2003P013

FINAL DRAINAGE REPORT
FOR
WIGWAM CREEK - PHASE 2B
MARICOPA COUNTY, ARIZONA

April 24, 2001
Revised: October 25, 2001

Coe & Van Loo Consultants, Inc.
4550 North 12th Street
Phoenix, Arizona 85014

CVL Project No. 01-0001-02-08

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FOR
WIGWAM CREEK - PHASE 2B
MARICOPA COUNTY, ARIZONA

April 24, 2001
Revised: October 25, 2001

Prepared for:

CHI Construction Company
7001 North Scottsdale Road, Suite 2050
Scottsdale, AZ 85253
(480) 483-0006

Prepared by:

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CVL Project No. 01-0001-02-08

CVL

Final Drainage Report
for
Wigwam Creek-Phase - 2B
Maricopa County, Arizona

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1.0 INTRODUCTION

1.1 Scope

Coe & Van Loo Consultants, Inc. (CVL) has been contracted by CHI Construction Company to provide engineering services in support of Wigwam Creek – Phase 2B. The purpose of this report is to provide hydrologic and hydraulic analyses within the site. In addition, this report addresses off-site drainage, on-site drainage and retention.

This report is focused on providing practical design information, evaluation, and calculations for statistical flood events up to and including the 100-year frequency flood. The procedures used herein are derived from, and performed with, currently accepted engineering methodologies and practices. Additionally, the criteria for this evaluation conforms to currently applicable ordinances, regulations and policies effected by the appropriate jurisdictional regulatory authorities for the referenced site.

The analysis presented herein focuses on evaluating stormwater runoff resulting from a statistical evaluation of storm events of particular duration and frequency up to and including a 100-year frequency event. A storm event exceeding the 100-year event may cause or create the risk of greater flood impact than is addressed and presented in this assessment. However, the scope of this assessment does not include, neither did CVL's client request that, evaluation of stormwater runoff resulting from storm events exceeding the 100-year frequency event.

1.2 Site Description

The site is located in the western part of the Phoenix metropolitan area on the east side of 127th Avenue south of Bethany Home Road in Maricopa County, Arizona (Figures 1 and 2). The entire site is bounded by a school site on the south, Wigwam Creek Phase I and II on the east, Bethany Home Road on the north, and 127th Avenue on the west. The site's location can be further described as within the eastern portion of Section 14, Township 2 North, Range 1 West, of the Gila and Salt River Meridian, Maricopa County, Arizona.

The site is currently undeveloped and encompasses approximately 18 acres. The Airline Canal, a concrete lined irrigation channel passes through the southeast portion of the site. This channel conveys irrigation water through the site to the farm fields downstream.

1.3 Development

The site is being developed as a single-family residential subdivision containing lots of varying sizes. 127th Avenue will provide ingress and egress to the site.

1.4 Regulatory Jurisdiction

The site is currently situated within the jurisdiction of Maricopa County. The site is designed to meet the Flood Control District of Maricopa County (FCDMC) standards as described in the *Drainage Design Manual for Maricopa County, Volumes I and II* (References 1 and 2).

2.0 HYDROLOGIC SETTING

2.1 Topography

The site is located in an alluvial basin that is typical of the central and southern Arizona basin and range physiographic provence. The site location can be found on the United States Geological Survey 7.5 minute quadrangle map entitled El Mirage (Reference 3). Existing ground slopes downward generally to the southeast at approximately 0.7 percent.

2.2 Regional Hydrology

Regional drainage patterns direct stormwater runoff generally to the east and southeast toward the Agua Fria River located approximately 1 mile east of the site. The historical land use is agricultural but is currently undergoing a transformation to a mix of agricultural, residential, and commercial uses.

The Flood Control District of Maricopa County (FCDMC) has conducted watershed-planning studies that address the hydrologic and hydraulic conditions of the area. The results of these studies are presented in the Reference 4, *White Tanks Drainage Master Study* (WTADMS). The WTADMS was later modified for the Colter Channel design and two reports were produced: *Hydrology of Colter Channel, Flood Control District of Maricopa County*, July 1992 (Reference 5) and *Recommendation Report, Colter Channel Project CRSS Civil Engineers, Inc. and Wood Patel & Associates, Inc.*, November 1992 (Reference 6).

3.0 MANAGEMENT OF OFF-SITE STORMWATER RUNOFF

Off-site flows were addressed in the Wigwam Creek Preliminary Drainage Report (Reference 8). **Off-site flows approaching the site from Litchfield Vista Views II subdivision will be intercepted by a channel on the east side of 127th Avenue, eventually outfalling to Colter Channel.** See Appendix D for the 127th Avenue channel calculations.

4.0 MANAGEMENT OF ON-SITE STORMWATER RUNOFF

4.1 On-Site Hydrology

The on-site hydrology is based on the rational method criteria as recommended by the FCDMC Hydrology Manual (Reference 10). Drainage sub-basins have been delineated based on the parcel lot layout and the final grading plans. Times of concentration have been based on FCDMC equation (Eqn. 3.2. Reference 2). For the on-site area, a C value of 0.52 was applied for the 10-year and 0.65 for the 100-year storm event. Refer to Plate 1 for on-site drainage patterns, and Appendix A for on-site hydrology.

4.2 On-Site Stormwater Runoff Management Plan

The streets within the project have been designed to convey the 10-year storm below top of curb per Maricopa County requirements (Reference 2). In addition, the 100-year flow will be less than 100 cfs in the street, with a maximum velocity of **10** feet per second. The 100-year flow depth will be at least 1 foot below finish floor elevations. Refer to Appendix A for street hydraulics calculations.

Each cul-de-sac is designed to intercept runoff from the adjacent four lots and direct flows easterly. Drainage easements are located at the end of the cul-de-sac. Drainage channels within each easement convey flow to local streets within Phase 1 and Phase 2, and ultimately discharge to the greenbelt channel. See **Figures 4 and 5** for impacts to Phase 1 and Phase 2.

4.3 On-Site Retention

The Colter Channel will serve as an outfall for the site. Phase 2B lies north of the Colter Channel. Areas north of the Colter Channel do not require retention basins as run-off discharges directly to the Colter Channel.

5.0 FLOOD ZONE INFORMATION

The Maricopa County, Arizona and Incorporated Areas Flood Insurance Rate Map (FIRM) panel number **04013C1615J, dated July 19, 2001** indicates (Figure 4) the subject site falls within Zone X (shaded) and Zone A.

Zone A is defined by FEMA as:

> "A special flood hazard area inundated by the 100-year flood with no base flood elevations determined."

Zone X (shaded) is defined by FEMA as:

> "Areas of 500 year flood; areas of 100-year flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from the 100-year flood."

The Zone A designated area is the ponding area behind the Airline Canal and this flood zone will be removed through FEMA CLOMR/LOMR process. The ponding will be removed by relocating the canal flow in a storm drain (Figure 5). Therefore, no other measures of flood proofing other than those mentioned in the on-site stormwater runoff management plan (Section 4.2) will be required.

6.0 SUMMARY AND CONCLUSIONS

1. **Off-site flows are directed southerly by a channel along 127th Avenue to the Colter Channel.**
2. The 10-year flow is to be conveyed within the street sections below the top of the curb. The 100-year flow is contained at an elevation that is below the finish floor elevations and does not exceed an elevation of 0.5 foot above the crown of the road at any location.
3. Run-off leaving the site discharges to the Colter Channel. Retention is not required for the areas draining directly to the Colter Channel.
4. The design of this project has been based on generally accepted engineering practices and in accordance with the Flood Control District of Maricopa County requirements.
5. The ponding area behind the Airline Canal, designated as Zone A, will be removed through the FEMA CLOMR/LOMR process.

7.0 REFERENCES

1. Flood Control District of Maricopa County, *Drainage Design Manual for Maricopa County, Arizona, Volume I, Hydrology,* January 1995.

2. Flood Control District of Maricopa County, *Drainage Design Manual for Maricopa County, Arizona, Volume II, Hydraulics,* January 1996.

3. United States Geological Survey (U.S.G.S.) 7.5-minute quadrangle topographic map, *El Mirage, Arizona*, 1957 (photo revised 1982).

4. White Tanks/Agua Fria Area Drainage Master Study Technical Data Notebook: by The WLB Group, Inc., May 1992.

5. Hydrology of Colter Channel Contributory Drainage Area; Flood Control District of Maricopa County, July 1992.

6. Recommendation Report, Colter Channel Project CRSS Civil Engineers, Inc., and Wood Patel & Associates, Inc., November 1992.

7. Federal Emergency Management Agency Flood Insurance Rate Map (FIRM) Maricopa County, Arizona and Incorporated Areas, **Panel Number 04013C1615J dated July 19, 2001.**

8. Coe & Van Loo, Preliminary Drainage report for Wigwam Creek, August 17, 1999.

DOCUMENT QUALITY ASSURANCE

As part of CVL's policy to provide quality products to its clients, all reports are subject to review for technical accuracy, validity of conclusions and appropriateness of recommendations.

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Date: *October 25, 2001*

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Date: *October 25, 2001*

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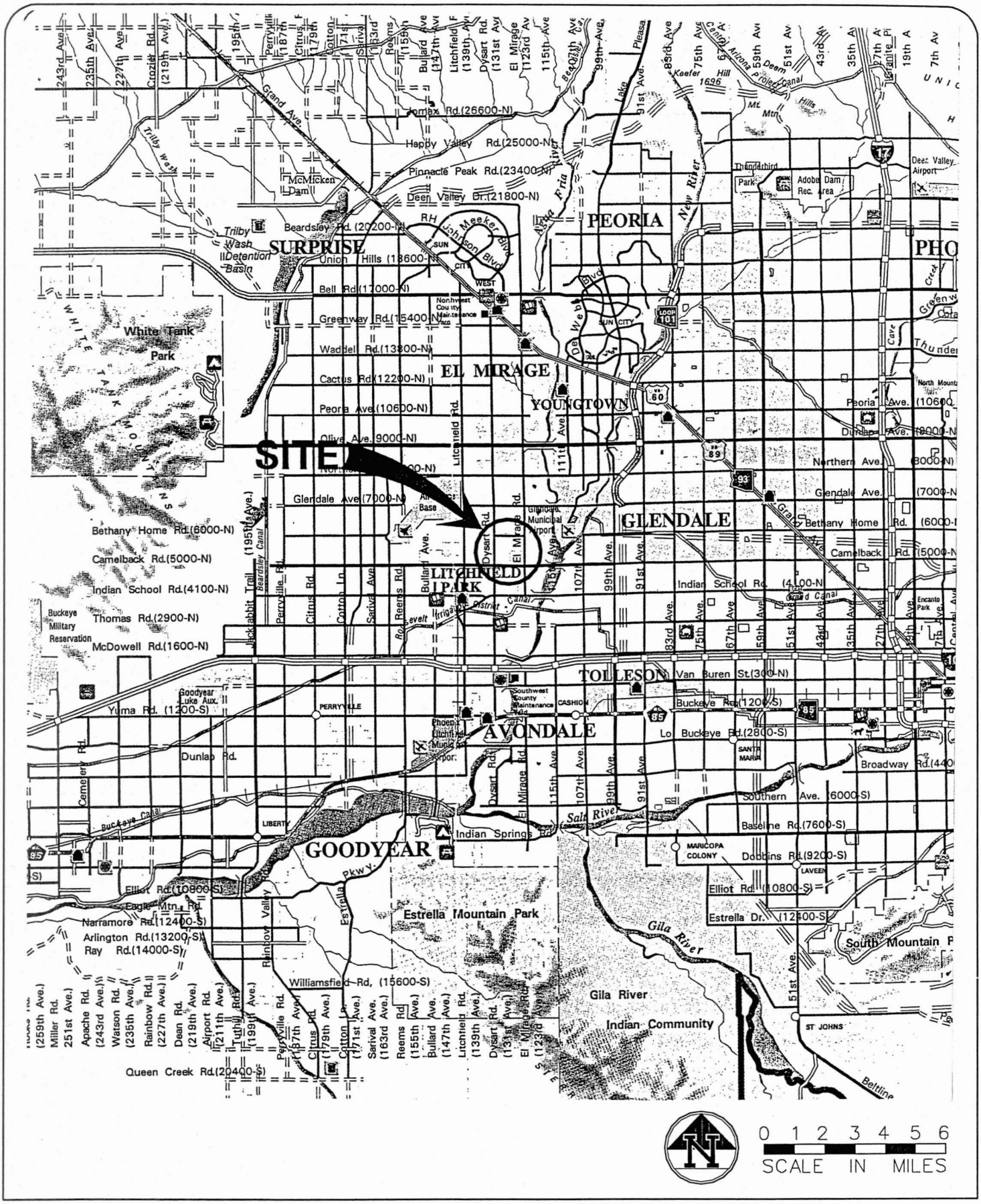
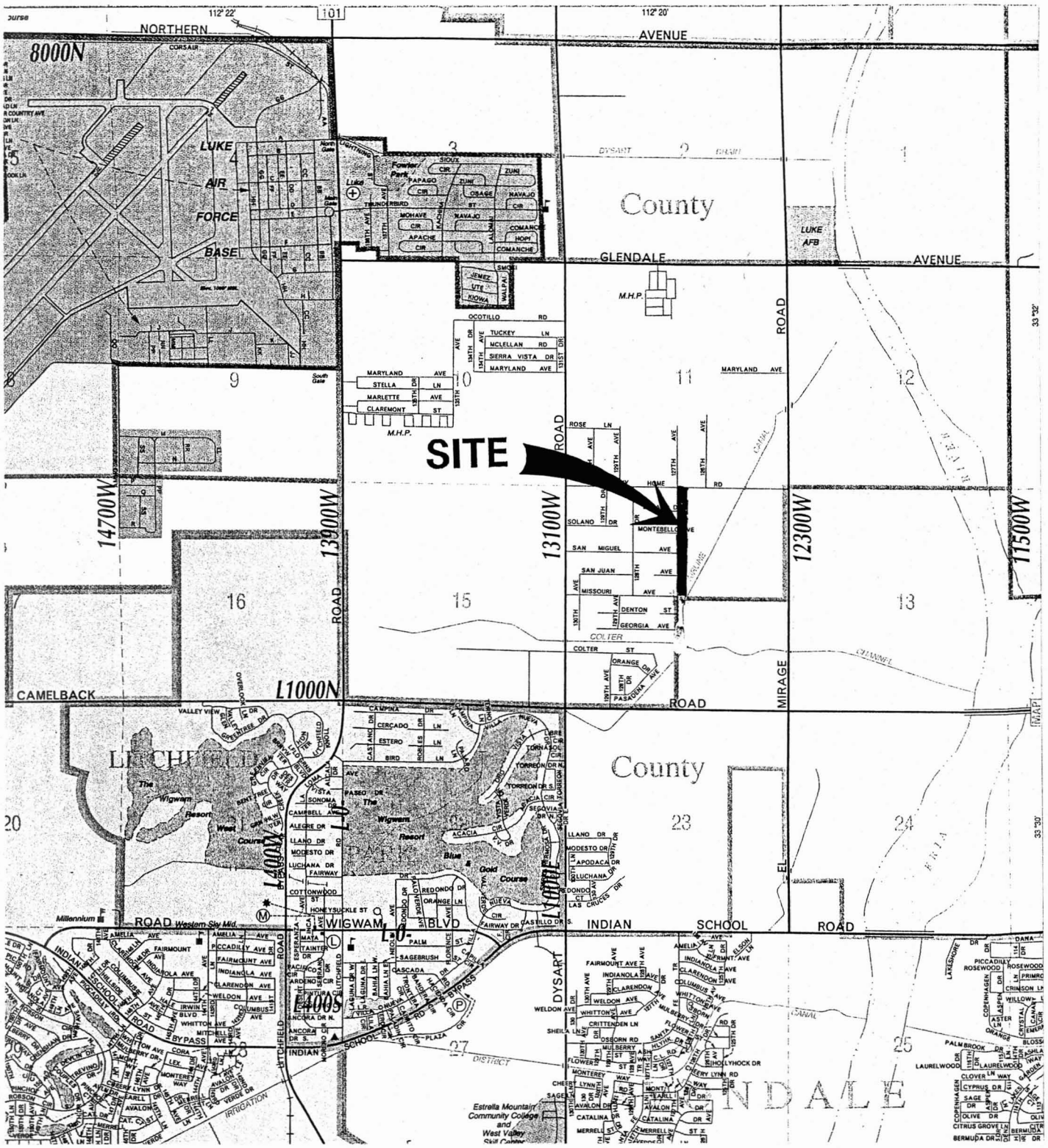
FIGURES



VICINITY MAP	WIGWAM CREEK PHASE 2B	JOB NO 010001-02
4550 NORTH 12TH STREET PHOENIX, ARIZONA 85014 TELEPHONE (602) 264-6831	COE & VAN LOO PLANNING • ENGINEERING • LANDSCAPE ARCHITECTURE	FIGURE 1



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SCALE IN MILES

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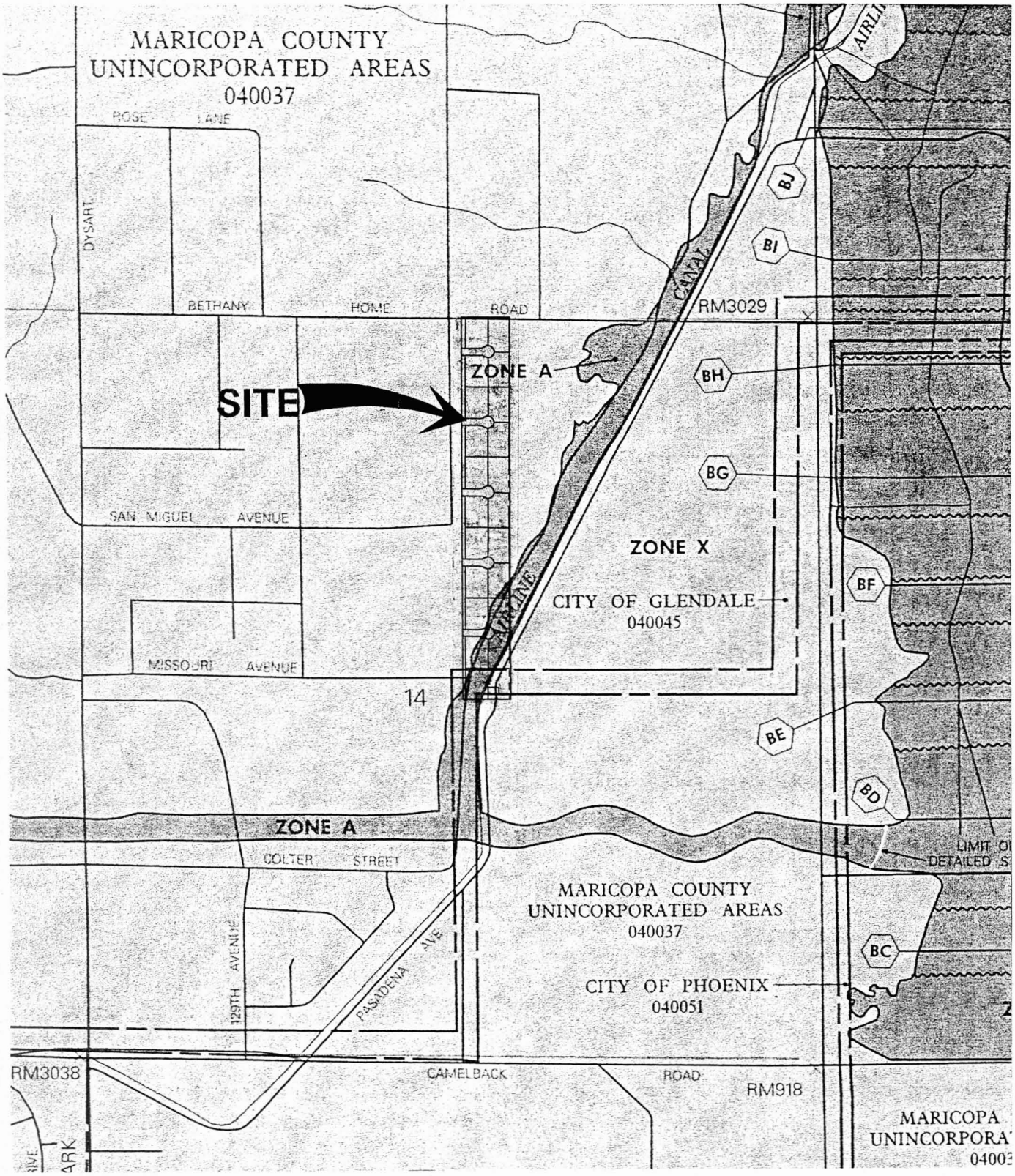
LOCATION MAP	WIGWAM CREEK PHASE 2B	JOB NO 010001–02
4550 NORTH 12TH STREET PHOENIX, ARIZONA 85014 TELEPHONE (602) 264-6831	COE & VAN LOO PLANNING • ENGINEERING • LANDSCAPE ARCHITECTURE	FIGURE 2



MARICOPA COUNTY, ARIZONA
AND INCORPORATED AREAS
04013C1615 J REV. JULY 19,2001

1000' 500' 0 1000'
SCALE IN FEET

FLOOD INSURANCE RATE MAP	WIGWAM CREEK PHASE 2B	JOB NO 010001-02
4550 NORTH 12TH STREET PHOENIX, ARIZONA 85014 TELEPHONE (602) 264-6831	COE & VAN LOO PLANNING • ENGINEERING • LANDSCAPE ARCHITECTURE	FIGURE 3

