14	1,770,159	40.64	0.063	Calabacillas W. Branch DMP		106.35	59.93

Weighted E Method

Basin	Area (sf)	Area (acres)	Treatment A		Treatment B		Treatment C		Treatment D		100-Year			10-Year		
			%	(acres)	%	(acres)	%	(acres)	%	(acres)	Weighted E (ac-ft)	Volume (ac-ft)	Flow cfs	Weighted E (ac-ft)	Volume (ac-ft)	Flow cfs
3	949,566	21.80	95.0%	20.709	0%	0.00	0%	0.00	5.0%	0.14	0.537	0.976	32.48	0.114	0.207	6.58
6	707,729	16.25	0.0%	0.000	20%	3.25	20%	3.25	40.0%	6.50	1.232	1.668	43.12	0.710	0.961	24.08
8	209,230	4.80	0.0%	0.000	20%	0.96	20%	0.96	40.0%	1.92	1.232	0.493	12.75	0.710	0.284	7.12

Equations:

Weighted E = $E_a \cdot A_a + E_b \cdot A_b + E_c \cdot A_c + E_d \cdot A_d$ / (Total Area)

Volume = Weighted D * Total Area

Flow = $Q_a \cdot A_a + Q_b \cdot A_b + Q_c \cdot A_c + Q_d \cdot A_d$

Excess Precipitation, E (inches)		
Zone 1	100-Year	10 - Year
E _a	0.55	0.11
E _b	0.73	0.26
E _c	0.95	0.43
E _d	2.24	1.43

Peak Discharge (cfs/acre)		
Zone 1	100-Year	10 - Year
Q _a	1.54	0.3
Q _b	2.16	0.81
Q _c	2.87	1.46
Q _d	4.12	2.57

Prorated Basin Calculations

Boca Negra Basin	Atrisco Vista Basin	Area (SF)	Area (Acre)	% of Prorated Basin	10- Year Flow (cfs)	100- Year Flow (cfs)
Boca Negra DMP Basins						
33A, B		39,877,756.46	915.47		83.57	204.8
	6	707,728.67	16.25	1.77%	1.48	3.63
	7	38,960,797.91	894.42	97.70%	81.65	200.09
	8	209,229.88	4.80	0.52%	0.44	1.07
36		8,703,890.84	199.81		31.03	75
	9	2,765,437.16	63.49	31.77%	9.86	23.83
	10	5,938,453.68	136.33	68.23%	21.17	51.17
Calabacillas West Branch Drainage Management Plan						
PW1		3,012,640.71	69.16		102	181
	12	551,112.54	12.65	18.29%	18.66	33.11
	13	691,368.72	15.87	22.95%	23.41	41.54
	14	1,770,159.45	40.64	58.76%	59.93	106.35

Appendix D3

Culvert Capacity Calculations

Rational Method

Duration = 24-hour
 Time of Concentration (minimum) 10 minutes
 100-year, 1-hour Precipitation * = 1.8 inches
 Intensity (100 year, 10 min) * = 5.21 in/hr
 100-year, 6-hour Precipitation * = 2.29 inches

Peak Discharge

Basins	Area (sq. ft.)	Area (sq. mi.)	Area (acre)	C - 100 year storm	100-year Peak Discharge (cfs)
E1A	2,367	0.000	0.05	0.86	0.24
E1B	6,034	0.000	0.14	0.86	0.62
E2	10,566	0.000	0.24	0.86	1.09
E3	9,906	0.000	0.23	0.86	1.02
E4	4,675	0.000	0.11	0.86	0.48
E5	4,139	0.000	0.10	0.86	0.43
E6	6,952	0.000	0.16	0.86	0.72
E7	8,219	0.000	0.19	0.86	0.85
E8	3996	0.000	0.09	0.86	0.41
E9	4,969	0.000	0.11	0.86	0.51
E10	9,305	0.000	0.21	0.86	0.96
E11	15,396	0.001	0.35	0.86	1.58
E12	2,287	0.000	0.05	0.86	0.24
E13	7,645	0.000	0.18	0.84	0.77
E14	3,610	0.000	0.08	0.84	0.36
E15	3,003	0.000	0.07	0.84	0.30
E16	2,893	0.000	0.07	0.88	0.30
W1A	15,841	0.001	0.36	0.86	1.63
W1B	40,363	0.001	0.93	0.86	4.15
W2	69,014	0.002	1.58	0.86	7.10
W3	62,979	0.002	1.45	0.86	6.48
W4	30,312	0.001	0.70	0.86	3.12
W5	26,834	0.001	0.62	0.86	2.76
W6	45,071	0.002	1.03	0.86	4.64
W7	55,946	0.002	1.28	0.86	5.75
W8	29,054	0.001	0.67	0.86	2.99
W9	35,151	0.001	0.81	0.86	3.62
W10	62,383	0.002	1.43	0.86	6.42
W11	99,575	0.004	2.29	0.86	10.24
W12	14,779	0.001	0.34	0.86	1.52
W13	49,434	0.000	1.13	0.84	4.97
W14	23,332	0.001	0.54	0.84	2.34
W15	21,024	0.001	0.48	0.84	2.11
W16	24,237	0.001	0.56	0.88	2.55

Notes:

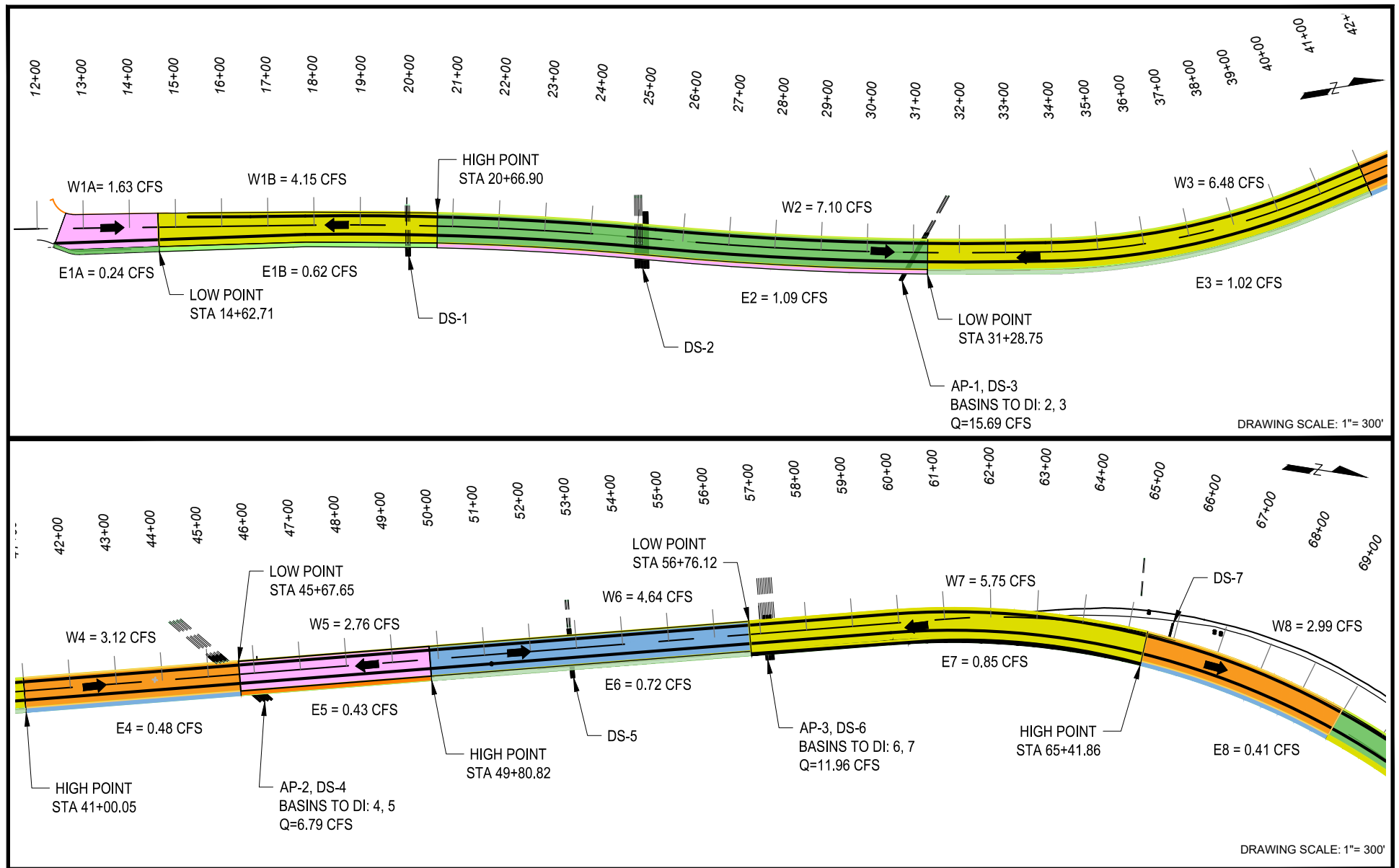
* Note: From NOAA website precipitation intensity estimate table

Formulas:

$$Q = C * i * A$$

i = intensity (inches/hour)

A = Area (acres)



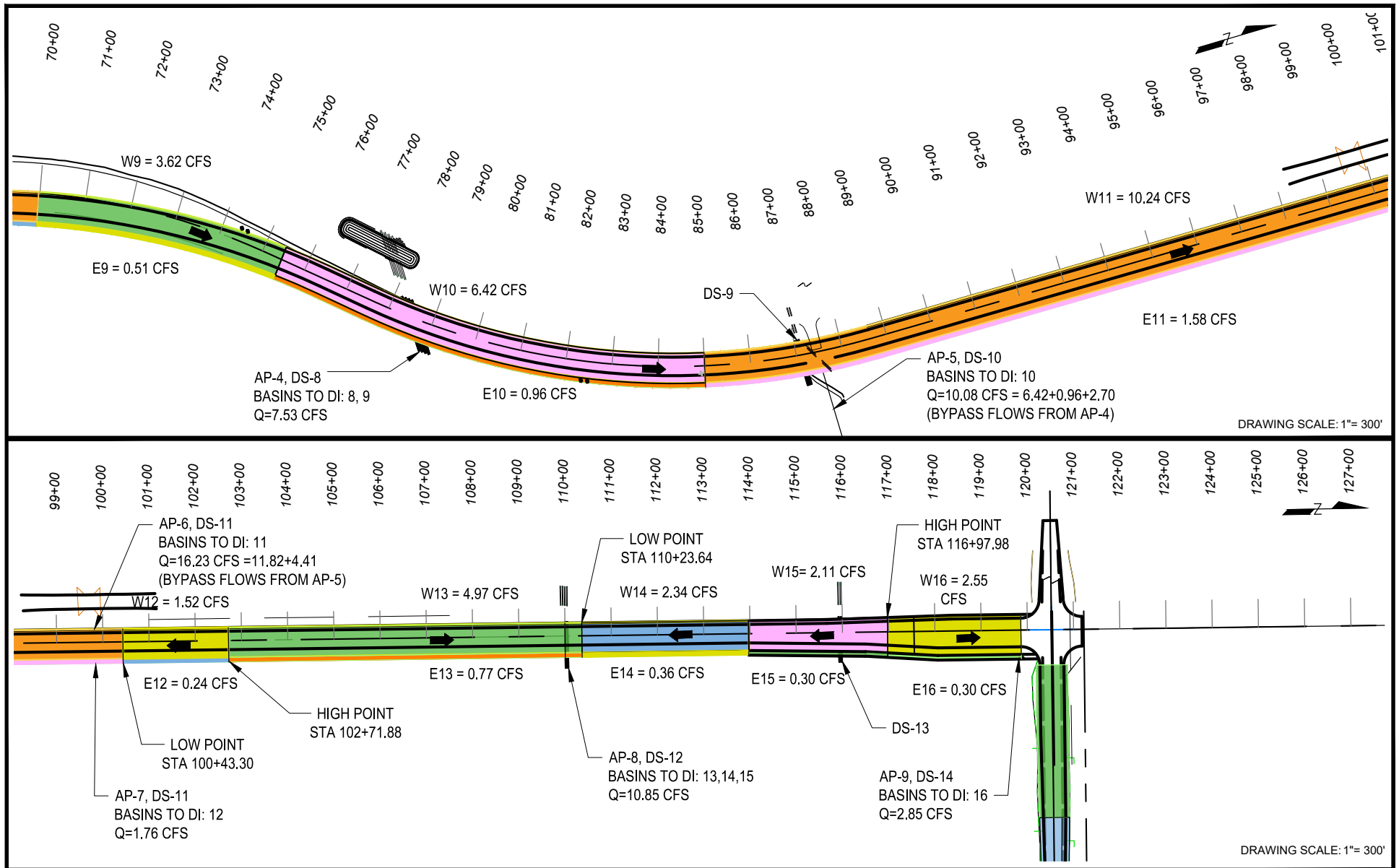
Parametrix
ENGINEERING · PLANNING · ENVIRONMENTAL SCIENCES

0 1
1 INCH = 300 FEET

DATE: April 5, 2021

FILE: BASINS DESIGN EXHIBIT EB

**FIGURE 3.
ROADWAY DRAINAGE BASINS**



**FIGURE 3. (CONT'D)
ROADWAY DRAINAGE BASINS**

Hydraulic Analysis Report

Project Data

Project Title: Project - AV Median Inlets

Project Date: Monday, April 5, 2021

Project Units: U.S. Customary Units

Median/Ditch Drop-Inlet Analysis: Median/Ditch Drop-Inlet Analysis - AP1

Notes:

Using Local Channel

Channel Analysis: Channel Analysis

Input Parameters

Channel Type: Triangular

Side Slope 1 (Z1): 6.0000 ft/ft

Side Slope 2 (Z2): 6.0000 ft/ft

Longitudinal Slope: 0.0050 ft/ft

Manning's n: 0.0300

Flow: 15.6900 cfs

Result Parameters

Depth: 1.0694 ft

Area of Flow: 6.8621 ft²

Wetted Perimeter: 13.0102 ft

Hydraulic Radius: 0.5274 ft

Average Velocity: 2.2865 ft/s

Top Width: 12.8332 ft

Froude Number: 0.5510

Critical Depth: 0.8426 ft

Critical Velocity: 3.6832 ft/s

Critical Slope: 0.0178 ft/ft

Critical Top Width: 10.11 ft

Calculated Max Shear Stress: 0.3337 lb/ft²

Calculated Avg Shear Stress: 0.1646 lb/ft²

Inlet Data:

Grate Width: 2.0000 ft

Grate Length: 3.3300 ft

Computed Data:

Perimeter: 10.6600 ft

Effective Perimeter: 5.3300 ft

Area: 5.994

Effective Area: 2.997

Depth at Center of Grate: 0.987 ft

Computed Top Width at Sag: 11.849 ft

Median/Ditch Drop-Inlet Analysis: Median/Ditch Drop-Inlet Analysis - AP2

Using Local Channel

Channel Analysis: Channel Analysis

Input Parameters

Channel Type: Triangular

Side Slope 1 (Z1): 6.0000 ft/ft

Side Slope 2 (Z2): 6.0000 ft/ft

Longitudinal Slope: 0.0035 ft/ft

Manning's n: 0.0300

Flow: 6.7900 cfs

Result Parameters

Depth: 0.8352 ft

Area of Flow: 4.1853 ft²

Wetted Perimeter: 10.1606 ft

Hydraulic Radius: 0.4119 ft

Average Velocity: 1.6223 ft/s

Top Width: 10.0224 ft

Froude Number: 0.4424

Critical Depth: 0.6027 ft

Critical Velocity: 3.1151 ft/s

Critical Slope: 0.0199 ft/ft

Critical Top Width: 7.23 ft

Calculated Max Shear Stress: 0.1824 lb/ft²

Calculated Avg Shear Stress: 0.0900 lb/ft²

Inlet Data:

Grate Width: 2.0000 ft

Grate Length: 3.3300 ft

Computed Data:

