ChangConsultants
Civil Engineering◦Hydrology◦Hydraulics◦Sedimentation

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December 26, 2018

Adam Guernsey
Harrison, Temblador, Hungerford & Johnson LLP
2801 T Street
Sacramento, CA 95816

Subject: Devil Creek Diversion Channel

Dear Adam:

The Devil Creek Diversion Channel (Channel) conveys storm flows in a southwest direction along Vulcan Materials Company's future Cajon Creek Area Q mining site in San Bernardino County. This reach is a concrete trapezoidal channel and confluences with the Cajon Wash near the south end of Area Q. The Federal Emergency Management Agency has mapped a Zone A floodplain along the channel (see the attached floodplain map). A Zone A floodplain is an approximate 100-year floodplain. Detailed engineering analyses were not performed to establish the floodplain, so the water surface elevations are unknown and the delineation is not precise. The FEMA mapping shows the floodplain extending beyond the Channel and into a portion of Area Q. I have performed research to assess the accuracy of the FEMA floodplain. As discussed below, 100-year and greater flows will be contained within the Channel and will have no impact on, or be impacted by, Vulcan's future operations in Area Q.

Tetra Tech prepared two July 2009 reports titled *Devil Creek Diversion Channel, County of San Bernardino, California, Hydrologic Analysis* and *Devil Creek Diversion Channel, County of San Bernardino, California, Hydraulic Analysis.* These reports contain detailed engineering analyses of the Channel and its watershed as part of a levee study. The levee reach is just upstream of the Area Q reach, but the analyses extend into Area Q. The San Bernardino County Flood Control District stated that the reports were approved. Relevant excerpts from the reports are attached.

The *Hydrologic Analysis* report determined the 100-year flow rate in the Channel just upstream of Area Q. The Watershed Map shows that the watershed area tributary to the Channel as it enters Area Q is 9.78 square miles. Table 9 indicates that the 100-year flow rate contributed from this area is 4,380 cubic feet per second (cfs). The flow rate along Area Q will be similar because the additional tributary drainage area added along Area Q is minor compared to the 9.78 square mile watershed area.

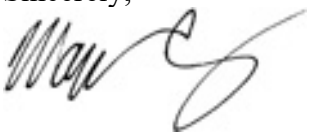
The *Hydraulic Analysis* report contains a HEC-RAS analysis of the Channel from Cajon Creek to upstream of Area Q. The report includes tabulated results, a work map showing cross-section locations, and cross-section plots. Area Q is located along HEC-RAS cross-section -29+35.00 to

27+49.42. The Table 1 results indicate that the 100-year flow depths along Area Q vary between 6.22 to 12.21 feet. The cross-section plots show that the channel has several feet of freeboard over these depths, so the 100-year flow will be contained with excess capacity.

I performed a normal depth analysis based on the average longitudinal slope and channel cross-section along Area Q using topographic mapping provided by Vulcan. The attached results show that the approximate capacity is just over 12,000 cfs. The *Hydrologic Analysis* report determined a 500-year flow rate of 11,800 cfs, so the channel can convey an extreme event above the 100-year design storm.

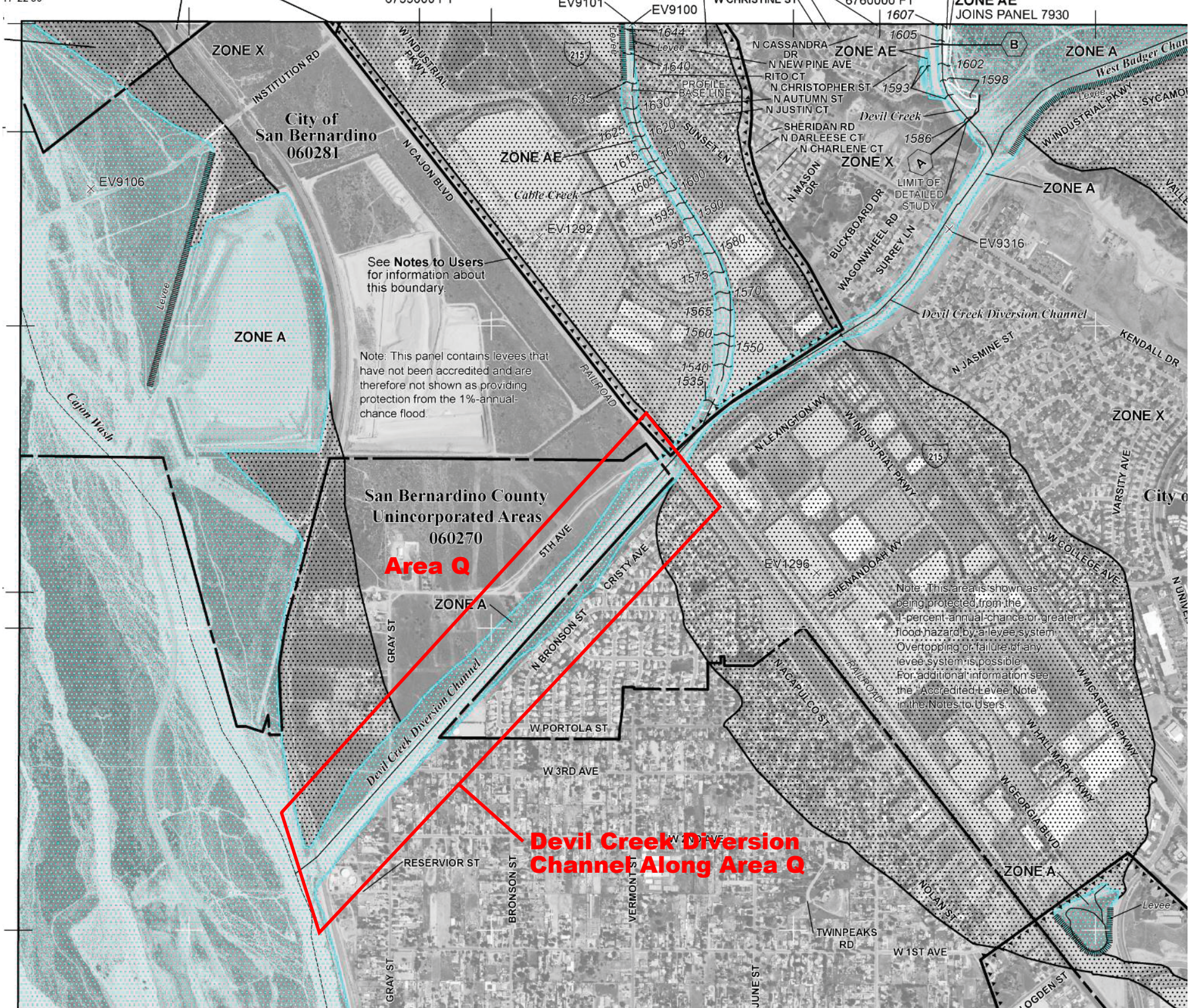
In summary, Tetra Tech's detailed engineering analyses of the Devil Creek Diversion Channel along Area Q are more accurate than FEMA's approximate Zone A floodplain. Tetra Tech's analyses were approved by the San Bernardino County Flood Control District. The Channel and watershed conditions have not changed significantly since the 2009 studies. Based on this, the 100-year and greater flows will be contained within the Channel and will have no impact on, or be impacted by, Vulcan's future operations in Area Q.

