Attachment 7: Technical Justification of Projects

PSP Requirements

Introduction 7-2

Technical Justification 7-3

Drainage Basins 7-3

Existing Conditions 7-5

Pre-Project Condition – 2-year Storm Event 7-6

Pre-Project Condition – 25-year Storm Event 7-7

Pre-Project Condition – 100-year Storm Event 7-8

Recommended Backbone Facilities 7-9

Post-Project Condition 7-10

Project Physical Benefits 7-11

Summary of Physical Benefits 7-11

Narrative Description of Project's Expected Flood Damage Reduction Benefits 7-11

Estimates of Historical Flood Damage Data 7-11

Estimates of Existing without-Project Conditions 7-11

Method Used to Estimate Physical Benefits 7-12

Acknowledgement of New Facilities, Policies, and Actions Required to Obtain Physical Benefits 7-12

Uncertainty of the Benefits 7-12

Description of Adverse Effects 7-12

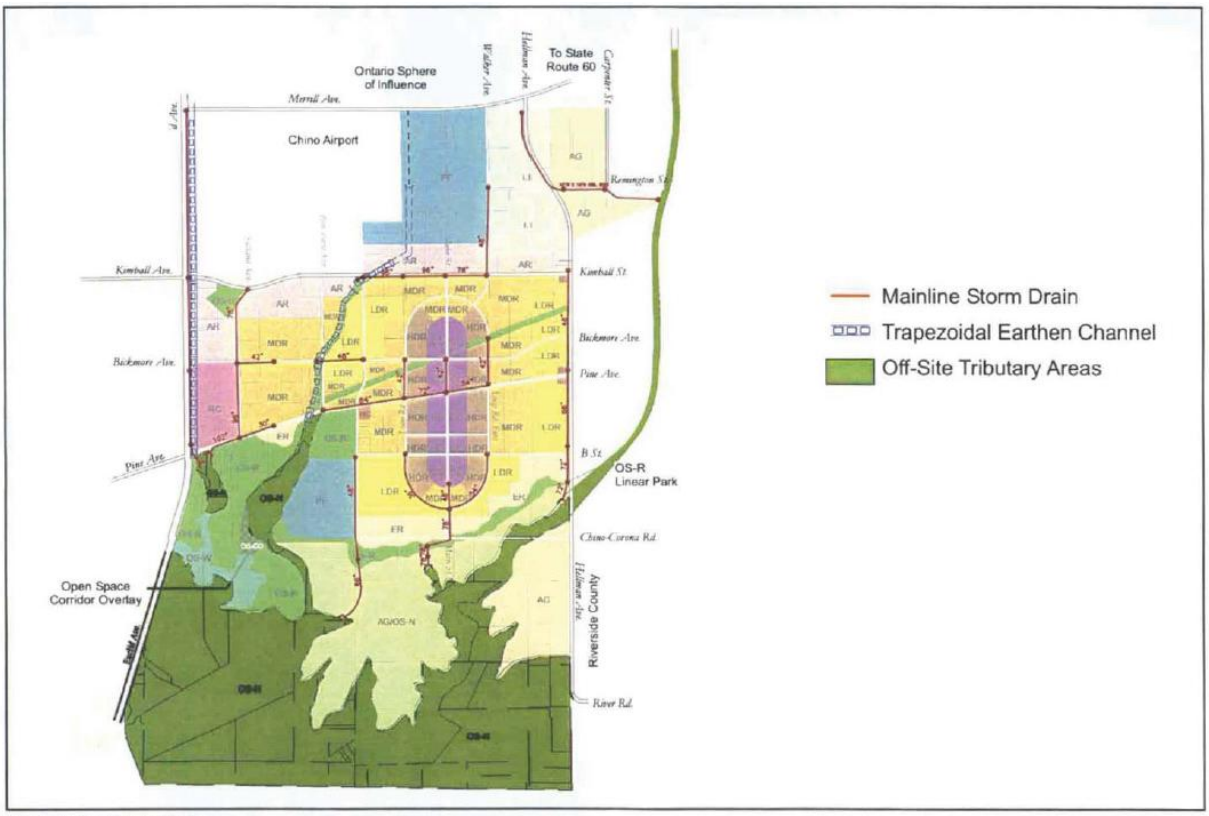
Hydraulic Study for Bickmore Channel Extension and Pine Avenue 7-13

Master Plan of Drainage – Subarea 2 – Chino Agricultural Preserve Area 7-81

Introduction

As part of the City of Chino's planning process for implementation of infrastructure facilities needed for the urbanization of the Chino Agricultural Preserve Area (The City of Chino Preserve), a Master Plan of Drainage Report was prepared and approved in March 2003.

The Study area encompasses approximately 5,435 acres of agricultural and open space property adjacent to the Cucamonga Creek Channel and upstream of US Army Corp of Engineers Prado Flood Control Basin. The ground surface in this area generally slopes from north to south, with over half the study area lying below the 566' High Water Elevation of the Prado Basin, and therefore within the impoundment area of the Prado Dam.



SOURCE: The Planning Center

MAP NOT TO SCALE

Michael Brandman Associates

05760012 - 6/2001

Exhibit **5.3-2**

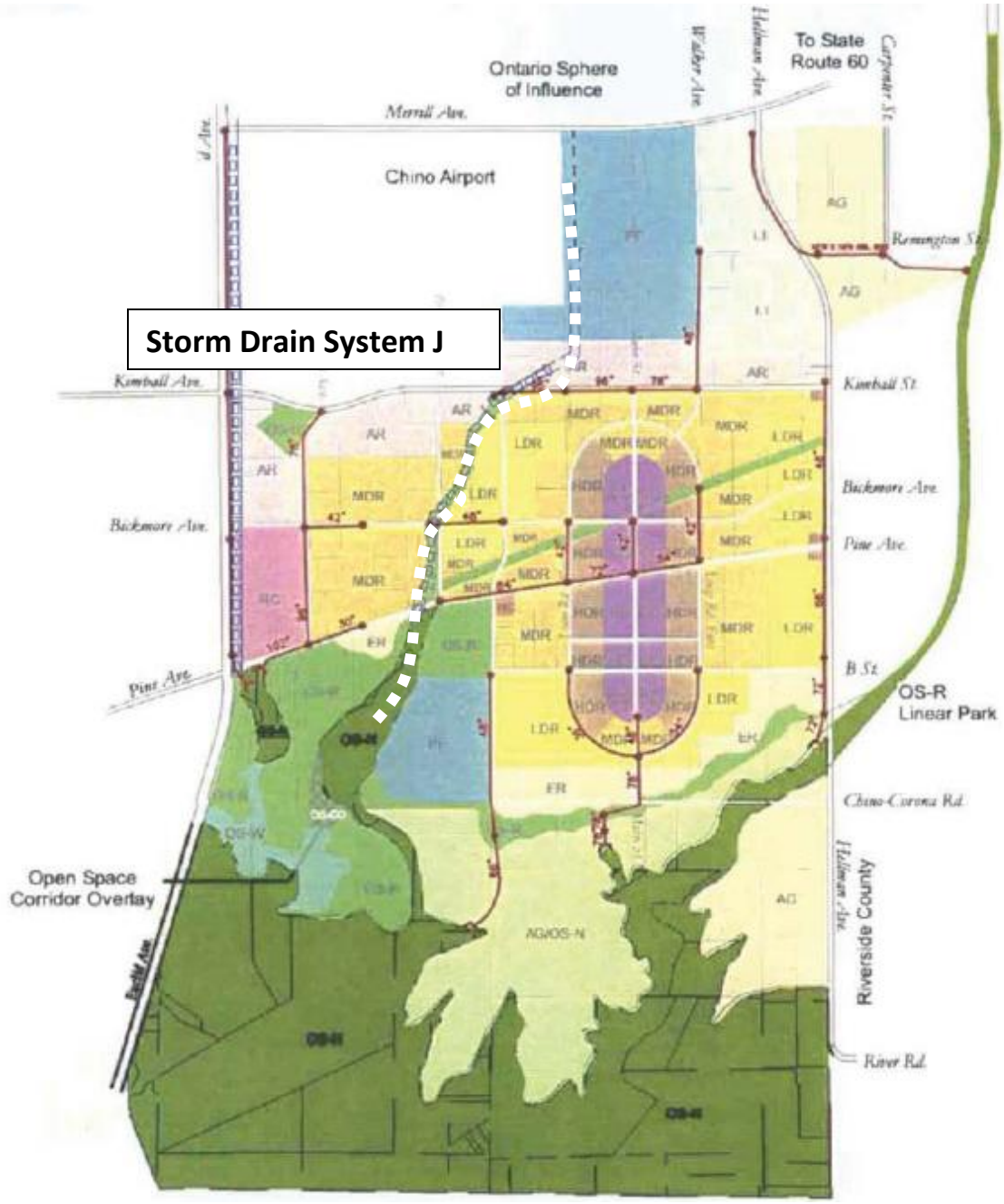
Storm Drainage Plan

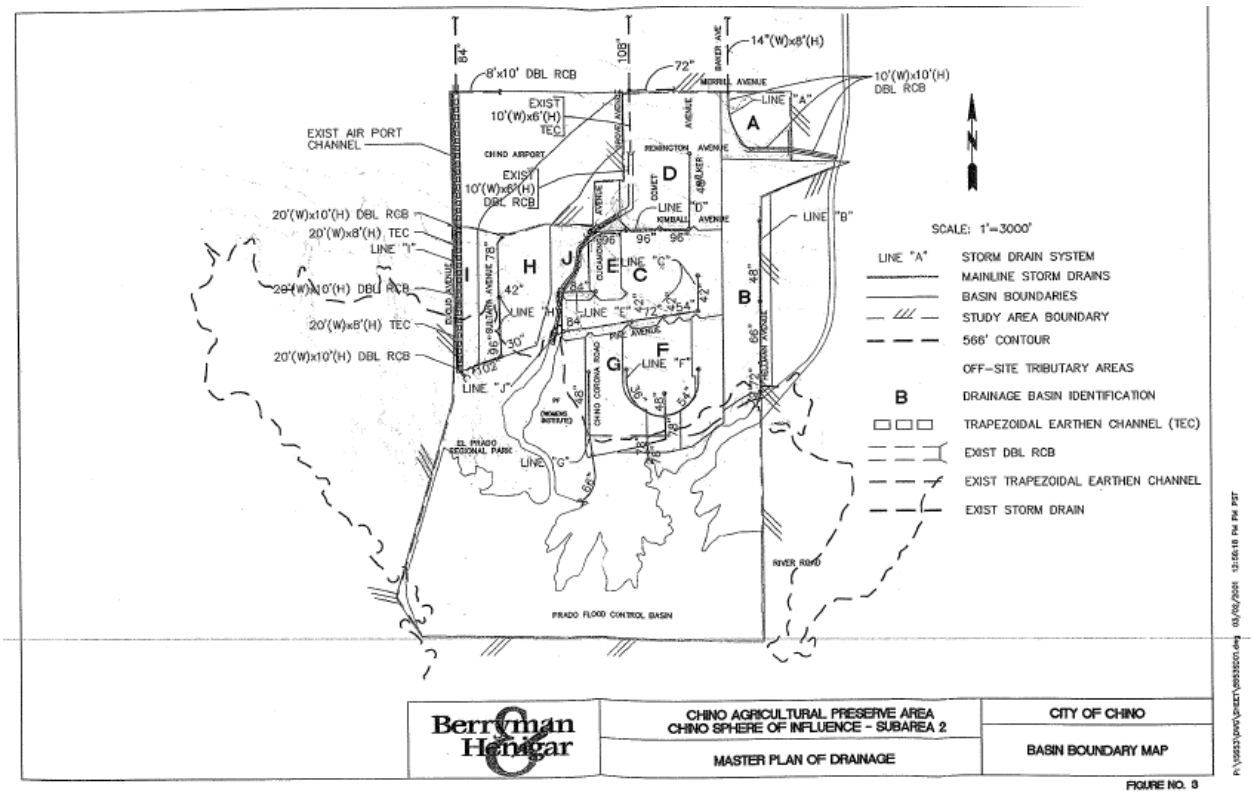
THE PRESERVE • CHINO SUBAREA 2

Technical Justification

Drainage Basins

Based on the existing and proposed flow patterns of the surface runoff, the developable portions of the study area have been divided into ten (10) Drainage Areas. Each Drainage Area Basin is tributary to a recommended Storm Drain System identified as Lines A through J. The focus of this project is Line J with its terminus at the Pine Avenue crossing.


Storm Drain System J
Ontario Sphere of Influence
To State Route 60
Merrill Ave.
Chino Airport
Walker Ave.
Hellman Ave.
Carpenter St.
Remington St.
Kimball Ave.
Kimball St.
Bickmore Ave.
Pine Ave.
B St.
OS-R Linear Park
Chino-Corona Rd.
Riverside County
River Rd.
Open Space Corridor Overlay
Euclid Ave.



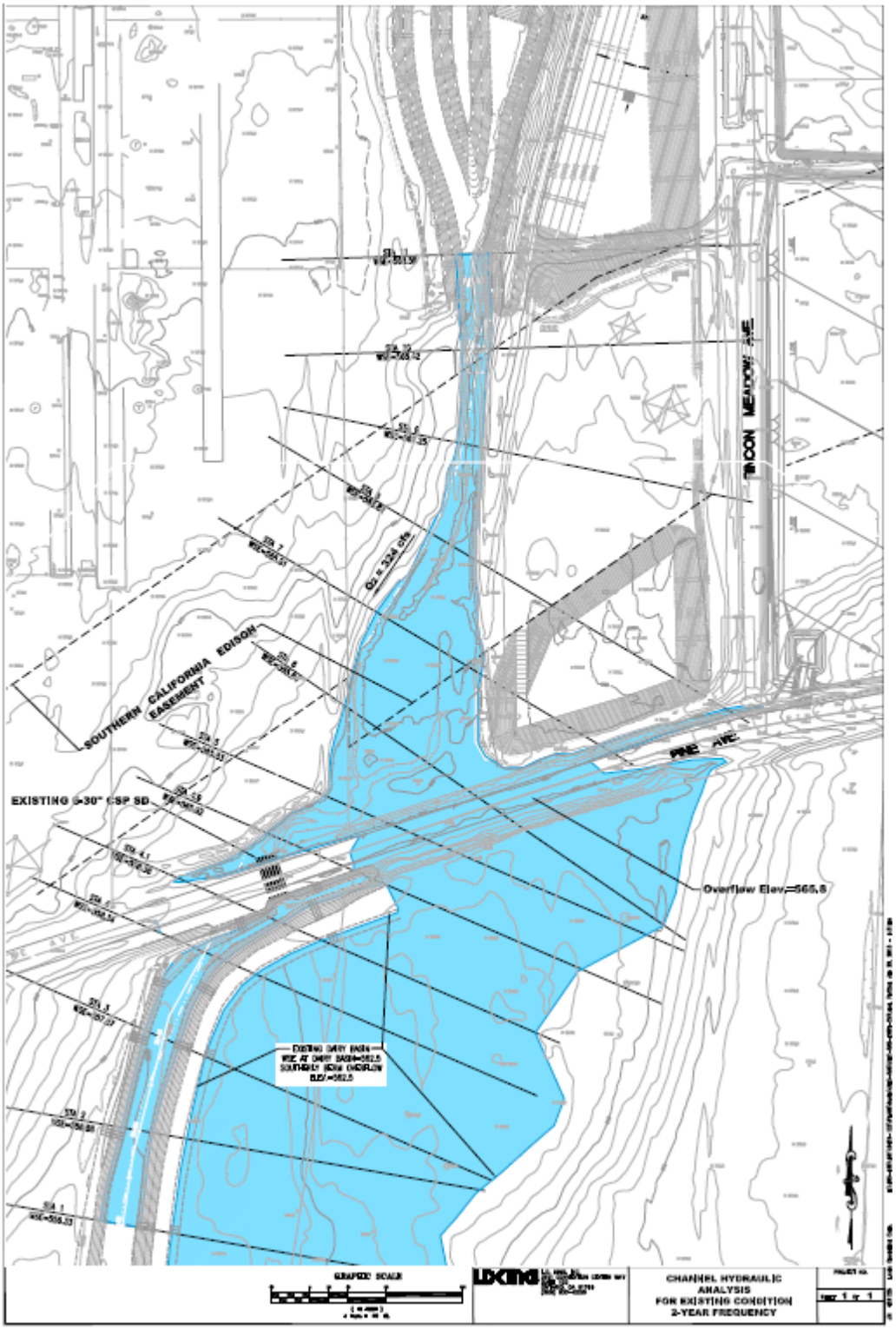
Existing Conditions

In the existing condition, the Bickmore Basins located to the north of the Project area outlet into an earthen channel which confluences with the Kimball Channel, which is also an earthen channel. These flows, combined with overland flows from properties east of Rincon Meadows Avenue, are directed southerly via existing earthen channel to an existing sump in Pine Avenue. This sump location is the focus of this Project.

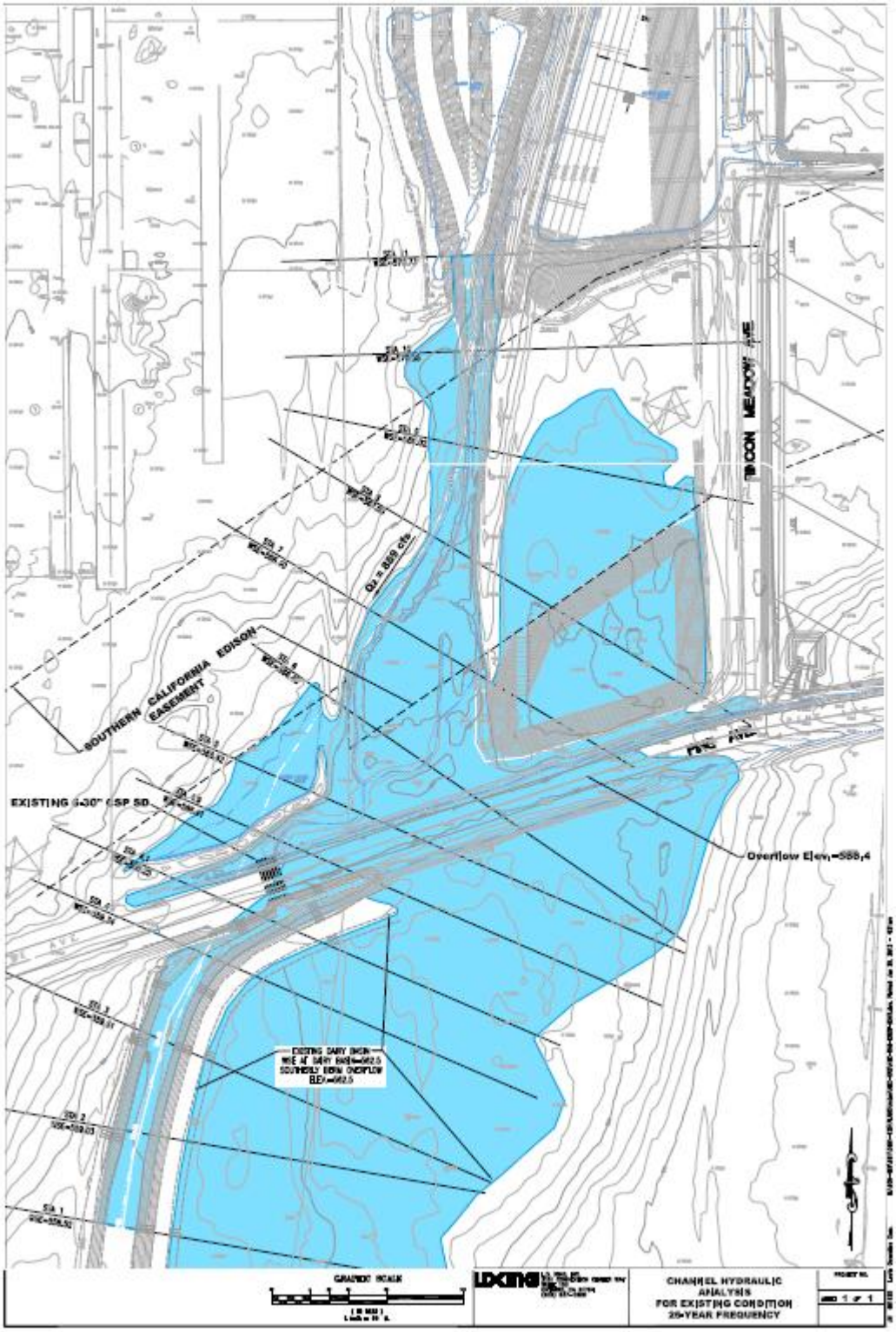
The existing crossing under Pine Avenue is composed of 6 existing corrugated steel pipes (CSP) which act as a culvert for the storm flows. On the south side of Pine Avenue, an existing earthen channel directs the flows southerly towards Prado Basin.

Under current conditions, a minor storm event, such as a 2-year event, tops the roadway and undermines the functionality of this major regional arterial. The exhibits, excerpts from the Hydraulic Study, illustrate the impacts to this location from a minimal 2-year event, a 25-year event, and a 100-year event.

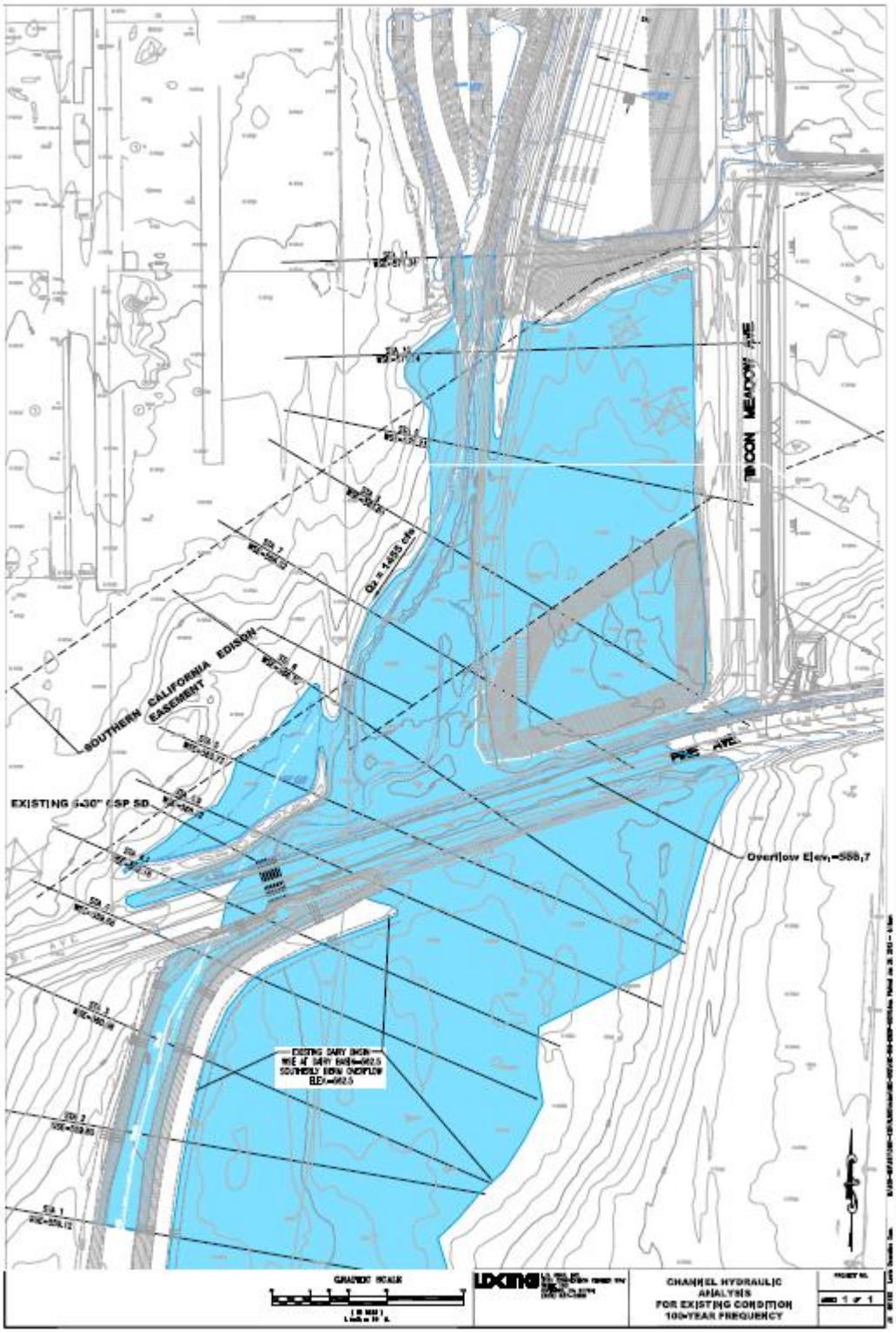
Pre-Project Condition – 2-year Storm Event



Pre-Project Condition – 25-year Storm Event



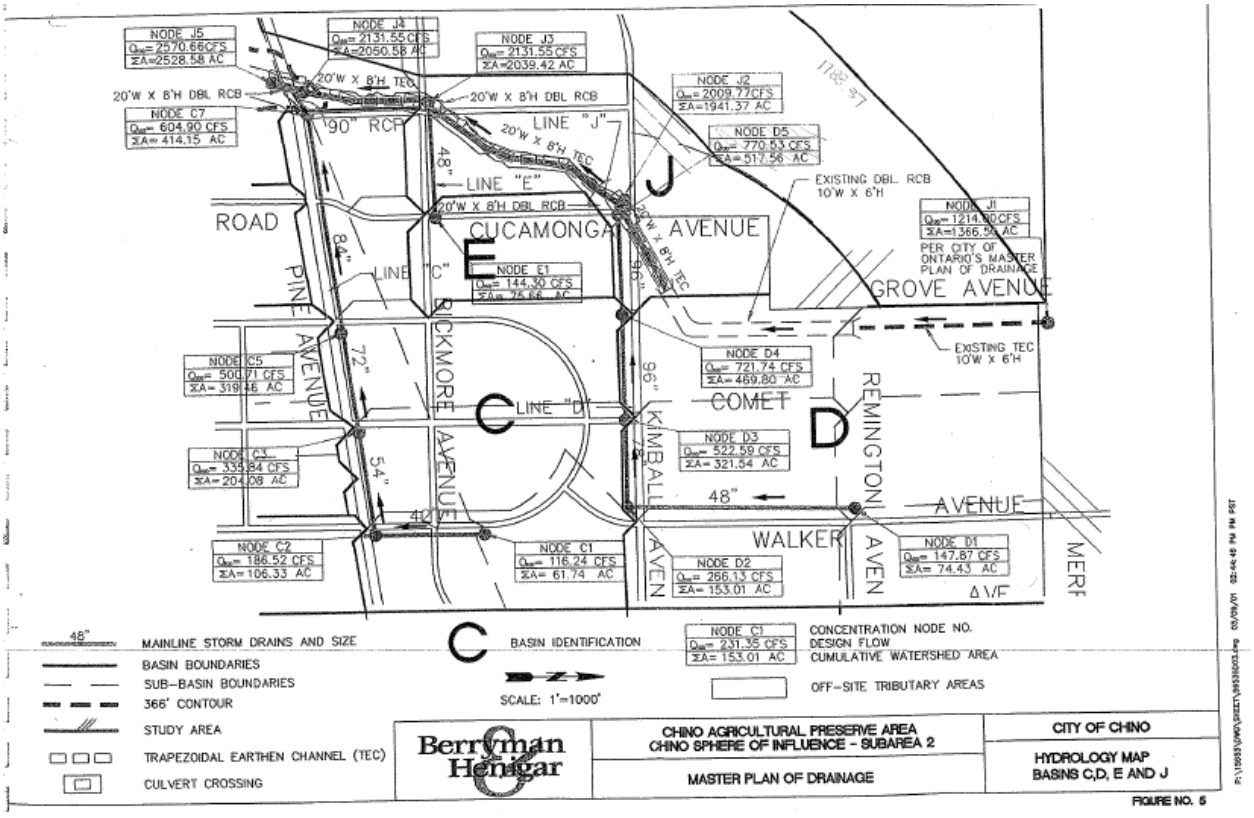
Pre-Project Condition – 100-year Storm Event



Recommended Backbone Facilities

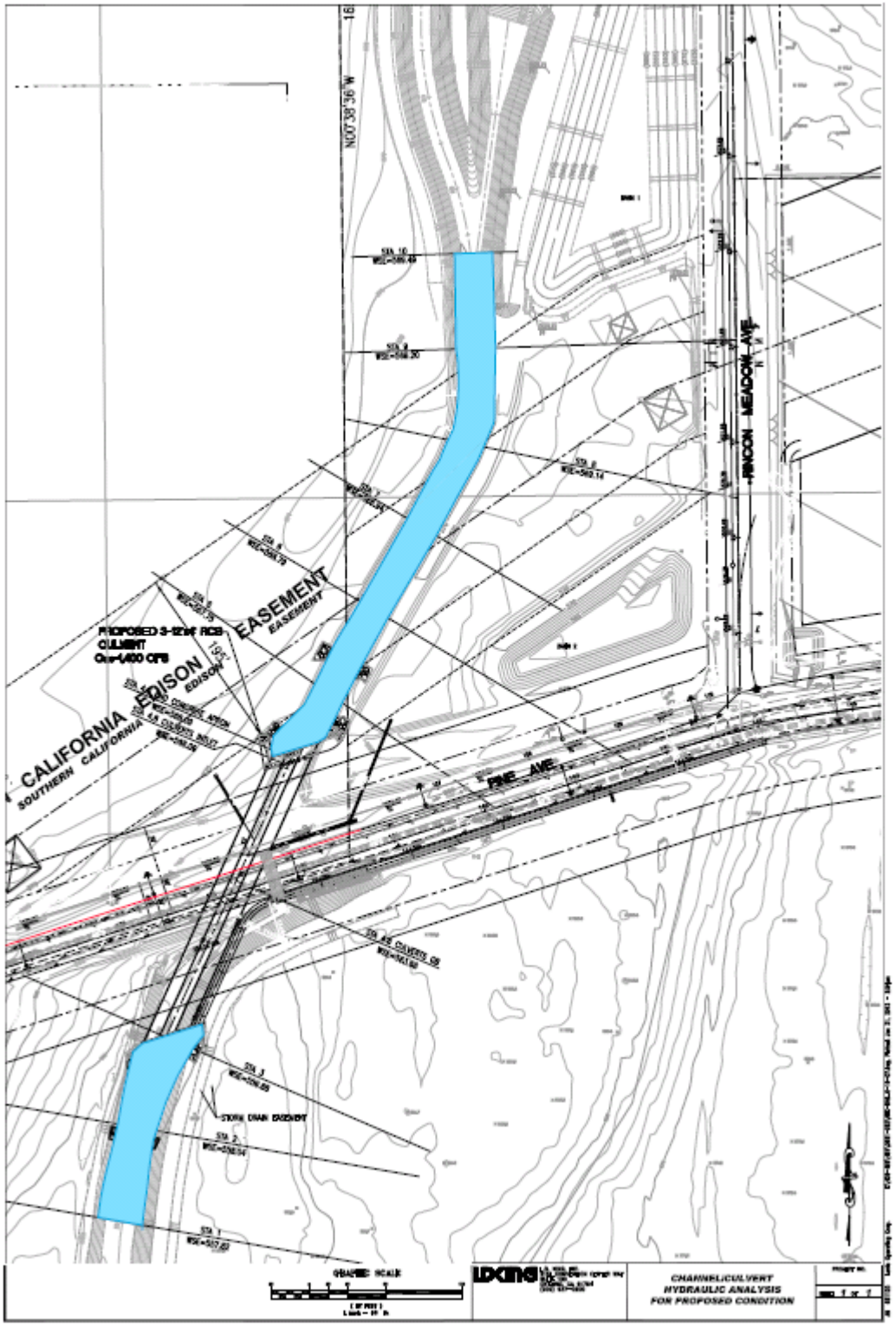
Facility sizes, tributary acreage, peak flow rates at concentration nodes and the Line J storm drain line are presented below in an excerpt from the Master Plan of Drainage.

A Hydraulic Study for the Bickmore Channel Extension and Pine Avenue has been prepared and is included in this section. This hydraulic study focuses on design necessary to construct the Pine Avenue crossing of "Line J".



Following the recommended improvements from the current design effort including the installation of the 12x4 triple RCB and the improvements to the earthen channel, the impacts to this critical local arterial will be addressed and alleviated. The excerpt below illustrates the overall impact of the improvements in a post project condition.

Post-Project Condition



Project Physical Benefits

The Project physical benefits are intended to be measurable accomplishments of the project over the period of analysis for the project life. Included are the measurable restoration, protection, and enhancement beneficial uses. Below outlines the Project benefits:

Summary of Physical Benefits

The table below shows the acres protected from flooding as a result of the project, under the 2-, 25-, and 100-year storm events.

Table 7 – Annual Project Physical Benefits				
Project Name: Project: Pine Ave Storm Drain Project				
Type of Benefit Claimed: Flood Protection				
Measure of Benefit Claimed (Name of Units): Acres				
Additional Information About this Measure: Acres of Land Protected				
(a)	(b)	(c)	(d)	(e)
		Physical Benefits		
Year	Storm Event	Without Project	With Project	Acres Protected as a result of Project (d) – (c)
2013 - 2042	2-Year	0	6.3	**6.3**
2013 - 2042	25-Year	0	8.9	**8.9**
2013 - 2042	100-Year	0	9.7	**9.7**

Narrative Description of Project's Expected Flood Damage Reduction Benefits

Estimates of Historical Flood Damage Data

The December 2010 flood event (categorized as a 2-year storm event) resulted in the undermining of the road itself and IEUA's Treatment Plant 1 reclaimed water outfall line, resulting in the need for emergency repairs to prevent more serious impacts. A 0.6 mile section of the road was closed for approximately one week, causing traffic delays and business losses and limiting access to residences and critical utilities.

Estimates of Existing without-Project Conditions

Presently, the area surrounding the Project lies within a FEMA 100-year floodplain and is under significant threat of flood damage from stormwater runoff. Even minor storm events may cause flooding and/or the undermining of the road and appurtenant utilities. All flood events, ranging from 2-year to 100-year, will result in medium-term road closure, causing traffic delays for automobile passengers and freight, business losses to local shops and dairies, emergency access problems for local residents and the

nearby California Institution for Women, and limited emergency access to Southern California Edison facilities.

Method Used to Estimate Physical Benefits

Channel hydraulic analyses for the existing conditions have been prepared for 2-year, 25-year, and 100-year storm events. Along with these analyses, the surface area of the flood waters were estimated for each of the storm events. It is expected that after the Project is implemented, stormwater will flow under Pine Avenue through a culvert capable of handling 100-year storm flows and directed downstream to the Prado Reservoir. All flooding anticipated in the without-Project scenario would be eliminated.

Acknowledgement of New Facilities, Policies, and Actions Required to Obtain the Physical Benefits

Improvements will consist of (1) purchase of right-of-way and easement, (2) construction of drainage facilities and street improvements, and (3) various administration, monitoring, and mitigation requirements. Please refer to Attachment 4 for additional details.

Uncertainty of the Benefits

The benefits were calculated based on statistical data to estimate the occurrence of 2-, 25-, and 100-year storm events. The benefits will be realized for any flood event that exceeds the capacity under current conditions.

Description of Adverse Effects

There will be no adverse effects other than the one-time impacts of short term local traffic inconvenience and noise during the construction period. These issues were addressed in the CEQA documents.

Hydraulic Study for Bickmore Channel Extension and Pine Avenue

HYDRAULIC STUDY
FOR BICKMORE CHANNEL EXTENSION
AND PINE AVENUE

In The City of Chino

PREPARED FOR:

LEWIS OPERATING CORP.

Prepared By:

L.D. KING, INC.

2151 Convention Center Way, Suite 100

Ontario, CA 91764

January 2013

INTRODUCTION

The purpose of this Channel Hydraulic Analysis is to study the impact that the storm flows from the Bickmore Basin, Kimball Basins and overland flows from property east of Rincon Meadows Avenue have on the downstream earthen channel, CSP culvert at Pine Avenue, the Pine Avenue roadway and the dairy land south of Pine Avenue.

The study area is located approximately 550 feet west of Rincon Meadows Avenue and approximately 600 feet south of Bickmore Avenue and extends southerly to Pine and to the existing dairy south of Pine Avenue. In the existing condition, the Bickmore Basin outlets into an earthen channel which confluences with the Kimball Channel which is also an earthen channel. These flows combined with overland flows from property east of Rincon Meadows Avenue are directed southerly via an existing earthen channel to an existing sump in Pine Avenue where there are six (6) existing corrugated steel pipes, (CSPs) which act as a culvert for the storm flows. On the south side of Pine Avenue there is an existing earthen channel which directs the flows southerly.

For this study, HEC- RAS Software, developed by the U.S. Corps of Engineers was used to estimate the water surface along the existing channels, culvert and roadway. For this study, a hydraulic analysis was run using storm flows from 2-year, 25-year and 100-year storm frequencies which are 324 cfs, 889 cfs, and 1,455 cfs respectively.

SUMMARY TABLE

Storm Frequency	Flow cfs	Culverts Capacity (cfs)	Overflow cfs	Overflow Width feet	Overflow Water Elev. (ft)	Overflow Depth (ft)
2-Year	324	155	169	260	565.8	0.6
25-Year	889	155	669	412	566.4	1.2
100-Year	1455	155	1300	481	566.7	1.5

CONCLUSION

Results from the hydraulic analysis show that the existing six (6) CMP culverts collect approximately 155 cfs, the remaining flows from the 2-year, 25-year and 100-year frequency storms spill over Pine Avenue into the existing earthen channel and onto adjacent dairy property.

