Upper East Fork Cave Creek
Campo Bello Drive Lateral
Concept Submittal
Design Report

Prepared For:

The Flood Control District of Maricopa County

Prepared By:

Project Engineering Consultants, Ltd.
3130 North 35th Avenue, Suite 1
Phoenix, Arizona 85017

March 23, 1994

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I. PROJECT DESCRIPTION

A. Introduction

The Campo Bello Drive Lateral is a joint project between the City of Phoenix (City) and the Flood Control District of Maricopa County (District), with the District acting as the lead agency. The Campo Bello Drive Lateral project was identified in the Upper East Fork Cave Creek Area Drainage Master Plan (ADMS), October/1987, prepared by NBS/Lowry, as one of several recommended alternatives for providing 100-year flood protection within the Upper East Fork Cave Creek watershed. In addition, a preliminary design for the recommended alternates, including the Campo Bello Drive Lateral, was prepared by NBS/Lowry.

The tributary area for the Campo Bello Drive Lateral is approximately one (1) square mile and is bounded on the north by Buffalo Ridge (Utopia Road), on the south by Campo Bello Drive, on the east by Cave Creek Road, and on the west by 12th Street.

Under contract with the City, Project Engineering Consultants, Ltd. (PEC) submitted a Routing Study, dated February 10, 1994, which identified three (3) proposed alternates for the Campo Bello Drive lateral alignment. The District and City approved Alternate A (see Exhibit A), and directed PEC to proceed with this design.

B. Storm Drain Alignment

The 'Proposed Routing Map' (Exhibit A) and the 'Plan and Profile Study' (Appendix) delineates storm drain routing for the Campo Bello Drive lateral as described below (proceeding downstream):

Reach 1: 442 cfs design Q is conveyed in a 8'x6' box or 7.5' diameter conduit centered in an existing drainage easement which is located north of the Grovers Avenue north R/W line. This conduit will begin at 17th Way and extending westbound approximately 1000 feet to the 16th Street intersection. At the Grovers Avenue and 16th Street intersection, the conduit alignment shifts and the storm drain enters the street pavement cross section. Curb opening type catch basins along Grovers Avenue and catch basins in the drainage easement will collect runoff and convey flows to the conduit. Also, an inlet structure in the existing drainage easement at the northeast corner of the 16th Street and Grovers Avenue intersection will collect runoff from the Sunrise Heights Mobile Home Park (subarea 13) and convey flows to the conduit.

Reach 2: 783 cfs design Q is conveyed in a 8'x8' box or 8' diameter conduit under the Grovers Avenue monument line, extending west approximately 2000 feet from the intersection of 16th Street. Several catch basins along both sides of Grovers Avenue must be installed to collect runoff from the north.

Reach 3: Continuing westward under the Grovers Avenue monument line, 783 cfs design Q is conveyed in a 8'x8' box or 9' diameter conduit approximately 700 feet to the intersection of 12th Street.

Reach 4: 783 cfs design Q is conveyed in a 8'x8' box or 9' diameter conduit along the 12th Street alignment, extending south approximately 1300 feet from the intersection of Grovers Avenue to the outfalling into Basin No. 5. It should be noted that recently constructed 12th Street pavement will be disturbed.

Reach 5: 266 cfs design Q will be conveyed in the existing Candle Creek Unit I landscaped drainage channel approximately 1300 feet to the west from the Rancho Verde Mirage detention basin to the 12th Street box culvert structure . Channel improvements including a hydraulic drop structure will be required at the inlet of the proposed 12th Street box culvert.

II. HYDROLOGY / HYDRAULICS

A. Hydrology

Methodology - To be consistent with the hydrology originally developed in the ADMS, the hydrologic analysis for this project was performed using the same U.S. Soil Conservation Service (SCS) TR-20 model and design parameter methodology that was used for the ADMS. Due to the relatively small tributary area for the Campo Bello Lateral as compared with the entire ADMS, a more detailed analysis was performed. Hydrology calculations and the TR-20 computer run can be found in the Appendix.

Rainfall - Flood routing was developed for the 100-year 24-hour event distributed using the City of Phoenix 24-hour Rainfall Distribution Table, City of Phoenix Stormdrain Design Manual (see Exhibit H). The rainfall depth used was 4.04 inches per City of Phoenix criteria.

Drainage Area - The drainage sub-area and zoning boundaries, points of concentration, and reach routing paths were determined using recent 2-foot contour mapping, site investigation, and comparison with the previous analysis provided in the ADMS. These items are identified in the 'Drainage Area Map' (see Exhibit D).

Curve Numbers - A composite curve number for each sub-area was determined (see Exhibit E) per the City of Phoenix Stormdrain Design Manual using the 'Soil Type Map' (see Exhibit F), Phoenix Planning Department zoning maps, 'Curve Number by Zoning Table' (see Exhibit G), and computed drainage areas. It should be noted that the entire tributary area for the Campo Bello Lateral has a Type 'B' soil type. A minimum curve number of 95 was used in hillside areas having slopes in excess of 10%.

Times of Concentration - Times of concentration were estimated using the upland method for overland flow conditions and gutter flow times from the City of Phoenix Stormdrain Design Manual for channelized flow conditions. A minimum time of concentration of 10 minutes was used.

Results - The computed peak discharge values as determined from the TR-20 run are listed in the Summary Table (see Exhibit I).

B. Hydraulics

Methodology - Circular pipe and single barrel rectangular drainage conduits were analyzed. Hydraulic properties were calculated using the Bernoulli theorem and are presented in tabular format (see Exhibit B). A plot of these hydraulic properties are shown in Exhibit C.

Main Line Pipe Sizing - The storm drain main line was sized using calculated peak flow rates determined in the TR-20 output. The storm drain conduit was designed to flow full requiring that a backwater analysis be utilized.

Manning's equation was used to choose the appropriate size and slope to handle design flows. The friction slope, S_f was calculated by using:

$$S_f = (Q*n/(1.486*R^{(2/3)})^2$$

From this equation the head loss can be determined by multiplying the friction slope by the length. Minor losses due to bends in the conduit or manholes were assumed to be negligible, however, the head loss caused from the grate at the outlet was calculated using the orifice equation.

The starting point for the hydraulic grade line at the outlet was the 100-year high water surface elevation for Basin No. 5. To this was added the head loss for the grate, and the result was the hydraulic grade line at the outfall of the conduit. Head losses due to friction slope were taken into account for subsequent upstream reaches.

Conduit sizes were then altered to keep this grade line below finished grade. After the sizes were determined, the conduits slope could be calculated. It was desired to keep the soffit elevations below the hydraulic grade line to insure that they were flowing to their full capacity. If the hydraulic grade line was determined to be below the soffit on a particular reach of pipe, the soffit was assumed to be the hydraulic grade line at the outlet of the adjacent upstream reach. This conservative assumption is an added safety factor in the design.

The size of cast-in-place pipe will have diameters 0.5 feet larger than for precast pipe to compensate for higher 'n' values inherent with this type of construction.

Culvert Design - The proposed routing design requires a culvert to convey runoff across 12th Street at station 10+00. This culvert was designed according to guidelines set by the Federal Highway Administration.

A concrete box culvert was chosen to be most suitable for this purpose due to utility placement. The invert was placed to avoid conflict with the 8" water line along 12th Street which required a three percent slope of the culvert at this location.

The tailwater conditions were assumed to be at a constant water surface elevation. This elevation was the same as the storm drain outlet elevation since they both outfall onto the same apron and grate.

Calculations were then performed to determine if the inlet or outlet conditions were controlling flow. The condition that required the highest headwater elevation was the controlling factor. The headwater was maintained below the finished roadway elevation. Calculations were done using the HY8 culvert analysis program to determine an acceptable size, and that size was then checked by hand calculations. The smallest culvert selected to meet these requirements was a 4'x6' single box with inlet control.

III. DESIGN CRITERIA

A. Utilities

1. The proposed storm drain from Basin No. 5 to Grovers Avenue along 12th Street is offset 16′ east of the monument line on the southern reach and is displaced to an offset of only 4′ at Angela Street. It is at this transition that a utility conflict will occur. A portion of the existing 8" water line will need to be removed and replaced before trenching.

2. At the intersection of 12th Street and Grovers, an existing 24" water line may need to be relocated where it conflicts with the storm drain conduit. In lieu of relocation, the feasibility of concrete encasement of the water line will be investigated which will allow for it to remain in place.

3. From 12th Street to 16th Street along Grovers Avenue the storm drain conduit is offset 1′ north of the monument line. This causes a utility conflict near 12th Street with approximately 700 feet of existing 8" water line. This water line will need to be relocated to the north.

4. An existing 12" water line is in conflict with the proposed storm drain conduit at the intersection of 16th Street and Grovers Avenue and will need to be relocated.

5. Potholing is recommended at 9 locations to determine actual location of existing utilities, as shown on Exhibit J. It should be noted that the potholing of the existing 24" water line (item 2 above) is critical to the design.

B. Site Access

Access during construction can be provided completely from existing street right-of-way. A detour plan will be provided in the construction drawings by PEC in accordance with the City of Phoenix standards.

C. Right-of-Way/Easements

The majority of the drainage conduit is within street right-of-way with the exception of the inlet structure on the northeast corner of 16th Street and Grovers Avenue. At this location, the inlet structure will be placed within a dedicated drainage easement in the Sunrise Heights Mobile Home Park. No additional right-of-way, easements, or rights-of-entry will be required.

D. Value Engineering

Preliminary analysis was performed for single barrel box (precast) and circular pipe (precast or cast-in-place) conduits. The following construction cost estimates for these alternate conduit materials are in-place costs including all contractor mark-ups:

	ALTERNATE	UNIT COST	QUANTITY	TOTAL COST
1.	8'x8' Precast Concrete Box	$300/LF	4080 LF	**$1,224,000**
2.	8' Diameter Precast Circular Pipe	$260/LF	2750 LF	$ 715,000
	9' Diameter Precast Circular Pipe	$280/LF	1330 LF	$ 372,400
			4080 LF	**$1,087,400**
3.	8.5' Diameter C.I.P. Pipe	$150/LF	2750 LF	$ 412,500
	9.5' Diameter C.I.P. Pipe	$170/LF	1330 LF	$ 226,100
			4080 LF	**$ 638,600**

E. Hazardous Materials

A 'windshield' survey of the proposed storm drain alignment indicate no visible signs of hazardous materials present with the project limits.

F. Maintenance Requirements

Periodic scheduled maintenance and visual inspection of the storm drain conduit will be required to be performed by the City of Phoenix. Access to the conduit will be via manholes located at approximately 640 feet on center.

G. Design Review and Permitting Requirements

Design review is required by the District at the Concept, 30%, 60%, and 90% submittals. The District has indicated that three (3) weeks will be required to complete their review process. In addition, PEC will copy to the City of Phoenix Engineering and Architectural Services Department and Streets and Transportation Department the above listed submittals for their review and coordination. Per the scope of work, PEC will submit plans to the City for review of water and sewer relocations, and the District will submit plans to all other utilities.