Sincerely,



Wayne W. Chang, M.S., P.E.

Enclosures


ZONE X
INSTITUTION RD
W INDUSTRIAL PKWY
City of San Bernardino 060281
N CAJON BLVD
ZONE AE
EV9106
EV9101
EV9100
1644
Levee
1640
1635
1630
1625
1620
1615
1610
1605
1600
1595
1590
1585
1580
1575
1570
1565
1560
1550
1540
1535
PROFILE BASE LINE
SUNSET LN
Cable Creek
EV1292
See Notes to Users for information about this boundary.
Note: This panel contains levees that have not been accredited and are therefore not shown as providing protection from the 1%-annual-chance flood.
RAILROAD
ZONE A
Levee
Cajon Wash
San Bernardino County Unincorporated Areas 060270
Area Q
5TH AVE
CRISTY AVE
GRAY ST
N BRONSON ST
Devil Creek Diversion Channel
W PORTOLA ST
W 3RD AVE
RESERVIOR ST
BRONSON ST
VERMONT ST
JUNE ST
GRAY ST
Devil Creek Diversion Channel Along Area Q
N CASSANDRA DR
N NEW PINE AVE
RITO CT
N CHRISTOPHER ST
N AUTUMN ST
N JUSTIN CT
SHERIDAN RD
N DARLEESE CT
N CHARLENE CT
1607
1605
1602
1598
1593
1586
Devil Creek
LIMIT OF DETAILED STUDY
N MASON DR
BUCKBOARD DR
WAGONWHEEL RD
SURREY LN
EV9316
JOINS PANEL 7930
West Badger Chan
W INDUSTRIAL PKWY
SYCAMO
VALLE
Devil Creek Diversion Channel
N JASMINE ST
KENDALL DR
N LEXINGTON WY
W INDUSTRIAL PKWY
215
ZONE X
VARSITY AVE
City o
EV1296
SHENANDOAH WY
W COLLEGE AVE
N UNIVE
Note: This area is shown as being protected from the 1-percent-annual-chance or greater flood hazard by a levee system. Overtopping or failure of any levee system is possible. For additional information see the "Accredited Levee Note" in the Notes to Users.
N ACAPULCO ST
RAILROAD
W MCARTHUR PKWY
W HALLMARK PKWY
W GEORGIA BLVD
ZONE A
Levee
NOLAN ST
TWINPEAKS RD
W 1ST AVE
OGDEN ST

C. REVIEW FEE

Has the review fee for the appropriate request category been included? ☐ Yes Fee amount: $_____

☒ No, Attach Explanation

Please see the DHS-FEMA Web site at http://www.fema.gov/plan/prevent/fhm/frm_fees.shtm **for Fee Amounts and Exemptions.**

D. SIGNATURE

All documents submitted in support of this request are correct to the best of my knowledge. I understand that any false statement may be punishable by fine or imprisonment under Title 18 of the United States Code, Section 1001.

Name: Granville M. Bowman	Company: County of San Bernardino	
Mailing Address: 825 E Third Street, Room 101 San Bernardino, CA 92415-0835	Daytime Telephone No.: 909-387-7906	Fax No.: 909-387-7911
	E-Mail Address: gbowman@dpw.sbcounty.gov	
Signature of Requester (required): KD MF	Date: 7/23/09	

As the community official responsible for floodplain management, I hereby acknowledge that we have received and reviewed this Letter of Map Revision (LOMR) or conditional LOMR request. Based upon the community's review, we find the completed or proposed project meets or is designed to meet all of the community floodplain management requirements, including the requirement that no fill be placed in the regulatory floodway, and that all necessary Federal, State, and local permits have been, or in the case of a conditional LOMR, will be obtained. In addition, we have determined that the land and any existing or proposed structures to be removed from the SFHA are or will be reasonably safe from flooding as defined in 44CFR 65.2(c), and that we have available upon request by FEMA, all analyses and documentation used to make this determination.

Community Official's Name and Title: Granville M. Bowman, Flood Control Engineer	Community Name: County of San Bernardino	
Mailing Address: 825 E Third Street, Room 101 San Bernardino, CA 92415-0835	Daytime Telephone No.: 909-387-7906	Fax No.: 909-387-7911
	E-Mail Address: gbowman@dpw.sbcounty.gov	
Community Official's Signature (required): KD MF	Date: 7/23/09	

CERTIFICATION BY REGISTERED PROFESSIONAL ENGINEER AND/OR LAND SURVEYOR

This certification is to be signed and sealed by a licensed land surveyor, registered professional engineer, or architect authorized by law to certify elevation information data, hydrologic and hydraulic analysis, and any other supporting information as per NFIP regulations paragraph 65.2(b) and as described in the MT-2 Forms Instructions. All documents submitted in support of this request are correct to the best of my knowledge. I understand that any false statement may be punishable by fine or imprisonment under Title 18 of the United States Code, Section 1001.

Certifier's Name: Yen Hsu Chen	License No.: 37763	Expiration Date: 12-31-2010
Company Name: Tetra Tech Inc.	Telephone No.: (949) 250-6788	Fax No.: (949) 250-6776
Signature:		Date: 07/24/09

Ensure the forms that are appropriate to your revision request are included in your submittal.

Form Name and (Number)	Required if ...
☒ Riverine Hydrology and Hydraulics Form (Form 2)	New or revised discharges or water-surface elevations
☒ Riverine Structures Form (Form 3)	Channel is modified, addition/revision of bridge/culverts, addition/revision of levee/floodwall, addition/revision of d[illegible]
☐ Coastal Analysis Form (Form 4)	New or revised coastal elevations
☐ Coastal Structures Form (Form 5)	Addition/revision of coastal structure
☐ Alluvial Fan Flooding Form (Form 6)	Flood control measures on alluvial fans

REGISTERED PROFESSIONAL ENGINEER
YEN-HSU CHEN
No. 37763
Exp. 12/31/10
Seal (Optional)
CIVIL
STATE OF CALIFORNIA

County of San Bernardino Certification of Tetra Tech Studies

Devil Creek Diversion Channel
County of San Bernardino, California

FEMA ID No.: 70
County System No.: 2-307-1A
Flood Source: Devil and Bailey Canyons and West Badger Channel
Communities: City of San Bernardino

Hydrologic Analysis

July 2009

TETRA TECH
17770 CARTWRIGHT ROAD, SUITE 500
IRVINE, CALIFORNIA 92614

streamflow data and the FEMA-approved analytical approach (Bulletin #17B). The Standard Project Flood (SPF) peak discharge documented in design memorandums for Devil Creek Diversion Channel is 16,500 cfs.

Table 9 – Adopted Discharge-Frequency Results for Devil Creek Diversion Channel (D.A. = 9.78 sq. mi.)

Return Frequency (years)	Adopted Discharge-Frequency Results for Devil Creek Diversion Channel[1] (Flow, cfs)
2	125
5	410
10	790
20	1,400
50	2,740
100	4,380
200	6,820
500	11,800

In order to perform a risk based analysis it was necessary to determine the appropriate equivalent record length to describe uncertainty based on the USACE's EM 1110-2-1619 (Risk-Based Analysis for Flood Damage Reduction Studies). Using the equivalent record length guidelines in Table 4-5 of the EM, 60 years should be used as the equivalent record length for the Devil Creek Diversion channel discharge-frequency relationship based on: (1) using 75 percent of the 81 year period of record for the Devil Canyon Creek gage, and (2) the fact that the USGS regional flood frequency analysis results were consistent with the adopted results at the Devil Diversion Channel.