2 – YEAR FREQUENCY

```
                    HEC-RAS Version 4.1.0 Jan 2010
                     U.S. Army Corps of Engineers
                    Hydrologic Engineering Center
                          609 Second Street
                          Davis, California


          X     X  XXXXXX    XXXX        XXXX       XX      XXXX
          X     X  X        X    X       X   X     X  X    X
          X     X  X        X            X   X    X    X   X
          XXXXXXX  XXXX     X       XXX  XXXX     XXXXXX    XXXX
          X     X  X        X            X  X     X    X        X
          X     X  X        X    X       X   X    X    X        X
          X     X  XXXXXX    XXXX        X    X   X    X   XXXXX
```

PROJECT DATA
Project Title: Bickmore Channel-Existing Condition 2-yr
Project File : BMCEexist-2yr.prj
Run Date and Time: 1/29/2013 4:24:41 PM

Project in English units

Project Description:
Channel Analysis for Existing Condition 2 Year

PLAN DATA

Plan Title: Plan 01
Plan File : e:\400-499\481\0481-125\PLANS\hydro\HEC-RAS\BMCEexist-2yr.p01

Geometry Title: Bickmore Channel Existing Condition 2-yr
Geometry File : e:\400-499\481\0481-125\PLANS\hydro\HEC-RAS\BMCEexist-2yr.g01

Flow Title : Bickmore Channel Existing Condition 2-yr
Flow File : e:\400-499\481\0481-125\PLANS\hydro\HEC-RAS\BMCEexist-2yr.f01

Plan Summary Information:

Number of:	Cross Sections	= 14	Multiple Openings	=	0
	Culverts	= 1	Inline Structures	=	0
	Bridges	= 0	Lateral Structures	=	0

Computational Information
Water surface calculation tolerance = 0.01
Critical depth calculation tolerance = 0.01
Maximum number of iterations = 20
Maximum difference tolerance = 0.3
Flow tolerance factor = 0.001

Computation Options
Critical depth computed only where necessary
Conveyance Calculation Method: At breaks in n values only
Friction Slope Method: Average Conveyance
Computational Flow Regime: Mixed Flow

FLOW DATA

Flow Title: Bickmore Channel Existing Condition 2-yr
Flow File : e:\400-499\481\0481-125\PLANS\hydro\HEC-RAS\BMCEexist-2yr.f01

Flow Data (cfs)

River	Reach	RS	PF 1
RIVER-1	Reach-1	11	324

Boundary Conditions

River	Reach	Profile	Upstream

Downstream

RIVER-1 Reach-1 PF 1 Normal S = 0.0011 Normal S = 0.005

GEOMETRY DATA

Geometry Title: Bickmore Channel Existing Condition 2-yr
Geometry File : e:\400-499\481\0481-125\PLANS\hydro\HEC-RAS\BMCEexist-2yr.g01

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 11

INPUT
Description: STA 11
Station Elevation Data num= 122

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	576.18	180.16	575.25	189.15	570.87	189.68	569.71	190.12	569.57
190.95	569.31	194.1	568.35	195.26	568	195.72	568.23	197.31	569
198.99	569.83	199.33	570	201.38	571	206.83	571.76	208.03	572
208.94	572	209.79	571.83	209.83	571	244.41	571	244.42	571.25
244.45	572	246.85	572.19	252.3	572.39	257.39	572.59	260.31	572.32
261.3	572.92	262.39	573.21	262.82	573	264.1	572.36	264.81	572
266.1	571.39	266.8	571	268.77	570.5	270.4	570	278.41	570
281.07	569.14	281.76	569	282.31	568.84	288.81	567	289.71	566.75
292.13	566.06	292.2	566.05	292.46	566	293.35	565.84	293.41	565.83
303.16	564.22	304.48	564	309.46	563.18	310.53	563	361.86	554.53
365.05	554	370.04	553.18	371.11	553	382.71	551.09	382.98	551.04
383.23	551	383.45	550.96	386.67	550.43	388.26	550	395.75	550
396.33	550.28	397.84	551	398.67	551.4	399.94	552	400.93	552.48
403.15	553.53	406.51	555.14	408.32	556	409.59	556.61	412.51	558
413.74	558.59	414.59	559	415.81	559.58	416.7	560	419.96	561.56
420.89	562	422.03	562.55	424.1	563.53	425.08	564	430.32	566.5
431.36	567	433.46	568	434.46	568.48	435.55	569	438.14	569.44
438.85	570	444.67	572.84	452.33	576.2	463.83	576.2	490	565.1
511.5	565.1	532.89	575.91	536.29	571.99	537.87	572.12	542.61	572.36
546.17	572.57	548.26	572.74	555.73	573.01	558.27	573.08	565.42	573.16
568.27	573.2	575.11	572.96	578.28	572.86	584.8	573.09	588.28	573.18
598.29	573.97	604.18	574.53	608.29	574.98	618.3	575.26	623.56	575.3
628.3	575.3	633.25	575.21	638.31	575.1	642.94	574.99	648.31	574.85
658.32	574.92	668.32	574.9	681.69	574.91	688.34	574.95	691.38	574.95
698.34	574.98	700	574.98						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.02	463.83	.02	532.89	.02

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
463.83	532.89	100	100	100	.1	.3

Left Levee Station= 463.78 Elevation= 576.16
Right Levee Station= 533.54 Elevation= 575.86

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 10

INPUT
Description: STA 10
Station Elevation Data num= 117

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	575.31	182.86	574.38	193.89	569.39	198.67	567.25	198.72	567.27
198.82	567.32	198.91	567.37	199	567.41	199.13	567.47	199.3	567.56
199.55	567.69	200.04	567.93	202.18	569	204.05	569.93	204.18	570
206.18	571	212.49	571	212.51	570.56	212.54	570	246.49	570
246.51	570.57	246.53	571	259.01	571.96	259.37	571.99	259.48	571.99
259.59	571.98	259.73	571.96	264.6	571.34	265.97	571.15	266.13	571.07
266.26	571	267.89	570.18	268.26	570	270.09	569.08	270.26	569
272.26	568	272.36	568	273.26	568.01	278.43	567.69	281.38	567.52
287.63	567.51	291.38	567.48	301.39	567.51	307.01	567.54	311.39	567.58

```
   316.7  567.44   321.4  567.33  326.39  567.29   331.4  567.19  341.41  567.31
  351.41  567.38  355.46  567.23  361.42  566.93  365.15  566.95  371.42  567.01
  374.83  567.09  381.43  567.28  384.52  567.26  391.43  567.24  394.21  567.09
  401.44  566.69   403.9  566.84  411.45  567.37  413.59  567.37  421.45  567.39
  431.46  567.45  442.89  567.41  450.02  568.97  451.47  569.28  452.35  569.41
  461.47  570.74  461.93  570.79  468.07  571.34  470.91   571.3  471.71  571.28
  476.23  571.18  481.22  570.19  481.44  570.14  488.97  564.92  508.97  564.92
   511.5   567.9  520.18  569.74   521.5  570.09  529.87   569.9  531.51  569.81
  539.56  569.92  541.51  569.92  549.25   570.3  551.52  570.38  558.94  570.87
  561.52  571.03  568.63  571.51  571.53   571.7  578.32  572.01  581.54  572.26
  588.01   572.8  591.54  573.14   597.7  573.47  601.55  573.69  607.39  573.72
  611.55  573.76  617.07  573.85  621.56  573.98  626.76  574.12  631.56  574.18
  641.57  574.15  646.14  574.15  651.57  574.21  655.83  574.49  661.58  574.93
  665.52  574.71  671.58  574.24  681.59  574.22   684.9  574.28  691.59  574.47
  694.59  574.48     700  574.52

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0    .035  259.01    .035  591.54    .035

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
        259.01  591.54           215.02     100   53.41             .1       .3
Left Levee      Station=  469.86      Elevation=  571.33
Right Levee     Station=  571.55      Elevation=  571.68

CROSS SECTION


RIVER: RIVER-1
REACH: Reach-1            RS: 9

INPUT
Description: STA 9
Station Elevation Data    num=     116
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0  573.33  162.52  572.84  166.21  571.02  167.97  570.09  172.92  567.52
  175.83     566  177.08  566.61  178.76  567.44  180.67  568.37  183.29  569.66
  183.99     570  225.19     570   225.2  570.21  226.69  570.31  236.53     571
  238.44  571.04  239.02     571   240.2     571  240.63     571  244.97   570.1
  245.49     570  246.36  569.78   247.5  569.02  249.53  568.03  249.59     568
  251.58  567.03  251.64     567  251.83  566.91  253.69     566  253.87  565.99
  254.72  565.97  260.38   565.9  262.63  565.92  272.83  566.19  283.04   566.3
  293.15  566.21  293.58  566.21  303.44  566.15  305.93  566.07  313.64   565.8
  318.71  565.75  323.84  565.63   331.5  565.64  344.12  565.59  344.28  565.59
  354.45   565.3  357.06  565.32  364.65  565.32  369.84  565.46  374.85  565.57
  382.62   565.7  385.05  565.75  394.67  565.61  395.25   565.6   395.4   565.6
  405.46  565.48  415.66  565.62  420.97  565.82  425.86  566.05  433.75  566.37
  436.06  566.46  441.09  566.56  446.86  566.65  452.47  568.08  456.46  569.05
  458.06  569.79  462.52   570.1  464.36  570.22  466.67  570.22   472.2  570.13
  472.59  570.12  481.37  566.27   482.4  565.85  483.55  565.68  487.07  565.21
  488.45  564.95  491.02  564.58  495.05  564.07  497.06  565.37  497.27  565.46
  497.66  565.57  507.47  567.95  510.44  568.12  517.67  568.51  523.22  569.05
  527.88   569.6     536  570.13  538.08  570.28  546.29  570.84  548.28  570.97
  548.78  571.02  558.48  571.94  561.56  572.14  568.68  572.77  574.34  573.02
  578.88  573.17  587.13  573.37  589.09   573.4  599.29  573.45  599.91  573.45
  609.49  573.51  612.69  573.46  619.69   573.3  625.47   573.3  629.89  573.25
  638.25  573.55  640.09   573.6   650.3  574.62  651.03  574.58   660.5     574
  663.82  573.93   670.7  573.75   676.6  573.82   680.9  573.85   691.1  574.14
     700  573.97

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0    .035   240.2    .035  558.48    .035

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         240.2  558.48           267.74     100   32.54             .1       .3
Left Levee      Station=  466.14      Elevation=  570.24
Right Levee     Station=  549.42      Elevation=  571.01

CROSS SECTION


RIVER: RIVER-1
REACH: Reach-1            RS: 8

INPUT
Description: STA 8
Station Elevation Data    num=     180
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
```

0	573.22	5.37	572.99	15.54	572.39	17.01	572.31	18.02	572.24
28.65	572.08	37.56	572.23	40.29	572.17	44.3	571.8	51.93	571.34
57.11	570.55	61.97	569.49	64.04	569.15	68.96	568.22	69.62	568.23
73.68	568.32	75.39	568.35	76.66	568.38	83.14	568.61	85.41	568.7
86.12	568.76	87.49	568.8	89.55	568.89	96.2	569.11	98.48	569.09
101.83	569.03	110.12	568.9	111.11	568.89	115.75	568.74	118.84	568.66
121.94	568.55	123.49	568.1	124.75	567.43	125.81	567.07	128.43	566.12
133.57	564.27	135.66	564.73	139.92	565.52	142.37	565.35	147.88	565.53
148.69	565.8	149.68	566.02	153.66	567.17	156.27	567.9	157.16	568.18
163.3	569.82	163.53	569.88	163.63	569.87	165.02	569.36	168.05	570
170.05	569	171.18	568.44	172.05	568	173.2	567.43	174.06	567
175.95	566.03	178.07	565	179.04	564.49	180.08	564	181.14	563.43
182.08	563	183.24	562.38	184.06	562	185.33	561.32	186.04	561
187.42	560.26	188.01	560	189.5	559.19	189.96	559	191.59	558.13
191.87	558	193.64	557.07	193.8	557	195.79	556.01	197.77	555.12
198.05	555	198.43	554.85	200.48	554.06	200.63	554	200.69	553.98
203.22	553	324.53	553	326.46	553.88	326.72	554	327.16	554.2
327.36	554.29	330.59	555.76	330.76	555.84	331.12	556	333.14	556.92
333.31	557	335.37	557.94	335.51	558	337.59	558.95	337.7	559
337.89	559.08	337.97	559.12	341.96	560.94	342.09	561	344.27	561.99
345.88	562.72	346.47	562.99	348.59	563.96	348.68	564	350.72	564.93
350.88	565	351.03	565.07	353.99	565.2	354.04	565.2	354.17	565.21
354.43	565.07	355.62	565.04	366.16	565.23	369.86	565.25	377.8	565.33
389.4	565.59	389.5	565.59	401.08	565.65	405.13	565.7	410.84	565.88
411.1	565.9	424.36	567.2	426.71	567.57	430.88	568.34	432.25	568.45
433.85	568.38	437.15	568.37	438.59	568.48	439.75	568.37	439.82	568.92
441.43	568.52	447.75	566.31	451.29	564.72	455.02	565.14	459.27	565.72
467.59	565.79	470.91	565.53	473	564.93	476.72	563.8	481.26	564.85
482.55	565.14	485.09	565.41	486.83	565.41	489.71	565.5	494	565.37
496.28	565.06	504.13	566.78	505.82	567.17	506.68	567.29	517.46	568.65
526.23	569.42	529.1	569.63	533.33	569.91	540.74	570.34	545.78	570.55
552.38	570.84	562.09	571.42	564.02	571.54	565.32	571.64	571.8	572.1
575.65	572.33	579.09	572.44	584.87	572.59	587.29	572.66	590.86	572.64
598.93	572.64	610.57	572.48	619.62	572.7	622.21	572.77	623.96	572.93
633.85	573.9	643.51	573.48	645.48	573.41	657.12	573.2	663.06	573.35
668.76	573.48	677.16	573.92	680.4	574.1	692.04	573.74	700	573.71

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.035	51.93	.035	545.78	.035

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
51.93	545.78	100	100	100	.1	.3

Left Levee Station= 441.1 Elevation= 568.43
Right Levee Station= 518.63 Elevation= 568.71

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 7

INPUT
Description: STA 7
Station Elevation Data num= 169

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	572.24	4.02	572.06	15.66	571.46	23.93	570.94	27.3	570.76
29.59	570.58	49.14	569.53	62.22	568.6	68.69	568.14	73.86	567.8
85.49	567.2	88.23	567.08	107.78	566.02	108.77	565.96	110.23	565.91
120.41	565.58	127.33	565.33	132.05	565.11	138.99	564.89	143.69	564.69
155.32	563.89	162.7	562.8	164.88	562.38	169.1	563.62	174.28	564.56
175.24	564.98	184.01	565.24	187.06	565.7	188.64	565.78	190.24	565.82
196.53	565.93	201.88	566.06	205.51	566.05	208.51	565.91	217.75	565.58
220.31	565.26	224.32	564.28	226.92	563.58	233.89	565.16	236.14	565.64
239.71	566.39	241.92	566.46	245.16	566.52	246.85	566.54	247.9	566.56
248.15	566.55	249.55	566.49	250.37	566.58	250.95	566.34	254.04	566.17
254.63	565.81	255.24	565.7	258.5	565.08	258.71	565	258.92	564.93
261.44	564	261.56	563.95	264.16	563	266.85	562.01	269.49	561.04
269.6	561	272.13	560.07	272.33	560	274.77	559.1	275.05	559
277.41	558.13	277.77	558	280.06	557.16	280.5	557	282.7	556.19
283.22	556	285.34	555.22	288.66	554	289.41	553.73	291.39	553
337.68	553	337.81	553.05	339.97	554	340.07	554.04	342.31	555
342.37	555.02	344.66	556	345.05	556.17	346.66	556.96	346.73	557
348.63	557.94	348.75	558	350.62	558.92	350.77	559	352.63	559.91
352.79	560	354.63	560.91	354.81	561	356.65	561.9	356.84	562
358.66	562.9	358.86	563	360.68	563.89	360.88	564	362.69	564.89
362.9	565	364.62	565.89	364.84	566	365.07	566.11	366.86	567
374.47	566.66	375.54	566.6	383.32	566	386.82	565.01	387.54	564.24
395.69	564.73	399.73	565.03	400.98	565.06	411.37	565.2	420.53	564.98

423.01	564.9	424.5	564.86	427.79	564.65	430.14	564.94	434.64	565.41
440.07	565.37	446.28	565.38	455.42	565.48	457.92	565.49	459.62	565.51
469.56	565.54	479.17	565.55	480.69	565.41	481.2	565.5	484.19	565.44
492.84	565.24	496.03	564.77	496.96	564.83	497.43	564.44	500.65	565.1
504.47	565.63	512.95	566.35	516.11	566.59	518.26	566.94	527.75	568.41
537.81	569.71	539.39	569.9	541.72	570.05	551.03	570.69	552.52	570.76
557.35	570.55	562.67	570.43	570.49	569.76	574.31	569.39	576.9	569.59
585.94	570.31	596.45	570.67	597.58	570.72	599.25	570.81	609.22	571.33
615.99	571.87	620.86	572.14	632.5	572.16	635.54	572.18	644.14	572.26
655.09	572.6	655.77	572.62	667.41	573.07	674.63	573.11	679.05	573.11
685.55	573.14	690.69	573.18	694.18	573.18	700	573.17		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.035	62.22	.035	552.52	.035

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
62.22	552.52	132.62	100	86.89	.1	.3

Left Levee Station= 367.15 Elevation= 567
Right Levee Station= 550.93 Elevation= 570.66

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 6

INPUT
Description: STA 6
Station Elevation Data num= 133

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	569.88	1.17	569.79	10.93	569.02	13.3	568.85	25.44	568.74
28.58	568.5	37.57	567.8	46.23	567.08	49.71	566.82	57.38	566.29
61.85	566.01	63.88	565.86	73.98	565.19	81.53	565.04	86.12	564.99
96.23	564.76	98.26	564.7	99.18	564.7	110.39	564.72	116.82	564.52
122.53	564.37	134.47	564.27	135.09	564.27	146.8	564.16	152.12	564.13
158.94	564.13	169.77	564.06	171.07	564.07	173.94	564.06	183.21	564.1
187.42	564.14	195.35	564.26	205.07	564.6	207.48	564.67	219.62	564.77
222.72	564.64	231.75	564.39	240.36	564.7	243.55	564.77	245.94	564.78
250.22	564.79	253.17	563.55	258.05	561.25	259.64	561.62	261.43	562.03
265.57	562.97	267.88	563.53	269.61	563.73	275.66	564.32	278.02	564.34
280.29	564.04	281.65	564.28	292.79	564.99	293.31	565	304.57	565.13
307.17	565.14	309.42	565.12	312.18	564.93	316.86	563.82	317.93	563.97
318.5	563.8	319.33	563.51	320	563.22	321.25	563.47	328.61	564.31
328.84	564.31	329.37	564.32	340.98	564.65	346.25	564.59	353.12	564.83
363.9	565.32	365.25	565.3	371.89	565.05	379.18	563.35	379.46	563.29
383.66	563.66	389.52	564.25	399.2	564.73	401.66	564.76	413.8	564.65
416.85	564.67	425.93	564.8	434.5	565.03	436.69	565.1	438.07	565.15
445.93	565.24	450.21	565.31	452.15	565.24	462.34	564.78	464.51	564.33
467.36	563.96	468.34	563.82	472.47	564.4	484.79	566.36	486.61	566.63
487.44	566.73	498.75	568.11	505.09	567.38	510.89	566.57	522.74	566.81
523.02	566.82	523.65	566.84	535.16	567.14	538.37	567.14	540.39	567.22
547.3	567.38	558.04	567.95	559.43	568.02	562.5	568.12	571.57	568.39
575.69	568.56	583.7	568.77	593.33	568.97	595.84	569.06	601.36	569.33
607.98	569.64	608.1	569.64	609.35	569.72	620.11	570.03	628.63	569.9
632.25	569.89	644.39	569.94	646.28	569.94	656.52	570.01	659.17	570.05
663.93	570.21	668.66	570.45	679.07	571.29	680.79	571.42	681.58	571.49
692.93	572.27	699.23	572.65	700	572.67				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.035	25.44	.035	620.11	.035

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
25.44	620.11	14.58	100	143.81	.1	.3

Left Levee Station= 27.9 Elevation= 568.5
Right Levee Station= 499.38 Elevation= 568.1

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 5

INPUT
Description: STA 5
Station Elevation Data num= 12

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	569.42	78	565	120	564	290	564	340	565

```
     375  565.44     412     564     452     565     465   567.5     520   566.7
     565     567     600     570

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0    .035       0    .035     600    .035

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0     600            73.29      70   64.68             .1       .3
Left Levee      Station=     .63      Elevation=  569.44
Right Levee     Station=  465.33      Elevation=   567.5

CROSS SECTION


RIVER: RIVER-1
REACH: Reach-1            RS: 4.9

INPUT
Description: STA 4.9
Station Elevation Data    num=       6
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0     565     450     565     465   562.5 485.001   562.5     500     565
     700     565

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0    .035       0    .035     700    .035

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0     700               60      60      60             .1       .3

CULVERT


RIVER: RIVER-1
REACH: Reach-1            RS: 4.7

INPUT
Description:
Distance from Upstream XS =       5
Deck/Roadway Width        =      50
Weir Coefficient          =     2.6
Upstream  Deck/Roadway Coordinates
    num=       9
     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord
       0   566.3     550  80.001  566.31     550     180  565.45     550
 279.999   565.3     550     380  565.64     550     480  566.51     550
     580  566.86     550     680  567.51     550     700   567.6     550

Upstream Bridge Cross Section Data
Station Elevation Data    num=       6
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0     565     450     565     465   562.5 485.001   562.5     500     565
     700     565

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0    .035       0    .035     700    .035

Bank Sta: Left   Right    Coeff Contr.   Expan.
             0     700             .1       .3

Downstream  Deck/Roadway Coordinates
    num=       9
     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord
       0   566.3     540  80.001  566.31     540     180  565.45     540
 279.999   565.3     540     380  565.64     540     480  566.51     540
     580  566.86     540     680  567.51     540     700   567.6     540

Downstream Bridge Cross Section Data
Station Elevation Data    num=       7
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
     350     562  414.71     562     428  561.55     430  561.55     465  561.55
     474     562     500     562

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
     350    .035     350    .035     500    .035
```

```
Bank Sta: Left   Right    Coeff Contr.   Expan.
           350     500              .1       .3

Upstream Embankment side slope              =       0 horiz. to 1.0 vertical
Downstream Embankment side slope            =       0 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow =     .95
Elevation at which weir flow begins         =
Energy head used in spillway design         =
Spillway height used in design              =
Weir crest shape                            = Broad Crested

Number of Culverts =  1

Culvert Name     Shape      Rise    Span
Culvert #1      Circular     2.5
FHWA Chart # 1 - Concrete Pipe Culvert
FHWA Scale # 1 - Square edge entrance with headwall
Solution Criteria = Highest U.S. EG
Culvert Upstrm Dist  Length    Top n  Bottom n  Depth Blocked  Entrance Loss Coef   Exit Loss
Coef
                  1      50     .024     .024        0                    .2                 1
Number of Barrels =  6
Upstream   Elevation =  562.5
Centerline Stations
    Sta.    Sta.    Sta.    Sta.    Sta.    Sta.
   466.5   469.5   472.5   475.5   478.5   481.5
Downstream Elevation =  561.55
Centerline Stations
    Sta.    Sta.    Sta.    Sta.    Sta.    Sta.
     432     437     442     447     452     457

CROSS SECTION


RIVER: RIVER-1
REACH: Reach-1            RS: 4.2

INPUT
Description: STA 4.2
Station Elevation Data    num=       7
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
     350     562  414.71     562     428  561.55     430  561.55     465  561.55
     474     562     500     562

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
     350    .035     350    .035     500    .035

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
           350     500               10      10      10              .1       .3

CROSS SECTION


RIVER: RIVER-1
REACH: Reach-1            RS: 4.1

INPUT
Description: STA 4.1
Station Elevation Data    num=      14
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0     565    12.8     564   91.76     563  269.65     563   314.9     562
     331   561.5  345.11  564.08   369.5   564.2  392.13  556.71   400.6  556.82
  423.85     564  439.51  566.04     452  566.71     464  566.93

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0    .035       0    .035     464    .035

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0     464               60      60      60              .1       .3

CROSS SECTION


RIVER: RIVER-1
REACH: Reach-1            RS: 4
```

```
INPUT
Description: STA 4
Station Elevation Data    num=      13
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0     565    39.3     563   61.62   562.5  194.97     563  215.86     563
  301.41     562  391.14     559  402.43  563.65  419.95  563.85  442.25  555.89
  457.97  556.38  501.65     565  516.03  566.67

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0    .035       0    .035  516.03    .035

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0  516.03             100     100     100             .1       .3
Left Levee      Station=  302.21      Elevation=  561.99
Right Levee     Station=  553.26      Elevation=   565.7

CROSS SECTION


RIVER: RIVER-1
REACH: Reach-1            RS: 3

INPUT
Description: STA 3
Station Elevation Data    num=      15
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0     565   45.71     563   139.6     562  267.95     562  304.62     559
  368.11     558  389.04   558.2  399.13  563.31  414.38  563.94  432.66  556.49
  461.08  555.06  473.44  560.48  479.56  559.82   486.4     560  583.87     565

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0    .035       0    .035  583.87    .035

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0  583.87            18.78     100  146.39             .1       .3
Left Levee      Station=     .63      Elevation=  565.01
Right Levee     Station=  473.55      Elevation=  560.47

CROSS SECTION


RIVER: RIVER-1
REACH: Reach-1            RS: 2

INPUT
Description: STA 2
Station Elevation Data    num=      16
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0     565    53.4     563  129.32     562  260.18     561  282.66     559
  328.96     558  387.18     558  397.18  563.22  412.51  563.84  432.62  555.44
  458.24  554.71  472.22  560.71  482.47  559.16  499.31     559  511.43     560
  629.55     567

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0    .035       0    .035  629.55    .035

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0  629.55             100     100     100             .1       .3
Left Levee      Station=   51.63      Elevation=     563
Right Levee     Station=  473.55      Elevation=  560.72

CROSS SECTION


RIVER: RIVER-1
REACH: Reach-1            RS: 1

INPUT
Description: STA 1
Station Elevation Data    num=      16
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0     568  140.39     562  190.64     561  254.84     560  283.64     559
  339.06     558   413.2   557.8  423.22  563.14  439.69  563.32  458.88   554.5
  491.16  554.13  503.81   559.6  515.33     559  555.56     559  588.34     560
  653.35     565
```

```
Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0    .035       0    .035  653.35    .035

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0  653.35                0       0       0              .1       .3
Left Levee      Station=  140.15      Elevation=  562.07
Right Levee     Station=  504.53      Elevation=  559.58
```

SUMMARY OF MANNING'S N VALUES

River:RIVER-1

Reach	River Sta.	n1	n2	n3
Reach-1	11	.02	.02	.02
Reach-1	10	.035	.035	.035
Reach-1	9	.035	.035	.035
Reach-1	8	.035	.035	.035
Reach-1	7	.035	.035	.035
Reach-1	6	.035	.035	.035
Reach-1	5	.035	.035	.035
Reach-1	4.9	.035	.035	.035
Reach-1	4.7	Culvert		
Reach-1	4.2	.035	.035	.035
Reach-1	4.1	.035	.035	.035
Reach-1	4	.035	.035	.035
Reach-1	3	.035	.035	.035
Reach-1	2	.035	.035	.035
Reach-1	1	.035	.035	.035

SUMMARY OF REACH LENGTHS

River: RIVER-1

Reach	River Sta.	Left	Channel	Right
Reach-1	11	100	100	100
Reach-1	10	215.02	100	53.41
Reach-1	9	267.74	100	32.54
Reach-1	8	100	100	100
Reach-1	7	132.62	100	86.89
Reach-1	6	14.58	100	143.81
Reach-1	5	73.29	70	64.68
Reach-1	4.9	60	60	60
Reach-1	4.7	Culvert		
Reach-1	4.2	10	10	10
Reach-1	4.1	60	60	60
Reach-1	4	100	100	100
Reach-1	3	18.78	100	146.39
Reach-1	2	100	100	100
Reach-1	1	0	0	0

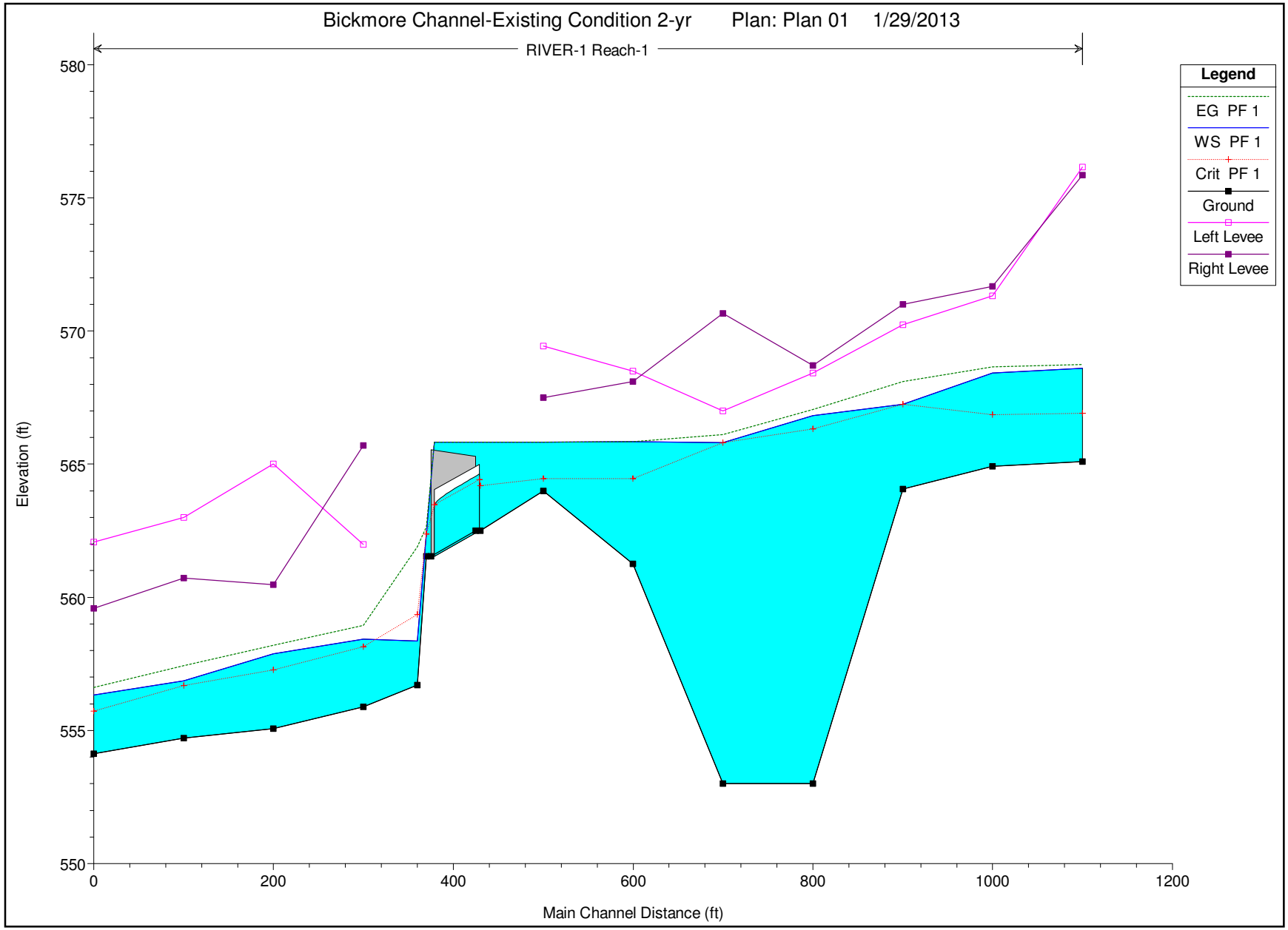
SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
River: RIVER-1

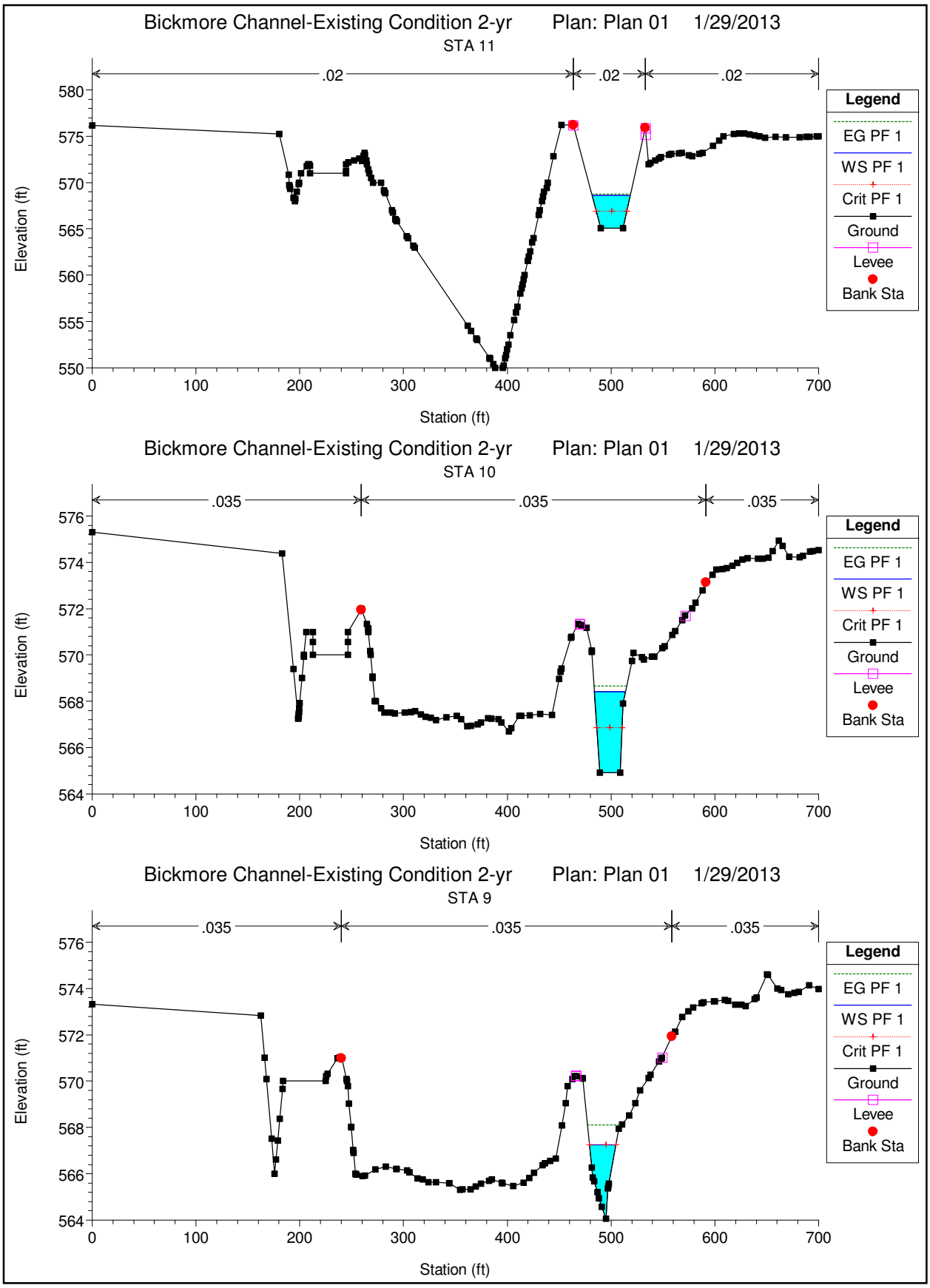
Reach	River Sta.	Contr.	Expan.
Reach-1	11	.1	.3
Reach-1	10	.1	.3
Reach-1	9	.1	.3
Reach-1	8	.1	.3
Reach-1	7	.1	.3
Reach-1	6	.1	.3
Reach-1	5	.1	.3
Reach-1	4.9	.1	.3
Reach-1	4.7	Culvert	
Reach-1	4.2	.1	.3
Reach-1	4.1	.1	.3
Reach-1	4	.1	.3

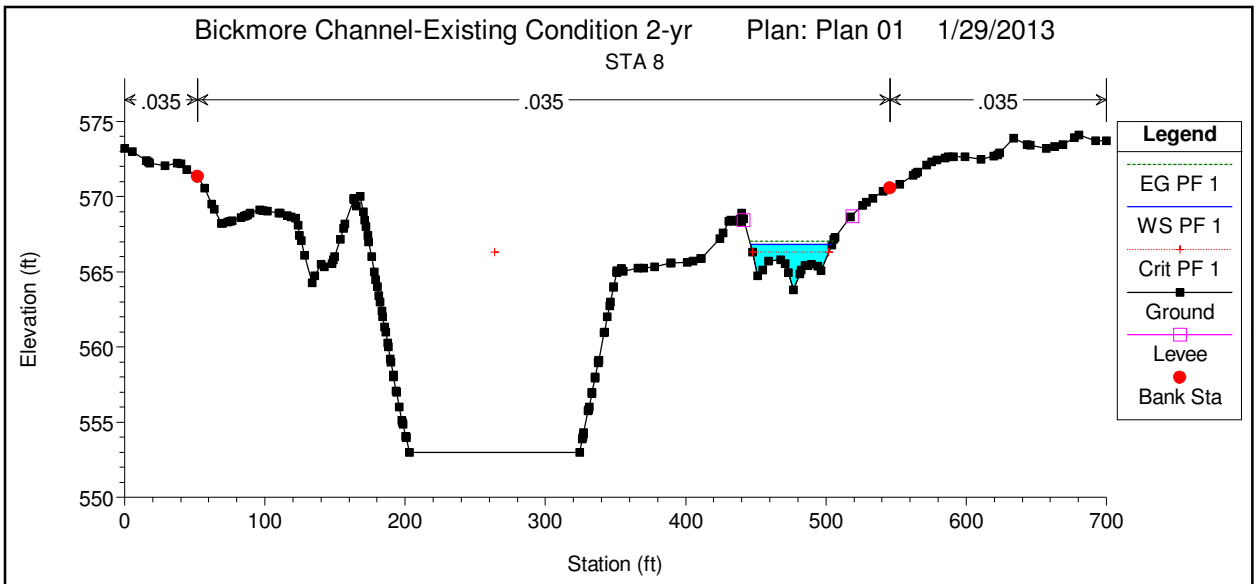
Reach-1	3	.1	.3
Reach-1	2	.1	.3
Reach-1	1	.1	.3

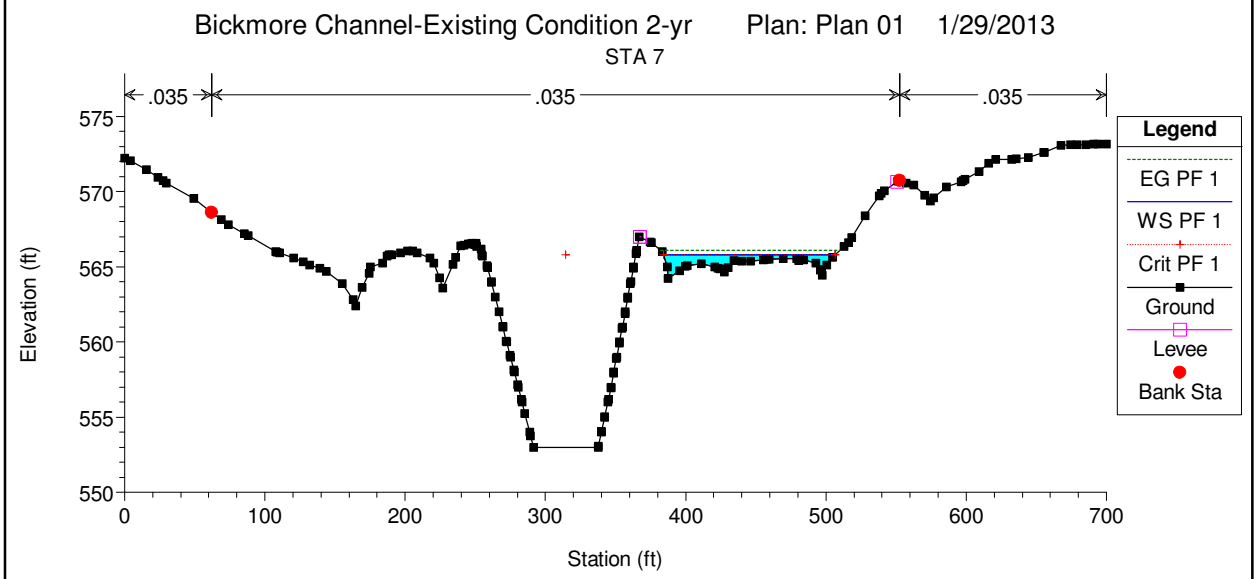
HEC-RAS Plan: Plan 01 River: RIVER-1 Reach: Reach-1 Profile: PF 1

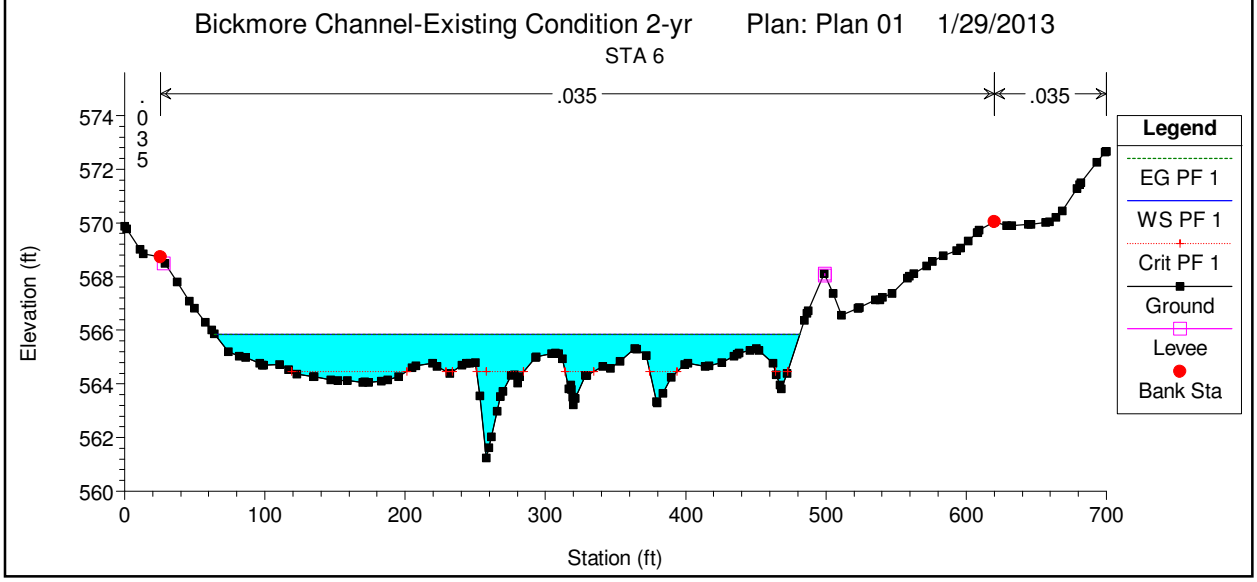
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Reach-1	11	PF 1	324.00	565.10	568.59	566.90	568.75	0.000501	3.19	101.56	36.65	0.34
Reach-1	10	PF 1	324.00	564.92	568.42	566.86	568.65	0.002273	3.83	84.68	30.06	0.40
Reach-1	9	PF 1	324.00	564.07	567.25	567.25	568.11	0.015744	7.43	43.63	25.48	1.00
Reach-1	8	PF 1	324.00	553.00	566.82	566.33	567.05	0.005237	3.87	83.67	58.00	0.57
Reach-1	7	PF 1	324.00	553.00	565.81	565.81	566.11	0.021648	4.42	73.36	122.56	1.01
Reach-1	6	PF 1	324.00	561.25	565.84	564.46	565.84	0.000131	0.58	554.43	417.33	0.09
Reach-1	5	PF 1	324.00	564.00	565.83	564.45	565.83	0.000119	0.58	555.85	392.90	0.09
Reach-1	4.9	PF 1	324.00	562.50	565.82	564.18	565.82	0.000145	0.49	660.91	700.00	0.09
Reach-1	4.7		Culvert									
Reach-1	4.2	PF 1	324.00	561.55	562.38	562.38	562.64	0.023043	4.15	78.01	150.00	1.01
Reach-1	4.1	PF 1	324.00	556.71	558.36	559.36	561.89	0.106510	15.07	21.50	18.45	2.46
Reach-1	4	PF 1	324.00	555.89	558.43	558.14	558.95	0.009709	5.83	55.61	33.19	0.79
Reach-1	3	PF 1	324.00	555.06	557.87	557.27	558.20	0.005217	4.56	71.01	38.23	0.59
Reach-1	2	PF 1	324.00	554.71	556.86	556.69	557.43	0.011428	6.05	53.54	34.03	0.85
Reach-1	1	PF 1	324.00	554.13	556.33	555.72	556.62	0.005005	4.37	74.10	41.33	0.58

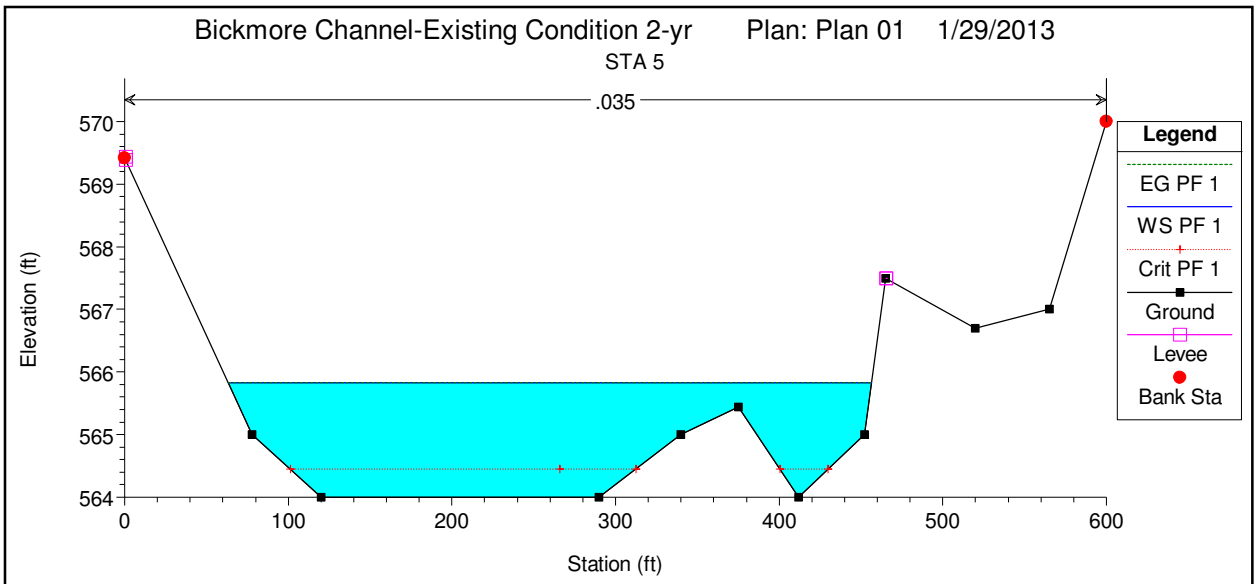

Bickmore Channel-Existing Condition 2-yr Plan: Plan 01 1/29/2013
RIVER-1 Reach-1
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Left Levee
Right Levee
Elevation (ft)
580
575
570
565
560
555
550
0
200
400
600
800
1000
1200
Main Channel Distance (ft)