Perimeter: 10.6600 ft

Effective Perimeter: 5.3300 ft

Area: 5.994

Effective Area: 2.997

Depth at Center of Grate: 0.5650 ft

Computed Top Width at Sag: 6.7795 ft

Median/Ditch Drop-Inlet Analysis: Median/Ditch Drop-Inlet Analysis - AP3

Using Local Channel

Channel Analysis: Channel Analysis

Input Parameters

Channel Type: Triangular
Side Slope 1 (Z1): 6.0000 ft/ft
Side Slope 2 (Z2): 6.0000 ft/ft
Longitudinal Slope: 0.0052 ft/ft
Manning's n: 0.0300
Flow: 11.9600 cfs

Result Parameters

Depth: 0.9588 ft
Area of Flow: 5.5163 ft²
Wetted Perimeter: 11.6649 ft
Hydraulic Radius: 0.4729 ft
Average Velocity: 2.1681 ft/s
Top Width: 11.5062 ft
Froude Number: 0.5518
Critical Depth: 0.7559 ft
Critical Velocity: 3.4886 ft/s
Critical Slope: 0.0185 ft/ft
Critical Top Width: 9.07 ft
Calculated Max Shear Stress: 0.3111 lb/ft²
Calculated Avg Shear Stress: 0.1534 lb/ft²

Inlet Data:

Grate Width: 2.0000 ft
Grate Length: 3.3300 ft

Computer Data

Perimeter: 10.66 ft
Effective Perimeter: 5.33 ft
Area: 5.994 ft²
Effective Area: 2.997 ft²
Depth at Center of Grate: 0.824 ft
Computer Top Width at Sag: 9.888 ft

Median/Ditch Drop-Inlet Analysis: Median/Ditch Drop-Inlet Analysis - AP4

Using Local Channel

Channel Analysis: Channel Analysis

Input Parameters

Channel Type: Triangular

Side Slope 1 (Z1): 6.0000 ft/ft

Side Slope 2 (Z2): 6.0000 ft/ft

Longitudinal Slope: 0.0205 ft/ft

Manning's n: 0.0300

Flow: 7.5300 cfs

Result Parameters

Depth: 0.6233 ft

Area of Flow: 2.3310 ft²

Wetted Perimeter: 7.5827 ft

Hydraulic Radius: 0.3074 ft

Average Velocity: 3.2304 ft/s

Top Width: 7.4796 ft

Froude Number: 1.0197

Critical Depth: 0.6282 ft

Critical Velocity: 3.1802 ft/s

Critical Slope: 0.0197 ft/ft

Critical Top Width: 7.54 ft

Calculated Max Shear Stress: 0.7973 lb/ft²

Calculated Avg Shear Stress: 0.3932 lb/ft²

Inlet Data:

Grate Width: 2.0000 ft

Grate Length: 3.3300 ft

Computed Data:

Intercepted flow: 4.4258 cfs

Bypass flow: 3.1042 cfs

Median/Ditch Drop-Inlet Analysis: Median/Ditch Drop-Inlet Analysis - AP5

Using Local Channel

Channel Analysis: Channel Analysis

Input Parameters

Channel Type: Triangular

Side Slope 1 (Z1): 6.0000 ft/ft

Side Slope 2 (Z2): 6.0000 ft/ft

Longitudinal Slope: 0.0150 ft/ft

Manning's n: 0.0300

Flow: 10.0800 cfs

Result Parameters

Depth: 0.7373 ft

Area of Flow: 3.2615 ft²

Wetted Perimeter: 8.9694 ft

Hydraulic Radius: 0.3636 ft

Average Velocity: 3.0906 ft/s

Top Width: 8.8474 ft

Froude Number: 0.8970

Critical Depth: 0.7059 ft

Critical Velocity: 3.3713 ft/s

Critical Slope: 0.0189 ft/ft

Critical Top Width: 8.47 ft

Calculated Max Shear Stress: 0.6901 lb/ft²

Calculated Avg Shear Stress: 0.3404 lb/ft²

Inlet Data:

Grate Width: 2.0000 ft

Grate Length: 3.3300 ft

Computed Data:

Intercepted flow: 5.2319 cfs

Bypass flow: 4.8481 cfs

Median/Ditch Drop-Inlet Analysis: Median/Ditch Drop-Inlet Analysis - AP6

Using Local Channel

Channel Analysis: Channel Analysis

Input Parameters

Channel Type: Triangular

Side Slope 1 (Z1): 6.0000 ft/ft

Side Slope 2 (Z2): 6.0000 ft/ft

Longitudinal Slope: 0.0150 ft/ft

Manning's n: 0.0300

Flow: 16.2300 cfs

Result Parameters

Depth: 0.8815 ft

Area of Flow: 4.6619 ft²

Wetted Perimeter: 10.7235 ft

Hydraulic Radius: 0.4347 ft

Average Velocity: 3.4814 ft/s

Top Width: 10.5776 ft

Froude Number: 0.9242

Critical Depth: 0.8541 ft

Critical Velocity: 3.7082 ft/s

Critical Slope: 0.0177 ft/ft

Critical Top Width: 10.25 ft

Calculated Max Shear Stress: 0.8250 lb/ft²

Calculated Avg Shear Stress: 0.4069 lb/ft²

Inlet Data:

Grate Width: 2.0000 ft

Grate Length: 3.3300 ft

Computed Data:

Perimeter: 10.6600 ft

Effective Perimeter: 5.3300 ft

Area: 5.994

Effective Area: 2.997

Depth at Center of Grate: 1.0157 ft

Computed Top Width at Sag: 12.1885 ft

Median/Ditch Drop-Inlet Analysis: Median/Ditch Drop-Inlet Analysis - AP7

Using Local Channel

Channel Analysis: Channel Analysis

Input Parameters

Channel Type: Triangular

Side Slope 1 (Z1): 6.0000 ft/ft

Side Slope 2 (Z2): 6.0000 ft/ft

Longitudinal Slope: 0.0035 ft/ft

Manning's n: 0.0300

Flow: 1.7600 cfs

Result Parameters

Depth: 0.5034 ft

Area of Flow: 1.5204 ft²

Wetted Perimeter: 6.1240 ft

Hydraulic Radius: 0.2483 ft

Average Velocity: 1.1576 ft/s

Top Width: 6.0407 ft

Froude Number: 0.4066

Critical Depth: 0.3512 ft

Critical Velocity: 2.3779 ft/s

Critical Slope: 0.0239 ft/ft

Critical Top Width: 4.21 ft

Calculated Max Shear Stress: 0.1099 lb/ft²

Calculated Avg Shear Stress: 0.0542 lb/ft²

Inlet Data:

Grate Width: 2.0000 ft

Grate Length: 3.3300 ft

Computed Data:

Perimeter: 10.6600 ft

Effective Perimeter: 5.3300 ft

Area: 5.994

Effective Area: 2.997

Depth at Center of Grate: 0.2297 ft

Computed Top Width at Sag: 2.7561 ft

Median/Ditch Drop-Inlet Analysis: Median/Ditch Drop-Inlet Analysis - AP8

Channel Analysis: Channel Analysis

Input Parameters

Channel Type: Triangular
Side Slope 1 (Z1): 6.0000 ft/ft
Side Slope 2 (Z2): 6.0000 ft/ft
Longitudinal Slope: 0.0039 ft/ft
Manning's n: 0.0300
Flow: 10.8500 cfs

Result Parameters

Depth: 0.9757 ft
Area of Flow: 5.7119 ft²
Wetted Perimeter: 11.8698 ft
Hydraulic Radius: 0.4812 ft
Average Velocity: 1.8996 ft/s
Top Width: 11.7083 ft
Froude Number: 0.4793
Critical Depth: 0.7270 ft
Critical Velocity: 3.4213 ft/s
Critical Slope: 0.0187 ft/ft
Critical Top Width: 8.72 ft
Calculated Max Shear Stress: 0.2374 lb/ft²
Calculated Avg Shear Stress: 0.1171 lb/ft²

Inlet Data:

Grate Width: 2.0000 ft
Grate Length: 3.3300 ft

Computer Data

Perimeter: 10.66 ft
Effective Perimeter: 5.33 ft
Area: 5.994 ft²
Effective Area: 2.997 ft²
Depth at Center of Grate: 0.772 ft
Computer Top Width at Sag: 9.266 ft

Median/Ditch Drop-Inlet Analysis: Median/Ditch Drop-Inlet Analysis - AP9

Using Local Channel

Channel Analysis: Channel Analysis

Input Parameters

Channel Type: Triangular

Side Slope 1 (Z1): 6.0000 ft/ft

Side Slope 2 (Z2): 6.0000 ft/ft

Longitudinal Slope: 0.0040 ft/ft

Manning's n: 0.0300

Flow: 2.8500 cfs

Result Parameters

Depth: 0.5882 ft

Area of Flow: 2.0759 ft²

Wetted Perimeter: 7.1559 ft

Hydraulic Radius: 0.2901 ft

Average Velocity: 1.3729 ft/s

Top Width: 7.0585 ft

Froude Number: 0.4461

Critical Depth: 0.4259 ft

Critical Velocity: 2.6186 ft/s

Critical Slope: 0.0224 ft/ft

Critical Top Width: 5.11 ft

Calculated Max Shear Stress: 0.1468 lb/ft²

Calculated Avg Shear Stress: 0.0724 lb/ft²

Inlet Data:

Grate Width: 2.0000 ft

Grate Length: 3.3300 ft

Computed Data:

Perimeter: 10.6600 ft

Effective Perimeter: 5.3300 ft

Area: 5.994

Effective Area: 2.997

Depth at Center of Grate: 0.3167 ft

Computed Top Width at Sag: 3.8005 ft

Existing Structure Summary

Structure	Station	Basin	Q (cfs)	Dev. 100-year Q (cfs)	Dev. 10-year Q (cfs)	Existing Structure	Length (ft)	Inlet Invert Elevation	Outlet Invert Elevation	Edge of Pavement Elevation	Culvert Slope (%)	Manning's n	Max Structure Capacity	Capacity Y/N
DS-1	19+99.75	1		84.40	N/A	2-36" RCP	80	5782.56	5781.21	5789.00	1.69%	0.012	134.33	Yes
DS-2A to DS-2C	25+03.92	2		340.00	N/A	3-36" RCP	97	5779.53	5779.13	5790.00	0.41%	0.012	279.09	No
DS-3	31+04.22	3		32.48	6.58	2-24" RCP	96	5778.35	5777.54	5786.00	0.84%	0.012	71.16	Yes
DS-4	45+56.39	5		83.03	36.92	4-36" RCP	125	5779.65	5778.72	5789.00	0.74%	0.012	347.93	Yes
DS-5	52+84.14	6		43.12	24.08	2-24" RCP	50	5781.66	5780.43	5784.50	2.46%	0.012	35.25	No
DS-6	57+16.54	7		200.09	81.65	5-42" RCP	77	5778.97	5778.00	5787.00	1.26%	0.012	518.04	Yes
DS-7	65+21.61	8		12.75	7.12	1-24" RCP	69	5793.82	5791.37	5800.00	3.55%	0.012	31.26	Yes
DS-8	78+34.60	9		23.83	9.86	4-36" RCP	88	5761.86	5759.4	5766.00	2.80%	0.012	189.09	Yes
DS-9	86+92.40	10		51.17	21.17	2-18" RCP	54	5744.37	5743.81	5749.00	1.04%	0.012	30.56	No
DS-10	87+16.62	10		51.17	21.17	2-18" RCP	73	5741.40	5740.78	5747.00	0.85%	0.012	37.73	No
DS-11	99+54.73	11	595	327.00	239.00	Bridge								
DS-12	109+78.40	12		33.11	18.66	4-18" RCP	35	5727.40	5724.59	5729.00	8.03%	0.012	24.50	No
DS-13	115+92.50	13, 14		147.89	83.34	2-30" RCP	35	5727.03	5725.59	5729.41	4.11%	0.012	42.63	No

Proposed Structure Summary

Structure	Station	Basin	Q (cfs)	Dev. 100-year Q (cfs)	Dev. 10-year Q (cfs)	Proposed Improvement	Length (ft)	Inlet Invert Elevation	Outlet Invert Elevation	Edge of Pavement Elevation	Culvert Slope (%)	Manning's n	Max Structure Capacity	Capacity Y/N
DS-1	19+99.75	1		84.40	N/A	Extend (2-36" RCP)	108.55	5782.56	5780.74	5790.50	1.68%	0.012	155.62	Yes
DS-2A to DS-2C	25+03.92	2		*	*	Extend (3-36" RCP)	122.67	5779.41	5778.90	5788.50	0.42%	0.012	*	Yes
DS-2D & 2E	25+16.74	2		340.00	N/A	Add 2-36" RCP	122.00	5779.41	5778.90	5788.50	0.42%	0.012	427.91	Yes
DS-3	31+04.22	3		32.48	6.58	Extend (2-24" RCP)	112.0	5777.59	5776.60	5783.50	0.88%	0.012	61.04	Yes
DS-4	45+56.39	5		83.03	36.92	Extend (4-36" RCP)	132	5778.86	5777.74	5786.00	0.85%	0.012	289.47	Yes
DS-5 **	52+84.14	6		43.12	24.08	Extend (2-24" RCP)	110	5780.28	5778.19	5786.50	1.90%	0.012	62.94	Yes
DS-6	57+16.54	7		200.09	81.65	Replace with 3-36" RCP	96	5778.00	5777.30	5784.50	0.73%	0.012	561.59	Yes
DS-7	65+21.61	8		12.75	7.12	Extend (1-24" RCP)	100	5789.39	5786.30	5794.00	3.09%	0.012	25.56	Yes
DS-8	78+34.60	9		23.83	9.86	Extend (4-36" RCP)	140	5757.98	5754.31	5764.00	2.62%	0.012	255.28	Yes
DS-9	86+92.40	10		51.17	21.17	Replace with 3-18"R x 26.5"S RCP	100	5742.63	5741.34	5746.00	1.29%	0.012	75.42	Yes
DS-10	87+16.62					Remove								
DS-11	99+54.73	11	595	327.00	239.00	Replace with 2-10'S x 7'H CBC	62	5720.40	5719.16	5728.00	2.00%	0.012	1339.07	Yes
DS-12	109+78.40	12		33.11	18.66	Replace with 2-24" RCP	100	5722.16	5716.26	5726.00	5.90%	0.012	44.45	Yes
DS-13	115+92.50	13		41.54	23.41	Replace with 2-18"R x 28.5"S RCP	88	5722.2	5720	5727.00	2.50%	0.012	54.5	Yes
DS-14	120+00	14		106.35	59.93	Add 3-30" RCP	100	5721	5720	5725.00	1.00%	0.012	110.04	Yes

* DS-2A thru DS-2E function as one structure

** DS-5 has capacity in proposed condition because crest of roadway has been raised.

Erosion Control Summary

Structure	Flow (cfs)	Flow per Culvert (cfs)	Culvert Diameter (ft)	Culvert Width (ft)	Culvert Height (ft)	# of Culverts	Tailwater Depth (Yt)*	Tailwater Depth/Conduit Height (Yt/D)	Circular Conduit Q/(D^2.5)	Rectangular Conduit Q/(WH^1.5)	At = Q/V***	Expansion Factor**	Length of Riprap (Lp)	Use (ft)
DS-1	84.4	42.2	3	3	3	2	0.45	0.150	2.71		8.44	1.1	17.33	20
DS-2	340	68.0	3	3	3	5	1.31	0.437	4.36		13.60	3.5	25.84	25
DS-3	32.48	16.2	2	2	2	2	0.33	0.165	2.87		3.25	1.2	9.41	10
DS-4	83	20.8	3	3	3	4	0.39	0.130	1.33		4.15	1.3	9.93	10
DS-5	43.12	21.6	2	2	2	2	0.28	0.140	3.81		4.31	0.8	10.72	10
DS-6	200.09	40.0	3.5	3.5	3.5	5	0.25	0.071	1.75		8.00	0.3	8.55	10
DS-7	12.75	12.8	2	2	2	1	0.13	0.065	2.25		2.55	0.3	5.28	10
DS-8	23.83	6.0	3	3	3	4	0.2	0.067	0.38		1.19	0.3	0.89	10
DS-9	51.17	17.1	28.5"S x 18"R	2.375	1.5	3	0.28	0.187		3.91	3.41	0.7	7.48	10
DS-10	Removed													
DS-11	595	297.5	10'S x 7'R	10	7	2	0.74	0.106		1.61	49.58	0.8	48.00	31
DS-12	33.11	16.6	2	2	2	2	0.17	0.085	2.93		3.31	0.6	10.49	10
DS-13	41.54	20.8	28.5"S x 18"R	2.375	1.5	2	0.24	0.160		4.76	4.15	0.5	7.90	10
DS-14	106.35	35.5	2.5	2.5	2.5	3	0.28	0.112	3.59		7.09	0.6	13.69	15