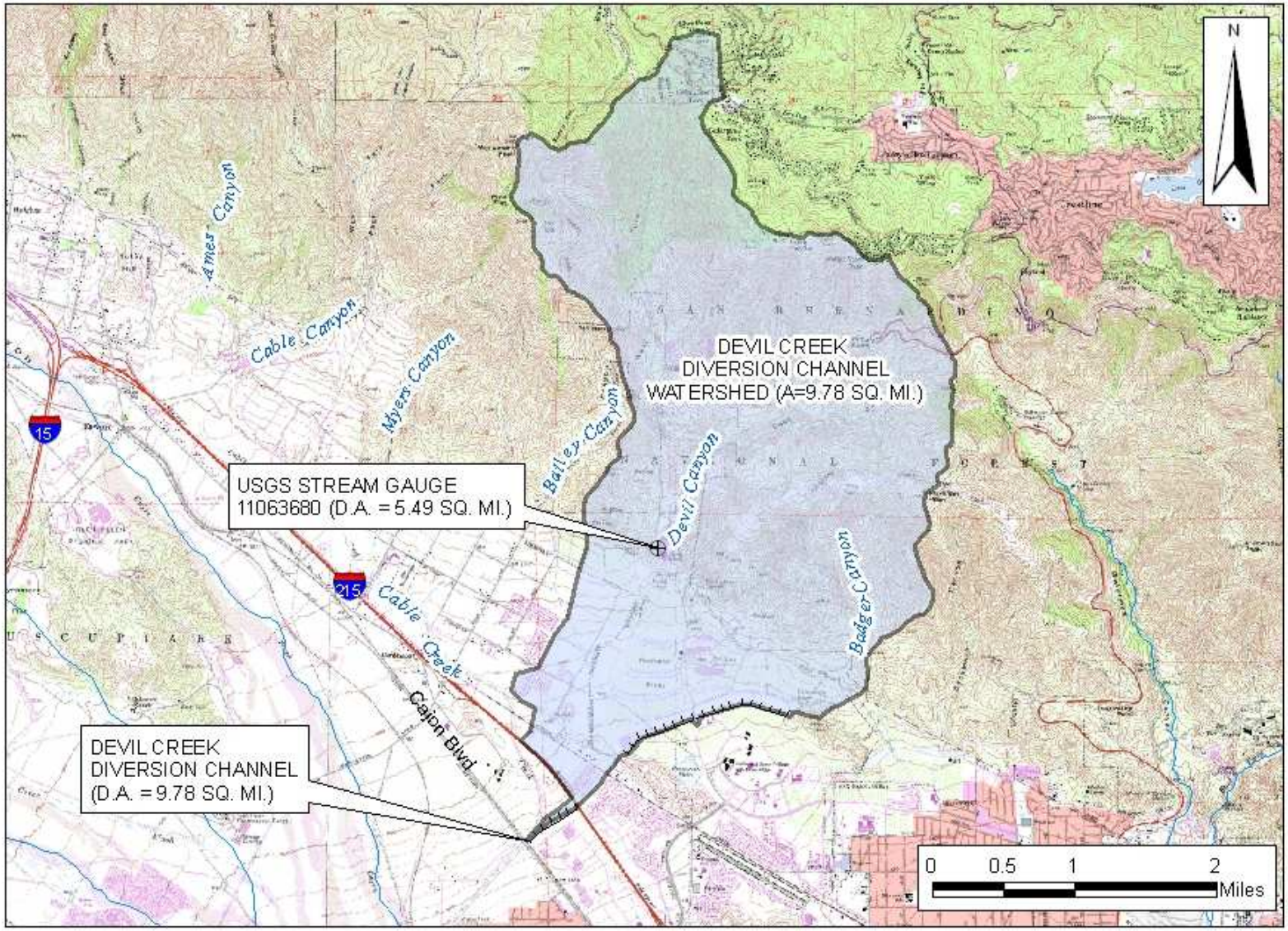


Figure 3 – Devil Creek Diversion Channel Watershed Map

Devil Creek Diversion Channel
County of San Bernardino, California

FEMA ID No.: 70
County System No.: 2-307-1A
Flood Source: Devil and Bailey Canyons and West Badger Channel
Communities: City of San Bernardino

Hydraulic Analysis

July 2009

TETRA TECH
17770 CARTWRIGHT ROAD, SUITE 500
IRVINE, CALIFORNIA 92614

Starting Water Surface Elevations

The critical flow depth elevations for each magnitude flood event were used as the starting upstream water surface elevation for each water surface profile. The computed water surface elevations along Cajon Creek at its confluence with the channel were used as the downstream controlling water surface elevations.

Determination of Stage-Discharge Uncertainty

Corps of Engineers guidelines for certification of levee systems are based on explicit incorporation of risk in assessing levee performance for hydrology and hydraulic engineering aspects. Hence a determination of stage-discharge uncertainty was performed in accordance with Chapter 5 of the Corps Engineering Manual 1110-2-1619 (Risk-Based Analysis for Flood Damage Reduction Studies). The results from the stage-discharge study are included in the Risk and Uncertainty Analysis Report.

HEC-RAS Results

A risk-based analysis of levee performance requires water surface profile determinations for a wide range of flow magnitudes. Water surface profiles were computed for the 2-year through 1000-year flood events using discharge frequency values determined in the Tetra Tech hydrologic analysis. Since FEMA certification requirements are based on the 100-year flood event (one percent chance exceedance flood), hydraulic results summarized below display only the 100-year flood event results. The hydraulic analysis was conducted using the 100-year peak discharges determined in the Tetra Tech hydrologic analysis of 4,380-cfs and 7,690-cfs at beginning of the channel and at the Cable Creek confluence, respectively. Table 1 shows the computed channel hydraulics of the 100-year peak discharge based on the mixed flow regime analysis. The computed water surface profile was plotted on Figure 2. The HEC-RAS computer printouts are presented in Appendix A.