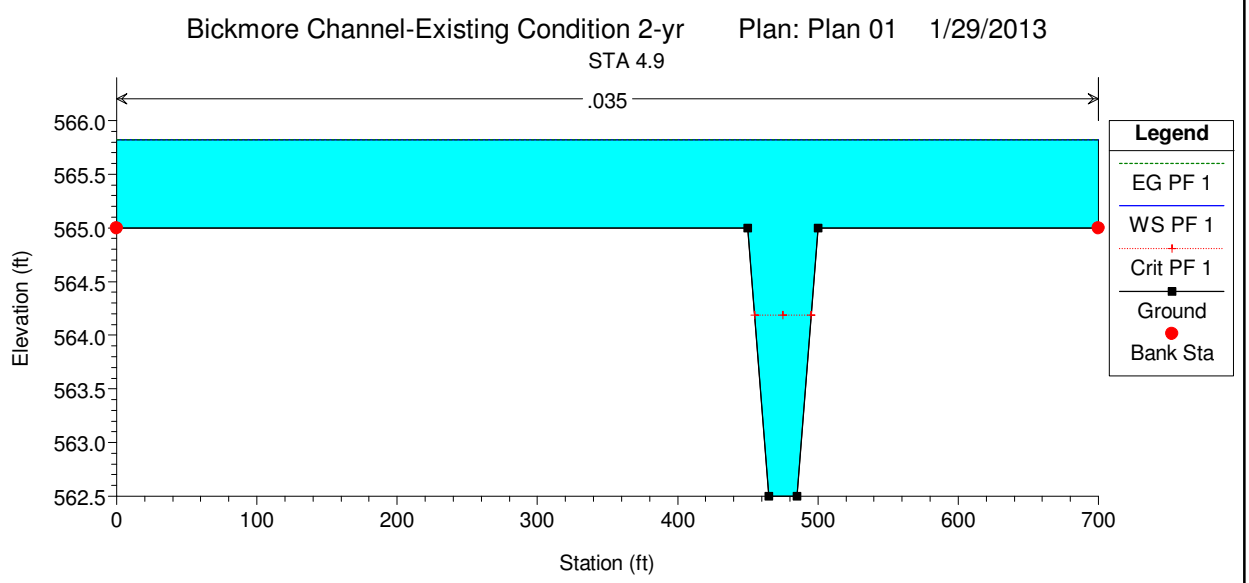

Bickmore Channel-Existing Condition 2-yr Plan: Plan 01 1/29/2013
STA 11
.02
.02
.02
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Levee
Bank Sta
Bickmore Channel-Existing Condition 2-yr Plan: Plan 01 1/29/2013
STA 10
.035
.035
.035
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Levee
Bank Sta
Bickmore Channel-Existing Condition 2-yr Plan: Plan 01 1/29/2013
STA 9
.035
.035
.035
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Levee
Bank Sta

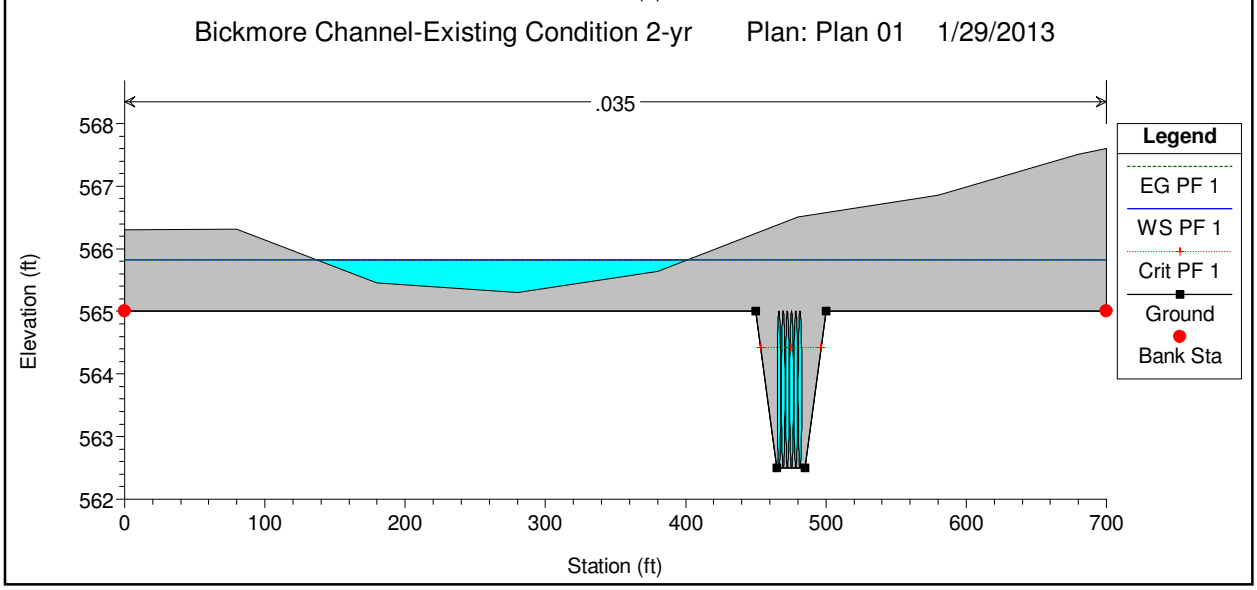

Bickmore Channel-Existing Condition 2-yr Plan: Plan 01 1/29/2013
STA 8
.035
.035
.035
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Levee
Bank Sta


Bickmore Channel-Existing Condition 2-yr Plan: Plan 01 1/29/2013
STA 7
.035
.035
.035
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Levee
Bank Sta

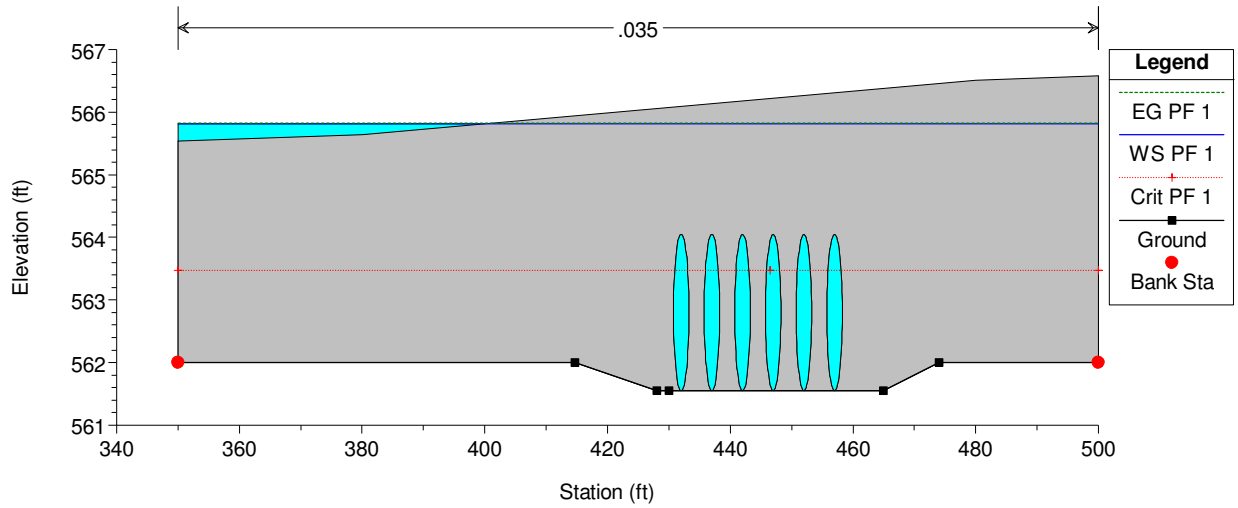

Bickmore Channel-Existing Condition 2-yr Plan: Plan 01 1/29/2013
STA 6
.035
.035
.035
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Levee
Bank Sta


Bickmore Channel-Existing Condition 2-yr Plan: Plan 01 1/29/2013
STA 5
.035
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Levee
Bank Sta


Bickmore Channel-Existing Condition 2-yr Plan: Plan 01 1/29/2013
STA 4.9
.035
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta

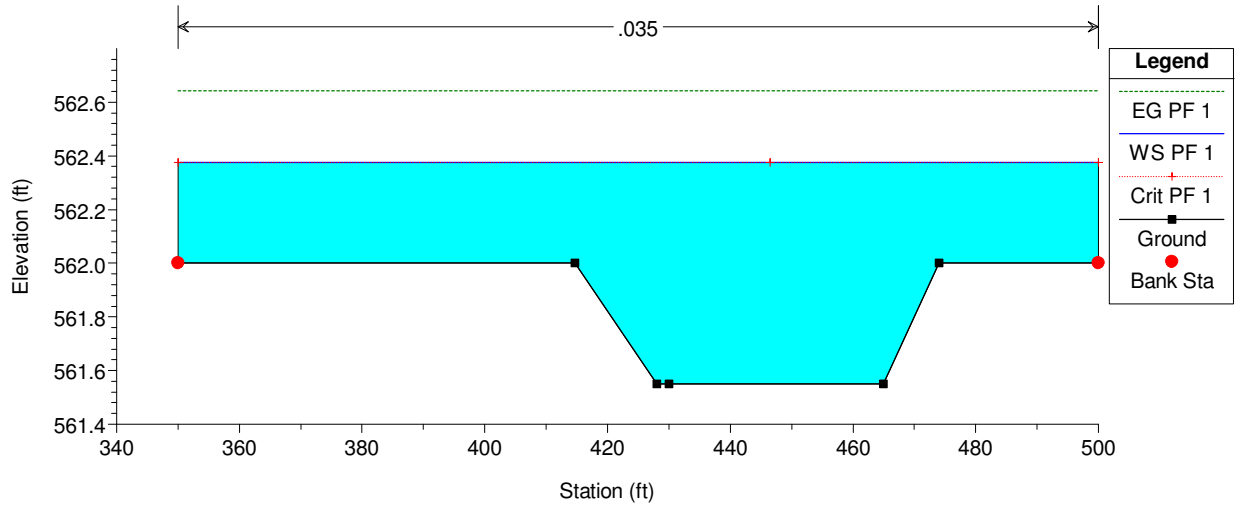

Bickmore Channel-Existing Condition 2-yr Plan: Plan 01 1/29/2013
.035
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta

Bickmore Channel-Existing Condition 2-yr Plan: Plan 01 1/29/2013



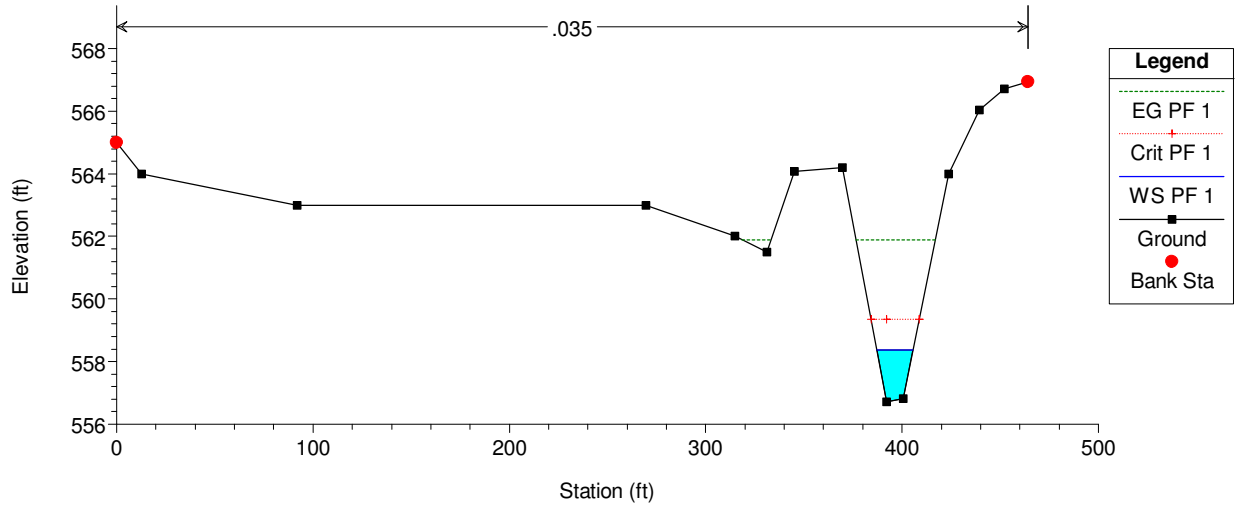
Bickmore Channel-Existing Condition 2-yr Plan: Plan 01 1/29/2013

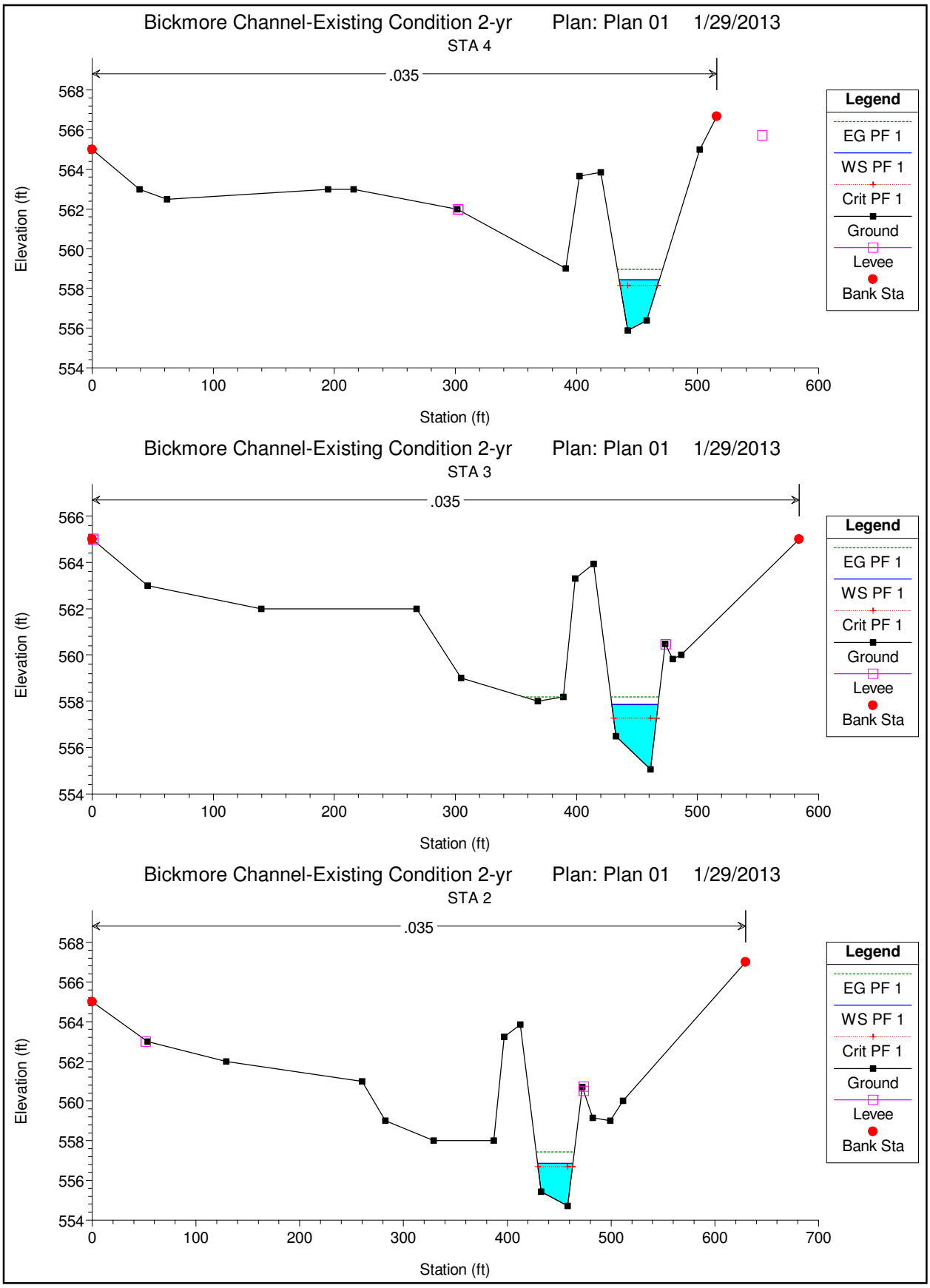
STA 4.2

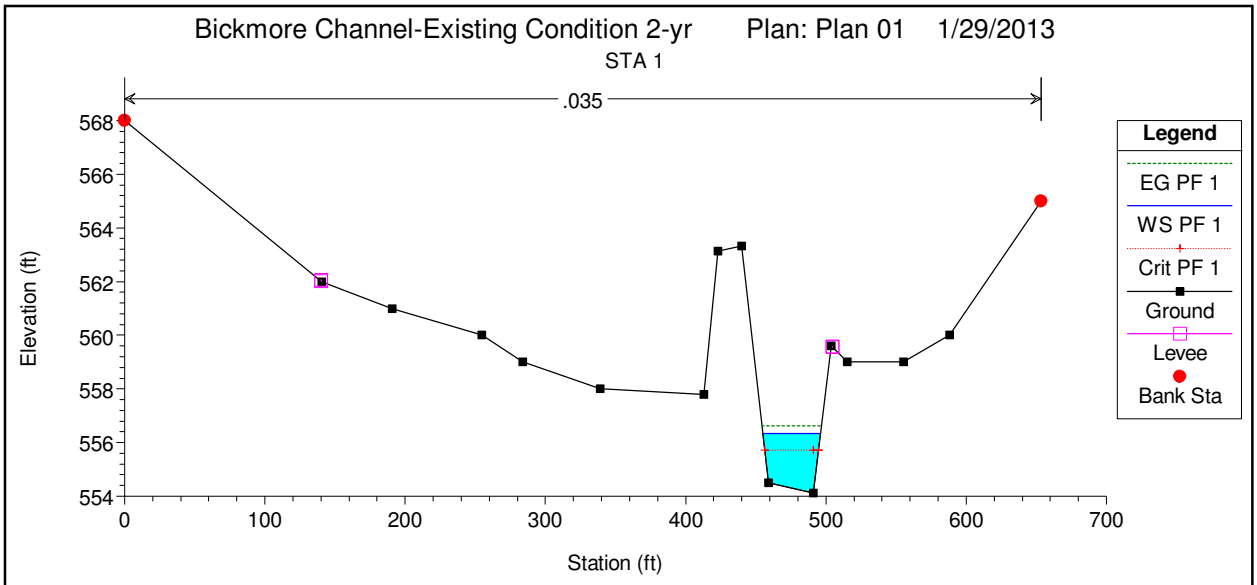


Bickmore Channel-Existing Condition 2-yr Plan: Plan 01 1/29/2013

STA 4.1




Bickmore Channel-Existing Condition 2-yr Plan: Plan 01 1/29/2013
STA 4
.035
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Levee
Bank Sta
Bickmore Channel-Existing Condition 2-yr Plan: Plan 01 1/29/2013
STA 3
.035
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Levee
Bank Sta
Bickmore Channel-Existing Condition 2-yr Plan: Plan 01 1/29/2013
STA 2
.035
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Levee
Bank Sta


Bickmore Channel-Existing Condition 2-yr
Plan: Plan 01
1/29/2013
STA 1
.035
Elevation (ft)
568
566
564
562
560
558
556
554
0
100
200
300
400
500
600
700
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Levee
Bank Sta

25 – YEAR FREQUENCY

```
                    HEC-RAS Version 4.1.0 Jan 2010
                     U.S. Army Corps of Engineers
                    Hydrologic Engineering Center
                          609 Second Street
                          Davis, California


          X     X  XXXXXX    XXXX        XXXX       XX      XXXX
          X     X  X        X    X       X   X     X  X    X
          X     X  X        X            X   X    X    X   X
          XXXXXXX  XXXX     X       XXX  XXXX     XXXXXX    XXXX
          X     X  X        X            X  X     X    X        X
          X     X  X        X    X       X   X    X    X        X
          X     X  XXXXXX    XXXX        X    X   X    X   XXXXX
```

PROJECT DATA
Project Title: BickmoreChannel-Existing Condition 25-yr
Project File : BMCEexist-25yr.prj
Run Date and Time: 1/29/2013 4:19:44 PM

Project in English units

Project Description:
Channel Analysis for Existing Condition 25 Year

PLAN DATA

Plan Title: Plan 01
Plan File : e:\400-499\481\0481-125\PLANS\hydro\HEC-RAS\BMCEexist-25yr.p01

Geometry Title: BickmoreChannel Existing Condition 25-yr
Geometry File : e:\400-499\481\0481-125\PLANS\hydro\HEC-RAS\BMCEexist-25yr.g01

Flow Title : BickmoreChannel Existing Condition 25-yr
Flow File : e:\400-499\481\0481-125\PLANS\hydro\HEC-RAS\BMCEexist-25yr.f01

Plan Summary Information:

Number of:	Cross Sections	= 14	Multiple Openings	=	0
	Culverts	= 1	Inline Structures	=	0
	Bridges	= 0	Lateral Structures	=	0

Computational Information
Water surface calculation tolerance = 0.01
Critical depth calculation tolerance = 0.01
Maximum number of iterations = 20
Maximum difference tolerance = 0.3
Flow tolerance factor = 0.001

Computation Options
Critical depth computed only where necessary
Conveyance Calculation Method: At breaks in n values only
Friction Slope Method: Average Conveyance
Computational Flow Regime: Mixed Flow

FLOW DATA

Flow Title: BickmoreChannel Existing Condition 25-yr
Flow File : e:\400-499\481\0481-125\PLANS\hydro\HEC-RAS\BMCEexist-25yr.f01

Flow Data (cfs)

River	Reach	RS	PF 1
RIVER-1	Reach-1	11	889

Boundary Conditions

River	Reach	Profile	Upstream

Downstream

RIVER-1 Reach-1 PF 1 Normal S = 0.0011 Normal S = 0.005

GEOMETRY DATA

Geometry Title: BickmoreChannel Existing Condition 25-yr
Geometry File : e:\400-499\481\0481-125\PLANS\hydro\HEC-RAS\BMCEexist-25yr.g01

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 11

INPUT
Description: STA 11
Station Elevation Data num= 122

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	576.18	180.16	575.25	189.15	570.87	189.68	569.71	190.12	569.57
190.95	569.31	194.1	568.35	195.26	568	195.72	568.23	197.31	569
198.99	569.83	199.33	570	201.38	571	206.83	571.76	208.03	572
208.94	572	209.79	571.83	209.83	571	244.41	571	244.42	571.25
244.45	572	246.85	572.19	252.3	572.39	257.39	572.59	260.31	572.32
261.3	572.92	262.39	573.21	262.82	573	264.1	572.36	264.81	572
266.1	571.39	266.8	571	268.77	570.5	270.4	570	278.41	570
281.07	569.14	281.76	569	282.31	568.84	288.81	567	289.71	566.75
292.13	566.06	292.2	566.05	292.46	566	293.35	565.84	293.41	565.83
303.16	564.22	304.48	564	309.46	563.18	310.53	563	361.86	554.53
365.05	554	370.04	553.18	371.11	553	382.71	551.09	382.98	551.04
383.23	551	383.45	550.96	386.67	550.43	388.26	550	395.75	550
396.33	550.28	397.84	551	398.67	551.4	399.94	552	400.93	552.48
403.15	553.53	406.51	555.14	408.32	556	409.59	556.61	412.51	558
413.74	558.59	414.59	559	415.81	559.58	416.7	560	419.96	561.56
420.89	562	422.03	562.55	424.1	563.53	425.08	564	430.32	566.5
431.36	567	433.46	568	434.46	568.48	435.55	569	438.14	569.44
438.85	570	444.67	572.84	452.33	576.2	463.83	576.2	490	565.1
511.5	565.1	532.89	575.91	536.29	571.99	537.87	572.12	542.61	572.36
546.17	572.57	548.26	572.74	555.73	573.01	558.27	573.08	565.42	573.16
568.27	573.2	575.11	572.96	578.28	572.86	584.8	573.09	588.28	573.18
598.29	573.97	604.18	574.53	608.29	574.98	618.3	575.26	623.56	575.3
628.3	575.3	633.25	575.21	638.31	575.1	642.94	574.99	648.31	574.85
658.32	574.92	668.32	574.9	681.69	574.91	688.34	574.95	691.38	574.95
698.34	574.98	700	574.98						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.02	463.83	.02	532.89	.02

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
463.83	532.89	100	100	100	.1	.3

Left Levee Station= 463.78 Elevation= 576.16
Right Levee Station= 533.54 Elevation= 575.86

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 10

INPUT
Description: STA 10
Station Elevation Data num= 117

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	575.31	182.86	574.38	193.89	569.39	198.67	567.25	198.72	567.27
198.82	567.32	198.91	567.37	199	567.41	199.13	567.47	199.3	567.56
199.55	567.69	200.04	567.93	202.18	569	204.05	569.93	204.18	570
206.18	571	212.49	571	212.51	570.56	212.54	570	246.49	570
246.51	570.57	246.53	571	259.01	571.96	259.37	571.99	259.48	571.99
259.59	571.98	259.73	571.96	264.6	571.34	265.97	571.15	266.13	571.07
266.26	571	267.89	570.18	268.26	570	270.09	569.08	270.26	569
272.26	568	272.36	568	273.26	568.01	278.43	567.69	281.38	567.52
287.63	567.51	291.38	567.48	301.39	567.51	307.01	567.54	311.39	567.58

```
   316.7  567.44   321.4  567.33  326.39  567.29   331.4  567.19  341.41  567.31
  351.41  567.38  355.46  567.23  361.42  566.93  365.15  566.95  371.42  567.01
  374.83  567.09  381.43  567.28  384.52  567.26  391.43  567.24  394.21  567.09
  401.44  566.69   403.9  566.84  411.45  567.37  413.59  567.37  421.45  567.39
  431.46  567.45  442.89  567.41  450.02  568.97  451.47  569.28  452.35  569.41
  461.47  570.74  461.93  570.79  468.07  571.34  470.91   571.3  471.71  571.28
  476.23  571.18  481.22  570.19  481.44  570.14  488.97  564.92  508.97  564.92
   511.5   567.9  520.18  569.74   521.5  570.09  529.87   569.9  531.51  569.81
  539.56  569.92  541.51  569.92  549.25   570.3  551.52  570.38  558.94  570.87
  561.52  571.03  568.63  571.51  571.53   571.7  578.32  572.01  581.54  572.26
  588.01   572.8  591.54  573.14   597.7  573.47  601.55  573.69  607.39  573.72
  611.55  573.76  617.07  573.85  621.56  573.98  626.76  574.12  631.56  574.18
  641.57  574.15  646.14  574.15  651.57  574.21  655.83  574.49  661.58  574.93
  665.52  574.71  671.58  574.24  681.59  574.22   684.9  574.28  691.59  574.47
  694.59  574.48     700  574.52

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0    .035  259.01    .035  591.54    .035

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
        259.01  591.54           215.02     100   53.41             .1       .3
Left Levee      Station=  469.86      Elevation=  571.33
Right Levee     Station=  571.55      Elevation=  571.68

CROSS SECTION


RIVER: RIVER-1
REACH: Reach-1            RS: 9

INPUT
Description: STA 9
Station Elevation Data    num=     116
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0  573.33  162.52  572.84  166.21  571.02  167.97  570.09  172.92  567.52
  175.83     566  177.08  566.61  178.76  567.44  180.67  568.37  183.29  569.66
  183.99     570  225.19     570   225.2  570.21  226.69  570.31  236.53     571
  238.44  571.04  239.02     571   240.2     571  240.63     571  244.97   570.1
  245.49     570  246.36  569.78   247.5  569.02  249.53  568.03  249.59     568
  251.58  567.03  251.64     567  251.83  566.91  253.69     566  253.87  565.99
  254.72  565.97  260.38   565.9  262.63  565.92  272.83  566.19  283.04   566.3
  293.15  566.21  293.58  566.21  303.44  566.15  305.93  566.07  313.64   565.8
  318.71  565.75  323.84  565.63   331.5  565.64  344.12  565.59  344.28  565.59
  354.45   565.3  357.06  565.32  364.65  565.32  369.84  565.46  374.85  565.57
  382.62   565.7  385.05  565.75  394.67  565.61  395.25   565.6   395.4   565.6
  405.46  565.48  415.66  565.62  420.97  565.82  425.86  566.05  433.75  566.37
  436.06  566.46  441.09  566.56  446.86  566.65  452.47  568.08  456.46  569.05
  458.06  569.79  462.52   570.1  464.36  570.22  466.67  570.22   472.2  570.13
  472.59  570.12  481.37  566.27   482.4  565.85  483.55  565.68  487.07  565.21
  488.45  564.95  491.02  564.58  495.05  564.07  497.06  565.37  497.27  565.46
  497.66  565.57  507.47  567.95  510.44  568.12  517.67  568.51  523.22  569.05
  527.88   569.6     536  570.13  538.08  570.28  546.29  570.84  548.28  570.97
  548.78  571.02  558.48  571.94  561.56  572.14  568.68  572.77  574.34  573.02
  578.88  573.17  587.13  573.37  589.09   573.4  599.29  573.45  599.91  573.45
  609.49  573.51  612.69  573.46  619.69   573.3  625.47   573.3  629.89  573.25
  638.25  573.55  640.09   573.6   650.3  574.62  651.03  574.58   660.5     574
  663.82  573.93   670.7  573.75   676.6  573.82   680.9  573.85   691.1  574.14
     700  573.97

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0    .035   240.2    .035  558.48    .035

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         240.2  558.48           267.74     100   32.54             .1       .3
Left Levee      Station=  466.14      Elevation=  570.24
Right Levee     Station=  549.42      Elevation=  571.01

CROSS SECTION


RIVER: RIVER-1
REACH: Reach-1            RS: 8

INPUT
Description: STA 8
Station Elevation Data    num=     180
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
```

0	573.22	5.37	572.99	15.54	572.39	17.01	572.31	18.02	572.24
28.65	572.08	37.56	572.23	40.29	572.17	44.3	571.8	51.93	571.34
57.11	570.55	61.97	569.49	64.04	569.15	68.96	568.22	69.62	568.23
73.68	568.32	75.39	568.35	76.66	568.38	83.14	568.61	85.41	568.7
86.12	568.76	87.49	568.8	89.55	568.89	96.2	569.11	98.48	569.09
101.83	569.03	110.12	568.9	111.11	568.89	115.75	568.74	118.84	568.66
121.94	568.55	123.49	568.1	124.75	567.43	125.81	567.07	128.43	566.12
133.57	564.27	135.66	564.73	139.92	565.52	142.37	565.35	147.88	565.53
148.69	565.8	149.68	566.02	153.66	567.17	156.27	567.9	157.16	568.18
163.3	569.82	163.53	569.88	163.63	569.87	165.02	569.36	168.05	570
170.05	569	171.18	568.44	172.05	568	173.2	567.43	174.06	567
175.95	566.03	178.07	565	179.04	564.49	180.08	564	181.14	563.43
182.08	563	183.24	562.38	184.06	562	185.33	561.32	186.04	561
187.42	560.26	188.01	560	189.5	559.19	189.96	559	191.59	558.13
191.87	558	193.64	557.07	193.8	557	195.79	556.01	197.77	555.12
198.05	555	198.43	554.85	200.48	554.06	200.63	554	200.69	553.98
203.22	553	324.53	553	326.46	553.88	326.72	554	327.16	554.2
327.36	554.29	330.59	555.76	330.76	555.84	331.12	556	333.14	556.92
333.31	557	335.37	557.94	335.51	558	337.59	558.95	337.7	559
337.89	559.08	337.97	559.12	341.96	560.94	342.09	561	344.27	561.99
345.88	562.72	346.47	562.99	348.59	563.96	348.68	564	350.72	564.93
350.88	565	351.03	565.07	353.99	565.2	354.04	565.2	354.17	565.21
354.43	565.07	355.62	565.04	366.16	565.23	369.86	565.25	377.8	565.33
389.4	565.59	389.5	565.59	401.08	565.65	405.13	565.7	410.84	565.88
411.1	565.9	424.36	567.2	426.71	567.57	430.88	568.34	432.25	568.45
433.85	568.38	437.15	568.37	438.59	568.48	439.75	568.37	439.82	568.92
441.43	568.52	447.75	566.31	451.29	564.72	455.02	565.14	459.27	565.72
467.59	565.79	470.91	565.53	473	564.93	476.72	563.8	481.26	564.85
482.55	565.14	485.09	565.41	486.83	565.41	489.71	565.5	494	565.37
496.28	565.06	504.13	566.78	505.82	567.17	506.68	567.29	517.46	568.65
526.23	569.42	529.1	569.63	533.33	569.91	540.74	570.34	545.78	570.55
552.38	570.84	562.09	571.42	564.02	571.54	565.32	571.64	571.8	572.1
575.65	572.33	579.09	572.44	584.87	572.59	587.29	572.66	590.86	572.64
598.93	572.64	610.57	572.48	619.62	572.7	622.21	572.77	623.96	572.93
633.85	573.9	643.51	573.48	645.48	573.41	657.12	573.2	663.06	573.35
668.76	573.48	677.16	573.92	680.4	574.1	692.04	573.74	700	573.71

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.035	51.93	.035	545.78	.035

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
51.93	545.78	100	100	100	.1	.3

Left Levee Station= 441.1 Elevation= 568.43
Right Levee Station= 518.63 Elevation= 568.71

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 7

INPUT
Description: STA 7
Station Elevation Data num= 169

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	572.24	4.02	572.06	15.66	571.46	23.93	570.94	27.3	570.76
29.59	570.58	49.14	569.53	62.22	568.6	68.69	568.14	73.86	567.8
85.49	567.2	88.23	567.08	107.78	566.02	108.77	565.96	110.23	565.91
120.41	565.58	127.33	565.33	132.05	565.11	138.99	564.89	143.69	564.69
155.32	563.89	162.7	562.8	164.88	562.38	169.1	563.62	174.28	564.56
175.24	564.98	184.01	565.24	187.06	565.7	188.64	565.78	190.24	565.82
196.53	565.93	201.88	566.06	205.51	566.05	208.51	565.91	217.75	565.58
220.31	565.26	224.32	564.28	226.92	563.58	233.89	565.16	236.14	565.64
239.71	566.39	241.92	566.46	245.16	566.52	246.85	566.54	247.9	566.56
248.15	566.55	249.55	566.49	250.37	566.58	250.95	566.34	254.04	566.17
254.63	565.81	255.24	565.7	258.5	565.08	258.71	565	258.92	564.93
261.44	564	261.56	563.95	264.16	563	266.85	562.01	269.49	561.04
269.6	561	272.13	560.07	272.33	560	274.77	559.1	275.05	559
277.41	558.13	277.77	558	280.06	557.16	280.5	557	282.7	556.19
283.22	556	285.34	555.22	288.66	554	289.41	553.73	291.39	553
337.68	553	337.81	553.05	339.97	554	340.07	554.04	342.31	555
342.37	555.02	344.66	556	345.05	556.17	346.66	556.96	346.73	557
348.63	557.94	348.75	558	350.62	558.92	350.77	559	352.63	559.91
352.79	560	354.63	560.91	354.81	561	356.65	561.9	356.84	562
358.66	562.9	358.86	563	360.68	563.89	360.88	564	362.69	564.89
362.9	565	364.62	565.89	364.84	566	365.07	566.11	366.86	567
374.47	566.66	375.54	566.6	383.32	566	386.82	565.01	387.54	564.24
395.69	564.73	399.73	565.03	400.98	565.06	411.37	565.2	420.53	564.98

423.01	564.9	424.5	564.86	427.79	564.65	430.14	564.94	434.64	565.41
440.07	565.37	446.28	565.38	455.42	565.48	457.92	565.49	459.62	565.51
469.56	565.54	479.17	565.55	480.69	565.41	481.2	565.5	484.19	565.44
492.84	565.24	496.03	564.77	496.96	564.83	497.43	564.44	500.65	565.1
504.47	565.63	512.95	566.35	516.11	566.59	518.26	566.94	527.75	568.41
537.81	569.71	539.39	569.9	541.72	570.05	551.03	570.69	552.52	570.76
557.35	570.55	562.67	570.43	570.49	569.76	574.31	569.39	576.9	569.59
585.94	570.31	596.45	570.67	597.58	570.72	599.25	570.81	609.22	571.33
615.99	571.87	620.86	572.14	632.5	572.16	635.54	572.18	644.14	572.26
655.09	572.6	655.77	572.62	667.41	573.07	674.63	573.11	679.05	573.11
685.55	573.14	690.69	573.18	694.18	573.18	700	573.17		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.035	62.22	.035	552.52	.035

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
62.22	552.52	132.62	100	86.89	.1	.3

Left Levee Station= 367.15 Elevation= 567
Right Levee Station= 550.93 Elevation= 570.66

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 6

INPUT
Description: STA 6
Station Elevation Data num= 133

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	569.88	1.17	569.79	10.93	569.02	13.3	568.85	25.44	568.74
28.58	568.5	37.57	567.8	46.23	567.08	49.71	566.82	57.38	566.29
61.85	566.01	63.88	565.86	73.98	565.19	81.53	565.04	86.12	564.99
96.23	564.76	98.26	564.7	99.18	564.7	110.39	564.72	116.82	564.52
122.53	564.37	134.47	564.27	135.09	564.27	146.8	564.16	152.12	564.13
158.94	564.13	169.77	564.06	171.07	564.07	173.94	564.06	183.21	564.1
187.42	564.14	195.35	564.26	205.07	564.6	207.48	564.67	219.62	564.77
222.72	564.64	231.75	564.39	240.36	564.7	243.55	564.77	245.94	564.78
250.22	564.79	253.17	563.55	258.05	561.25	259.64	561.62	261.43	562.03
265.57	562.97	267.88	563.53	269.61	563.73	275.66	564.32	278.02	564.34
280.29	564.04	281.65	564.28	292.79	564.99	293.31	565	304.57	565.13
307.17	565.14	309.42	565.12	312.18	564.93	316.86	563.82	317.93	563.97
318.5	563.8	319.33	563.51	320	563.22	321.25	563.47	328.61	564.31
328.84	564.31	329.37	564.32	340.98	564.65	346.25	564.59	353.12	564.83
363.9	565.32	365.25	565.3	371.89	565.05	379.18	563.35	379.46	563.29
383.66	563.66	389.52	564.25	399.2	564.73	401.66	564.76	413.8	564.65
416.85	564.67	425.93	564.8	434.5	565.03	436.69	565.1	438.07	565.15
445.93	565.24	450.21	565.31	452.15	565.24	462.34	564.78	464.51	564.33
467.36	563.96	468.34	563.82	472.47	564.4	484.79	566.36	486.61	566.63
487.44	566.73	498.75	568.11	505.09	567.38	510.89	566.57	522.74	566.81
523.02	566.82	523.65	566.84	535.16	567.14	538.37	567.14	540.39	567.22
547.3	567.38	558.04	567.95	559.43	568.02	562.5	568.12	571.57	568.39
575.69	568.56	583.7	568.77	593.33	568.97	595.84	569.06	601.36	569.33
607.98	569.64	608.1	569.64	609.35	569.72	620.11	570.03	628.63	569.9
632.25	569.89	644.39	569.94	646.28	569.94	656.52	570.01	659.17	570.05
663.93	570.21	668.66	570.45	679.07	571.29	680.79	571.42	681.58	571.49
692.93	572.27	699.23	572.65	700	572.67				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.035	25.44	.035	620.11	.035

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
25.44	620.11	14.58	100	143.81	.1	.3

Left Levee Station= 27.9 Elevation= 568.5
Right Levee Station= 499.38 Elevation= 568.1