Calculations based on Urban Storm Drainage Criteria Manual, Volume 2, updated 2016, Section 3.2.1 Riprap Apron

* From HY-8 output

** From Figure 9-35 USDCM

*** V=5 ft/s (non-cohesive soils) for all culverts except DS-11. DS-11 used channel velocity of 6 fps based on HEC-RAS velocity in Boca Negra DMP

CBC riprap length does not include length of concrete apron (17')

HY-8 Culvert Analysis Report

Existing

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 1 cfs

Design Flow: 40 cfs

Maximum Flow: 84.4 cfs

Site Data - DS-1

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 5782.56 ft

Outlet Station: 80.00 ft

Outlet Elevation: 5781.21 ft

Number of Barrels: 2

Culvert Data Summary - DS-1

Barrel Shape: Circular

Barrel Diameter: 3.00 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Mitered to Conform to Slope

Inlet Depression: None

Roadway Data for Crossing: Sta 19+99.75 (Ex)

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 100.00 ft

Crest Elevation: 5789.00 ft

Roadway Surface: Paved

Roadway Top Width: 64.00 ft

Table 1 - Culvert Summary Table: DS-1

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
1.00	1.00	5782.87	0.310	0.0*	1-S2n	0.157	0.218	0.157	0.034	3.541	5.693
9.34	9.34	5783.54	0.976	0.0*	1-S2n	0.454	0.676	0.454	0.129	6.927	13.174
17.68	17.68	5783.93	1.367	0.0*	1-S2n	0.621	0.938	0.636	0.187	8.084	16.493
26.02	26.02	5784.25	1.692	0.0*	1-S2n	0.753	1.147	0.779	0.233	8.920	18.809
34.36	34.36	5784.53	1.973	0.176	1-S2n	0.868	1.325	0.914	0.273	9.425	20.629
40.00	40.00	5784.71	2.148	0.357	1-S2n	0.939	1.435	0.988	0.298	9.859	21.692
51.04	51.04	5785.04	2.477	0.724	1-S2n	1.067	1.630	1.136	0.342	10.400	23.459
59.38	59.38	5785.29	2.734	1.015	1-S2n	1.158	1.765	1.244	0.372	10.722	24.611
67.72	67.72	5785.57	3.011	1.320	5-S2n	1.244	1.890	1.339	0.400	11.090	25.648
76.06	76.06	5785.88	3.316	1.641	5-S2n	1.327	2.006	1.439	0.426	11.348	26.596
84.40	84.40	5786.21	3.655	1.978	5-S2n	1.408	2.116	1.531	0.452	11.632	27.461

* Full Flow Headwater elevation is below inlet invert.

Straight Culvert

Inlet Elevation (invert): 5782.56 ft, Outlet Elevation (invert): 5781.21 ft

Culvert Length: 80.01 ft, Culvert Slope: 0.0169

Table 2 - Summary of Culvert Flows at Crossing: Sta 19+99.75 (Ex)

Headwater Elevation (ft)	Total Discharge (cfs)	DS-1 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
5782.87	1.00	1.00	0.00	1
5783.54	9.34	9.34	0.00	1
5783.93	17.68	17.68	0.00	1
5784.25	26.02	26.02	0.00	1
5784.53	34.36	34.36	0.00	1
5784.71	40.00	40.00	0.00	1
5785.04	51.04	51.04	0.00	1
5785.29	59.38	59.38	0.00	1
5785.57	67.72	67.72	0.00	1
5785.88	76.06	76.06	0.00	1
5786.21	84.40	84.40	0.00	1
5789.00	134.33	134.33	0.00	Overtopping

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 1 cfs

Design Flow: 250 cfs

Maximum Flow: 340 cfs

Site Data - DS-2

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 5779.53 ft

Outlet Station: 97.00 ft

Outlet Elevation: 5779.13 ft

Number of Barrels: 3

Culvert Data Summary - DS-2

Barrel Shape: Circular

Barrel Diameter: 3.00 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Mitered to Conform to Slope

Inlet Depression: None

Roadway Data for Crossing: Sta 25+03.92 (Ex)

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 100.00 ft

Crest Elevation: 5790.00 ft

Roadway Surface: Paved

Roadway Top Width: 64.00 ft

Table 3 - Culvert Summary Table: DS-2

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
1.00	1.00	5779.78	0.247	0.0*	1-S2n	0.177	0.178	0.177	0.051	1.945	3.785
34.90	34.90	5781.09	1.562	0.778	1-S2n	1.022	1.082	1.022	0.401	5.471	13.195
68.80	68.80	5781.83	2.296	1.517	1-S2n	1.488	1.541	1.488	0.580	6.556	16.215
102.70	102.70	5782.81	3.010	3.280	7-M2c	1.914	1.900	1.900	0.717	7.251	18.218
136.60	136.60	5783.46	3.925	3.895	7-M2c	2.406	2.198	2.198	0.831	8.204	19.760
170.50	170.50	5784.64	5.112	4.624	7-M2c	3.000	2.443	2.443	0.930	9.222	21.019
204.40	204.40	5786.07	6.544	5.734	7-M2c	3.000	2.632	2.632	1.019	10.367	22.097
250.00	250.00	5788.27	8.739	7.471	7-M2c	3.000	2.799	2.799	1.127	12.139	23.345
272.20	272.20	5789.56	10.032	8.413	7-M2c	3.000	2.851	2.851	1.175	13.079	23.891
306.10	281.99	5790.19	10.657	8.851	7-M2c	3.000	2.862	2.862	1.244	13.520	24.659
340.00	284.11	5790.33	10.795	8.953	7-M2c	3.000	2.824	2.824	1.309	13.722	25.366

* Full Flow Headwater elevation is below inlet invert.

Straight Culvert

Inlet Elevation (invert): 5779.53 ft, Outlet Elevation (invert): 5779.13 ft

Culvert Length: 97.00 ft, Culvert Slope: 0.0041

Table 4 - Summary of Culvert Flows at Crossing: Sta 25+03.92 (Ex)

Headwater Elevation (ft)	Total Discharge (cfs)	DS-2 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
5779.78	1.00	1.00	0.00	1
5781.09	34.90	34.90	0.00	1
5781.83	68.80	68.80	0.00	1
5782.81	102.70	102.70	0.00	1
5783.46	136.60	136.60	0.00	1
5784.64	170.50	170.50	0.00	1
5786.07	204.40	204.40	0.00	1
5788.27	250.00	250.00	0.00	1
5789.56	272.20	272.20	0.00	1
5790.19	306.10	281.99	23.94	8
5790.33	340.00	284.11	55.53	5
5790.00	279.09	279.09	0.00	Overtopping

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 1 cfs

Design Flow: 6.58 cfs

Maximum Flow: 32.48 cfs

Site Data - DS-3

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 5778.35 ft

Outlet Station: 96.00 ft

Outlet Elevation: 5777.54 ft

Number of Barrels: 2

Culvert Data Summary - DS-3

Barrel Shape: Circular

Barrel Diameter: 2.00 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Mitered to Conform to Slope

Inlet Depression: None

Roadway Data for Crossing: Sta 31+04.22 (Ex)

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 100.00 ft

Crest Elevation: 5786.00 ft

Roadway Surface: Paved

Roadway Top Width: 64.00 ft

Table 5 - Culvert Summary Table: DS-3

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
1.00	1.00	5778.69	0.343	0.0*	1-S2n	0.206	0.242	0.206	0.043	2.934	4.519
4.15	4.15	5779.07	0.716	0.0*	1-S2n	0.410	0.500	0.410	0.100	4.480	7.722
6.58	6.58	5779.26	0.914	0.0*	1-S2n	0.516	0.634	0.516	0.131	5.124	9.126
10.44	10.44	5779.53	1.181	0.112	1-S2n	0.654	0.806	0.654	0.171	5.844	10.754
13.59	13.59	5779.72	1.368	0.311	1-S2n	0.753	0.924	0.753	0.199	6.286	11.778
16.74	16.74	5779.89	1.542	0.519	1-S2n	0.843	1.031	0.848	0.224	6.596	12.651
19.89	19.89	5780.07	1.716	0.740	1-S2n	0.929	1.128	0.934	0.248	6.906	13.403
23.04	23.04	5780.25	1.900	0.974	1-S2n	1.012	1.218	1.019	0.269	7.158	14.068
26.18	26.18	5780.45	2.101	1.223	5-S2n	1.094	1.302	1.102	0.290	7.381	14.669
29.33	29.33	5780.68	2.325	1.487	5-S2n	1.175	1.380	1.183	0.309	7.579	15.222
32.48	32.48	5780.93	2.575	1.767	5-S2n	1.257	1.453	1.265	0.327	7.753	15.733

* Full Flow Headwater elevation is below inlet invert.

Straight Culvert

Inlet Elevation (invert): 5778.35 ft, Outlet Elevation (invert): 5777.54 ft

Culvert Length: 96.00 ft, Culvert Slope: 0.0084

Table 6 - Summary of Culvert Flows at Crossing: Sta 31+04.22 (Ex)

Headwater Elevation (ft)	Total Discharge (cfs)	DS-3 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
5778.69	1.00	1.00	0.00	1
5779.07	4.15	4.15	0.00	1
5779.26	6.58	6.58	0.00	1
5779.53	10.44	10.44	0.00	1
5779.72	13.59	13.59	0.00	1
5779.89	16.74	16.74	0.00	1
5780.07	19.89	19.89	0.00	1
5780.25	23.04	23.04	0.00	1
5780.45	26.18	26.18	0.00	1
5780.68	29.33	29.33	0.00	1
5780.93	32.48	32.48	0.00	1
5786.00	71.16	71.16	0.00	Overtopping

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 1 cfs

Design Flow: 36.92 cfs

Maximum Flow: 83 cfs

Site Data - DS-4

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 5779.65 ft

Outlet Station: 125.00 ft

Outlet Elevation: 5778.72 ft

Number of Barrels: 4

Culvert Data Summary - DS-4

Barrel Shape: Circular

Barrel Diameter: 3.00 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Mitered to Conform to Slope

Inlet Depression: None

Roadway Data for Crossing: Sta 45+56.39 (Ex)

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 100.00 ft

Crest Elevation: 5789.00 ft

Roadway Surface: Paved

Roadway Top Width: 64.00 ft

Table 7 - Culvert Summary Table: DS-4

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
1.00	1.00	5779.87	0.216	0.0*	1-S2n	0.133	0.154	0.133	0.030	2.209	6.602
9.20	9.20	5780.32	0.668	0.0*	1-S2n	0.393	0.471	0.393	0.111	4.210	15.269
17.40	17.40	5780.58	0.929	0.0*	1-S2n	0.536	0.652	0.536	0.161	5.081	19.163
25.60	25.60	5780.79	1.138	0.0*	1-S2n	0.648	0.795	0.648	0.201	5.698	21.913
36.92	36.92	5781.03	1.382	0.095	1-S2n	0.779	0.960	0.779	0.248	6.330	24.791
42.00	42.00	5781.13	1.481	0.180	1-S2n	0.832	1.026	0.837	0.267	6.510	25.892
50.20	50.20	5781.29	1.638	0.316	1-S2n	0.912	1.125	0.912	0.296	6.910	27.438
58.40	58.40	5781.43	1.784	0.451	1-S2n	0.987	1.217	0.994	0.322	7.135	28.829
66.60	66.60	5781.57	1.920	0.586	1-S2n	1.057	1.304	1.066	0.347	7.394	30.065
74.80	74.80	5781.70	2.049	0.723	1-S2n	1.125	1.385	1.135	0.370	7.632	31.198
83.00	83.00	5781.82	2.173	0.863	1-S2n	1.190	1.463	1.202	0.392	7.838	32.231

* Full Flow Headwater elevation is below inlet invert.

Straight Culvert

Inlet Elevation (invert): 5779.65 ft, Outlet Elevation (invert): 5778.72 ft

Culvert Length: 125.00 ft, Culvert Slope: 0.0074

Table 8 - Summary of Culvert Flows at Crossing: Sta 45+56.39 (Ex)

Headwater Elevation (ft)	Total Discharge (cfs)	DS-4 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
5779.87	1.00	1.00	0.00	1
5780.32	9.20	9.20	0.00	1
5780.58	17.40	17.40	0.00	1
5780.79	25.60	25.60	0.00	1
5781.03	36.92	36.92	0.00	1
5781.13	42.00	42.00	0.00	1
5781.29	50.20	50.20	0.00	1
5781.43	58.40	58.40	0.00	1
5781.57	66.60	66.60	0.00	1
5781.70	74.80	74.80	0.00	1
5781.82	83.00	83.00	0.00	1
5789.00	347.93	347.93	0.00	Overtopping

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 1 cfs

Design Flow: 24.08 cfs

Maximum Flow: 43.12 cfs

Site Data - DS-5

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 5781.66 ft

Outlet Station: 50.00 ft

Outlet Elevation: 5780.43 ft

Number of Barrels: 2

Culvert Data Summary - DS-5

Barrel Shape: Circular

Barrel Diameter: 2.00 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Mitered to Conform to Slope

Inlet Depression: None

Roadway Data for Crossing: Sta 52+84.14 (Ex)

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 100.00 ft

Crest Elevation: 5784.50 ft

Roadway Surface: Paved

Roadway Top Width: 36.00 ft

Table 9 - Culvert Summary Table: DS-5

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
1.00	1.00	5782.01	0.350	0.0*	1-S2n	0.159	0.242	0.159	0.031	4.279	6.269
5.21	5.21	5782.48	0.825	0.0*	1-S2n	0.352	0.562	0.352	0.083	6.996	11.738
9.42	9.42	5782.80	1.137	0.0*	1-S2n	0.472	0.764	0.489	0.118	7.919	14.606
13.64	13.64	5783.05	1.393	0.0*	1-S2n	0.569	0.926	0.597	0.146	8.648	16.669
17.85	17.85	5783.29	1.625	0.115	1-S2n	0.655	1.066	0.696	0.171	9.175	18.330
24.08	24.08	5783.65	1.987	0.524	1-S2n	0.768	1.246	0.833	0.204	9.715	20.319
26.27	26.27	5783.79	2.129	0.678	5-S2n	0.805	1.304	0.877	0.214	9.912	20.922
30.48	30.48	5784.10	2.436	0.991	5-S2n	0.874	1.407	0.955	0.233	10.292	22.014
34.70	34.70	5784.45	2.790	1.575	5-S2n	0.941	1.501	1.036	0.251	10.554	22.980
38.91	35.77	5784.55	2.888	1.652	5-S2n	0.958	1.523	1.056	0.268	10.626	23.863
43.12	36.13	5784.58	2.922	1.678	5-S2n	0.963	1.531	1.063	0.285	10.651	24.691

* Full Flow Headwater elevation is below inlet invert.