Table 1 100-year Flood Event Computed Channel Hydraulics

HEC-RAS Station	100-Year Discharge (cfs)	Minimum Channel Elevation (ft.)	Estimated Water Surface Elevation (ft.)	Maximum Flow Depth (ft.)	Average Flow Velocity (ft./sec.)	Top Width (ft.)	Froude Number
77+10.77	4,380	1,576.72	1,579.69	2.97	9.83	150.00	1.00
76+31.91	4,380	1,565.47	1,566.63	1.16	27.12	139.50	4.44
75+48.36	4,380	1,555.27	1,556.35	1.08	31.58	128.40	5.35
73+94.91	4,380	1,555.27	1,557.31	2.04	19.93	107.90	2.46
72+49.94	4,380	1,552.28	1,559.29	7.01	7.06	89.27	0.47
70+90.61	4,380	1,551.44	1,558.68	7.24	8.99	67.30	0.59
69+38.99	4,380	1,550.29	1,557.02	6.73	13.01	50.00	0.88
68+81.71	Kendall Drive Bridge						

68+31.02	4,380	1,548.49	1,556.57	8.08	10.84	50.00	0.67
66+38.71	4,380	1,548.74	1,555.63	6.89	12.72	50.00	0.85
64+52.92	4,380	1,548.08	1,555.71	7.63	11.48	50.00	0.73
62+77.38	4,380	1,547.98	1,555.44	7.46	11.74	50.00	0.76
61+09.99	4,380	1,547.84	1,555.19	7.35	11.91	50.00	0.77
59+54.95	4,380	1,547.43	1,555.17	7.74	11.33	50.00	0.72
57+90.35	4,380	1,547.17	1,555.01	7.84	11.17	50.00	0.70
56+44.24	4,380	1,547.22	1,554.61	7.39	11.85	50.00	0.77
54+93.14	4,380	1,547.02	1,554.42	7.40	11.83	50.00	0.77
53+37.31	4,380	1,546.76	1,554.26	7.50	11.69	50.00	0.75
52+82.68	I-215 Freeway Bridge (Upstream end of Levee)						
51+59.66	4,380	1,546.43	1,554.09	7.66	11.44	50.00	0.73
50+25.34	4,380	1,546.20	1,553.97	7.77	11.28	50.00	0.71
48+65.43	4,380	1,546.14	1,553.71	7.57	11.57	50.00	0.74
47+36.18	4,380	1,546.23	1,553.03	6.80	12.87	50.00	0.87
46+79.95	Industrial Pkwy. Bridge						
46+24.43	4,380	1,545.60	1,552.40	6.80	12.89	50.00	0.87
44+75.15	4,380	1,545.35	1,552.17	6.82	12.85	50.00	0.87
43+10.12	4,380	1,545.15	1,551.80	6.65	13.18	50.00	0.90
41+41.01	4,380	1,544.85	1,551.03	6.18	14.17	50.00	1.00
39+89.99	4,380	1,544.06	1,549.94	5.88	14.89	50.00	1.08
38+05.32	4,380	1,541.90	1,546.38	4.48	19.56	50.00	1.63
36+15.66	4,380	1,539.66	1,543.73	4.07	21.52	50.00	1.88
34+42.94	4,380	1,537.69	1,541.59	3.90	22.44	50.00	2.00
32+72.56	4,380	1,536.14	1,540.03	3.89	22.49	50.00	2.01
31+11.43	4,380	1,534.11	1,539.12	5.01	21.85	40.00	1.72
29+64.18	4,380	1,532.47	1,537.25	4.78	22.92	40.00	1.85
29+14.02	BNSF Railroad Bridge (Downstream End of Levee)						
28+74.28	4,380	1,531.42	1,536.13	4.71	23.26	40.00	1.89
28+41.60	4,380	1,530.95	1,535.54	4.59	23.85	40.00	1.96
27+90.49	Cajon Blvd. Bridge						
27+49.42	4,380	1,529.46	1,541.06	11.60	5.03	75.00	0.26
26+91.83	7,690	1,529.38	1,541.05	11.67	8.79	75.00	0.45
26+28.36	7,690	1,528.67	1,534.89	6.22	20.78	79.55	1.70
25+40.42	7,690	1,528.34	1,539.49	11.15	8.66	110.78	0.54
24+34.11	7,690	1,527.65	1,539.35	11.70	8.98	103.42	0.55
23+21.91	7,690	1,527.00	1,538.89	11.89	10.19	92.87	0.63
22+00.73	7,690	1,526.00	1,538.21	12.21	11.75	81.34	0.73
20+81.76	7,690	1,525.20	1,536.50	11.30	15.22	70.66	1.00
19+66.33	7,690	1,525.00	1,535.64	10.64	16.06	69.57	1.07
18+45.60	7,690	1,524.00	1,534.97	10.97	15.80	69.66	1.02
17+21.77	7,690	1,523.56	1,533.90	10.34	16.71	67.75	1.10
15+93.19	7,690	1,523.00	1,533.28	10.28	16.60	69.57	1.09
14+65.63	7,690	1,522.00	1,532.32	10.32	16.82	68.95	1.10
13+31.79	7,690	1,521.00	1,531.13	10.13	17.10	68.55	1.12

Channel along Area Q in red.

11+81.31	7,690	1,519.17	1,529.31	10.14	18.60	65.29	1.24
10+55.47	7,690	1,519.00	1,529.21	10.21	16.56	70.54	1.11
09+42.19	7,690	1,517.87	1,527.14	9.27	19.42	64.68	1.37
08+32.22	7,690	1,517.00	1,525.70	8.70	20.95	62.86	1.53
07+02.70	7,690	1,516.00	1,524.29	8.29	22.10	61.03	1.61
05+83.29	7,690	1,515.00	1,523.29	8.29	22.66	60.61	1.69
04+44.43	7,690	1,513.15	1,521.50	8.35	24.01	58.04	1.80
03+33.02	7,690	1,513.00	1,520.97	7.97	23.81	59.82	1.80
02+13.23	7,690	1,512.00	1,519.84	7.84	24.34	58.75	1.85
00+93.61	7,690	1,510.41	1,518.50	8.09	25.02	57.28	1.90
00+14.84	7,690	1,510.00	1,517.89	7.89	25.14	57.64	1.92
-29+35.00	7,690	1,485.00	1,492.44	7.44	27.45	55.55	2.15

The computed water surface elevations with respect to the top of levee elevations are summarized in Table 2 for the 100-year flood event. Figure 2 depicts the profile of the top of levee, current channel invert, and computed water surface along the channel's leveed reach. The table and figure indicate that the top of levee is a minimum of 10.11-feet higher than the computed water surface for the 100-year flood event.

Table 2 100-year Flood Event Computed Water Surface Elevations versus Top of Levee Elevations

HEC-RAS Station	Top of Levee Elevation (ft.)	Channel Invert Elevation (ft.)	Computed 100-year Water Surface Elevation (ft.)	Freeboard (ft.)	FEMA Required Freeboard (ft.)
52+82.68	I-215 Freeway Bridge (Upstream end of Levee)				
51+59.66	1564.96	1546.43	1554.09	10.87	3.5
50+25.34	1564.09	1546.20	1553.97	10.12	3
48+65.43	1564.32	1546.14	1553.71	10.61	3
47+36.18	1566.44	1546.23	1553.03	13.41	3
46+24.43	1566.05	1545.60	1552.40	13.65	3
44+75.15	1567.29	1545.35	1552.17	15.12	3
43+10.12	1566.84	1545.15	1551.8	15.04	3
41+41.01	1564.89	1544.85	1551.03	13.86	3
39+89.99	1562.82	1544.06	1549.94	12.88	3
38+05.32	1560.45	1541.90	1546.38	14.07	3
36+15.66	1559.59	1539.66	1543.73	15.86	3
34+42.94	1558.24	1537.69	1541.59	16.65	3
32+72.56	1553.86	1536.14	1540.03	13.83	3
31+11.43	1549.23	1534.11	1539.12	10.11	3
29+64.18	1551.59	1532.47	1537.25	14.34	3
29+14.02	BNSF Railroad Bridge (Downstream End of Levee)				