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 5

INPUT
Description: STA 5
Station Elevation Data num= 12

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	569.42	78	565	120	564	290	564	340	565

```
     375  565.44     412     564     452     565     465   567.5     520   566.7
     565     567     600     570

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0    .035       0    .035     600    .035

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0     600            73.29      70   64.68             .1       .3
Left Levee      Station=     .63      Elevation=  569.44
Right Levee     Station=  465.33      Elevation=   567.5

CROSS SECTION


RIVER: RIVER-1
REACH: Reach-1            RS: 4.9

INPUT
Description: STA 4.9
Station Elevation Data    num=       6
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0     565     450     565     465   562.5 485.001   562.5     500     565
     700     565

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0    .035       0    .035     700    .035

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0     700               60      60      60             .1       .3

CULVERT


RIVER: RIVER-1
REACH: Reach-1            RS: 4.7

INPUT
Description:
Distance from Upstream XS =       5
Deck/Roadway Width        =      50
Weir Coefficient          =     2.6
Upstream  Deck/Roadway Coordinates
    num=       9
     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord
       0   566.3     550  80.001  566.31     550     180  565.45     550
 279.999   565.3     550     380  565.64     550     480  566.51     550
     580  566.86     550     680  567.51     550     700   567.6     550

Upstream Bridge Cross Section Data
Station Elevation Data    num=       6
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0     565     450     565     465   562.5 485.001   562.5     500     565
     700     565

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0    .035       0    .035     700    .035

Bank Sta: Left   Right    Coeff Contr.   Expan.
             0     700             .1       .3

Downstream  Deck/Roadway Coordinates
    num=       9
     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord
       0   566.3     540  80.001  566.31     540     180  565.45     540
 279.999   565.3     540     380  565.64     540     480  566.51     540
     580  566.86     540     680  567.51     540     700   567.6     540

Downstream Bridge Cross Section Data
Station Elevation Data    num=       7
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
     350     562  414.71     562     428  561.55     430  561.55     465  561.55
     474     562     500     562

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
     350    .035     350    .035     500    .035
```

```
Bank Sta: Left   Right    Coeff Contr.   Expan.
           350     500              .1       .3

Upstream Embankment side slope              =       0 horiz. to 1.0 vertical
Downstream Embankment side slope            =       0 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow =     .95
Elevation at which weir flow begins         =
Energy head used in spillway design         =
Spillway height used in design              =
Weir crest shape                            = Broad Crested

Number of Culverts =  1

Culvert Name     Shape      Rise    Span
Culvert #1      Circular     2.5
FHWA Chart # 1 - Concrete Pipe Culvert
FHWA Scale # 1 - Square edge entrance with headwall
Solution Criteria = Highest U.S. EG
Culvert Upstrm Dist  Length    Top n  Bottom n  Depth Blocked  Entrance Loss Coef   Exit Loss
Coef
                  1      50     .024     .024        0                    .2                 1
Number of Barrels =  6
Upstream   Elevation =  562.5
Centerline Stations
    Sta.    Sta.    Sta.    Sta.    Sta.    Sta.
   466.5   469.5   472.5   475.5   478.5   481.5
Downstream Elevation =  561.55
Centerline Stations
    Sta.    Sta.    Sta.    Sta.    Sta.    Sta.
     432     437     442     447     452     457

CROSS SECTION


RIVER: RIVER-1
REACH: Reach-1            RS: 4.2

INPUT
Description: STA 4.2
Station Elevation Data    num=       7
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
     350     562  414.71     562     428  561.55     430  561.55     465  561.55
     474     562     500     562

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
     350    .035     350    .035     500    .035

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
           350     500               10      10      10              .1       .3

CROSS SECTION


RIVER: RIVER-1
REACH: Reach-1            RS: 4.1

INPUT
Description: STA 4.1
Station Elevation Data    num=      14
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0     565    12.8     564   91.76     563  269.65     563   314.9     562
     331   561.5  345.11  564.08   369.5   564.2  392.13  556.71   400.6  556.82
  423.85     564  439.51  566.04     452  566.71     464  566.93

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0    .035       0    .035     464    .035

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0     464               60      60      60              .1       .3

CROSS SECTION


RIVER: RIVER-1
REACH: Reach-1            RS: 4
```

```
INPUT
Description: STA 4
Station Elevation Data    num=      13
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0     565    39.3     563   61.62   562.5  194.97     563  215.86     563
  301.41     562  391.14     559  402.43  563.65  419.95  563.85  442.25  555.89
  457.97  556.38  501.65     565  516.03  566.67

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0    .035       0    .035  516.03    .035

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0  516.03             100     100     100             .1       .3
Left Levee      Station=  302.21      Elevation=  561.99
Right Levee     Station=  553.26      Elevation=   565.7

CROSS SECTION


RIVER: RIVER-1
REACH: Reach-1            RS: 3

INPUT
Description: STA 3
Station Elevation Data    num=      15
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0     565   45.71     563   139.6     562  267.95     562  304.62     559
  368.11     558  389.04   558.2  399.13  563.31  414.38  563.94  432.66  556.49
  461.08  555.06  473.44  560.48  479.56  559.82   486.4     560  583.87     565

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0    .035       0    .035  583.87    .035

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0  583.87            18.78     100  146.39             .1       .3
Left Levee      Station=     .63      Elevation=  565.01
Right Levee     Station=  473.55      Elevation=  560.47

CROSS SECTION


RIVER: RIVER-1
REACH: Reach-1            RS: 2

INPUT
Description: STA 2
Station Elevation Data    num=      16
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0     565    53.4     563  129.32     562  260.18     561  282.66     559
  328.96     558  387.18     558  397.18  563.22  412.51  563.84  432.62  555.44
  458.24  554.71  472.22  560.71  482.47  559.16  499.31     559  511.43     560
  629.55     567

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0    .035       0    .035  629.55    .035

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0  629.55             100     100     100             .1       .3
Left Levee      Station=   51.63      Elevation=     563
Right Levee     Station=  473.55      Elevation=  560.72

CROSS SECTION


RIVER: RIVER-1
REACH: Reach-1            RS: 1

INPUT
Description: STA 1
Station Elevation Data    num=      16
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0     568  140.39     562  190.64     561  254.84     560  283.64     559
  339.06     558   413.2   557.8  423.22  563.14  439.69  563.32  458.88   554.5
  491.16  554.13  503.81   559.6  515.33     559  555.56     559  588.34     560
  653.35     565
```

```
Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0    .035       0    .035  653.35    .035

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0  653.35                0       0       0              .1       .3
Left Levee      Station=  140.15      Elevation=  562.07
Right Levee     Station=  504.53      Elevation=  559.58
```

SUMMARY OF MANNING'S N VALUES

River:RIVER-1

Reach	River Sta.	n1	n2	n3
Reach-1	11	.02	.02	.02
Reach-1	10	.035	.035	.035
Reach-1	9	.035	.035	.035
Reach-1	8	.035	.035	.035
Reach-1	7	.035	.035	.035
Reach-1	6	.035	.035	.035
Reach-1	5	.035	.035	.035
Reach-1	4.9	.035	.035	.035
Reach-1	4.7	Culvert		
Reach-1	4.2	.035	.035	.035
Reach-1	4.1	.035	.035	.035
Reach-1	4	.035	.035	.035
Reach-1	3	.035	.035	.035
Reach-1	2	.035	.035	.035
Reach-1	1	.035	.035	.035

SUMMARY OF REACH LENGTHS

River: RIVER-1

Reach	River Sta.	Left	Channel	Right
Reach-1	11	100	100	100
Reach-1	10	215.02	100	53.41
Reach-1	9	267.74	100	32.54
Reach-1	8	100	100	100
Reach-1	7	132.62	100	86.89
Reach-1	6	14.58	100	143.81
Reach-1	5	73.29	70	64.68
Reach-1	4.9	60	60	60
Reach-1	4.7	Culvert		
Reach-1	4.2	10	10	10
Reach-1	4.1	60	60	60
Reach-1	4	100	100	100
Reach-1	3	18.78	100	146.39
Reach-1	2	100	100	100
Reach-1	1	0	0	0

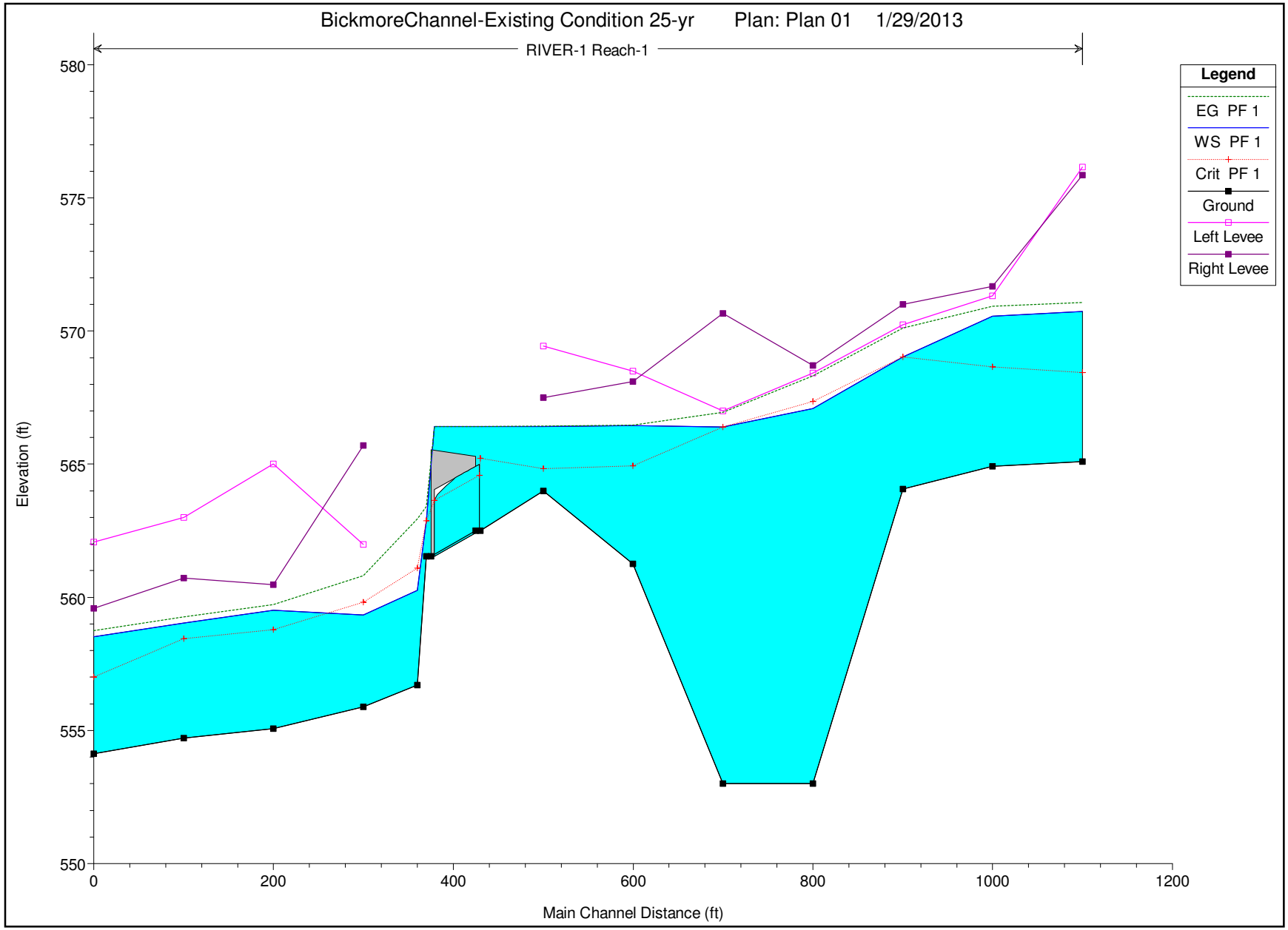
SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
River: RIVER-1

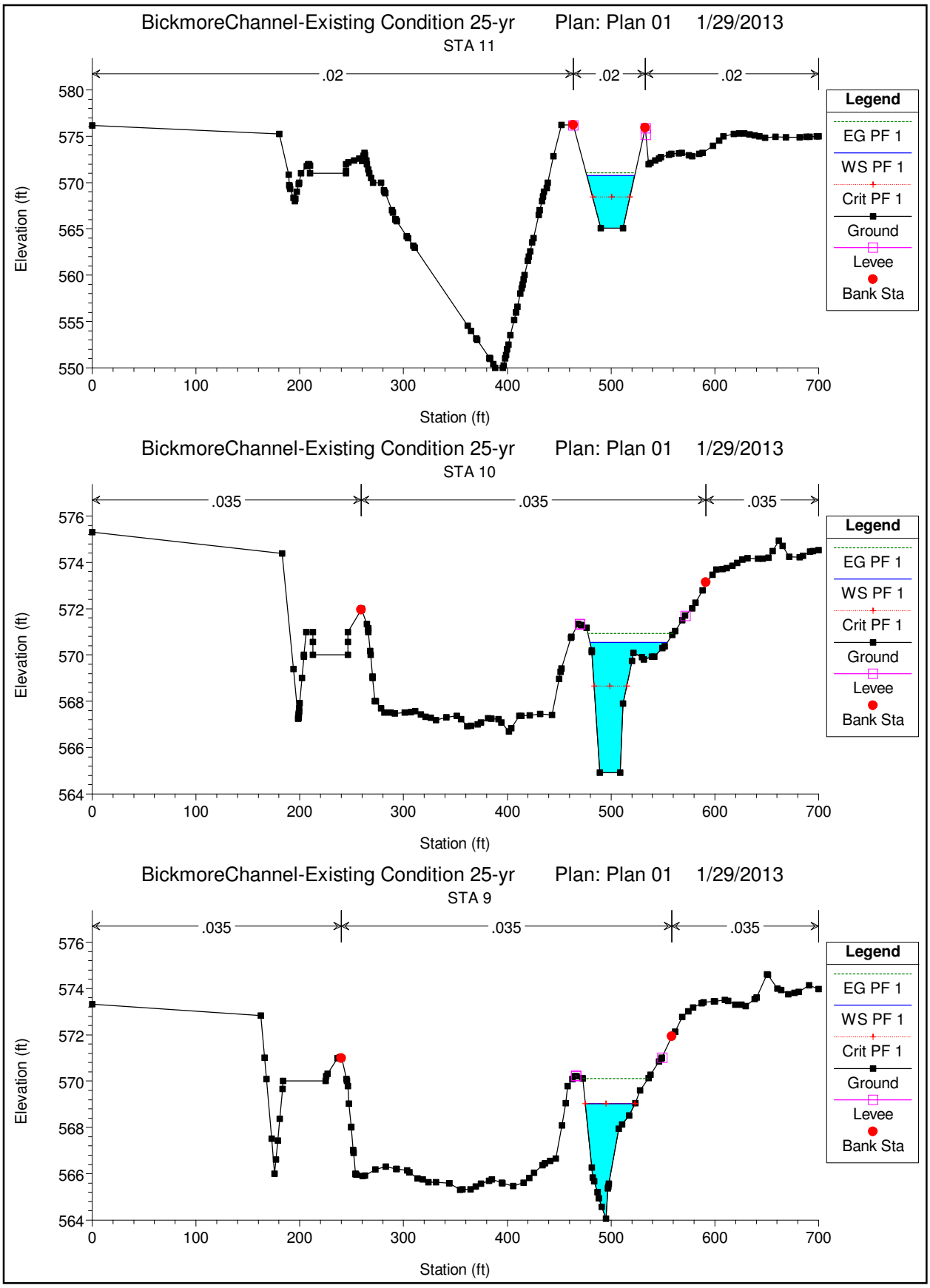
Reach	River Sta.	Contr.	Expan.
Reach-1	11	.1	.3
Reach-1	10	.1	.3
Reach-1	9	.1	.3
Reach-1	8	.1	.3
Reach-1	7	.1	.3
Reach-1	6	.1	.3
Reach-1	5	.1	.3
Reach-1	4.9	.1	.3
Reach-1	4.7	Culvert	
Reach-1	4.2	.1	.3
Reach-1	4.1	.1	.3
Reach-1	4	.1	.3

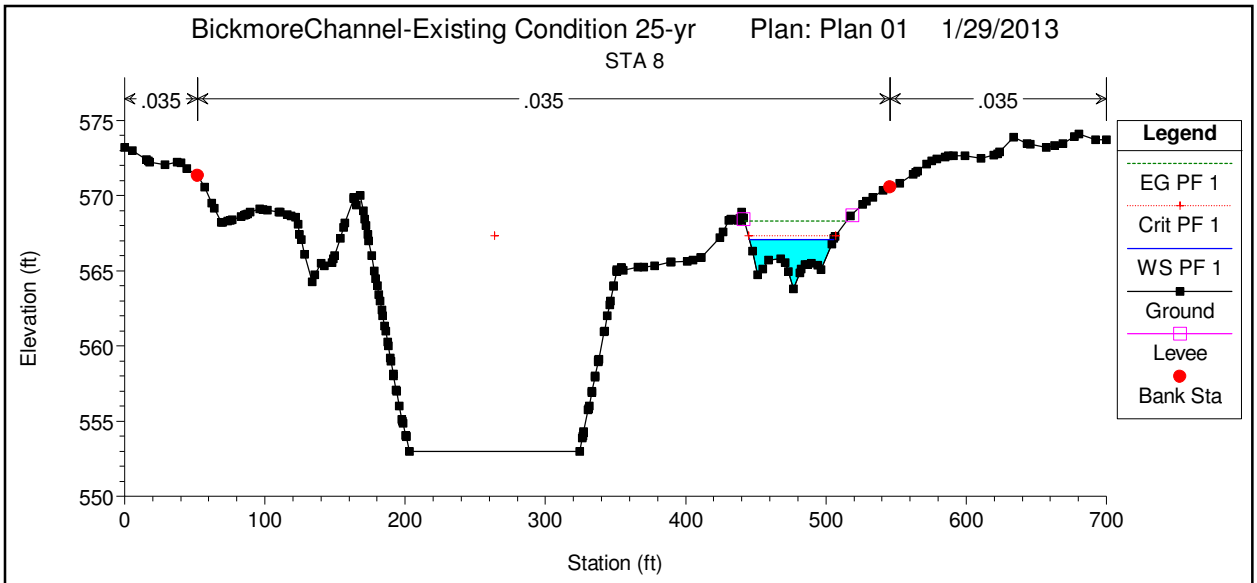
Reach-1	3	.1	.3
Reach-1	2	.1	.3
Reach-1	1	.1	.3

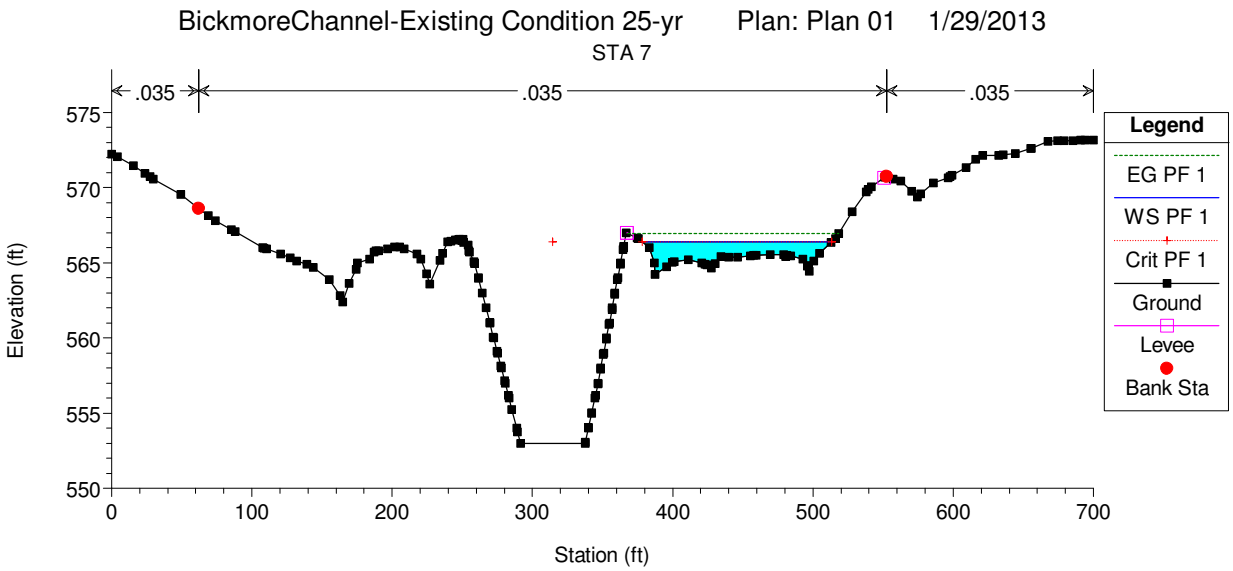
HEC-RAS Plan: Plan 01 River: RIVER-1 Reach: Reach-1 Profile: PF 1

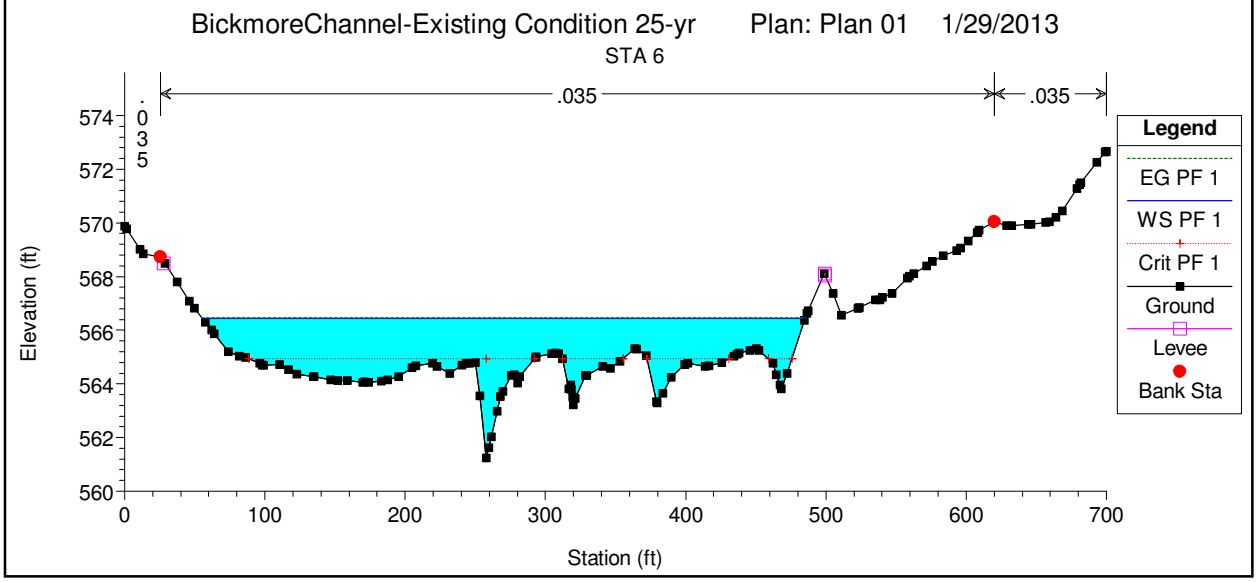
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Reach-1	11	PF 1	889.00	565.10	570.73	568.44	571.07	0.000641	4.68	189.94	45.93	0.41
Reach-1	10	PF 1	889.00	564.92	570.55	568.66	570.93	0.004551	4.98	178.62	74.67	0.57
Reach-1	9	PF 1	889.00	564.07	569.02	569.02	570.12	0.014212	8.41	105.73	47.85	1.00
Reach-1	8	PF 1	889.00	553.00	567.09	567.35	568.32	0.022956	8.91	99.76	59.96	1.22
Reach-1	7	PF 1	889.00	553.00	566.40	566.40	566.95	0.017491	5.96	149.13	135.42	1.00
Reach-1	6	PF 1	889.00	561.25	566.45	564.94	566.47	0.000286	1.09	812.84	430.32	0.14
Reach-1	5	PF 1	889.00	564.00	566.42	564.83	566.44	0.000287	1.12	792.64	406.44	0.14
Reach-1	4.9	PF 1	889.00	562.50	566.41	565.22	566.42	0.000216	0.83	1073.50	700.00	0.12
Reach-1	4.7		Culvert									
Reach-1	4.2	PF 1	889.00	561.55	562.88	562.88	563.40	0.018126	5.77	154.02	150.00	1.00
Reach-1	4.1	PF 1	889.00	556.71	560.25	561.10	562.94	0.034472	13.15	67.62	30.30	1.55
Reach-1	4	PF 1	889.00	555.89	559.34	559.82	560.82	0.025281	9.77	90.97	51.26	1.29
Reach-1	3	PF 1	889.00	555.06	559.51	558.78	559.73	0.003931	3.76	236.62	139.19	0.51
Reach-1	2	PF 1	889.00	554.71	559.03	558.44	559.27	0.005277	3.97	223.71	151.07	0.58
Reach-1	1	PF 1	889.00	554.13	558.52	557.00	558.75	0.005008	3.86	230.02	155.67	0.56

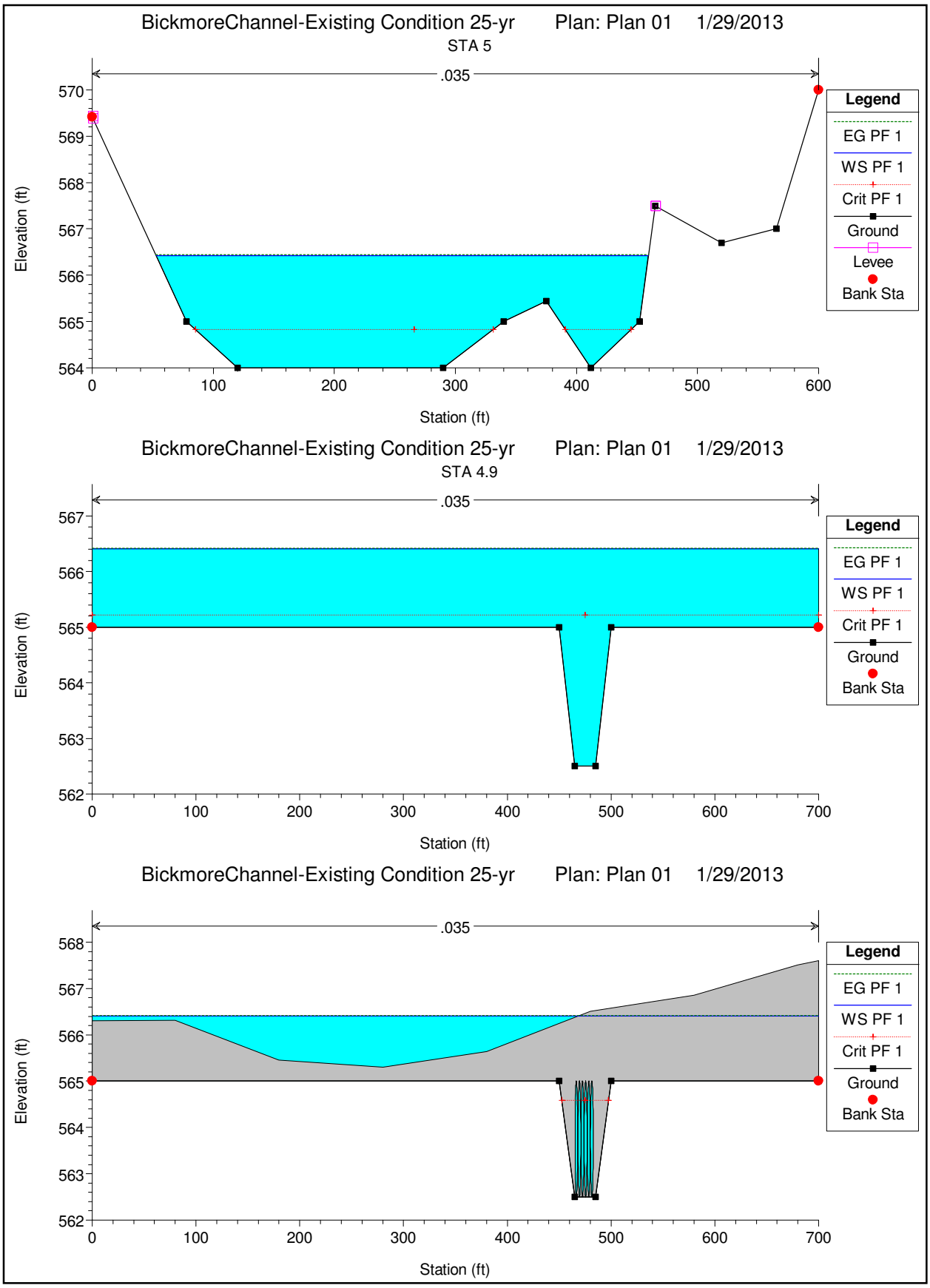

BickmoreChannel-Existing Condition 25-yr Plan: Plan 01 1/29/2013
RIVER-1 Reach-1
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Left Levee
Right Levee
Elevation (ft)
580
575
570
565
560
555
550
0
200
400
600
800
1000
1200
Main Channel Distance (ft)

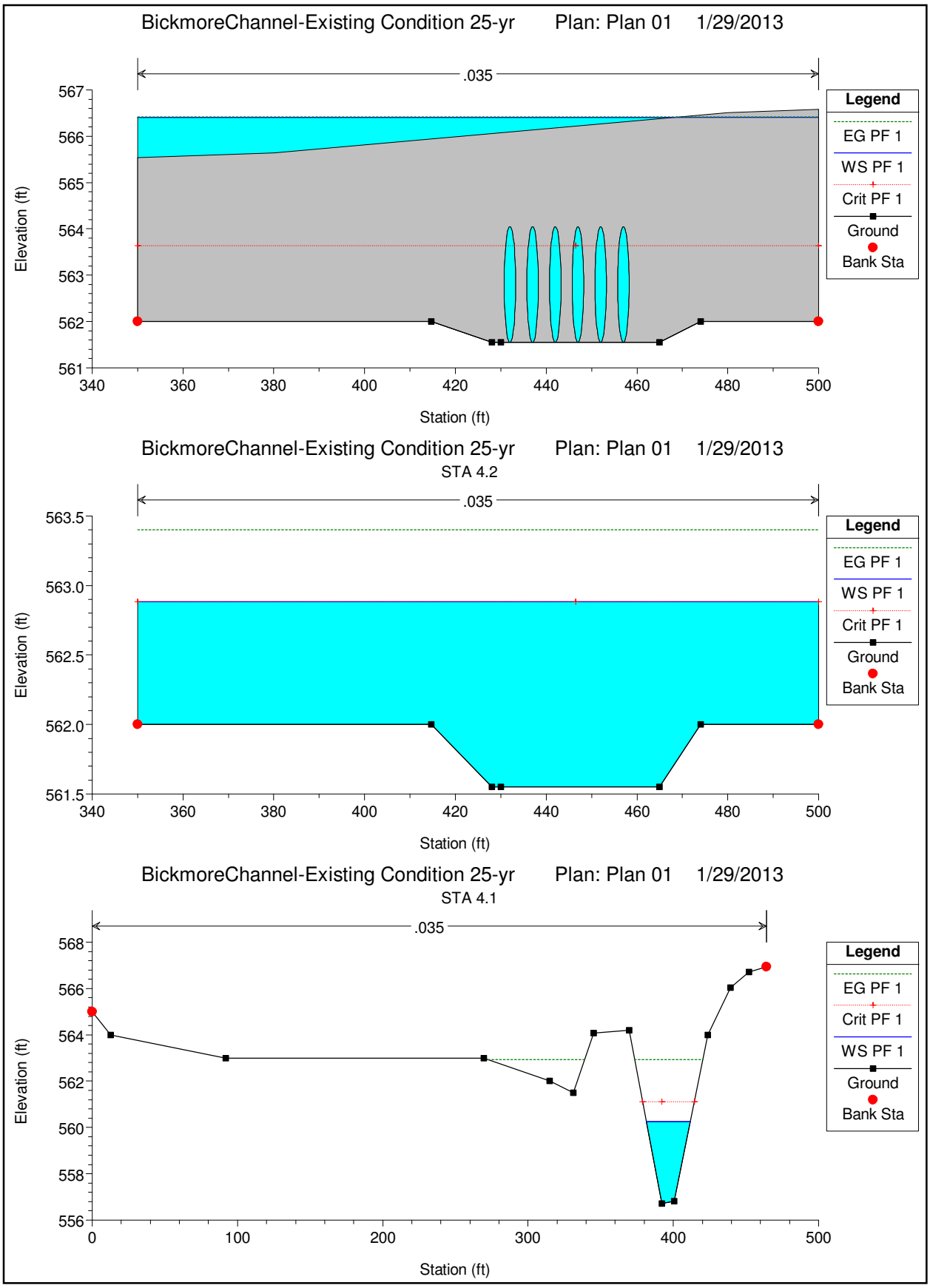

BickmoreChannel-Existing Condition 25-yr Plan: Plan 01 1/29/2013
STA 11
.02
.02
.02
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Levee
Bank Sta
BickmoreChannel-Existing Condition 25-yr Plan: Plan 01 1/29/2013
STA 10
.035
.035
.035
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Levee
Bank Sta
BickmoreChannel-Existing Condition 25-yr Plan: Plan 01 1/29/2013
STA 9
.035
.035
.035
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Levee
Bank Sta

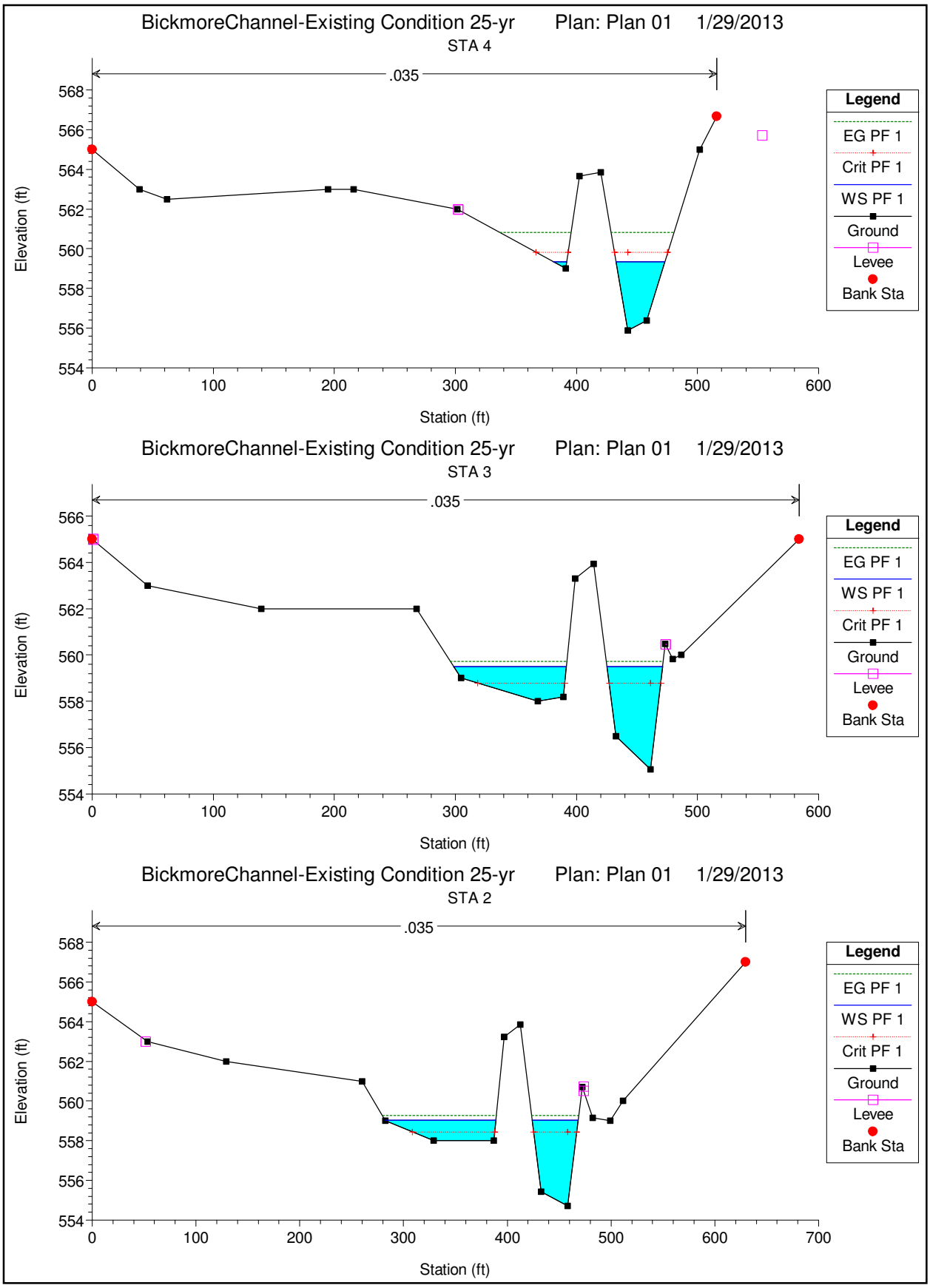

BickmoreChannel-Existing Condition 25-yr Plan: Plan 01 1/29/2013
STA 8
.035
.035
.035
Elevation (ft)
Station (ft)
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Levee
Bank Sta

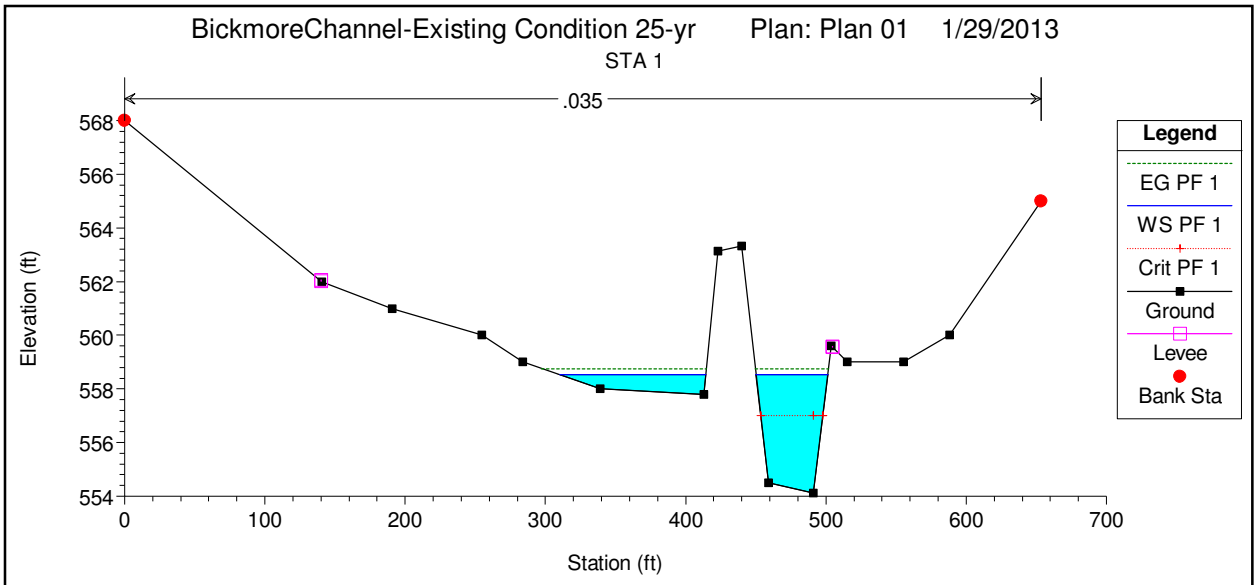

BickmoreChannel-Existing Condition 25-yr Plan: Plan 01 1/29/2013
STA 7
.035
.035
.035
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Levee
Bank Sta


BickmoreChannel-Existing Condition 25-yr Plan: Plan 01 1/29/2013
STA 6
.035
.035
.035
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Levee
Bank Sta


BickmoreChannel-Existing Condition 25-yr Plan: Plan 01 1/29/2013
STA 5
.035
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Levee
Bank Sta
BickmoreChannel-Existing Condition 25-yr Plan: Plan 01 1/29/2013
STA 4.9
.035
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
BickmoreChannel-Existing Condition 25-yr Plan: Plan 01 1/29/2013
.035
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta


BickmoreChannel-Existing Condition 25-yr Plan: Plan 01 1/29/2013
.035
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
BickmoreChannel-Existing Condition 25-yr Plan: Plan 01 1/29/2013
STA 4.2
.035
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
BickmoreChannel-Existing Condition 25-yr Plan: Plan 01 1/29/2013
STA 4.1
.035
Elevation (ft)
Station (ft)
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta


BickmoreChannel-Existing Condition 25-yr Plan: Plan 01 1/29/2013
STA 4
.035
Elevation (ft)
Station (ft)
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Levee
Bank Sta
BickmoreChannel-Existing Condition 25-yr Plan: Plan 01 1/29/2013
STA 3
.035
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Levee
Bank Sta
BickmoreChannel-Existing Condition 25-yr Plan: Plan 01 1/29/2013
STA 2
.035
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Levee
Bank Sta


BickmoreChannel-Existing Condition 25-yr
Plan: Plan 01
1/29/2013
STA 1
.035
Elevation (ft)
568
566
564
562
560
558
556
554
0
100
200
300
400
500
600
700
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Levee
Bank Sta

100 – YEAR FREQUENCY

```
                    HEC-RAS Version 4.1.0 Jan 2010
                     U.S. Army Corps of Engineers
                    Hydrologic Engineering Center
                          609 Second Street
                          Davis, California


          X     X  XXXXXX    XXXX        XXXX       XX      XXXX
          X     X  X        X    X       X   X     X  X    X
          X     X  X        X            X   X    X    X   X
          XXXXXXX  XXXX     X       XXX  XXXX     XXXXXX    XXXX
          X     X  X        X            X  X     X    X        X
          X     X  X        X    X       X   X    X    X        X
          X     X  XXXXXX    XXXX        X    X   X    X   XXXXX
```

PROJECT DATA
Project Title: BickmoreChannelExisting Condition 100-yr
Project File : BMCEexist-100yr.prj
Run Date and Time: 1/29/2013 4:07:12 PM

Project in English units

Project Description:
Channel Analysis for Existing Condition 100 Year

PLAN DATA

Plan Title: Plan 01
Plan File : e:\400-499\481\0481-125\PLANS\hydro\HEC-RAS\BMCEexist-100yr.p01

Geometry Title: BickmoreChannelExisting Condition 100-yr
Geometry File : e:\400-499\481\0481-125\PLANS\hydro\HEC-RAS\BMCEexist-100yr.g01

Flow Title : BickmoreChanne Existing Condition 100-yr
Flow File : e:\400-499\481\0481-125\PLANS\hydro\HEC-RAS\BMCEexist-100yr.f01

Plan Summary Information:

Number of:	Cross Sections	= 14	Multiple Openings	=	0
	Culverts	= 1	Inline Structures	=	0
	Bridges	= 0	Lateral Structures	=	0

Computational Information
Water surface calculation tolerance = 0.01
Critical depth calculation tolerance = 0.01
Maximum number of iterations = 20
Maximum difference tolerance = 0.3
Flow tolerance factor = 0.001

Computation Options
Critical depth computed only where necessary
Conveyance Calculation Method: At breaks in n values only
Friction Slope Method: Average Conveyance
Computational Flow Regime: Mixed Flow

FLOW DATA

Flow Title: BickmoreChanne Existing Condition 100-yr
Flow File : e:\400-499\481\0481-125\PLANS\hydro\HEC-RAS\BMCEexist-100yr.f01

Flow Data (cfs)