H. Construction Duration and Schedule

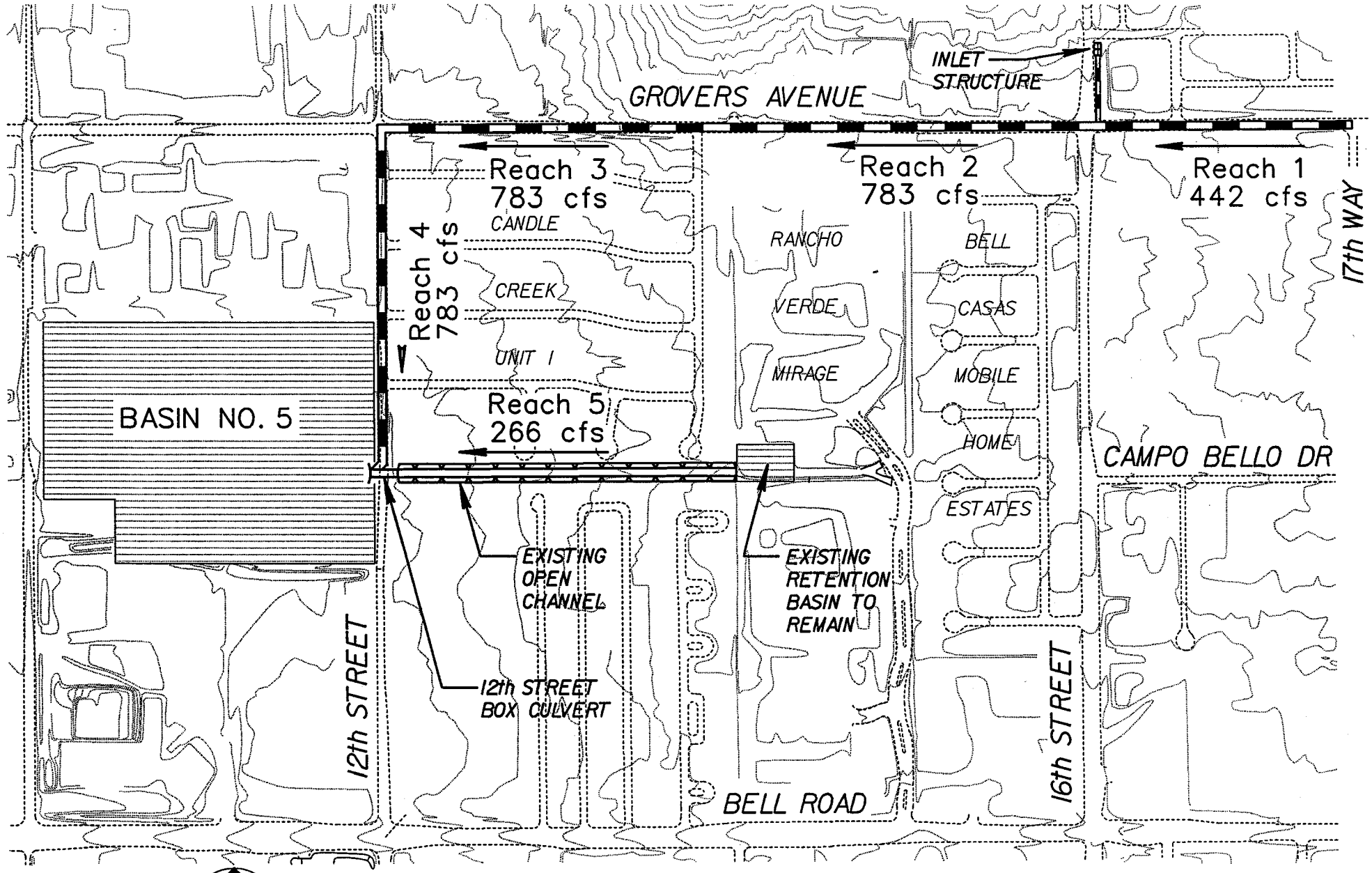
It is anticipated that the construction duration for this project will be approximately six (6) months in length. Since right-of-way acquisition will not be required, this project can be prepared for bid advertisement immediately upon completion of the final contract documents.

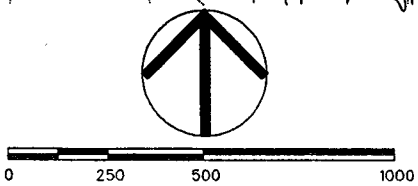
I. Special Project Features

The contract documents will allow for competitive bidding for the following alternate materials:

A. Precast Concrete Box Culvert (Single Barrel)
B. Precast Concrete Circular Pipe
C. Cast-in-Place Pipe

At the outfall into Basin No. 5 at 12th Street, both the storm drain and the box culvert will discharge into the same apron. A small catch basin was designed in a depressed portion of the apron that can convey a 2 year storm and divert it to a 30 inch drainage pipe that traverses the basin length. For larger flows, stormwater exceeds the capacity of the catch basin and diverts up through a safety grate, and into Basin No. 5.





LEGEND

DRAIN CONDUIT

OPEN CHANNEL

BOX CULVERT

PROPOSED ROUTING MAP
CAMPO BELLO DRIVE LATERAL

EXHIBIT A

EXHIBIT B

PRECAST SINGLE BARREL BOX

PROJECT ENGINEERING CONSULTANTS, LTD.
3130 N. 35th Avenue, Suite 1
Phoenix, Arizona 85017

Project: Campo Bello Drive Lateral
Flood Control District of Maricopa County

Rev:
Chkd: LMM
Date: 3-16-94

Sheet: 1 of 3
By: KJS
Date: 3-16-94

Station	Dist. (ft)	Q (cfs)	Box X-Section Width (ft)	Box X-Section Hgt (ft)	Area (sq-ft)	Velocity (fps)	Velocity Head	Ground Elev	Invert Elev	Soffit Elev	Lid Thick (in)	T/Lid Elev	HGL Elev	EGL Elev	Cover Over Box	Cover Over HGL	Hydro Head	Slope of Box ('/ft)	SF ('/ft)	Slope of HGL ('/ft)	HL (ft)	Flowing Full?
1003.5	0	783	8	8	64	12.2	2.32	1394.30	1379.40	1387.40	8	1388.07	1390.28	1392.60	6.23	4.02	10.88	—	—	—	—	—
1074.19	70.69	783	8	8	64	12.2	2.32	1394.45	1379.54	1387.54	8	1388.21	1390.60	1392.93	6.24	3.85	11.06	0.0020	0.0045	0.0045	0.32135	Yes
1048.5	0	783	8	8	64	12.2	2.32	1394.45	1379.54	1387.54	8	1388.21	1390.60	1392.93	6.24	3.85	11.06	—	—	—	—	—
1523.69	475.19	783	8	8	64	12.2	2.32	1395.40	1380.49	1388.49	8	1389.16	1392.76	1395.09	6.24	2.64	12.27	0.0020	0.0045	0.0045	2.16016	Yes
1523.69	0	783	8	8	64	12.2	2.32	1395.40	1380.49	1388.49	8	1389.16	1392.76	1395.09	6.24	2.64	12.27	—	—	—	—	—
1624.75	101.06	783	8	8	64	12.2	2.32	1395.67	1380.69	1388.69	8	1389.36	1393.22	1395.55	6.31	2.45	12.53	0.0020	0.0045	0.0045	0.45941	Yes
1624.5	0	783	8	8	64	12.2	2.32	1395.67	1380.69	1388.69	8	1389.36	1393.22	1395.55	6.31	2.45	12.53	—	—	—	—	—
1725.56	101.06	783	8	8	64	12.2	2.32	1395.86	1380.89	1388.89	8	1389.56	1393.68	1396.00	6.30	2.18	12.79	0.0020	0.0045	0.0045	0.45941	Yes
1725.32	0	783	8	8	64	12.2	2.32	1395.86	1380.89	1388.89	8	1389.56	1393.68	1396.00	6.30	2.18	12.79	—	—	—	—	—
2230	504.68	783	8	8	64	12.2	2.32	1397.01	1381.90	1389.90	8	1390.57	1395.97	1398.30	6.44	1.04	14.07	0.0020	0.0045	0.0045	2.29422	Yes
2230	0	783	8	8	64	12.2	2.32	1397.01	1381.90	1389.90	8	1390.57	1395.97	1398.30	6.44	1.04	14.07	—	—	—	—	—
2234.6	4.6	783	8	8	64	12.2	2.32	1397.02	1381.92	1389.92	8	1390.59	1396.00	1398.32	6.43	1.02	14.08	0.0043	0.0045	0.0045	0.02091	Yes
2234.6	0	783	8	8	64	12.2	2.32	1397.02	1381.92	1389.92	8	1390.59	1396.00	1398.32	6.43	1.02	14.08	—	—	—	—	—
2312.94	78.34	783	8	8	64	12.2	2.32	1397.33	1382.31	1390.31	8	1390.98	1396.35	1398.68	6.35	0.98	14.04	0.0050	0.0045	0.0045	0.35613	Yes

Notes: n = 0.013

* When conduit is not flowing full, then soffit elevation assumed to be HGL elevation (ie: conservative).

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Station	Dist. (ft)	Q (cfs)	Box X-Section Width (ft)	Box X-Section Hgt (ft)	Area (sq-ft)	Velocity (fps)	Velocity Head	Ground Elev	Invert Elev	Soffit Elev	Lid Thick (in)	T/Lid Elev	HGL Elev	EGL Elev	Cover Over Box	Cover Over HGL	Hydro Head	Slope of Box ('/ft)	SF ('/ft)	Slope of HGL ('/ft)	HL (ft)	Flowing Full?
2329.22	0	783	8	8	64	12.2	2.32	1397.33	1382.31	1390.31	8	1390.98	1396.35	1398.67	6.35	0.98	14.04	—	—	—	—	—
2900	570.78	783	8	8	64	12.2	2.32	1401.89	1385.17	1393.17	8	1393.84	1398.94	1401.27	8.05	2.95	13.77	0.0050	0.0045	0.0045	2.59471	Yes
2900	0	783	8	8	64	12.2	2.32	1401.89	1385.17	1393.17	8	1393.84	1398.94	1401.27	8.05	2.95	13.77	—	—	—	—	—
3540	640	783	8	8	64	12.2	2.32	1408.99	1392.85	1400.85	8	1401.52	1401.85	1404.18	7.47	7.14	9.00	0.0120	0.0045	0.0045	2.90937	Yes
3540	0	783	8	8	64	12.2	2.32	1408.99	1392.85	1400.85	8	1401.52	1401.85	1404.18	7.47	7.14	9.00	—	—	—	—	—
4180	640	783	8	8	64	12.2	2.32	1413.35	1396.69	1404.69	8	1405.36	1404.76	1407.09	7.99	8.59	8.07	0.0060	0.0045	0.0045	2.90937	Yes
4180	0	783	8	8	64	12.2	2.32	1413.35	1396.69	1404.69	8	1405.36	1404.76	1407.09	7.99	8.59	8.07	—	—	—	—	—
4820	640	783	8	8	64	12.2	2.32	1416.21	1399.89	1407.89	8	1408.56	1407.67	1410.00	7.65	8.54	7.78	0.0050	0.0045	0.0045	2.90937	No *
4820	0	783	8	8	64	12.2	2.32	1416.21	1399.89	1407.89	8	1408.56	1407.89	1410.21	7.65	8.32	8.00	—	—	—	—	—
4826.33	6.33	783	8	8	64	12.2	2.32	1416.25	1399.93	1407.93	8	1408.60	1407.92	1410.24	7.65	8.33	7.99	0.0063	0.0045	0.0045	0.02878	No *
4826.33	0	783	8	8	64	12.2	2.32	1416.25	1399.93	1407.93	8	1408.60	1407.93	1410.25	7.65	8.32	8.00	—	—	—	—	—
4952.51	126.18	783	8	8	64	12.2	2.32	1416.88	1400.82	1408.82	8	1409.49	1408.50	1410.83	7.39	8.38	7.68	0.0071	0.0045	0.0045	0.5736	No *
4950.42	0	783	8	8	64	12.2	2.32	1416.88	1400.82	1408.82	8	1409.49	1408.82	1411.14	7.39	8.06	8.00	—	—	—	—	—
5075.43	125.01	783	8	8	64	12.2	2.32	1417.71	1401.69	1409.69	8	1410.36	1409.39	1411.71	7.35	8.32	7.70	0.0070	0.0045	0.0045	0.56828	No *

Notes: n = 0.013

* When conduit is not flowing full, then soffit elevation assumed to be HGL elevation (ie: conservative).