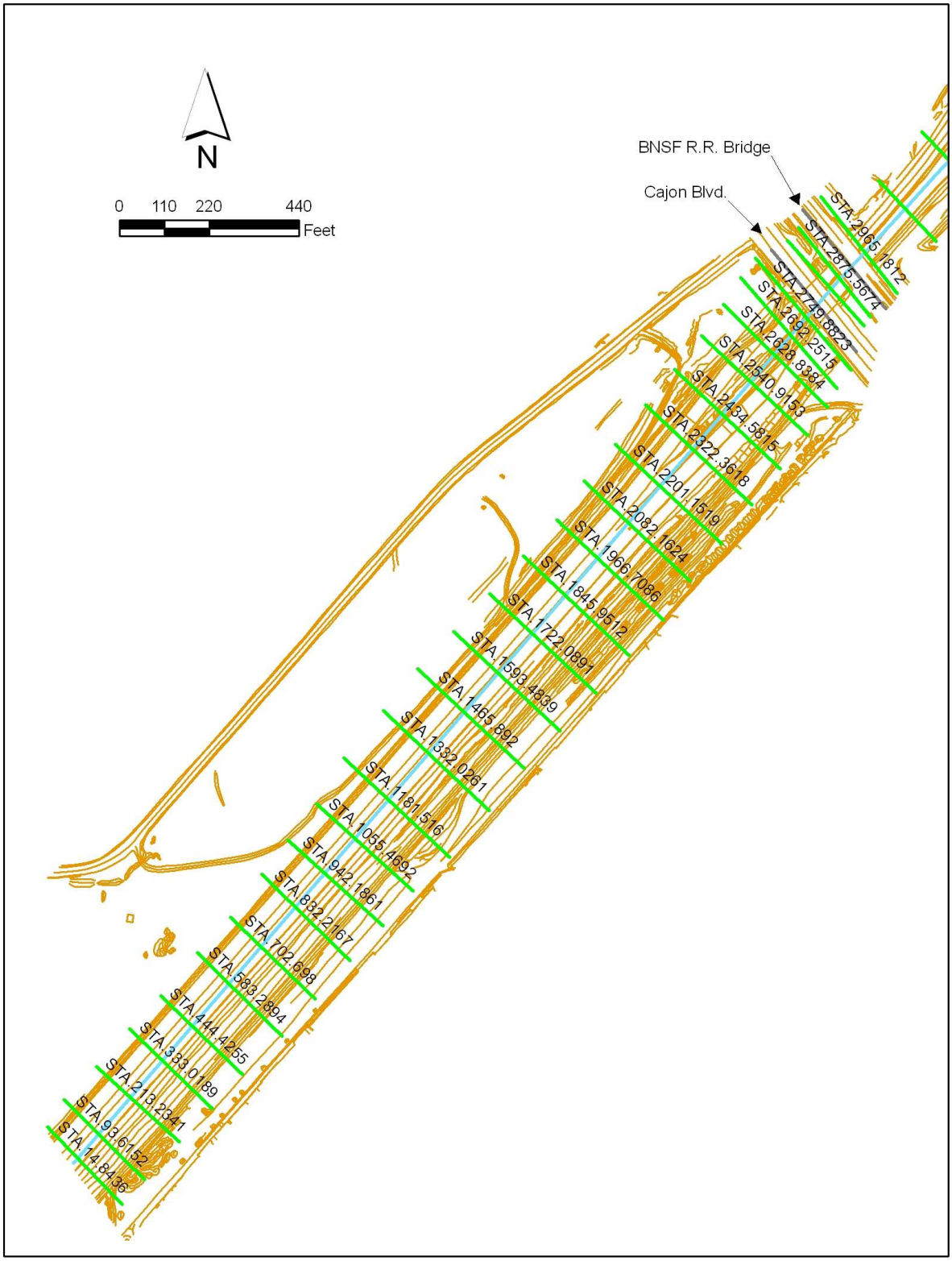
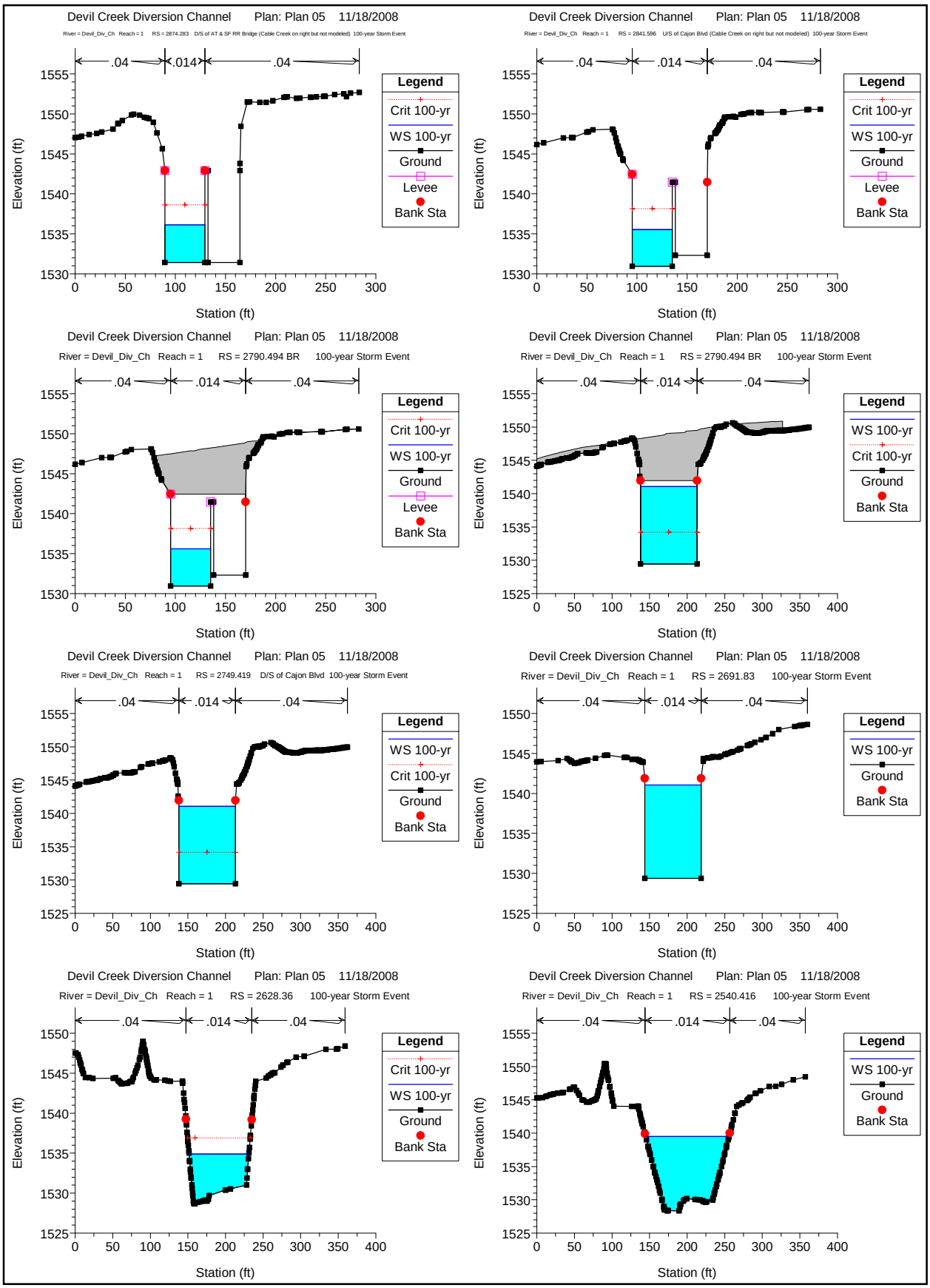
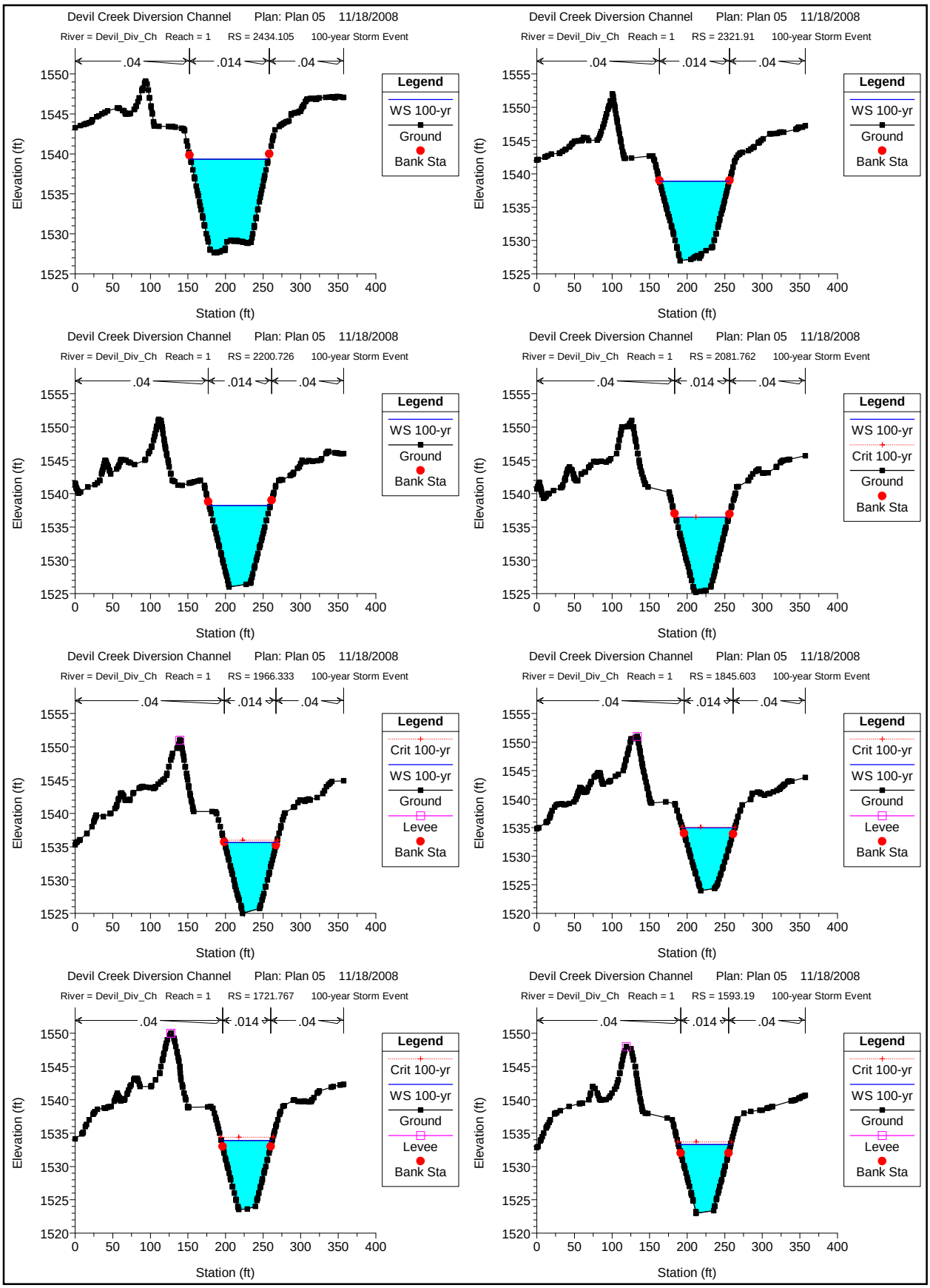