River	Reach	RS	PF 1
RIVER-1	Reach-1	11	1455

Boundary Conditions

River	Reach	Profile	Upstream

Downstream

RIVER-1 Reach-1 PF 1 Normal S = 0.0011 Normal S = 0.005

GEOMETRY DATA

Geometry Title: BickmoreChannelExisting Condition 100-yr
Geometry File : e:\400-499\481\0481-125\PLANS\hydro\HEC-RAS\BMCEexist-100yr.g01

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 11

INPUT
Description: STA 11
Station Elevation Data num= 122

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	576.18	180.16	575.25	189.15	570.87	189.68	569.71	190.12	569.57
190.95	569.31	194.1	568.35	195.26	568	195.72	568.23	197.31	569
198.99	569.83	199.33	570	201.38	571	206.83	571.76	208.03	572
208.94	572	209.79	571.83	209.83	571	244.41	571	244.42	571.25
244.45	572	246.85	572.19	252.3	572.39	257.39	572.59	260.31	572.32
261.3	572.92	262.39	573.21	262.82	573	264.1	572.36	264.81	572
266.1	571.39	266.8	571	268.77	570.5	270.4	570	278.41	570
281.07	569.14	281.76	569	282.31	568.84	288.81	567	289.71	566.75
292.13	566.06	292.2	566.05	292.46	566	293.35	565.84	293.41	565.83
303.16	564.22	304.48	564	309.46	563.18	310.53	563	361.86	554.53
365.05	554	370.04	553.18	371.11	553	382.71	551.09	382.98	551.04
383.23	551	383.45	550.96	386.67	550.43	388.26	550	395.75	550
396.33	550.28	397.84	551	398.67	551.4	399.94	552	400.93	552.48
403.15	553.53	406.51	555.14	408.32	556	409.59	556.61	412.51	558
413.74	558.59	414.59	559	415.81	559.58	416.7	560	419.96	561.56
420.89	562	422.03	562.55	424.1	563.53	425.08	564	430.32	566.5
431.36	567	433.46	568	434.46	568.48	435.55	569	438.14	569.44
438.85	570	444.67	572.84	452.33	576.2	463.83	576.2	490	565.1
511.5	565.1	532.89	575.91	536.29	571.99	537.87	572.12	542.61	572.36
546.17	572.57	548.26	572.74	555.73	573.01	558.27	573.08	565.42	573.16
568.27	573.2	575.11	572.96	578.28	572.86	584.8	573.09	588.28	573.18
598.29	573.97	604.18	574.53	608.29	574.98	618.3	575.26	623.56	575.3
628.3	575.3	633.25	575.21	638.31	575.1	642.94	574.99	648.31	574.85
658.32	574.92	668.32	574.9	681.69	574.91	688.34	574.95	691.38	574.95
698.34	574.98	700	574.98						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.02	463.83	.02	532.89	.02

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
463.83	532.89	100	100	100	.1	.3

Left Levee Station= 463.78 Elevation= 576.16
Right Levee Station= 533.54 Elevation= 575.86

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 10

INPUT
Description: STA 10
Station Elevation Data num= 117

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	575.31	182.86	574.38	193.89	569.39	198.67	567.25	198.72	567.27
198.82	567.32	198.91	567.37	199	567.41	199.13	567.47	199.3	567.56
199.55	567.69	200.04	567.93	202.18	569	204.05	569.93	204.18	570
206.18	571	212.49	571	212.51	570.56	212.54	570	246.49	570
246.51	570.57	246.53	571	259.01	571.96	259.37	571.99	259.48	571.99
259.59	571.98	259.73	571.96	264.6	571.34	265.97	571.15	266.13	571.07
266.26	571	267.89	570.18	268.26	570	270.09	569.08	270.26	569
272.26	568	272.36	568	273.26	568.01	278.43	567.69	281.38	567.52
287.63	567.51	291.38	567.48	301.39	567.51	307.01	567.54	311.39	567.58

316.7	567.44	321.4	567.33	326.39	567.29	331.4	567.19	341.41	567.31
351.41	567.38	355.46	567.23	361.42	566.93	365.15	566.95	371.42	567.01
374.83	567.09	381.43	567.28	384.52	567.26	391.43	567.24	394.21	567.09
401.44	566.69	403.9	566.84	411.45	567.37	413.59	567.37	421.45	567.39
431.46	567.45	442.89	567.41	450.02	568.97	451.47	569.28	452.35	569.41
461.47	570.74	461.93	570.79	468.07	571.34	470.91	571.3	471.71	571.28
476.23	571.18	481.22	570.19	481.44	570.14	488.97	564.92	508.97	564.92
511.5	567.9	520.18	569.74	521.5	570.09	529.87	569.9	531.51	569.81
539.56	569.92	541.51	569.92	549.25	570.3	551.52	570.38	558.94	570.87
561.52	571.03	568.63	571.51	571.53	571.7	578.32	572.01	581.54	572.26
588.01	572.8	591.54	573.14	597.7	573.47	601.55	573.69	607.39	573.72
611.55	573.76	617.07	573.85	621.56	573.98	626.76	574.12	631.56	574.18
641.57	574.15	646.14	574.15	651.57	574.21	655.83	574.49	661.58	574.93
665.52	574.71	671.58	574.24	681.59	574.22	684.9	574.28	691.59	574.47
694.59	574.48	700	574.52						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.035	259.01	.035	591.54	.035

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.
259.01 591.54 215.02 100 53.41 .1 .3
Left Levee Station= 469.86 Elevation= 571.33
Right Levee Station= 571.55 Elevation= 571.68

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 9

INPUT
Description: STA 9
Station Elevation Data num= 73

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	573.33	162.52	572.84	166.21	571.02	167.97	570.09	172.92	567.52
175.83	566	177.08	566.61	178.76	567.44	180.67	568.37	183.29	569.66
183.99	570	225.19	570	225.2	570.21	226.69	570.31	236.53	571
238.44	571.04	239.02	571	240.2	571	240.63	571	244.97	570.1
245.49	570	246.36	569.78	458.06	569.79	462.52	570.1	464.36	570.22
466.67	570.22	472.2	570.13	472.59	570.12	481.37	566.27	482.4	565.85
483.55	565.68	487.07	565.21	488.45	564.95	491.02	564.58	495.05	564.07
497.06	565.37	497.27	565.46	497.66	565.57	507.47	567.95	510.44	568.12
517.67	568.51	523.22	569.05	527.88	569.6	536	570.13	538.08	570.28
546.29	570.84	548.28	570.97	548.78	571.02	558.48	571.94	561.56	572.14
568.68	572.77	574.34	573.02	578.88	573.17	587.13	573.37	589.09	573.4
599.29	573.45	599.91	573.45	609.49	573.51	612.69	573.46	619.69	573.3
625.47	573.3	629.89	573.25	638.25	573.55	640.09	573.6	650.3	574.62
651.03	574.58	660.5	574	663.82	573.93	670.7	573.75	676.6	573.82
680.9	573.85	691.1	574.14	700	573.97				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.035	240.2	.035	558.48	.035

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.
240.2 558.48 267.74 100 32.54 .1 .3
Left Levee Station= 238.99 Elevation= 571.05
Right Levee Station= 549.42 Elevation= 571.01

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 8

INPUT
Description: STA 8
Station Elevation Data num= 180

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	573.22	5.37	572.99	15.54	572.39	17.01	572.31	18.02	572.24
28.65	572.08	37.56	572.23	40.29	572.17	44.3	571.8	51.93	571.34
57.11	570.55	61.97	569.49	64.04	569.15	68.96	568.22	69.62	568.23
73.68	568.32	75.39	568.35	76.66	568.38	83.14	568.61	85.41	568.7
86.12	568.76	87.49	568.8	89.55	568.89	96.2	569.11	98.48	569.09
101.83	569.03	110.12	568.9	111.11	568.89	115.75	568.74	118.84	568.66
121.94	568.55	123.49	568.1	124.75	567.43	125.81	567.07	128.43	566.12
133.57	564.27	135.66	564.73	139.92	565.52	142.37	565.35	147.88	565.53
148.69	565.8	149.68	566.02	153.66	567.17	156.27	567.9	157.16	568.18

163.3	569.82	163.53	569.88	163.63	569.87	165.02	569.36	168.05	570
170.05	569	171.18	568.44	172.05	568	173.2	567.43	174.06	567
175.95	566.03	178.07	565	179.04	564.49	180.08	564	181.14	563.43
182.08	563	183.24	562.38	184.06	562	185.33	561.32	186.04	561
187.42	560.26	188.01	560	189.5	559.19	189.96	559	191.59	558.13
191.87	558	193.64	557.07	193.8	557	195.79	556.01	197.77	555.12
198.05	555	198.43	554.85	200.48	554.06	200.63	554	200.69	553.98
203.22	553	324.53	553	326.46	553.88	326.72	554	327.16	554.2
327.36	554.29	330.59	555.76	330.76	555.84	331.12	556	333.14	556.92
333.31	557	335.37	557.94	335.51	558	337.59	558.95	337.7	559
337.89	559.08	337.97	559.12	341.96	560.94	342.09	561	344.27	561.99
345.88	562.72	346.47	562.99	348.59	563.96	348.68	564	350.72	564.93
350.88	565	351.03	565.07	353.99	565.2	354.04	565.2	354.17	565.21
354.43	565.07	355.62	565.04	366.16	565.23	369.86	565.25	377.8	565.33
389.4	565.59	389.5	565.59	401.08	565.65	405.13	565.7	410.84	565.88
411.1	565.9	424.36	567.2	426.71	567.57	430.88	568.34	432.25	568.45
433.85	568.38	437.15	568.37	438.59	568.48	439.75	568.37	441.69	568.38
441.69	568.41	447.75	566.31	451.29	564.72	455.02	565.14	459.27	565.72
467.59	565.79	470.91	565.53	473	564.93	476.72	563.8	481.26	564.85
482.55	565.14	485.09	565.41	486.83	565.41	489.71	565.5	494	565.37
496.28	565.06	504.13	566.78	505.82	567.17	506.68	567.29	517.46	568.65
526.23	569.42	529.1	569.63	533.33	569.91	540.74	570.34	545.78	570.55
552.38	570.84	562.09	571.42	564.02	571.54	565.32	571.64	571.8	572.1
575.65	572.33	579.09	572.44	584.87	572.59	587.29	572.66	590.86	572.64
598.93	572.64	610.57	572.48	619.62	572.7	622.21	572.77	623.96	572.93
633.85	573.9	643.51	573.48	645.48	573.41	657.12	573.2	663.06	573.35
668.76	573.48	677.16	573.92	680.4	574.1	692.04	573.74	700	573.71

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.035	51.93	.035	545.78	.035

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
51.93	545.78	100	100	100	.1	.3

Left Levee Station= 168.91 Elevation= 570
Right Levee Station= 518.63 Elevation= 568.71

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 7

INPUT
Description: STA 7
Station Elevation Data num= 169

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	572.24	4.02	572.06	15.66	571.46	23.93	570.94	27.3	570.76
29.59	570.58	49.14	569.53	62.22	568.6	68.69	568.14	73.86	567.8
85.49	567.2	88.23	567.08	107.78	566.02	108.77	565.96	110.23	565.91
120.41	565.58	127.33	565.33	132.05	565.11	138.99	564.89	143.69	564.69
155.32	563.89	162.7	562.8	164.88	562.38	169.1	563.62	174.28	564.56
175.24	564.98	184.01	565.24	187.06	565.7	188.64	565.78	190.24	565.82
196.53	565.93	201.88	566.06	205.51	566.05	208.51	565.91	217.75	565.58
220.31	565.26	224.32	564.28	226.92	563.58	233.89	565.16	236.14	565.64
239.71	566.39	241.92	566.46	245.16	566.52	246.85	566.54	247.9	566.56
248.15	566.55	249.55	566.49	250.37	566.58	250.95	566.34	254.04	566.17
254.63	565.81	255.24	565.7	258.5	565.08	258.71	565	258.92	564.93
261.44	564	261.56	563.95	264.16	563	266.85	562.01	269.49	561.04
269.6	561	272.13	560.07	272.33	560	274.77	559.1	275.05	559
277.41	558.13	277.77	558	280.06	557.16	280.5	557	282.7	556.19
283.22	556	285.34	555.22	288.66	554	289.41	553.73	291.39	553
337.68	553	337.81	553.05	339.97	554	340.07	554.04	342.31	555
342.37	555.02	344.66	556	345.05	556.17	346.66	556.96	346.73	557
348.63	557.94	348.75	558	350.62	558.92	350.77	559	352.63	559.91
352.79	560	354.63	560.91	354.81	561	356.65	561.9	356.84	562
358.66	562.9	358.86	563	360.68	563.89	360.88	564	362.69	564.89
362.9	565	364.62	565.89	364.84	566	365.07	566.11	366.86	567
374.47	566.66	375.54	566.6	383.32	566	386.82	565.01	387.54	564.24
395.69	564.73	399.73	565.03	400.98	565.06	411.37	565.2	420.53	564.98
423.01	564.9	424.5	564.86	427.79	564.65	430.14	564.94	434.64	565.41
440.07	565.37	446.28	565.38	455.42	565.48	457.92	565.49	459.62	565.51
469.56	565.54	479.17	565.55	480.69	565.41	481.2	565.5	484.19	565.44
492.84	565.24	496.03	564.77	496.96	564.83	497.43	564.44	500.65	565.1
504.47	565.63	512.95	566.35	516.11	566.59	518.26	566.94	527.75	568.41
537.81	569.71	539.39	569.9	541.72	570.05	551.03	570.69	552.52	570.76
557.35	570.55	562.67	570.43	570.49	569.76	574.31	569.39	576.9	569.59
585.94	570.31	596.45	570.67	597.58	570.72	599.25	570.81	609.22	571.33
615.99	571.87	620.86	572.14	632.5	572.16	635.54	572.18	644.14	572.26

```
  655.09   572.6  655.77  572.62  667.41  573.07  674.63  573.11  679.05  573.11
  685.55  573.14  690.69  573.18  694.18  573.18     700  573.17

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0    .035   62.22    .035  552.52    .035

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         62.22  552.52            132.62     100   86.89              .1       .3

CROSS SECTION


RIVER: RIVER-1
REACH: Reach-1            RS: 6

INPUT
Description: STA 6
Station Elevation Data    num=     133
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0  569.88    1.17  569.79   10.93  569.02    13.3  568.85   25.44  568.74
   28.58   568.5   37.57   567.8   46.23  567.08   49.71  566.82   57.38  566.29
   61.85  566.01   63.88  565.86   73.98  565.19   81.53  565.04   86.12  564.99
   96.23  564.76   98.26   564.7   99.18   564.7  110.39  564.72  116.82  564.52
  122.53  564.37  134.47  564.27  135.09  564.27   146.8  564.16  152.12  564.13
  158.94  564.13  169.77  564.06  171.07  564.07  173.94  564.06  183.21   564.1
  187.42  564.14  195.35  564.26  205.07   564.6  207.48  564.67  219.62  564.77
  222.72  564.64  231.75  564.39  240.36   564.7  243.55  564.77  245.94  564.78
  250.22  564.79  253.17  563.55  258.05  561.25  259.64  561.62  261.43  562.03
  265.57  562.97  267.88  563.53  269.61  563.73  275.66  564.32  278.02  564.34
  280.29  564.04  281.65  564.28  292.79  564.99  293.31     565  304.57  565.13
  307.17  565.14  309.42  565.12  312.18  564.93  316.86  563.82  317.93  563.97
   318.5   563.8  319.33  563.51     320  563.22  321.25  563.47  328.61  564.31
  328.84  564.31  329.37  564.32  340.98  564.65  346.25  564.59  353.12  564.83
   363.9  565.32  365.25   565.3  371.89  565.05  379.18  563.35  379.46  563.29
  383.66  563.66  389.52  564.25   399.2  564.73  401.66  564.76   413.8  564.65
  416.85  564.67  425.93   564.8   434.5  565.03  436.69   565.1  438.07  565.15
  445.93  565.24  450.21  565.31  452.15  565.24  462.34  564.78  464.51  564.33
  467.36  563.96  468.34  563.82  472.47   564.4  484.79  566.36  486.61  566.63
  487.44  566.73  498.75  568.11  505.09  567.38  510.89  566.57  522.74  566.81
  523.02  566.82  523.65  566.84  535.16  567.14  538.37  567.14  540.39  567.22
   547.3  567.38  558.04  567.95  559.43  568.02   562.5  568.12  571.57  568.39
  575.69  568.56   583.7  568.77  593.33  568.97  595.84  569.06  601.36  569.33
  607.98  569.64   608.1  569.64  609.35  569.72  620.11  570.03  628.63   569.9
  632.25  569.89  644.39  569.94  646.28  569.94  656.52  570.01  659.17  570.05
  663.93  570.21  668.66  570.45  679.07  571.29  680.79  571.42  681.58  571.49
  692.93  572.27  699.23  572.65     700  572.67

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0    .035   25.44    .035  620.11    .035

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         25.44  620.11             14.58     100  143.81              .1       .3
Left Levee      Station=    27.9      Elevation=   568.5
Right Levee     Station=  499.38      Elevation=   568.1

CROSS SECTION


RIVER: RIVER-1
REACH: Reach-1            RS: 5

INPUT
Description: STA 5
Station Elevation Data    num=      12
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0  569.42      78     565     120     564     290     564     340     565
     375  565.44     412     564     452     565     465   567.5     520   566.7
     565     567     600     570

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0    .035       0    .035     600    .035

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0     600             73.29      70   64.68              .1       .3
Left Levee      Station=     .63      Elevation=  569.44
Right Levee     Station=  465.33      Elevation=   567.5
```

CROSS SECTION

RIVER: RIVER-1
REACH: Reach-1 RS: 4.9

INPUT
Description: STA 4.9
Station Elevation Data num= 6

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	565	450	565	465	562.5	485.001	562.5	500	565
700	565								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.035	0	.035	700	.035

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
0	700	60	60	60	.1	.3

CULVERT

RIVER: RIVER-1
REACH: Reach-1 RS: 4.7

INPUT
Description:
Distance from Upstream XS = 5
Deck/Roadway Width = 50
Weir Coefficient = 2.6
Upstream Deck/Roadway Coordinates
num= 9

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
0	566.3	550	80.001	566.31	550	180	565.45	550
279.999	565.3	550	380	565.64	550	480	566.51	550
580	566.86	550	680	567.51	550	700	567.6	550

Upstream Bridge Cross Section Data
Station Elevation Data num= 6

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	565	450	565	465	562.5	485.001	562.5	500	565
700	565								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.035	0	.035	700	.035

Bank Sta: Left	Right	Coeff Contr.	Expan.
0	700	.1	.3

Downstream Deck/Roadway Coordinates
num= 9

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
0	566.3	540	80.001	566.31	540	180	565.45	540
279.999	565.3	540	380	565.64	540	480	566.51	540
580	566.86	540	680	567.51	540	700	567.6	540

Downstream Bridge Cross Section Data
Station Elevation Data num= 7

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
350	562	414.71	562	428	561.55	430	561.55	465	561.55
474	562	500	562						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
350	.035	350	.035	500	.035

Bank Sta: Left	Right	Coeff Contr.	Expan.
350	500	.1	.3

Upstream Embankment side slope = 0 horiz. to 1.0 vertical
Downstream Embankment side slope = 0 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow = .95
Elevation at which weir flow begins =
Energy head used in spillway design =
Spillway height used in design =
Weir crest shape = Broad Crested

```
Number of Culverts =  1

Culvert Name     Shape      Rise    Span
Culvert #1      Circular     2.5
FHWA Chart # 1 - Concrete Pipe Culvert
FHWA Scale # 1 - Square edge entrance with headwall
Solution Criteria = Highest U.S. EG
Culvert Upstrm Dist  Length    Top n  Bottom n  Depth Blocked  Entrance Loss Coef   Exit Loss
Coef
                 1      50     .024     .024        0                    .2                1
Number of Barrels =  6
Upstream   Elevation =  562.5
Centerline Stations
    Sta.    Sta.    Sta.    Sta.    Sta.    Sta.
   466.5   469.5   472.5   475.5   478.5   481.5
Downstream Elevation =  561.55
Centerline Stations
    Sta.    Sta.    Sta.    Sta.    Sta.    Sta.
     432     437     442     447     452     457

CROSS SECTION


RIVER: RIVER-1
REACH: Reach-1            RS: 4.2

INPUT
Description: STA 4.2
Station Elevation Data    num=       7
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
     350     562  414.71     562     428  561.55     430  561.55     465  561.55
     474     562     500     562

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
     350    .035     350    .035     500    .035

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
           350     500               10      10      10             .1       .3

CROSS SECTION


RIVER: RIVER-1
REACH: Reach-1            RS: 4.1

INPUT
Description: STA 4.1
Station Elevation Data    num=      14
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0     565    12.8     564   91.76     563  269.65     563   314.9     562
     331   561.5  345.11  564.08   369.5   564.2  392.13  556.71   400.6  556.82
  423.85     564  439.51  566.04     452  566.71     464  566.93

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0    .035       0    .035     464    .035

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0     464               60      60      60             .1       .3

CROSS SECTION


RIVER: RIVER-1
REACH: Reach-1            RS: 4

INPUT
Description: STA 4
Station Elevation Data    num=      13
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0     565    39.3     563   61.62   562.5  194.97     563  215.86     563
  301.41     562  391.14     559  402.43  563.65  419.95  563.85  442.25  555.89
  457.97  556.38  501.65     565  516.03  566.67

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0    .035       0    .035  516.03    .035
```

```
Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0  516.03              100     100     100             .1       .3
Left Levee      Station=  334.85      Elevation=  562.58
Right Levee     Station=  553.26      Elevation=   565.7

CROSS SECTION


RIVER: RIVER-1
REACH: Reach-1            RS: 3

INPUT
Description: STA 3
Station Elevation Data    num=      15
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0     565   45.71     563   139.6     562  267.95     562  304.62     559
  368.11     558  389.04   558.2  399.13  563.31  414.38  563.94  432.66  556.49
  461.08  555.06  473.44  560.48  479.56  559.82   486.4     560  583.87     565

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0    .035       0    .035  583.87    .035

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0  583.87             18.78     100  146.39             .1       .3
Left Levee      Station=     .63      Elevation=  565.01
Right Levee     Station=  473.55      Elevation=  560.47

CROSS SECTION


RIVER: RIVER-1
REACH: Reach-1            RS: 2

INPUT
Description: STA 2
Station Elevation Data    num=      16
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0     565    53.4     563   129.32     562  260.18     561  282.66     559
  328.96     558  387.18     558  397.18  563.22  412.51  563.84  432.62  555.44
  458.24  554.71  472.22  560.71  482.47  559.16  499.31     559  511.43     560
  629.55     567

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0    .035       0    .035  629.55    .035

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0  629.55              100     100     100             .1       .3
Left Levee      Station=   51.63      Elevation=     563
Right Levee     Station=  473.55      Elevation=  560.72

CROSS SECTION


RIVER: RIVER-1
REACH: Reach-1            RS: 1

INPUT
Description: STA 1
Station Elevation Data    num=      16
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0     568  140.39     562  190.64     561  254.84     560  283.64     559
  339.06     558   413.2   557.8  423.22  563.14  439.69  563.32  458.88   554.5
  491.16  554.13  503.81   559.6  515.33     559  555.56     559  588.34     560
  653.35     565

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0    .035       0    .035  653.35    .035

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0  653.35                0       0       0             .1       .3
Left Levee      Station=  140.15      Elevation=  562.07
Right Levee     Station=  504.53      Elevation=  559.58
```

SUMMARY OF MANNING'S N VALUES

River:RIVER-1

Reach	River Sta.	n1	n2	n3
Reach-1	11	.02	.02	.02
Reach-1	10	.035	.035	.035
Reach-1	9	.035	.035	.035
Reach-1	8	.035	.035	.035
Reach-1	7	.035	.035	.035
Reach-1	6	.035	.035	.035
Reach-1	5	.035	.035	.035
Reach-1	4.9	.035	.035	.035
Reach-1	4.7	Culvert		
Reach-1	4.2	.035	.035	.035
Reach-1	4.1	.035	.035	.035
Reach-1	4	.035	.035	.035
Reach-1	3	.035	.035	.035
Reach-1	2	.035	.035	.035
Reach-1	1	.035	.035	.035

SUMMARY OF REACH LENGTHS

River: RIVER-1

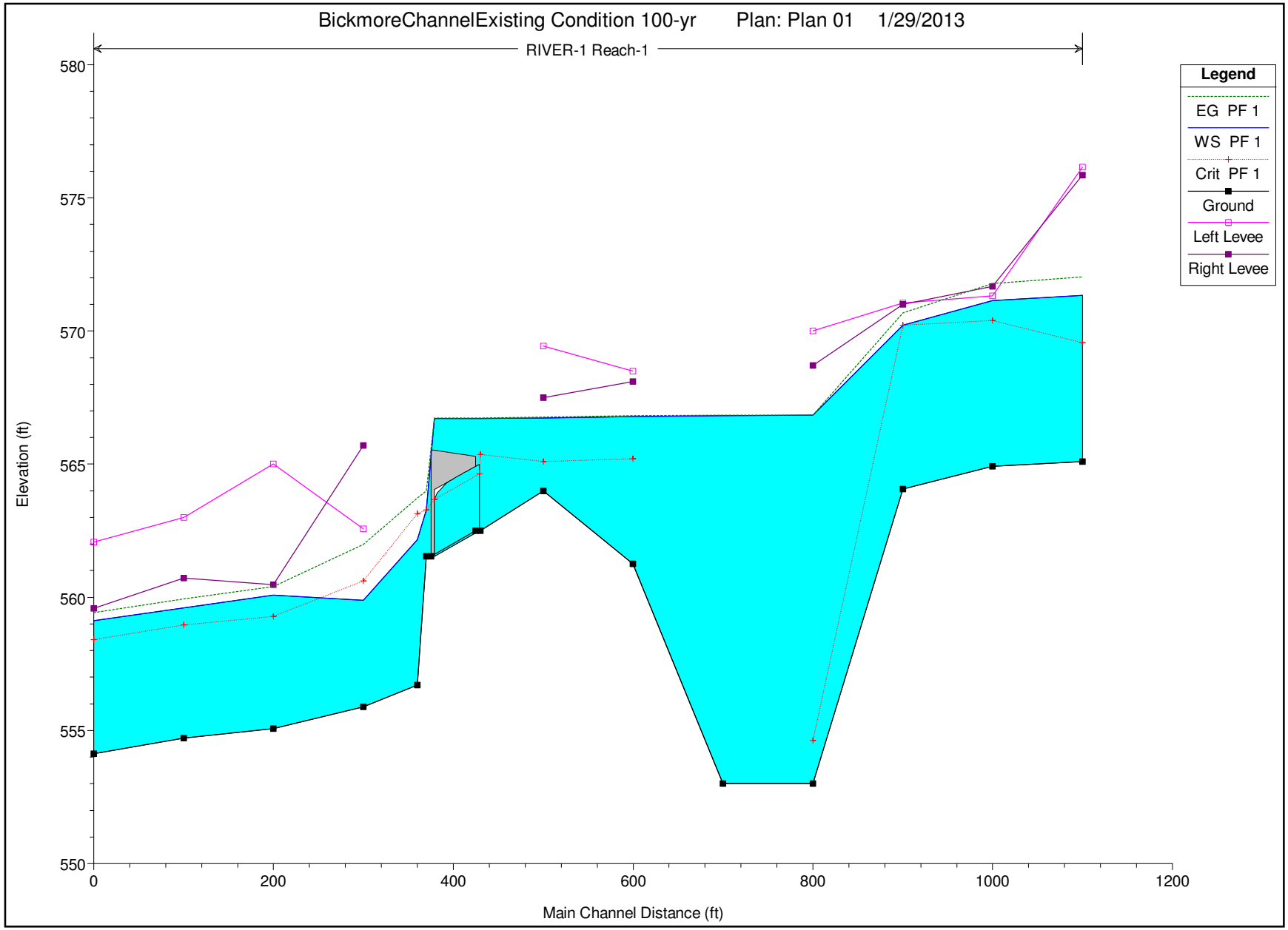
Reach	River Sta.	Left	Channel	Right
Reach-1	11	100	100	100
Reach-1	10	215.02	100	53.41
Reach-1	9	267.74	100	32.54
Reach-1	8	100	100	100
Reach-1	7	132.62	100	86.89
Reach-1	6	14.58	100	143.81
Reach-1	5	73.29	70	64.68
Reach-1	4.9	60	60	60
Reach-1	4.7	Culvert		
Reach-1	4.2	10	10	10
Reach-1	4.1	60	60	60
Reach-1	4	100	100	100
Reach-1	3	18.78	100	146.39
Reach-1	2	100	100	100
Reach-1	1	0	0	0

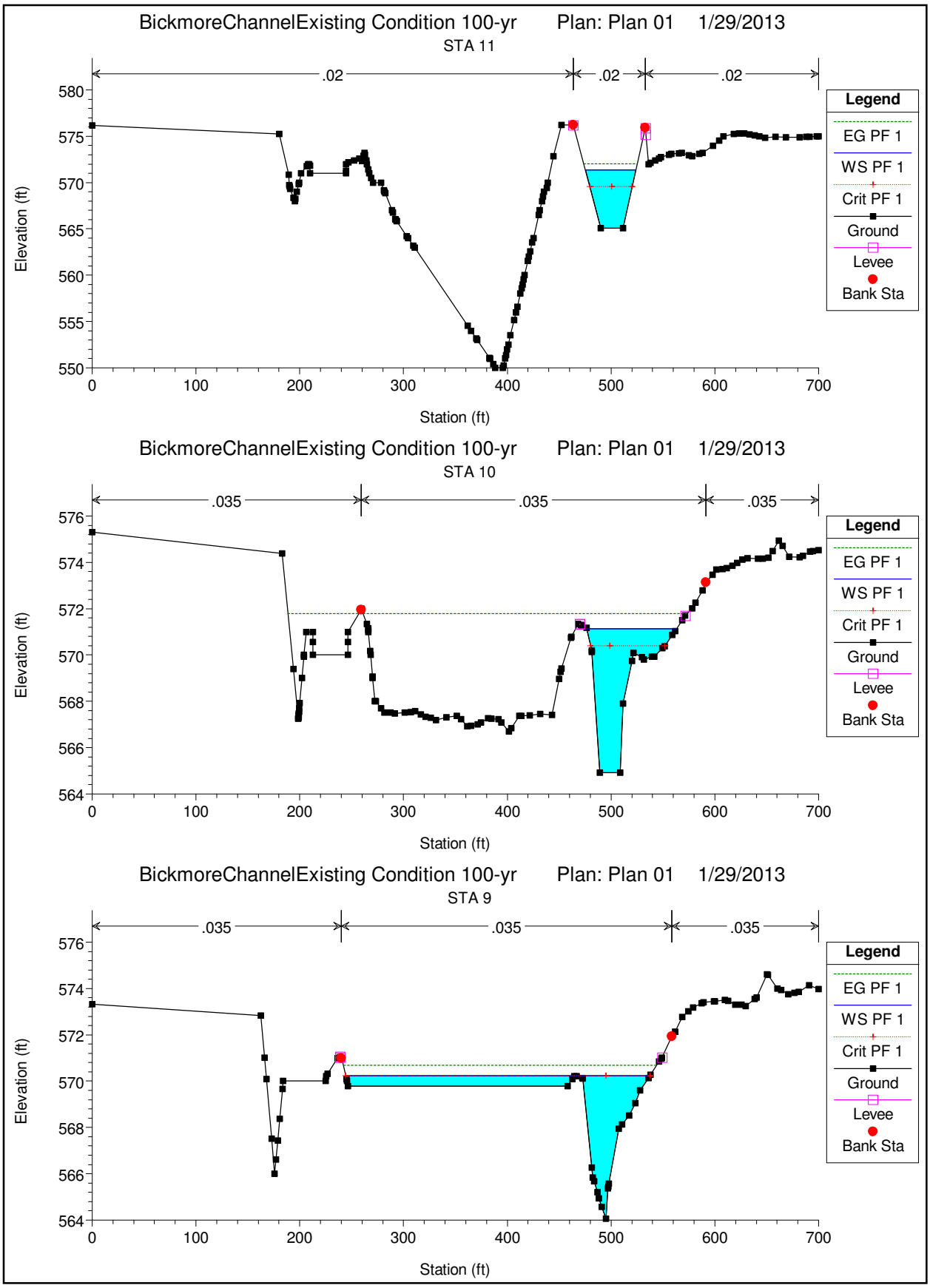
SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
River: RIVER-1

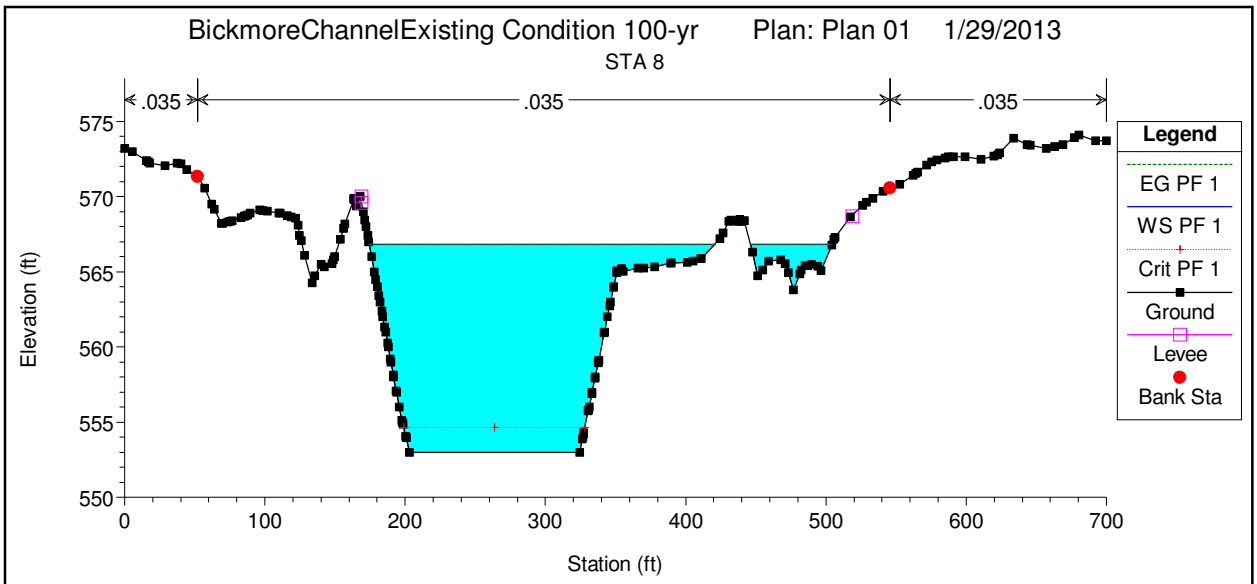
Reach	River Sta.	Contr.	Expan.
Reach-1	11	.1	.3
Reach-1	10	.1	.3
Reach-1	9	.1	.3
Reach-1	8	.1	.3
Reach-1	7	.1	.3
Reach-1	6	.1	.3
Reach-1	5	.1	.3
Reach-1	4.9	.1	.3
Reach-1	4.7	Culvert	
Reach-1	4.2	.1	.3
Reach-1	4.1	.1	.3
Reach-1	4	.1	.3
Reach-1	3	.1	.3
Reach-1	2	.1	.3
Reach-1	1	.1	.3

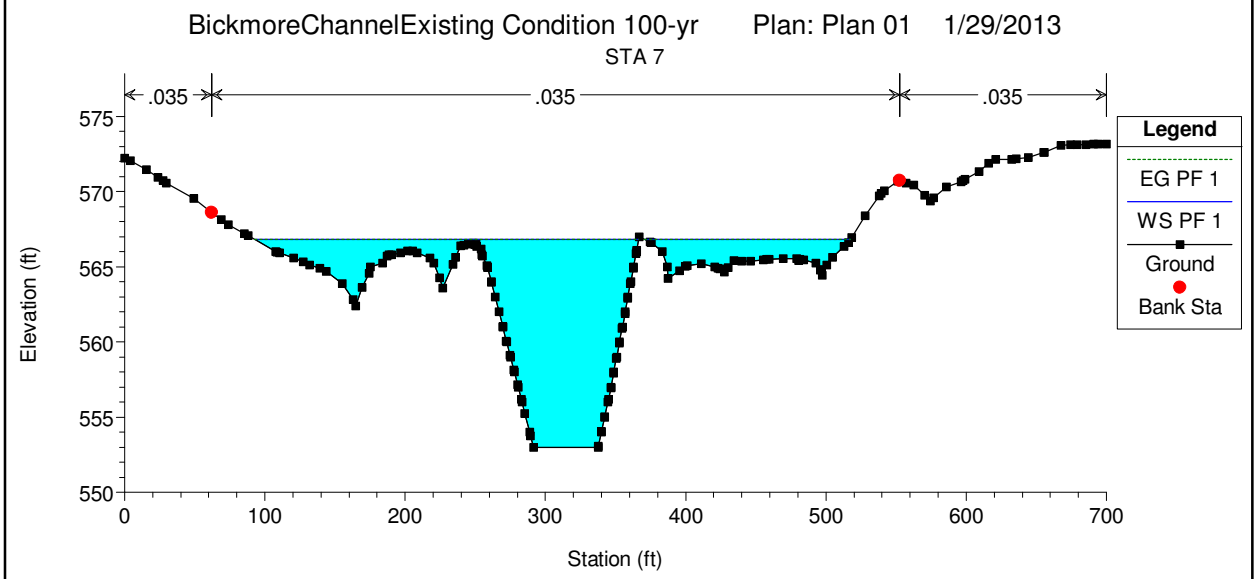
HEC-RAS Plan: Plan 01 River: RIVER-1 Reach: Reach-1 Profile: PF 1

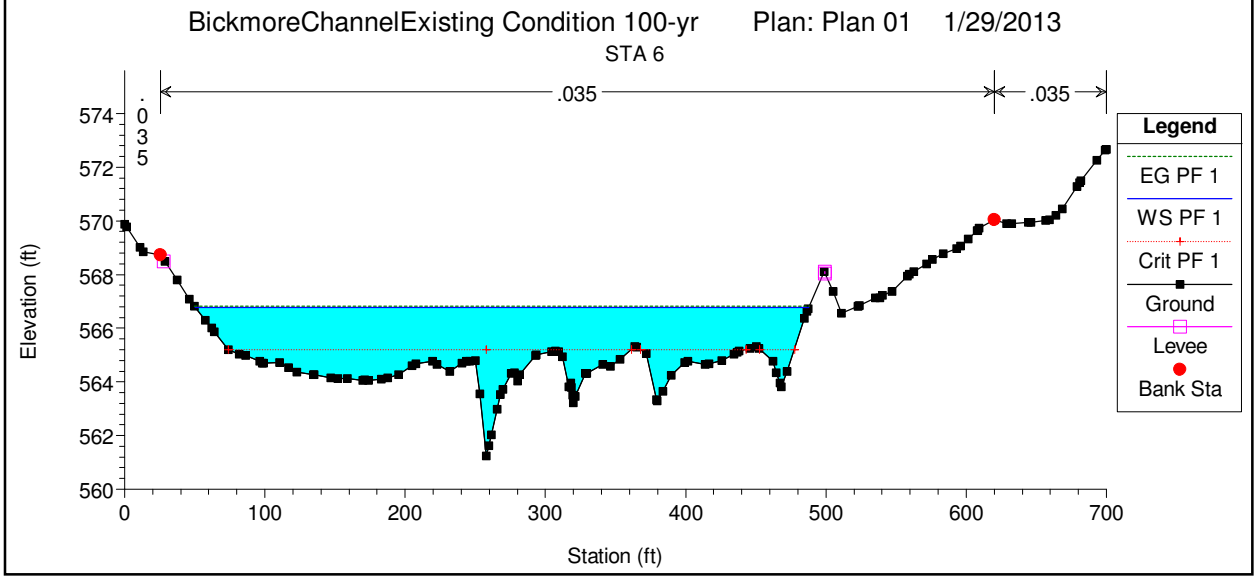
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Reach-1	11	PF 1	1455.00	565.10	571.34	569.57	572.03	0.001161	6.65	218.69	48.57	0.55
Reach-1	10	PF 1	1455.00	564.92	571.14	570.41	571.78	0.006686	6.42	226.73	86.81	0.70
Reach-1	9	PF 1	1455.00	564.07	570.23	570.23	570.68	0.018503	5.42	268.31	292.99	1.00
Reach-1	8	PF 1	1455.00	553.00	566.84	554.63	566.84	0.000016	0.64	2266.61	304.39	0.04
Reach-1	7	PF 1	1455.00	553.00	566.82		566.84	0.000085	0.93	1567.12	420.31	0.08
Reach-1	6	PF 1	1455.00	561.25	566.78	565.21	566.82	0.000454	1.52	957.60	437.63	0.18
Reach-1	5	PF 1	1455.00	564.00	566.73	565.10	566.77	0.000476	1.58	921.25	413.60	0.19
Reach-1	4.9	PF 1	1455.00	562.50	566.72	565.37	566.74	0.000314	1.13	1291.44	700.00	0.15
Reach-1	4.7		Culvert									
Reach-1	4.2	PF 1	1455.00	561.55	563.28	563.28	564.00	0.016467	6.82	213.49	150.00	1.01
Reach-1	4.1	PF 1	1455.00	556.71	562.16	563.14	563.72	0.021520	10.04	144.86	68.97	1.22
Reach-1	4	PF 1	1455.00	555.89	559.88	560.62	561.99	0.037775	11.65	124.86	73.16	1.57
Reach-1	3	PF 1	1455.00	555.06	560.08	559.28	560.40	0.004306	4.56	319.00	149.98	0.55
Reach-1	2	PF 1	1455.00	554.71	559.60	558.97	559.93	0.005063	4.65	312.67	161.26	0.59
Reach-1	1	PF 1	1455.00	554.13	559.12	558.42	559.42	0.005000	4.35	334.58	189.51	0.58