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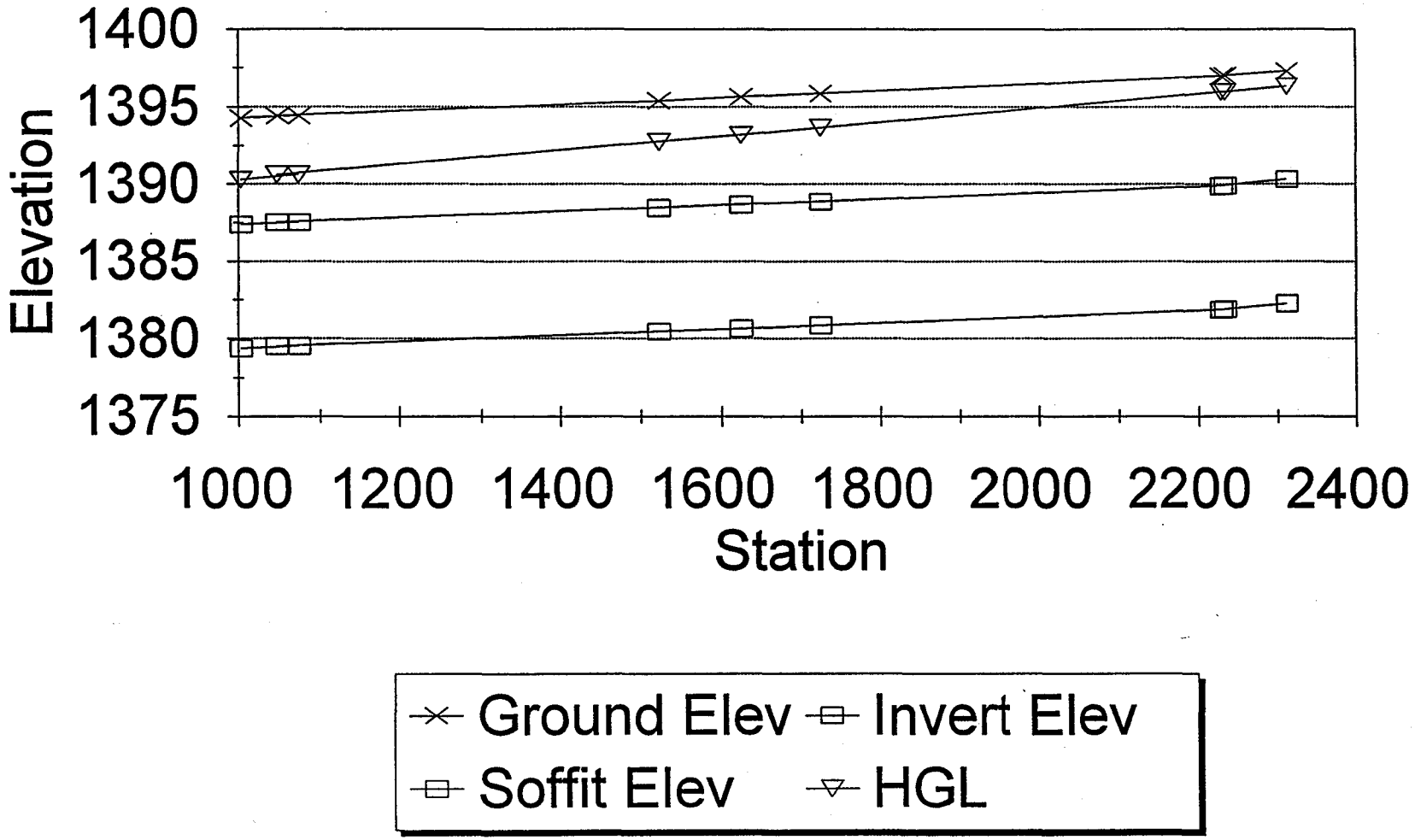
5073.47	0	675	8	6	48	14.1	3.07	1417.71	1403.69	1409.69	8	1410.36	1409.69	1412.76	7.35	8.02	6	—	—	—	—	—
5360	286.53	675	8	6	48	14.1	3.07	1418.90	1405.70	1411.70	8	1412.37	1411.80	1414.87	6.53	7.10	6.10	0.0070	0.0074	0.0074	2.11358	Yes
5360	0	675	8	6	48	14.1	3.07	1418.90	1405.70	1411.70	8	1412.37	1411.80	1414.87	6.53	7.10	6.10	—	—	—	—	—
5920.04	560.04	675	8	6	48	14.1	3.07	1423.43	1409.78	1415.78	8	1416.45	1415.93	1419.01	6.98	7.50	6.15	0.0073	0.0074	0.0074	4.13111	Yes

Notes: n = 0.013

* When conduit is not flowing full, then soffit elevation assumed to be HGL elevation (ie: conservative).

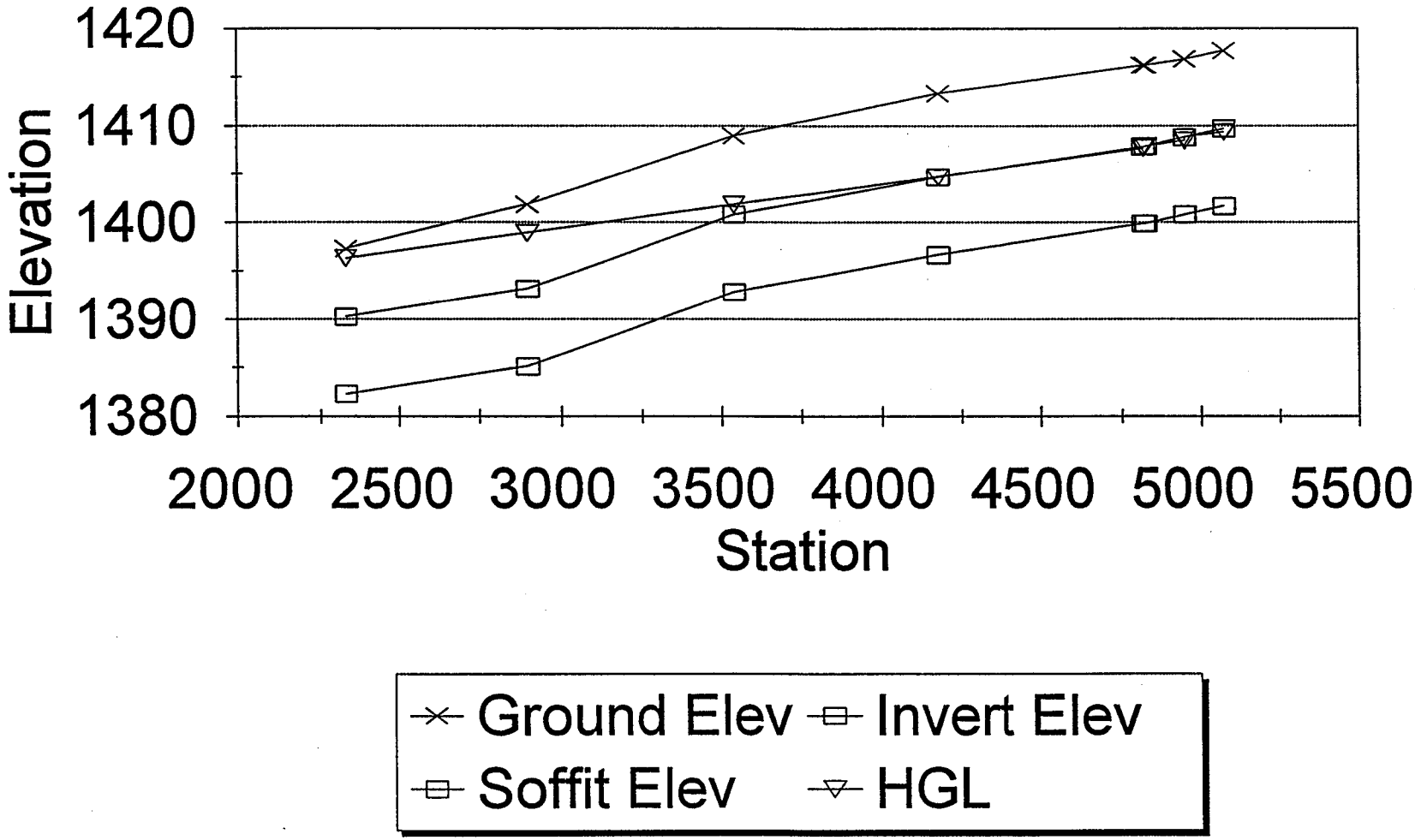
Campo Bello Drive Lateral

Graph of Hydraulic Properties



Campo Bello Drive Lateral

Graph of Hydraulic Properties



Campo Bello Drive Lateral

Graph of Hydraulic Properties

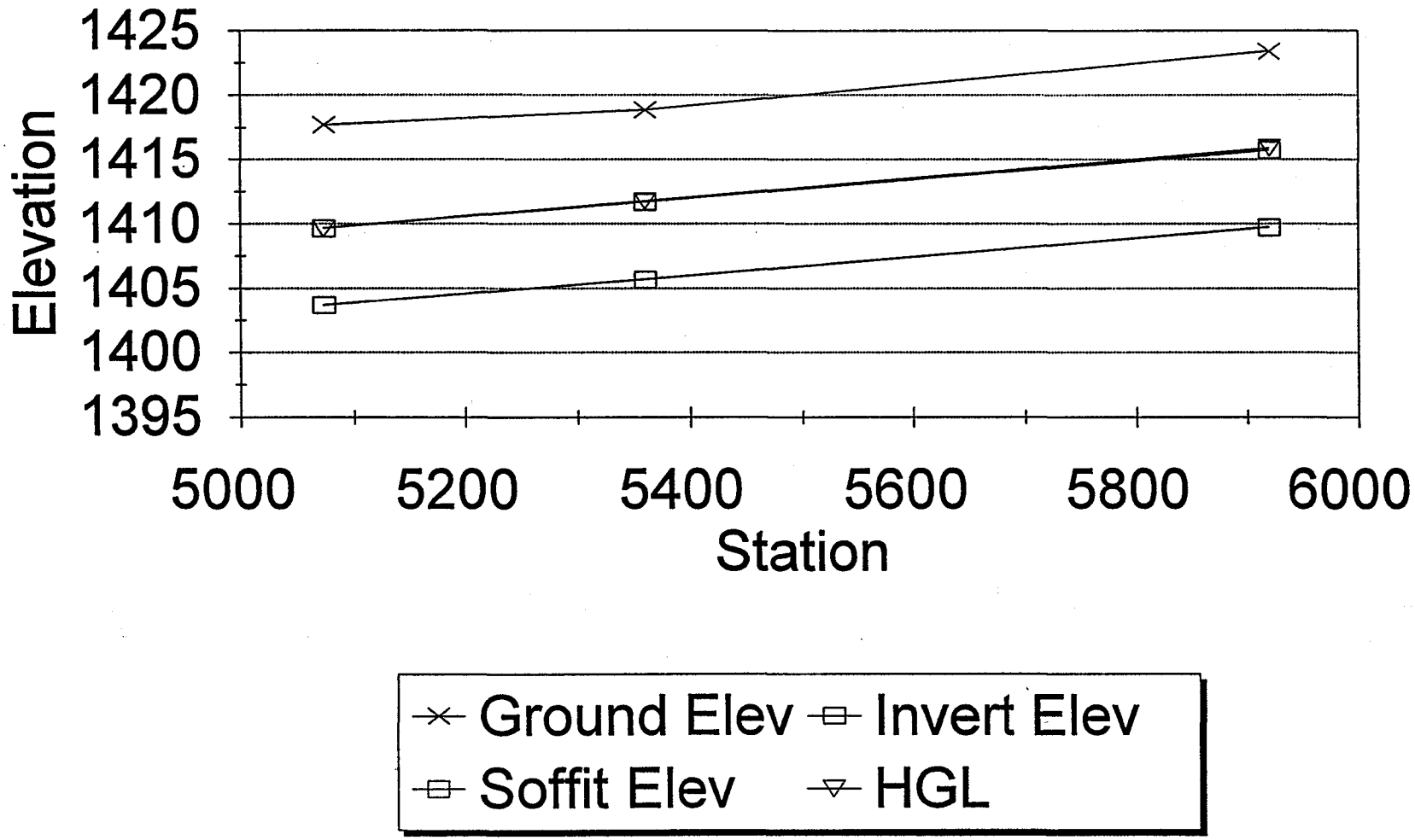


EXHIBIT C

PRECAST CONCRETE PIPE

PROJECT ENGINEERING CONSULTANTS, LTD.
3130 N. 35th Avenue, Suite 1
Phoenix, Arizona 85017