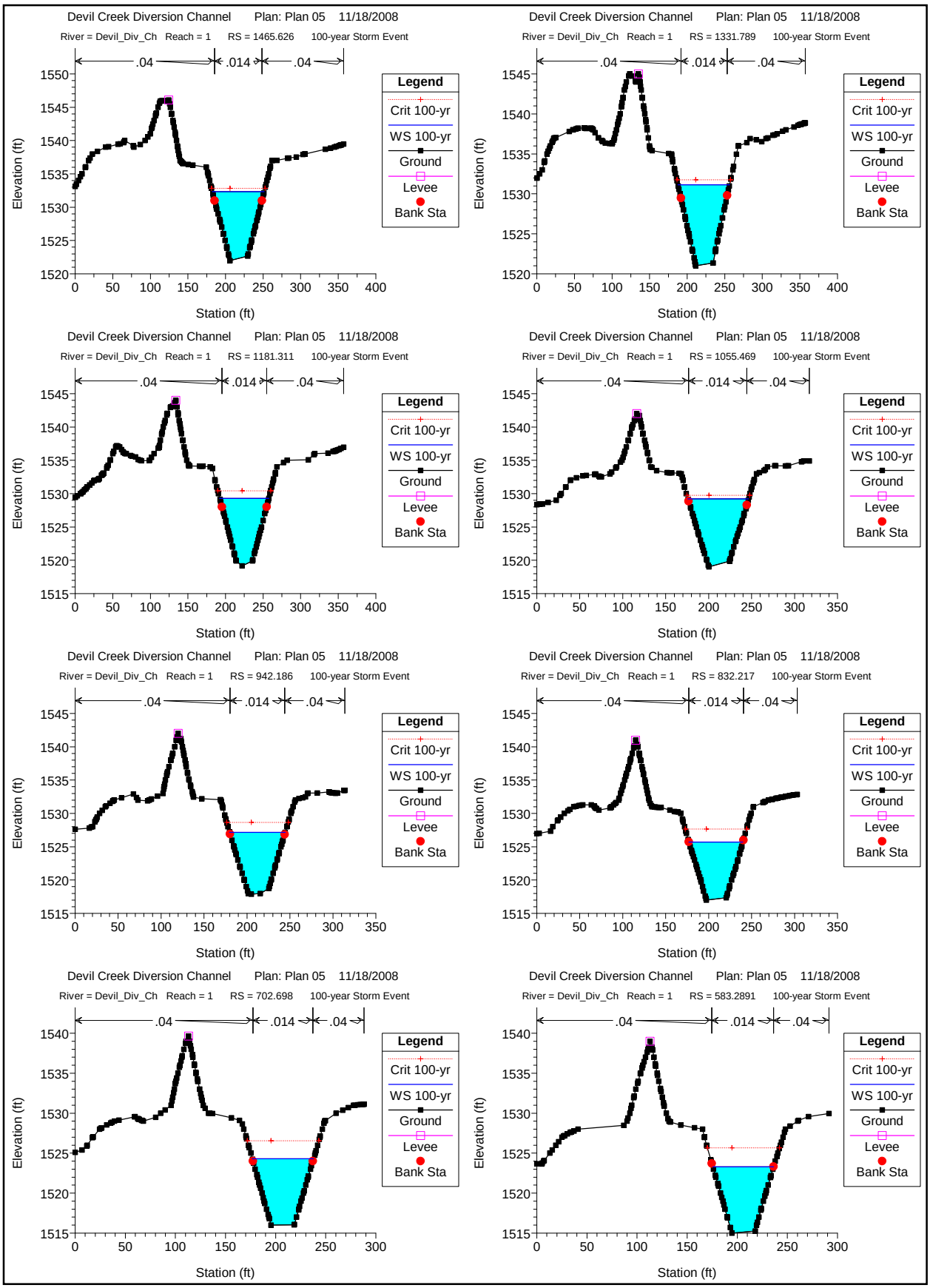
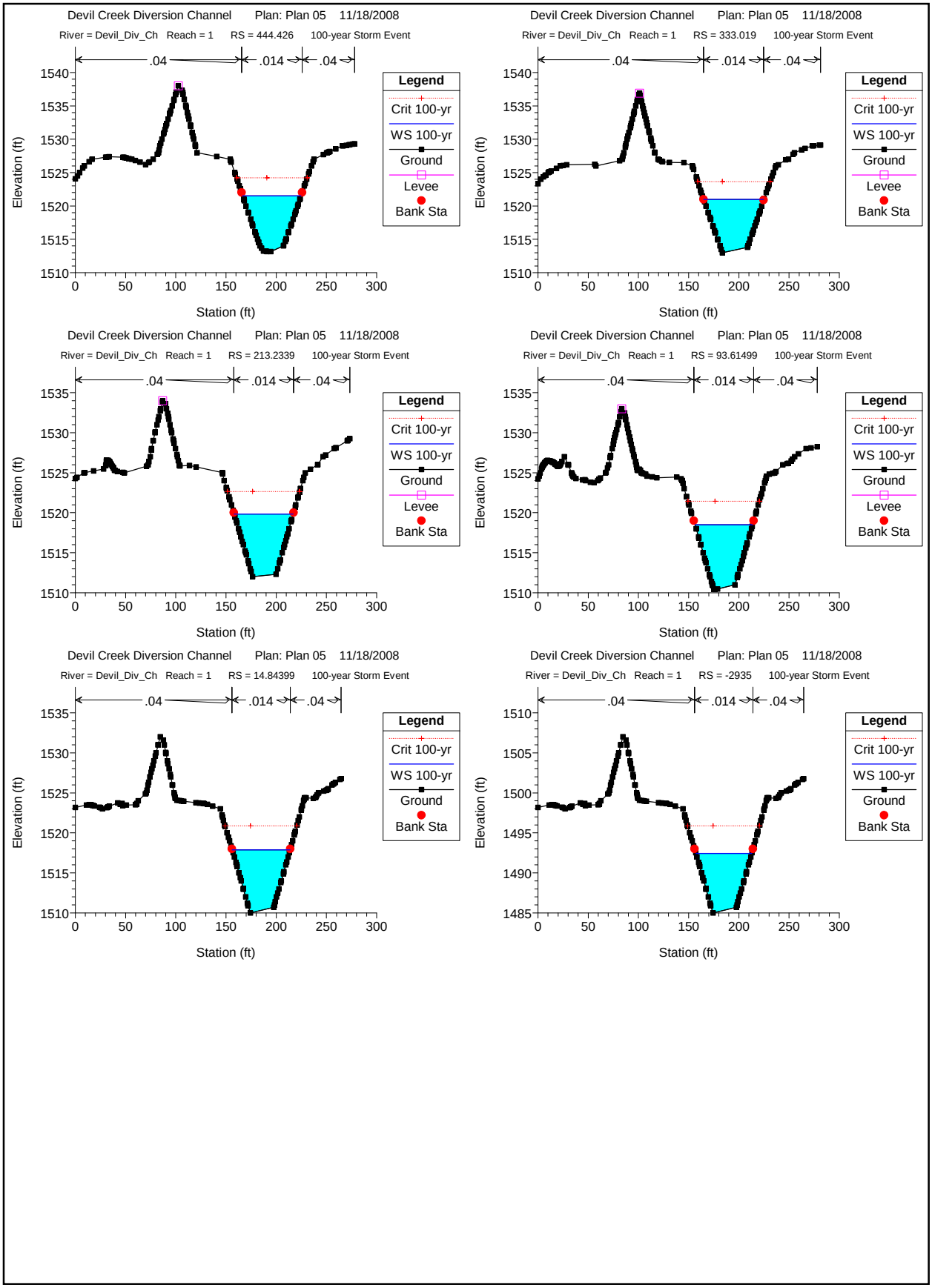