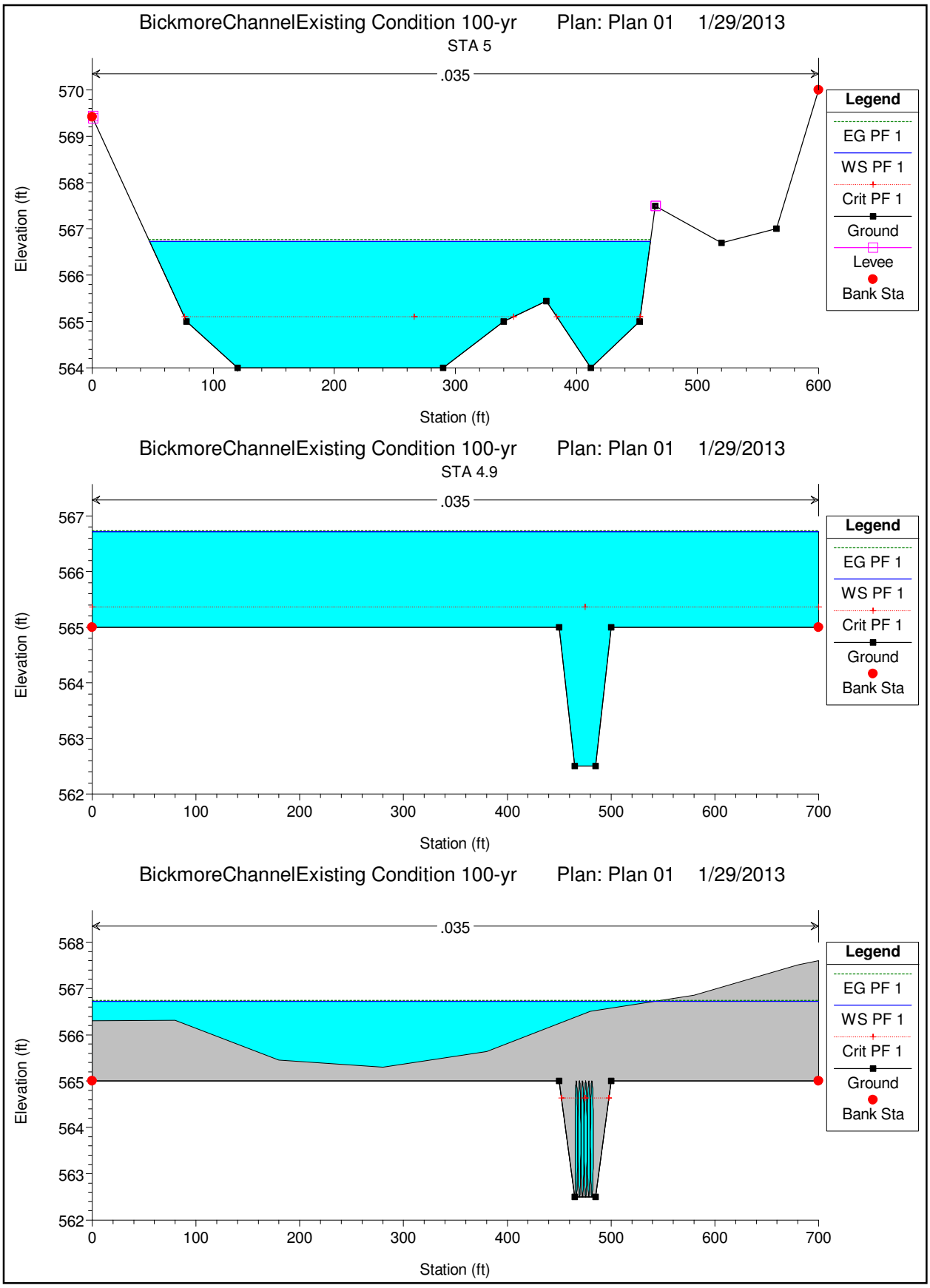

BickmoreChannelExisting Condition 100-yr Plan: Plan 01 1/29/2013
RIVER-1 Reach-1
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Left Levee
Right Levee
Elevation (ft)
580
575
570
565
560
555
550
0
200
400
600
800
1000
1200
Main Channel Distance (ft)

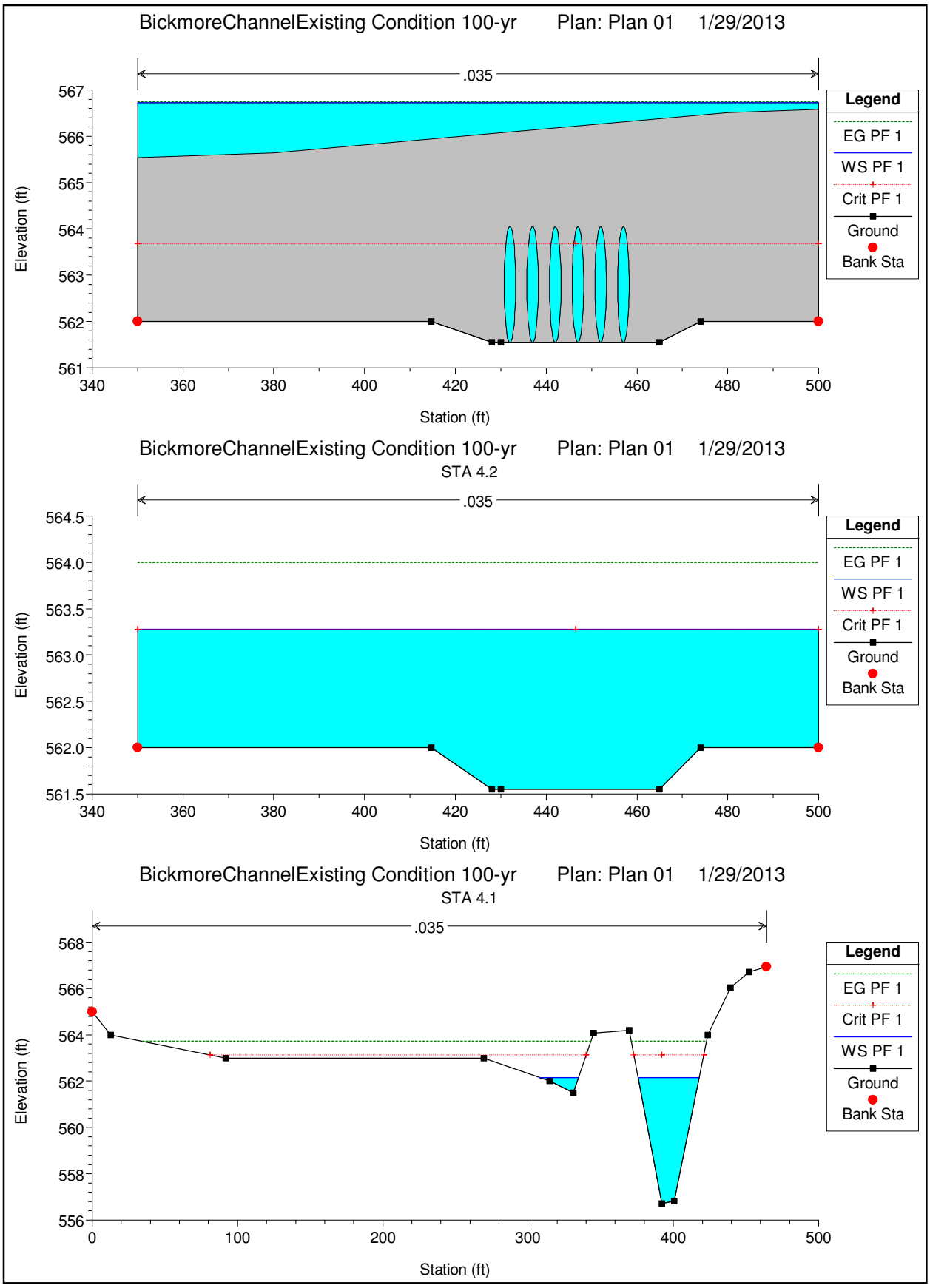

BickmoreChannelExisting Condition 100-yr Plan: Plan 01 1/29/2013
STA 11
.02
.02
.02
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Levee
Bank Sta
BickmoreChannelExisting Condition 100-yr Plan: Plan 01 1/29/2013
STA 10
.035
.035
.035
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Levee
Bank Sta
BickmoreChannelExisting Condition 100-yr Plan: Plan 01 1/29/2013
STA 9
.035
.035
.035
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Levee
Bank Sta

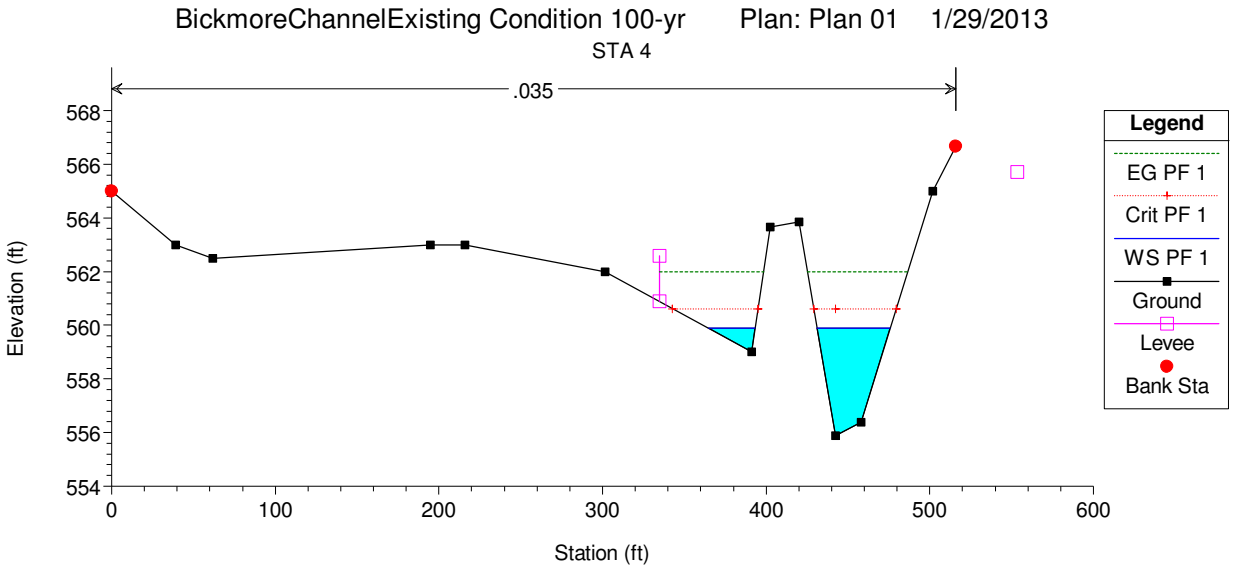

BickmoreChannelExisting Condition 100-yr Plan: Plan 01 1/29/2013
STA 8
.035
.035
.035
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Levee
Bank Sta

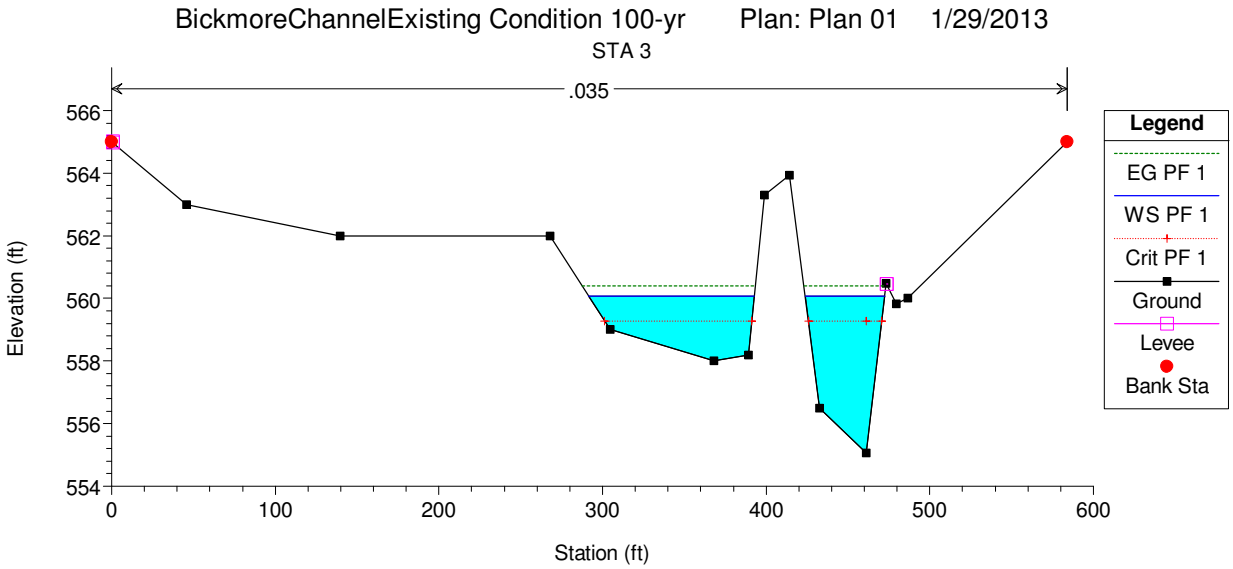

BickmoreChannelExisting Condition 100-yr Plan: Plan 01 1/29/2013
STA 7
.035
.035
.035
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Bank Sta

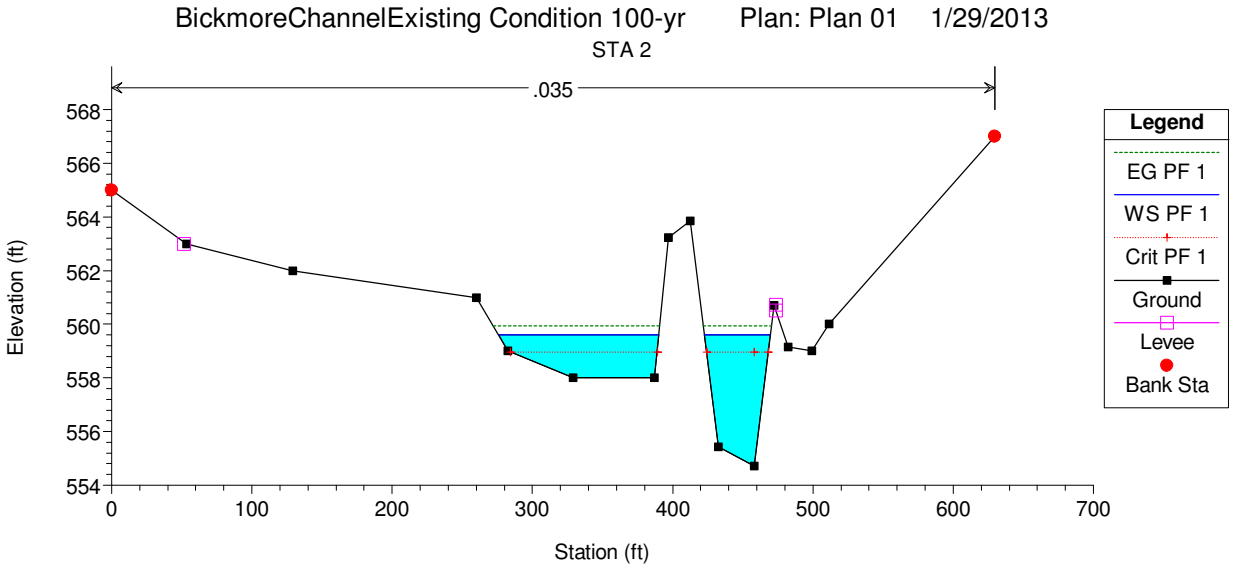

BickmoreChannelExisting Condition 100-yr Plan: Plan 01 1/29/2013
STA 6
.035
.035
.035
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Levee
Bank Sta

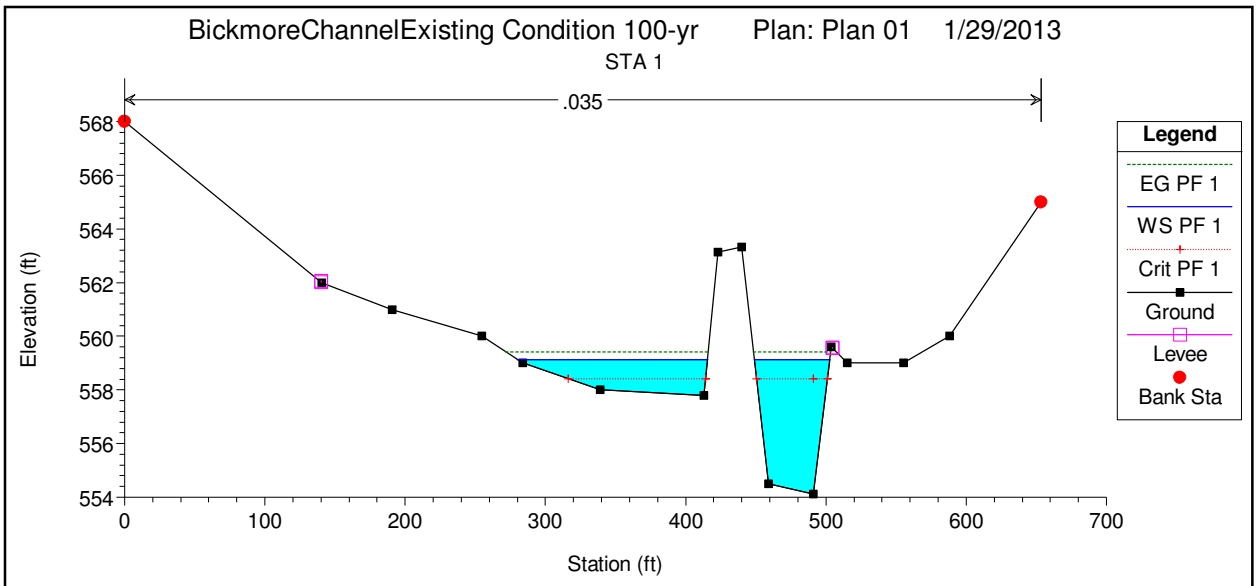

BickmoreChannelExisting Condition 100-yr Plan: Plan 01 1/29/2013
STA 5
.035
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Levee
Bank Sta
BickmoreChannelExisting Condition 100-yr Plan: Plan 01 1/29/2013
STA 4.9
.035
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
BickmoreChannelExisting Condition 100-yr Plan: Plan 01 1/29/2013
.035
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta

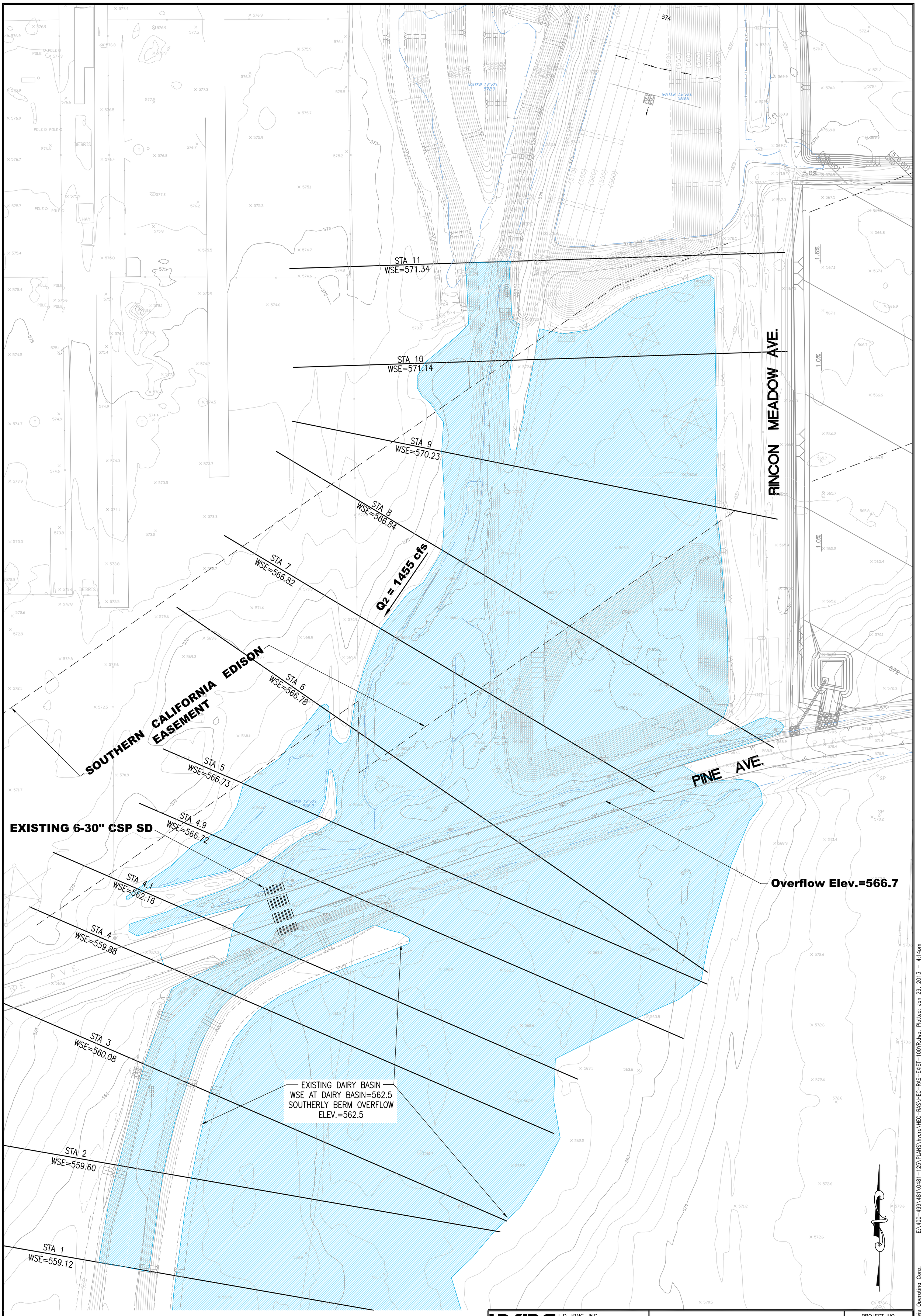

BickmoreChannelExisting Condition 100-yr Plan: Plan 01 1/29/2013
.035
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
BickmoreChannelExisting Condition 100-yr Plan: Plan 01 1/29/2013
STA 4.2
.035
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
BickmoreChannelExisting Condition 100-yr Plan: Plan 01 1/29/2013
STA 4.1
.035
Elevation (ft)
Station (ft)
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta


BickmoreChannelExisting Condition 100-yr Plan: Plan 01 1/29/2013
STA 4
.035
Elevation (ft)
Station (ft)
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Levee
Bank Sta


BickmoreChannelExisting Condition 100-yr Plan: Plan 01 1/29/2013
STA 3
.035
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Levee
Bank Sta


BickmoreChannelExisting Condition 100-yr Plan: Plan 01 1/29/2013
STA 2
.035
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Levee
Bank Sta


BickmoreChannelExisting Condition 100-yr Plan: Plan 01 1/29/2013
STA 1
.035
Elevation (ft)
568
566
564
562
560
558
556
554
0
100
200
300
400
500
600
700
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Levee
Bank Sta



GRAPHIC SCALE

40 0 20 40 80 160

(IN FEET)
1 inch = 40 ft.

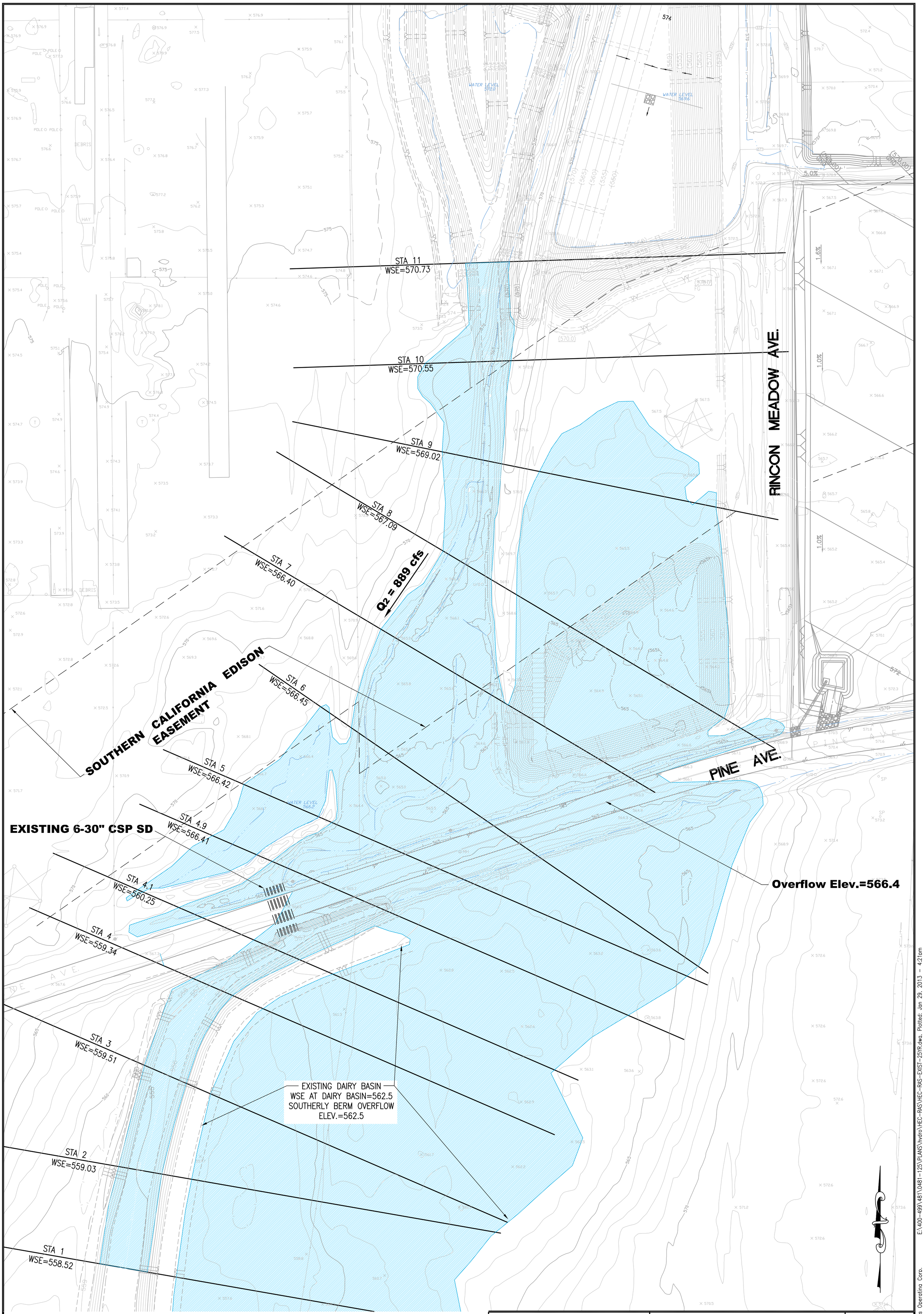
L.D. KING, INC.
2151 CONVENTION CENTER WAY
SUITE 100
ONTARIO, CA 91764
(909) 937-0200

CHANNEL HYDRAULIC ANALYSIS FOR EXISTING CONDITION 100-YEAR FREQUENCY

PROJECT NO.

SHEET 1 OF 1

JN 481125 Lewis Operating Corp. E:\400-499\481\0481-125\PLANS\hydro\HEC-RAS\HEC-RAS-EXIST-100YR.dwg, Plotted: Jan 29, 2013 - 4:14pm



GRAPHIC SCALE

40 0 20 40 80 160

(IN FEET)
1 inch = 40 ft.

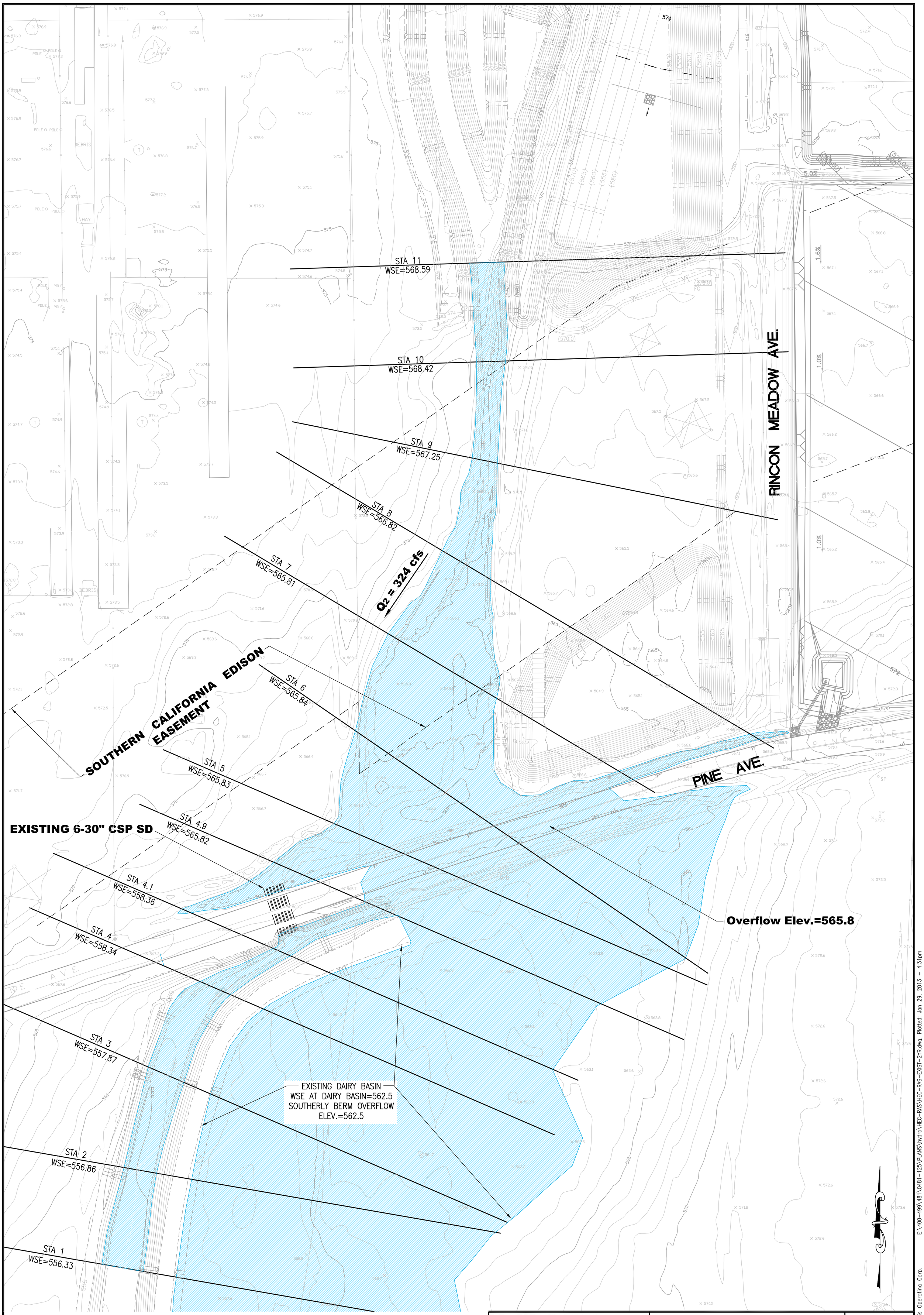
LDKING
L.D. KING, INC.
2151 CONVENTION CENTER WAY
SUITE 100
ONTARIO, CA 91764
(909) 937-0200

CHANNEL HYDRAULIC ANALYSIS FOR EXISTING CONDITION 25-YEAR FREQUENCY

PROJECT NO.

SHEET 1 OF 1

JN 481125 Lewis Operating Corp. E:\400-499\481\0481-125\PLANS\hydro\HEC-RAS\HEC-RAS-EXIST-25YR.dwg, Plotted: Jan 29, 2013 - 4:21pm



GRAPHIC SCALE

40 0 20 40 80 160

(IN FEET)
1 inch = 40 ft.

L.D. KING, INC.
2151 CONVENTION CENTER WAY
SUITE 100
ONTARIO, CA 91764
(909) 937-0200

CHANNEL HYDRAULIC ANALYSIS FOR EXISTING CONDITION 2-YEAR FREQUENCY

PROJECT NO.

SHEET 1 OF 1

JN 481125 Lewis Operating Corp. E:\400-499\481\0481-125\PLANS\hydro\HEC-RAS\HEC-RAS-EXIST-2YR.dwg, Plotted: Jan 29, 2013 – 4:31pm

```
FILE: 481178linej.WSW                    W S P G W  - EDIT LISTING - Version 14.06              Date: 1-31-2013  Time: 2:35:21
                                   WATER SURFACE PROFILE - CHANNEL DEFINITION LISTING                                  PAGE    1
 CARD  SECT  CHN   NO OF  AVE PIER  HEIGHT 1  BASE    ZL    ZR   INV   Y(1)  Y(2)  Y(3)  Y(4)  Y(5)  Y(6)  Y(7)  Y(8)  Y(9)  Y(10)
 CODE   NO   TYPE PIER/PIP WIDTH    DIAMETER  WIDTH              DROP

 CD      3    3      2    1.000    4.000   36.000    .000   .000    .00
 CD      4    4      1             7.000
 CD      5    2      0     .000    8.000   50.000                    .00
 CD      6    1      0     .000    8.000   20.000   2.000  2.000    .00
 CD      7    1      0     .000   10.000   65.000   2.000  2.000    .00
 CD      9    1      0     .000    5.300   32.000   2.000  2.000    .00
 CD     10    1      0     .000    6.000   26.000   2.000  2.000    .00
 CD     11    2      0     .000    7.700   52.000                    .00
 CD     12    2      0     .000    4.600   75.000                    .00
 CD     13    1      0     .000    4.600    4.600   2.000  2.000    .00
 CD      1    5      0        .000
 CD      2    5      0        .000
FILE:                                    W S P G W  - EDIT LISTING - Version 14.06              Date: 1-31-2013  Time: 2:35:21
                                   WATER SURFACE PROFILE - CROSS SECTION POINT LISTING                                 PAGE    2
   CARD  SECT  NO OF    X(1) , Y(1)    X(2) , Y(2)    X(3) , Y(3)    X(4) , Y(4)    X(5) , Y(5)    X(6) , Y(6)    X(7) , Y(7)
   CODE   NO   POINTS   X(8) , Y(8)    X(9) , Y(9)   X(10) ,Y(10)   X(11) ,Y(11)    X(N) , Y(N)   X(N+1),Y(N+1)  X(35) ,Y(35)

   PTS     1     4        .000 560.800   13.600 554.800   40.000 555.100   60.000 563.800
   PTS     2     5        .000 560.000   10.000 555.300   35.000 555.300   76.000 555.300   85.000 560.000
                                                W S P G W                                                          PAGE NO   1
                          WATER SURFACE PROFILE - TITLE CARD LISTING
HEADING LINE NO 1 IS -
                            PINE BOX  LINE 'J'
HEADING LINE NO 2 IS -

HEADING LINE NO 3 IS -

                                                W S P G W                                                          PAGE NO   2
                          WATER SURFACE PROFILE - ELEMENT CARD LISTING
 ELEMENT NO   1 IS A SYSTEM OUTLET      *         *     *
                    U/S DATA   STATION    INVERT  SECT                                    W S ELEV
                                673.000  554.030    9                                       554.030
 ELEMENT NO   2 IS A TRANSITION         *         *     *
                    U/S DATA   STATION    INVERT  SECT              N                           RADIUS   ANGLE
                                773.000  554.800   10             .030                            .000     .000
 ELEMENT NO   3 IS A TRANSITION         *         *     *
                    U/S DATA   STATION    INVERT  SECT              N                           RADIUS   ANGLE
                                873.000  555.300    7             .033                            .000     .000
 ELEMENT NO   4 IS A JUNCTION           *         *     *     *           *                     *               *
                    U/S DATA   STATION    INVERT  SECT LAT-1 LAT-2   N      Q3        Q4     INVERT-3 INVERT-4  PHI 3  PHI 4
                                893.000  555.400    3     4     0   .015   123.000      .000   555.400      .000    .000     .000
                                                                                                RADIUS    ANGLE
                                                                                                  .000    .000
 ELEMENT NO   5 IS A REACH              *         *     *
                    U/S DATA   STATION    INVERT  SECT              N                           RADIUS    ANGLE     ANG PT  MAN H
                               1071.000  560.840    3             .015                            .000     .000      .000     0
 ELEMENT NO   6 IS A REACH              *         *     *
                    U/S DATA   STATION    INVERT  SECT              N                           RADIUS    ANGLE     ANG PT  MAN H
                               1222.000  561.600    3             .015                            .000     .000      .000     0
 ELEMENT NO   7 IS A  WALL  ENTRANCE                  *
                    U/S DATA   STATION    INVERT  SECT             FP
                               1222.000  561.600   11             .200
 ELEMENT NO   8 IS A TRANSITION         *         *     *
                    U/S DATA   STATION    INVERT  SECT              N                           RADIUS   ANGLE
                               1297.000  564.450    6             .033                            .000     .000
 ELEMENT NO   9 IS A REACH              *         *     *
                    U/S DATA   STATION    INVERT  SECT              N                           RADIUS    ANGLE     ANG PT  MAN H
```

```
                                1335.000  564.500    6              .033                          .000     .000      .000     0
ELEMENT NO  10 IS A REACH                *         *     *
                     U/S DATA   STATION    INVERT  SECT              N                          RADIUS    ANGLE     ANG PT  MAN H
                                1583.120  564.790    6              .030                          .000     .000      .000     0
ELEMENT NO  11 IS A REACH                *         *     *
                     U/S DATA   STATION    INVERT  SECT              N                          RADIUS    ANGLE     ANG PT  MAN H
                                1643.000  564.860    6              .030                       108.917   31.500      .000     0
ELEMENT NO  12 IS A REACH                *         *     *
                     U/S DATA   STATION    INVERT  SECT              N                          RADIUS    ANGLE     ANG PT  MAN H
                                1689.240  564.920    6              .030                          .000     .000      .000     0
                                                          W S P G W                                                   PAGE NO   3
                           WATER SURFACE PROFILE - ELEMENT CARD LISTING
ELEMENT NO  13 IS A SYSTEM HEADWORKS                      *                       *
                     U/S DATA   STATION    INVERT  SECT                                     W S ELEV
                                1689.240  564.920    6                                      571.500
```

Station / L/Elem	Invert Elev / Ch Slope	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head / SF Ave	Energy Grd.El. / HF	Super Elev / SE Dpth	Critical Depth / Froude N	Flow Top Width / Norm Dp	Height/Dia.-FT / "N"	Base Wt or I.D. / X-Fall	ZL / ZR	No Wth Prs/Pip / Type Ch
673.000	554.030	3.222	557.252	1400.00	11.30	1.98	559.24	.00	3.61	44.89	5.300	32.000	2.00	0 .0
TRANS STR	.0077					.0117	1.17	3.22	1.20		.030	.00	2.00	TRAP
773.000	554.800	4.020	558.820	1400.00	10.23	1.63	560.45	.00	4.02	42.08	6.000	26.000	2.00	0 .0
TRANS STR	.0050					.0060	.60	4.02	1.00		.033	.00	2.00	TRAP
873.000	555.300	5.948	561.248	1400.00	3.06	.15	561.39	.00	2.37	88.79	10.000	65.000	2.00	0 .0
JUNCT STR	.0050							5.95	.24		.015	.00	2.00	TRAP
893.000	555.400	1.932	557.332	1277.00	19.44	5.87	563.20	.00	3.53	36.00	4.000	36.000	.00	2 1.0
7.630	.0306					.0235	.18	1.93	2.54	1.77	.015	.00	.00	BOX
900.630	555.633	1.943	557.576	1277.00	19.33	5.80	563.38	.00	3.53	36.00	4.000	36.000	.00	2 1.0
48.991	.0306					.0217	1.06	1.94	2.52	1.77	.015	.00	.00	BOX
949.621	557.130	2.038	559.168	1277.00	18.43	5.28	564.44	.00	3.53	36.00	4.000	36.000	.00	2 1.0
32.462	.0306					.0189	.61	2.04	2.34	1.77	.015	.00	.00	BOX
982.083	558.123	2.137	560.260	1277.00	17.57	4.80	565.06	.00	3.53	36.00	4.000	36.000	.00	2 1.0
23.363	.0306					.0164	.38	2.14	2.18	1.77	.015	.00	.00	BOX
1005.446	558.837	2.241	561.078	1277.00	16.76	4.36	565.44	.00	3.53	36.00	4.000	36.000	.00	2 1.0
17.555	.0306					.0142	.25	2.24	2.03	1.77	.015	.00	.00	BOX
1023.001	559.373	2.351	561.724	1277.00	15.98	3.96	565.69	.00	3.53	36.00	4.000	36.000	.00	2 1.0
13.489	.0306					.0124	.17	2.35	1.89	1.77	.015	.00	.00	BOX