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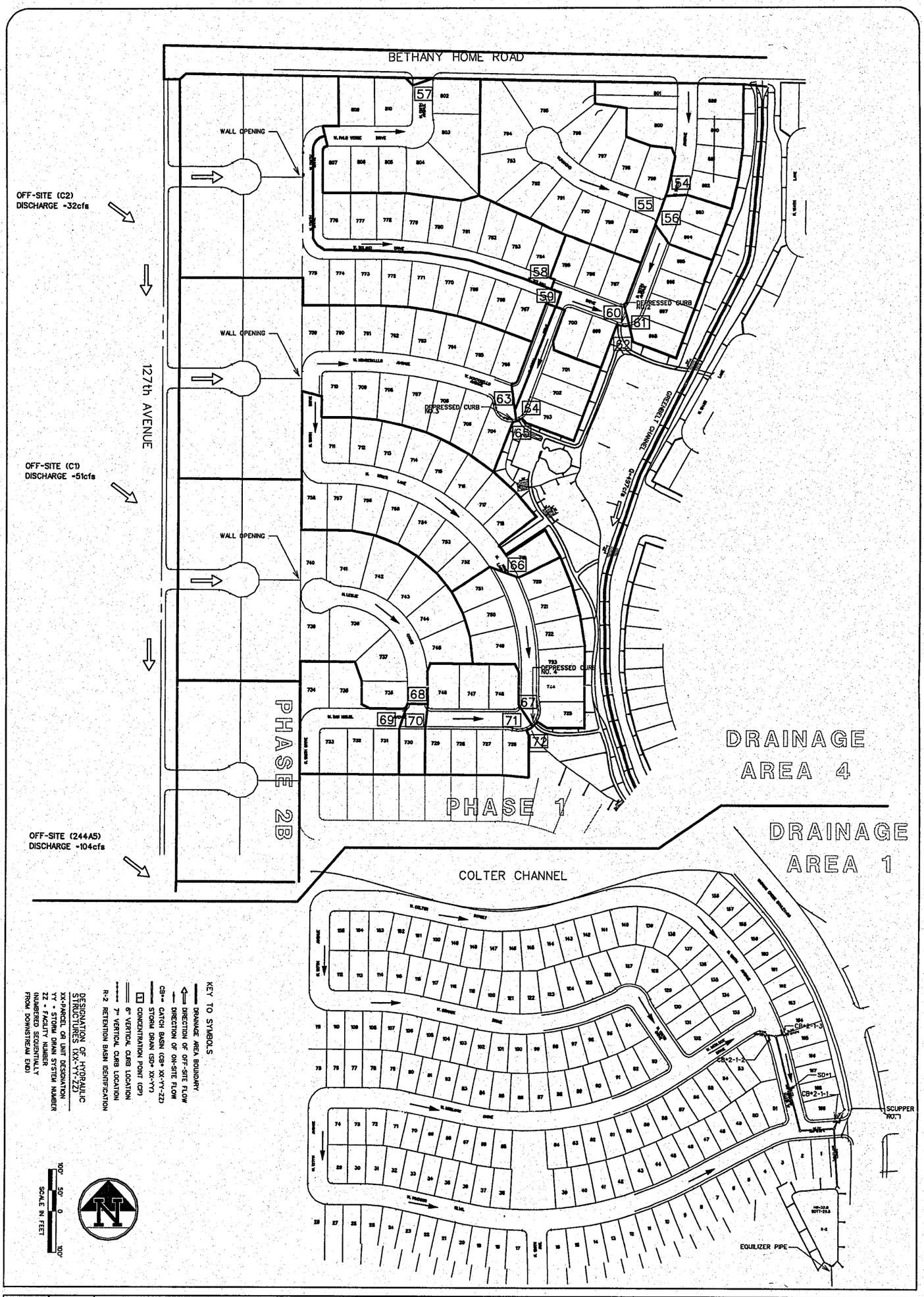

FIGURE 4	JOB NO. 000046-03	**DRAINAGE MAP** (PHASE 2B DRAINAGE IMPACTS TO PHASE 2)
		4550 NORTH 12TH STREET PHOENIX, ARIZONA 85014 TELEPHONE (602) 264-6831
		WIGWAM CREEK PHASE 2
		COE & VAN LOO PLANNING • ENGINEERING • LANDSCAPE ARCHITECTURE

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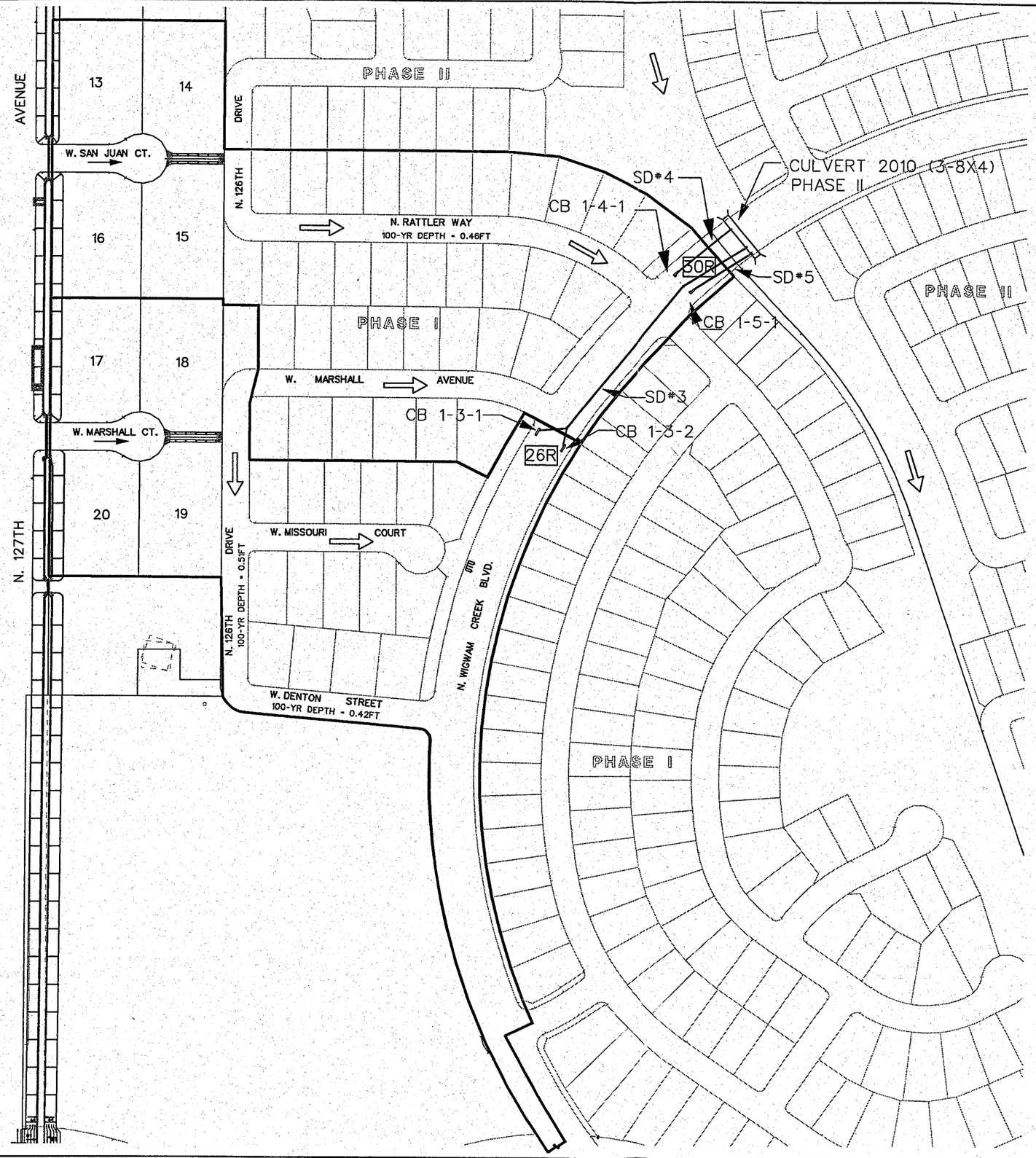

KEY TO SYMBOLS

- DRAINAGE AREA BOUNDARY
- DIRECTION OF OFF-SITE FLOW
- DIRECTION OF ON-SITE FLOW
- CB#- CATCH BASIN (CB# XX-YY-ZZ)
- STORM DRAIN (SD# XX-YY)
- [1] CONCENTRATION POINT (CP)

NOTES

FLOWS AT CONCENTRATION POINT 26R INCREASE 1cfs COMPARED WITH THE ORIGINAL PHASE 1 ANALYSIS. FLOWS AT CONCENTRATION POINT 30R INCREASE 6 cfs. SD#4 AND SD#5 WILL BE UPSIZED FROM A 18" PIPE TO A 24" PIPE.

THE IMPACT TO PHASE 2 WILL BE ADDRESSED IN THE PHASE 2 FINAL DRAINAGE REPORT.

200' 100' 0 200'

SCALE IN FEET

WIGWAM CREEK PHASE 2B

COE & VAN LOO
PLANNING • ENGINEERING • LANDSCAPE ARCHITECTURE

DRAINAGE MAP
(PHASE 2B IMPACTS TO PHASE 1)

4550 NORTH 12TH STREET
PHOENIX, ARIZONA 85014
TELEPHONE (602) 264-6831

JOB NO.
01-0001-02

FIGURE 5

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APPENDIX A

Hydrology and Street Hydraulics Calculations

SUMMARY OF RATIONAL METHOD PEAK FLOW HYDROLOGY
Wigwam Creek – Phase IIB

CP Concentration Point	Sub-basin Area (ac)	A Cum. Area (ac)	C Weighted Runoff Coefficient			i Intensity (in/hr)			Q Peak Flow Rate (cfs)			S Street Slope (%)	Flow Capacity (cfs)		Depth (ft) 100-year
			Return Period			Return Period			Return Period				4" Type 6"		
			10-Year	50-Year	100-Year	10-Year	50-Year	100-Year	10-Year	50-Year	100-Year		10-Year	10-Year	
1	3.56	3.56	0.52	0.62	0.65	5.7	7.7	8.7	11	17	20	0.016	21	-	0.34
2	3.53	3.53	0.52	0.62	0.65	5.2	7.4	8.5	10	16	20	0.013	19	-	0.35
3	3.47	3.47	0.52	0.62	0.65	5.4	7.6	8.7	10	17	20	0.019	23	-	0.32
4	3.35	3.35	0.52	0.62	0.65	5.4	7.6	8.7	9	16	19	0.013	19	-	0.33
5	3.28	3.28	0.52	0.62	0.65	5.3	7.6	8.7	9	16	19	0.019	23	-	0.31

RATIONAL FOR WINDOWS

Flood Control District of Maricopa County Rational Method

Project Information

Project Name: WigWam Creek Phase 2B

Project Description: On-Site Peak Flows

Drainage Point: 1

Location: On-Site

Drainage Basin Data

Water Course Length: 500.00 ft

Basin Area: 3.560 acres

High Elevation: 63.00 ft

Low Elevation: 52.60 ft

Average Slope: 0.0208 ft/ft

Roughness, Kb: 0.0366 (A)

10-Year Runoff Coefficient: 0.520

10-Year 6 Hour Rainfall Depth: 2.00 inches

Hydrological Summary Table

Parameter	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Q (cfs)	7	9	11	14	17	20
C	0.520	0.520	0.520	0.572	0.624	0.650
Tc (min)	5.4	5.0	5.0	5.0	5.0	5.0
i (in/hr)	3.6	4.9	5.7	6.7	7.7	8.7

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Wednesday, October 10, 2001 1:13:40 p

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Author: Frank M. Gu, P.E.
Email: frank@netcom.com
URL: http://www.he.net/~esc/rational.html

RATIONAL FOR WINDOWS

Flood Control District of Maricopa County Rational Method

Project Information

Project Name: WigWam Creek Phase 2B

Project Description: On-Site Peak Flows

Drainage Point: 2

Location: On-Site

Drainage Basin Data

Water Course Length: 500.00 ft

Basin Area: 3.530 acres

High Elevation: 53.00 ft

Low Elevation: 49.20 ft

Average Slope: 0.0076 ft/ft

Roughness, Kb: 0.0366 (A)

10-Year Runoff Coefficient: 0.520

10-Year 6 Hour Rainfall Depth: 2.00 inches

Hydrological Summary Table

Parameter	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Q (cfs)	6	8	10	13	16	20
C	0.520	0.520	0.520	0.572	0.624	0.650
Tc (min)	7.8	6.9	6.4	5.9	5.6	5.3
i (in/hr)	3.1	4.3	5.2	6.4	7.4	8.5

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RATIONAL FOR WINDOWS

Flood Control District of Maricopa County Rational Method

Project Information

Project Name: WigWam Creek Phase 2B

Project Description: On-Site Peak Flows

Drainage Point: 3

Location: On-Site

Drainage Basin Data

Water Course Length: 510.00 ft

Basin Area: 3.470 acres

High Elevation: 52.00 ft

Low Elevation: 46.80 ft

Average Slope: 0.0102 ft/ft

Roughness, Kb: 0.0366 (A)

10-Year Runoff Coefficient: 0.520

10-Year 6 Hour Rainfall Depth: 2.00 inches

Hydrological Summary Table

Parameter	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Q (cfs)	6	8	10	13	17	20
C	0.520	0.520	0.520	0.572	0.624	0.650
Tc (min)	7.1	6.3	5.8	5.4	5.1	5.0
i (in/hr)	3.3	4.5	5.4	6.6	7.6	8.7

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Wednesday, October 10, 2001 1:17:42 p

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RATIONAL FOR WINDOWS

Flood Control District of Maricopa County Rational Method

Project Information

Project Name: WigWam Creek Phase 2B

Project Description: On-Site Peak Flows

Drainage Point: 4

Location: On-Site

Drainage Basin Data

Water Course Length: 510.00 ft

Basin Area: 3.350 acres

High Elevation: 50.00 ft

Low Elevation: 45.00 ft

Average Slope: 0.0098 ft/ft

Roughness, Kb: 0.0367 (A)

10-Year Runoff Coefficient: 0.520

10-Year 6 Hour Rainfall Depth: 2.00 inches

Hydrological Summary Table

Parameter	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Q (cfs)	6	8	9	13	16	19
C	0.520	0.520	0.520	0.572	0.624	0.650
Tc (min)	7.2	6.3	5.9	5.5	5.2	5.0
i (in/hr)	3.2	4.5	5.4	6.6	7.6	8.7

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RATIONAL FOR WINDOWS

Flood Control District of Maricopa County Rational Method

Project Information

Project Name: WigWam Creek Phase 2B

Project Description: On-Site Peak Flows

Drainage Point: 5

Location: On-Site

Drainage Basin Data

Water Course Length: 500.00 ft

Basin Area: 3.280 acres

High Elevation: 47.00 ft

Low Elevation: 42.36 ft

Average Slope: 0.0093 ft/ft

Roughness, Kb: 0.0368 (A)

10-Year Runoff Coefficient: 0.520

10-Year 6 Hour Rainfall Depth: 2.00 inches

Hydrological Summary Table

Parameter	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Q (cfs)	6	8	9	12	16	19
C	0.520	0.520	0.520	0.572	0.624	0.650
Tc (min)	7.2	6.4	6.0	5.5	5.2	5.0
i (in/hr)	3.2	4.5	5.3	6.6	7.6	8.7

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Tuesday, April 10, 2001 10:07:38 a

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Flood Control District of Maricopa County Rational Method

Project Information

Project Name: WigWam Creek Phase 2B

Project Description: Phase 2B Drainage Impacts to Phase 1

Drainage Point: 26R

Location: Off-Site

Drainage Basin Data

Water Course Length: 1960.00 ft

Basin Area: 11.260 acres

High Elevation: 45.50 ft

Low Elevation: 36.60 ft

Average Slope: 0.0045 ft/ft

Roughness, Kb: 0.0334 (A)

10-Year Runoff Coefficient: 0.520

10-Year 6 Hour Rainfall Depth: 2.00 inches

Hydrological Summary Table

Parameter	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Q (cfs)	12	16	20	28	36	44
C	0.520	0.520	0.520	0.572	0.624	0.650
Tc (min)	20.5	17.9	16.7	15.2	14.3	13.5
i (in/hr)	2.0	2.8	3.4	4.4	5.1	6.0

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RATIONAL FOR WINDOWS

Flood Control District of Maricopa County Rational Method

Project Information

Project Name: WigWam Creek Phase 2B

Project Description: Phase 2B Drainage Impacts to Phase 1

Drainage Point: 30R

Location: Off-Site

Drainage Basin Data

Water Course Length: 2400.00 ft

Basin Area: 24.150 acres

High Elevation: 45.50 ft

Low Elevation: 35.50 ft

Average Slope: 0.0042 ft/ft

Roughness, Kb: 0.0314 (A)

10-Year Runoff Coefficient: 0.520

10-Year 6 Hour Rainfall Depth: 2.00 inches

Hydrological Summary Table

Parameter	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Q (cfs)	23	33	40	57	73	89
C	0.520	0.520	0.520	0.572	0.624	0.650
Tc (min)	23.1	20.2	18.7	17.0	16.0	15.1
i (in/hr)	1.9	2.6	3.2	4.1	4.9	5.7

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URL: http://www.he.net/~esc/rational.html

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Table
Rating Table for Irregular Channel

Project Description	
Project File	n:\980098\hydro\haestad\local st.fm2
Worksheet	Phase 2b Local St
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Discharge

Constant Data	
Water Surface Elevation	0.33 ft

Input Data			
	Minimum	Maximum	Increment
Channel Slope	0.002000	0.020000	0.000200 ft/ft

Rating Table

Channel Slope (ft/ft)	Wtd. Mannings Coefficient	Discharge (cfs)	Velocity (ft/s)
0.002000	0.016	7.51	1.36
0.002200	0.016	7.87	1.43
0.002400	0.016	8.22	1.49
0.002600	0.016	8.56	1.55
0.002800	0.016	8.88	1.61
0.003000	0.016	9.20	1.67
0.003200	0.016	9.50	1.72
0.003400	0.016	9.79	1.78
0.003600	0.016	10.07	1.83
0.003800	0.016	10.35	1.88
0.004000	0.016	10.62	1.93
0.004200	0.016	10.88	1.97
0.004400	0.016	11.14	2.02
0.004600	0.016	11.39	2.07
0.004800	0.016	11.63	2.11
0.005000	0.016	11.87	2.15
0.005200	0.016	12.11	2.20
0.005400	0.016	12.34	2.24
0.005600	0.016	12.56	2.28
0.005800	0.016	12.79	2.32
0.006000	0.016	13.00	2.36
0.006200	0.016	13.22	2.40
0.006400	0.016	13.43	2.44
0.006600	0.016	13.64	2.47
0.006800	0.016	13.84	2.51
0.007000	0.016	14.05	2.55

Table
Rating Table for Irregular Channel

Rating Table			
Channel Slope (ft/ft)	Wtd. Mannings Coefficient	Discharge (cfs)	Velocity (ft/s)
0.007200	0.016	14.25	2.58
0.007400	0.016	14.44	2.62
0.007600	0.016	14.64	2.66
0.007800	0.016	14.83	2.69
0.008000	0.016	15.02	2.72
0.008200	0.016	15.20	2.76
0.008400	0.016	15.39	2.79
0.008600	0.016	15.57	2.82
0.008800	0.016	15.75	2.86
0.009000	0.016	15.93	2.89
0.009200	0.016	16.10	2.92
0.009400	0.016	16.28	2.95
0.009600	0.016	16.45	2.98
0.009800	0.016	16.62	3.02
0.010000	0.016	16.79	3.05
0.010200	0.016	16.96	3.08
0.010400	0.016	17.12	3.11
0.010600	0.016	17.28	3.14
0.010800	0.016	17.45	3.17
0.011000	0.016	17.61	3.19
0.011200	0.016	17.77	3.22
0.011400	0.016	17.92	3.25
0.011600	0.016	18.08	3.28
0.011800	0.016	18.24	3.31
0.012000	0.016	18.39	3.34
0.012200	0.016	18.54	3.36
0.012400	0.016	18.69	3.39
0.012600	0.016	18.84	3.42
0.012800	0.016	18.99	3.45
0.013000	0.016	19.14	3.47
0.013200	0.016	19.29	3.50
0.013400	0.016	19.43	3.53
0.013600	0.016	19.58	3.55
0.013800	0.016	19.72	3.58
0.014000	0.016	19.86	3.60
0.014200	0.016	20.01	3.63
0.014400	0.016	20.15	3.66
0.014600	0.016	20.29	3.68
0.014800	0.016	20.42	3.71
0.015000	0.016	20.56	3.73
0.015200	0.016	20.70	3.76
0.015400	0.016	20.83	3.78
0.015600	0.016	20.97	3.80
0.015800	0.016	21.10	3.83
0.016000	0.016	21.24	3.85

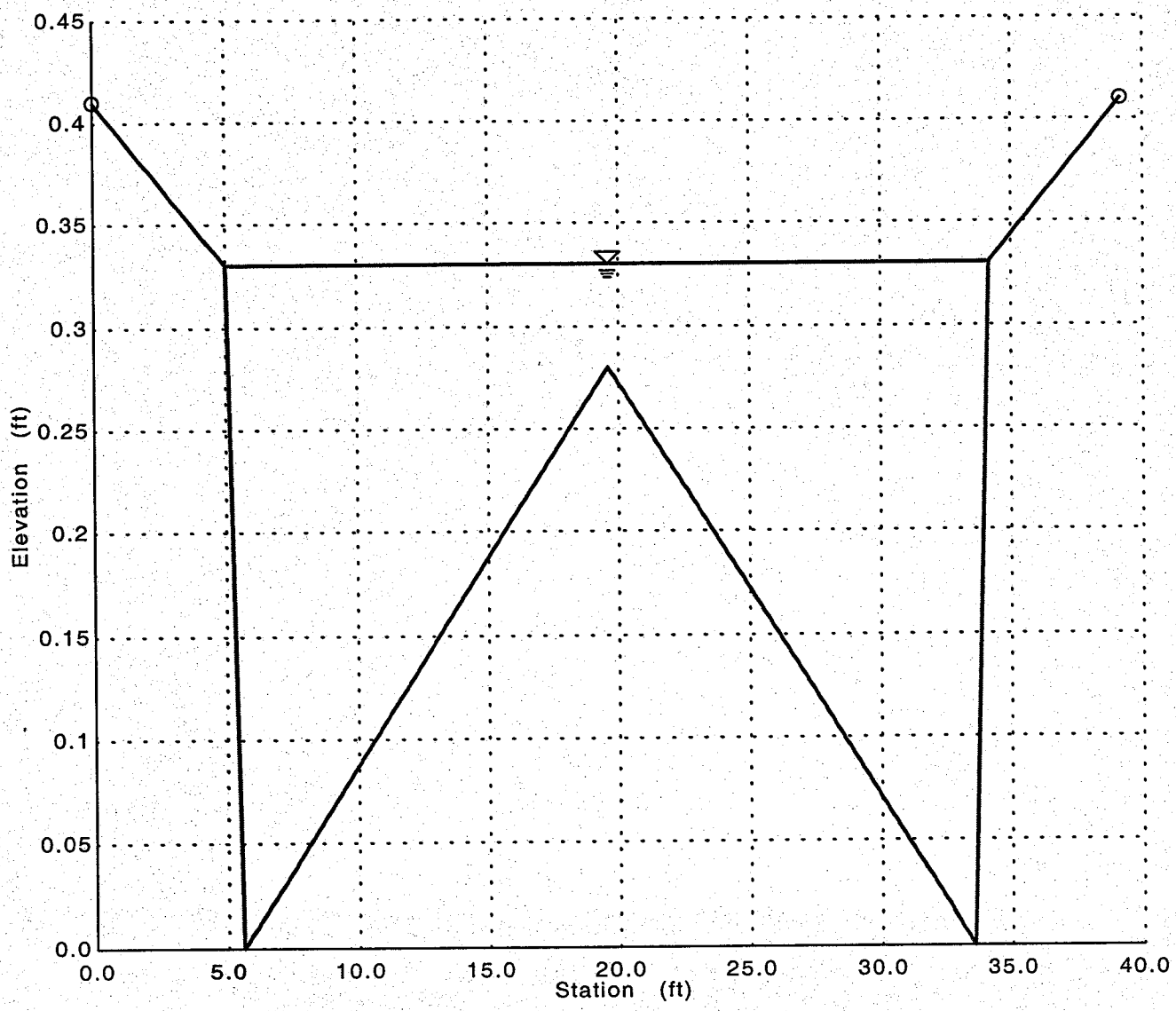
Table
Rating Table for Irregular Channel