Straight Culvert

Inlet Elevation (invert): 5781.66 ft, Outlet Elevation (invert): 5780.43 ft

Culvert Length: 50.02 ft, Culvert Slope: 0.0246

Table 10 - Summary of Culvert Flows at Crossing: Sta 52+84.14 (Ex)

Headwater Elevation (ft)	Total Discharge (cfs)	DS-5 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
5782.01	1.00	1.00	0.00	1
5782.48	5.21	5.21	0.00	1
5782.80	9.42	9.42	0.00	1
5783.05	13.64	13.64	0.00	1
5783.29	17.85	17.85	0.00	1
5783.65	24.08	24.08	0.00	1
5783.79	26.27	26.27	0.00	1
5784.10	30.48	30.48	0.00	1
5784.45	34.70	34.70	0.00	1
5784.55	38.91	35.77	3.04	8
5784.58	43.12	36.13	6.83	4
5784.50	35.25	35.25	0.00	Overtopping

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 1 cfs

Design Flow: 81.65 cfs

Maximum Flow: 200.09 cfs

Site Data - DS-6

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 5778.97 ft

Outlet Station: 77.00 ft

Outlet Elevation: 5778.00 ft

Number of Barrels: 5

Culvert Data Summary - DS-6

Barrel Shape: Circular

Barrel Diameter: 3.50 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Mitered to Conform to Slope

Inlet Depression: None

Roadway Data for Crossing: Sta 57+16.54 (Ex)

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 100.00 ft

Crest Elevation: 5787.00 ft

Roadway Surface: Paved

Roadway Top Width: 64.00 ft

Table 11 - Culvert Summary Table: DS-6

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
1.00	1.00	5779.15	0.183	0.0*	1-S2n	0.101	0.132	0.101	0.011	2.457	4.718
20.91	20.91	5779.85	0.875	0.0*	1-S2n	0.442	0.612	0.442	0.066	5.931	15.746
40.82	40.82	5780.21	1.240	0.0*	1-S2n	0.611	0.862	0.622	0.098	7.054	20.479
60.73	60.73	5780.50	1.530	0.139	1-S2n	0.743	1.057	0.765	0.124	7.804	23.898
81.65	81.65	5780.77	1.796	0.355	1-S2n	0.862	1.232	0.895	0.148	8.405	26.813
100.54	100.54	5780.99	2.019	0.544	1-S2n	0.958	1.373	1.003	0.167	8.832	29.048
120.45	120.45	5781.20	2.232	0.741	1-S2n	1.051	1.508	1.108	0.187	9.216	31.123
140.36	140.36	5781.40	2.431	0.940	1-S2n	1.138	1.634	1.211	0.204	9.500	32.994
160.27	160.27	5781.59	2.621	1.141	1-S2n	1.221	1.751	1.301	0.221	9.844	34.718
180.18	180.18	5781.78	2.809	1.346	1-S2n	1.300	1.862	1.395	0.237	10.076	36.278
200.09	200.09	5781.97	3.000	1.557	1-S2n	1.376	1.967	1.480	0.252	10.339	37.769

* Full Flow Headwater elevation is below inlet invert.

Straight Culvert

Inlet Elevation (invert): 5778.97 ft, Outlet Elevation (invert): 5778.00 ft

Culvert Length: 77.01 ft, Culvert Slope: 0.0126

Table 12 - Summary of Culvert Flows at Crossing: Sta 57+16.54 (Ex)

Headwater Elevation (ft)	Total Discharge (cfs)	DS-6 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
5779.15	1.00	1.00	0.00	1
5779.85	20.91	20.91	0.00	1
5780.21	40.82	40.82	0.00	1
5780.50	60.73	60.73	0.00	1
5780.77	81.65	81.65	0.00	1
5780.99	100.54	100.54	0.00	1
5781.20	120.45	120.45	0.00	1
5781.40	140.36	140.36	0.00	1
5781.59	160.27	160.27	0.00	1
5781.78	180.18	180.18	0.00	1
5781.97	200.09	200.09	0.00	1
5787.00	518.04	518.04	0.00	Overtopping

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 1 cfs

Design Flow: 7.12 cfs

Maximum Flow: 12.75 cfs

Site Data - DS-7

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 5793.82 ft

Outlet Station: 69.00 ft

Outlet Elevation: 5791.37 ft

Number of Barrels: 1

Culvert Data Summary - DS-7

Barrel Shape: Circular

Barrel Diameter: 2.00 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Mitered to Conform to Slope

Inlet Depression: None

Roadway Data for Crossing: Sta 65+21.61 (Ex)

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 100.00 ft

Crest Elevation: 5800.00 ft

Roadway Surface: Paved

Roadway Top Width: 64.00 ft

Table 13 - Culvert Summary Table: DS-7

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
1.00	1.00	5794.33	0.507	0.0*	1-S2n	0.203	0.344	0.203	0.028	5.977	7.050
2.17	2.17	5794.58	0.760	0.0*	1-S2n	0.294	0.512	0.294	0.044	7.555	9.511
3.35	3.35	5794.78	0.956	0.0*	1-S2n	0.364	0.640	0.364	0.057	8.572	11.197
4.53	4.53	5794.95	1.127	0.0*	1-S2n	0.422	0.748	0.422	0.068	9.367	12.534
5.70	5.70	5795.10	1.278	0.0*	1-S2n	0.474	0.843	0.484	0.078	9.717	13.686
7.12	7.12	5795.26	1.443	0.0*	1-S2n	0.530	0.947	0.548	0.089	10.200	14.866
8.05	8.05	5795.37	1.545	0.0*	1-S2n	0.565	1.010	0.595	0.096	10.265	15.561
9.22	9.22	5795.49	1.674	0.0*	1-S2n	0.605	1.085	0.634	0.104	10.771	16.344
10.40	10.40	5795.63	1.806	0.0*	1-S2n	0.644	1.155	0.682	0.112	10.997	17.080
11.58	11.58	5795.76	1.944	0.0*	1-S2n	0.681	1.221	0.720	0.119	11.374	17.762
12.75	12.75	5795.91	2.093	0.0*	5-S2n	0.718	1.284	0.765	0.126	11.528	18.377

* Full Flow Headwater elevation is below inlet invert.

Straight Culvert

Inlet Elevation (invert): 5793.82 ft, Outlet Elevation (invert): 5791.37 ft

Culvert Length: 69.04 ft, Culvert Slope: 0.0355

Table 14 - Summary of Culvert Flows at Crossing: Sta 65+21.61 (Ex)

Headwater Elevation (ft)	Total Discharge (cfs)	DS-7 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
5794.33	1.00	1.00	0.00	1
5794.58	2.17	2.17	0.00	1
5794.78	3.35	3.35	0.00	1
5794.95	4.53	4.53	0.00	1
5795.10	5.70	5.70	0.00	1
5795.26	7.12	7.12	0.00	1
5795.37	8.05	8.05	0.00	1
5795.49	9.22	9.22	0.00	1
5795.63	10.40	10.40	0.00	1
5795.76	11.58	11.58	0.00	1
5795.91	12.75	12.75	0.00	1
5800.00	31.26	31.26	0.00	Overtopping

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 1 cfs

Design Flow: 9.86 cfs

Maximum Flow: 23.83 cfs

Site Data - DS-8

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 5761.86 ft

Outlet Station: 88.00 ft

Outlet Elevation: 5759.40 ft

Number of Barrels: 4

Culvert Data Summary - DS-8

Barrel Shape: Circular

Barrel Diameter: 3.00 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Mitered to Conform to Slope

Inlet Depression: None

Roadway Data for Crossing: Sta 78+34.60 (Ex)

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 100.00 ft

Crest Elevation: 5766.00 ft

Roadway Surface: Paved

Roadway Top Width: 64.00 ft

Table 15 - Culvert Summary Table: DS-8

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
1.00	1.00	5762.08	0.222	0.0*	1-S2n	0.095	0.154	0.095	0.031	3.594	6.398
3.28	3.28	5762.26	0.404	0.0*	1-S2n	0.173	0.280	0.173	0.062	4.973	10.094
5.57	5.57	5762.39	0.530	0.0*	1-S2n	0.225	0.365	0.225	0.085	5.756	12.309
7.85	7.85	5762.49	0.632	0.0*	1-S2n	0.263	0.435	0.263	0.104	6.426	13.984
9.86	9.86	5762.57	0.711	0.0*	1-S2n	0.295	0.488	0.295	0.119	6.847	15.180
12.41	12.41	5762.66	0.801	0.0*	1-S2n	0.329	0.549	0.329	0.136	7.345	16.493
14.70	14.70	5762.73	0.874	0.0*	1-S2n	0.357	0.598	0.364	0.150	7.506	17.513
16.98	16.98	5762.80	0.942	0.0*	1-S2n	0.384	0.644	0.384	0.163	8.029	18.427
19.26	19.26	5762.87	1.007	0.0*	1-S2n	0.407	0.687	0.407	0.175	8.364	19.265
21.55	21.55	5762.93	1.067	0.0*	1-S2n	0.429	0.727	0.429	0.187	8.650	20.029
23.83	23.83	5762.99	1.126	0.0*	1-S2n	0.452	0.766	0.452	0.199	8.895	20.719

* Full Flow Headwater elevation is below inlet invert.

Straight Culvert

Inlet Elevation (invert): 5761.86 ft, Outlet Elevation (invert): 5759.40 ft

Culvert Length: 88.03 ft, Culvert Slope: 0.0280

Table 16 - Summary of Culvert Flows at Crossing: Sta 78+34.60 (Ex)

Headwater Elevation (ft)	Total Discharge (cfs)	DS-8 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
5762.08	1.00	1.00	0.00	1
5762.26	3.28	3.28	0.00	1
5762.39	5.57	5.57	0.00	1
5762.49	7.85	7.85	0.00	1
5762.57	9.86	9.86	0.00	1
5762.66	12.41	12.41	0.00	1
5762.73	14.70	14.70	0.00	1
5762.80	16.98	16.98	0.00	1
5762.87	19.26	19.26	0.00	1
5762.93	21.55	21.55	0.00	1
5762.99	23.83	23.83	0.00	1
5766.00	189.09	189.09	0.00	Overtopping

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 1 cfs

Design Flow: 21.17 cfs

Maximum Flow: 51.17 cfs

Site Data - DS-9

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 5744.37 ft

Outlet Station: 54.00 ft

Outlet Elevation: 5743.81 ft

Number of Barrels: 2

Culvert Data Summary - DS-9

Barrel Shape: Circular

Barrel Diameter: 1.50 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Mitered to Conform to Slope

Inlet Depression: None

Roadway Data for Crossing: Sta 86+92.40 (Ex)

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 100.00 ft

Crest Elevation: 5749.00 ft

Roadway Surface: Paved

Roadway Top Width: 36.00 ft

Table 17 - Culvert Summary Table: DS-9

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
1.00	1.00	5744.74	0.373	0.0*	1-S2n	0.211	0.262	0.211	0.040	3.287	4.822
6.02	6.02	5745.34	0.975	0.213	1-S2n	0.521	0.659	0.525	0.116	5.456	9.467
11.03	11.03	5745.78	1.409	0.729	1-S2n	0.728	0.906	0.738	0.166	6.371	11.752
16.05	16.05	5746.33	1.963	1.349	5-S2n	0.917	1.097	0.930	0.206	6.975	13.382
21.17	21.17	5747.11	2.745	2.227	5-S2n	1.125	1.250	1.133	0.242	7.391	14.686
26.09	26.09	5748.04	3.672	2.974	7-M2c	1.500	1.352	1.352	0.272	7.775	15.741
31.10	30.61	5749.01	4.643	3.854	7-M2c	1.500	1.412	1.412	0.301	8.873	16.683
36.12	30.83	5749.07	4.698	3.897	7-M2c	1.500	1.414	1.414	0.327	8.928	17.508
41.14	30.97	5749.11	4.735	3.927	7-M2c	1.500	1.415	1.415	0.352	8.964	18.243
46.15	31.10	5749.14	4.767	3.952	7-M2c	1.500	1.417	1.417	0.375	8.996	18.926
51.17	31.20	5749.17	4.795	3.972	7-M2c	1.500	1.417	1.417	0.397	9.023	19.541

* Full Flow Headwater elevation is below inlet invert.

Straight Culvert

Inlet Elevation (invert): 5744.37 ft, Outlet Elevation (invert): 5743.81 ft

Culvert Length: 54.00 ft, Culvert Slope: 0.0104

Table 18 - Summary of Culvert Flows at Crossing: Sta 86+92.40 (Ex)

Headwater Elevation (ft)	Total Discharge (cfs)	DS-9 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
5744.74	1.00	1.00	0.00	1
5745.34	6.02	6.02	0.00	1
5745.78	11.03	11.03	0.00	1
5746.33	16.05	16.05	0.00	1
5747.11	21.17	21.17	0.00	1
5748.04	26.09	26.09	0.00	1
5749.01	31.10	30.61	0.44	10
5749.07	36.12	30.83	5.20	6
5749.11	41.14	30.97	10.01	4
5749.14	46.15	31.10	14.99	4
5749.17	51.17	31.20	19.80	3
5749.00	30.56	30.56	0.00	Overtopping

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 1 cfs

Design Flow: 21.17 cfs

Maximum Flow: 51.17 cfs

Site Data - DS-10

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 5741.40 ft

Outlet Station: 73.00 ft

Outlet Elevation: 5740.78 ft

Number of Barrels: 2

Culvert Data Summary - DS-10

Barrel Shape: Circular

Barrel Diameter: 1.50 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Square Edge with Headwall

Inlet Depression: None

Roadway Data for Crossing: Sta 87+16.62 (Ex)

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 100.00 ft

Crest Elevation: 5747.00 ft

Roadway Surface: Paved

Roadway Top Width: 64.00 ft

Table 19 - Culvert Summary Table: DS-10

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
1.00	1.00	5741.75	0.354	0.0*	1-S2n	0.222	0.262	0.222	0.043	3.060	4.536
6.02	6.02	5742.35	0.946	0.158	1-S2n	0.549	0.659	0.549	0.123	5.133	8.881
11.03	11.03	5742.78	1.379	0.683	1-S2n	0.772	0.906	0.772	0.176	6.019	11.007
16.05	16.05	5743.23	1.825	1.319	5-S2n	0.982	1.097	0.982	0.218	6.549	12.520
21.17	21.17	5743.81	2.414	2.219	5-S2n	1.240	1.250	1.240	0.256	6.776	13.733
26.09	26.09	5744.55	3.150	3.029	7-M2c	1.500	1.352	1.352	0.288	7.775	14.708
31.10	31.10	5745.47	4.073	4.007	7-M2c	1.500	1.417	1.417	0.318	8.997	15.581
36.12	36.12	5746.59	5.193	5.125	7-M2c	1.500	1.467	1.467	0.346	10.277	16.339
41.14	37.92	5747.05	5.648	5.577	6-FFc	1.500	1.500	1.500	0.372	10.730	17.028
46.15	38.08	5747.09	5.690	5.617	6-FFc	1.500	1.500	1.500	0.397	10.776	17.657
51.17	38.21	5747.12	5.724	5.649	6-FFc	1.500	1.500	1.500	0.420	10.812	18.228

* Full Flow Headwater elevation is below inlet invert.