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Station	Dist. (ft)	Q (cfs)	Pipe Dia. (ft)	Area (sq-ft)	Velocity (fps)	Velocity Head	Ground Elev	Invert Elev	Soffit Elev	Wall Thick (in)	T/Pipe Elev	HGL Elev	EGL Elev	Cover Over Pipe	Cover Over HGL	Hydro Head	Slope of Pipe ('/ft)	SF ('/ft)	Slope of HGL ('/ft)	HL (ft)	Flowing Full?
1048.5	0	783	9	63.62	12.3	2.35	1394.45	1379.54	1388.54	9	1389.29	1390.60	1392.95	5.16	3.85	11.06	—	—	—	—	—
1523.69	475.19	783	9	63.62	12.3	2.35	1395.40	1380.49	1389.49	9	1390.24	1392.19	1394.54	5.16	3.21	11.70	0.0020	0.0034	0.0034	1.59208	Yes
1523.69	0	783	9	63.62	12.3	2.35	1395.40	1380.49	1389.49	9	1390.24	1392.19	1394.54	5.16	3.21	11.70	—	—	—	—	—
1624.75	101.06	783	9	63.62	12.3	2.35	1395.67	1380.69	1389.69	9	1390.44	1392.53	1394.88	5.23	3.14	11.84	0.0020	0.0034	0.0034	0.33859	Yes
1624.5	0	783	9	63.62	12.3	2.35	1395.67	1380.69	1389.69	9	1390.44	1392.53	1394.88	5.23	3.14	11.84	—	—	—	—	—
1725.56	101.06	783	9	63.62	12.3	2.35	1395.86	1380.89	1389.89	9	1390.64	1392.87	1395.22	5.22	2.99	11.98	0.0020	0.0034	0.0034	0.33859	Yes
1725.32	0	783	9	63.62	12.3	2.35	1395.86	1380.89	1389.89	9	1390.64	1392.87	1395.22	5.22	2.99	11.98	—	—	—	—	—
2230	504.68	783	9	63.62	12.3	2.35	1397.01	1381.90	1390.90	9	1391.65	1394.56	1396.91	5.36	2.45	12.66	0.0020	0.0034	0.0034	1.69089	Yes
2230	0	783	9	63.62	12.3	2.35	1397.01	1381.90	1390.90	9	1391.65	1394.56	1396.91	5.36	2.45	12.66	—	—	—	—	—
2234.6	4.6	783	9	63.62	12.3	2.35	1397.02	1381.92	1390.92	9	1391.67	1394.58	1396.93	5.35	2.44	12.66	0.0043	0.0034	0.0034	0.01541	Yes
2234.6	0	783	9	63.62	12.3	2.35	1397.02	1381.92	1390.92	9	1391.67	1394.58	1396.93	5.35	2.44	12.66	—	—	—	—	—
2312.94	78.34	783	9	63.62	12.3	2.35	1397.33	1382.32	1391.32	9	1392.07	1394.84	1397.19	5.26	2.49	12.52	0.0051	0.0034	0.0034	0.26247	Yes
2329.22	0	783	9	63.62	12.3	2.35	1397.33	1382.32	1391.32	9	1392.07	1394.84	1397.19	5.26	2.49	12.52	—	—	—	—	—
2900	570.78	783	9	63.62	12.3	2.35	1401.89	1385.17	1394.17	9	1394.92	1396.75	1399.10	6.97	5.14	11.58	0.0050	0.0034	0.0034	1.91235	Yes

Notes: n = 0.012

* When conduit is not flowing full, then soffit elevation assumed to be HGL elevation (ie: conservative).

PROJECT ENGINEERING CONSULTANTS, LTD.

3130 N. 35th Avenue, Suite 1

Phoenix, Arizona 85017

Project: Campo Bello Drive Lateral

Flood Control District of Maricopa County

Rev:

Chkd: LMM

Date: 3-17-94

Sheet: 2 of 3

By: KJS

Date: 3-17-94

Station	Dist. (ft)	Q (cfs)	Pipe Dia. (ft)	Area (sq-ft)	Velocity (fps)	Velocity Head	Ground Elev	Invert Elev	Soffit Elev	Wall Thick (in)	T/Pipe Elev	HGL Elev	EGL Elev	Cover Over Pipe	Cover Over HGL	Hydro Head	Slope of Pipe ('/ft)	SF ('/ft)	Slope of HGL ('/ft)	HL (ft)	Flowing Full?
2900	0	783	8	50.27	15.6	3.77	1401.89	1385.17	1393.17	9	1393.92	1396.75	1400.52	7.97	5.14	11.58	—	—	—	—	—
3540	640	783	8	50.27	15.6	3.77	1408.99	1392.85	1400.85	9	1401.60	1400.77	1404.54	7.39	8.22	7.92	0.0120	0.0063	0.0063	4.01879	No *
3540	0	783	8	50.27	15.6	3.77	1408.99	1392.85	1400.85	9	1401.60	1400.85	1404.62	7.39	8.14	8.00	—	—	—	—	—
4180	640	783	8	50.27	15.6	3.77	1413.35	1396.69	1404.69	9	1405.44	1404.87	1408.64	7.91	8.48	8.18	0.0060	0.0063	0.0063	4.01879	Yes
4180	0	783	8	50.27	15.6	3.77	1413.35	1396.69	1404.69	9	1405.44	1404.87	1408.64	7.91	8.48	8.18	—	—	—	—	—
4820	640	783	8	50.27	15.6	3.77	1416.21	1399.89	1407.89	9	1408.64	1408.89	1412.66	7.57	7.32	9.00	0.0050	0.0063	0.0063	4.01879	Yes
4820	0	783	8	50.27	15.6	3.77	1416.21	1399.89	1407.89	9	1408.64	1408.89	1412.66	7.57	7.32	9.00	—	—	—	—	—
4826.33	6.33	783	8	50.27	15.6	3.77	1416.25	1399.93	1407.93	9	1408.68	1408.93	1412.70	7.57	7.32	9.00	0.0063	0.0063	0.0063	0.03975	Yes
4826.33	0	783	8	50.27	15.6	3.77	1416.25	1399.93	1407.93	9	1408.68	1408.93	1412.70	7.57	7.32	9.00	—	—	—	—	—
4952.51	126.18	783	8	50.27	15.6	3.77	1416.88	1400.82	1408.82	9	1409.57	1409.72	1413.49	7.31	7.16	8.90	0.0071	0.0063	0.0063	0.79233	Yes
4950.42	0	783	8	50.27	15.6	3.77	1416.88	1400.82	1408.82	9	1409.57	1409.72	1413.49	7.31	7.16	8.90	—	—	—	—	—
5075.43	125.01	783	8	50.27	15.6	3.77	1417.71	1401.69	1409.69	9	1410.44	1410.50	1414.27	7.27	7.21	8.81	0.0070	0.0063	0.0063	0.78498	Yes
5073.47	0	675	7.5	44.18	15.3	3.62	1417.71	1402.19	1409.69	8.5	1410.40	1410.50	1414.13	7.31	7.21	8.31	—	—	—	—	—
5360	286.53	675	7.5	44.18	15.3	3.62	1418.90	1404.20	1411.70	8.5	1412.41	1412.39	1416.02	6.49	6.51	8.19	0.0070	0.0066	0.0066	1.8865	Yes

Notes: n = 0.012

* When conduit is not flowing full, then soffit elevation assumed to be HGL elevation (ie: conservative).

PROJECT ENGINEERING CONSULTANTS, LTD.

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Sheet: 3 of 3

By: KJS

Date: 3-17-94

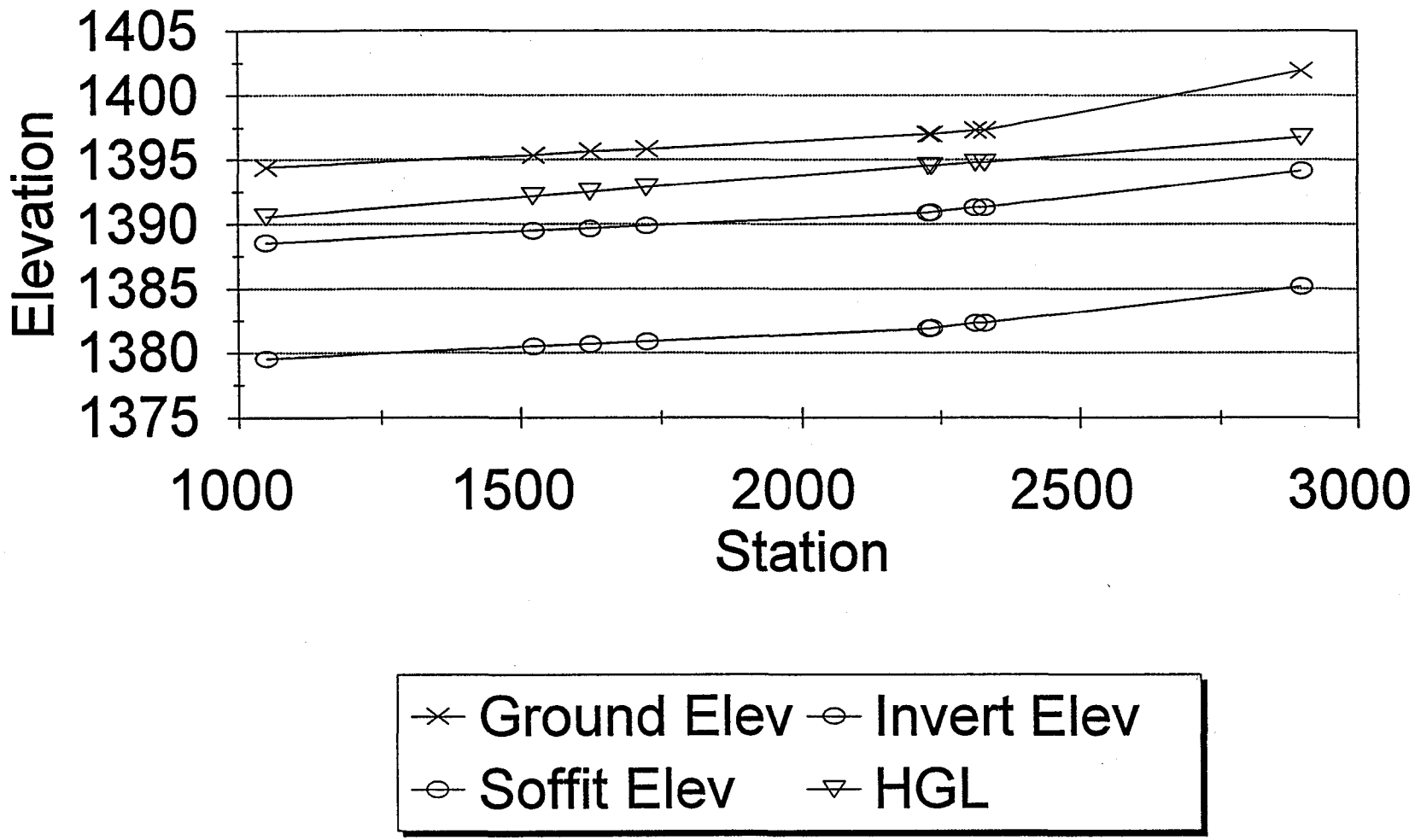
Station	Dist. (ft)	Q (cfs)	Pipe Dia. (ft)	Area (sq-ft)	Velocity (fps)	Velocity Head	Ground Elev	Invert Elev	Soffit Elev	Wall Thick (in)	T/Pipe Elev	HGL Elev	EGL Elev	Cover Over Pipe	Cover Over HGL	Hydro Head	Slope of Pipe ('/ft)	SF ('/ft)	Slope of HGL ('/ft)	HL (ft)	Flowing Full?
5360	0	675	7.5	44.18	15.3	3.62	1418.90	1404.20	1411.70	8.5	1412.41	1412.39	1416.01	6.49	6.51	8.19	—	—	—	—	—
5920.04	560.04	675	7.5	44.18	15.3	3.62	1423.43	1408.28	1415.78	8.5	1416.49	1416.08	1419.70	6.94	7.35	7.80	0.0073	0.0066	0.0066	3.68729	Yes

Notes: n = 0.012

* When conduit is not flowing full, then soffit elevation assumed to be HGL elevation (ie: conservative).