Rating Table			
Channel Slope (ft/ft)	Wtd. Mannings Coefficient	Discharge (cfs)	Velocity (ft/s)
0.016200	0.016	21.37	3.88
0.016400	0.016	21.50	3.90
0.016600	0.016	21.63	3.92
0.016800	0.016	21.76	3.95
0.017000	0.016	21.89	3.97
0.017200	0.016	22.02	3.99
0.017400	0.016	22.15	4.02
0.017600	0.016	22.27	4.04
0.017800	0.016	22.40	4.06
0.018000	0.016	22.52	4.09
0.018200	0.016	22.65	4.11
0.018400	0.016	22.77	4.13
0.018600	0.016	22.90	4.15
0.018800	0.016	23.02	4.18
0.019000	0.016	23.14	4.20
0.019200	0.016	23.26	4.22
0.019400	0.016	23.38	4.24
0.019600	0.016	23.50	4.26
0.019800	0.016	23.62	4.29
0.020000	0.016	23.74	4.31

Cross Section (4" Curb)
Cross Section for Irregular Channel

Project Description	
Project File	n:\980098\hydro\haestad\local st.fm2
Worksheet	Phase 2b Local St
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Discharge

Section Data		
Wtd. Mannings Coefficient	0.016	
Channel Slope	0.002000	ft/ft
Water Surface Elevation	0.33	ft
Discharge	7.51	cfs



APPENDIX B

Curb Opening & Rip Rap Calculations

WIGWAM CREEK PHASE 2B (01-0001-02)
CURB OPENING CALCULATIONS

CP - C2 - CURB OPENING NO.(s) 1

"Flow-by" Catch Basin Interception Capacity

Q100 @ CP- C2 = 32 cfs

Qd = Qdesign = 32.0 cfs, street slope = 1.10 %
D = Depth of flow = 0.50 ft

a) W = Width of Depressed Gutter [inch] , [ft] = 17 = 1.42
T = Spread = 25.0 ft
W/T = 1.42 / 25.0 = 0.057

b) Sw' = Cross-slope of gutter section = 2 inch (depression)/ 17 inch ≡ 0.118 ft/ft
Sx = Pavement cross-slope = 0.020 ft/ft
Sw = Sw' + Sx = 0.138
Sw/Sx = 0.138 / 0.020 = 6.90

c) Eo = 0.14 (Fig. 3.23) ♦

d) Se = Sx + Sw'*Eo
= 0.020 + (0.118)*(0.14)
= 0.037

e) Qd = 32.0 cfs
Lt = 57.5 ft
Length of Curb Opening = 60 ft

f) E = Efficiency of Inlet
= 1-(1-L/Lt)^1.8 (Eqn 3.5) ♦
= 1 - (1 - 60 / 57.5)^1.8
= 1 - (1 - 1.04)^1.8
= 1 - (-0.04)^1.8
= 1 - (-0.00)
= 1.00

g) Flow intercepted = Q*E = 32.0 cfs * 1.00 = 32.11 cfs = 32.10 cfs

h) Flow-by = Qd - Qintercepted = (32.0 cfs - 32.1 cfs) * 1 0.1 cfs

So: Total flow-by @ CP - C2 = 0.1 cfs

Total flow intercepted = (32.1 cfs) * 1 = 32.1 cfs @ CP - C2 (for the 100-year flow)

♦ MCFCD Volume II Hydraulics, Reference 2

WIGWAM CREEK PHASE 2B (01-0001-02)
DEPRESSED CURB CALCULATIONS

CP - C1 - CURB OPENING NO.(s) 2

Using inlet - sump condition calculation of total interception capacity.

Q100 @ CP- C1 = 49 cfs

Compute "sump" condition interception capacity for curb inlet; weir flow:

So: Qi = Cw (L)d^1.5 (Weir Flow Eqn, Eqn. 3.9) ♦

Where:
Cw = Weir Coefficient for Curb Inlet = 3.0
Lt = Length of Curb Opening (ft)
d = Ponding depth at curb = 0.50 ft
Qi = Amount of street flow caught by an inlet (cfs)

Estimate Required Length of Curb Opening

$$L = \left[\frac{Qi}{Cw * d^{1.5}}\right] = \left[\frac{49.00 \text{ cfs}}{3.00 * 0.50^{1.5}}\right] = 46.2 \text{ ft}$$

For Design: For depressed curb, total curb opening = 48 ft

Design depressed curb interception capacity >= required capacity of the Q100 in the street at CP - C1

♦ MCFCD Volume II Hydraulics, Reference 2

WIGWAM CREEK PHASE 2B (01-0001-02)
DEPRESSED CURB CALCULATIONS

CP - 244A5- CURB OPENING NO.(s) 3

Using inlet - sump condition calculation of total interception capacity.

Q100 @ CP- 244A5 = 75 cfs

Compute "sump" condition interception capacity for curb inlet; weir flow:

So: Qi = Cw (L)d^1.5 (Weir Flow Eqn, Eqn. 3.9) ♦

Where:
Cw = Weir Coefficient for Curb Inlet = 3.0
Lt = Length of Curb Opening (ft)
d = Ponding depth at curb = 0.50 ft
Qi = Amount of street flow caught by an inlet (cfs)

Estimate Required Length of Curb Opening

$$L = \left[\frac{Qi}{Cw * d^{1.5}}\right] = \left[\frac{75.00 \text{ cfs}}{3.00 * 0.50^{1.5}}\right] = 70.7 \text{ ft}$$

For Design: For depressed curb, total curb opening = 72 ft

Design depressed curb interception capacity >= required capacity of the Q100 in the street at CP - 244A5

♦ MCFCD Volume II Hydraulics, Reference 2

RIPRAP CALCULATIONS FOR THE CURB OPENINGS ALONG 172TH AVENUE

From the Clark county Regional Flood Control District Hydrologic Criteria and Drainage Design Manual

For the determination of rock size the following equation was used:

Equation 761a $d_{50} = \frac{0.014\,(Q/WH^{1.5})\,H}{(Yt/H)}$

Curb Opening No.1 $d_{50} = \frac{0.014\,(32/60(0.5)^{1.5})\,0.5}{(0.5/0.5)}$ Yt is assumed to be the Top of Curb

$d_{50} =$ 0.10 ft

Curb Opening No.2 $d_{50} = \frac{0.014\,(49/48(0.5)^{1.5})\,0.5}{(0.5/0.5)}$ Yt is assumed to be the Top of Curb

$d_{50} =$ 0.20 ft

Curb Opening No.3 $d_{50} = \frac{0.014\,(75/72(0.5)^{1.5})\,0.5}{(0.5/0.5)}$ Yt is assumed to be the Top of Curb

$d_{50} =$ 0.21 ft

Note: d_{50} = 0.5ft was used for all curb openings

CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

ADOPTED

AUGUST 12, 1999

on one side of the channel, that side should be used as the upstream of the ladder pairs. The side of the channel with the better access should be downstream of the ladder pairs to allow rescue crews to mobilize their equipment. Main-gates in the perimeter fencing should be located at the ladder locations. The bottom rung of the ladder should be placed 1 foot vertically above the channel invert with the remaining rungs at a comfortable spacing for climbing. Yellow stripes (3 feet wide) will be painted on either side of each ladder to assist rescue crews in locating the ladders. The ladders should be made of either galvanized steel or some other UV-resistant material.

707.4 Outlet Protection

Scour resulting from highly turbulent rapidly decelerating flow is a common problem at conduit outlets. Both riprap and gabions have been used for outlet protection in unlined or vegetation lined channels. The following riprap protection is suggested for outlet Froude Numbers up to 2.5 (Froude Parameters $Q/D^{2.5}$ or $Q/WH^{1.5} < 14$ $ft^{0.5}/sec$) where the outlet of the conduit slope is parallel with the channel gradient and the conduit outlet invert is flush with the riprap channel protection (USDCM, 1969). Here Q is the discharge in cubic feet per second, D is the diameter of a circular conduit in feet and W and H are the width and height of a rectangular conduit in feet.

707.4.1 Configuration of Protection

Figure 711 illustrates a typical riprap basin at a conduit outlet. The additional thickness of the riprap just downstream from the outlet is to assure protection from extreme flow conditions which might cause rock movement in this region. Note that protection is required under the conduit barrel and an end slope is provided to accommodate degradation of the downstream channel.

707.4.2 Rock Size

The required rock size may be selected from **Figure 712** for circular conduits and from **Figure 713** for rectangular conduits. **Figure 712** is valid for $Q/D^{2.5} \leq 6.0$ and **Figure 713** is valid for $Q/WH^{1.5} \leq 8.0$. The parameters in these two figures are:

a. $Q/D^{1.5}$ or $Q/WH^{0.5}$ in which Q is the design discharge in cubic feet per second and D is a circular conduit diameter in feet and W and H are the width and height of a rectangular conduit in feet.

b. Y_t /D or Y_t /H in which Y_t is the tailwater depth in feet, D is the diameter of a circular conduit and H is the height of a rectangular conduit in feet. In cases where Y_t is unknown or a hydraulic jump is suspected downstream of the outlet. Use $Y_t/D = Y_t/H = 0.40$ when using **Figures 712** and **713**.

The riprap size requirements in **Figures 712** and **713** are based on the following non-dimensional parametric equations (USDCM,1969):

Circular Culvert:

$$(d_{50}/D)\ (Y_t/D)^{1.2}/(Q/D^{2.5}) = 0.023 \qquad (760)$$

Rectangular Culvert:

(a) For Q/WH1.5 < 4.0, use (USDCM, 1969):

$$(d_{50}/H)\ (Y_t/H)/(Q/WH^{1.5}) = 0.014 \qquad (761a)$$

(b) For Q/WH1.5 $\geq$ 4.0, use (CHEN, 1970, 1969):

$$(d_{50}/H)\ (Y_t/H)^2/(Q/WH^{1.5})^{2.5} = 0.0019 \qquad (761b)$$

The rock size requirements were determined assuming that the flow in the culvert barrel is not super-critical. **Equations 760** and **761** can be used when the flow in the culvert is less than a pipe full and is super-critical if the value of D or H is modified for use with **Figures 712** and **713**. Whenever the flow is super-critical in the culvert, substitute the average depth (D_a) for D and average height (H_a) for H, in which D_a is defined as:

$$D_a = 1/2\ (D + Y_n) \qquad (762)$$

in which maximum D_a shall not exceed D, and:

$$H_a = 1/2\ (H + Y_n) \qquad (763)$$

in which maximum H_a shall not exceed H and:

D_a = A Parameter to be Used in **Figure 712** Whenever the Culvert Flow is Super-Critical

D = Diameter of a Circular Culvert, in ft

H_a = A Parameter to be Used in **Figure 713** Whenever the Culvert Flow is Super-Critical

H = Height of a Rectangular Culvert, in ft

Y_n = Normal Depth of Super-Critical Flow in the Culvert

707.4.3 Extent of Protection

The length of the riprap protection downstream from the outlet depends on the degree of protection desired. To prevent all erosion, the riprap must be continued until the velocity has been reduced to the allowable velocity in the outlet channel. The rate at which the velocity of a jet from a conduit outlet decreases is not well known. For the procedure recommended here, the velocity decrease is assumed to be related to the angle of lateral expansions, θ, of the jet. The velocity is related to the expansion factor, (1/ (2 tan θ)), which may be determined directly using **Figures 714** or **715.**

Assuming that the expanding jet has a rectangular shape:

$$L = (1/(2 \tan \theta))(A_t / Y_t - W) \quad (764)$$

In which:

L = Length of Protection, in ft

W = Width of the Conduit, in ft (Use Diameter for Circular Conduits)

Y_t = Tailwater Depth, in ft

θ = The Expansion Angle of the Culvert Flow

$$A_t = Q / V \quad (765)$$

Q = Design Discharge in cfs

V = The Allowable Non-Eroding Velocity in the Downstream Channel in fps

A_t = Required Area of Flow at Allowable Velocity, in sq ft

In certain circumstances, **Equation 764** may yield unreasonable results. Therefore, in no case should L be less than 3D or 3H, nor does L need to be greater than 10D or 10H whenever the Froude parameter $Q/D^{2.5} \leq 6.0$ or $Q/WH^{1.5} \leq 8.0$. Whenever the Froude parameter is greater than these maximums, increase the maximum L required by one-fourth D or H for each whole number the Froude parameter is greater than 6 or 8 for circular or rectangular pipe, respectively.

707.4.4 Multiple Conduits

The procedures outlined in the sections above can be used to design outlet erosion protection for multi-barrel culvert installations by hypothetically replacing the multiple barrels with a single hydraulically equivalent rectangular conduit. The dimensions of the equivalent conduit may be established as follows: First, distribute the total discharge, Q, among the individual conduits. Where all the conduits are hydraulically similar and identically situated, the flow can be assumed to be equally distributed, otherwise, the flow through each barrel must be computed. Next, compute the Froude parameter $Q_i/D_i^{2.5}$ or $Q_i/W_i\ H_i^{1.5}$, where the subscript i indicates the discharge and dimensions associated with an individual conduit. If the installation includes dissimilar conduits, select the conduit with the largest value of the Froude parameter to determine the dimensions of the equivalent conduit. Make the height of the equivalent conduit, H_e, equal to the height, or diameter, of the selected individual conduit. The width of the equivalent conduit, W_e, is determined by equating the Froude parameter from the selected individual conduit with the Froude parameter associated with the equivalent conduit, $Q_e/W_eH_e^{1.5}$.

708 EXAMPLE APPLICATIONS

708.1 Example: Degradation and Aggradation

a. Channel Design Using the Equilibrium Slope Concept (Refer to Section 704.2.1.2). The following is an example of the procedure by which the equilibrium slope of a channel can be calculated. The physical layout of the system is given in the following figure. The upstream channelized section has been in existence for many years

APPENDIX C

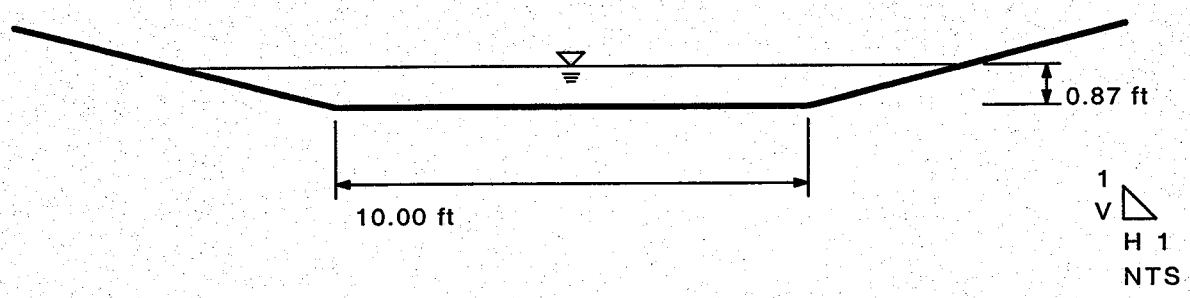
Drainage Easement Cross-Sections

Drainage Easement (E1)
Cross Section for Trapezoidal Channel

Project Description	
Project File	n:\980098\hydro\haestad\phase2b\project9.fm2
Worksheet	E1
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data		
Mannings Coefficient	0.030	
Channel Slope	0.002000	ft/ft
Depth	0.87	ft
Left Side Slope	4.000000	H : V
Right Side Slope	4.000000	H : V
Bottom Width	10.00	ft
Discharge	20.00	cfs

(CP-1 100 year)



Drainage Easement (E1)
Worksheet for Trapezoidal Channel

Project Description	
Project File	n:\980098\hydro\haestad\phase2b\project9.fm2
Worksheet	E1
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.030	
Channel Slope	0.002000	ft/ft
Left Side Slope	4.000000	H : V
Right Side Slope	4.000000	H : V
Bottom Width	10.00	ft
Discharge	20.00	cfs

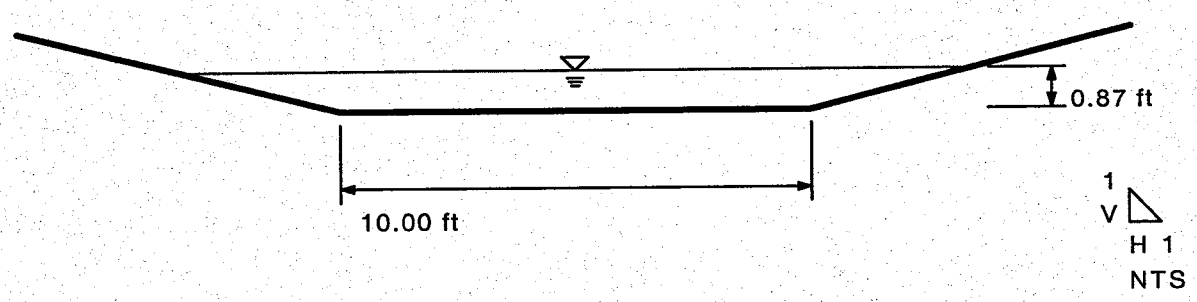
Results		
Depth	0.87	ft
Flow Area	11.67	ft^2
Wetted Perimeter	17.15	ft
Top Width	16.93	ft
Critical Depth	0.47	ft
Critical Slope	0.017941	ft/ft
Velocity	1.71	ft/s
Velocity Head	0.05	ft
Specific Energy	0.91	ft
Froude Number	0.36	
Flow is subcritical.		

Drainage Easement (E2)
Cross Section for Trapezoidal Channel

Project Description	
Project File	n:\980098\hydro\haestad\phase2b\project9.fm2
Worksheet	E2
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data		
Mannings Coefficient	0.030	
Channel Slope	0.002000	ft/ft
Depth	0.87	ft
Left Side Slope	4.000000	H : V
Right Side Slope	4.000000	H : V
Bottom Width	10.00	ft
Discharge	20.00	cfs

(CP-2 100 year)



Drainage Easement (E2)
Worksheet for Trapezoidal Channel

Project Description	
Project File	n:\980098\hydro\haestad\phase2b\project9.fm2
Worksheet	E2
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.030	
Channel Slope	0.002000	ft/ft
Left Side Slope	4.000000	H : V
Right Side Slope	4.000000	H : V
Bottom Width	10.00	ft
Discharge	20.00	cfs

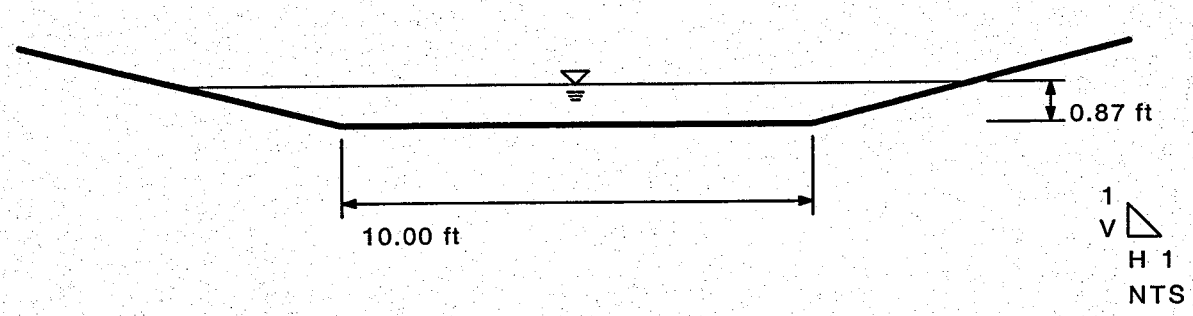
Results		
Depth	0.87	ft
Flow Area	11.67	ft^2
Wetted Perimeter	17.15	ft
Top Width	16.93	ft
Critical Depth	0.47	ft
Critical Slope	0.017941	ft/ft
Velocity	1.71	ft/s
Velocity Head	0.05	ft
Specific Energy	0.91	ft
Froude Number	0.36	
Flow is subcritical.		

Drainage Easement (E3)
Cross Section for Trapezoidal Channel

Project Description	
Project File	n:\980098\hydro\haestad\phase2b\project9.fm2
Worksheet	E3
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data		
Mannings Coefficient	0.030	
Channel Slope	0.002000	ft/ft
Depth	0.87	ft
Left Side Slope	4.000000	H : V
Right Side Slope	4.000000	H : V
Bottom Width	10.00	ft
Discharge	20.00	cfs

(CP-3 100 year)



Drainage Easement (E3)
Worksheet for Trapezoidal Channel

Project Description	
Project File	n:\980098\hydro\haestad\phase2b\project9.fm2
Worksheet	E3
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.030	
Channel Slope	0.002000	ft/ft
Left Side Slope	4.000000	H : V
Right Side Slope	4.000000	H : V
Bottom Width	10.00	ft
Discharge	20.00	cfs

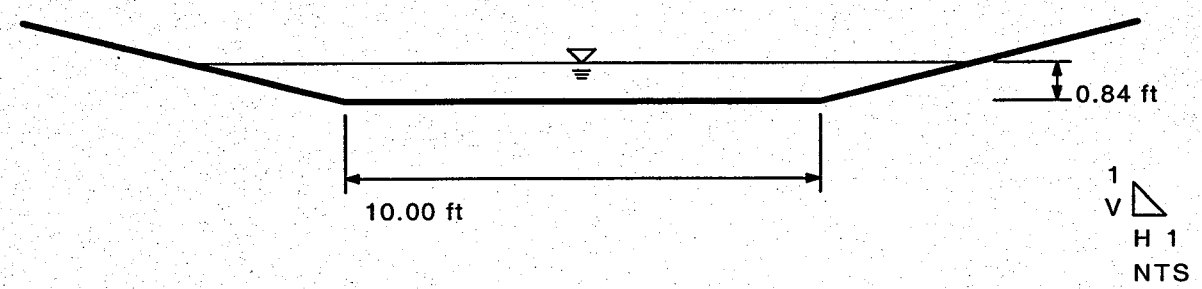
Results		
Depth	0.87	ft
Flow Area	11.67	ft^2
Wetted Perimeter	17.15	ft
Top Width	16.93	ft
Critical Depth	0.47	ft
Critical Slope	0.017941	ft/ft
Velocity	1.71	ft/s
Velocity Head	0.05	ft
Specific Energy	0.91	ft
Froude Number	0.36	
Flow is subcritical.		