Station / L/Elem	Invert Elev / Ch Slope	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head / SF Ave	Energy Grd.El. / HF	Super Elev / SE Dpth	Critical Depth / Froude N	Flow Top Width / Norm Dp	Height/Dia.-FT / "N"	Base Wt or I.D. / X-Fall	ZL / ZR	No Wth Prs/Pip / Type Ch
1036.490	559.785	2.466	562.251	1277.00	15.23	3.60	565.85	.00	3.53	36.00	4.000	36.000	.00	2 1.0

```
-|-       -|-       -|-       -|-       -|-      -|-      -|-       -|-      -|-       -|-       -|-       -|-      -|-       |-
  10.458    .0306                                          .0107      .11     2.47    1.76    1.77    .015       .00   .00  BOX
     |         |         |         |         |         |         |         |         |         |         |         |         |         |
1046.947   560.105    2.586   562.691   1277.00   14.52    3.28   565.97     .00    3.53   36.00    4.000   36.000   .00   2  1.0
-|-       -|-       -|-       -|-       -|-      -|-      -|-       -|-      -|-       -|-       -|-       -|-      -|-       |-
   8.089    .0306                                          .0094      .08     2.59    1.64    1.77    .015       .00   .00  BOX
     |         |         |         |         |         |         |         |         |         |         |         |         |         |
1055.037   560.352    2.712   563.064   1277.00   13.85    2.98   566.04     .00    3.53   36.00    4.000   36.000   .00   2  1.0
-|-       -|-       -|-       -|-       -|-      -|-      -|-       -|-      -|-       -|-       -|-       -|-      -|-       |-
   6.171    .0306                                          .0081      .05     2.71    1.52    1.77    .015       .00   .00  BOX
     |         |         |         |         |         |         |         |         |         |         |         |         |         |
1061.208   560.541    2.844   563.385   1277.00   13.20    2.71   566.09     .00    3.53   36.00    4.000   36.000   .00   2  1.0
-|-       -|-       -|-       -|-       -|-      -|-      -|-       -|-      -|-       -|-       -|-       -|-      -|-       |-
   4.572    .0306                                          .0071      .03     2.84    1.42    1.77    .015       .00   .00  BOX
     |         |         |         |         |         |         |         |         |         |         |         |         |         |
1065.780   560.680    2.983   563.664   1277.00   12.59    2.46   566.12     .00    3.53   36.00    4.000   36.000   .00   2  1.0
-|-       -|-       -|-       -|-       -|-      -|-      -|-       -|-      -|-       -|-       -|-       -|-      -|-       |-
   3.206    .0306                                          .0062      .02     2.98    1.32    1.77    .015       .00   .00  BOX
     |         |         |         |         |         |         |         |         |         |         |         |         |         |
1068.986   560.778    3.129   563.907   1277.00   12.00    2.24   566.14     .00    3.53   36.00    4.000   36.000   .00   2  1.0
-|-       -|-       -|-       -|-       -|-      -|-      -|-       -|-      -|-       -|-       -|-       -|-      -|-       |-
   2.014    .0306                                          .0054      .01     3.13    1.23    1.77    .015       .00   .00  BOX
     |         |         |         |         |         |         |         |         |         |         |         |         |         |
1071.000   560.840    3.282   564.122   1277.00   11.45    2.03   566.16     .00    3.53   36.00    4.000   36.000   .00   2  1.0
-|-       -|-       -|-       -|-       -|-      -|-      -|-       -|-      -|-       -|-       -|-       -|-      -|-       |-
  36.602    .0050                                          .0050      .18     3.28    1.15    3.28    .015       .00   .00  BOX
     |         |         |         |         |         |         |         |         |         |         |         |         |         |
1107.602   561.024    3.282   564.306   1277.00   11.45    2.03   566.34     .00    3.53   36.00    4.000   36.000   .00   2  1.0
-|-       -|-       -|-       -|-       -|-      -|-      -|-       -|-      -|-       -|-       -|-       -|-      -|-       |-
  94.518    .0050                                          .0049      .46     3.28    1.15    3.28    .015       .00   .00  BOX
     |         |         |         |         |         |         |         |         |         |         |         |         |         |
1202.120   561.500    3.360   564.860   1277.00   11.18    1.94   566.80     .00    3.53   36.00    4.000   36.000   .00   2  1.0
-|-       -|-       -|-       -|-       -|-      -|-      -|-       -|-      -|-       -|-       -|-       -|-      -|-       |-
  19.880    .0050                                          .0044      .09     3.36    1.11    3.28    .015       .00   .00  BOX
```

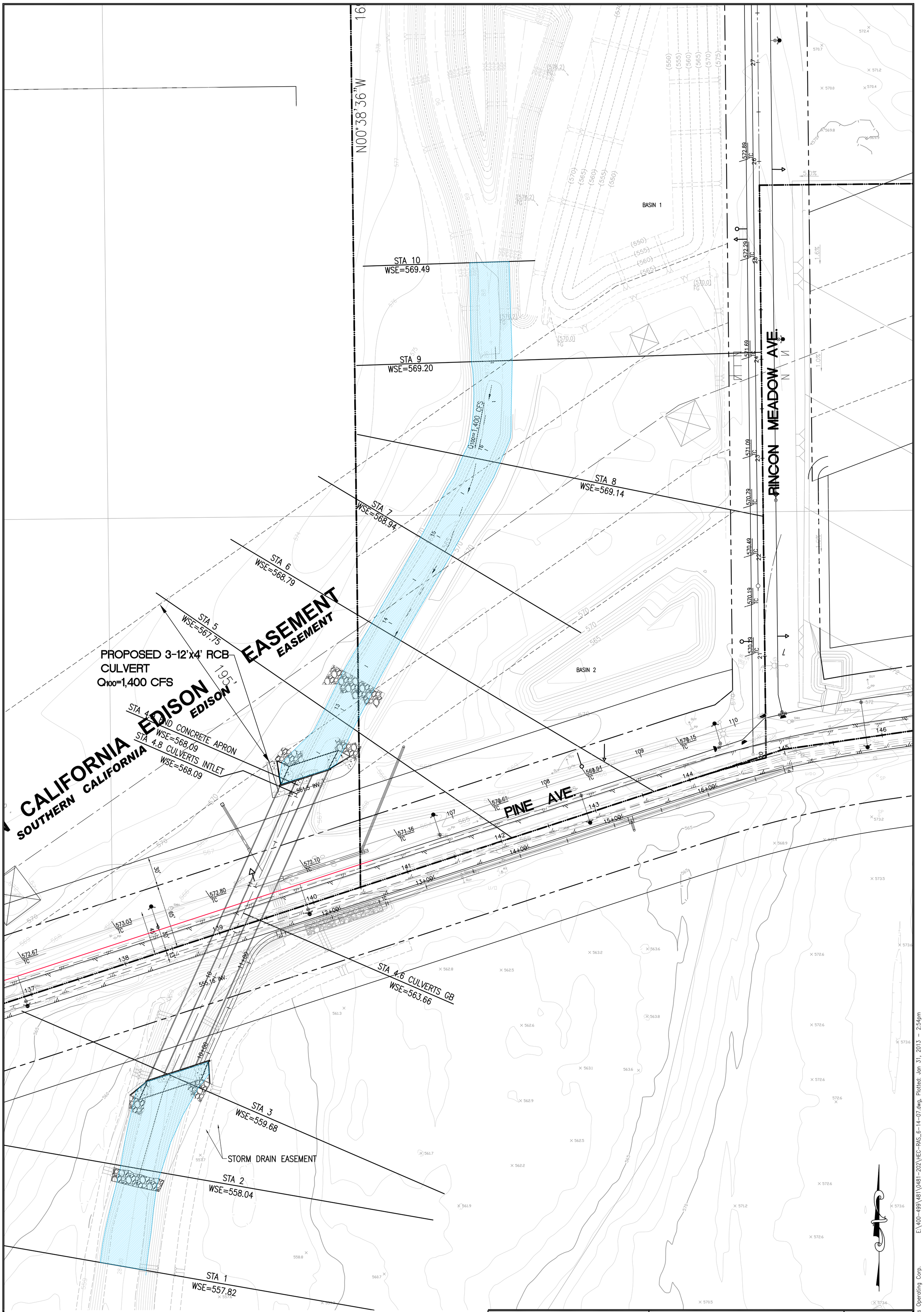


```
******************************************************************************************************************************************* ********
         | Invert  |  Depth  |  Water  |    Q    |  Vel     Vel  |  Energy | Super |Critical|Flow Top|Height/|Base Wt|      |No Wth
 Station |  Elev   |  (FT)   |  Elev   |  (CFS)  | (FPS)    Head |  Grd.El.|  Elev | Depth  | Width  |Dia.-FT|or I.D.|  ZL  |Prs/Pip
       -|-       -|-       -|-       -|-       -|-      -|-       -|-      -|-       -|-       -|-       -|-      -|-    -|
 L/Elem  |Ch Slope |         |         |         |         |  SF Ave|    HF   |SE Dpth|Froude N|Norm Dp |  "N"  | X-Fall|  ZR  |Type Ch
********|*********|********|********|********|*******|*******|********|*******|********|********|*******|*******|*****|*******
         |         |         |         |         |         |         |         |         |         |         |         |         |         |
 1222.000   561.600    3.525   565.125   1277.00   10.65    1.76   566.89     .00    3.53   36.00    4.000   36.000   .00   2  1.0
       -|-       -|-       -|-       -|-       -|-      -|-       -|-       -|-       -|-       -|-       -|-      -|-       |-
 WALL  ENTRANCE
         |         |         |         |         |         |         |         |         |         |         |         |         |         |
 1222.000   561.600    6.168   567.768   1277.00    3.98     .25   568.01     .00    2.66   52.00    7.700   52.000   .00   0   .0
       -|-       -|-       -|-       -|-       -|-      -|-       -|-       -|-       -|-       -|-       -|-      -|-       |-
TRANS STR   .0380                                                            6.17     .28           .033      .00   .00  RECTANG
         |         |         |         |         |         |         |         |         |         |         |         |         |         |
 1297.000   564.450    4.316   568.766   1277.00   10.33    1.66   570.42     .00    4.32   37.26    8.000   20.000  2.00   0   .0
       -|-       -|-       -|-       -|-       -|-      -|-       -|-       -|-       -|-       -|-       -|-      -|-       |-
    1.039    .0013                                          .0107      .01     4.32    1.00    7.62    .033       .00  2.00  TRAP
         |         |         |         |         |         |         |         |         |         |         |         |         |         |
 1298.039   564.451    4.477   568.928   1277.00    9.85    1.51   570.44     .00    4.32   37.91    8.000   20.000  2.00   0   .0
       -|-       -|-       -|-       -|-       -|-      -|-       -|-       -|-       -|-       -|-       -|-      -|-       |-
    3.533    .0013                                          .0094      .03     4.48     .94    7.62    .033       .00  2.00  TRAP
```

```
         |         |       |         |         |         |       |       |       |       |       |       |
1301.572   564.456   4.642   569.098   1277.00    9.39    1.37   570.47     .00    4.32    38.57    8.000   20.000  2.00   0   .0
       -|-       -|-     -|-       -|-       -|-     -|-     -|-      -|-     -|-     -|-      -|-     -|-     -|-     -|-
   6.691    .0013                                        .0082     .05    4.64     .88    7.62    .033     .00  2.00  TRAP
         |         |       |         |         |         |       |       |       |       |       |       |
1308.263   564.465   4.813   569.277   1277.00    8.96    1.25   570.52     .00    4.32    39.25    8.000   20.000  2.00   0   .0
       -|-       -|-     -|-       -|-       -|-     -|-     -|-      -|-     -|-     -|-      -|-     -|-     -|-     -|-
  10.693    .0013                                        .0072     .08    4.81     .83    7.62    .033     .00  2.00  TRAP
         |         |       |         |         |         |       |       |       |       |       |       |
1318.956   564.479   4.988   569.467   1277.00    8.54    1.13   570.60     .00    4.32    39.95    8.000   20.000  2.00   0   .0
       -|-       -|-     -|-       -|-       -|-     -|-     -|-      -|-     -|-     -|-      -|-     -|-     -|-     -|-
  15.785    .0013                                        .0063     .10    4.99     .78    7.62    .033     .00  2.00  TRAP
         |         |       |         |         |         |       |       |       |       |       |       |
1334.742   564.500   5.169   569.669   1277.00    8.14    1.03   570.70     .00    4.32    40.68    8.000   20.000  2.00   0   .0
       -|-       -|-     -|-       -|-       -|-     -|-     -|-      -|-     -|-     -|-      -|-     -|-     -|-     -|-
    .258    .0013                                        .0058     .00    5.17     .73    7.62    .033     .00  2.00  TRAP
         |         |       |         |         |         |       |       |       |       |       |       |
1335.000   564.500   5.172   569.672   1277.00    8.14    1.03   570.70     .00    4.32    40.69    8.000   20.000  2.00   0   .0
       -|-       -|-     -|-       -|-       -|-     -|-     -|-      -|-     -|-     -|-      -|-     -|-     -|-     -|-
  27.778    .0012                                        .0045     .13    5.17     .73    7.48    .030     .00  2.00  TRAP
```



```
*************************************************************************************************************************************** ********
         | Invert  |  Depth |  Water  |    Q    |  Vel     Vel  |  Energy | Super |Critical|Flow Top|Height/|Base Wt|       |No Wth
 Station |  Elev   |  (FT)  |  Elev   |  (CFS)  | (FPS)    Head |  Grd.El.|  Elev |  Depth |  Width |Dia.-FT|or I.D.|  ZL   |Prs/Pip
       -|-       -|-      -|-       -|-       -|-     -|-      -|-     -|-      -|-      -|-      -|-     -|-    -|
 L/Elem  |Ch Slope |        |         |         |       SF Ave|    HF   |SE Dpth|Froude N|Norm Dp |  "N"  | X-Fall|  ZR   |Type Ch
*********|*********|********|*********|*********|*******|*******|*********|*******|********|********|*******|*******|*****  |*******
         |         |        |         |         |       |       |         |       |        |        |       |       |       |
1362.778   564.532   5.359   569.891   1277.00    7.76     .93   570.83     .00    4.32    41.43    8.000   20.000  2.00   0   .0
       -|-       -|-     -|-       -|-       -|-     -|-     -|-      -|-     -|-     -|-      -|-     -|-     -|-     -|-
  38.437    .0012                                        .0040     .15    5.36     .69    7.48    .030     .00  2.00  TRAP
         |         |       |         |         |         |       |       |       |       |       |       |
1401.214   564.577   5.551   570.128   1277.00    7.40     .85   570.98     .00    4.32    42.20    8.000   20.000  2.00   0   .0
       -|-       -|-     -|-       -|-       -|-     -|-     -|-      -|-     -|-     -|-      -|-     -|-     -|-     -|-
  52.526    .0012                                        .0035     .18    5.55     .64    7.48    .030     .00  2.00  TRAP
         |         |       |         |         |         |       |       |       |       |       |       |
1453.741   564.639   5.749   570.387   1277.00    7.05     .77   571.16     .00    4.32    42.99    8.000   20.000  2.00   0   .0
       -|-       -|-     -|-       -|-       -|-     -|-     -|-      -|-     -|-     -|-      -|-     -|-     -|-     -|-
  71.533    .0012                                        .0030     .22    5.75     .61    7.48    .030     .00  2.00  TRAP
         |         |       |         |         |         |       |       |       |       |       |       |
1525.274   564.722   5.952   570.675   1277.00    6.72     .70   571.38     .00    4.32    43.81    8.000   20.000  2.00   0   .0
       -|-       -|-     -|-       -|-       -|-     -|-     -|-      -|-     -|-     -|-      -|-     -|-     -|-     -|-
  57.846    .0012                                        .0027     .16    5.95     .57    7.48    .030     .00  2.00  TRAP
         |         |       |         |         |         |       |       |       |       |       |       |
1583.120   564.790   6.083   570.873   1277.00    6.53     .66   571.53     .31    4.32    44.33    8.000   20.000  2.00   0   .0
       -|-       -|-     -|-       -|-       -|-     -|-     -|-      -|-     -|-     -|-      -|-     -|-     -|-     -|-
  59.880    .0012                                        .0025     .15    6.39     .55    7.48    .030     .00  2.00  TRAP
         |         |       |         |         |         |       |       |       |       |       |       |
1643.000   564.860   6.197   571.057   1277.00    6.36     .63   571.69     .00    4.32    44.79    8.000   20.000  2.00   0   .0
       -|-       -|-     -|-       -|-       -|-     -|-     -|-      -|-     -|-     -|-      -|-     -|-     -|-     -|-
  46.240    .0013                                        .0024     .11    6.20     .53    7.29    .030     .00  2.00  TRAP
         |         |       |         |         |         |       |       |       |       |       |       |
1689.240   564.920   6.266   571.186   1277.00    6.27     .61   571.80     .00    4.32    45.06    8.000   20.000  2.00   0   .0
       -|-       -|-     -|-       -|-       -|-     -|-     -|-      -|-     -|-     -|-      -|-     -|-     -|-     -|-
```



GRAPHIC SCALE

40 0 20 40 80 160

(IN FEET)
1 inch = 40 ft.

L.D. KING, INC.
2151 CONVENTION CENTER WAY
SUITE 100
ONTARIO, CA 91764
(909) 937-0200

CHANNEL/CULVERT HYDRAULIC ANALYSIS FOR PROPOSED CONDITION

PROJECT NO.

SHEET 1 OF 1

JN 481125 Lewis Operating Corp. E:\400-499\481\0481-202\HEC-RAS_6-14-07.dwg, Plotted: Jan 31, 2013 - 2:54pm

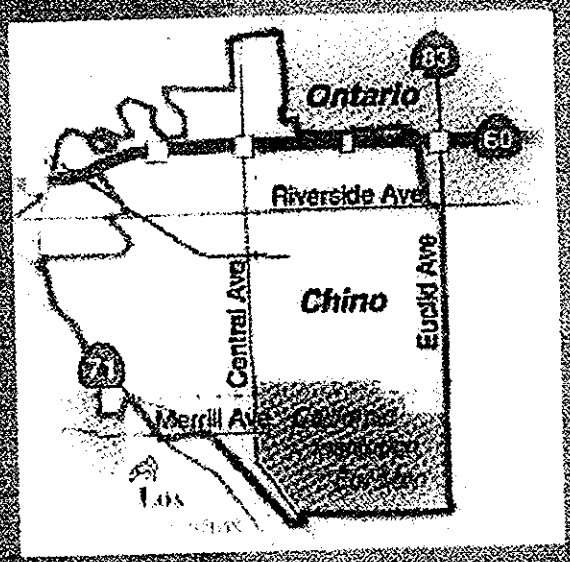
Master Plan of Drainage – Subarea 2 – Chino Agricultural Preserve Area

Master Plan of Drainage

Subarea 2

Chino Sphere of Influence

Chino Agricultureal Preserve Area



Berryman & Hernigar

October 2003

MASTER PLAN OF DRAINAGE

CITY OF CHINO, CALIFORNIA

Prepared for:

CITY OF CHINO

PUBLIC WORKS DEPARTMENT

13220 Central Avenue

Chino, California 91710

Prepared by:

Berryman & Henigar, Inc.

2001 E. First Street

Santa Ana, California 92705

(714) 568-7300

Under the supervision of:

REGISTERED PROFESSIONAL ENGINEER
MOHAMMED NAJIEB KHAN ROWTHER
37127
EXP. DATE 6/30/04
CIVIL
STATE OF CALIFORNIA

CITY OF CHINO
PUBLIC WORKS/ENGINEERING
OCT 2 2003

Mohammed N.K. Rowther

Mohammed N.K. Rowther

10/20/03

Date

TABLE OF CONTENTS

PAGE

INTRODUCTION 1

STUDY AREA 1

LAND USE 3

HYDROLOGIC CRITERIA 3

HYDRAULIC CRITERIA 3

OFF-SITE FLOWS 6

DRAINAGE BASINS 6

RECOMMENDED BACKBONE FACILITIES 8

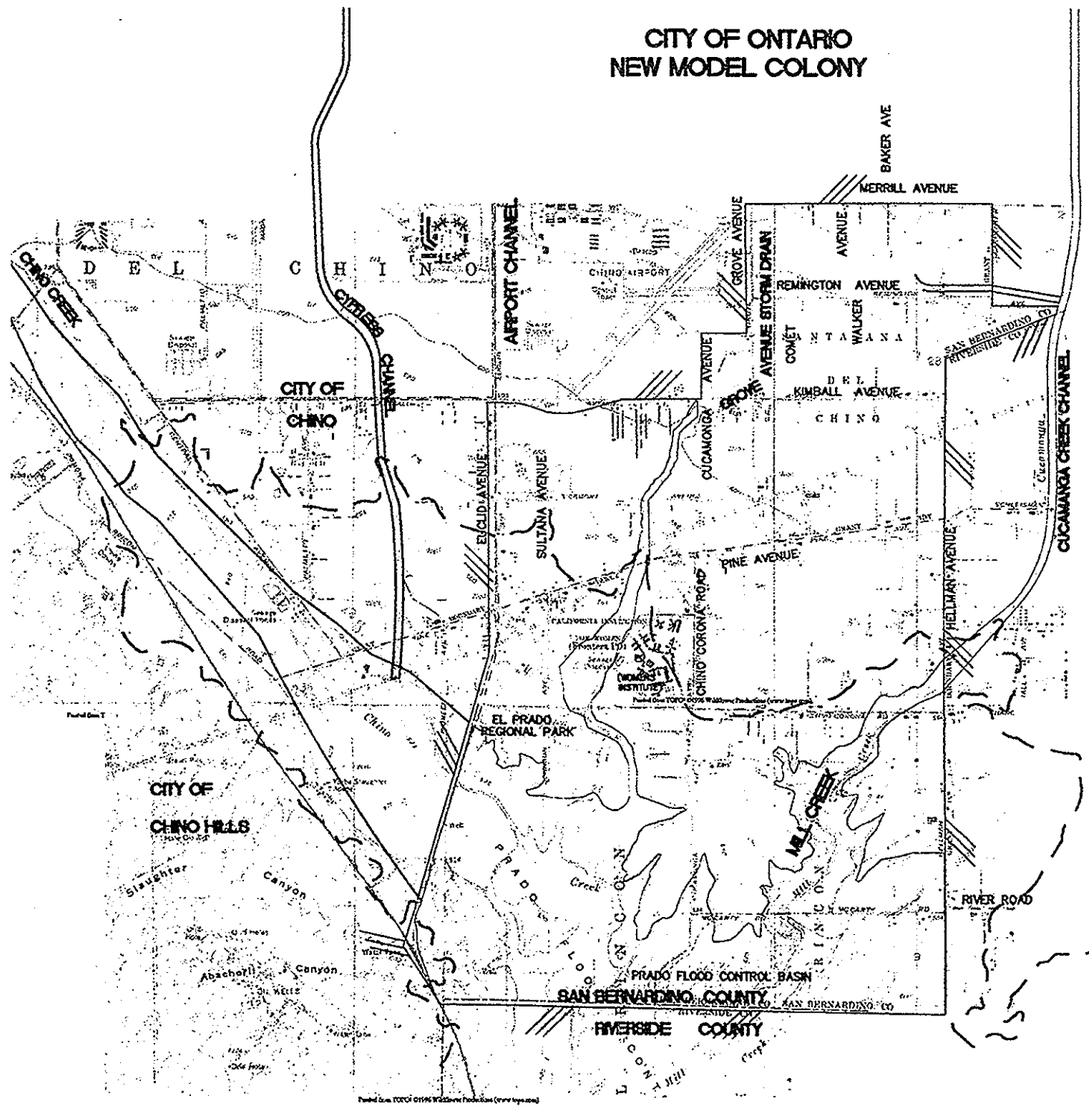
COST ESTIMATES 10

APPENDIX A
BASIN HYDROLOGY MAPS

APPENDIX B
FACILITY DATA SUMMARY TABLE

APPENDIX C
CAPITAL COST ESTIMATES

APPENDIX D
ISOHYETAL MAPS



N.T.S.

LEGEND

566' CONTOUR

STUDY AREA

Berryman & Henigar	CHINO AGRICULTURAL PRESERVE AREA CITY OF CHINO SPHERE OF INFLUENCE - SUBAREA 2	CITY OF CHINO
	MASTER PLAN OF DRAINAGE	STUDY AREA MAP

FIGURE NO. 1

P:\15653\DWG\SHEET\5653MASPL.dwg 03/02/2001 12:09:31 PM PST

MASTER PLAN OF DRAINAGE
CITY OF CHINO'S SPHERE OF INFLUENCE – SUBAREA 2
CHINO AGRICULTURAL PRESERVE
FINAL REPORT

INTRODUCTION

As a part of the planning process for the implementation of infrastructure facilities needed for the development of the Chino Agricultural Preserve Area, the City has authorized *Berryman & Henigar* to prepare this Master Plan of Drainage Study and Report of City of Chino's Sphere of Influence – Subarea 2.

This Report presents type, sizes, alignments and cost estimates for recommended backbone drainage facilities required to support full built-out condition of the Study Area.

STUDY AREA

As shown in Figure 1, the Study Area is comprised of the area within the City of Chino's Sphere of Influence (Subarea 2) of the Chino Agricultural Preserve. It is located in the southwest corner of the County of San Bernardino, and is bounded by Euclid Avenue in the City of Chino to the west, County of Riverside to the south and east, and Chino Airport and the City of Ontario's New Model Colony to the north.

The Study Area encompasses approximately 8.5 square miles (5,435.33 acres) of agricultural and open space property adjacent to Cucamonga Creek Channel, and upstream of the U.S. Army Corp of Engineers' Prado Flood Control Basin. The ground surface in this area generally slopes from north to south, with over half (approximately 4.5 square miles) the Study Area lying below the 566' High Water Elevation of the Prado Basin, and therefore within the impoundment area of the Prado Dam.

There is a partially improved storm drain that extends north through the Study Area as an unimproved natural watercourse from the Prado Basin to the outlet of Grove Avenue Storm Drain, located north of Kimball Avenue and west of Grove Avenue. The storm drain then extends north across the Chino Airport Runway as a 10' (wide) x 6' (high) double barrel reinforced box (RCB), thence as a trapezoidal concrete channel across the airport property to Merrill Avenue.

LAND USE

The study is based on ultimate built-out condition of the approved land use plan shown in Figure 2, Land Use Map.

HYDROLOGIC CRITERIA

This master plan study has been prepared in conformance with the hydrological procedures and standards set forth in the San Bernardino County Hydrology Manual, 1986 Revision (Manual).

Based on the size of each tributary drainage area, the Rational Method or the Unit Hydrograph method was used to calculate the peak runoff at each concentration node. The 100 year frequency storm events were used to determine design peak flows for sizing drainage facilities.

Surface characteristics of pervious areas were based on ultimate development (built-out according to land use maps), having good urban covers (well landscaped), and an average antecedent moisture condition (AMC) II.

Point rainfall data was based on the Isohyetal Maps for Valley Areas, provided in the San Bernardino County Hydrology Manual, 1986 Revision (Manual).

HYDRAULIC CRITERIA

The hydraulic criteria outlined in this section are to be used as a guide to be followed for the final design of storm drain facilities in the Study Area. This criteria has been used to the extent applicable in this master plan study.

1. Hydraulic calculations shall be in accordance with "Los Angeles County Flood Control District Design Manual, Hydraulic", dated March 1982.

2. Closed conduits may be designed as flowing full and may be allowed to flow under pressure if the hydraulic grade line is sufficiently below the ground surface to intercept flows with a minimum freeboard at the catch basin of six (6) inches below the gutter flow lines.

3. Where debris may be expected, the design flows shall be increased by an appropriate bulking factor.

4. The velocity in pipe shall not exceed forty (40) feet per second (fps). For velocities from twenty (20) to thirty (30) fps, the minimum concrete cover over the reinforcing steel in the pipe shall be one-half (1/2) inch greater than the normal cover (1 1/2 inches minimum). For velocities from thirty (30) to forty (40) fps, the minimum concrete cover over the reinforcing steel in the pipe shall be one (1) inch greater than the normal cover (2 inches minimum).

5. Minimum spacing between manholes shall be follows:

   a. For conduit thirty (30) inches or smaller, manholes shall be spaced at intervals of approximately three hundred (300) feet. Where the proposed pipe is less than thirty (30) inches in diameter and the horizontal alignment has numerous bends or angle points, the manhole spacing shall be reduced to approximately two hundred (200) feet.

   b. For conduit diameter greater than thirty (30) inches but smaller than forty five (45) inches, manholes shall be spaced at intervals of approximately four hundred (400) feet.

   c. For conduit diameter forty-five (45) inches or larger, manholes shall be spaced at maximum intervals of five hundred (500) feet.

6. Pressure manhole shaft and pressure frame and cover shall be used whenever the water surface in the storm drain can potentially exceed one (1) foot above top of the manhole cover.

7. All manholes and catch basins covers located within the impoundment area of the Prado Basin, below the 566' elevation, shall be securely bolted to the manhole frame.

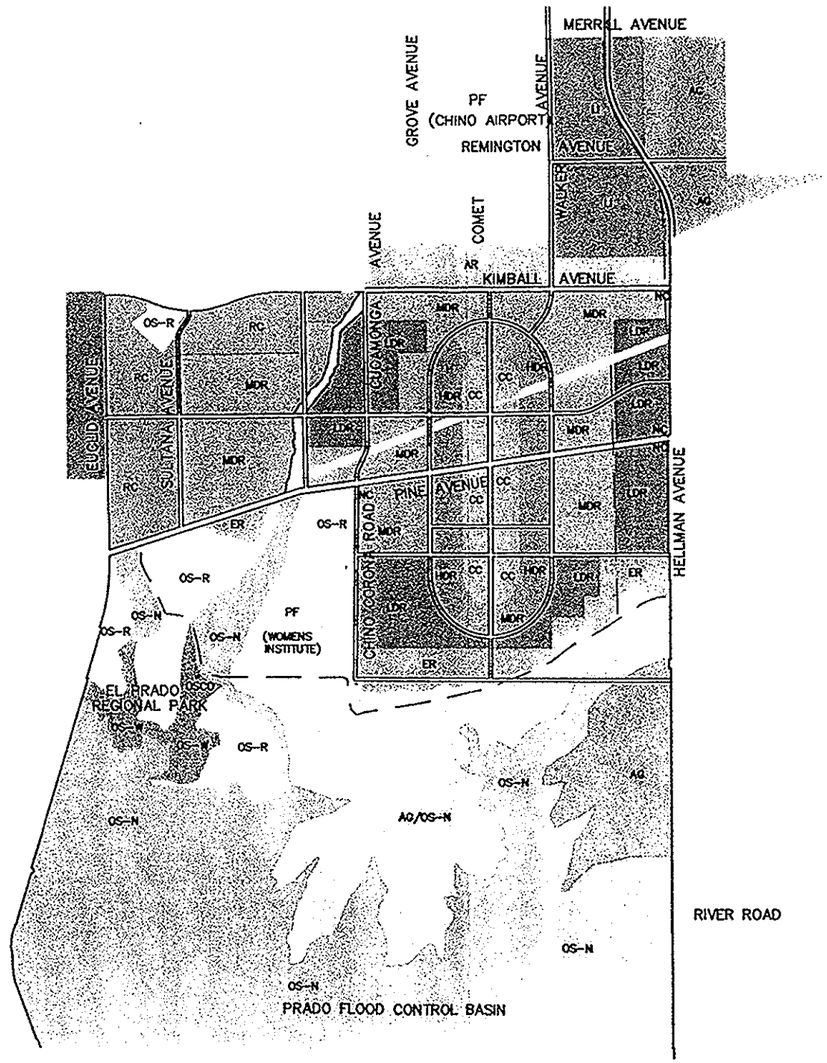
8. The minimum diameter of mainlines and lateral drains shall be 24 inches, and catch basin connector pipe shall be eighteen (18) inches. In cases where the pipe may carry significant amounts of debris, the minimum diameter of mainline pipes shall be thirty-six (36) inches.

9. For storm drains that outlet into earthen channels, outlet structures shall be provided to prevent erosion and property damage. Velocity of flow at the outlet should agree as closely as possible with the existing channel velocity. When the discharge velocity is low or sub-critical, the outlet structures shall consist of a headwall, wing-walls, and apron. When the

discharge velocity is high or supercritical, an appropriate energy dissipater and bank protection structure shall be designed in the vicinity of the outlet.

10. If development occurs in the upstream areas prior to construction of the downstream storm drain facilities, local detention basin should be implemented to handle the additional flows generated from such development. The detention basins shall be designed to retard the discharge from the developing property to 80% of the peak flows calculated for pre-development conditions, and remain operational until full construction of the downstream storm drain facilities.

SCALE: 1'=3000'



LEGEND

- ER – ESTATE RESIDENTIAL
- LDR – LOW DENSITY RESIDENTIAL
- MDR – MEDIUM DENSITY RESIDENTIAL
- HDR – HIGH DENSITY RESIDENTIAL
- NC – NEIGHBORHOOD COMMERCIAL
- RC – REGIONAL COMMERCIAL
- CC – COMMUNITY CORE
- LI – LIGHT INDUSTRIAL
- AR – AIRPORT RELATED
- PF – PUBLIC FACILITY
- OS–R – OPEN SPACE–RECREATION
- OS–N – OPEN SPACE–NATURAL
- OS–W – OPEN SPACE–WATER
- AG – AGRICULTURE
- AG/OS–N AGRICULTURE AND OPEN SPACE–NATURAL
- PROPOSED STREETS

Berryman & Henigar

CHINO AGRICULTURAL PRESERVE AREA
CITY OF CHINO SPHERE OF INFLUENCE–SUBAREA 2

MASTER PLAN OF DRAINAGE

CITY OF CHINO

LAND USE MAP

FIGURE NO. 2

P:\15653\DWG\SHEET\5653LDUSE-SD.dwg 03/02/2001 12:29:16 PM PST

discharge velocity is high or supercritical, an appropriate energy dissipater and bank protection structure shall be designed in the vicinity of the outlet.

OFF-SITE FLOWS

Storm water runoff from the City of Ontario enters the Study Area from the north. Ultimate 100-year storm runoff hydrographs for Ontario's master planned storm drains, per Ontario's Master Plan of Drainage for New Model Colony prepared by L.D. King, Inc., have been incorporated in this study for conveyance to downstream regional drainage facilities. Ontario's master planned storm drains enter the Study Area at three locations as follows:

1. LINE "A": A 14'(wide) x 8'(high) RC Box storm drain is proposed to enter the Study Area at the intersection of Merrill Avenue and Baker Avenue, conveying storm runoff from approximately 1,362 acres with a peak flow of 1,620 cfs.

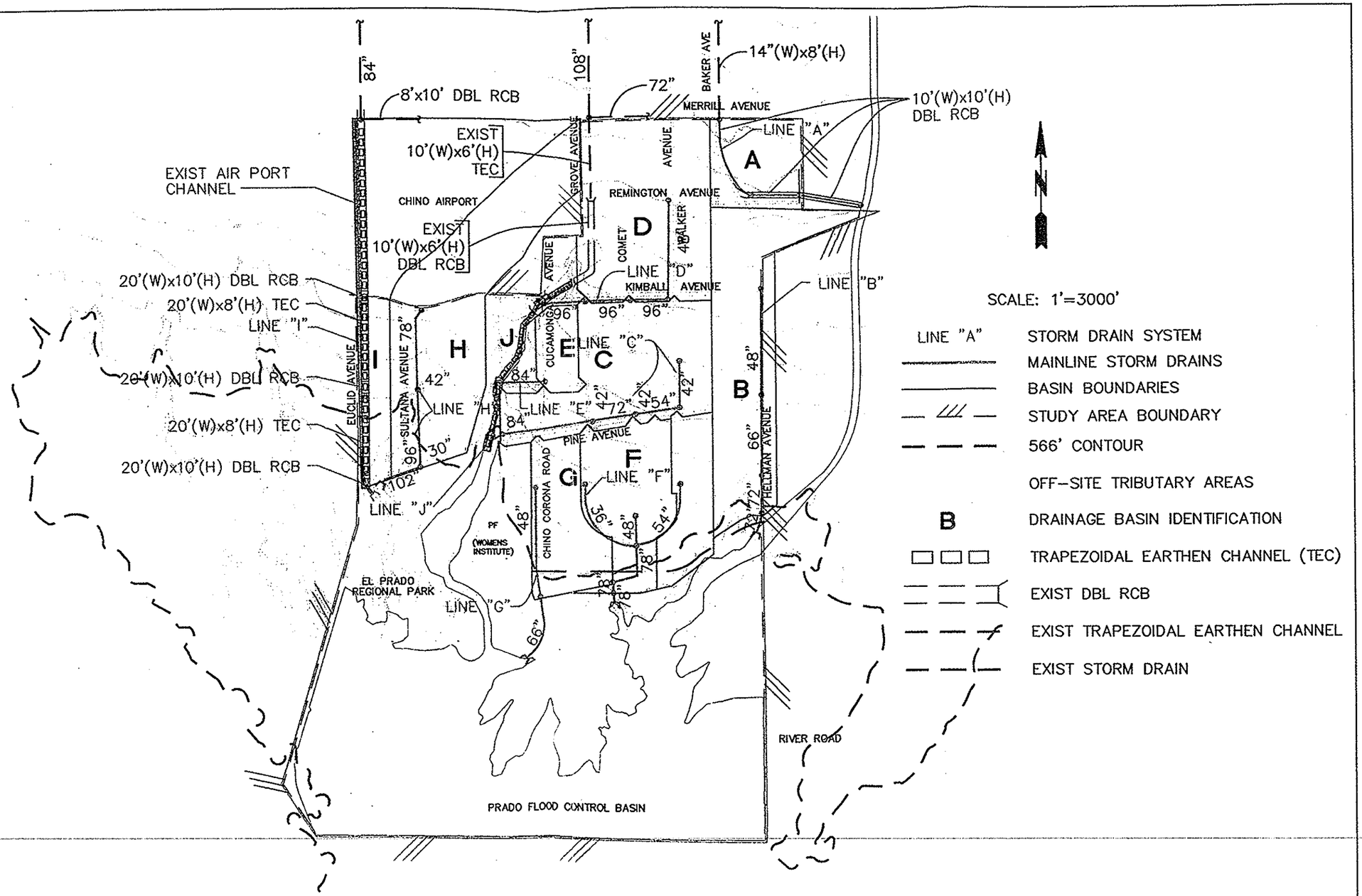
2. LINE "B": A 108" RCP storm drain in Grove Avenue, with a 72" RCP lateral storm drain in Merrill Avenue, is proposed to drain to the existing 10'(wide) x 6'(high) TEC Grove Avenue Storm Drain Channel. This storm drain system will have a peak design flow of 1,214 cfs as it enters the Study Area, with a tributary drainage area of approximately 1,367 acres.

3. LINE "C": A 10'(wide) x 8'(high) RC Box storm drain in Merrill Avenue and an 84" RCP storm drain in Euclid Avenue are proposed to confluence and drain to the existing Airport Channel along Euclid Avenue. This storm drain system will have a peak design flow of 1,443 cfs as it enters the City of Chino, with a tributary drainage area of approximately 1,840 acres. The Airport Channel enters the Study Area at the intersection of Euclid Avenue and Kimball Avenue with a peak flow of 1,846 cfs and a tributary drainage area of 2,277 acres.

DRAINAGE BASINS

Based on the flow pattern of surface runoff, the developable portions of the Study Area have been divided into ten (10) Drainage Basins, as shown in Figure 3, Basin Boundary Map. Each Drainage Basin is tributary to a Recommended Storm Drain System identified as Lines A through J.

The Drainage Basins have been sub-divided into Sub-Basins with concentration nodes to facilitate flow calculations and sizing of the storm drain facilities.



Berryman & Henigar

CHINO AGRICULTURAL PRESERVE AREA
CHINO SPHERE OF INFLUENCE - SUBAREA 2

MASTER PLAN OF DRAINAGE

CITY OF CHINO

BASIN BOUNDARY MAP

FIGURE NO. 3

P:\15653\DWG\SHEET\5653SD01.dwg 03/02/2001 12:56:18 PM PST

RECOMMENDED BACKBONE FACILITIES

Facility sizes, along with tributary acreage and peak flow rates at concentration nodes along each storm drain "Line" are presented in Figures 4, 5, 6, and 7, included in Appendix A of this report.

Sizes of recommended storm drains have been based on preliminary hydraulic calculations of friction losses (major losses) in the mainline conduits. The hydraulic gradients of the conduits were set to be at maximum of 85% of design slope, which was assumed to parallel existing average ground elevations at concentration nodes. The 15% available capacity of the hydraulic gradient is to provide for minor losses at junctions, manholes, transitions and bends. Summary of hydraulic data for the proposed facility is presented in Table 1, FACILITY DATA SUMMARY TABLE, included in Appendix B of this report.

LINE "A":

Storm Drain Line "A" is essentially an extension of City of Ontario's master planned Storm Drain " WALK-A1", which runs south in Walker Avenue through New Model Colony to Subarea 2. With Ontario's planned realignment of Walker Avenue and Merrill Avenue, and Chino's planned realignment of Hellman Avenue between Kimball Avenue and Merrill Avenue, Walker Avenue and Hellman Avenue will be aligned across their intersection with Merrill Avenue.

Line "A" is proposed to start at the terminus of Ontario's planned storm drain "WALK-A1" at Merrill Avenue, and run south in the proposed new alignment of Hellman Avenue from Merrill Avenue to Remington Avenue; thence turn east along Remington Avenue to the Cucamonga Creek Channel. This storm drain system will convey storm runoff from approximately 162 acres of Drainage Basin A of Subarea 2, and runoff from approximately 1,480 acres of the City of Ontario.

LINE "A" is comprised of approximately 6,000 feet of 10' x 10' double-barrel RCB with a total Capital Cost estimated at $13.55 million for City of Ontario.

LINE "B":

Storm Drain Line "B" will convey stormwater runoff from approximately 286 acres of Drainage Basin B and approximately 86 acres of off-site area from Riverside County. Drainage Basin B covers the area south of Remington Avenue between Baker Avenue and the San Bernardino/Riverside County Line

Line "B" is comprised of approximately 7,100 linear feet of 48 to 72 inch RCP storm drain in Hellman Avenue that extends from Kimball Avenue to Mill Creek in

the Prado Basin. The total Capital Cost for this storm drain system is estimated at $3.35 million for City of Chino.

LINE "C", LINE "D" and LINE "E":

Storm Drain Lines "C", "D" and "E" are proposed storm drain systems serving portions of the Study Area bounded by Grove Avenue, Merrill Avenue, Baker Avenue and Pine Avenue. These storm drain systems convey stormwater flows in Pine Avenue, Bickmore Avenue and Kimball Avenue westerly to the watercourse downstream of Grove Avenue Storm Drain.

Line "C" is comprised of approximately 9,850 feet of 42 to 90 inch RCP mainline and lateral storm drains with an estimated Project Capital Cost of $4.92 million for City of Chino.

Line "D" is comprised of approximately 6,700 feet of 48 to 96 inch RCP mainline and lateral storm drains with an estimated Project Capital Cost of $3.8 million for City of Chino

Line "E" is approximately 1,450 feet of 48 inch RCP storm drain in Bickmore Avenue with an estimated Project Capital Cost of $0.6 million for City of Chino.

LINE "F" and LINE "G":

Storm Drain Lines "F" and "G" are storm drain systems proposed to service the developable portions of the Study Area that lie to the south of Pine Avenue. These storm drains convey tributary flows southerly to the Prado Basin.

Line "F" is comprised of approximately 8,000 feet of 36 to 78 inch RCP mainline and lateral storm drains with an estimated Project Capital Cost of $3.59 million for City of Chino.

Line "G" is approximately 5,100 feet of 48 to 66 inch RCP storm drain in Chino Corona Road with an estimated Project Capital Cost of $2.22 million for City of Chino.