Straight Culvert

Inlet Elevation (invert): 5741.40 ft, Outlet Elevation (invert): 5740.78 ft

Culvert Length: 73.00 ft, Culvert Slope: 0.0085

Table 20 - Summary of Culvert Flows at Crossing: Sta 87+16.62 (Ex)

Headwater Elevation (ft)	Total Discharge (cfs)	DS-10 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
5741.75	1.00	1.00	0.00	1
5742.35	6.02	6.02	0.00	1
5742.78	11.03	11.03	0.00	1
5743.23	16.05	16.05	0.00	1
5743.81	21.17	21.17	0.00	1
5744.55	26.09	26.09	0.00	1
5745.47	31.10	31.10	0.00	1
5746.59	36.12	36.12	0.00	1
5747.05	41.14	37.92	3.10	17
5747.09	46.15	38.08	7.99	5
5747.12	51.17	38.21	12.87	4
5747.00	37.73	37.73	0.00	Overtopping

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 0 cfs

Design Flow: 42.07 cfs

Maximum Flow: 74.65 cfs

Site Data - DS-12

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 5727.40 ft

Outlet Station: 35.00 ft

Outlet Elevation: 5724.59 ft

Number of Barrels: 4

Culvert Data Summary - DS-12

Barrel Shape: Circular

Barrel Diameter: 1.50 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Mitered to Conform to Slope

Inlet Depression: None

Roadway Data for Crossing: STA 109+78.40 (Ex)

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 100.00 ft

Crest Elevation: 5729.00 ft

Roadway Surface: Paved

Roadway Top Width: 30.00 ft

Table 21 - Culvert Summary Table: DS-12

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
0.00	0.00	5727.40	0.000	0.000	0-NF	0.000	0.000	0.000	0.000	0.000	0.000
7.47	7.47	5728.22	0.819	0.0*	1-S2n	0.244	0.514	0.244	0.072	9.969	19.537
14.93	14.93	5728.57	1.174	0.0*	1-S2n	0.344	0.738	0.364	0.109	11.241	25.224
22.40	22.40	5728.90	1.498	0.0*	1-S2n	0.423	0.912	0.461	0.138	12.140	29.196
29.86	25.63	5729.06	1.657	0.0*	5-S2n	0.453	0.979	0.502	0.163	12.350	32.315
37.33	26.60	5729.11	1.709	0.0*	5-S2n	0.462	0.998	0.511	0.186	12.525	34.943
42.07	27.10	5729.14	1.736	0.0*	5-S2n	0.466	1.007	0.515	0.199	12.626	36.415
52.26	28.03	5729.19	1.788	0.0*	5-S2n	0.474	1.025	0.524	0.226	12.746	39.176
59.72	28.61	5729.22	1.821	0.0*	5-S2n	0.479	1.036	0.533	0.244	12.727	41.002
67.19	29.16	5729.25	1.853	0.0*	5-S2n	0.484	1.046	0.540	0.261	12.728	42.627
74.65	29.66	5729.28	1.883	0.0*	5-S2n	0.488	1.055	0.546	0.277	12.739	44.145

* Full Flow Headwater elevation is below inlet invert.

Straight Culvert

Inlet Elevation (invert): 5727.40 ft, Outlet Elevation (invert): 5724.59 ft

Culvert Length: 35.11 ft, Culvert Slope: 0.0803

Table 22 - Summary of Culvert Flows at Crossing: STA 109+78.40 (Ex)

Headwater Elevation (ft)	Total Discharge (cfs)	DS-12 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
5727.40	0.00	0.00	0.00	1
5728.22	7.47	7.47	0.00	1
5728.57	14.93	14.93	0.00	1
5728.90	22.40	22.40	0.00	1
5729.06	29.86	25.63	4.07	9
5729.11	37.33	26.60	10.62	5
5729.14	42.07	27.10	14.87	4
5729.19	52.26	28.03	24.15	4
5729.22	59.72	28.61	30.92	3
5729.25	67.19	29.16	37.91	3
5729.28	74.65	29.66	44.93	3
5729.00	24.50	24.50	0.00	Overtopping

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 1 cfs

Design Flow: 59.93 cfs

Maximum Flow: 106.35 cfs

Site Data - DS-13

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 5727.03 ft

Outlet Station: 35.00 ft

Outlet Elevation: 5725.59 ft

Number of Barrels: 2

Culvert Data Summary - DS-13

Barrel Shape: Circular

Barrel Diameter: 2.50 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Square Edge with Headwall

Inlet Depression: None

Roadway Data for Crossing: STA 115+74.58 (Ex)

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 100.00 ft

Crest Elevation: 5729.41 ft

Roadway Surface: Paved

Roadway Top Width: 30.00 ft

Table 23 - Culvert Summary Table: DS-13

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
1.00	1.00	5727.33	0.299	0.0*	1-S2n	0.133	0.228	0.133	0.027	4.972	7.364
11.54	11.54	5728.09	1.059	0.0*	1-S2n	0.427	0.794	0.460	0.114	9.292	18.586
22.07	22.07	5728.59	1.558	0.0*	1-S2n	0.590	1.112	0.667	0.166	10.497	23.414
32.61	32.61	5729.02	1.992	0.228	1-S2n	0.719	1.364	0.841	0.208	11.230	26.805
43.14	42.80	5729.41	2.382	0.656	1-S2n	0.828	1.572	0.990	0.245	11.832	29.454
53.67	45.04	5729.50	2.470	0.754	1-S2n	0.850	1.614	1.019	0.277	11.972	31.688
59.93	45.93	5729.54	2.505	0.794	5-S2n	0.859	1.631	1.031	0.295	12.029	32.834
74.75	47.73	5729.61	2.577	0.874	5-S2n	0.877	1.663	1.056	0.334	12.096	35.284
85.28	48.83	5729.65	2.622	0.924	5-S2n	0.888	1.683	1.072	0.360	12.143	36.793
95.81	49.80	5729.69	2.662	0.969	5-S2n	0.897	1.700	1.085	0.384	12.186	38.167
106.35	50.73	5729.73	2.701	1.011	5-S2n	0.906	1.716	1.098	0.407	12.228	39.438

* Full Flow Headwater elevation is below inlet invert.

Straight Culvert

Inlet Elevation (invert): 5727.03 ft, Outlet Elevation (invert): 5725.59 ft

Culvert Length: 35.03 ft, Culvert Slope: 0.0411

Table 24 - Summary of Culvert Flows at Crossing: STA 115+74.58 (Ex)

Headwater Elevation (ft)	Total Discharge (cfs)	DS-13 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
5727.33	1.00	1.00	0.00	1
5728.09	11.54	11.54	0.00	1
5728.59	22.07	22.07	0.00	1
5729.02	32.61	32.61	0.00	1
5729.41	43.14	42.80	0.15	27
5729.50	53.67	45.04	8.44	6
5729.54	59.93	45.93	13.73	4
5729.61	74.75	47.73	26.80	4
5729.65	85.28	48.83	36.38	4
5729.69	95.81	49.80	45.79	3
5729.73	106.35	50.73	55.48	3
5729.41	42.63	42.63	0.00	Overtopping

HY-8 Culvert Analysis Report

Proposed

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 1 cfs

Design Flow: 40 cfs

Maximum Flow: 84.4 cfs

Site Data - DS-1

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 5782.56 ft

Outlet Station: 108.55 ft

Outlet Elevation: 5780.74 ft

Number of Barrels: 2

Culvert Data Summary - DS-1

Barrel Shape: Circular

Barrel Diameter: 3.00 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Mitered to Conform to Slope

Inlet Depression: None

Roadway Data for Crossing: Sta 19+99.75 (Proposed)

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 100.00 ft

Crest Elevation: 5790.50 ft

Roadway Surface: Paved

Roadway Top Width: 64.00 ft

Table 25 - Culvert Summary Table: DS-1

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
1.00	1.00	5782.87	0.310	0.0*	1-S2n	0.157	0.218	0.157	0.034	3.534	5.693
9.34	9.34	5783.54	0.976	0.0*	1-S2n	0.455	0.676	0.455	0.129	6.911	13.174
17.68	17.68	5783.93	1.367	0.0*	1-S2n	0.622	0.938	0.622	0.187	8.340	16.493
26.02	26.02	5784.25	1.691	0.0*	1-S2n	0.754	1.147	0.770	0.233	9.073	18.809
34.36	34.36	5784.53	1.973	0.0*	1-S2n	0.869	1.325	0.899	0.273	9.640	20.629
40.00	40.00	5784.71	2.148	0.0*	1-S2n	0.940	1.435	0.978	0.298	9.999	21.692
51.04	51.04	5785.04	2.477	0.289	1-S2n	1.069	1.630	1.118	0.342	10.626	23.459
59.38	59.38	5785.29	2.734	0.593	1-S2n	1.160	1.765	1.213	0.372	11.080	24.611
67.72	67.72	5785.57	3.011	0.912	5-S2n	1.246	1.890	1.314	0.400	11.371	25.648
76.06	76.06	5785.88	3.316	1.250	5-S2n	1.330	2.006	1.404	0.426	11.714	26.596
84.40	84.40	5786.21	3.654	1.605	5-S2n	1.411	2.116	1.498	0.452	11.964	27.461

* Full Flow Headwater elevation is below inlet invert.

Straight Culvert

Inlet Elevation (invert): 5782.56 ft, Outlet Elevation (invert): 5780.74 ft

Culvert Length: 108.57 ft, Culvert Slope: 0.0168

Table 26 - Summary of Culvert Flows at Crossing: Sta 19+99.75 (Proposed)

Headwater Elevation (ft)	Total Discharge (cfs)	DS-1 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
5782.87	1.00	1.00	0.00	1
5783.54	9.34	9.34	0.00	1
5783.93	17.68	17.68	0.00	1
5784.25	26.02	26.02	0.00	1
5784.53	34.36	34.36	0.00	1
5784.71	40.00	40.00	0.00	1
5785.04	51.04	51.04	0.00	1
5785.29	59.38	59.38	0.00	1
5785.57	67.72	67.72	0.00	1
5785.88	76.06	76.06	0.00	1
5786.21	84.40	84.40	0.00	1
5790.50	155.62	155.62	0.00	Overtopping

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 1 cfs

Design Flow: 250 cfs

Maximum Flow: 340 cfs

Site Data - DS-2

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 5779.41 ft

Outlet Station: 122.00 ft

Outlet Elevation: 5778.90 ft

Number of Barrels: 5

Culvert Data Summary - DS-2

Barrel Shape: Circular

Barrel Diameter: 3.00 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Mitered to Conform to Slope

Inlet Depression: None

Roadway Data for Crossing: Sta 25+03.92 (Proposed)

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 100.00 ft

Crest Elevation: 5788.50 ft

Roadway Surface: Paved

Roadway Top Width: 64.00 ft

Table 27 - Culvert Summary Table: DS-2

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
1.00	1.00	5779.63	0.190	0.215	2-M2c	0.138	0.137	0.137	0.051	1.726	3.785
34.90	34.90	5780.60	1.186	0.358	1-S2n	0.782	0.831	0.782	0.401	4.757	13.195
68.80	68.80	5781.13	1.719	0.814	1-S2n	1.114	1.180	1.114	0.580	5.759	16.215
102.70	102.70	5781.56	2.154	1.266	1-S2n	1.390	1.455	1.390	0.717	6.407	18.218
136.60	136.60	5781.97	2.560	1.747	1-S2n	1.646	1.689	1.649	0.831	6.862	19.760
170.50	170.50	5782.69	3.001	3.279	7-M2c	1.900	1.896	1.896	0.930	7.240	21.019
204.40	204.40	5783.05	3.517	3.642	7-M2c	2.171	2.082	2.082	1.019	7.808	22.097
250.00	250.00	5783.77	4.362	4.159	7-M2c	3.000	2.301	2.301	1.127	8.594	23.345
272.20	272.20	5784.25	4.839	4.456	7-M2c	3.000	2.395	2.395	1.175	8.997	23.891
306.10	306.10	5785.05	5.642	5.079	7-M2c	3.000	2.523	2.523	1.244	9.649	24.659
340.00	340.00	5785.94	6.526	5.829	7-M2c	3.000	2.630	2.630	1.309	10.353	25.366

Straight Culvert

Inlet Elevation (invert): 5779.41 ft, Outlet Elevation (invert): 5778.90 ft

Culvert Length: 122.00 ft, Culvert Slope: 0.0042

Table 28 - Summary of Culvert Flows at Crossing: Sta 25+03.92 (Proposed)

Headwater Elevation (ft)	Total Discharge (cfs)	DS-2 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
5779.63	1.00	1.00	0.00	1
5780.60	34.90	34.90	0.00	1
5781.13	68.80	68.80	0.00	1
5781.56	102.70	102.70	0.00	1
5781.97	136.60	136.60	0.00	1
5782.69	170.50	170.50	0.00	1
5783.05	204.40	204.40	0.00	1
5783.77	250.00	250.00	0.00	1
5784.25	272.20	272.20	0.00	1
5785.05	306.10	306.10	0.00	1
5785.94	340.00	340.00	0.00	1
5788.50	427.91	427.91	0.00	Overtopping

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 1 cfs

Design Flow: 6.58 cfs

Maximum Flow: 32.48 cfs

Site Data - DS-3

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 5777.59 ft

Outlet Station: 112.00 ft

Outlet Elevation: 5776.60 ft

Number of Barrels: 2

Culvert Data Summary - DS-3

Barrel Shape: Circular

Barrel Diameter: 2.00 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Mitered to Conform to Slope

Inlet Depression: None

Roadway Data for Crossing: Sta 31+04.22 (Proposed)

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 100.00 ft

Crest Elevation: 5783.50 ft

Roadway Surface: Paved

Roadway Top Width: 64.00 ft

Table 29 - Culvert Summary Table: DS-3

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
1.00	1.00	5777.93	0.343	0.0*	1-S2n	0.203	0.242	0.203	0.043	2.984	4.519
4.15	4.15	5778.31	0.716	0.0*	1-S2n	0.405	0.500	0.405	0.100	4.557	7.722
6.58	6.58	5778.50	0.914	0.0*	1-S2n	0.510	0.634	0.510	0.131	5.209	9.126
10.44	10.44	5778.77	1.182	0.0*	1-S2n	0.646	0.806	0.646	0.171	5.943	10.754
13.59	13.59	5778.96	1.369	0.143	1-S2n	0.743	0.924	0.743	0.199	6.393	11.778
16.74	16.74	5779.13	1.543	0.358	1-S2n	0.833	1.031	0.833	0.224	6.763	12.651
19.89	19.89	5779.31	1.716	0.586	1-S2n	0.917	1.128	0.917	0.248	7.076	13.403
23.04	23.04	5779.49	1.900	0.829	1-S2n	0.999	1.218	0.999	0.269	7.346	14.068
26.18	26.18	5779.69	2.101	1.088	5-S2n	1.078	1.302	1.078	0.290	7.579	14.669
29.33	29.33	5779.92	2.326	1.364	5-S2n	1.157	1.380	1.164	0.309	7.734	15.222
32.48	32.48	5780.17	2.576	1.657	5-S2n	1.237	1.453	1.244	0.327	7.910	15.733

* Full Flow Headwater elevation is below inlet invert.