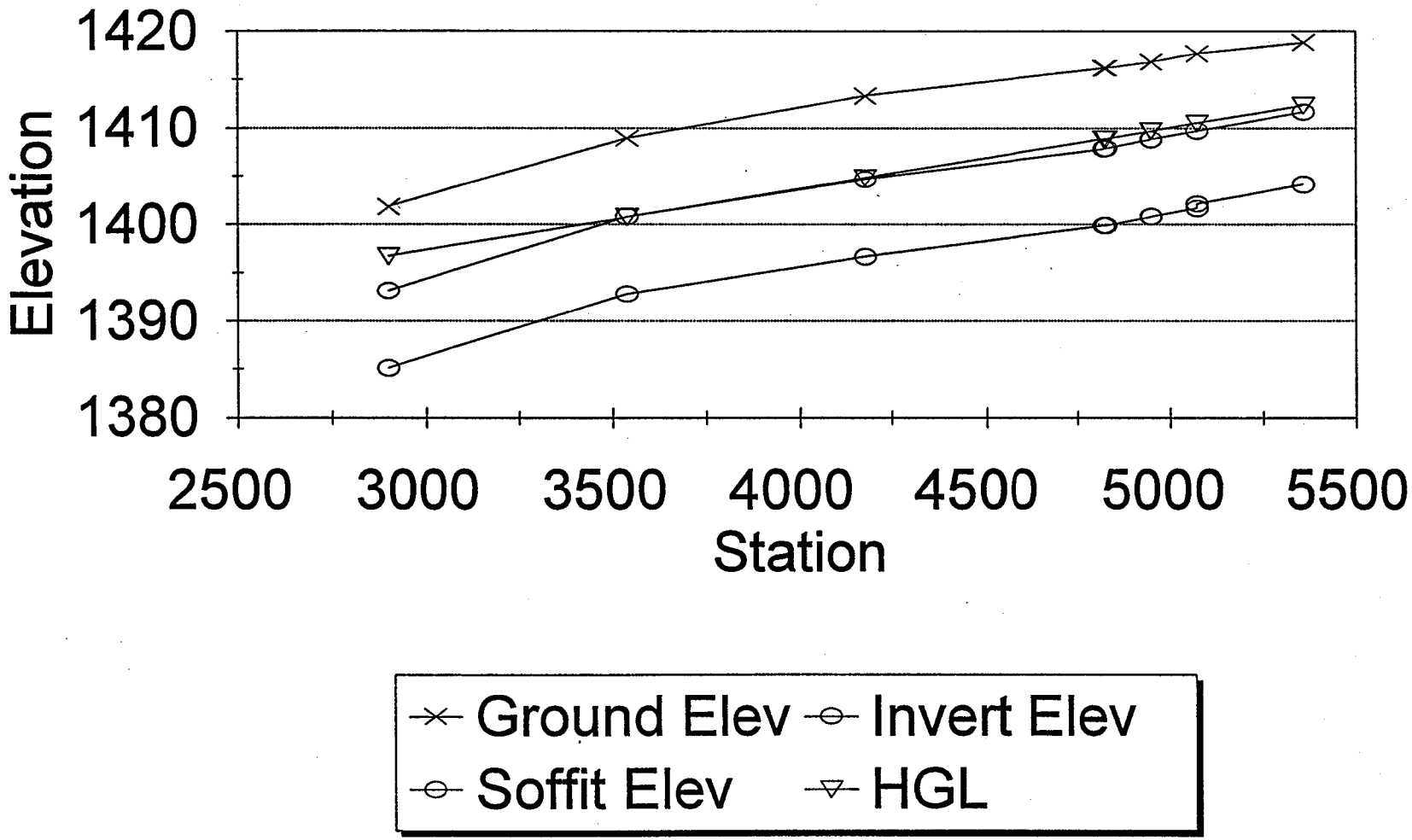
Campo Bello Drive Lateral

Graph of Hydraulic Properties



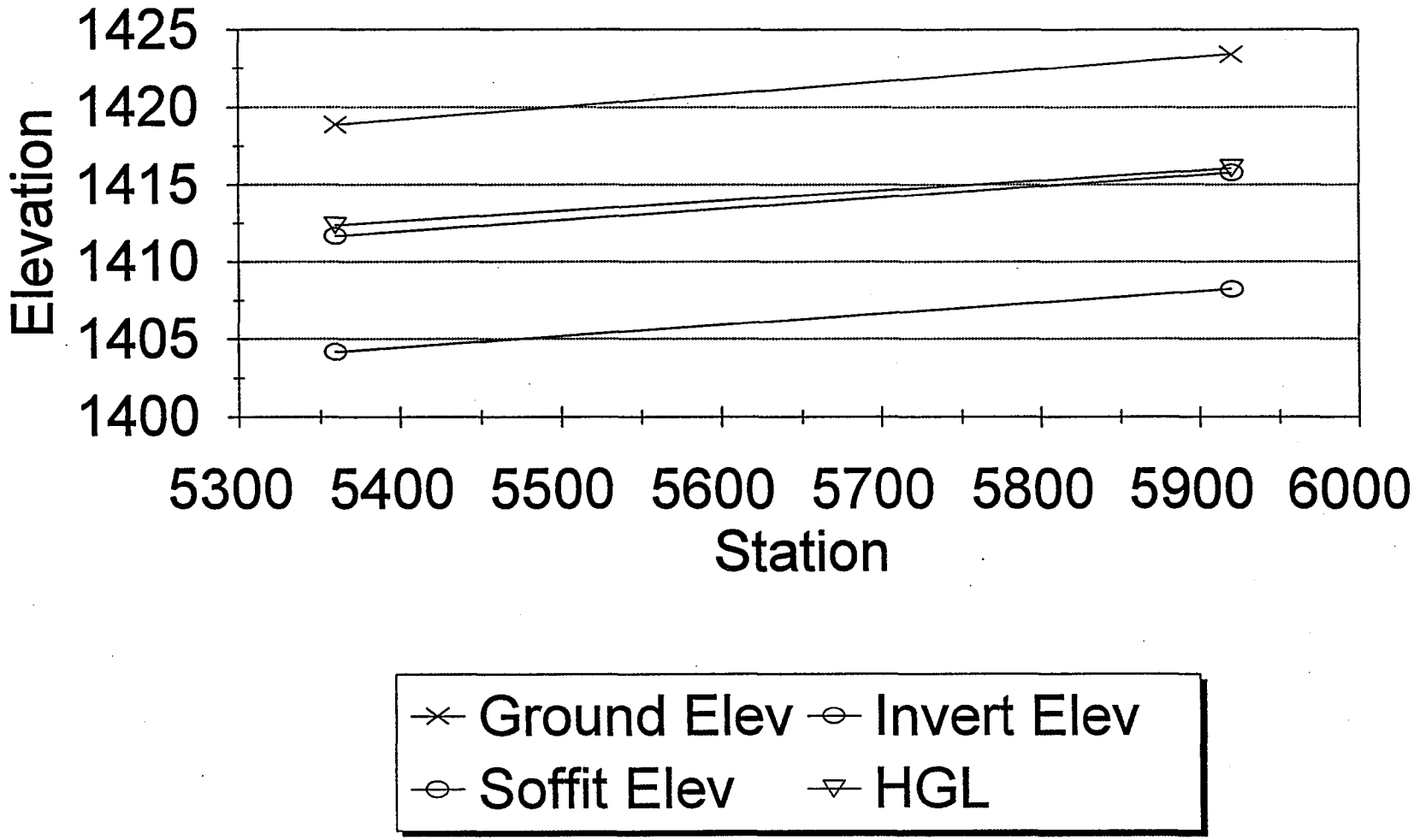
Campo Bello Drive Lateral

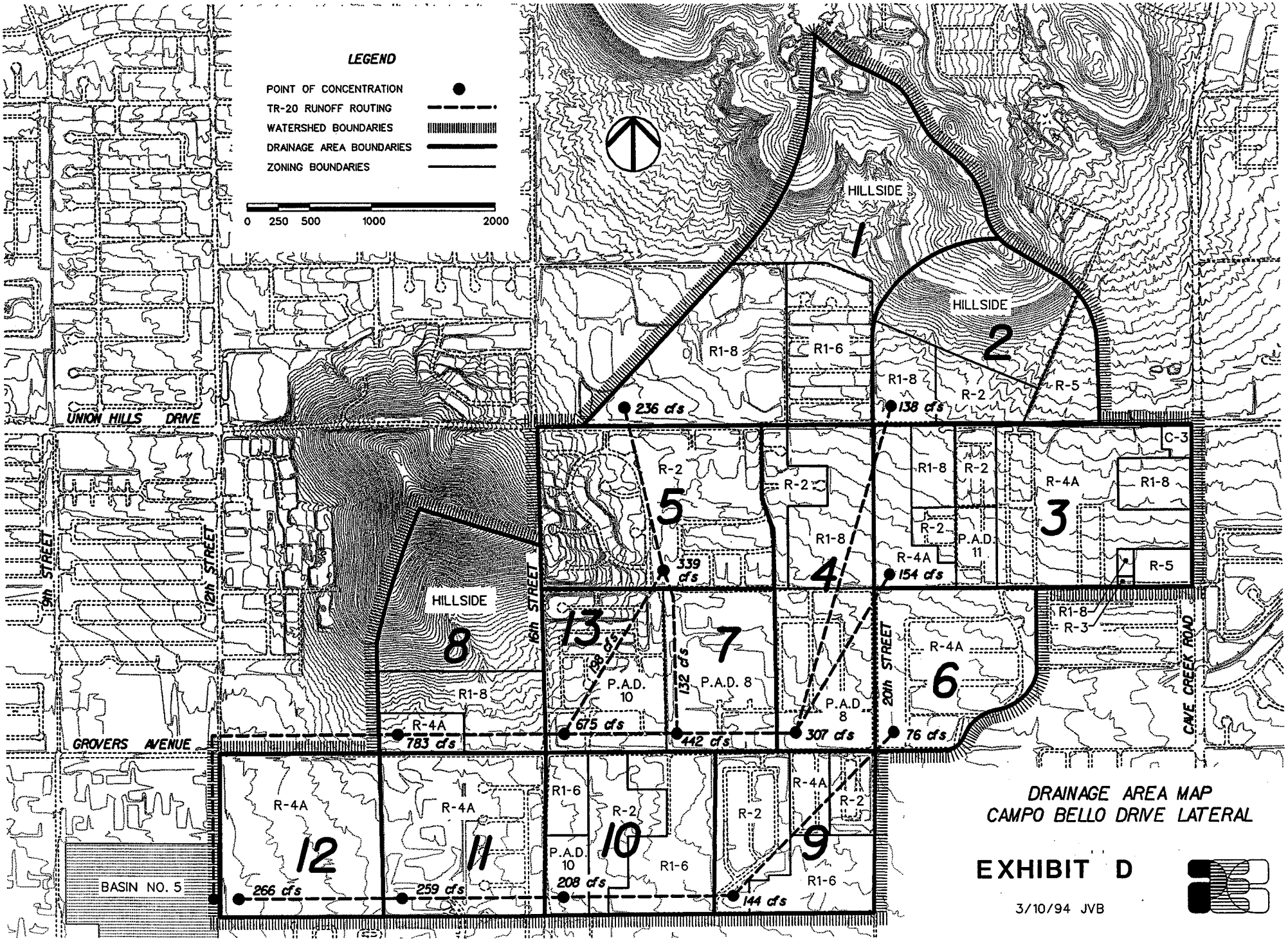
Graph of Hydraulic Properties



Campo Bello Drive Lateral

Graph of Hydraulic Properties





DRAINAGE AREA MAP
CAMPO BELLO DRIVE LATERAL

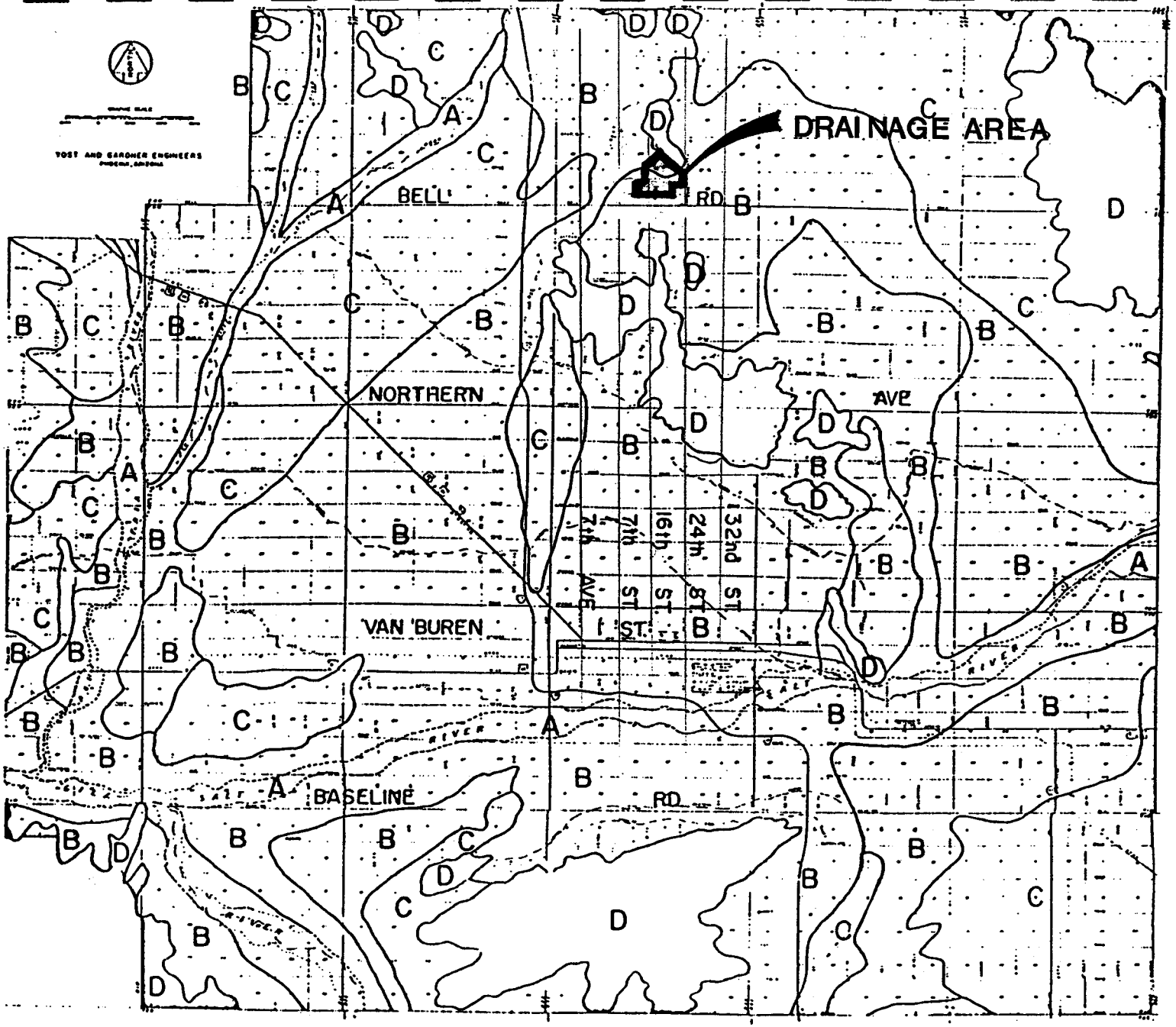
EXHIBIT D

3/10/94 JVB

EXHIBIT E - Composite Curve Number
Campobello Drive Lateral

JVB 1/18/94

Sub Area	Total Area Acres	Total Area Sq. Miles	Area (Acres) - Type B Soil Cover Complex: C Cn=92	R1-6 Cn=84	R1-8 Cn=82	R2 Cn=84	R3 Cn=85	R4, R5 Cn=86	PAD Cn=84	Hillside Cn=98	Composite Cn Compt'd	Composite Cn USE
1	101.0	0.158		19.9	31.8					49.3	90.20	90
2	54.0	0.084			9.0	8.4		9.0		27.6	91.16	91
3	80.0	0.125	1.5		12.1	8.2	0.3	52.9	5.0		85.17	85
4	50.0	0.078			18.5	7.5			24.0		83.26	83
5	56.0	0.088				56.0					84.00	84
6	35.0	0.055						35.0			86.00	86
7	57.0	0.089							57.0		84.00	84
8	54.0	0.084			15.3			5.1		33.6	92.33	92
9	40.0	0.063		12.5		22.5		5.0			84.25	84
10	40.0	0.063		22.6		12.0			5.4		84.00	84
11	40.0	0.063						40.0			86.00	86
12	40.0	0.063						40.0			86.00	86



SOIL TYPES

FROM "GENERAL SOIL MAP OF MARICOPA COUNTY"

EXHIBIT F

EXHIBIT G

CURVE NUMBERS BY ZONING FOR USE WITH SCS OR TR-20 METHODS OF DETERMINING RUNOFF IN THE CITY OF PHOENIX

ZONING	TYPE B	TYPE C	TYPE D
RE-43) S-1)	77	83	86
RE-35	79	84	87
RE-25	79	84	87
E1-18	80	84	87
R1-14	80	85	88
R1-10	81	85	89
R1-8	82	87	90
R1-6	84	88	90
R-3	85	88	90
R-4) R-40) R-5)	86	89	91
A-1) A-2)	85	91	93
C-1) C-2) C-3)	92	94	95
CO	88	91	93
PSC	95	95	95
HR R4A	95 87	95 90	95 92
Hillside (over 10% sloping).	98	98	98

EXHIBIT H

24 HOUR RAINFALL DISTRIBUTION

TIME (HOUR)	ACCUMULATIVE RAINFALL	TIME (HOUR)	ACCUMULATIVE RAINFALL
0	.000	12.5	.83
.5	.004	13.0	.86
1.0	.008	13.5	.88
1.5	.013	14.0	.893
2.0	.018	14.5	.907
2.5	.022	15.0	.92
3.0	.026	15.5	.924
3.5	.031	16.0	.928
4.0	.035	16.5	.933
4.5	.040	17.0	.937
5.0	.044	17.5	.942
5.5	.048	18.0	.947
6.0	.053	18.5	.951
6.5	.057	19.0	.956
7.0	.062	19.5	.96
7.5	.066	20.0	.964
8.0	.071	20.5	.969
8.5	.075	21.0	.973
9.0	.08	21.5	.978
9.5	.093	22.0	.982
10.0	.107	22.5	.987
10.5	.12	23.0	.991
11.0	.14	23.5	.995
11.5	.17	24.0	1.00
12.0	.50		

PEAK DISCHARGE SUMMARY TABLE

SUMMARY TABLE 1 - SELECTED RESULTS OF STANDARD AND EXECUTIVE CONTROL INSTRUCTIONS IN THE ORDER PERFORMED
(A STAR(*) AFTER THE PEAK DISCHARGE TIME AND RATE (CFS) VALUES INDICATES A FLAT TOP HYDROGRAPH
A QUESTION MARK(?) INDICATES A HYDROGRAPH WITH PEAK AS LAST POINT.)

SECTION/ STRUCTURE ID	STANDARD CONTROL OPERATION	DRAINAGE AREA (SQ MI)	RAIN TABLE #	ANTEC MOIST COND	MAIN TIME INCREM (HR)	PRECIPITATION BEGIN (HR)	PRECIPITATION AMOUNT (IN)	PRECIPITATION DURATION (HR)	RUNOFF AMOUNT (IN)	PEAK DISCHARGE ELEVATION (FT)	PEAK DISCHARGE TIME (HR)	PEAK DISCHARGE RATE (CFS)	PEAK DISCHARGE RATE (CSM)