Drainage Easement (E4)
Cross Section for Trapezoidal Channel

Project Description	
Project File	untitled.fm2
Worksheet	E4
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data		
Mannings Coefficient	0.030	
Channel Slope	0.002000	ft/ft
Depth	0.84	ft
Left Side Slope	4.000000	H : V
Right Side Slope	4.000000	H : V
Bottom Width	10.00	ft
Discharge	19.00	cfs

(CP-4 100 yr)



Drainge Easement (E4)
Worksheet for Trapezoidal Channel

Project Description	
Project File	untitled.fm2
Worksheet	E4
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.030	
Channel Slope	0.002000	ft/ft
Left Side Slope	4.000000	H : V
Right Side Slope	4.000000	H : V
Bottom Width	10.00	ft
Discharge	19.00	cfs

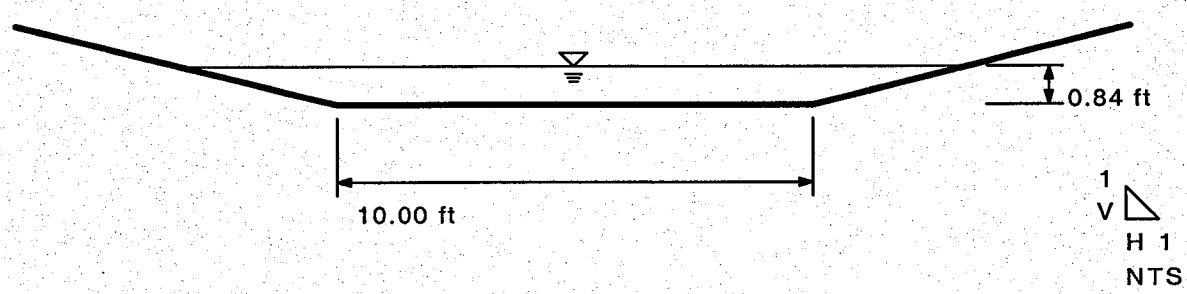
Results		
Depth	0.84	ft
Flow Area	11.26	ft^2
Wetted Perimeter	16.95	ft
Top Width	16.74	ft
Critical Depth	0.45	ft
Critical Slope	0.018108	ft/ft
Velocity	1.69	ft/s
Velocity Head	0.04	ft
Specific Energy	0.89	ft
Froude Number	0.36	
Flow is subcritical.		

Drainge Easement (E5)
Cross Section for Trapezoidal Channel

Project Description	
Project File	untitled.fm2
Worksheet	E5
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data		
Mannings Coefficient	0.030	
Channel Slope	0.002000	ft/ft
Depth	0.84	ft
Left Side Slope	4.000000	H : V
Right Side Slope	4.000000	H : V
Bottom Width	10.00	ft
Discharge	19.00	cfs

(CP-5 100 year)



Drainage Easement (E5)
Worksheet for Trapezoidal Channel

Project Description	
Project File	untitled.fm2
Worksheet	E5
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.030	
Channel Slope	0.002000	ft/ft
Left Side Slope	4.000000	H : V
Right Side Slope	4.000000	H : V
Bottom Width	10.00	ft
Discharge	19.00	cfs

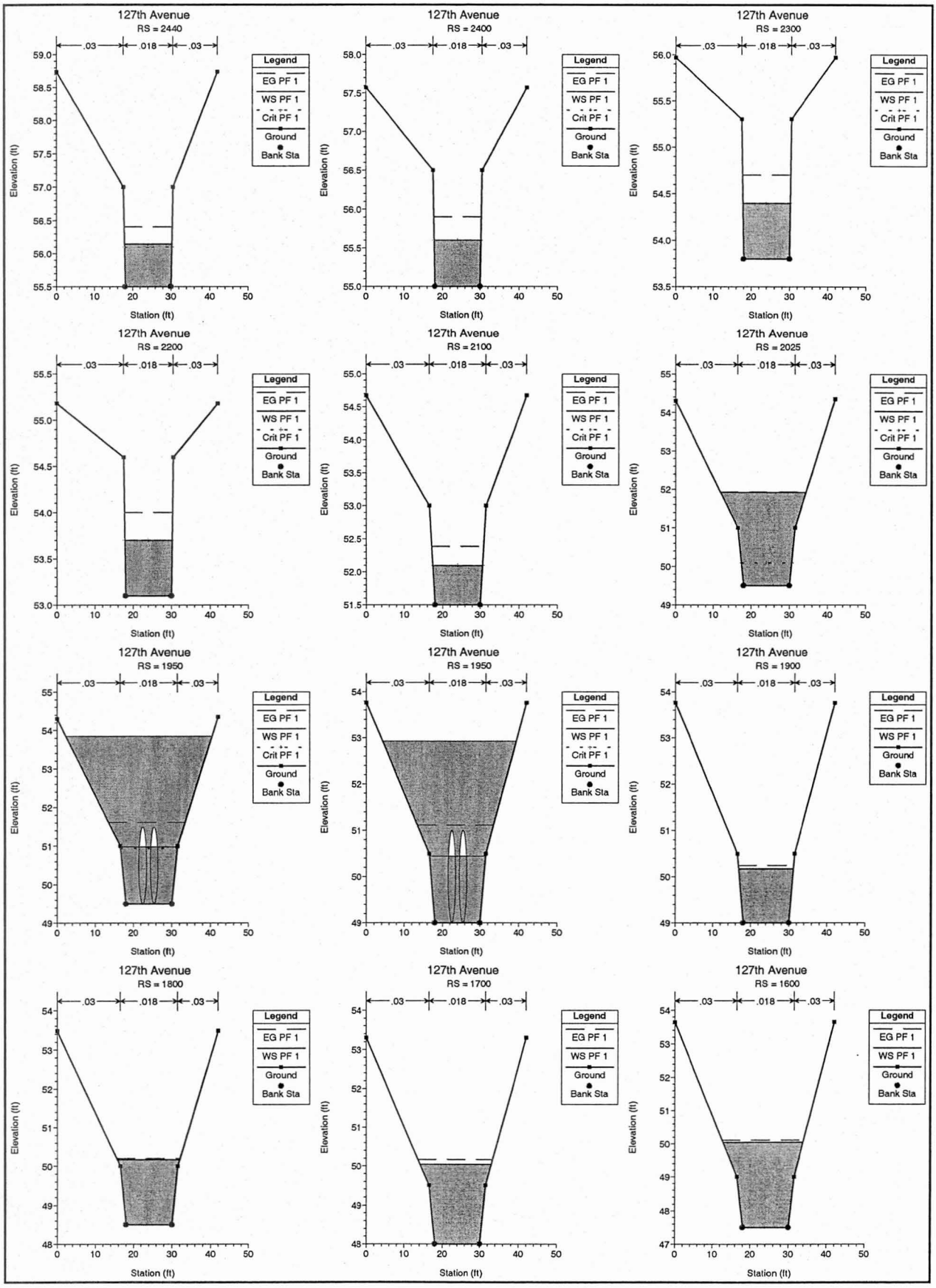
Results		
Depth	0.84	ft
Flow Area	11.26	ft^2
Wetted Perimeter	16.95	ft
Top Width	16.74	ft
Critical Depth	0.45	ft
Critical Slope	0.018108	ft/ft
Velocity	1.69	ft/s
Velocity Head	0.04	ft
Specific Energy	0.89	ft
Froude Number	0.36	
Flow is subcritical.		

APPENDIX D

HEC-RAS Calculations For 127th Avenue Channel

HEC-RAS Plan: Plan 01 River: 127th Ave Reach: R1 Profile: PF 1

Reach	River Sta	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)	
R1	2440	32.00	55.50	56.15	56.10	56.41	0.004432	4.11	7.89	12.43	0.90
R1	2400	32.00	55.00	55.60	55.60	55.90	0.005644	4.42	7.33	12.40	1.00
R1	2300	32.00	53.80	54.40	54.40	54.70	0.005630	4.41	7.34	12.40	1.00
R1	2200	32.00	53.10	53.70	53.70	54.00	0.005599	4.41	7.35	12.40	1.00
R1	2100	32.00	51.50	52.10	52.10	52.39	0.005583	4.37	7.50	13.19	1.00
R1	2025	32.00	49.50	51.93	50.10	51.94	0.000042	0.97	37.66	22.55	0.11
R1	1950	Culvert									
R1	1900	32.00	49.00	50.17		50.24	0.000555	2.16	15.48	14.35	0.35
R1	1800	32.00	48.50	50.17		50.21	0.000163	1.48	22.96	16.34	0.20
R1	1700	77.00	48.00	50.05		50.17	0.000459	2.85	29.53	18.89	0.35
R1	1600	77.00	47.50	50.05		50.12	0.000209	2.23	39.14	21.09	0.25
R1	1525	77.00	47.20	50.05	48.26	50.10	0.000138	1.95	46.14	23.45	0.20
R1	1450	Culvert									
R1	1400	77.00	47.00	48.61		48.82	0.001069	3.71	22.03	16.08	0.52
R1	1300	77.00	46.90	48.50		48.71	0.001113	3.76	21.75	16.21	0.52
R1	1200	77.00	46.80	48.38		48.59	0.001159	3.81	21.46	16.08	0.53
R1	1100	77.00	46.30	48.39		48.50	0.000417	2.76	31.70	23.53	0.34
R1	1010	77.00	45.70	48.41	46.76	48.46	0.000156	2.00	48.15	31.10	0.21
R1	960	Culvert									
R1	920	77.00	45.11	46.42		46.74	0.002228	4.66	17.39	14.61	0.72
R1	800	77.00	44.26	46.39		46.50	0.001099	2.72	32.38	23.33	0.33
R1	700	77.00	43.55	46.38		46.42	0.000346	1.84	51.93	32.68	0.19
R1	600	149.00	42.84	46.29		46.37	0.000533	2.61	75.03	41.16	0.25
R1	510	149.00	42.20	46.29	43.85	46.35	0.000117	2.28	92.63	40.90	0.20
R1	460	Culvert									
R1	410	149.00	41.85	45.14		45.27	0.000281	3.06	63.26	32.94	0.30
R1	300	149.00	41.60	45.14		45.24	0.000209	2.77	72.24	35.89	0.26
R1	210	149.00	41.30	45.14	42.95	45.22	0.000151	2.49	83.22	38.77	0.22
R1	190	Culvert									
R1	170	149.00	41.10	43.27		43.65	0.001381	5.14	32.55	21.70	0.62
R1	100	149.00	40.90	43.24		43.55	0.001051	4.71	36.35	23.51	0.54
R1	0	149.00	40.60	43.20		43.44	0.000700	4.13	43.03	26.33	0.45
R1	-300	248.00	39.70	42.00	42.00	42.90	0.003103	8.00	35.54	23.43	0.93
R1	-600	248.00	38.80	41.35		42.03	0.002095	7.05	41.95	26.45	0.78
R1	-855	248.00	38.10	41.21	40.40	41.59	0.000949	5.42	60.03	34.41	0.54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127th Avenue
RS = 1800
127th Avenue
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127th Avenue
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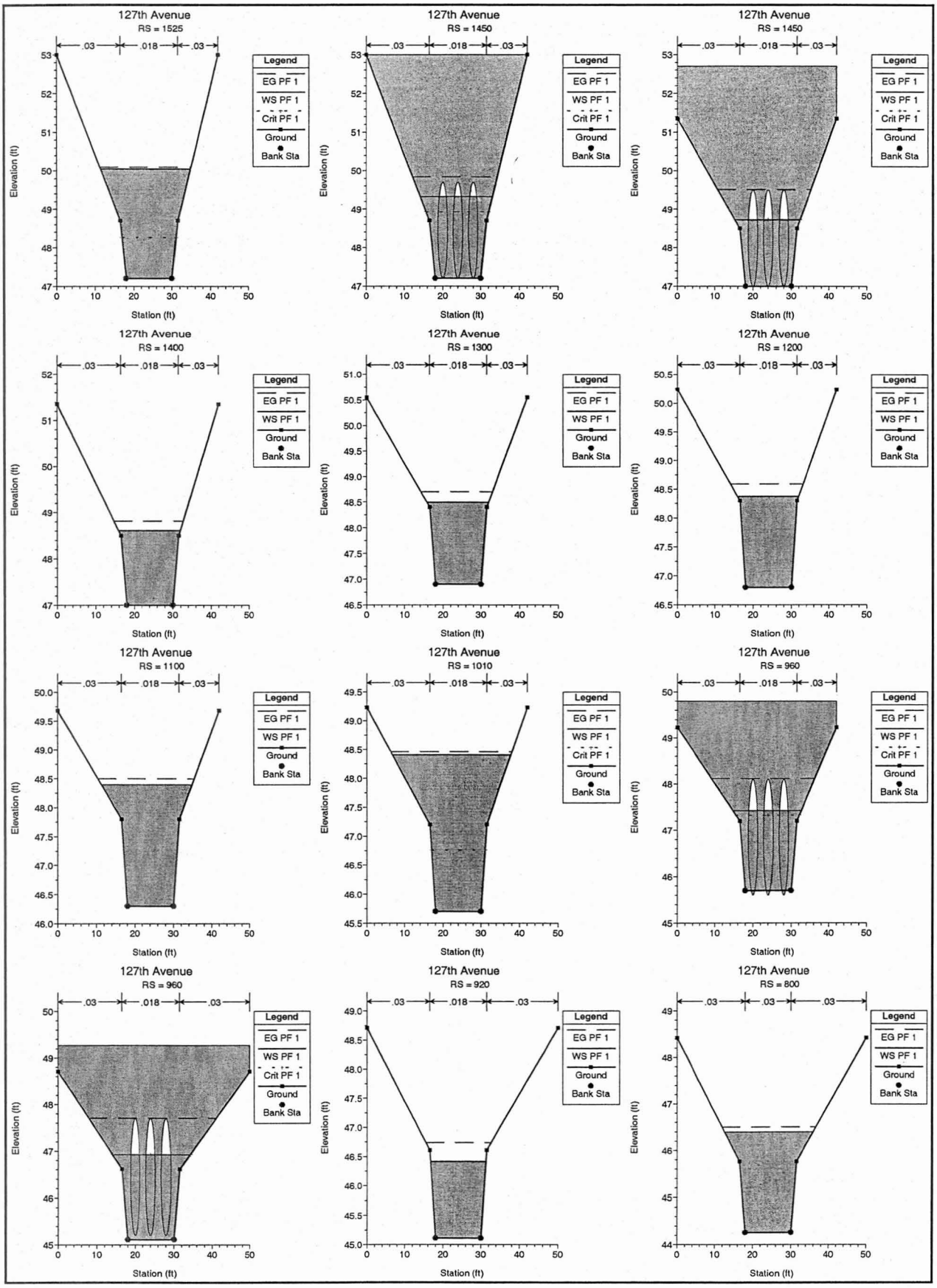
.03
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)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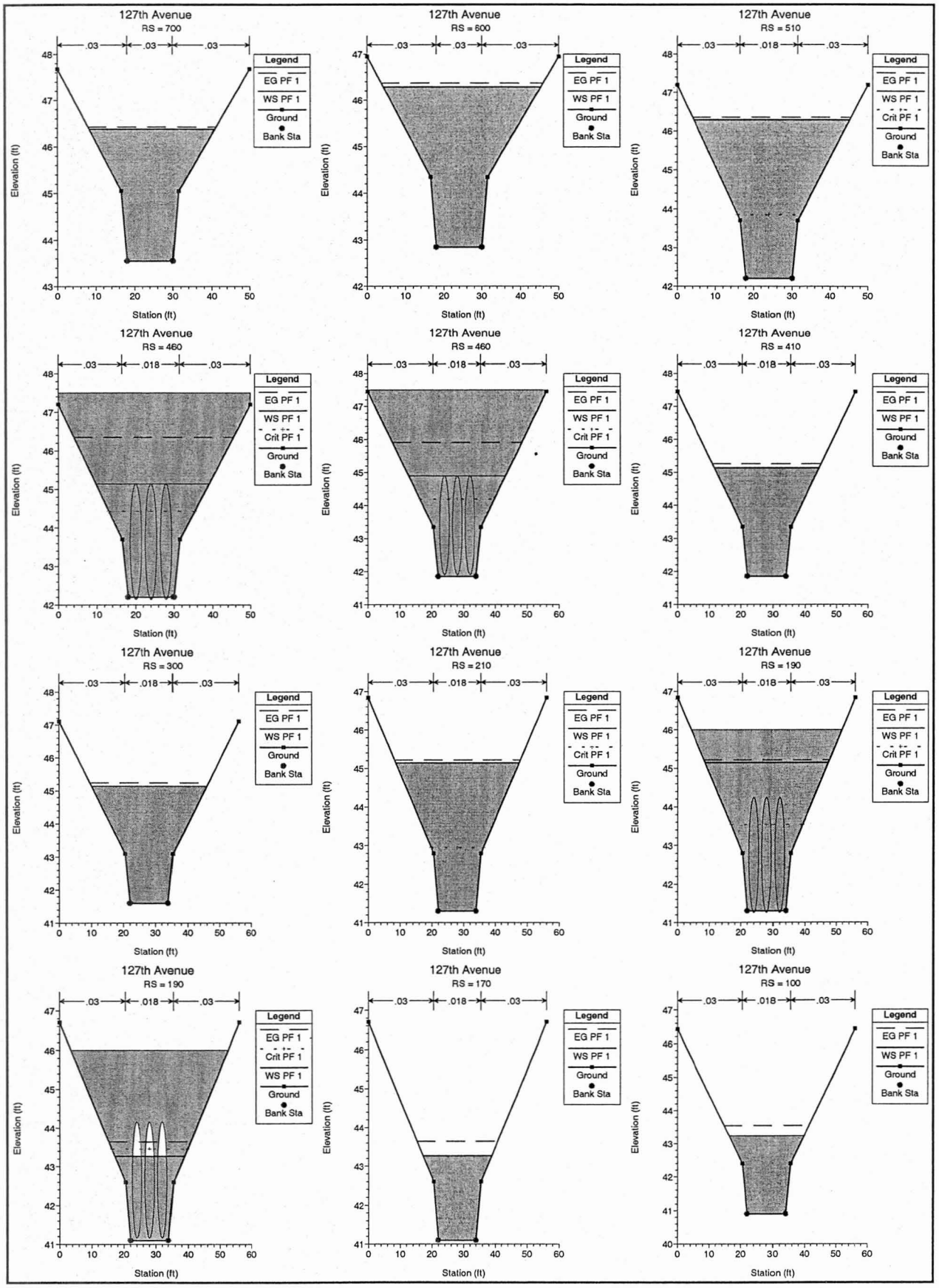
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)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WS PF 1
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EG PF 1
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Crit PF 1
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Station (ft)
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WS PF 1
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Bank Sta
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Station (ft)
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EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
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Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
127th Avenue
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.03 .018 .03
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
127th Avenue
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Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
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EG PF 1
WS PF 1
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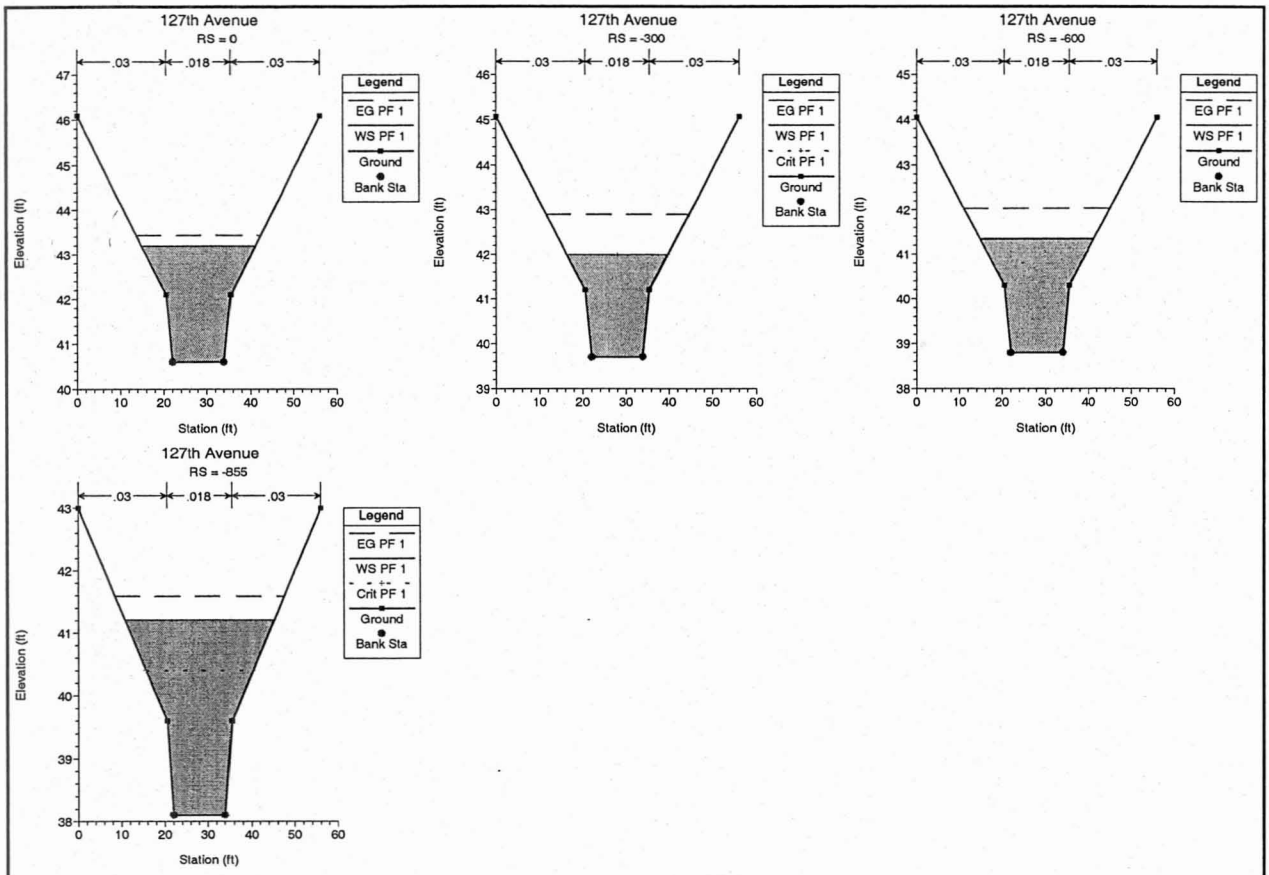
Bank Sta
Elevation (ft)
Station (ft)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Ground
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Station (ft)
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.018
.03
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
127th Avenue
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.018
.03
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
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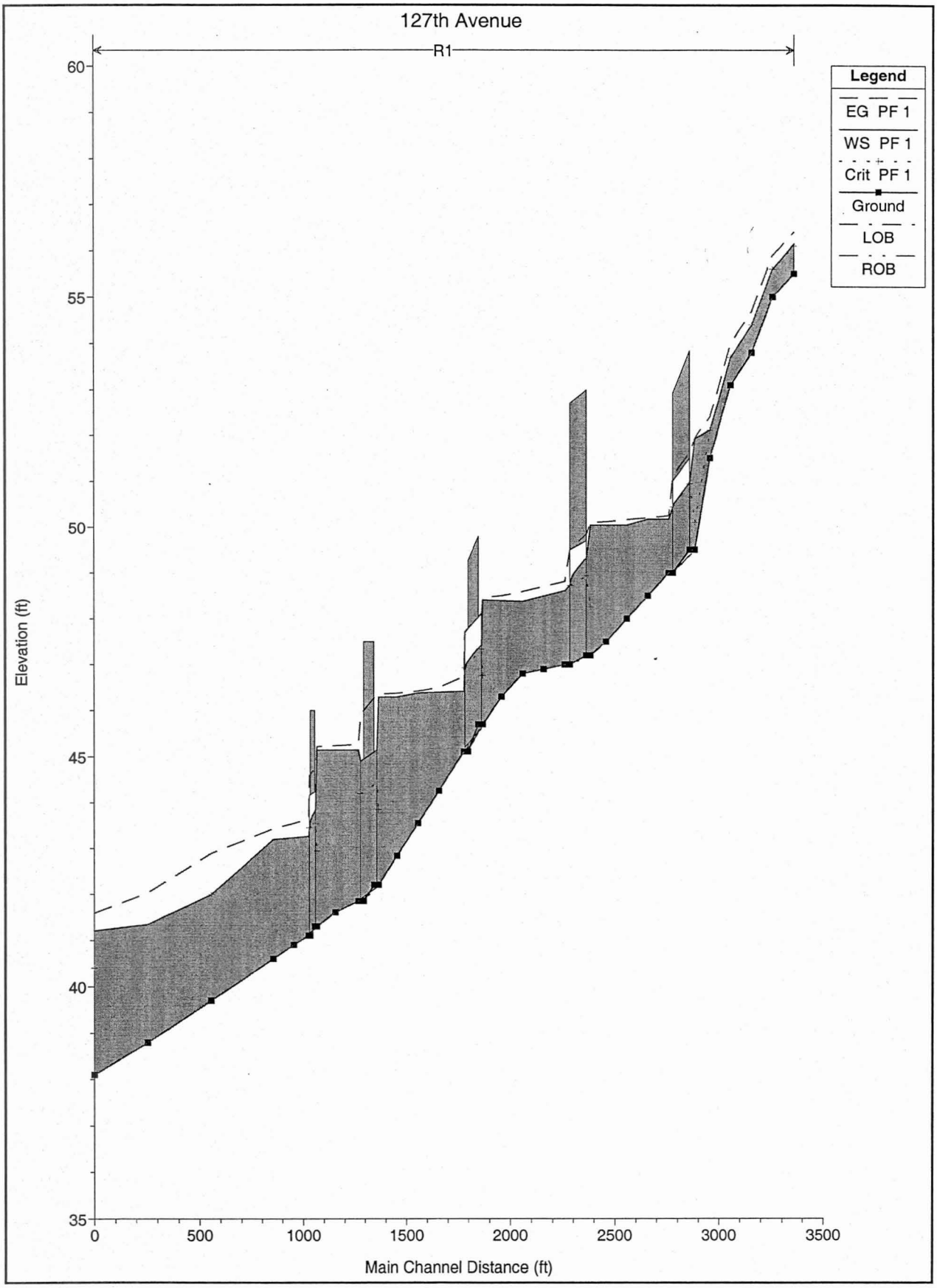
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)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Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
LOB
ROB
Elevation (ft)
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55
50
45
40
35
0
500
1000
1500
2000
2500
3000
3500
Main Channel Distance (ft)