Straight Culvert

Inlet Elevation (invert): 5777.59 ft, Outlet Elevation (invert): 5776.60 ft

Culvert Length: 112.00 ft, Culvert Slope: 0.0088

Table 30 - Summary of Culvert Flows at Crossing: Sta 31+04.22 (Proposed)

Headwater Elevation (ft)	Total Discharge (cfs)	DS-3 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
5777.93	1.00	1.00	0.00	1
5778.31	4.15	4.15	0.00	1
5778.50	6.58	6.58	0.00	1
5778.77	10.44	10.44	0.00	1
5778.96	13.59	13.59	0.00	1
5779.13	16.74	16.74	0.00	1
5779.31	19.89	19.89	0.00	1
5779.49	23.04	23.04	0.00	1
5779.69	26.18	26.18	0.00	1
5779.92	29.33	29.33	0.00	1
5780.17	32.48	32.48	0.00	1
5783.50	61.04	61.04	0.00	Overtopping

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 1 cfs

Design Flow: 36.92 cfs

Maximum Flow: 83 cfs

Site Data - DS-4

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 5778.86 ft

Outlet Station: 132.00 ft

Outlet Elevation: 5777.74 ft

Number of Barrels: 4

Culvert Data Summary - DS-4

Barrel Shape: Circular

Barrel Diameter: 3.00 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Mitered to Conform to Slope

Inlet Depression: None

Roadway Data for Crossing: Sta 45+56.39 (Proposed)

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 100.00 ft

Crest Elevation: 5786.00 ft

Roadway Surface: Paved

Roadway Top Width: 64.00 ft

Table 31 - Culvert Summary Table: DS-4

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
1.00	1.00	5779.08	0.217	0.0*	1-S2n	0.128	0.154	0.128	0.030	2.326	6.602
9.20	9.20	5779.53	0.669	0.0*	1-S2n	0.381	0.471	0.381	0.111	4.404	15.269
17.40	17.40	5779.79	0.930	0.0*	1-S2n	0.518	0.652	0.518	0.161	5.330	19.163
25.60	25.60	5780.00	1.139	0.0*	1-S2n	0.627	0.795	0.627	0.201	5.966	21.913
36.92	36.92	5780.24	1.384	0.0*	1-S2n	0.753	0.960	0.753	0.248	6.635	24.791
42.00	42.00	5780.34	1.483	0.0*	1-S2n	0.804	1.026	0.804	0.267	6.887	25.892
50.20	50.20	5780.50	1.640	0.128	1-S2n	0.881	1.125	0.889	0.296	7.157	27.438
58.40	58.40	5780.65	1.786	0.264	1-S2n	0.953	1.217	0.953	0.322	7.561	28.829
66.60	66.60	5780.78	1.922	0.400	1-S2n	1.021	1.304	1.030	0.347	7.755	30.065
74.80	74.80	5780.91	2.051	0.538	1-S2n	1.086	1.385	1.098	0.370	7.983	31.198
83.00	83.00	5781.04	2.175	0.679	1-S2n	1.149	1.463	1.162	0.392	8.204	32.231

* Full Flow Headwater elevation is below inlet invert.

Straight Culvert

Inlet Elevation (invert): 5778.86 ft, Outlet Elevation (invert): 5777.74 ft

Culvert Length: 132.00 ft, Culvert Slope: 0.0085

Table 32 - Summary of Culvert Flows at Crossing: Sta 45+56.39 (Proposed)

Headwater Elevation (ft)	Total Discharge (cfs)	DS-4 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
5779.08	1.00	1.00	0.00	1
5779.53	9.20	9.20	0.00	1
5779.79	17.40	17.40	0.00	1
5780.00	25.60	25.60	0.00	1
5780.24	36.92	36.92	0.00	1
5780.34	42.00	42.00	0.00	1
5780.50	50.20	50.20	0.00	1
5780.65	58.40	58.40	0.00	1
5780.78	66.60	66.60	0.00	1
5780.91	74.80	74.80	0.00	1
5781.04	83.00	83.00	0.00	1
5786.00	289.47	289.47	0.00	Overtopping

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 1 cfs

Design Flow: 24.08 cfs

Maximum Flow: 43.12 cfs

Site Data - DS-5

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 5780.28 ft

Outlet Station: 110.00 ft

Outlet Elevation: 5778.19 ft

Number of Barrels: 2

Culvert Data Summary - DS-5

Barrel Shape: Circular

Barrel Diameter: 2.00 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Mitered to Conform to Slope

Inlet Depression: None

Roadway Data for Crossing: Sta 52+84.14 (Proposed)

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 100.00 ft

Crest Elevation: 5786.50 ft

Roadway Surface: Paved

Roadway Top Width: 64.00 ft

Table 33 - Culvert Summary Table: DS-5

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
1.00	1.00	5780.63	0.347	0.0*	1-S2n	0.168	0.242	0.168	0.031	3.928	6.269
5.21	5.21	5781.10	0.819	0.0*	1-S2n	0.375	0.562	0.375	0.083	6.391	11.738
9.42	9.42	5781.41	1.129	0.0*	1-S2n	0.504	0.764	0.504	0.118	7.589	14.606
13.64	13.64	5781.67	1.386	0.0*	1-S2n	0.609	0.926	0.609	0.146	8.432	16.669
17.85	17.85	5781.90	1.618	0.0*	1-S2n	0.701	1.066	0.701	0.171	9.093	18.330
24.08	24.08	5782.26	1.979	0.0*	1-S2n	0.824	1.246	0.839	0.204	9.626	20.319
26.27	26.27	5782.40	2.122	0.0*	5-S2n	0.865	1.304	0.894	0.214	9.666	20.922
30.48	30.48	5782.71	2.428	0.362	5-S2n	0.941	1.407	0.961	0.233	10.207	22.014
34.70	34.70	5783.06	2.782	1.014	5-S2n	1.015	1.501	1.048	0.251	10.412	22.980
38.91	38.91	5783.46	3.185	1.404	5-S2n	1.087	1.585	1.125	0.268	10.684	23.863
43.12	43.12	5783.91	3.634	1.830	5-S2n	1.159	1.661	1.200	0.285	10.950	24.691

* Full Flow Headwater elevation is below inlet invert.

Straight Culvert

Inlet Elevation (invert): 5780.28 ft, Outlet Elevation (invert): 5778.19 ft

Culvert Length: 110.02 ft, Culvert Slope: 0.0190

Table 34 - Summary of Culvert Flows at Crossing: Sta 52+84.14 (Proposed)

Headwater Elevation (ft)	Total Discharge (cfs)	DS-5 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
5780.63	1.00	1.00	0.00	1
5781.10	5.21	5.21	0.00	1
5781.41	9.42	9.42	0.00	1
5781.67	13.64	13.64	0.00	1
5781.90	17.85	17.85	0.00	1
5782.26	24.08	24.08	0.00	1
5782.40	26.27	26.27	0.00	1
5782.71	30.48	30.48	0.00	1
5783.06	34.70	34.70	0.00	1
5783.46	38.91	38.91	0.00	1
5783.91	43.12	43.12	0.00	1
5786.50	62.94	62.94	0.00	Overtopping

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 1 cfs

Design Flow: 81.65 cfs

Maximum Flow: 200.09 cfs

Site Data - DS-6

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 5778.00 ft

Outlet Station: 96.00 ft

Outlet Elevation: 5777.30 ft

Number of Barrels: 5

Culvert Data Summary - DS-6

Barrel Shape: Circular

Barrel Diameter: 3.50 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Mitered to Conform to Slope

Inlet Depression: None

Roadway Data for Crossing: Sta 57+16.54 (Proposed)

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 100.00 ft

Crest Elevation: 5787.00 ft

Roadway Surface: Paved

Roadway Top Width: 64.00 ft

Table 35 - Culvert Summary Table: DS-6

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
1.00	1.00	5778.18	0.182	0.0*	1-S2n	0.113	0.132	0.113	0.011	2.059	4.718
20.91	20.91	5778.87	0.870	0.0*	1-S2n	0.503	0.612	0.503	0.066	4.906	15.746
40.82	40.82	5779.23	1.232	0.186	1-S2n	0.699	0.862	0.699	0.098	5.968	20.479
60.73	60.73	5779.52	1.519	0.411	1-S2n	0.852	1.057	0.861	0.124	6.604	23.898
81.65	81.65	5779.78	1.783	0.630	1-S2n	0.991	1.232	1.004	0.148	7.155	26.813
100.54	100.54	5780.01	2.006	0.821	1-S2n	1.103	1.373	1.121	0.167	7.560	29.048
120.45	120.45	5780.22	2.219	1.021	1-S2n	1.213	1.508	1.237	0.187	7.922	31.123
140.36	140.36	5780.42	2.418	1.222	1-S2n	1.316	1.634	1.345	0.204	8.240	32.994
160.27	160.27	5780.61	2.608	1.427	1-S2n	1.415	1.751	1.449	0.221	8.520	34.718
180.18	180.18	5780.80	2.796	1.637	1-S2n	1.510	1.862	1.548	0.237	8.779	36.278
200.09	200.09	5780.99	2.987	1.853	1-S2n	1.602	1.967	1.644	0.252	9.014	37.769

* Full Flow Headwater elevation is below inlet invert.

Straight Culvert

Inlet Elevation (invert): 5778.00 ft, Outlet Elevation (invert): 5777.30 ft

Culvert Length: 96.00 ft, Culvert Slope: 0.0073

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Table 36 - Summary of Culvert Flows at Crossing: Sta 57+16.54 (Proposed)

Headwater Elevation (ft)	Total Discharge (cfs)	DS-6 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
5778.18	1.00	1.00	0.00	1
5778.87	20.91	20.91	0.00	1
5779.23	40.82	40.82	0.00	1
5779.52	60.73	60.73	0.00	1
5779.78	81.65	81.65	0.00	1
5780.01	100.54	100.54	0.00	1
5780.22	120.45	120.45	0.00	1
5780.42	140.36	140.36	0.00	1
5780.61	160.27	160.27	0.00	1
5780.80	180.18	180.18	0.00	1
5780.99	200.09	200.09	0.00	1
5787.00	561.59	561.59	0.00	Overtopping

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 1 cfs

Design Flow: 7.12 cfs

Maximum Flow: 12.75 cfs

Site Data - DS-7

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 5789.39 ft

Outlet Station: 100.00 ft

Outlet Elevation: 5786.30 ft

Number of Barrels: 1

Culvert Data Summary - DS-7

Barrel Shape: Circular

Barrel Diameter: 2.00 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Mitered to Conform to Slope

Inlet Depression: None

Roadway Data for Crossing: Sta 65+21.61 (Proposed)

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 100.00 ft

Crest Elevation: 5794.00 ft

Roadway Surface: Paved

Roadway Top Width: 64.00 ft

Table 37 - Culvert Summary Table: DS-7

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
1.00	1.00	5789.89	0.504	0.0*	1-S2n	0.210	0.344	0.210	0.028	5.700	7.050
2.17	2.17	5790.15	0.756	0.0*	1-S2n	0.305	0.512	0.305	0.044	7.181	9.511
3.35	3.35	5790.34	0.950	0.0*	1-S2n	0.376	0.640	0.376	0.057	8.170	11.197
4.53	4.53	5790.51	1.121	0.0*	1-S2n	0.437	0.748	0.437	0.068	8.920	12.534
5.70	5.70	5790.66	1.272	0.0*	1-S2n	0.490	0.843	0.490	0.078	9.536	13.686
7.12	7.12	5790.83	1.436	0.0*	1-S2n	0.549	0.947	0.560	0.089	9.886	14.866
8.05	8.05	5790.93	1.539	0.0*	1-S2n	0.585	1.010	0.585	0.096	10.524	15.561
9.22	9.22	5791.06	1.667	0.0*	1-S2n	0.628	1.085	0.635	0.104	10.766	16.344
10.40	10.40	5791.19	1.799	0.0*	1-S2n	0.668	1.155	0.696	0.112	10.685	17.080
11.58	11.58	5791.33	1.938	0.0*	1-S2n	0.707	1.221	0.721	0.119	11.337	17.762
12.75	12.75	5791.48	2.087	0.0*	5-S2n	0.745	1.284	0.776	0.126	11.311	18.377

* Full Flow Headwater elevation is below inlet invert.

Straight Culvert

Inlet Elevation (invert): 5789.39 ft, Outlet Elevation (invert): 5786.30 ft

Culvert Length: 100.05 ft, Culvert Slope: 0.0309

Table 38 - Summary of Culvert Flows at Crossing: Sta 65+21.61 (Proposed)

Headwater Elevation (ft)	Total Discharge (cfs)	DS-7 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
5789.89	1.00	1.00	0.00	1
5790.15	2.17	2.17	0.00	1
5790.34	3.35	3.35	0.00	1
5790.51	4.53	4.53	0.00	1
5790.66	5.70	5.70	0.00	1
5790.83	7.12	7.12	0.00	1
5790.93	8.05	8.05	0.00	1
5791.06	9.22	9.22	0.00	1
5791.19	10.40	10.40	0.00	1
5791.33	11.58	11.58	0.00	1
5791.48	12.75	12.75	0.00	1
5794.00	25.56	25.56	0.00	Overtopping

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 1 cfs

Design Flow: 9.86 cfs

Maximum Flow: 23.83 cfs

Site Data - DS-8

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 5757.98 ft

Outlet Station: 140.00 ft

Outlet Elevation: 5754.31 ft

Number of Barrels: 4

Culvert Data Summary - DS-8

Barrel Shape: Circular

Barrel Diameter: 3.00 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Mitered to Conform to Slope

Inlet Depression: None

Roadway Data for Crossing: Sta 78+34.60 (Proposed)

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 100.00 ft

Crest Elevation: 5764.00 ft

Roadway Surface: Paved

Roadway Top Width: 64.00 ft

Table 39 - Culvert Summary Table: DS-8

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
1.00	1.00	5758.20	0.222	0.0*	1-S2n	0.096	0.154	0.096	0.031	3.517	6.398
3.28	3.28	5758.38	0.403	0.0*	1-S2n	0.175	0.280	0.175	0.062	4.867	10.094
5.57	5.57	5758.51	0.528	0.0*	1-S2n	0.229	0.365	0.229	0.085	5.614	12.309
7.85	7.85	5758.61	0.630	0.0*	1-S2n	0.267	0.435	0.267	0.104	6.282	13.984
9.86	9.86	5758.69	0.709	0.0*	1-S2n	0.300	0.488	0.300	0.119	6.684	15.180
12.41	12.41	5758.78	0.799	0.0*	1-S2n	0.334	0.549	0.334	0.136	7.184	16.493
14.70	14.70	5758.85	0.872	0.0*	1-S2n	0.363	0.598	0.363	0.150	7.548	17.513
16.98	16.98	5758.92	0.940	0.0*	1-S2n	0.390	0.644	0.390	0.163	7.858	18.427
19.26	19.26	5758.98	1.004	0.0*	1-S2n	0.413	0.687	0.413	0.175	8.180	19.265
21.55	21.55	5759.04	1.065	0.0*	1-S2n	0.436	0.727	0.438	0.187	8.405	20.029
23.83	23.83	5759.10	1.123	0.0*	1-S2n	0.460	0.766	0.460	0.199	8.687	20.719

* Full Flow Headwater elevation is below inlet invert.

Straight Culvert

Inlet Elevation (invert): 5757.98 ft, Outlet Elevation (invert): 5754.31 ft

Culvert Length: 140.05 ft, Culvert Slope: 0.0262

Table 40 - Summary of Culvert Flows at Crossing: Sta 78+34.60 (Proposed)

Headwater Elevation (ft)	Total Discharge (cfs)	DS-8 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
5758.20	1.00	1.00	0.00	1
5758.38	3.28	3.28	0.00	1
5758.51	5.57	5.57	0.00	1
5758.61	7.85	7.85	0.00	1
5758.69	9.86	9.86	0.00	1
5758.78	12.41	12.41	0.00	1
5758.85	14.70	14.70	0.00	1
5758.92	16.98	16.98	0.00	1
5758.98	19.26	19.26	0.00	1
5759.04	21.55	21.55	0.00	1
5759.10	23.83	23.83	0.00	1
5764.00	255.28	255.28	0.00	Overtopping

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 1 cfs

Design Flow: 21.17 cfs

Maximum Flow: 51.17 cfs

Site Data - DS-9

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 5742.63 ft

Outlet Station: 100.00 ft

Outlet Elevation: 5741.34 ft

Number of Barrels: 3

Culvert Data Summary - DS-9

Barrel Shape: Pipe Arch

Barrel Span: 28.50 in

Barrel Rise: 18.00 in

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Grooved Edge with Headwall

Inlet Depression: None

Roadway Data for Crossing: Sta 86+92.40 (Proposed)

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 100.00 ft

Crest Elevation: 5746.00 ft

Roadway Surface: Paved

Roadway Top Width: 64.00 ft

Table 41 - Culvert Summary Table: DS-9

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
1.00	1.00	5742.83	0.199	0.0*	1-S2n	0.113	0.144	0.113	0.027	2.519	3.728
6.02	6.02	5743.11	0.476	0.0*	1-S2n	0.262	0.361	0.262	0.078	4.608	7.510
11.03	11.03	5743.30	0.673	0.0*	1-S2n	0.356	0.504	0.356	0.112	5.666	9.471
16.05	16.05	5743.48	0.852	0.0*	1-S2n	0.434	0.621	0.434	0.139	6.419	10.907
21.17	21.17	5743.66	1.030	0.0*	1-S2n	0.507	0.727	0.507	0.164	7.021	12.097
26.09	26.09	5743.83	1.197	0.0*	1-S2n	0.572	0.819	0.579	0.186	7.388	13.069
31.10	31.10	5744.00	1.368	0.136	1-S2n	0.637	0.906	0.644	0.206	7.807	13.948
36.12	36.12	5744.17	1.543	0.398	5-S2n	0.701	0.987	0.712	0.225	8.111	14.724
41.14	41.14	5744.36	1.727	0.681	5-S2n	0.765	1.062	0.778	0.243	8.396	15.435
46.15	46.15	5744.55	1.922	1.169	5-S2n	0.831	1.130	0.845	0.260	8.649	16.092
51.17	51.17	5744.76	2.130	1.462	5-S2n	0.898	1.191	0.914	0.276	8.854	16.695

* Full Flow Headwater elevation is below inlet invert.