ALTERNATE 1 STORM 1													
XSECTION 2	RUNOFF	.08	1	2	.08	.0	4.04	24.00	3.05	---	12.44	137.40	1635.7
XSECTION 4	REACH	.08	1	2	.08	.0	4.04	24.00	3.01	---	13.00	106.88	1272.4
XSECTION 3	RUNOFF	.13	1	2	.08	.0	4.04	24.00	2.47	---	12.57	153.98	1231.8
XSECTION 4	REACH	.13	1	2	.08	.0	4.04	24.00	2.46	---	12.80	134.99	1079.9
XSECTION 4	ADDHYD	.21	1	2	.08	.0	4.04	24.00	2.68	---	12.88	233.03	1115.0
XSECTION 4	RUNOFF	.08	1	2	.08	.0	4.04	24.00	2.29	---	12.78	75.11	962.9
XSECTION 4	ADDHYD	.29	1	2	.08	.0	4.04	24.00	2.58	---	12.85	306.77	1068.9
XSECTION 7	REACH	.29	1	2	.08	.0	4.04	24.00	2.57	---	12.95	305.89	1065.8
XSECTION 1	RUNOFF	.16	1	2	.08	.0	4.04	24.00	2.94	---	12.50	236.29	1495.5
XSECTION 5	REACH	.16	1	2	.08	.0	4.04	24.00	2.93	---	12.62	231.09	1462.6
XSECTION 5	RUNOFF	.09	1	2	.08	.0	4.04	24.00	2.39	---	12.56	108.34	1231.1
XSECTION 5	ADDHYD	.25	1	2	.08	.0	4.04	24.00	2.74	---	12.60	338.56	1376.3
XSECTION 1	DIVERT	.25	1	2	.08	.0	4.04	24.00	1.10	4.39	12.60	135.42	550.5
XSECTION 2	DIVERT	.00	1	2	.08	.0	4.04	24.00	1.10	4.39	12.60	203.14	**********
XSECTION 7	REACH	.25	1	2	.08	.0	4.04	24.00	1.09	---	12.72	132.67	539.3
XSECTION 7	ADDHYD	.53	1	2	.08	.0	4.04	24.00	1.89	---	12.85	424.65	796.7
XSECTION 7	RUNOFF	.05	1	2	.08	.0	4.04	24.00	2.40	---	12.48	61.21	1360.1
XSECTION 7	ADDHYD	.58	1	2	.08	.0	4.04	24.00	1.93	---	12.79	441.86	764.5
XSECTION 13	REACH	.00	1	2	.08	.0	4.04	24.00	1.93	---	12.73	197.80	**********
XSECTION 13	ADDHYD	.58	1	2	.08	.0	4.04	24.00	2.63	---	12.76	638.24	1104.2
XSECTION 13	RUNOFF	.05	1	2	.08	.0	4.04	24.00	2.39	---	12.49	60.18	1337.3
XSECTION 13	ADDHYD	.62	1	2	.08	.0	4.04	24.00	2.61	---	12.68	675.32	1084.0
XSECTION 8	REACH	.62	1	2	.08	.0	4.04	24.00	2.61	---	12.68	675.32	1084.0
XSECTION 8	RUNOFF	.08	1	2	.08	.0	4.04	24.00	3.14	---	12.45	135.25	1610.1
XSECTION 8	ADDHYD	.71	1	2	.08	.0	4.04	24.00	2.67	---	12.59	782.77	1107.2
XSECTION 6	RUNOFF	.05	1	2	.08	.0	4.04	24.00	2.57	---	12.51	75.57	1373.9
XSECTION 9	REACH	.05	1	2	.08	.0	4.04	24.00	2.56	---	12.75	69.90	1270.9
XSECTION 9	RUNOFF	.06	1	2	.08	.0	4.04	24.00	2.39	---	12.54	79.70	1265.1
XSECTION 9	ADDHYD	.12	1	2	.08	.0	4.04	24.00	2.47	---	12.60	143.87	1219.3
XSECTION 10	REACH	.12	1	2	.08	.0	4.04	24.00	2.46	---	12.73	139.84	1185.1
XSECTION 10	RUNOFF	.06	1	2	.08	.0	4.04	24.00	2.38	---	12.68	69.42	1102.0
XSECTION 10	ADDHYD	.18	1	2	.08	.0	4.04	24.00	2.43	---	12.71	208.88	1154.0
XSECTION 11	REACH	.18	1	2	.08	.0	4.04	24.00	2.43	---	12.87	200.19	1106.0
XSECTION 11	RUNOFF	.06	1	2	.08	.0	4.04	24.00	2.56	---	12.54	82.57	1310.7
XSECTION 11	ADDHYD	.24	1	2	.08	.0	4.04	24.00	2.46	---	12.74	259.30	1062.7
XSECTION 12	REACH	.24	1	2	.08	.0	4.04	24.00	2.46	---	12.89	252.23	1033.7
XSECTION 12	RUNOFF	.06	1	2	.08	.0	4.04	24.00	2.58	---	12.44	96.03	1524.3
XSECTION 12	ADDHYD	.31	1	2	.08	.0	4.04	24.00	2.48	---	12.51	266.13	866.9