Figure 1 – (Continued)


Devil Creek Diversion Channel Plan: Plan 05 11/18/2008
River = Devil_Div_Ch Reach = 1 RS = 2874.283 D/S of AT & SF RR Bridge (Cable Creek on right but not modeled) 100-year Storm Event
.04 .014 .04
Legend
Crit 100-yr
WS 100-yr
Ground
Levee
Bank Sta
Elevation (ft)
Station (ft)
Devil Creek Diversion Channel Plan: Plan 05 11/18/2008
River = Devil_Div_Ch Reach = 1 RS = 2841.596 U/S of Cajon Blvd (Cable Creek on right but not modeled) 100-year Storm Event
.04 .014 .04
Legend
Crit 100-yr
WS 100-yr
Ground
Levee
Bank Sta
Elevation (ft)
Station (ft)
Devil Creek Diversion Channel Plan: Plan 05 11/18/2008
River = Devil_Div_Ch Reach = 1 RS = 2790.494 BR 100-year Storm Event
.04 .014 .04
Legend
Crit 100-yr
WS 100-yr
Ground
Levee
Bank Sta
Elevation (ft)
Station (ft)
Devil Creek Diversion Channel Plan: Plan 05 11/18/2008
River = Devil_Div_Ch Reach = 1 RS = 2790.494 BR 100-year Storm Event
.04 .014 .04
Legend
WS 100-yr
Crit 100-yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
Devil Creek Diversion Channel Plan: Plan 05 11/18/2008
River = Devil_Div_Ch Reach = 1 RS = 2749.419 D/S of Cajon Blvd 100-year Storm Event
.04 .014 .04
Legend
WS 100-yr
Crit 100-yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
Devil Creek Diversion Channel Plan: Plan 05 11/18/2008
River = Devil_Div_Ch Reach = 1 RS = 2691.83 100-year Storm Event
.04 .014 .04
Legend
WS 100-yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
Devil Creek Diversion Channel Plan: Plan 05 11/18/2008
River = Devil_Div_Ch Reach = 1 RS = 2628.36 100-year Storm Event
.04 .014 .04
Legend
Crit 100-yr
WS 100-yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
Devil Creek Diversion Channel Plan: Plan 05 11/18/2008
River = Devil_Div_Ch Reach = 1 RS = 2540.416 100-year Storm Event
.04 .014 .04
Legend
WS 100-yr
Ground
Bank Sta
Elevation (ft)
Station (ft)