Straight Culvert

Inlet Elevation (invert): 5742.63 ft, Outlet Elevation (invert): 5741.34 ft

Culvert Length: 100.01 ft, Culvert Slope: 0.0129

Table 42 - Summary of Culvert Flows at Crossing: Sta 86+92.40 (Proposed)

Headwater Elevation (ft)	Total Discharge (cfs)	DS-9 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
5742.83	1.00	1.00	0.00	1
5743.11	6.02	6.02	0.00	1
5743.30	11.03	11.03	0.00	1
5743.48	16.05	16.05	0.00	1
5743.66	21.17	21.17	0.00	1
5743.83	26.09	26.09	0.00	1
5744.00	31.10	31.10	0.00	1
5744.17	36.12	36.12	0.00	1
5744.36	41.14	41.14	0.00	1
5744.55	46.15	46.15	0.00	1
5744.76	51.17	51.17	0.00	1
5746.00	75.42	75.42	0.00	Overtopping

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 1 cfs

Design Flow: 21.17 cfs

Maximum Flow: 51.17 cfs

Site Data - DS-10

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 5741.56 ft

Outlet Station: 120.00 ft

Outlet Elevation: 5740.46 ft

Number of Barrels: 2

Culvert Data Summary - DS-10

Barrel Shape: Circular

Barrel Diameter: 2.00 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Square Edge with Headwall

Inlet Depression: None

Roadway Data for Crossing: Sta 87+16.62 (Proposed)

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 100.00 ft

Crest Elevation: 5747.00 ft

Roadway Surface: Paved

Roadway Top Width: 64.00 ft

Table 43 - Culvert Summary Table: DS-10

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
1.00	1.00	5741.89	0.326	0.0*	1-S2n	0.201	0.242	0.201	0.043	3.025	4.536
6.02	6.02	5742.39	0.827	0.0*	1-S2n	0.483	0.605	0.483	0.123	5.147	8.881
11.03	11.03	5742.73	1.174	0.0*	1-S2n	0.659	0.829	0.659	0.176	6.114	11.007
16.05	16.05	5743.04	1.481	0.188	1-S2n	0.805	1.008	0.805	0.218	6.777	12.520
21.17	21.17	5743.32	1.760	0.553	1-S2n	0.941	1.166	0.941	0.256	7.289	13.733
26.09	26.09	5743.58	2.025	0.939	5-S2n	1.064	1.299	1.070	0.288	7.628	14.708
31.10	31.10	5743.88	2.317	1.373	5-S2n	1.188	1.422	1.195	0.318	7.941	15.581
36.12	36.12	5744.21	2.646	2.083	5-S2n	1.314	1.531	1.320	0.346	8.209	16.339
41.14	41.14	5744.58	3.025	2.552	5-S2n	1.449	1.626	1.454	0.372	8.408	17.028
46.15	46.15	5745.02	3.458	3.069	5-S2n	1.607	1.708	1.610	0.397	8.515	17.657
51.17	51.17	5745.51	3.948	3.509	7-M2c	2.000	1.776	1.776	0.420	8.677	18.228

* Full Flow Headwater elevation is below inlet invert.

Straight Culvert

Inlet Elevation (invert): 5741.56 ft, Outlet Elevation (invert): 5740.46 ft

Culvert Length: 120.01 ft, Culvert Slope: 0.0092

Table 44 - Summary of Culvert Flows at Crossing: Sta 87+16.62 (Proposed)

Headwater Elevation (ft)	Total Discharge (cfs)	DS-10 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
5741.89	1.00	1.00	0.00	1
5742.39	6.02	6.02	0.00	1
5742.73	11.03	11.03	0.00	1
5743.04	16.05	16.05	0.00	1
5743.32	21.17	21.17	0.00	1
5743.58	26.09	26.09	0.00	1
5743.88	31.10	31.10	0.00	1
5744.21	36.12	36.12	0.00	1
5744.58	41.14	41.14	0.00	1
5745.02	46.15	46.15	0.00	1
5745.51	51.17	51.17	0.00	1
5747.00	63.92	63.92	0.00	Overtopping

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 1 cfs

Design Flow: 327 cfs

Maximum Flow: 595 cfs

Site Data - DS-11

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 5720.40 ft

Outlet Station: 62.00 ft

Outlet Elevation: 5719.16 ft

Number of Barrels: 2

Culvert Data Summary - DS-11

Barrel Shape: Concrete Box

Barrel Span: 10.00 ft

Barrel Rise: 7.00 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Square Edge (90°) Headwall

Inlet Depression: None

Roadway Data for Crossing: Sta 99+54.73 (Proposed)

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 100.00 ft

Crest Elevation: 5728.00 ft

Roadway Surface: Paved

Roadway Top Width: 64.00 ft

Table 47 - Culvert Summary Table: DS-11

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
1.00	1.00	5720.47	0.072	0.0*	1-S2n	0.009	0.043	0.009	0.016	5.454	2.439
60.40	60.40	5721.50	1.105	0.0*	1-S2n	0.357	0.657	0.371	0.190	8.149	12.327
119.80	119.80	5722.14	1.744	0.0*	1-S2n	0.546	1.037	0.604	0.286	9.920	16.021
179.20	179.20	5722.68	2.281	0.157	1-S2n	0.703	1.356	0.809	0.363	11.077	18.654
238.60	238.60	5723.16	2.761	0.473	1-S2n	0.842	1.641	1.006	0.430	11.860	20.757
327.00	327.00	5723.81	3.407	0.920	1-S2n	1.032	2.025	1.278	0.518	12.792	23.306
357.40	357.40	5724.01	3.614	1.070	1-S2n	1.094	2.148	1.370	0.546	13.047	24.076
416.80	416.80	5724.40	3.996	1.360	1-S2n	1.208	2.380	1.541	0.598	13.525	25.459
476.20	476.20	5724.76	4.361	1.649	1-S2n	1.318	2.601	1.707	0.646	13.948	26.704
535.60	535.60	5725.11	4.711	1.937	1-S2n	1.424	2.814	1.869	0.692	14.329	27.851
595.00	595.00	5725.45	5.049	2.226	1-S2n	1.526	3.018	2.027	0.736	14.677	28.912

* Full Flow Headwater elevation is below inlet invert.

Straight Culvert

Inlet Elevation (invert): 5720.40 ft, Outlet Elevation (invert): 5719.16 ft

Culvert Length: 62.01 ft, Culvert Slope: 0.0200

Table 48 - Summary of Culvert Flows at Crossing: Sta 99+54.73 (Proposed)

Headwater Elevation (ft)	Total Discharge (cfs)	DS-11 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
5720.47	1.00	1.00	0.00	1
5721.50	60.40	60.40	0.00	1
5722.14	119.80	119.80	0.00	1
5722.68	179.20	179.20	0.00	1
5723.16	238.60	238.60	0.00	1
5723.81	327.00	327.00	0.00	1
5724.01	357.40	357.40	0.00	1
5724.40	416.80	416.80	0.00	1
5724.76	476.20	476.20	0.00	1
5725.11	535.60	535.60	0.00	1
5725.45	595.00	595.00	0.00	1
5728.00	1079.00	1079.00	0.00	Overtopping

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 0 cfs

Design Flow: 18.66 cfs

Maximum Flow: 33.11 cfs

Site Data - DS-12

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 5722.16 ft

Outlet Station: 100.00 ft

Outlet Elevation: 5716.26 ft

Number of Barrels: 2

Culvert Data Summary - DS-12

Barrel Shape: Circular

Barrel Diameter: 2.00 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Mitered to Conform to Slope

Inlet Depression: None

Roadway Data for Crossing: STA 109+78.40 (Proposed)

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 100.00 ft

Crest Elevation: 5726.00 ft

Roadway Surface: Paved

Roadway Top Width: 64.00 ft

Table 45 - Culvert Summary Table: DS-12

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
0.00	0.00	5722.16	0.000	0.000	0-NF	0.000	0.000	0.000	0.000	0.000	0.000
3.31	3.31	5722.84	0.680	0.0*	1-S2n	0.228	0.445	0.228	0.045	8.344	14.325
6.62	6.62	5723.14	0.982	0.0*	1-S2n	0.319	0.636	0.319	0.067	10.227	18.653
9.93	9.93	5723.38	1.219	0.0*	1-S2n	0.389	0.785	0.389	0.086	11.526	21.719
13.24	13.24	5723.58	1.419	0.0*	1-S2n	0.449	0.912	0.449	0.101	12.528	24.139
16.56	16.56	5723.76	1.603	0.0*	1-S2n	0.503	1.025	0.503	0.116	13.362	26.179
18.66	18.66	5723.88	1.718	0.0*	1-S2n	0.534	1.091	0.534	0.124	13.833	27.366
23.18	23.18	5724.14	1.979	0.0*	1-S2n	0.597	1.222	0.597	0.141	14.712	29.535
26.49	26.49	5724.35	2.192	0.0*	5-S2n	0.640	1.310	0.640	0.152	15.276	30.982
29.80	29.80	5724.59	2.431	0.0*	5-S2n	0.681	1.391	0.708	0.163	14.964	32.293
33.11	33.11	5724.86	2.699	0.0*	5-S2n	0.720	1.467	0.756	0.173	15.213	33.531

* Full Flow Headwater elevation is below inlet invert.

Straight Culvert

Inlet Elevation (invert): 5722.16 ft, Outlet Elevation (invert): 5716.26 ft

Culvert Length: 100.17 ft, Culvert Slope: 0.0590

Table 46 - Summary of Culvert Flows at Crossing: STA 109+78.40 (Proposed)

Headwater Elevation (ft)	Total Discharge (cfs)	DS-12 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
5722.16	0.00	0.00	0.00	1
5722.84	3.31	3.31	0.00	1
5723.14	6.62	6.62	0.00	1
5723.38	9.93	9.93	0.00	1
5723.58	13.24	13.24	0.00	1
5723.76	16.56	16.56	0.00	1
5723.88	18.66	18.66	0.00	1
5724.14	23.18	23.18	0.00	1
5724.35	26.49	26.49	0.00	1
5724.59	29.80	29.80	0.00	1
5724.86	33.11	33.11	0.00	1
5726.00	44.45	44.45	0.00	Overtopping

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 1 cfs

Design Flow: 23.41 cfs

Maximum Flow: 41.54 cfs

Site Data - DS-13

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 5722.20 ft

Outlet Station: 108.00 ft

Outlet Elevation: 5720.00 ft

Number of Barrels: 2

Culvert Data Summary - DS-13

Barrel Shape: Pipe Arch

Barrel Span: 28.50 in

Barrel Rise: 18.00 in

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Square Edge with Headwall

Inlet Depression: None

Roadway Data for Crossing: STA 115+74.58 (Proposed Arch)

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 100.00 ft

Crest Elevation: 5727.00 ft

Roadway Surface: Paved

Roadway Top Width: 64.00 ft

Table 49 - Culvert Summary Table: DS-13

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
1.00	1.00	5722.44	0.239	0.0*	1-S2n	0.122	0.176	0.122	0.027	3.369	7.364
5.05	5.05	5722.77	0.566	0.0*	1-S2n	0.262	0.410	0.262	0.070	5.796	13.695
9.11	9.11	5723.00	0.804	0.0*	1-S2n	0.353	0.568	0.353	0.099	7.083	17.056
13.16	13.16	5723.25	1.045	0.0*	1-S2n	0.429	0.698	0.429	0.123	8.009	19.488
17.22	17.22	5723.49	1.292	0.0*	1-S2n	0.498	0.814	0.498	0.144	8.738	21.454
21.27	21.27	5723.75	1.551	0.0*	5-S2n	0.563	0.920	0.563	0.163	9.342	23.112
23.41	23.41	5723.89	1.694	0.0*	5-S2n	0.596	0.971	0.596	0.172	9.619	23.920
29.38	29.38	5724.33	2.128	0.117	5-S2n	0.688	1.102	0.704	0.196	10.017	25.862
33.43	33.43	5724.66	2.458	0.713	5-S2n	0.750	1.179	0.778	0.211	10.231	27.049
37.49	37.49	5725.02	2.820	1.151	5-S2n	0.812	1.247	0.844	0.226	10.551	28.103
41.54	41.54	5725.42	3.220	1.630	5-S2n	0.876	1.303	0.876	0.240	11.249	29.090

* Full Flow Headwater elevation is below inlet invert.

Straight Culvert

Inlet Elevation (invert): 5722.20 ft, Outlet Elevation (invert): 5720.00 ft

Culvert Length: 108.02 ft, Culvert Slope: 0.0204

Table 50 - Summary of Culvert Flows at Crossing: STA 115+74.58 (Proposed Arch)

Headwater Elevation (ft)	Total Discharge (cfs)	DS-13 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
5722.44	1.00	1.00	0.00	1
5722.77	5.05	5.05	0.00	1
5723.00	9.11	9.11	0.00	1
5723.25	13.16	13.16	0.00	1
5723.49	17.22	17.22	0.00	1
5723.75	21.27	21.27	0.00	1
5723.89	23.41	23.41	0.00	1
5724.33	29.38	29.38	0.00	1
5724.66	33.43	33.43	0.00	1
5725.02	37.49	37.49	0.00	1
5725.42	41.54	41.54	0.00	1
5727.00	54.50	54.50	0.00	Overtopping

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 1 cfs

Design Flow: 59.93 cfs

Maximum Flow: 106.35 cfs

Site Data - DS-14

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 5723.47 ft

Outlet Station: 132.00 ft

Outlet Elevation: 5719.46 ft

Number of Barrels: 3

Culvert Data Summary - DS-14

Barrel Shape: Circular

Barrel Diameter: 2.50 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Square Edge with Headwall

Inlet Depression: None

Roadway Data for Crossing: STA 119+18.06 (Proposed Arch)

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 100.00 ft

Crest Elevation: 5727.40 ft

Roadway Surface: Paved

Roadway Top Width: 64.00 ft

Table 51 - Culvert Summary Table: DS-14

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
1.00	1.00	5723.72	0.246	0.0*	1-S2n	0.116	0.186	0.116	0.018	4.007	5.658
11.54	11.54	5724.33	0.862	0.0*	1-S2n	0.378	0.644	0.378	0.076	8.226	14.731
22.07	22.07	5724.69	1.216	0.0*	1-S2n	0.520	0.900	0.521	0.112	9.921	18.879
32.61	32.61	5725.03	1.556	0.0*	1-S2n	0.632	1.103	0.632	0.141	11.154	21.876
43.14	43.14	5725.32	1.854	0.0*	1-S2n	0.728	1.277	0.746	0.167	11.694	24.289
53.67	53.67	5725.60	2.127	0.0*	1-S2n	0.816	1.432	0.816	0.189	12.853	26.341
59.93	59.93	5725.76	2.286	0.0*	1-S2n	0.865	1.517	0.895	0.202	12.647	27.431
74.75	74.75	5726.15	2.677	0.0*	5-S2n	0.974	1.700	1.006	0.230	13.471	29.722
85.28	85.28	5726.45	2.982	0.0*	5-S2n	1.047	1.818	1.092	0.249	13.791	31.172
95.81	95.81	5726.79	3.321	0.0*	5-S2n	1.117	1.925	1.169	0.266	14.184	32.503
106.35	106.35	5727.17	3.699	0.301	5-S2n	1.186	2.021	1.246	0.283	14.500	33.737

* Full Flow Headwater elevation is below inlet invert.