LINE "H":

Storm Drain Line "H" is an approximately 8,400 feet of 30 to 102 inch diameter storm drain system in Pine Avenue, Bickmore Avenue and Sultana Avenue, with an estimated total Capital Cost of $4.95 million for City of Chino. Starting at Kimball Avenue, the proposed storm drain will run south in Sultana Avenue to drain into the natural watercourse south of Pine Avenue, east of Euclid Avenue.

It is tabled to receive flows from an approximately 287 acres area of Chino Airport and 308 acres from Drainage Basin H.

LINE "I":

The existing storm drain system along Euclid Avenue is comprised of an unimproved, under-capacity earthen ditch along the easterly side of the roadway from Pine Avenue to Kimball Avenue in the Study Area, and an improved trapezoidal earthen channel (Airport Channel) in the street right-of-way from Kimball Avenue to Merrill Avenue in the City of Chino.

Three alternative options were evaluated for this drain.

Option 1: An improved earthen trapezoidal channel, downstream from the Airport Channel, from Kimball Avenue to the natural watercourse south of Pine Avenue, with RCB culvert crossings under Kimball Avenue, Bickmore Avenue and Pine Avenue is recommended option. Assuming that the channel could be constructed within the 200-foot wide existing street right-of-way, the estimated Capital Cost for this Option is $2.55 million. Where estimated Capital Cost share for City of Chino and City of Ontario is $ 0.59 million and $1.96 million respectively.

Option 2: A concrete-lined trapezoidal channel from the outlet to Merrill Avenue, with RCB crossings at Kimball Avenue, Bickmore Avenue and Pine Avenue would have a Capital Cost estimate of $6.0 million.

Option 3: An underground RCB storm drain from the outlet to Merrill Avenue would have a total estimated Capital Cost of $6.9 million.

LINE "J":

Storm Drain Line "J" is comprised of improvements to the natural watercourse downstream from the existing Grove Avenue Storm Drain to south of Pine Avenue. Recommended improvements include the construction of approximately 6,000 linear feet of 20' wide x 8' high earthen trapezoidal channel with RCB culvert crossings at Pine Avenue and Bickmore Avenue, at a total estimated Capital Cost of $2.76 million. Where estimated Capital Cost share for City of Chino and City of Ontario is $ 0.91 million and $1.85 million respectively.

COST ESTIMATES

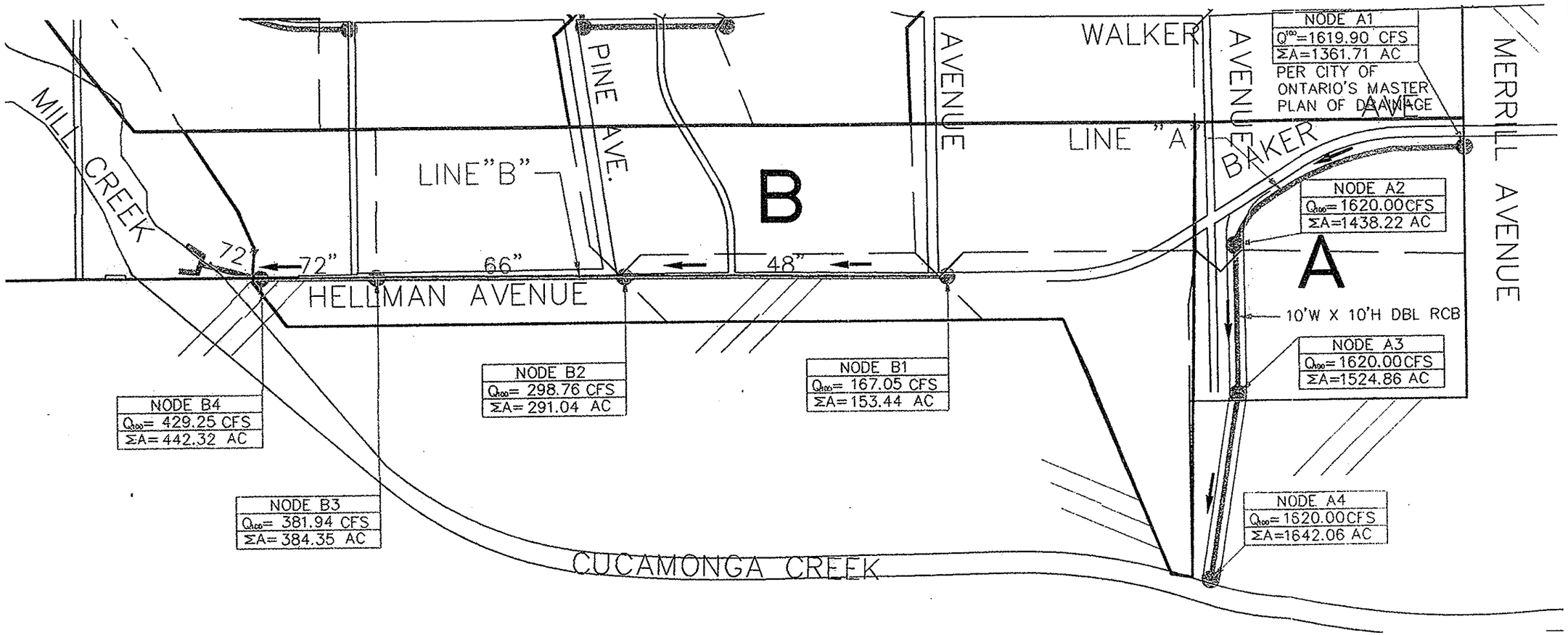
Presented in Appendix C is a detailed breakdown of construction quantities and capital costs for the recommended storm drain systems. Estimates for

construction and project costs have been developed using February 2001 construction costs, based on ENR Construction Cost Index of 6,270, for the recommended storm drain facilities shown on the Basin Hydrology Maps.

The Construction Costs incorporates a contingency of 20% and the Capital Costs includes 10% of Construction Costs for engineering and administration.

APPENDIX A

BASIN HYDROLOGY MAPS



48" MAINLINE STORM DRAINS AND SIZE

BASIN BOUNDARIES

SUB-BASIN BOUNDARIES

566' CONTOUR

STUDY AREA

OFF-SITE TRIBUTARY AREAS

B BASIN IDENTIFICATION

NODE A1
Q100= 111.23 CFS
ΣA= 372.70 AC

CONCENTRATION NODE NO.
DESIGN FLOW
CUMULATIVE WATERSHED AREA

N

SCALE: 1'=1000'

Berryman & Henigar

CHINO AGRICULTURAL PRESERVE AREA
CITY OF CHINO SPHERE OF INFLUENCE - SUBAREA 2

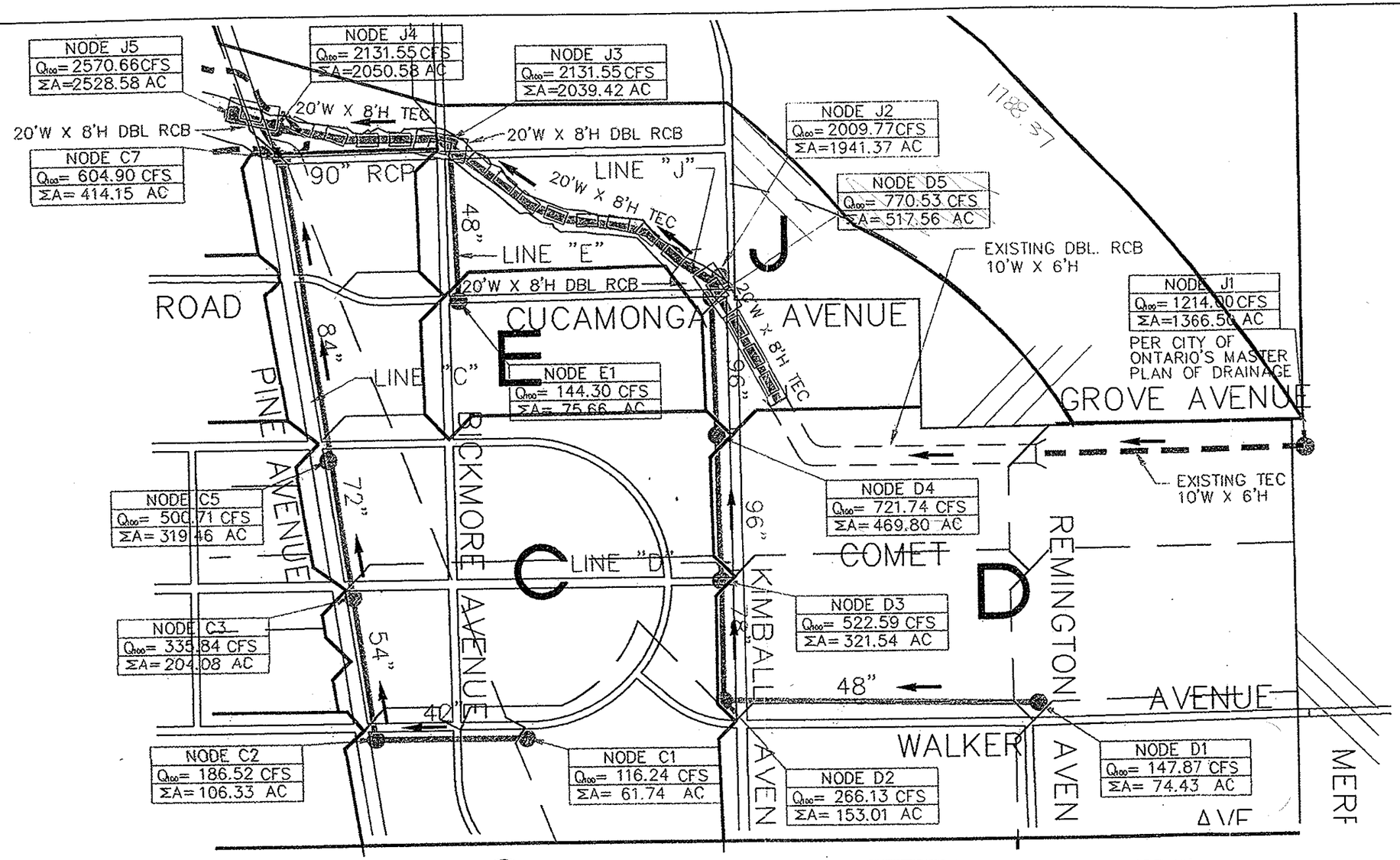
MASTER PLAN OF DRAINAGE

CITY OF CHINO

HYDROLOGY MAP
BASINS A AND B

FIGURE NO. 4

P:\15653\DWG\SHEET\56535D02.dwg 03/09/01 09:48:01 AM PST



48" MAINLINE STORM DRAINS AND SIZE

BASIN BOUNDARIES

SUB-BASIN BOUNDARIES

366' CONTOUR

STUDY AREA

TRAPEZOIDAL EARTHEN CHANNEL (TEC)

CULVERT CROSSING

C BASIN IDENTIFICATION

SCALE: 1'=1000'

NODE C1
Q100= 231.35 CFS
ΣA= 153.01 AC

CONCENTRATION NODE NO.
DESIGN FLOW
CUMULATIVE WATERSHED AREA

OFF-SITE TRIBUTARY AREAS

Berryman & Henigar

CHINO AGRICULTURAL PRESERVE AREA
CHINO SPHERE OF INFLUENCE - SUBAREA 2

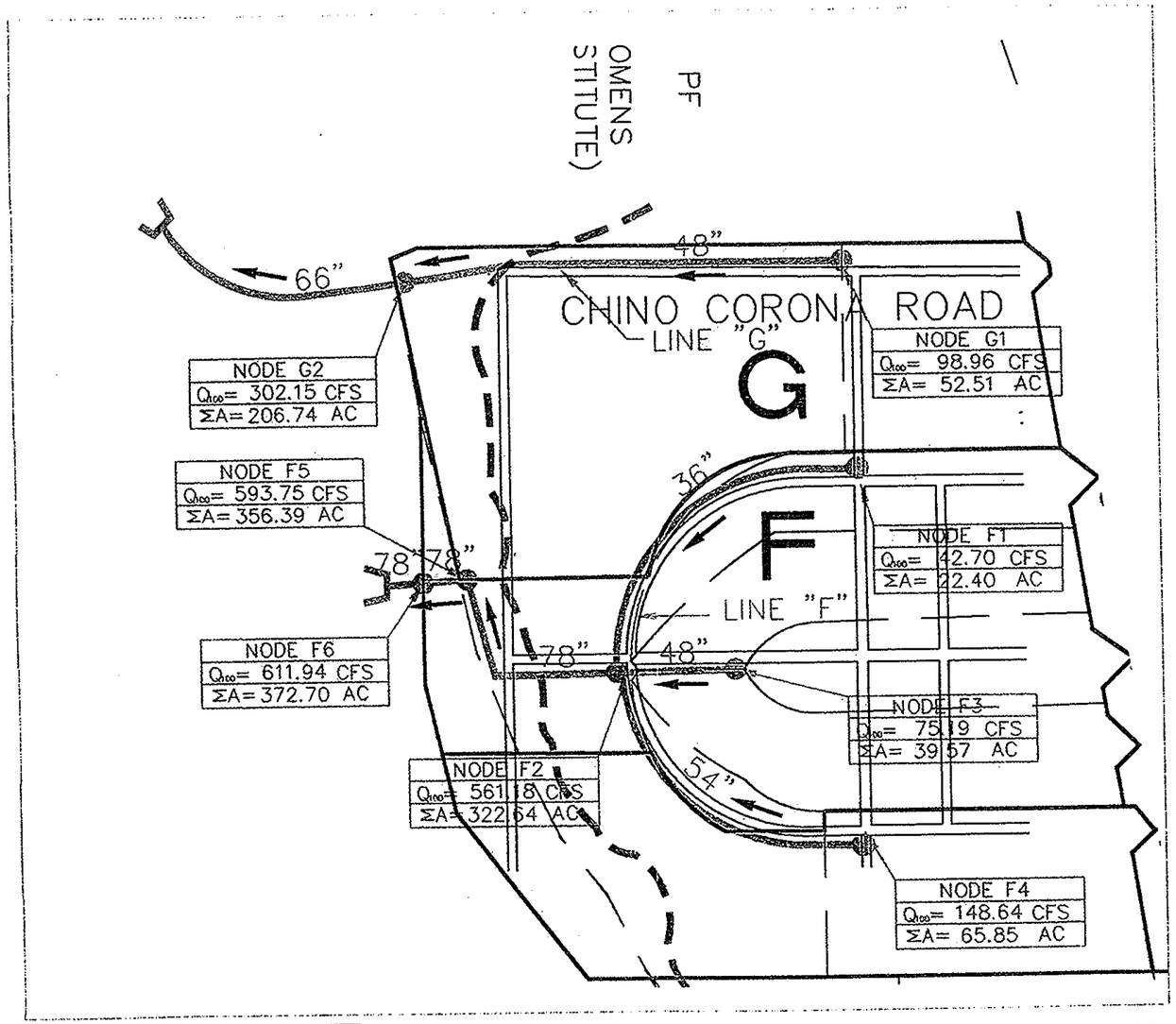
MASTER PLAN OF DRAINAGE

CITY OF CHINO

HYDROLOGY MAP
BASINS C,D, E AND J

FIGURE NO. 5

P:\15653\DWG\SHEET\5653SD03.dwg 03/09/01 02:44:46 PM PST



48" MAINLINE STORM DRAINS AND SIZE

BASIN BOUNDARIES

SUB-BASIN BOUNDARIES

566' CONTOUR

F BASIN IDENTIFICATION

NODE F5	CONCENTRATION NODE NO.
Q_{100}= 368.11 CFS	DESIGN FLOW
ΣA= 356.39 AC	CUMULATIVE WATERSHED AREA

SCALE: 1'=1000'

Berryman & Henigar

CHINO AGRICULTURAL PRESERVE AREA
CITY OF CHINO SPHERE OF INFLUENCE - SUBAREA 2

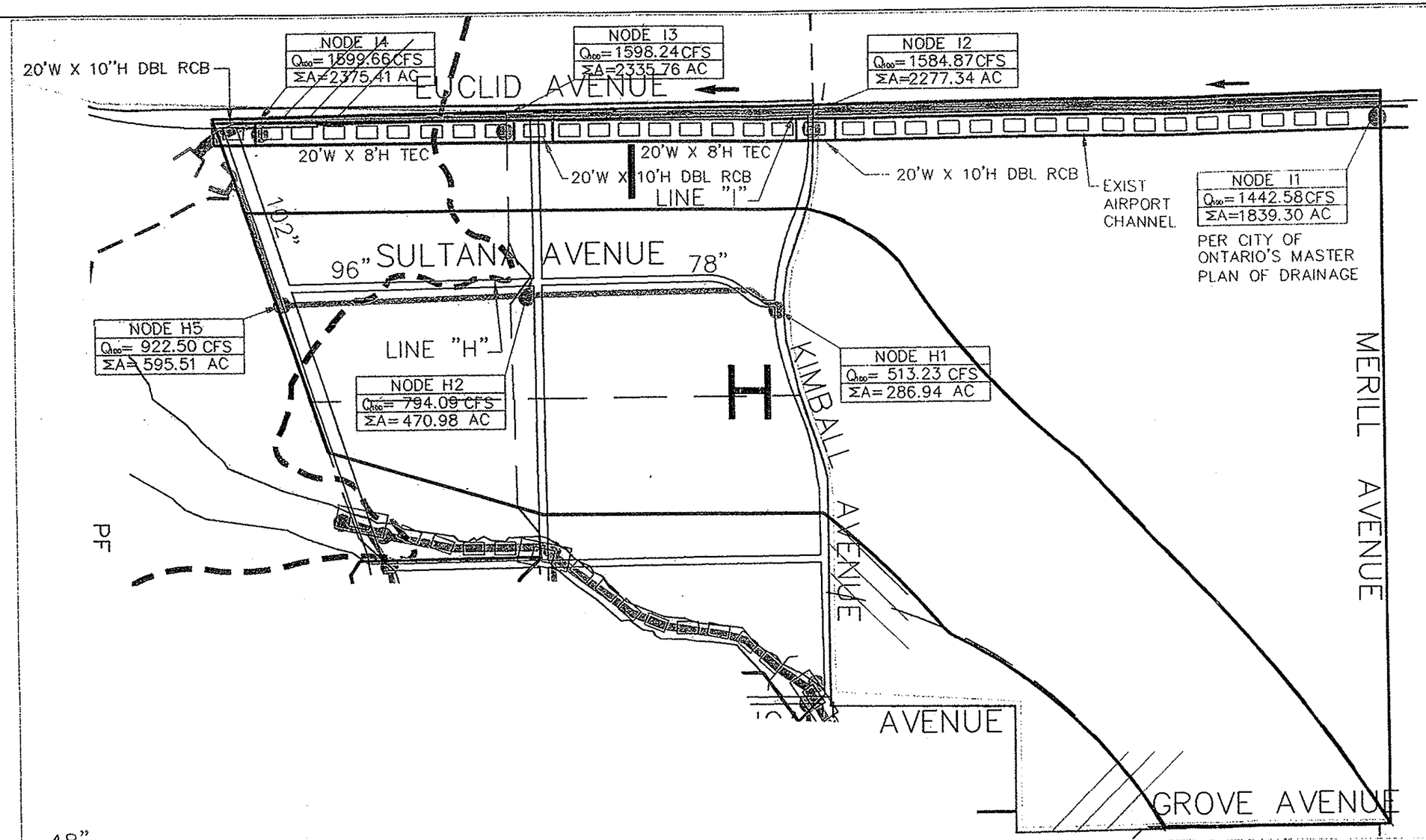
MASTER PLAN OF DRAINAGE

CITY OF CHINO

HYDROLOGY MAP
BASIN F AND G

FIGURE NO. 6

P:\15653\DWG\SHEET\5653SD04.dwg 03/12/2001 01:39:42 PM PST



MAINLINE STORM DRAINS

BASIN BOUNDARIES

SUB-BASIN BOUNDARIES

566' CONTOUR

STUDY AREA

TRAPEZOIDAL EARTHEN CHANNEL (TEC)

CULVERT CROSSING

H BASIN INDENTIFICATION

SCALE: 1'=1000'

NODE H1
Q_{25}= 359 CFS
ΣA= 286.94 AC

CONCENTRATION NODE NO.
DESIGN FLOW
CUMULATIVE WATERSHED AREA

OFF-SITE TRIBUTARY AREAS

Berryman & Henigar

CHINO AGRICULTURAL PRESERVE AREA
CITY OF CHINO SPHERE OF INFLUENCE - SUBAREA 2

MASTER PLAN OF DRAINAGE

CITY OF CHINO

HYDROLOGY MAP
BASIN H AND I

FIGURE NO. 7

P:\15653\DWG\SHEET\5653SD05.dwg 03/07/2001 09:54:06 AM PST

APPENDIX B

FACILITY DATA SUMMARY TABLE

TABLE 1: FACILITY DATA

MASTER PLAN OF DRAINAGE - CHINO SPHERE OF INFLUENCE SUBAREA-2

LINE	NODE		LENGTH	ELEVATION		GROUND	DESIGN	HYDRAULIC	Q10	Q25	Q100	DESIGN	k= Q/Sf^.5	PIPE	BOX SIZE	CHANNEL
	FROM	TO		U/S	D/S	SLOPE	SLOPE	GRADIENT				FLOW		SIZE	DBL. RCB	SIZE
#	#	#	ft	ft	ft	ft/ft	ft/ft	ft/ft	cfs	cfs	cfs	cfs		in	ft X ft	ft X ft
A	Merrill Ave	A1	2800	663	650	0.0046429	0.0021	0.001785			1620	1620	38343.867		10' W X 10' H	
	A1	A2	1400	649	646	0.0021429	0.0021	0.001785			1620	1620	38343.867		10' W X 10' H	
	A2	A3	1800	646	639	0.0038889	0.0021	0.001785			1620	1620	38343.867		10' W X 10' H	
B	B1	B2	3100	628	612	0.0051613	0.01098	0.009333	91	111	159	111	1148.9797	48		
	B2	B3	2400	612	578	0.0141667	0.01098	0.009333	155	192	277	277	2867.2736	66		
	B3	B4	1100	578	570	0.0072727	0.01098	0.009333	193	240	348	348	3602.2065	72		
	B4	OUTLET	500	570	550	0.04	0.01098	0.009333	205	259	382	382	3954.1463	72		
C	C1	C2	1450	610	602	0.0055172	0.0065	0.005525	73	86	110	73	982.10228	42		
	C2	C3	1300	602	595	0.0053846	0.0065	0.005525	116	137	176	137	1843.1235	54		
	C3	C5	1350	595	590	0.0037037	0.0065	0.005525	203	242	314	314	4224.3851	72		
	C5	C7	2700	590	570	0.0074074	0.0065	0.005525	303	361	469	469	6309.6708	84		
	C7	OUTLET	600	570	565	0.0083333	0.0065	0.005525	363	435	567	567	7628.1095	90		
	C4	C3	1200	608	595	0.0108333	0.008	0.006800	58	67	88	58	703.35331	42		
	C6	C5	1250	600	590	0.008	0.008	0.006800	82	96	125	82	994.39606	42		
D	D1	D2	2800	640.5	625	0.0055357	0.005	0.004250	83	97	126	83	1273.1619	48		
	D2	D3	1300	625	620.5	0.0034615	0.003	0.002550	150	177	231	231	4574.4816	78		
	D3	D4	1300	620.5	618	0.0019231	0.003	0.002550	296	349	458	458	9069.7515	96		
	D4	OUTLET	1300	618	610	0.0061538	0.006	0.005100	410	483	636	636	8905.7813	96		
E	E1	E2	1450	580	571	0.0062069	0.0062	0.005270	80	94	124	80	1102.0078	48		

TABLE 1: FACILITY DATA

MASTER PLAN OF DRAINAGE - CHINO SPHERE OF INFLUENCE SUBAREA-2

LINE	NODE		LENGTH	ELEVATION		GROUND	DESIGN	HYDRAULIC	Q10	Q25	Q100	DESIGN	k= Q/Sf^.5	PIPE	BOX SIZE	CHANNEL
	FROM	TO		U/S	D/S	SLOPE	SLOPE	GRADIENT				FLOW		SIZE	DBL. RCB	SIZE
#	#	#	ft	ft	ft	ft/ft	ft/ft	ft/ft	cfs	cfs	cfs	cfs		in	ft X ft	ft X ft
F	F1	F2	2600	577	572	0.0019231	0.002	0.001700	27	32	41	27	654.84619	36		
	F3	F2	900	575	572	0.0033333	0.002	0.001700	44	51	67	44	1067.1568	48		
	F4	F2	2150	582	572	0.0046512	0.002	0.001700	64	76	102	64	1552.228	54		
	F2	F5	1750	572	560	0.0068571	0.006	0.005100	302	357	471	357	4998.9999	78		
	F5	F6	400	560	555	0.0125	0.006	0.005100	310	368	490	368	5153.0307	78		
	F6	OUTLET	200	555	550	0.025	0.006	0.005100	317	377	503	377	5279.0559	78		
G	G1	G2	3300	574.9	565	0.003	0.003	0.002550	58	68	88	58	1148.5711	48		
	G2	OUTLET	1800	565	550	0.0083333	0.003	0.002550	150	184	252	150	2970.4426	66		
H	H1	H2	2500	594	571	0.0092	0.0075	0.006375	307	359	467	359	4496.2904	78		
	H2	H5	2300	571	565	0.0026087	0.0075	0.006375	471	554	721	721	9030.1543	96		
	H5	OUTLET	1200	565	550	0.0125	0.0075	0.006375	541	639	839	839	10508.044	102		
	H3	H2	1200	580	571	0.0075	0.0075	0.006375	70	83	109	70	876.71401	42		
	H4	H5	1200	570	562	0.0066667	0.0066	0.005610	26	32	44	26	347.12982	30		
EARTHEN TRAPEZOIDAL CHANNEL (OPTION 1)																
I	I2	I3	2900	595	574	0.0072414	0.007				1396	1396				20' W X 8' H
	I3	I4	2300	574	559	0.0065217	0.007				1605	1605				20' W X 8' H
	I4	OUTLET	700	559	551	0.0114286	0.007				1621	1621				20' W X 8' H
CONCRETE TRAPEZOIDAL CHANNEL (OPTION 2)																
I	I1	I2	5300	635	595	0.0075472	0.007				1443	1443				20' W X 5' H
	I2	I3	2900	595	574	0.0072414	0.007				1396	1396				20' W X 5' H
I	I3	I4	2300	574	559	0.0065217	0.007				1605	1605				20' W X 5' H
	I4	OUTLET	700	559	551	0.0114286	0.007				1621	1621				20' W X 5' H

TABLE 1: FACILITY DATA

MASTER PLAN OF DRAINAGE - CHINO SPHERE OF INFLUENCE SUBAREA-2

LINE	NODE		LENGTH	ELEVATION		GROUND	DESIGN	HYDRAULIC	Q10	Q25	Q100	DESIGN	k= Q/Sf^.5	PIPE	BOX SIZE	CHANNEL
	FROM	TO		U/S	D/S	SLOPE	SLOPE	GRADIENT				FLOW		SIZE	DBL. RCB	SIZE
#	#	#	ft	ft	ft	ft/ft	ft/ft	ft/ft	cfs	cfs	cfs	cfs		in	ft X ft	ft X ft
REINFORCED CONCRETE BOX (OPTION 3)																
I	I1	I2	5300	635	595	0.0075472	0.007	0.005950			1443	1443	18707.159			20' W X 5' H
	I2	I3	2900	595	574	0.0072414	0.007	0.005950			1396	1396	18097.848			20' W X 5' H
	I3	I4	2300	574	559	0.0065217	0.007	0.005950			1605	1605	20807.34			20' W X 5' H
	I4	OUTLET	700	559	551	0.0114286	0.007	0.005950			1621	1621	21014.765			20' W X 5' H
EARTHEN TRAPEZOIDAL CHANNEL																
J	Exist. RCB	J2	1000	609	602	0.007	0.007				1763	1763				20' W X 8' H
	J2	J3	3200	602	580	0.006875	0.007				1763	1763				20' W X 8' H
	J3	OUTLET	2000	580	566	0.007	0.007				1763	1763				20' W X 8' H

APPENDIX C

CAPITAL COST ESTIMATES

TABLE 1: CAPITAL COST ESTIMATE SUMMARY
MASTER PLAN OF DRAINAGE
CHINO SPHERE OF INFLUENCE- SUBAREA -2

LINE #	CITY OF CHINO CAPITAL COST	CITY OF ONTARIO CAPITAL COST	TOTAL CAPITAL COST
A		$ 13,550,000	$ 13,550,000
B	$ 3,345,320		$ 3,345,320
C	$ 4,921,400		$ 4,921,400
D	$ 3,804,020		$ 3,804,020
E	$ 589,820		$ 589,820
F	$ 3,587,100		$ 3,587,100
G	$ 2,223,100		$ 2,223,100
H	$ 4,953,740		$ 4,953,740
I	$ 587,203	$ 1,965,853	$ 2,553,056
J	$ 910,457	$ 1,848,503	$ 2,758,960
TOTAL COST	$ 24,922,160	$ 17,364,356	$ 42,286,516

CAPITAL COST ESTIMATE

LINE A

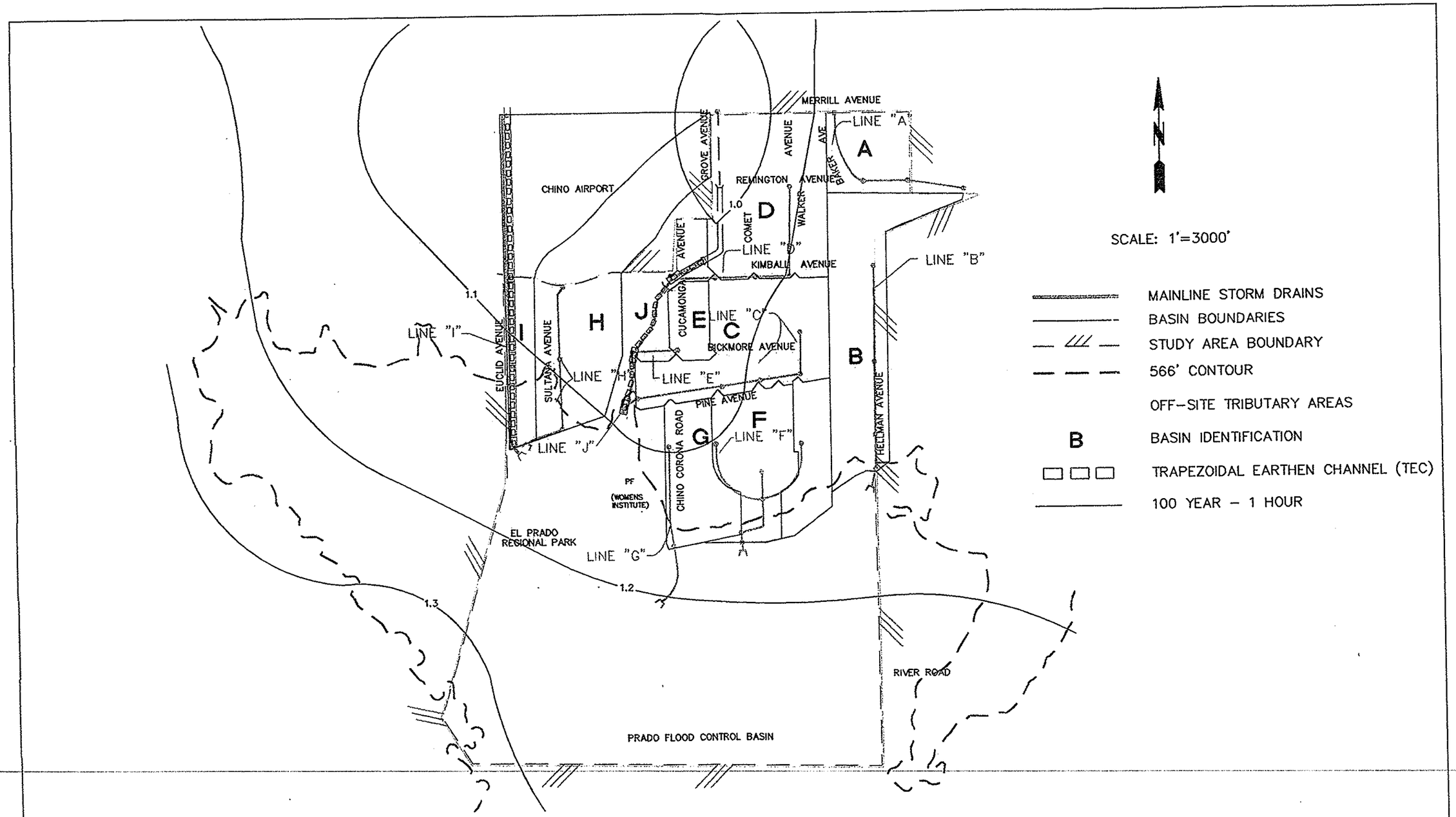
TABLE 2: CAPITAL COST ESTIMATE

MASTER PLAN OF DRAINAGE - CHINO SPHERE OF INFLUENCE - SUBAREA -2

LINE	NODE		SIZE	LENGTH	CONST.	CONST.	ENGR./	TOTAL COST	TOTAL CAPITAL COST	CITY OF CHINO	CITY OF ONTARIO
	FROM	TO			COST	COST	ADMIN.			CAPITAL COST	CAPITAL COST
#				ft	$/LF					0% COST	100% COST
A	MERRILL AVE	CUCAMONGA	10' (W) X 10' (H) DBL. RCB	6000	2,000	$ 12,000,000	$ 1,200,000	$ 13,200,000	$ 13,200,000		$ 13,200,000
		CREEK									
	40' WIDE DRAINAGE EASMENT							$ 350,000	$ 350,000		$ 350,000
TOTAL CAPITAL COST =									$ 13,550,000		$ 13,550,000

APPENDIX D

ISOHYTAL MAPS



Berryman & Henigar

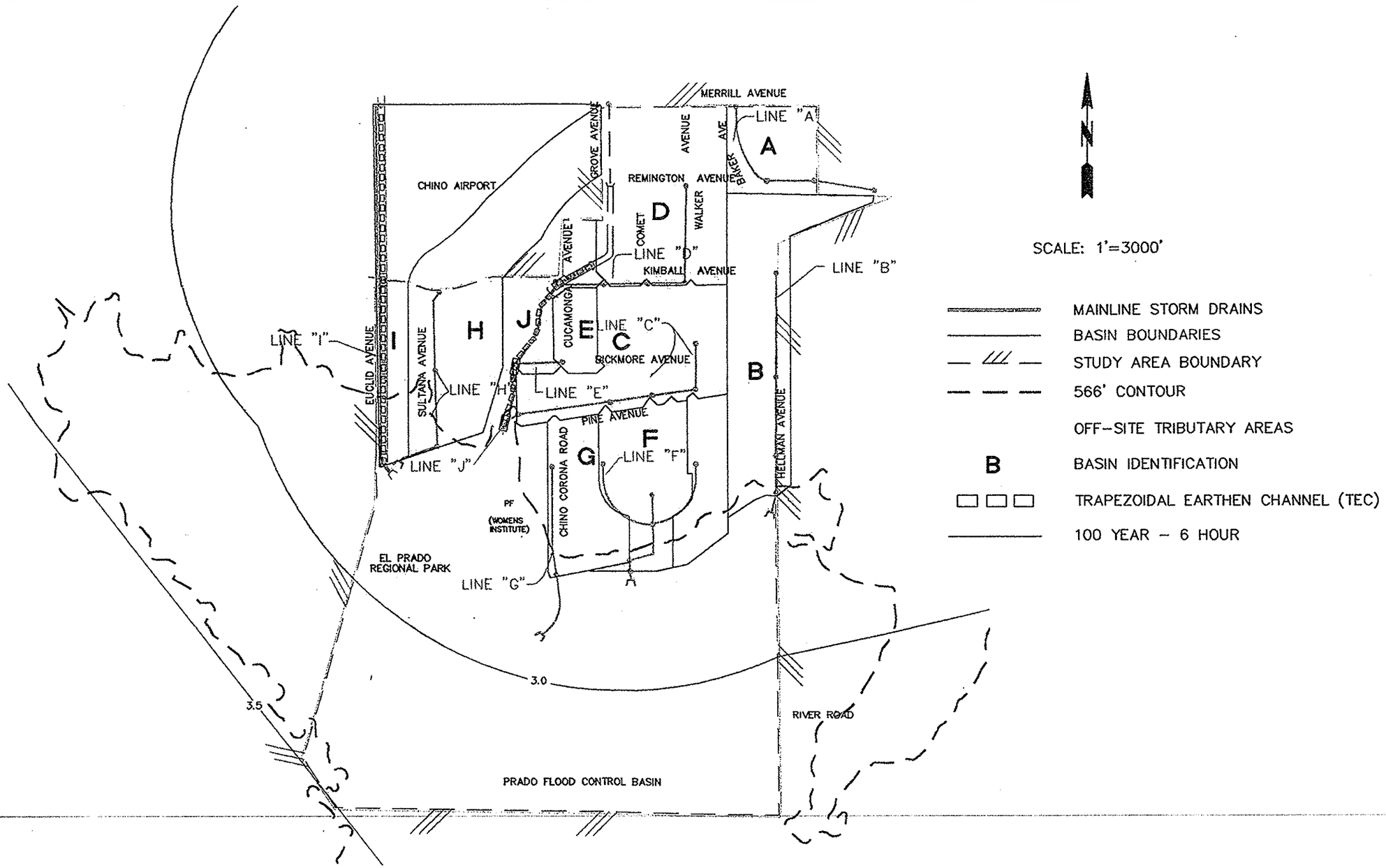
CHINO AGRICULTURAL PRESERVE AREA
CHINO SPHERE OF INFLUENCE - SUBAREA 2

MASTER PLAN OF DRAINAGE

CITY OF CHINO

ISOHYETALS
100 YEAR - 1 HOUR

FIGURE NO. 8



Berryman & Henigar

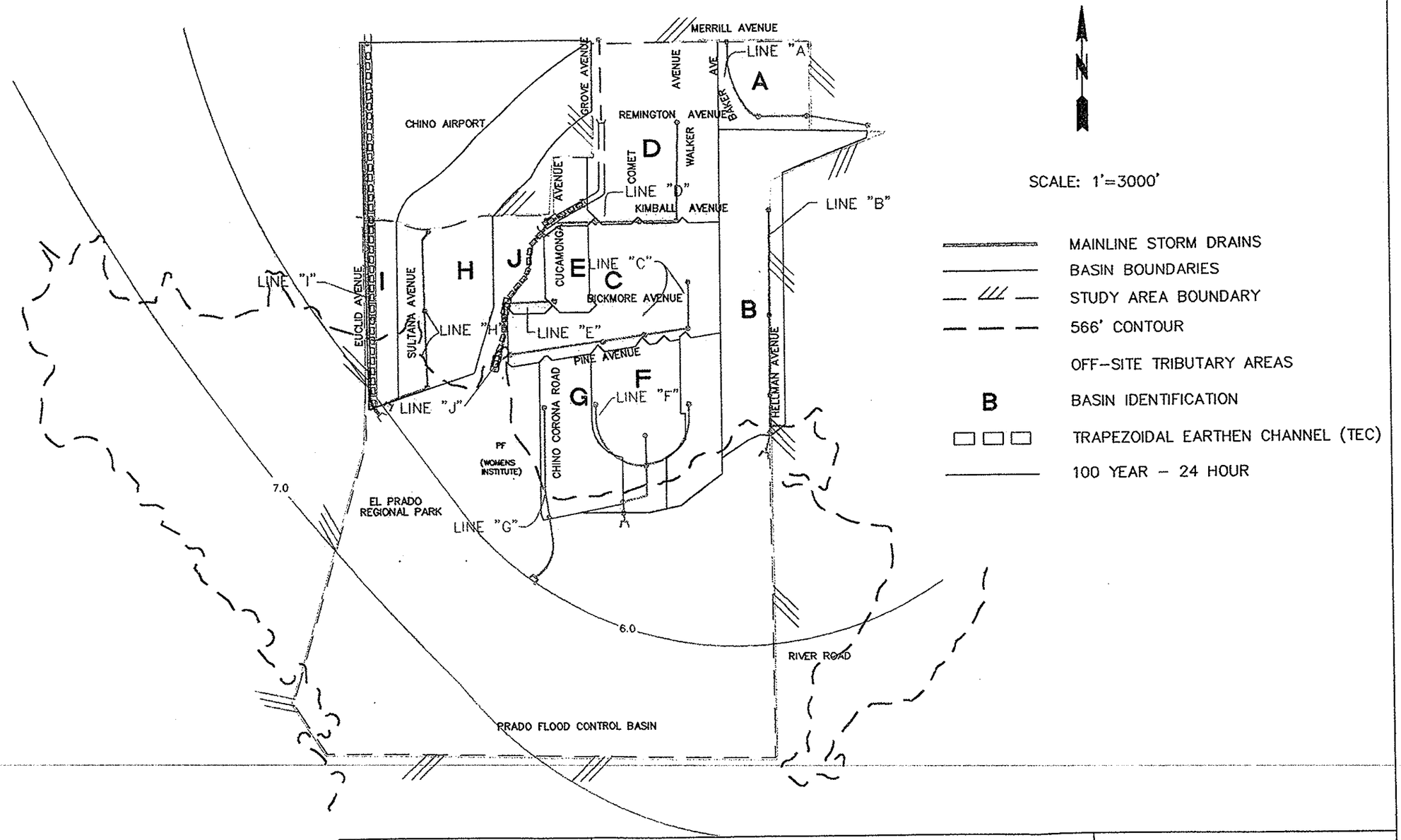
CHINO AGRICULTURAL PRESERVE AREA
CHINO SPHERE OF INFLUENCE - SUBAREA 2

MASTER PLAN OF DRAINAGE

CITY OF CHINO

ISOHYETALS
100 YEAR - 6 HOUR

FIGURE NO. 8



Berryman & Henigar

CHINO AGRICULTURAL PRESERVE AREA
CHINO SPHERE OF INFLUENCE - SUBAREA 2

MASTER PLAN OF DRAINAGE

CITY OF CHINO

ISOHYETALS
100 YEAR - 24 HOUR

FIGURE NO. 8