Colter Channel HEC-RAS

Used for tailwater elevation for 127th Ave Channel

HEC-RAS Plan: Imported Pla River: RIVER-1 Reach: Reach-1 Profile: PF 1

Reach	River Sta	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	19080	70.00	1058.80	1060.31		1060.51	0.006224	3.60	19.43	21.70	0.67
Reach-1	19000	70.00	1058.30	1059.90		1060.07	0.004927	3.31	21.16	22.52	0.60
Reach-1	18750	70.00	1056.80	1058.22		1058.47	0.008287	4.01	17.44	20.51	0.77
Reach-1	18700	70.00	1056.50	1058.10		1058.20	0.002837	2.64	26.51	26.21	0.46
Reach-1	18500	125.00	1055.30	1057.12		1057.36	0.005332	3.92	31.90	27.97	0.65
Reach-1	18250	125.00	1053.80	1055.46		1055.76	0.007720	4.45	28.10	26.93	0.77
Reach-1	18000	125.00	1052.30	1055.30		1055.34	0.000546	1.66	75.10	43.07	0.22
Reach-1	17750	340.00	1050.80	1055.07		1055.16	0.000768	2.44	139.60	58.36	0.28
Reach-1	17580	340.00	1049.80	1054.97		1055.05	0.000541	2.33	145.81	49.42	0.24
Reach-1	17550	340.00	1049.80	1054.98		1055.03	0.000291	1.75	194.84	64.00	0.18
Reach-1	17480	340.00	1049.60	1054.97		1055.01	0.000251	1.67	203.76	64.00	0.16
Reach-1	17420	340.00	1049.50	1054.95	1051.88	1054.99	0.000230	1.62	209.34	64.00	0.16
Reach-1	17390	Culvert									
Reach-1	17360	340.00	1049.40	1052.92		1053.11	0.002017	3.52	96.59	47.91	0.44
Reach-1	17310	340.00	1049.30	1052.98		1053.03	0.000391	1.77	192.19	78.72	0.20
Reach-1	17250	540.00	1049.30	1052.84		1052.98	0.001166	2.98	181.21	77.01	0.34
Reach-1	16900	540.00	1048.70	1052.53		1052.64	0.000774	2.58	209.13	81.01	0.28
Reach-1	16600	620.00	1048.20	1052.29		1052.40	0.000777	2.69	230.38	84.07	0.29
Reach-1	16350	900.00	1047.70	1051.87		1052.10	0.001611	3.88	232.11	84.65	0.41
Reach-1	16300	900.00	1047.60	1051.80		1052.02	0.001450	3.73	241.23	86.10	0.39
Reach-1	16250	900.00	1047.60	1051.71		1051.94	0.001592	3.86	233.33	84.99	0.41
Reach-1	16000	900.00	1047.20	1051.32		1051.55	0.001586	3.85	233.63	85.03	0.41
Reach-1	15750	900.00	1046.70	1050.93		1051.16	0.001508	3.79	237.47	85.26	0.40
Reach-1	15500	900.00	1046.30	1050.57		1050.79	0.001459	3.75	240.14	85.56	0.39
Reach-1	15250	900.00	1045.90	1050.24		1050.44	0.001265	3.56	253.15	87.68	0.37
Reach-1	15080	900.00	1045.60	1050.07		1050.24	0.000996	3.28	274.59	89.75	0.33
Reach-1	14950	900.00	1045.40	1049.95		1050.11	0.001018	3.17	283.84	99.37	0.33
Reach-1	14750	1060.00	1045.00	1049.62		1049.85	0.001445	3.91	271.05	89.92	0.40
Reach-1	14707	1060.00	1044.90	1049.56		1049.79	0.001388	3.85	275.00	90.44	0.39
Reach-1	14662	1060.00	1044.90	1049.48		1049.73	0.001493	3.96	267.94	89.50	0.40
Reach-1	14652	1060.00	1044.90	1049.28	1047.93	1049.69	0.002773	5.12	207.04	65.45	0.51
Reach-1	14600	Bridge									
Reach-1	14548	1060.00	1044.70	1048.93		1049.38	0.003184	5.38	197.17	64.52	0.54
Reach-1	14538	1060.00	1044.70	1049.02		1049.30	0.001797	4.23	250.50	86.95	0.44
Reach-1	14487	1060.00	1044.60	1048.93		1049.21	0.001781	4.22	251.30	87.06	0.44
Reach-1	14250	1080.00	1044.20	1048.46		1048.76	0.001989	4.41	244.84	86.17	0.46
Reach-1	14000	1080.00	1043.70	1047.90		1048.23	0.002246	4.60	234.64	84.88	0.49
Reach-1	13750	1080.00	1043.30	1047.19		1047.59	0.002915	5.06	213.62	81.64	0.55
Reach-1	13630	1080.00	1043.08	1046.05	1045.96	1046.96	0.009437	7.64	141.43	70.36	0.95
Reach-1	13628	1080.00	1042.08	1046.48		1046.76	0.001792	4.25	254.11	87.43	0.44
Reach-1	13500	1080.00	1041.90	1046.25		1046.53	0.001814	4.26	253.63	87.82	0.44
Reach-1	13250	1080.00	1041.40	1045.77		1046.07	0.001890	4.33	249.50	86.93	0.45
Reach-1	13000	1080.00	1041.00	1045.29		1045.59	0.001926	4.36	247.54	86.42	0.45
Reach-1	12750	1080.00	1040.60	1044.74		1045.07	0.002221	4.58	235.96	85.35	0.49
Reach-1	12500	1080.00	1040.10	1043.99		1044.41	0.003103	5.16	209.12	81.14	0.57
Reach-1	12400	1080.00	1039.95	1042.83	1042.83	1043.82	0.010769	8.00	135.00	69.15	1.01
Reach-1	12398	1080.00	1037.95	1042.27		1042.57	0.001940	4.38	246.79	86.26	0.46
Reach-1	12250	1080.00	1037.70	1041.94		1042.26	0.002152	4.53	238.19	85.35	0.48
Reach-1	12000	1080.00	1037.20	1041.36		1041.70	0.002340	4.67	231.20	84.36	0.50
Reach-1	11900	1080.00	1037.10	1041.08		1041.45	0.002618	4.85	222.54	83.44	0.52
Reach-1	11825	1210.00	1036.92	1039.98	1039.98	1041.02	0.010497	8.20	147.62	71.52	1.01
Reach-1	11820	1210.00	1034.57	1040.53		1040.67	0.000618	3.00	403.64	105.40	0.27
Reach-1	11801	1210.00	1034.50	1040.53	1037.59	1040.66	0.000600	2.95	409.82	107.04	0.27
Reach-1	11776.5	Culvert									
Reach-1	11752	1210.00	1034.40	1039.09		1039.38	0.001716	4.32	280.15	91.05	0.43
Reach-1	11652	1210.00	1034.20	1038.91		1039.20	0.001725	4.33	279.68	91.02	0.43
Reach-1	11500	1210.00	1033.90	1038.66		1038.95	0.001648	4.26	284.27	91.63	0.43
Reach-1	11250	1210.00	1033.40	1038.32		1038.56	0.001351	3.96	305.73	94.70	0.39
Reach-1	11000	1210.00	1032.80	1038.04	1035.88	1038.25	0.001097	3.68	329.07	97.35	0.35
Reach-1	10921	Culvert									
Reach-1	10750	1210.00	1032.30	1036.67		1037.02	0.002249	4.76	253.96	87.30	0.49
Reach-1	10688	1210.00	1032.00	1036.57		1036.88	0.001854	4.45	272.14	89.73	0.45
Reach-1	10628	1210.00	1031.90	1036.46		1036.77	0.001878	4.47	270.87	89.57	0.45
Reach-1	10500	1210.00	1031.80	1036.14		1036.50	0.002284	4.78	253.34	87.78	0.50
Reach-1	10250	1210.00	1031.20	1035.52		1035.90	0.002508	4.95	244.58	86.25	0.52
Reach-1	10040	1210.00	1030.78	1033.84	1033.84	1034.88	0.010495	8.20	147.49	71.34	1.01
Reach-1	10038	1210.00	1028.78	1033.00		1033.40	0.002682	5.07	238.59	85.23	0.53
Reach-1	10000	1210.00	1028.70	1032.91		1033.30	0.002613	5.01	241.47	86.13	0.53
Reach-1	9750	1210.00	1028.00	1032.21		1032.62	0.002794	5.14	235.35	84.95	0.54
Reach-1	9500	1210.00	1027.40	1031.42		1031.87	0.003185	5.39	224.41	83.19	0.58
Reach-1	9385	1210.00	1027.10	1030.15	1030.15	1031.20	0.010587	8.22	147.14	71.40	1.01
Reach-1	9384	1210.00	1023.75	1028.03		1028.41	0.000719	4.97	243.51	85.81	0.52
Reach-1	9337	1210.00	1023.70	1027.99		1028.38	0.000741	5.03	240.76	85.27	0.53
Reach-1	9327	1210.00	1023.70	1027.60	1026.96	1028.33	0.001617	6.85	176.58	62.31	0.72

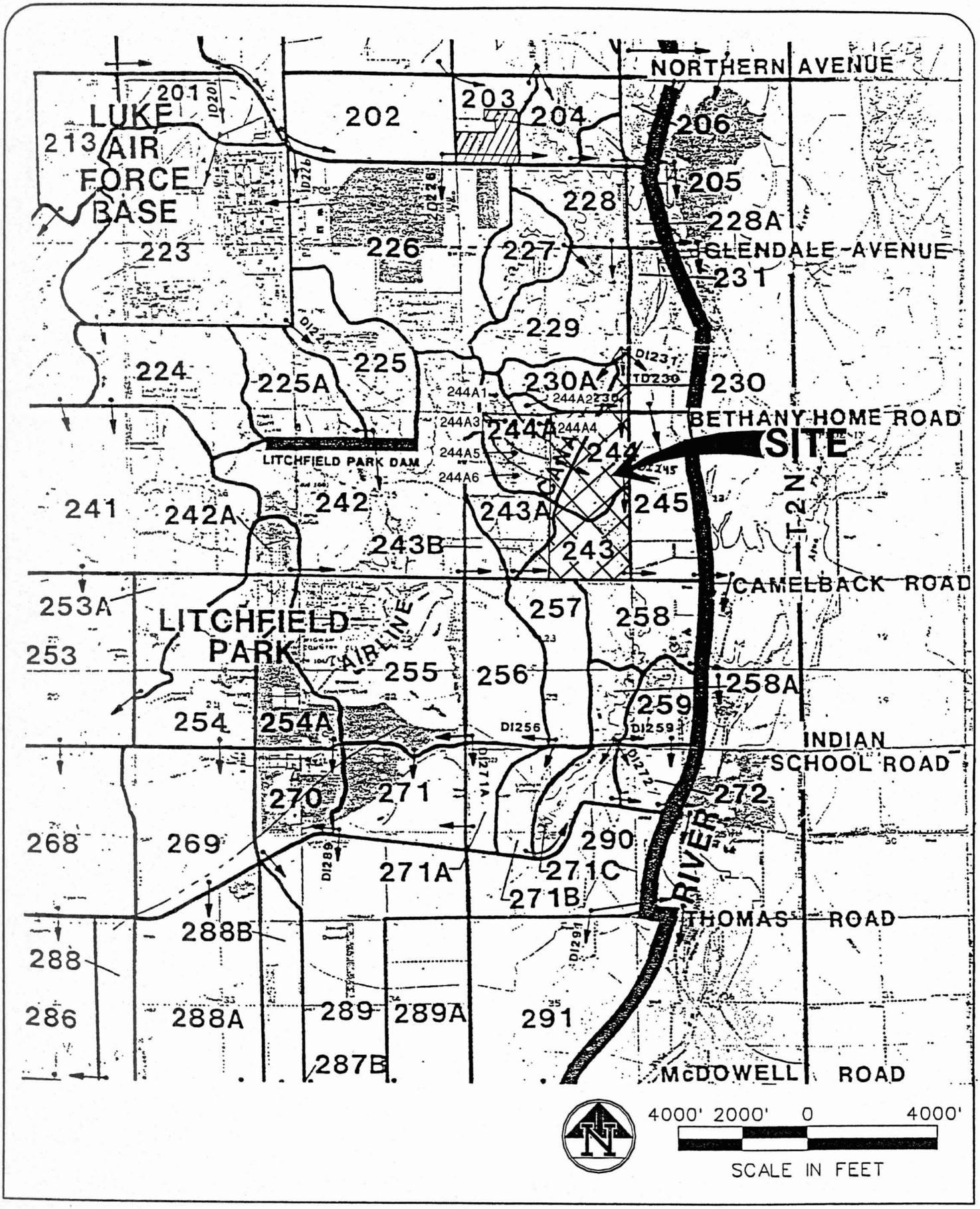
7th channel → 1st fall STA 11946

HEC-RAS Plan: Imported Pla River: RIVER-1 Reach: Reach-1 Profile: PF 1 (Continued)

Reach	River Sta	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	9285	Bridge									
Reach-1	9243	1210.00	1023.50	1026.75	1026.75	1027.96	0.003332	8.81	137.38	58.05	1.01
Reach-1	9233	1210.00	1023.50	1026.56	1026.56	1027.60	0.010380	8.17	148.16	71.57	1.00
Reach-1	9133	1210.00	1023.30	1025.94		1026.13	0.001626	3.52	343.42	146.12	0.41
Reach-1	9000	1210.00	1023.10	1025.72		1025.91	0.001677	3.56	339.97	145.83	0.41
Reach-1	8750	1210.00	1022.70	1025.28		1025.48	0.001774	3.63	333.15	144.58	0.42
Reach-1	8500	1210.00	1022.30	1024.79		1025.01	0.002002	3.78	320.33	143.52	0.45
Reach-1	8250	1210.00	1021.90	1024.11		1024.40	0.003002	4.30	281.52	140.87	0.54
Reach-1	8000	1210.00	1021.50	1023.71		1023.86	0.001415	3.02	401.05	194.28	0.37
Reach-1	7978	1210.00	1021.50	1023.67		1023.82	0.001520	3.08	392.32	194.01	0.38
Reach-1	7973	1210.00	1021.50	1023.65		1023.81	0.001845	3.23	375.12	187.74	0.40
Reach-1	7968	1210.00	1021.50	1023.64		1023.80	0.001577	3.12	387.77	193.73	0.39
Reach-1	7750	1210.00	1021.10	1023.33		1023.47	0.001374	2.98	405.37	195.16	0.36
Reach-1	7500	1210.00	1020.60	1023.06		1023.17	0.000985	2.69	450.50	197.95	0.31
Reach-1	7300	1210.00	1020.20	1022.86		1022.95	0.000760	2.48	488.55	199.55	0.28
Reach-1	7250	1210.00	1020.10	1022.83		1022.92	0.000618	2.28	531.11	210.45	0.25
Reach-1	7000	1210.00	1019.90	1022.69		1022.77	0.000579	2.23	542.25	211.08	0.25
Reach-1	6750	1210.00	1019.70	1022.55		1022.63	0.000535	2.17	556.96	212.68	0.24
Reach-1	6660	1210.00	1019.80	1022.49	1020.91	1022.57	0.000654	2.32	522.22	210.69	0.26
Reach-1	6630	Culvert									
Reach-1	6600	1210.00	1019.80	1022.43		1022.52	0.000703	2.37	510.33	210.00	0.27
Reach-1	6500	1210.00	1019.50	1022.38		1022.45	0.000515	2.15	563.46	213.06	0.23
Reach-1	6250	1210.00	1019.30	1022.26		1022.33	0.000471	2.09	579.15	213.15	0.22
Reach-1	6000	1210.00	1019.00	1022.16		1022.22	0.000376	1.94	622.35	215.54	0.20
Reach-1	5750	1210.00	1018.80	1022.08		1022.13	0.000333	1.87	647.16	216.90	0.19
Reach-1	5500	1210.00	1018.60	1022.00		1022.05	0.000293	1.79	674.36	218.38	0.18
Reach-1	5250	1210.00	1018.40	1021.94		1021.98	0.000256	1.71	705.73	221.03	0.17
Reach-1	5000	1210.00	1018.20	1021.88		1021.92	0.000223	1.64	737.48	222.77	0.16
Reach-1	4750	1210.00	1018.00	1021.83		1021.87	0.000200	1.61	751.81	214.73	0.15
Reach-1	4576	1210.00	1017.80	1021.80	1018.91	1021.84	0.000166	1.52	794.76	213.33	0.14

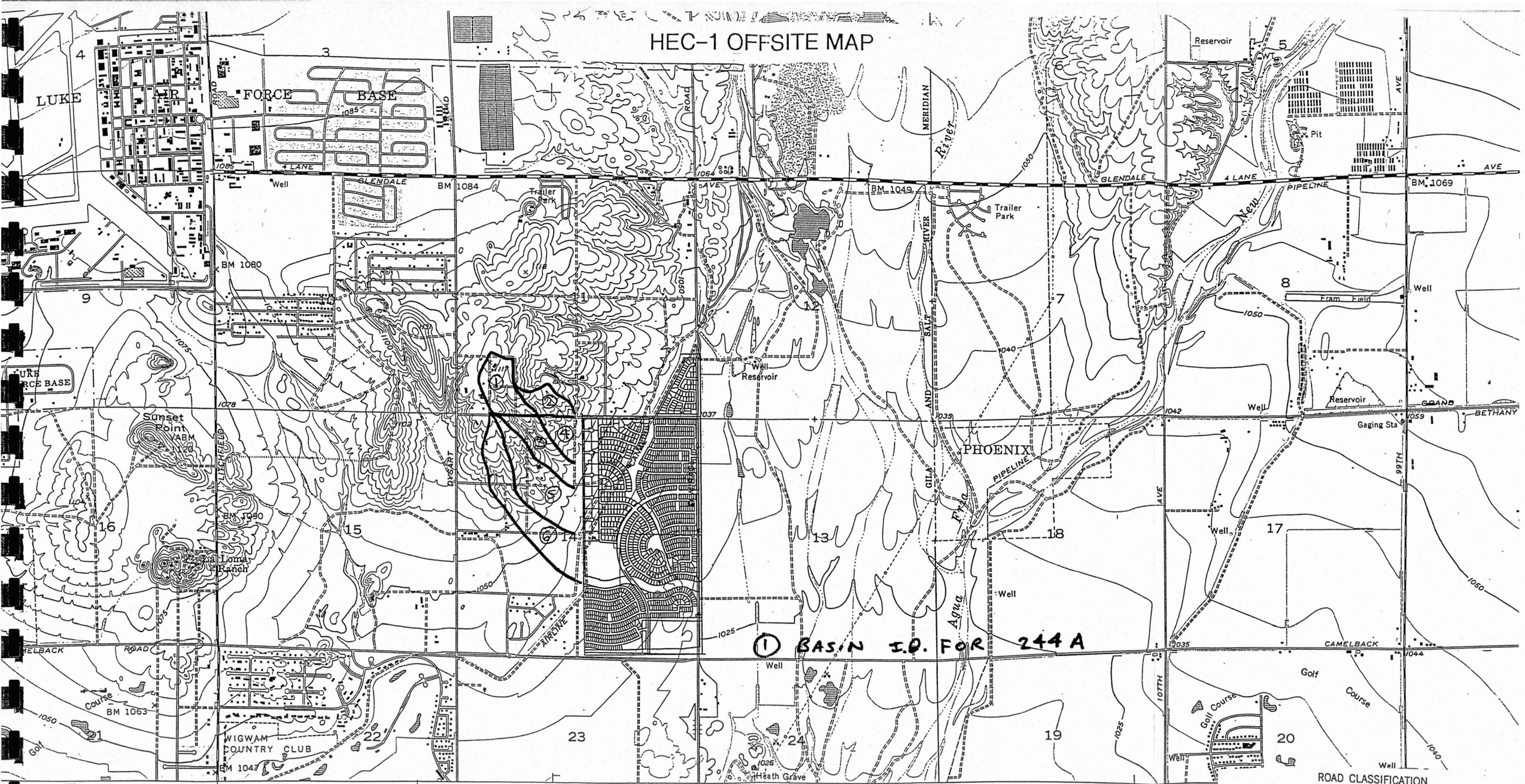
APPENDIX E

Off-Site Drainage Exhibit & Calculations



OFF-SITE MAP (WHITE TANKS ADMS)	WIGWAM CREEK	JOB NO 980098-01
4550 NORTH 12TH STREET PHOENIX, ARIZONA 85014 TELEPHONE (602) 264-6831	COE & VAN LOO PLANNING • ENGINEERING • LANDSCAPE ARCHITECTURE	FIGURE 4