Straight Culvert

Inlet Elevation (invert): 5723.47 ft, Outlet Elevation (invert): 5719.46 ft

Culvert Length: 132.06 ft, Culvert Slope: 0.0304

Table 52 - Summary of Culvert Flows at Crossing: STA 119+18.06 (Proposed Arch)

Headwater Elevation (ft)	Total Discharge (cfs)	DS-14 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
5723.72	1.00	1.00	0.00	1
5724.33	11.54	11.54	0.00	1
5724.69	22.07	22.07	0.00	1
5725.03	32.61	32.61	0.00	1
5725.32	43.14	43.14	0.00	1
5725.60	53.67	53.67	0.00	1
5725.76	59.93	59.93	0.00	1
5726.15	74.75	74.75	0.00	1
5726.45	85.28	85.28	0.00	1
5726.79	95.81	95.81	0.00	1
5727.17	106.35	106.35	0.00	1
5727.40	112.23	112.23	0.00	Overtopping

Appendix D4

Atrisco Vista Draft Preliminary Report Excerpts

Structure #	Station	Drainage Mgmt. Plan	Contributing Basin(s)	Sub-basin I.D.	Analysis Point / Junction			Overall Contributing Basin				Sub-basin					Added Flow		Bulking Factor % ²	Existing Q100 cfs	Developed Q100 cfs	Existing Structure	Preliminary Recommendation	Comments
					I.D.	Existing Q100, cfs	Developed Q100, cfs	I.D.	Area sq. mi.	Existing Q100, cfs	Developed Q100, cfs	I.D.	Area sq. mi.	Fraction of Basin Area	Existing Q100, cfs ¹	Developed Q100, cfs ¹	Existing cfs	Developed cfs						
1	10+00	DEIIADR	SB3					SB3	0.160						50	189			7%	54	202	2-36" RCP	Extend or replace in-kind	Assume 7% bulking, grade to allow overflow to Structure 2
2	15+00	DEIIADR	SB2					SB2	0.072						44	48			7%	47	51	3-36" RCP	Extend or replace in-kind	Assume 7% bulking
3	21+00	DEIIADR	NB1	NB1.1				NB1	0.304	93	93	NB1.1	0.057	0.19	17	17	23	33	7%	42	52	2-24" RCP	Extend or replace in-kind	Assume 7% bulking, add detention pond "A" outflow of 23/33 cfs (AP2NB), without routing
4	35+50	BNDMPU			J37	50	78	37A,B											7%	54	83	4-36" RCP	Extend or replace in-kind	Use 7% bulking
5	42+75	BNDMPU			J33AB																	2-24" RCP	Extend or replace in-kind	Use 7% bulking. Drains to Structure #6, which has capacity for the entire basin, so a sub-basin was not delineated
6	47+00	BNDMPU			J33AB	118	191	33A,B											7%	126	204	5-42" RCP	Extend or replace in-kind	Use 7% bulking
					Basins 6, 7, 8																			Use 7% bulking. Drains to Structure #6, which has capacity for the entire basin, so a sub-basin was not delineated
7	55+00	BNDMPU			J33AB																	1-24" RCP	Extend or replace in-kind	Use 7% bulking
8	68+25	BNDMPU			J36	62	70	36											7%	66	75	4-36" RCP	Extend or replace in-kind	Use 7% bulking
					Basins 9, 10																			Use 7% bulking. Structure #8 has capacity for the entire basin, so a sub-basin was not delineated
9	76+75	BNDMPU			J36																	2-18" RCP	Extend or replace in-kind	Use 7% bulking. Structure #8 has capacity for the entire basin, so a sub-basin was not delineated
10	89+50	BNDMPU			AP5	595	327								595	327				595	327	Slab bridge, 20' span	Widen	N. Fork Boca Negra Arroyo
11A	100+00	CWBDMP	PW1	PW1.1				PW1	0.107	N/A	181	PW1.1	0.044	0.41		74						3 - 30" CMPs		
11B	109+75	CWBDMP	PW1	PW1.2				PW1	0.107	N/A	181	PW1.2	0.063	0.59		107						4 - 30" CMPs		
12A	102+75	CWBDMP	PW2	PW2.1				PW2	0.1	N/A	156	PW2.1	0.079	0.79		123						4 - 30" CMPs		
12B	125+25	CWBDMP	PW2	PW2.2				PW2	0.1	N/A	156	PW2.2	0.016	0.16		25						1 - 30" CMP		
13A	130+75	CWBDMP	PW3	PW3.1				PW3	0.346	N/A	454	PW3.1	0.179	0.52		235						2 - 60" CMPs		
13B	138+75	CWBDMP	PW3	PW3.2				PW3	0.346	N/A	454	PW3.2	0.086	0.25		113						4 - 30" CMPs		
13C	150+00	CWBDMP	PW3	PW3.3				PW3	0.346	N/A	454	PW3.3	0.081	0.23		106						4 - 30" CMPs		Need an inlet berm at NW corner
14	172+25	CWBDMP			AP4		935													935		4 - 10' x 7' CBCs		Calabacillas West Branch Arroyo, assume 4.0' HW to top of bank at west property line
15A	181+00	CWBDMP	PW5	PW5.1				PW5	0.181	N/A	286	PW5.1	0.037	0.20		58					58	2 - 30" CMPs		
15B	191+00	CWBDMP	PW5	PW5.2				PW5	0.181	N/A	286	PW5.2	0.144	0.80		228					228	7 - 30" CMPs		
16	209+00	CAWMP			MB_102_J	2645	3891													2645	3891	Bridge		Calabacillas Middle Branch Arroyo
17	216+50	CAWMP	B_301 MB_103 MB_601	B301.3 MB_103.1 MB_601				B_301 MB_103 MB_601	1.355 0.664 0.8	583 416 322	1046 1058 513	B301.3 MB_103.1 MB_601	0.106 0.111 0.8	0.08 0.17 1.00	46 70 322	82 177 513				437	772	2 - 12' x 6' CBC's		Assume 5.0' HW to west property line
18A	236+00	CAWMP	B_301	B_301.2A				B_301	1.355	583	1046	B_301.2A	0.033	0.02	14	25				14	25	1 - 30" CMP		
18B	245+00	CAWMP	B_301	B_301.2B				B_301	1.355	583	1046	B_301.2B	0.086	0.06	37	66				37	66	3 - 30" CMPs		
19	255+00	CAWMP	B_301	B_301.1				B_301	1.355	583	1046	B_301.1	0.739	0.55	318	570				318	570	3 - 12' x 7' CBC		Design for developed flow in existing channel, assume 3.0' bank-full depth
20	268+25	CAWMP			AP23	830	1217													830	1217	8 - 10' x 4' CBC		Calabacillas Tributary B, design for developed flow in existing channel, assume 3.0' bank-full depth
21A	278+75	CAWMP	B_202	B_202.2A				B_202	1.607	629	1029	B_202.2A	0.092	0.06	36	59				36	59	2 - 30" CMPs		
21B	290+00	CAWMP	B_202	B_202.2B				B_202	1.607	629	1029	B_202.2B	0.384	0.24	150	246				150	246	8 - 30" CMPs		
22	294+00	CAWMP	B_104 B_202	B_104.1 B_202.1				B_104 B_202	1.32 1.607	652 629	1102 1029	B_104.1 B_202.1	0.47 0.118	0.36 0.07	232 46	392 76				278	468	2 - 10' x 4' CBCs		Assume 4.0' HW, need inlet berm at SW corner

Notes:

1 DMP flows were prorated based on fraction of total basin area(s) as needed

2 Bulking factors were assumed if they were not already included in DMP flows

Abbreviations:

BNDMPU = Drainage Management Plan Update for Boca Negra Arroyo, Draft (August 2018)

CAWMP = INTERIM Calabacillas Watershed Park Management Plan (February 2015)

CWBDMP = Calabacillas West Branch Arroyo Drainage and Storm Water Quality Management Plan, Final (August 2018)

DEIIADR = Double Eagle II Airport Drainage Report (March 1988)

CBC = concrete box culvert

CMP = corrugated metal pipe

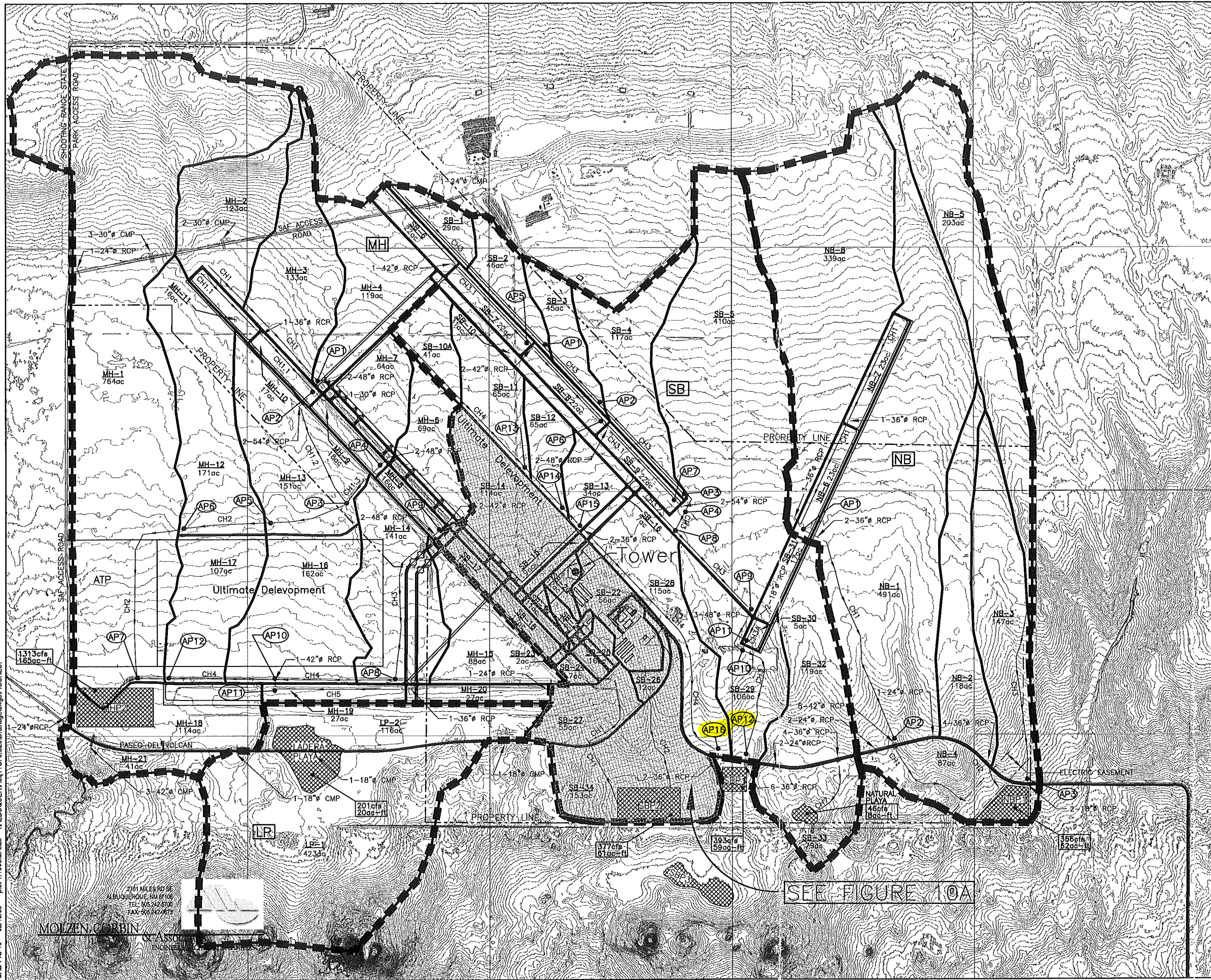
HW = headwater

RCP = reinforced concrete pipe

TABLE 5-9

RUNOFFS FOR SOUTH BOCA NEGRA SUBBASIN (ULTIMATE CONDITION)

Subbasin	Dr. Area	Dr. Area	Q _{100-6hr}	V _{100-6hr}	Unit Q	Comment
	sm	ac	cfs	af	Cfs/ac	
SB-1	0.0500	32	14	1.770	0.429	Channel along RW 4L
SB-2	0.0700	45	11	2.019	0.255	Channel along RW 4L
AP1; 2.1	0.1200	77	25	3.789	0.323	CH3
SB-3	0.0700	45	11	2.019	0.238	Channel along RW 4L
AP2; 3.1	0.1900	122	35	5.808	0.290	CH3
SB-4	0.1800	115	30	5.193	0.264	Channel along TW C?
AP3; 4.1	0.3700	237	66	11.001	0.277	CH3
SB-6	0.0300	19	43	1.768	2.226	Infield-1-42" under C3
SB-7	0.0300	19	37	1.768	1.922	Infield to AP5
AP5; 7.1	0.0600	38	79	3.533	2.058	2-42" under C3
SB-8	0.0300	19	38	1.768	1.969	Infield to AP6
AP6; 8.1	0.0900	58	113	5.298	1.958	2-48" under C2
SB-9	0.0300	19	43	1.768	2.226	Infield, to AP7
AP7; 9.1	0.1200	77	138	7.062	1.792	2-54" under C1
AP4; 9.1	0.4900	314	155	18.062	0.494	CH3
SB-10	0.0500	32	26	3.056	0.811	Bet TWC and C;1-36"C1
AP8	0.5400	346	168	21.114	0.486	Merge CH3.2 and CH3
SB-5	0.6400	410	146	18.474	0.357	Old Det Pond A, now AP9
AP9	1.1800	755	301	39.586	0.399	3-48"
SB-31	0.0300	19	38	1.768	1.969	Infield-1-42"
SB-30	0.0100	6	13	0.589	1.972	Infield to AP11
AP11; 30.1	0.0400	26	50	2.357	1.969	1-48" under D1
AP10	1.2200	781	321	41.943	0.411	CH3
SB-29	0.1700	109	25	4.968	0.231	to AP12
AP12	1.3900	890	340	46.912	0.382	6-36" under IAR
SB-10A	0.0600	38	13	1.732	0.330	CH4
SB-11	0.1000	64	14	3.106	0.218	to AP13
AP13	0.1600	102	24	4.838	0.239	CH4
SB-12	0.0600	38	12	1.866	0.307	to AP14
AP14	0.2200	141	36	6.704	0.256	CH4
SB-13	0.0500	32	15	1.556	0.480	to AP15
AP15	0.2700	173	47	8.259	0.272	2-36"
SB-16	0.0100	6	12	0.611	1.852	
16.1	0.2800	179	50	8.869	0.279	2-36"
SB-28	0.1800	115	35	5.962	0.304	to AP16
AP16	0.4600	294	84	14.829	0.284	2-36"
SBP1	1.8500	1,184	411	61.741	0.347	AP16+AP12
SB-14	0.1800	115	193	19.812	1.679	3-42"; to inlet 1



LEGEND	
DRAINAGE BASIN	■ ■ ■ ■ ■ ■ ■ ■
DRAINAGE SUB-BASIN	— — — — —
CHANNEL FLOWLINES	→ → → → →
DRAINAGE PONDS	▨ ▨ ▨ ▨ ▨ ▨ ▨ ▨
ANALYSIS POINT	○ AP

Double Eagle II Airport - Albuquerque, New Mexico

Figure 10
Drainage Features Ultimate Conditions



Approx. Scale: 1"=1000'