Devil Creek Diversion Channel Plan: Plan 05 11/18/2008
River = Devil_Div_Ch Reach = 1 RS = 2434.105 100-year Storm Event
.04 .014 .04
Legend
WS 100-yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
Devil Creek Diversion Channel Plan: Plan 05 11/18/2008
River = Devil_Div_Ch Reach = 1 RS = 2321.91 100-year Storm Event
.04 .014 .04
Legend
WS 100-yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
Devil Creek Diversion Channel Plan: Plan 05 11/18/2008
River = Devil_Div_Ch Reach = 1 RS = 2200.726 100-year Storm Event
.04 .014 .04
Legend
WS 100-yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
Devil Creek Diversion Channel Plan: Plan 05 11/18/2008
River = Devil_Div_Ch Reach = 1 RS = 2081.762 100-year Storm Event
.04 .014 .04
Legend
WS 100-yr
Crit 100-yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
Devil Creek Diversion Channel Plan: Plan 05 11/18/2008
River = Devil_Div_Ch Reach = 1 RS = 1966.333 100-year Storm Event
.04 .014 .04
Legend
Crit 100-yr
WS 100-yr
Ground
Levee
Bank Sta
Elevation (ft)
Station (ft)
Devil Creek Diversion Channel Plan: Plan 05 11/18/2008
River = Devil_Div_Ch Reach = 1 RS = 1845.603 100-year Storm Event
.04 .014 .04
Legend
Crit 100-yr
WS 100-yr
Ground
Levee
Bank Sta
Elevation (ft)
Station (ft)
Devil Creek Diversion Channel Plan: Plan 05 11/18/2008
River = Devil_Div_Ch Reach = 1 RS = 1721.767 100-year Storm Event
.04 .014 .04
Legend
Crit 100-yr
WS 100-yr
Ground
Levee
Bank Sta
Elevation (ft)
Station (ft)
Devil Creek Diversion Channel Plan: Plan 05 11/18/2008
River = Devil_Div_Ch Reach = 1 RS = 1593.19 100-year Storm Event
.04 .014 .04
Legend
Crit 100-yr
WS 100-yr
Ground
Levee
Bank Sta
Elevation (ft)
Station (ft)


Devil Creek Diversion Channel Plan: Plan 05 11/18/2008
River = Devil_Div_Ch Reach = 1 RS = 1465.626 100-year Storm Event
.04 .014 .04
Legend
Crit 100-yr
WS 100-yr
Ground
Levee
Bank Sta
Elevation (ft)
Station (ft)
Devil Creek Diversion Channel Plan: Plan 05 11/18/2008
River = Devil_Div_Ch Reach = 1 RS = 1331.789 100-year Storm Event
.04 .014 .04
Legend
Crit 100-yr
WS 100-yr
Ground
Levee
Bank Sta
Elevation (ft)
Station (ft)
Devil Creek Diversion Channel Plan: Plan 05 11/18/2008
River = Devil_Div_Ch Reach = 1 RS = 1181.311 100-year Storm Event
.04 .014 .04
Legend
Crit 100-yr
WS 100-yr
Ground
Levee
Bank Sta
Elevation (ft)
Station (ft)
Devil Creek Diversion Channel Plan: Plan 05 11/18/2008
River = Devil_Div_Ch Reach = 1 RS = 1055.469 100-year Storm Event
.04 .014 .04
Legend
Crit 100-yr
WS 100-yr
Ground
Levee
Bank Sta
Elevation (ft)
Station (ft)
Devil Creek Diversion Channel Plan: Plan 05 11/18/2008
River = Devil_Div_Ch Reach = 1 RS = 942.186 100-year Storm Event
.04 .014 .04
Legend
Crit 100-yr
WS 100-yr
Ground
Levee
Bank Sta
Elevation (ft)
Station (ft)
Devil Creek Diversion Channel Plan: Plan 05 11/18/2008
River = Devil_Div_Ch Reach = 1 RS = 832.217 100-year Storm Event
.04 .014 .04
Legend
Crit 100-yr
WS 100-yr
Ground
Levee
Bank Sta
Elevation (ft)
Station (ft)
Devil Creek Diversion Channel Plan: Plan 05 11/18/2008
River = Devil_Div_Ch Reach = 1 RS = 702.698 100-year Storm Event
.04 .014 .04
Legend
Crit 100-yr
WS 100-yr
Ground
Levee
Bank Sta
Elevation (ft)
Station (ft)
Devil Creek Diversion Channel Plan: Plan 05 11/18/2008
River = Devil_Div_Ch Reach = 1 RS = 583.2891 100-year Storm Event
.04 .014 .04
Legend
Crit 100-yr
WS 100-yr
Ground
Levee
Bank Sta
Elevation (ft)
Station (ft)


Devil Creek Diversion Channel Plan: Plan 05 11/18/2008
River = Devil_Div_Ch Reach = 1 RS = 444.426 100-year Storm Event
.04 .014 .04
Legend
Crit 100-yr
WS 100-yr
Ground
Levee
Bank Sta
Elevation (ft)
Station (ft)
Devil Creek Diversion Channel Plan: Plan 05 11/18/2008
River = Devil_Div_Ch Reach = 1 RS = 333.019 100-year Storm Event
.04 .014 .04
Legend
Crit 100-yr
WS 100-yr
Ground
Levee
Bank Sta
Elevation (ft)
Station (ft)
Devil Creek Diversion Channel Plan: Plan 05 11/18/2008
River = Devil_Div_Ch Reach = 1 RS = 213.2339 100-year Storm Event
.04 .014 .04
Legend
Crit 100-yr
WS 100-yr
Ground
Levee
Bank Sta
Elevation (ft)
Station (ft)
Devil Creek Diversion Channel Plan: Plan 05 11/18/2008
River = Devil_Div_Ch Reach = 1 RS = 93.61499 100-year Storm Event
.04 .014 .04
Legend
Crit 100-yr
WS 100-yr
Ground
Levee
Bank Sta
Elevation (ft)
Station (ft)
Devil Creek Diversion Channel Plan: Plan 05 11/18/2008
River = Devil_Div_Ch Reach = 1 RS = 14.84399 100-year Storm Event
.04 .014 .04
Legend
Crit 100-yr
WS 100-yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
Devil Creek Diversion Channel Plan: Plan 05 11/18/2008
River = Devil_Div_Ch Reach = 1 RS = -2935 100-year Storm Event
.04 .014 .04
Legend
Crit 100-yr
WS 100-yr
Ground
Bank Sta
Elevation (ft)
Station (ft)

Normal Depth Analysis

Worksheet for Trapezoidal Channel - 1

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Roughness Coefficient	0.014	
Channel Slope	0.00300	ft/ft
Normal Depth	12.00	ft
Left Side Slope	2.25	ft/ft (H:V)
Right Side Slope	2.25	ft/ft (H:V)
Bottom Width	20.00	ft

Results

Discharge	12146.94	ft³/s
Flow Area	564.00	ft²
Wetted Perimeter	79.09	ft
Hydraulic Radius	7.13	ft
Top Width	74.00	ft
Critical Depth	14.05	ft
Critical Slope	0.00152	ft/ft
Velocity	21.54	ft/s
Velocity Head	7.21	ft
Specific Energy	19.21	ft
Froude Number	1.38	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	12.00	ft
Critical Depth	14.05	ft
Channel Slope	0.00300	ft/ft