HEC-1 OFFSITE MAP



edited, and published by the Geological Survey

l by USGS and NOS/NOAA

d drainage compiled from aerial photographs
. Topography by planetable surveys 1957

nic projection. 10,000-foot grid ticks based on
ordinate system, central zone
r Universal Transverse Mercator grid ticks,
hown in blue. 1927 North American Datum
ce on the predicted North American Datum 1983
the projection lines 2 meters south and
east as shown by dashed corner ticks

be private inholdings within the boundaries of
al or State reservations shown on this map

UTM GRID AND 1982 MAGNETIC NORTH
DECLINATION AT CENTER OF SHEET

SCALE 1:24 000

CONTOUR INTERVAL 5 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

THIS MAP COMPLIES WITH NATIONAL MAP ACCURACY STANDARDS
FOR SALE BY U. S. GEOLOGICAL SURVEY, DENVER, COLORADO 80225, OR RESTON, VIRGINIA 22092

ROAD CLASSIFICATION

Heavy-duty — Light-duty
Medium-duty — Unimproved dirt
U. S. Route — State Route

ARIZONA
QUADRANGLE LOCATION

EL MIRAGE, ARIZ.
N3330—W11215/7.5

1957
PHOTOREVISED 1982
DMA 3551 III SE-SERIES V898

WigWam Creek Final(all phases constructed)

```
****************************************
*                                      *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *
*              MAY   1991              *
*           VERSION 4.0.1E             *
*     Lahey F77L-EM/32 version 5.01    *
*       Dodson & Associates, Inc.      *
*  RUN DATE  10/09/01  TIME  15:18:04  *
****************************************
```

```
****************************************
*                                      *
*    U.S. ARMY CORPS OF ENGINEERS      *
*    HYDROLOGIC ENGINEERING CENTER     *
*          609 SECOND STREET           *
*       DAVIS, CALIFORNIA 95616        *
*           (916) 551-1748             *
*                                      *
****************************************
```

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

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

  1           ID      WLB HYDROLOGY FOR PROPOSED COLTER CHANNEL
  2           ID      PROPOSED CONDITIONS,          6 HOUR STORM
  3           ID       DATE OF MODEL RUN: FEBRUARY 19, 1999 - BY CVL/KA
  4           ID       FOR WIGWAM CREEK DEVELOPMENT CVL CONTRACT # 980098-01
  5           ID       FILE PATH: N:\980098\HYDRO\HEC1\PROP6HRF.DAT
              *DIAGRAM
  6           IT       5                    300
  7           IO       5
  8           IN      15
              *

  9           KK     223
 10           BA    1.26
 11           KM     RAINFALL DEPTH OF 3.10 WAS SPATIALLY REDUCED AS SHOWN ON THE PB RECORD
 12           KM     AN AEREAL REDUCTION COEFFICIENT OF .960 WAS USED
 13           PB     3.1       .
 14           PC    .000    .011    .017    .027    .039    .049    .059    .069    .080    .090
 15           PC    .103    .117    .138    .183    .269    .458    .686    .823    .889    .929
 16           PC    .949    .962    .974    .988    1.00
 17           LG     .12     .33    5.09     .20    72.0
 18           UI     119     218     491     643     786    1003    1453    1254     993     797
 19           UI     634     465     257     200     140     112      37      37      37      37
 20           UI      37       0       0       0       0       0       0       0       0       0
              *

 21           KK    D223
 22           DT   DI225
 23           DI       0      60     400    1000    4000    8000
 24           DQ       0      60      60      60      60      60
              *

 25           KK    R223
 26           RS       4              -1
 27           RC     .03    .025     .03    2900   .0017
 28           RX    1000    1120    1350    1590    1780    1960    2129    2130
 29           RY    1067    1066    1064    1063    1063    1064  1065.5  1065.5
              *

 30           KK    D223
 31           DR   DI225
              *

 32           KK    R223
 33           RS      13              -1       0
 34           RC     .07    .035     .07    5680   .0028
 35           RX     515     790     960     990    1010    1070    1225    1300
 36           RY      74      70      69      68      68      72      74      76
              *

 37           KK     225
 38           BA    0.43
 39           LG      .3     .33    3.63     .31     4.0
 40           UI      39      67     156     206     250     311     448     450     347     284
 41           UI     227     179     112      68      59      39      25      12      12      12
 42           UI      12      12       0       0       0       0       0       0       0       0
              *
```

```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

  43          KK   1I225
  44          HC       2     .43
              *

  45          KK    225A
  46          BA     .37
  47          LG     .35     .35    3.91     .25     0.0
  48          UI      38      82     169     219     275     386     456     340     271     210
  49          UI     153      82      64      41      28      12      12      12      12       0
              *

  50          KK   CP225
  51          HC       2     .80
              *

  52          KK   SR225
  53          RS       1    STOR       0       0
  54          SV       0     .15    4.51   15.36   32.82   74.75  118.94  130.82  143.56  173.50
  55          SQ       0       2       7      15      43      82     110     116    1359    6554
  56          SE  1058.8    1059    1060    1061    1062    1064    1066  1066.5    1067    1068
              *

  57          KK    R225
  58          RS       3              -1       0
  59          RC     .06     .03     .06    1790   .0039
  60          RX     800     930     955     995    1005    1020    1360    1525
  61          RY    1064    1060    1058    1057    1057    1058    1060    1064
              *

  62          KK    242D
  63          BA     .13
  64          LG     .35     .35    3.76     .31     0.0
  65          UI      45     142     250     274     164      74      34      11       8       0
              *

  66          KK  1I242D
  67          HC       2     .93
              *

  68          KK    242B
  69          BA     .07
  70          LG     .35     .35    3.76     .31     0.0
  71          UI      20      67     108     152      97      56      22      11       4       4
  72          UI       0       0       0       0       0       0       0       0       0       0
              *

  73          KK   R242B
  74          RS       1              -1       0
  75          RC     .04    .022     .04    1080   .0061
  76          RX    1000    1005    1010    1028    1122    1140    1145    1150
  77          RY    1056    1056    1055  1049.5  1049.5    1055    1056    1056
              *
```

```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

  78          KK    242C
  79          BA     .16
  80          LG     .35      .35     3.76      .31      0.0
  81          UI      17       39       78      100      127      187      191      144      113       87
  82          UI      58       30       25       17        7        5        5        5        0        0
              *

  83          KK  CP242C
  84          HC       2      .23
              *

  85          KK   R242C
  86          RS       1               -1        0
  87          RC     .04     .022      .04      200    .0061
  88          RX    1000     1005     1010     1028     1122     1140     1145     1150
  89          RY  1053.5   1053.5   1052.5     1048     1048   1052.5   1053.5   1053.5
              *

  90          KK  CP242D
  91          HC       2     1.16
              *

  92          KK   R242D
  93          RS       1               -1        0
  94          RC     .04     .022      .04      870    .0011
  95          RX    1000     1005     1010     1028     1172     1190     1195     1200
  96          RY    1053     1053     1052   1047.5   1047.5     1052     1053     1053
              *

  97          KK    242E
  98          BA    0.05
  99          LG     .35      .35     3.76      .31      0.0
 100          UI      46      147      132       46       11        0        0        0        0        0
              *

 101          KK  CP242E
 102          HC       2     1.21
              *

 103          KK   R242E
 104          RS       1       -1        0
 105          RC     .04     .022      .04      720    .0011
 106          RX    1000     1005     1010     1028     1172     1190     1195     1200
 107          RY    1052     1052     1051   1046.5   1046.5     1051     1052     1052
              *

 108          KK    242F
 109          BA     .30
 110          LG     .35      .35     3.76      .31      0.0
 111          UI      35       94      173      223      303      428      323      248      187      124
 112          UI      61       48       32       11       11       11       11        0        0        0
              *
```

```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 113          KK  CP242F
 114          HC       2    1.51
              *

 115          KK   R242F
 116          RS       3              -1       0
 117          RC     .04     .022     .04    3800   .0022
 118          RX    1000     1005    1010    1028    1172    1190    1195    1200
 119          RY  1048.5   1048.5  1047.5    1043    1043  1047.5  1048.5  1048.5
              *

 120          KK    243A
 121          BA    0.17
 122          LG     .37      .15    4.14     .39     5.0
 123          UI      14       16      49      66      79      94     116     163     156     124
 124          UI     104       86      70      54      32      24      20      14      11       4
 125          UI       4        4       4       4       0       0       0       0       0       0
              *

 126          KK  CP243A
 127          HC       2    1.68
              *

 128          KK   R243A
 129          RS       1      -1       0
 130          RC     .04     .022     .04    2400    .072
 131          RX    1000     1005    1010    1028    1172    1190    1195    1200
 132          RY  1035.5   1035.5  1034.5    1030    1030  1034.5  1035.5  1035.5
              *

 133          KK     227
 134          BA     .23
 135          LG     .32      .34    3.77     .33     3.0
 136          UI      34      132     200     294     397     277     195     117      58      36
 137          UI      14       10      10       0       0       0       0       0       0       0
              *

 138          KK    R227
 139          RS       6              -1       0
 140          RC     .02     .045     .07    4400   .0061
 141          RX    1000     1010    1020    1040    1055    1150    1275    1325
 142          RY  1050.9   1050.5  1050.5    1050    1050    1052    1054    1056
              *

 143          KK     228
 144          BA     .28
 145          LG     .35      .36    3.58     .29     0.0
 146          UI      34       96     172     224     319     402     293     222     164      91
 147          UI      57       37      20      10      10      10       0       0       0       0
              *
```

```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 148          KK    R228
 149          RS       5              -1       0
 150          RC     .02     .045     .07    3550    .0061
 151          RX    1000     1010    1020    1040     1055    1150    1275    1325
 152          RY  1050.9   1050.5  1050.5    1050     1050    1052    1054    1056
              *

 153          KK     229
 154          BA     .51
 155          LG     .33      .34    4.11     .37      2.0
 156          UI      86      338     507     805      853     577     387     174     107      51
 157          UI      25       25       0       0        0       0       0       0       0       0
              *

 158          KK   CP229
 159          HC       3     1.02
              *

 160          KK    D229
 161          DT   1D230
 162          DI       0      612    1224    2470     3990    4952
 163          DQ       0      133     265     750     1379    2121
              *

 164          KK    D229
 165          DT   DI231
 166          DI       0      523    1047    1970     3071    3538
 167          DQ       0      133     265     750     1379    2121
              *

 168          KK    R229
 169          RS       4              -1       0
 170          RC     .03     .035     .07    2100    .0011
 171          RX    1000     1005    1010    1020     1040    1050    1060    1140
 172          RY    1047     1047  1046.5    1046     1046    1047    1048    1050
              *

 173          KK    230A
 174          BA     .18
 175          LG     .35      .35    4.03     .36      0.0
 176          UI      54      177     293     390      243     133      55      25      11      11
 177          UI       0        0       0       0        0       0       0       0       0       0
              *

 178          KK  CP230A
 179          HC       2      1.2
              *

 180          KK   D230A
 181          DT   2D230
 182          DI       0       26     221     743     1717    3247    5429
 183          DQ       0       17     190     653     1515    2867    4799
              *
```

```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 184          KK   R230A
 185          RS      10              -1       0
 186          RC     .07     .045     .07    1400  .00043
 187          RX    1000     1005    1010    1040    1110    1150    1275    1400
 188          RY    1046     1046    1046  1043.5    1044    1046    1047    1048
              *   ************************

 189          KK     QW4   BASIN
 190          BA     .01
 191          LG      .3     .35    2.65     1.4      15
 192          UI      25      45       7       0       0       0       0       0       0       0
 193          UI       0       0       0       0       0       0       0       0       0       0

 194          KK     QW5   BASIN
 195          BA    .007
 196          LG      .3     .35    2.65     1.4      15
 197          UI      13      31       9       1       0       0       0       0       0       0
 198          UI       0       0       0       0       0       0       0       0       0       0

 199          KK     QW6   BASIN
 200          BA    .026
 201          LG      .3     .35    4.55     .41      15
 202          UI      20      60      75      32      10       2       0       0       0       0
 203          UI       0       0       0       0       0       0       0       0       0       0

 204          KK   COMBINE QW4,QW5,QW6
 205          HC       4

 206          KK   244A1
 207          KM   BASIN 1
 208          KM    THE FOLLOWING PARAMETERS WERE PROVIDED FOR THIS BASIN
 209          KM    L=       .4  Lca=       .2   S=   89.8  Kn= .050  LAG=  10.8
 210          KM    DESERT/RANGELAND S-GRAPH WAS USED FOR THE BASIN
 211          BA     .04
 212          IN      15
 213          LG     .30     .25    4.55     .42   15.00
 214          UI     30.     99.     90.     42.     19.      8.      3.      0.      0.      0.
 215          UI      0.      0.      0.      0.      0.      0.      0.      0.      0.      0.

 216          KK   RET 1
 217          KM   ROUTE FLOW THROUGH RETENTION BASIN 1
 218          KM   RETENTION CAUSED BY UPSTREAM PONDING BEHIND CULVERT
 219          KM   SQ BASED ON CULVERT MASTER RESULTS
 220          RS       1    STOR       0
 221          SA      .3     .71    1.42    1.77
 222          SE       0       5      10      15
 223          SQ       0      62     101     128

 224          KK   244A3
 225          KM   BASIN 244A3
 226          KM    THE FOLLOWING PARAMETERS WERE PROVIDED FOR THIS BASIN
 227          KM    L=       .4  Lca=       .2   S=   89.8  Kn= .050  LAG=  10.8
 228          KM    DESERT/RANGELAND S-GRAPH WAS USED FOR THE BASIN
 229          BA     .02
```

```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 230          LG     .30     .25    4.55     .42   15.00
 231          UI     17.     57.     52.     24.     11.      5.      2.      0.      0.      0.
 232          UI      0.      0.      0.      0.      0.      0.      0.      0.      0.      0.

 233          KK      C1
 234          HC       2

 235          KK   244A2
 236          KM   BASIN 244A2
 237          KM    THE FOLLOWING PARAMETERS WERE PROVIDED FOR THIS BASIN
 238          KM    L=        .3  Lca=        .2   S=  116.0  Kn= .050  LAG=   9.0
 239          KM    DESERT/RANGELAND S-GRAPH WAS USED FOR THE BASIN
 240          BA     .02
 241          LG     .30     .25    4.55     .42   15.00
 242          UI     26.     73.     44.     17.      6.      2.      0.      0.      0.      0.
 243          UI      0.      0.      0.      0.      0.      0.      0.      0.      0.      0.

 244          KK   RET 2
 245          KM   ROUTE FLOW THROUGH RETENTION BASIN 2
 246          KM   RETENTION CAUSED BY UPSTREAM PONDING BEHIND CULVERT
 247          KM   SQ BASED ON CULVERT MASTER RESULTS
 248          RS      1    STOR       0
 249          SA     .3     .48     .96
 250          SE      0       5      10
 251          SQ      0      30      47

 252          KK   244A4
 253          KM   BASIN 244A4
 254          KM    THE FOLLOWING PARAMETERS WERE PROVIDED FOR THIS BASIN
 255          KM    L=        .1  Lca=        .1   S=  143.0  Kn= .050  LAG=   3.7
 256          KM    DESERT/RANGELAND S-GRAPH WAS USED FOR THE BASIN
 257          BA     .02
 258          LG     .30     .25    4.55     .42   15.00
 259          UI    102.     35.      0.      0.      0.      0.      0.      0.      0.      0.
 260          UI      0.      0.      0.      0.      0.      0.      0.      0.      0.      0.

 261          KK      C2
 262          HC       2

 263          KK      C3
 264          HC       2

 265          KK   244A5
 266          KM   BASIN 244A5
 267          KM    THE FOLLOWING PARAMETERS WERE PROVIDED FOR THIS BASIN
 268          KM    L=        .6  Lca=        .3   S=   95.0  Kn= .050  LAG=  15.1
 269          KM    DESERT/RANGELAND S-GRAPH WAS USED FOR THE BASIN
 270          BA     .07
 271          LG     .30     .25    4.55     .42   15.00
 272          UI     24.     93.    139.    115.     66.     36.     21.     12.      5.      4.
 273          UI      4.      0.      0.      0.      0.      0.      0.      0.      0.      0.
 274          UI      0.      0.      0.      0.      0.      0.      0.      0.      0.      0.
```

```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 275          KK      C4
 276          HC       2

 277          KK   244A6
 278          KM   BASIN 244A6
 279          KM    THE FOLLOWING PARAMETERS WERE PROVIDED FOR THIS BASIN
 280          KM    L=        .8  Lca=        .4   S=   79.2  Kn= .050  LAG=  19.6
 281          KM    DESERT/RANGELAND S-GRAPH WAS USED FOR THE BASIN
 282          BA     .10
 283          LG     .30     .25    4.55     .42   15.00
 284          UI     20.     78.    138.    163.    135.     87.     56.     36.     23.     14.
 285          UI     10.      4.      4.      4.      0.      0.      0.      0.      0.      0.
 286          UI      0.      0.      0.      0.      0.      0.      0.      0.      0.      0.

 287          KK      C5
 288          HC       2

 289          KK       A
 290          KM   BASIN A
 291          KM    THE FOLLOWING PARAMETERS WERE PROVIDED FOR THIS BASIN
 292          KM    L=        .3  Lca=        .1   S=   85.7  Kn= .050  LAG=   8.8
 293          KM    PHOENIX VALLEY S-GRAPH WAS USED FOR THIS BASIN
 294          BA     .09
 295          LG     .25     .25    4.70     .38   30.00
 296          UI    110.    333.    207.     49.     11.      0.      0.      0.      0.      0.
 297          UI      0.      0.      0.      0.      0.      0.      0.      0.      0.      0.
              *

 298          KK   D230A
 299          DR   2D230
              *

 300          KK   R230A
 301          RS       1              -1       0
 302          RC     .05    .035     .03    1000   .0091
 303          RX    1000    1005    1010    1020    1040    1060    1100    1300
 304          RY    1041  1040.5  1040.5    1040    1040  1040.5    1038  1040.5
              *

 305          KK    CP A
 306          HC       2

 307          KK   RT-AE
 308          RS      10              -1       0
 309          RC   0.025   0.025   0.025    2000   .0025
 310          RX     990    1000    1009    1029    1049    1058    1060    1070
 311          RY    1003    1003    1000    1000    1000    1003    1003    1003

 312          KK       E
 313          KM   BASIN E
 314          KM    THE FOLLOWING PARAMETERS WERE PROVIDED FOR THIS BASIN
 315          KM    L=        .2  Lca=        .1   S=   20.0  Kn= .050  LAG=   7.6
 316          KM    PHOENIX VALLEY S-GRAPH WAS USED FOR THIS BASIN
 317          BA     .05
```

```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 318          LG     .25     .25    4.65     .39   30.00
 319          UI     71.    189.     73.     12.      0.      0.      0.      0.      0.      0.
 320          UI      0.      0.      0.      0.      0.      0.      0.      0.      0.      0.

 321          KK    CP E
 322          HC       2

 323          KK   RT-EC
 324          RS      10              -1       0
 325          RC   0.025   0.025   0.025    2000   .0025
 326          RX     990    1000    1009    1029    1049    1058    1060    1070
 327          RY    1003    1003    1000    1000    1000    1003    1003    1003

 328          KK   CP A2
 329          KM   BASIN A2
 330          KM    THE FOLLOWING PARAMETERS WERE PROVIDED FOR THIS BASIN
 331          KM    L=        .2  Lca=        .1   S=   66.7  Kn= .050  LAG=   6.0
 332          KM    PHOENIX VALLEY S-GRAPH WAS USED FOR THIS BASIN
 333          BA     .02
 334          LG     .25     .25    4.80     .36   30.00
 335          UI     45.     80.     12.      0.      0.      0.      0.      0.      0.      0.
 336          UI      0.      0.      0.      0.      0.      0.      0.      0.      0.      0.

 337          KK  RT-A2D
 338          RS      10              -1       0
 339          RC   0.025   0.025   0.025     800   .0025
 340          RX     990    1000    1009    1029    1049    1058    1060    1070
 341          RY    1003    1003    1000    1000    1000    1003    1003    1003

 342          KK       D
 343          KM   BASIN D
 344          KM    THE FOLLOWING PARAMETERS WERE PROVIDED FOR THIS BASIN
 345          KM    L=        .1  Lca=        .1   S=   54.5  Kn= .050  LAG=   5.0
 346          KM    PHOENIX VALLEY S-GRAPH WAS USED FOR THIS BASIN
 347          BA     .03
 348          LG     .25     .25    4.80     .36   30.00
 349          UI    105.     96.      0.      0.      0.      0.      0.      0.      0.      0.
 350          UI      0.      0.      0.      0.      0.      0.      0.      0.      0.      0.

 351          KK    CP-D
 352          HC       2
              *

 353          KK   DR229
 354          DR   1D230
              *

 355          KK    R229
 356          RS       2              -1       0
 357          RC     .02    .045     .06    1850    .005
 358          RX     980     985     990    1000    1020    1040    1100    1150
 359          RY    1044  1043.5  1043.5    1042    1042    1044  1044.5    1045
```

```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 360          KK      A1
 361          KM   BASIN A1
 362          BA    0.03
 363          LG     .25      .25     4.90      .35    30.00
 364          UI     83.     118.      14.       0.       0.       0.       0.       0.       0.       0.
 365          UI      0.       0.       0.       0.       0.       0.       0.       0.       0.       0.

 366          KK   CP A1
 367          HC       2

 368          KK  RT-A1B
 369          RS      10                -1        0
 370          RC   0.025    0.025    0.025     1200    .0025
 371          RX     990     1000     1009     1029     1049     1058     1060     1070
 372          RY    1003     1003     1000     1000     1000     1003     1003     1003
              * DDM    ***** Inserted *****

 373          KK       B
 374          KM   BASIN B
 375          KM    THE FOLLOWING PARAMETERS WERE PROVIDED FOR THIS BASIN
 376          KM    L=        .3  Lca=        .2   S=    36.0  Kn= .050  LAG=  10.5
 377          KM    PHOENIX VALLEY S-GRAPH WAS USED FOR THIS BASIN
 378          BA     .09
 379          LG     .25      .25     4.60      .40    30.00
 380          UI     73.     225.     239.      92.      26.       8.       0.       0.       0.       0.
 381          UI      0.       0.       0.       0.       0.       0.       0.       0.       0.       0.

 382          KK    CP B
 383          HC       2
              *

 384          KK       C
 385          KM   BASIN C
 386          KM    THE FOLLOWING PARAMETERS WERE PROVIDED FOR THIS BASIN
 387          KM    L=        .2  Lca=        .1   S=    73.9  Kn= .050  LAG=   7.9
 388          KM    PHOENIX VALLEY S-GRAPH WAS USED FOR THIS BASIN
 389          BA     .05
 390          LG     .25      .25     4.35      .48    30.00
 391          UI     69.     191.      84.      16.       0.       0.       0.       0.       0.       0.
 392          UI      0.       0.       0.       0.       0.       0.       0.       0.       0.       0.

 393          KK    CP C
 394          HC       2

 395          KK   RT-CF
 396          RS      10                -1        0
 397          RC   0.025    0.025    0.025     1000    .0025
 398          RX     990     1000     1009     1029     1049     1058     1060     1070
 399          RY    1003     1003     1000     1000     1000     1003     1003     1003
```

```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

  400         KK       F
  401         KM   BASIN F
  402         KM    THE FOLLOWING PARAMETERS WERE PROVIDED FOR THIS BASIN
  403         KM    L=        .2  Lca=       .1   S=   40.0  Kn= .050  LAG=   6.7
  404         KM    PHOENIX VALLEY S-GRAPH WAS USED FOR THIS BASIN
  405         BA     .04
  406         LG     .25     .25    4.10     .55   30.00
  407         UI     75.    165.     41.      6.      0.      0.      0.      0.      0.      0.
  408         UI      0.      0.      0.      0.      0.      0.      0.      0.      0.      0.

  409         KK    CP F
  410         HC       2
              *
  411         ZZ
```

WigWam Creek Final(all phases constructed)

SCHEMATIC DIAGRAM OF STREAM NETWORK

```
INPUT
LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

 NO.      (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

  9         223
            .
            .
 22         .------->   DI225
 21      D223
            V
            V
 25      R223
            .
            .
 31         .          .<-------   DI225
 30         .       D223
            .          V
            .          V
 32         .       R223
            .          .
            .          .
 37         .          .         225
            .          .           .
            .          .           .
 43         .      1I225............
            .          .
            .          .
 45         .          .        225A
            .          .           .
            .          .           .
 50         .      CP225............
            .          V
            .          V
 52         .      SR225
            .          V
            .          V
 57         .       R225
            .          .
            .          .
 62         .          .        242D
            .          .           .
            .          .           .
 66         .     1I242D............
            .          .
            .          .
 68         .          .        242B
            .          .           V
            .          .           V
 73         .          .       R242B
            .          .           .
            .          .           .
 78         .          .           .        242C
            .          .           .          .
            .          .           .          .
 83         .          .      CP242C............
            .          .           V
            .          .           V
 85         .          .       R242C
            .          .           .
            .          .           .
 90         .     CP242D............
            .          V
            .          V
 92         .      R242D
            .          .
            .          .
 97         .          .        242E
            .          .           .
            .          .           .
101         .     CP242E............
            .          V
            .          V
103         .      R242E
            .          .
```

WigWam Creek Final(all phases constructed)

```
108                 242F
                      .
                      .
113            CP242F............
                   V
                   V
115             R242F
                      .
                      .
120                 243A
                      .
                      .
126            CP243A............
                   V
                   V
128             R243A
                      .
                      .
133                 227
                      V
                      V
138                 R227
                      .
                      .
143                   .        228
                      .          V
                      .          V
148                   .       R228
                      .          .
                      .          .
153                   .          .        229
                      .          .          .
                      .          .          .
158                 CP229......................
                      .
                      .
161                   .------->   1D230
160                 D229
                      .
                      .
165                   .------->   DI231
164                 D229
                      V
                      V
168                 R229
                      .
                      .
173                   .       230A
                      .          .
                      .          .
178               CP230A............
                      .
                      .
181                   .------->   2D230
180               D230A
                      V
                      V
184               R230A
                      .
                      .
189                   .        QW4
                      .          .
                      .          .
194                   .          .        QW5
                      .          .          .
                      .          .          .
199                   .          .          .        QW6
                      .          .          .          .
                      .          .          .          .
204               COMBI.................................
                      .
                      .
206                   .      244A1
                      .         V
                      .         V
216                   .      RET 1
```

WigWam Creek Final(all phases constructed)

```
224                 244A3
                      .
                      .
233              C1...........
                      .
                      .
235                 244A2
                      V
                      V
244                 RET 2
                      .
                      .
252                                   244A4
                      .                 .
                      .                 .
261                   C2...........
                      .
                      .
263              C3...........
                      .
                      .
265                 244A5
                      .
                      .
275              C4...........
                      .
                      .
277                 244A6
                      .
                      .
287              C5...........
                      .
                      .
289                   A
                      .
                      .
299                   .                 .<-------   2D230
298                   .             D230A
                      .                 V
                      .                 V
300                   .             R230A
                      .                 .
                      .                 .
305                 CP A...........
                      V
                      V
307                 RT-AE
                      .
                      .
312                   .                 E
                      .                 .
                      .                 .
321                 CP E...........
                      V
                      V
323                 RT-EC
                      .
                      .
328                   .             CP A2
                      .                 V
                      .                 V
337                   .            RT-A2D
                      .                 .
                      .                 .
342                   .                 .          D
                      .                 .          .
                      .                 .          .
351                   .            CP-D...........
                      .                 .
                      .                 .
354                   .                 .          .<-------   1D230
353                   .                 .       DR229
                      .                 .          V
                      .                 .          V
355                   .                 .       R229
```

WigWam Creek Final(all phases constructed)

```
                                                  .
                                                  .
360                                               .          A1
                                                  .          .
                                                  .          .
366                                           CP A1...........
                                                  V
                                                  V
368                                           RT-A1B
                                                  .
                                                  .
373                                               .          B
                                                  .          .
                                                  .          .
382                                           CP B...........
                                                  .
                                                  .
384                                               .          C
                                                  .          .
                                                  .          .
393                                           CP C...........
                                                  V
                                                  V
395                                           RT-CF
                                                  .
                                                  .
400                                               .          F
                                                  .          .
                                                  .          .
409                                           CP F...........
```

***) RUNOFF ALSO COMPUTED AT THIS LOCATION

WigWam Creek Final(all phases constructed)

```
****************************************
*                                      *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *
*            MAY   1991                *
*          VERSION 4.0.1E              *
*   Lahey F77L-EM/32 version 5.01      *
*      Dodson & Associates, Inc.       *
*  RUN DATE  10/09/01  TIME  15:18:04  *
****************************************
```

```
****************************************
*                                      *
*    U.S. ARMY CORPS OF ENGINEERS      *
*    HYDROLOGIC ENGINEERING CENTER     *
*          609 SECOND STREET           *
*       DAVIS, CALIFORNIA 95616        *
*           (916) 551-1748             *
*                                      *
****************************************
```

WLB HYDROLOGY FOR PROPOSED COLTER CHANNEL
PROPOSED CONDITIONS, 6 HOUR STORM
DATE OF MODEL RUN: FEBRUARY 19, 1999 - BY CVL/KA
FOR WIGWAM CREEK DEVELOPMENT CVL CONTRACT # 980098-01
FILE PATH: N:\980098\HYDRO\HEC1\PROP6HRF.DAT

```
7 IO        OUTPUT CONTROL VARIABLES
                 IPRNT          5  PRINT CONTROL
                 IPLOT          0  PLOT CONTROL
                 QSCAL         0.  HYDROGRAPH PLOT SCALE

  IT        HYDROGRAPH TIME DATA
                 NMIN          5  MINUTES IN COMPUTATION INTERVAL
                 IDATE     1    0  STARTING DATE
                 ITIME        0000  STARTING TIME
                    NQ        300  NUMBER OF HYDROGRAPH ORDINATES
                NDDATE     2    0  ENDING DATE
                NDTIME        0055  ENDING TIME
                 ICENT         19  CENTURY MARK

            COMPUTATION INTERVAL    0.08 HOURS
                 TOTAL TIME BASE   24.92 HOURS

      ENGLISH UNITS
           DRAINAGE AREA          SQUARE MILES
           PRECIPITATION DEPTH    INCHES
           LENGTH, ELEVATION      FEET
           FLOW                   CUBIC FEET PER SECOND
           STORAGE VOLUME         ACRE-FEET
           SURFACE AREA           ACRES
           TEMPERATURE            DEGREES FAHRENHEIT
```

WigWam Creek Final(all phases constructed)

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
HYDROGRAPH AT	223	1604.	4.42	353.	89.	86.	1.26		
DIVERSION TO	DI225	60.	4.42	59.	16.	15.	1.26		
HYDROGRAPH AT	D223	1544.	4.42	294.	74.	71.	1.26		
ROUTED TO	R223	1481.	4.67	294.	74.	71.	1.26	1064.33	4.67
HYDROGRAPH AT	D223	60.	1.08	59.	16.	15.	0.00		
ROUTED TO	R223	60.	2.67	58.	16.	15.	0.00	68.90	2.58
HYDROGRAPH AT	225	378.	4.50	58.	15.	14.	0.43		
2 COMBINED AT	1I225	438.	4.50	116.	30.	29.	0.43		
HYDROGRAPH AT	225A	353.	4.42	50.	12.	12.	0.37		
2 COMBINED AT	CP225	790.	4.42	166.	43.	41.	0.80		
ROUTED TO	SR225	72.	5.75	67.	36.	35.	0.80	1063.50	5.75
ROUTED TO	R225	72.	5.92	67.	36.	35.	0.80	1057.91	5.83
HYDROGRAPH AT	242D	147.	4.08	16.	4.	4.	0.13		
2 COMBINED AT	1I242D	160.	4.08	76.	40.	39.	0.93		
HYDROGRAPH AT	242B	78.	4.17	9.	2.	2.	0.07		
ROUTED TO	R242B	72.	4.25	9.	2.	2.	0.07	1049.80	4.25
HYDROGRAPH AT	242C	144.	4.42	19.	5.	5.	0.16		
2 COMBINED AT	CP242C	211.	4.33	28.	7.	7.	0.23		
ROUTED TO	R242C	212.	4.33	28.	7.	7.	0.23	1048.59	4.33
2 COMBINED AT	CP242D	348.	4.25	104.	47.	45.	1.16		
ROUTED TO	R242D	341.	4.33	103.	47.	45.	1.16	1048.52	4.33
HYDROGRAPH AT	242E	61.	4.00	6.	2.	1.	0.05		
2 COMBINED AT	CP242E	373.	4.25	108.	49.	47.	1.21		
ROUTED TO	R242E	370.	4.33	108.	48.	47.	1.21	1047.57	4.33
HYDROGRAPH AT	242F	283.	4.33	37.	9.	9.	0.30		
2 COMBINED AT	CP242F	653.	4.33	144.	58.	55.	1.51		
ROUTED TO	R242F	605.	4.58	140.	57.	55.	1.51	1044.17	4.58
HYDROGRAPH AT	243A	143.	4.50	24.	6.	6.	0.17		
2 COMBINED AT	CP243A	748.	4.58	162.	63.	61.	1.68		
ROUTED TO	R243A	748.	4.58	162.	63.	61.	1.68	1030.46	4.58
HYDROGRAPH AT	227	238.	4.25	29.	7.	7.	0.23		
ROUTED TO	R227	211.	4.58	29.	7.	7.	0.23	1051.21	4.58
HYDROGRAPH AT	228	275.	4.33	36.	9.	9.	0.28		
ROUTED TO	R228	258.	4.58	36.	9.	9.	0.28	1051.31	4.58
HYDROGRAPH AT	229	494.	4.25	57.	14.	14.	0.51		

WigWam Creek Final(all phases constructed)

3 COMBINED AT	CP229	745.	4.42	121.	30.	29.	1.02		
DIVERSION TO	1D230	162.	4.42	26.	7.	6.	1.02		
HYDROGRAPH AT	D229	584.	4.42	95.	24.	23.	1.02		
DIVERSION TO	DI231	148.	4.42	24.	6.	6.	1.02		
HYDROGRAPH AT	D229	435.	4.42	71.	18.	17.	1.02		
ROUTED TO	R229	414.	4.67	71.	18.	17.	1.02	1049.07	4.67
HYDROGRAPH AT	230A	185.	4.17	19.	5.	5.	0.18		
2 COMBINED AT	CP230A	451.	4.50	90.	23.	22.	1.20		
DIVERSION TO	2D230	394.	4.50	77.	19.	19.	1.20		
HYDROGRAPH AT	D230A	57.	4.50	13.	3.	3.	1.20		
ROUTED TO	R230A	56.	4.92	13.	3.	3.	1.20	1044.78	4.92
HYDROGRAPH AT	QW4	6.	4.00	1.	0.	0.	0.01		
HYDROGRAPH AT	QW5	4.	4.00	0.	0.	0.	0.01		
HYDROGRAPH AT	QW6	30.	4.08	3.	1.	1.	0.03		
4 COMBINED AT	COMBI	57.	4.92	17.	4.	4.	1.24		
HYDROGRAPH AT	244A1	45.	4.08	5.	1.	1.	0.04		
ROUTED TO	RET 1	27.	4.33	5.	1.	1.	0.04	2.20	4.33
HYDROGRAPH AT	244A3	26.	4.08	3.	1.	1.	0.02		
2 COMBINED AT	C1	49.	4.08	8.	2.	2.	0.06		
HYDROGRAPH AT	244A2	27.	4.00	3.	1.	1.	0.02		
ROUTED TO	RET 2	12.	4.33	3.	1.	1.	0.02	2.06	4.33
HYDROGRAPH AT	244A4	24.	4.00	3.	1.	1.	0.02		
2 COMBINED AT	C2	32.	4.00	5.	1.	1.	0.04		
2 COMBINED AT	C3	77.	4.00	14.	3.	3.	0.10		
HYDROGRAPH AT	244A5	75.	4.08	9.	2.	2.	0.07		
2 COMBINED AT	C4	149.	4.08	23.	6.	6.	0.17		
HYDROGRAPH AT	244A6	104.	4.17	14.	4.	3.	0.10		
2 COMBINED AT	C5	248.	4.08	37.	9.	9.	0.27		
HYDROGRAPH AT	A	129.	4.00	17.	4.	4.	0.09		
HYDROGRAPH AT	D230A	394.	4.50	77.	19.	19.	0.00		
ROUTED TO	R230A	393.	4.58	77.	19.	19.	0.00	1039.46	4.58
2 COMBINED AT	CP A	420.	4.33	93.	23.	23.	0.09		
ROUTED TO	RT-AE	418.	4.42	93.	23.	23.	0.09	1002.04	4.42
HYDROGRAPH AT	E	63.	4.00	8.	2.	2.	0.05		
2 COMBINED AT	CP E	433.	4.42	100.	25.	24.	0.14		
ROUTED TO	RT-EC	434.	4.50	100.	25.	24.	0.14	1002.08	4.50
HYDROGRAPH AT	CP A2	26.	4.00	3.	1.	1.	0.02		
ROUTED TO	RT-A2D	26.	4.08	3.	1.	1.	0.02	1000.39	4.08

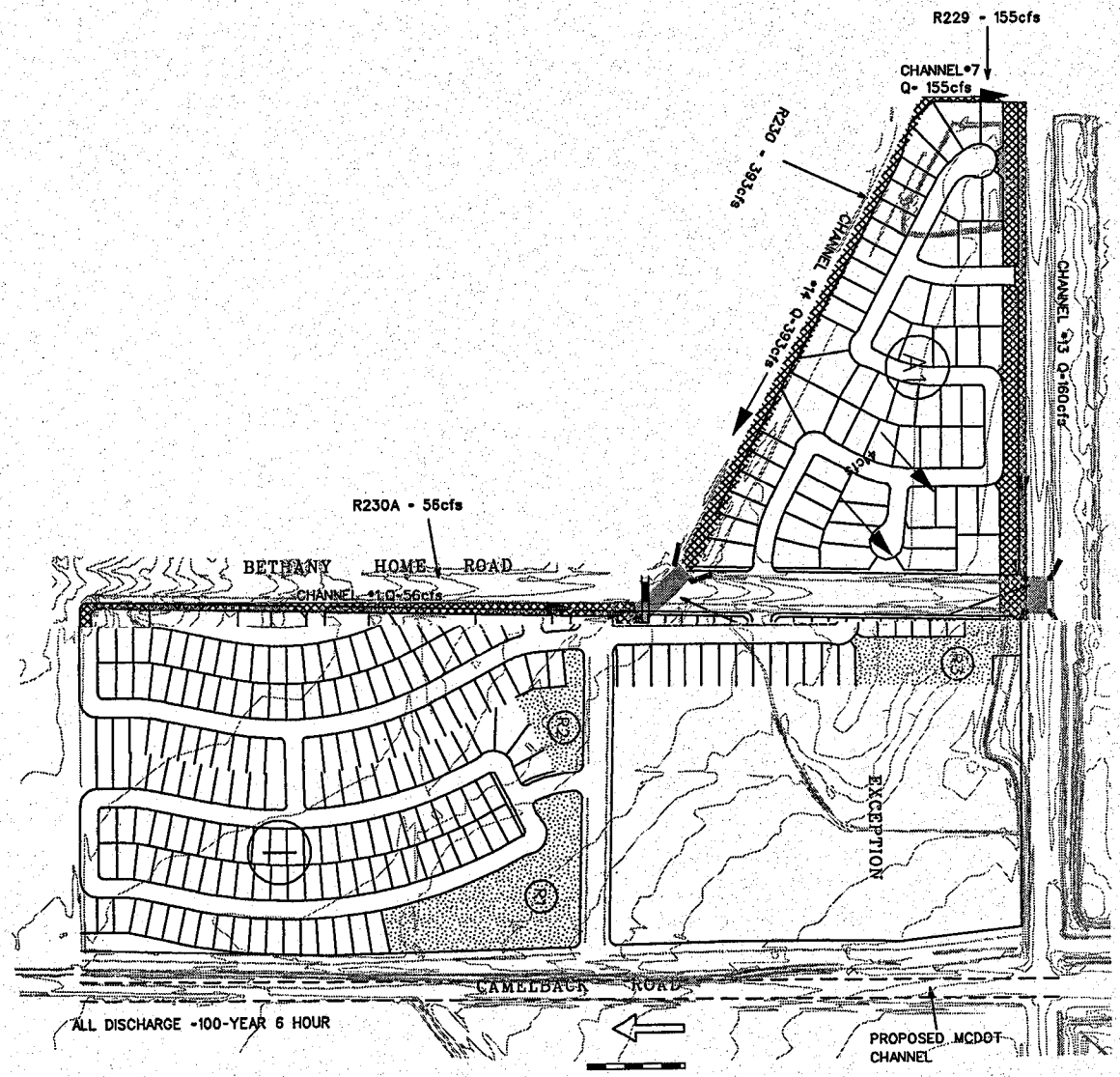
WigWam Creek Final(all phases constructed)

HYDROGRAPH AT	D	38.	4.00	5.	1.	1.	0.03		
2 COMBINED AT	CP-D	61.	4.00	8.	2.	2.	0.05		
HYDROGRAPH AT	DR229	162.	4.42	26.	7.	6.	0.00		
ROUTED TO	R229	155.	4.58	26.	7.	6.	0.00	1043.69	4.58
HYDROGRAPH AT	A1	41.	4.00	5.	1.	1.	0.03		
2 COMBINED AT	CP A1	160.	4.58	31.	8.	8.	0.03		
ROUTED TO	RT-A1B	160.	4.67	31.	8.	8.	0.03	1001.17	4.67
HYDROGRAPH AT	B	116.	4.00	15.	4.	4.	0.09		
2 COMBINED AT	CP B	181.	4.08	46.	12.	11.	0.12		
HYDROGRAPH AT	C	63.	4.00	8.	2.	2.	0.05		
2 COMBINED AT	CP C	240.	4.08	54.	14.	13.	0.17		
ROUTED TO	RT-CF	235.	4.17	54.	14.	13.	0.17	1001.46	4.17
HYDROGRAPH AT	F	49.	4.00	6.	2.	1.	0.04		
2 COMBINED AT	CP F	277.	4.08	60.	15.	15.	0.21		

** NORMAL END OF HEC-1 ***

APPENDIX F

Excerpt from Preliminary Drainage Report



500' 250' 0 500'

SCALE IN FEET

FIGURE 4

JOB NO. 00046-04

PROPOSED DRAINAGE PLAN

4550 NORTH 12TH STREET
PHOENIX, ARIZONA 85014
TELEPHONE (602) 264-6831

WIGWAM CREEK

COE & VAN LOO

PLANNING • ENGINEERING • LANDSCAPE ARCHITECTURE

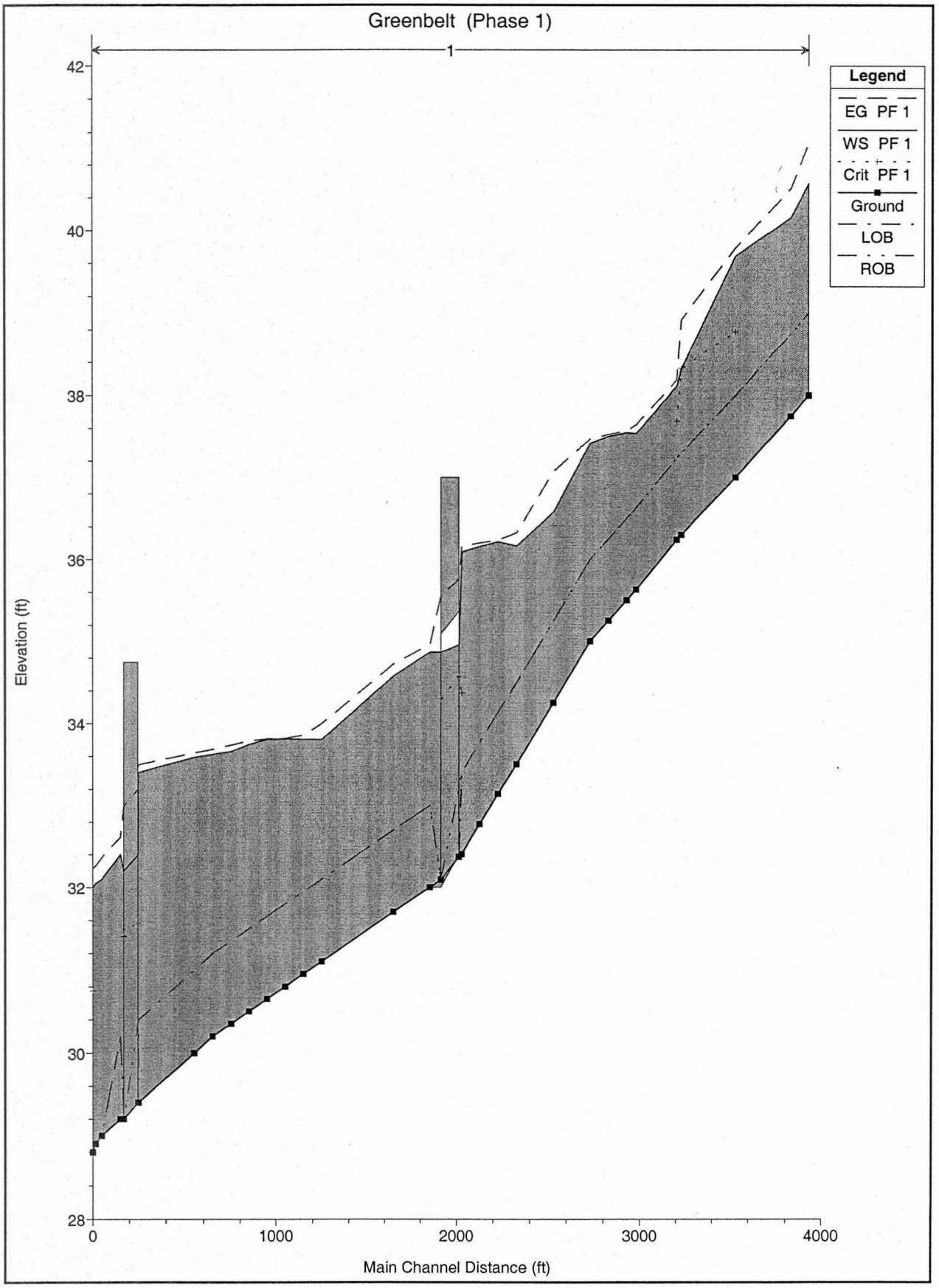
APPENDIX G

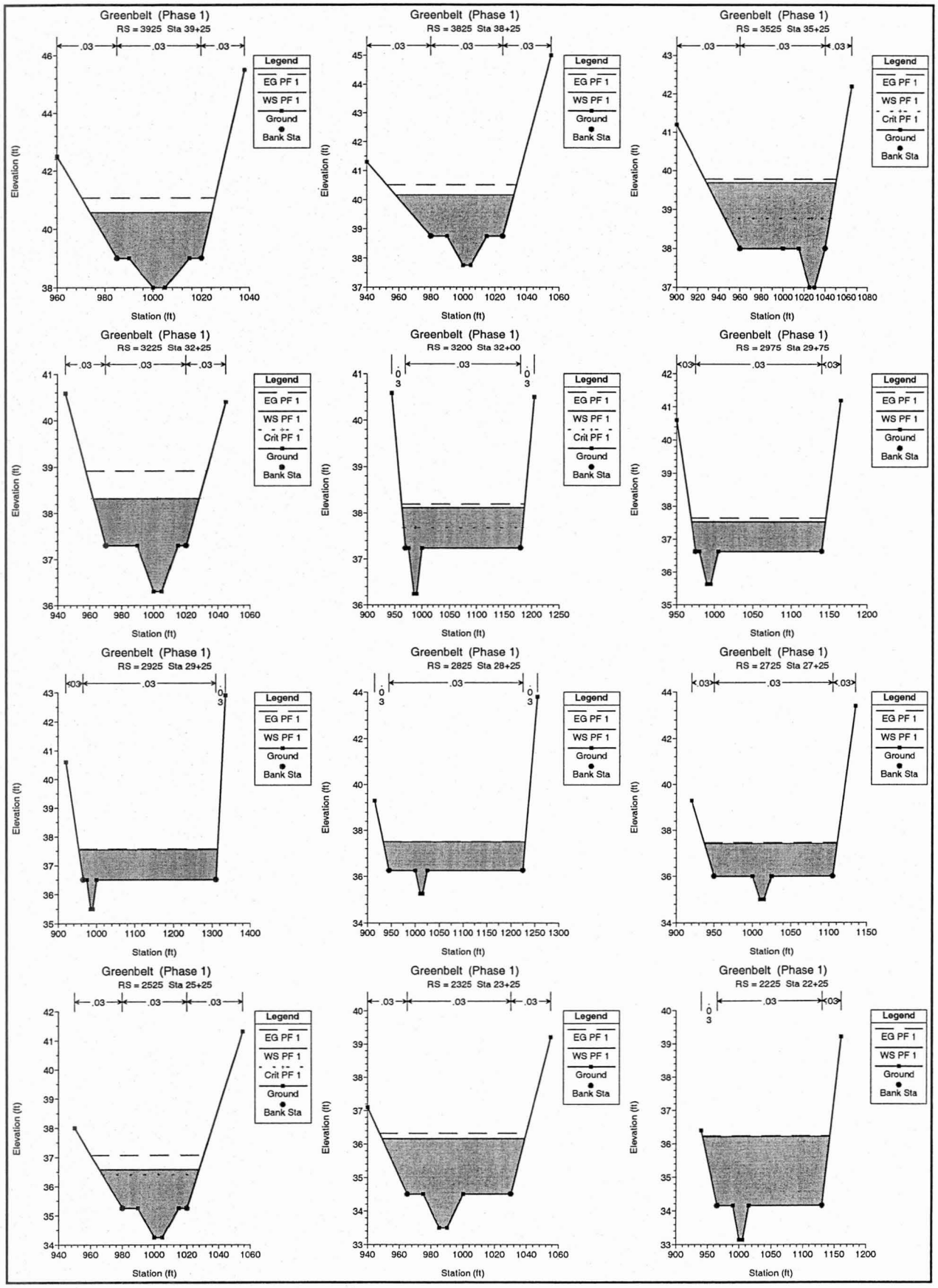
HEC-RAS Calculations For Greenbelt

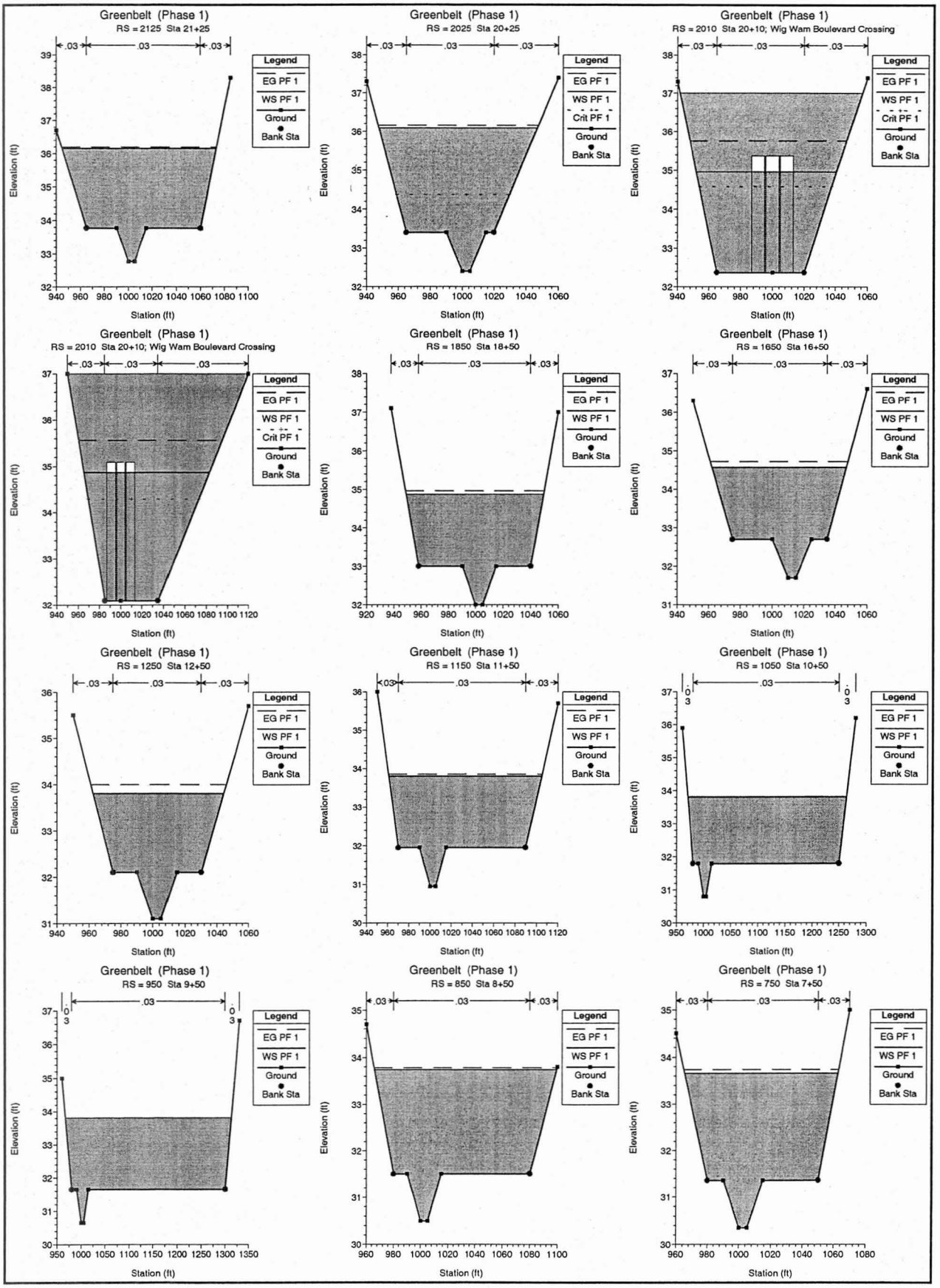
CVL

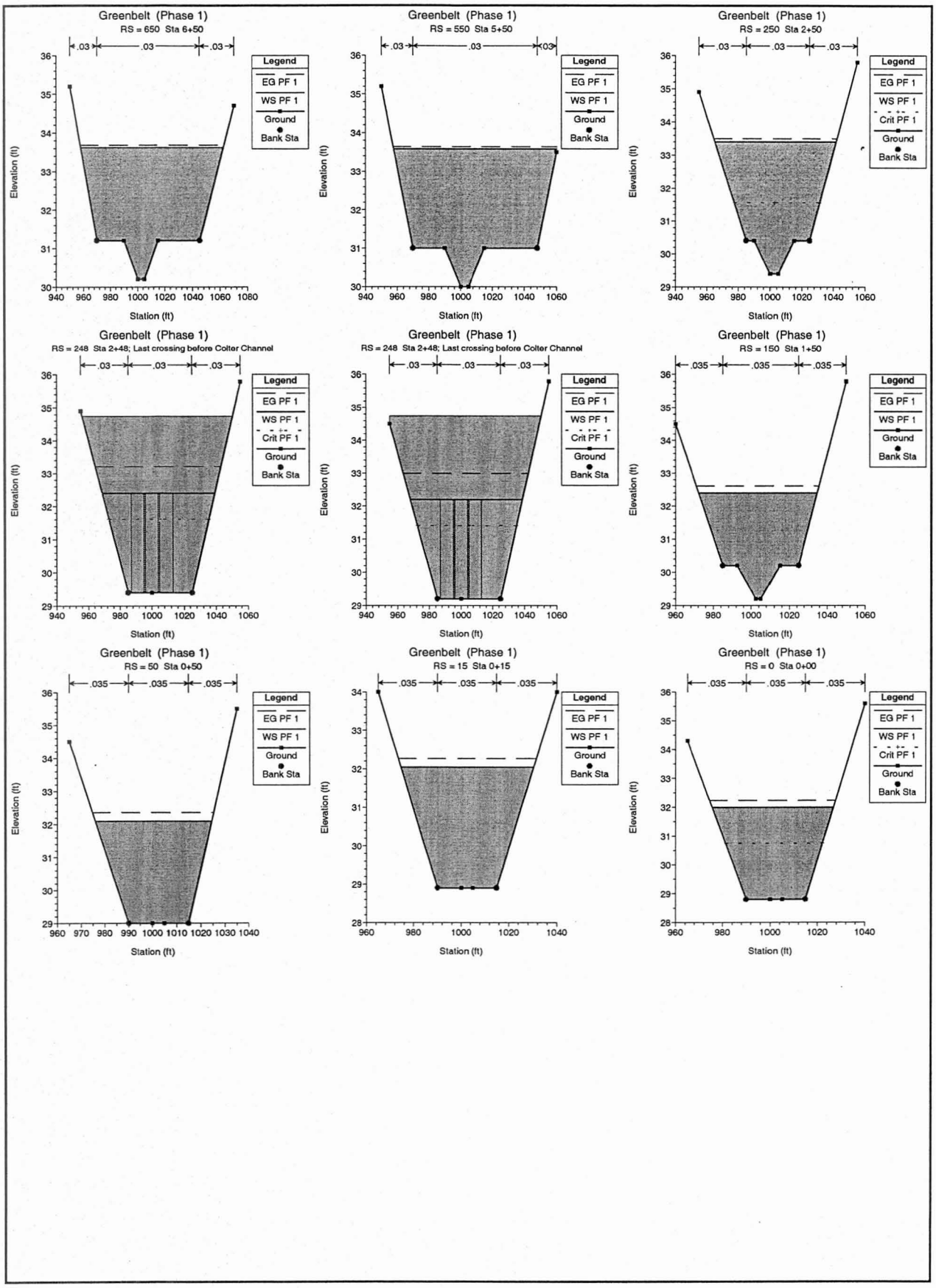
HEC-RAS Plan: gb River: Greenbelt Reach: 1 Profile: PF 1

Reach	River Sta	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)	
1	3925	446.00	38.00	40.57		41.07	0.005490	5.82	82.41	50.61	0.72
1	3825	446.00	37.75	40.16		40.51	0.004855	4.99	98.65	73.84	0.67
1	3525	446.00	37.00	39.69	38.78	39.79	0.001199	2.61	185.60	121.77	0.34
1	3225	446.00	36.30	38.32	38.32	38.92	0.011259	6.33	74.37	66.05	0.97
1	3200	446.00	36.24	38.12	37.68	38.19	0.002099	2.19	205.64	223.33	0.40
1	2975	446.00	35.63	37.54		37.65	0.002896	2.66	169.59	175.68	0.47
1	2925	446.00	35.50	37.55		37.57	0.000495	1.17	384.83	360.60	0.20
1	2825	446.00	35.25	37.50		37.52	0.000410	1.20	376.39	297.29	0.18
1	2725	446.00	35.00	37.42		37.47	0.000793	1.84	247.92	173.63	0.26
1	2525	446.00	34.25	36.58	36.41	37.07	0.006969	5.88	82.70	62.13	0.79
1	2325	446.00	33.50	36.16		36.32	0.001897	3.30	143.91	89.86	0.42
1	2225	446.00	33.14	36.21		36.24	0.000201	1.17	393.87	200.25	0.14
1	2125	446.00	32.77	36.16		36.20	0.000330	1.68	282.13	128.58	0.19
1	2025	446.00	32.40	36.09	34.37	36.16	0.000489	2.26	222.13	99.11	0.23
1	2010	Culvert									
1	1850	446.00	32.00	34.87		34.96	0.000977	2.50	185.65	100.48	0.31
1	1650	446.00	31.70	34.58		34.72	0.001492	3.16	151.11	85.06	0.38
1	1250	446.00	31.10	33.80		34.00	0.002213	3.67	131.50	81.73	0.46
1	1150	446.00	30.95	33.81		33.86	0.000516	1.77	260.27	144.04	0.22
1	1050	446.00	30.80	33.81		33.82	0.000094	0.78	581.80	293.53	0.10
1	950	446.00	30.65	33.81		33.81	0.000054	0.62	732.94	345.69	0.07
1	850	446.00	30.50	33.75		33.79	0.000369	1.70	277.23	133.56	0.19
1	750	446.00	30.35	33.66		33.74	0.000618	2.28	208.44	97.35	0.25
1	650	446.00	30.20	33.63		33.69	0.000471	2.04	232.67	104.46	0.22
1	550	446.00	30.00	33.59		33.64	0.000372	1.89	249.06	102.33	0.20
1	250	446.00	29.40	33.40	31.57	33.50	0.000575	2.67	190.33	76.72	0.26
1	248	Culvert									
1	150	446.00	29.20	32.40		32.62	0.002464	3.89	125.38	62.61	0.43
1	50	446.00	29.00	32.10		32.37	0.002440	4.46	114.12	48.63	0.45
1	15	446.00	28.90	32.05		32.27	0.002013	4.09	127.38	55.88	0.41
1	0	446.00	28.80	32.00	30.75	32.23	0.002082	4.21	122.10	51.31	0.41


Greenbelt (Phase 1)
1
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
LOB
ROB
Elevation (ft)
42
40
38
36
34
32
30
28
0
1000
2000
3000
4000
Main Channel Distance (ft)


Greenbelt (Phase 1)
RS = 3925 Sta 39+25
Greenbelt (Phase 1)
RS = 3825 Sta 38+25
Greenbelt (Phase 1)
RS = 3525 Sta 35+25
Greenbelt (Phase 1)
RS = 3225 Sta 32+25
Greenbelt (Phase 1)
RS = 3200 Sta 32+00
Greenbelt (Phase 1)
RS = 2975 Sta 29+75
Greenbelt (Phase 1)
RS = 2925 Sta 29+25
Greenbelt (Phase 1)
RS = 2825 Sta 28+25
Greenbelt (Phase 1)
RS = 2725 Sta 27+25
Greenbelt (Phase 1)
RS = 2525 Sta 25+25
Greenbelt (Phase 1)
RS = 2325 Sta 23+25
Greenbelt (Phase 1)
RS = 2225 Sta 22+25
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)


Greenbelt (Phase 1)
RS = 2125 Sta 21+25
Greenbelt (Phase 1)
RS = 2025 Sta 20+25
Greenbelt (Phase 1)
RS = 2010 Sta 20+10; Wig Wam Boulevard Crossing
Greenbelt (Phase 1)
RS = 2010 Sta 20+10; Wig Wam Boulevard Crossing
Greenbelt (Phase 1)
RS = 1850 Sta 18+50
Greenbelt (Phase 1)
RS = 1650 Sta 16+50
Greenbelt (Phase 1)
RS = 1250 Sta 12+50
Greenbelt (Phase 1)
RS = 1150 Sta 11+50
Greenbelt (Phase 1)
RS = 1050 Sta 10+50
Greenbelt (Phase 1)
RS = 950 Sta 9+50
Greenbelt (Phase 1)
RS = 850 Sta 8+50
Greenbelt (Phase 1)
RS = 750 Sta 7+50
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)

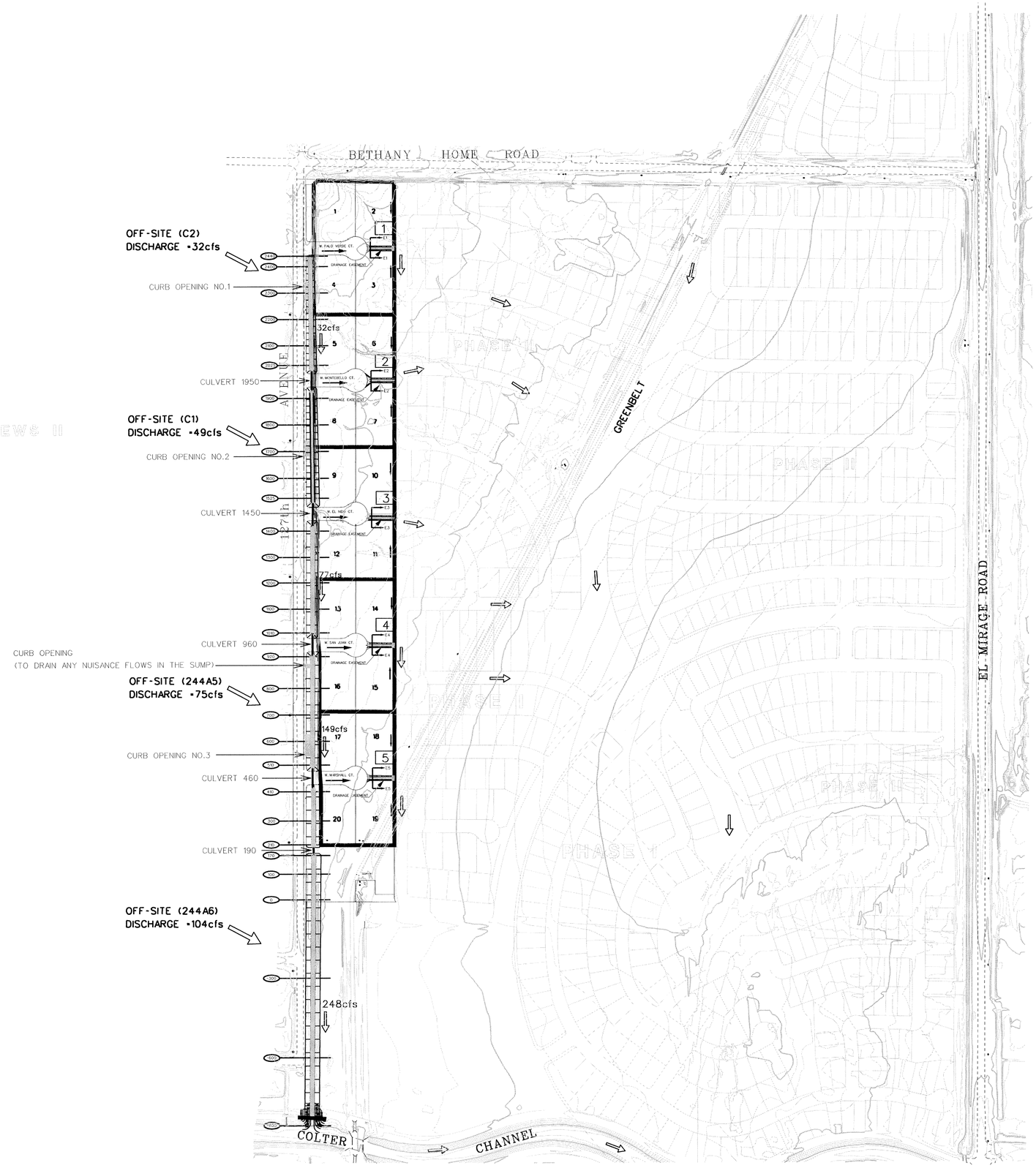

Greenbelt (Phase 1)
RS = 650 Sta 6+50
Greenbelt (Phase 1)
RS = 550 Sta 5+50
Greenbelt (Phase 1)
RS = 250 Sta 2+50
Greenbelt (Phase 1)
RS = 248 Sta 2+48; Last crossing before Colter Channel
Greenbelt (Phase 1)
RS = 248 Sta 2+48; Last crossing before Colter Channel
Greenbelt (Phase 1)
RS = 150 Sta 1+50
Greenbelt (Phase 1)
RS = 50 Sta 0+50
Greenbelt (Phase 1)
RS = 15 Sta 0+15
Greenbelt (Phase 1)
RS = 0 Sta 0+00
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
.03
.035

APPENDIX H

FCD Table

FCD Table Wigwam Creek (010001-02)		
Miles/Acres of Protected Natural Watercourse	0	0
Miles of Improved Watercourse or Storm Drain	0.62	
Acres of Retention or Detention Areas	0	

PLATE



KEY TO SYMBOLS

- DRAINAGE AREA BOUNDARY
- DIRECTION OF OFF-SITE FLOW
- DIRECTION OF ON-SITE FLOW
- 1 CONCENTRATION POINT (CP)
- 1400 HEC-RAS STATION

200' 100' 0 200'
SCALE IN FEET

WIGWAM CREEK PHASE 2B

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DRAINAGE MAP

4550 NORTH 12TH STREET
PHOENIX, ARIZONA 85014
TELEPHONE (602) 264-6831

JOB NO.
01-0001-02

PLATE 1

DATE:- Apr. 11, 2001
TIME:- 11:44:06
FILE:- n:\980098\land\phase2b\sdmap.dgn