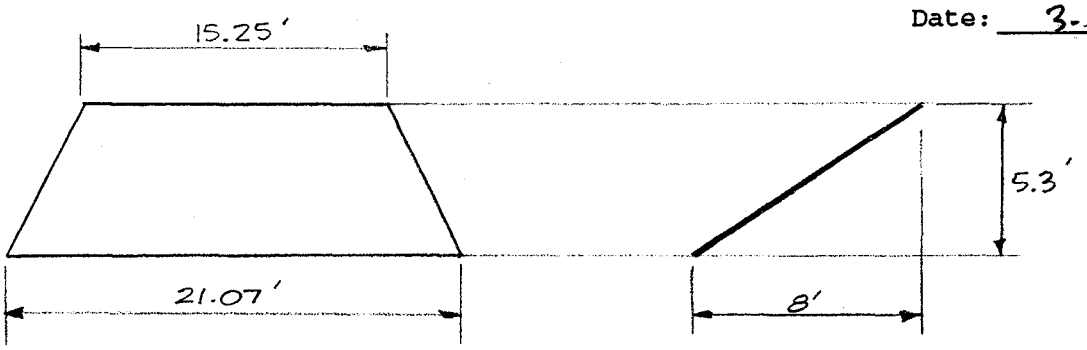
1

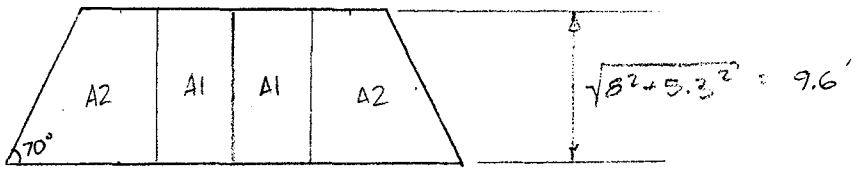
EXHIBIT I

PROJECT ENGINEERING
CONSULTANTS, LTD.
3130 N. 35th AVENUE, SUITE 1
PHOENIX, ARIZONA 85017

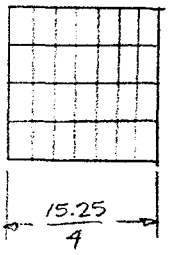
CAMPO BELLO DRIVE LATERAL
OUTLET INTO BASIN #5 GRATE

Sht:
Job# 93041
By: K. SHORT
Date: 3-10-94
Chkd: JVB
Date: 3-23-94



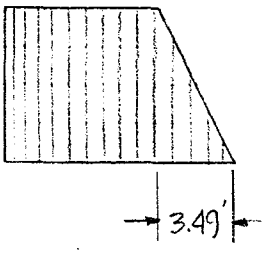


A1



$$A_1 = \left[\frac{15.25'}{4} \times 12''/' - 9(1'')\right]\left[9.6' \times 12''/' - 5(1'')\right] \Big/ \left(12''/' \cdot 12''/'\right)$$

$$A_1 = 28.11 \text{ FT}^2$$



$$A_2 = 28.11 + \frac{1}{2}\left[\frac{3.49' \times 12''/' - 7(1'')}{12''/'}\right]\left[\frac{9.6 \times 12''/' - 5(1'')}{12''/'}\right] - \frac{\sqrt{3.49^2+9.6^2}\,(1'')}{12''/'}$$

$$A_2 = 42.31 \text{ FT}^2$$

TOTAL CLEAR OPENING AREA $= 2 \times A_1 + 2 \times A_2$

$= 2(28.11) + 2(42.31)$

$= 140.84 \text{ FT}^2$

PROJECT ENGINEERING
CONSULTANTS, LTD.
3130 N. 35th AVENUE, SUITE 1
PHOENIX, ARIZONA 85017

CAMPO BELLO DRIVE LATERAL
OUTLET INTO BASIN #5 GRATE
HEAD LOSS

Sht:
Job# 93041
By: K SHORT
Date: 3-10-94
Chkd: JVB
Date: 3-23-94

ORIFICE EQUATION :

$$Q = K A_o \sqrt{2g\Delta h}$$

K = flow coefficient
= 0.67 FOR GRATES
A_o = CLEAR OPENING AREA
g = 32.16 FT/S²
Δh = head loss
Q = flow RATE

$$\Delta h = \left(\frac{Q}{K A_o}\right)^2 \Big/ (2g)$$

Q = 783 CFS (FROM SD down 12th St) + 266 CFS (FROM CULVERT)
− 140 CFS (diverted EAST) − 1 CFS (30" PIPE FLOW)
= 908 CFS

$$\Delta h = \left(\frac{908 \text{ CFS}}{0.67 \times 140.84 \text{ FT}^2}\right)^2 \Big/ (2 \times 32.16 \text{ FT/S}^2)$$

Δh = 1.44 FT

HWE_{100} = 1388.84

HGL = 1388.84 + 1.44 = 1390.28

Figure 4.42
Culvert Design Form

Project: CAMPO BELLO DRIVE LATERAL	Station:	CULVERT DESIGN FORM
	Sheet ____ of ____	Designer/Date: ____ / ____
		Reviewer/Date: ____ / ____

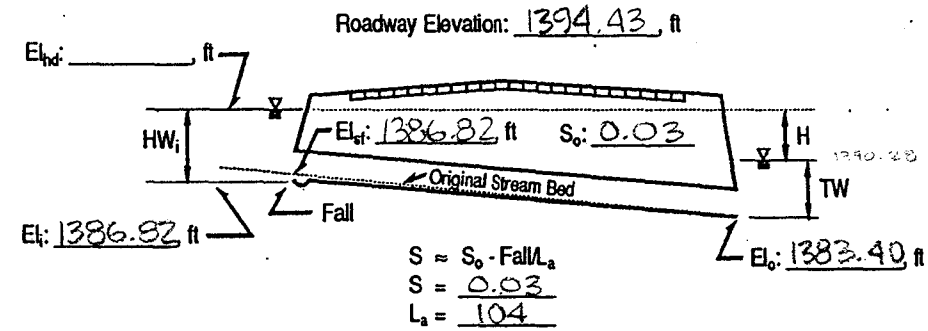
Hydrological Data

See Add'l shts

- ☐ Method: TR20
- ☐ Drainage Area: ____ ☐ Stream Slope: ____
- ☐ Channel Shape: ____
- ☐ Routing: ____ ☐ Other: ____

Design Flows/Tailwater

R.I., years	Flow, cfs	TW, ft
100	266	6.88



Culvert Description: Material - Shape - Size - Entrance	Total Flow Q, cfs	Flow Per Barrel Q/N (1)	Headwater Calculations: Inlet Control HW_i/D (2)	HW_i	Fall (3)	EL_{hi} (4)	Outlet Control TW (5)	d_c	$\frac{d_c + D}{2}$	h_o (6)	k_e	H (7)	EL_{ho} (8)	Control Headwater Elevation	Outlet Velocity	Comments
6' × 4' CONCRETE BOX - 30°-75°	266	266	1.87	7.48	0	94.3	6.88	3.94	3.97	6.88	0.4	3.32	93.6	1394.3		

Technical Footnotes:

(1) Use Q/NB for box culverts.
(2) HW_i/D = HW/D or HW_f/D from design charts
(3) FALL ≐ $HW_i - (EL_{hd} - EL_{sf})$; Fall is zero for culverts on grade.
(4) $EL_{hi} = HW_i + EL_i$ (invert of inlet control section)
(5) TW based on downstream control or flow depth in channel.
(6) h_o = TW or $(d_c + D)/2$ (whichever is greater).
(7) $H = \left[1 + k_e + (29n^2L)/R^{1.33}\right] V^2/2g$
(8) $EL_{ho} = EL_o + H + h_o$

Subscript Definitions:

a. approximate
f. culvert fact
hd. Design Headwater
hj. Headwater in inlet control
he. Headwater in outlet control
i. inlet control section
o. Outlet
sf. Streambed at culvert face
TW. Tailwater

Comments / Discussion:

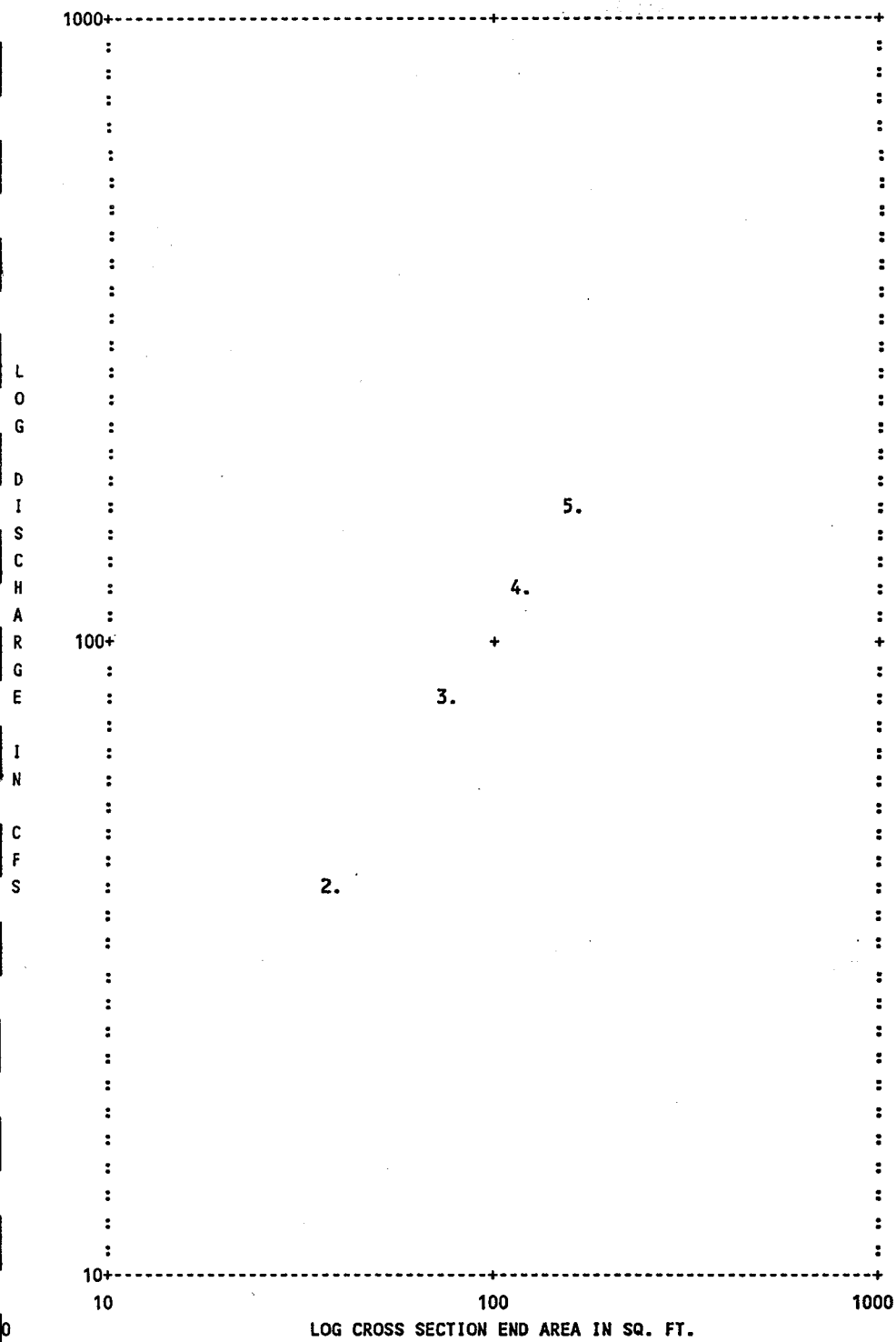
Culvert Barrel Selected:

Size: ____
Shape: ____
Material: ____ n: ____
Entrance: ____

```
******************80-80 LIST OF INPUT DATA FOR TR-20 HYDROLOGY******************

JOB TR-20                                          SUMMARY  NOPLOTS
TITLE 000 CAMPOBELLO DRIVE LATERAL                DATE: 3-10-94
TITLE 000 JOB NUMBER:  93041                   FILENAME: CAMPO3.DAT
 5 RAINFL 1            .0208
 8        0.           .004        .008        .0130       .018
 8        .022         .026        .031        .035        .04
 8        .044         .048        .053        .057        .062
 8        .066         .071        .075        .080        .093
 8        .107         .120        .140        .170        .500
 8        .830         .860        .880        .893        .907
 8        .920         .924        .928        .933        .937
 8        .942         .947        .951        .956        .960
 8        .964         .969        .973        .978        .982
 8        .987         .991        .995        1.00        1.00
 9 ENDTBL
 2 XSECTN   001         1.0
 8                      1.          0.          0.
 8                      2.          40.         40.
 8                      3.          80.         80.
 8                      4.          120.        120.
 8                      5.          160.        160.
 9 ENDTBL
 2 XSECTN   002         1.0
 8                      1.          0.          0.
 8                      2.          60.         60.
 8                      3.          120.        120.
 8                      4.          180.        180.
 8                      5.          240.        240.
 9 ENDTBL
 6 RUNOFF 1 002       6 .084        91.         .17
 6 REACH  3 004   6   5 2800.       .035        1.66
 6 RUNOFF 1 003       7 .125        85.         .61
 6 REACH  3 004   7   6 1600.       .035        1.66
 6 ADDHYD 4 004   5 6 7
 6 RUNOFF 1 004       5 .078        83.         .98
 6 ADDHYD 4 004   5 7 6
 6 REACH  3 007   6   3 950.        .26         1.54
 6 RUNOFF 1 001       6 .158        90.         .45
 6 REACH  3 005   6   5 1700.       .22         1.54
 6 RUNOFF 1 005       7 .088        84.         .56
 6 ADDHYD 4 005   5 7 6
 6 DIVERT 6 001   6 1 2             1.          2.
 6 REACH  3 007   1   5 1300.       .26         1.54
 6 ADDHYD 4 007   3 5 6
 6 RUNOFF 1 007       7 .045        84.         .31
 6 ADDHYD 4 007   6 7 5
 6 REACH  3 013   2   6 1700.       .26         1.54
 6 ADDHYD 4 013   6 5 7
 6 RUNOFF 1 013       5 .045        84.         .36
 6 ADDHYD 4 013   7 5 6
 6 REACH  3 008   6   5 1400.       1.84        1.81
 6 RUNOFF 1 008       6 .084        92.         .30
 6 ADDHYD 4 008   5 6 1
 6 RUNOFF 1 006       5 .055        86.         .42
 6 REACH  3 009   5   6 1950.       .22         1.54
 6 RUNOFF 1 009       7 .063        84.         .50
 6 ADDHYD 4 009   6 7 5
 6 REACH  3 010   5   7 1300.       .22         1.54
 6 RUNOFF 1 010       6 .063        84.         .79
 6 ADDHYD 4 010   6 7 5
 6 REACH  3 011   5   6 1400.       .14         1.54
 6 RUNOFF 1 011       7 .063        86.         .54
 6 ADDHYD 4 011   6 7 5
 6 REACH  3 012   5   6 1300.       .10         1.60
 6 RUNOFF 1 012       7 .063        86.         .14
 6 ADDHYD 4 012   6 7 2
   ENDATA
 7 INCREM 6             .08
 7 COMPUT 7 002   012               4.04        24.         1 2  01  01
   ENDCMP 1
   ENDJOB 2

0*****************************END OF 80-80 LIST*******************************
```

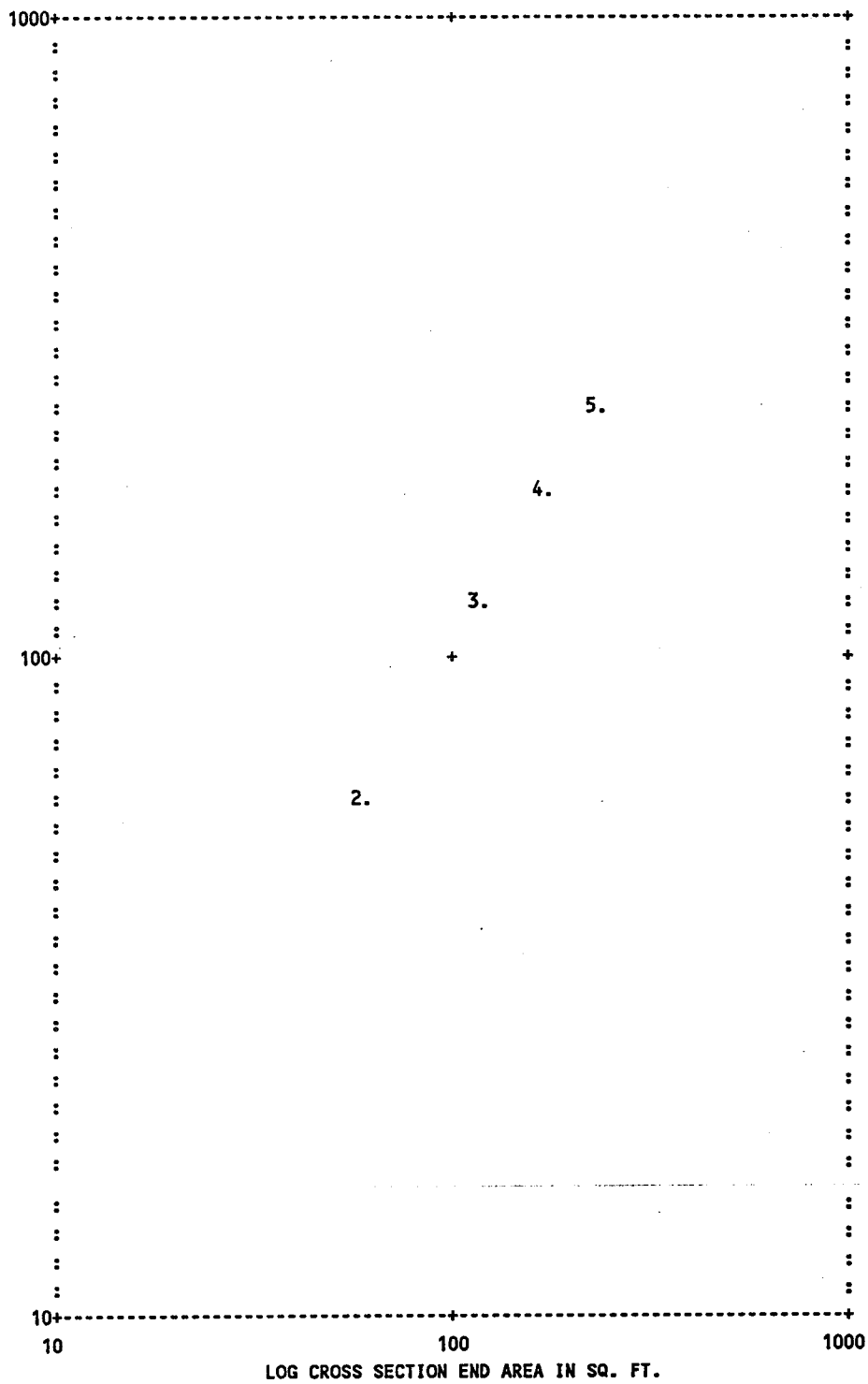


CROSS SECTION 1 END AREA VS DISCHARGE

REFERENCE NO'S	DISCHARGE (CFS)	END AREA (SQ.FT.)	M
1	.00	.00	1.00
2	40.00	40.00	1.00
3	80.00	80.00	1.00
4	120.00	120.00	1.00
5	160.00	160.00	1.00

LEGEND

+ = GRID REFERENCE
. = LOCATION OF PLOTTED VALUE
3 = REFERENCE NO. OF PLOTTED VALUE
X = MULTIPLE REFERENCE NUMBERS
B = BANKFULL RELATION SHOWN ON AXIS



CROSS SECTION 2 END AREA VS DISCHARGE

REFERENCE NO'S	DISCHARGE (CFS)	END AREA (SQ.FT.)	M
1	.00	.00	1.00
2	60.00	60.00	1.00
3	120.00	120.00	1.00
4	180.00	180.00	1.00
5	240.00	240.00	1.00

LEGEND

+ = GRID REFERENCE

. = LOCATION OF PLOTTED VALUE
3 = REFERENCE NO. OF PLOTTED VALUE
X = MULTIPLE REFERENCE NUMBERS
B = BANKFULL RELATION SHOWN ON AXIS

SUMMARY TABLE 1 - SELECTED RESULTS OF STANDARD AND EXECUTIVE CONTROL INSTRUCTIONS IN THE ORDER PERFORMED
(A STAR(*) AFTER THE PEAK DISCHARGE TIME AND RATE (CFS) VALUES INDICATES A FLAT TOP HYDROGRAPH
A QUESTION MARK(?) INDICATES A HYDROGRAPH WITH PEAK AS LAST POINT.)

SECTION/ STRUCTURE ID	STANDARD CONTROL OPERATION	DRAINAGE AREA (SQ MI)	RAIN TABLE #	ANTEC MOIST COND	MAIN TIME INCREM (HR)	PRECIPITATION BEGIN (HR)	PRECIPITATION AMOUNT (IN)	PRECIPITATION DURATION (HR)	RUNOFF AMOUNT (IN)	PEAK DISCHARGE ELEVATION (FT)	PEAK DISCHARGE TIME (HR)	PEAK DISCHARGE RATE (CFS)	PEAK DISCHARGE RATE (CSM)
ALTERNATE 1 STORM 1													
XSECTION 2	RUNOFF	.08	1	2	.08	.0	4.04	24.00	3.05	---	12.44	137.40	1635.7
XSECTION 4	REACH	.08	1	2	.08	.0	4.04	24.00	3.01	---	13.00	106.88	1272.4
XSECTION 3	RUNOFF	.13	1	2	.08	.0	4.04	24.00	2.47	---	12.57	153.98	1231.8
XSECTION 4	REACH	.13	1	2	.08	.0	4.04	24.00	2.46	---	12.80	134.99	1079.9
XSECTION 4	ADDHYD	.21	1	2	.08	.0	4.04	24.00	2.68	---	12.88	233.03	1115.0
XSECTION 4	RUNOFF	.08	1	2	.08	.0	4.04	24.00	2.29	---	12.78	75.11	962.9
XSECTION 4	ADDHYD	.29	1	2	.08	.0	4.04	24.00	2.58	---	12.85	306.77	1068.9
XSECTION 7	REACH	.29	1	2	.08	.0	4.04	24.00	2.57	---	12.95	305.89	1065.8
XSECTION 1	RUNOFF	.16	1	2	.08	.0	4.04	24.00	2.94	---	12.50	236.29	1495.5
XSECTION 5	REACH	.16	1	2	.08	.0	4.04	24.00	2.93	---	12.62	231.09	1462.6
XSECTION 5	RUNOFF	.09	1	2	.08	.0	4.04	24.00	2.39	---	12.56	108.34	1231.1
XSECTION 5	ADDHYD	.25	1	2	.08	.0	4.04	24.00	2.74	---	12.60	338.56	1376.3
XSECTION 1	DIVERT	.25	1	2	.08	.0	4.04	24.00	1.10	4.39	12.60	135.42	550.5
XSECTION 2	DIVERT	.00	1	2	.08	.0	4.04	24.00	1.10	4.39	12.60	203.14	**********
XSECTION 7	REACH	.25	1	2	.08	.0	4.04	24.00	1.09	---	12.72	132.67	539.3
XSECTION 7	ADDHYD	.53	1	2	.08	.0	4.04	24.00	1.89	---	12.85	424.65	796.7
XSECTION 7	RUNOFF	.05	1	2	.08	.0	4.04	24.00	2.40	---	12.48	61.21	1360.1
XSECTION 7	ADDHYD	.58	1	2	.08	.0	4.04	24.00	1.93	---	12.79	441.86	764.5
XSECTION 13	REACH	.00	1	2	.08	.0	4.04	24.00	1.93	---	12.73	197.80	**********
XSECTION 13	ADDHYD	.58	1	2	.08	.0	4.04	24.00	2.63	---	12.76	638.24	1104.2
XSECTION 13	RUNOFF	.05	1	2	.08	.0	4.04	24.00	2.39	---	12.49	60.18	1337.3
XSECTION 13	ADDHYD	.62	1	2	.08	.0	4.04	24.00	2.61	---	12.68	675.32	1084.0
XSECTION 8	REACH	.62	1	2	.08	.0	4.04	24.00	2.61	---	12.68	675.32	1084.0
XSECTION 8	RUNOFF	.08	1	2	.08	.0	4.04	24.00	3.14	---	12.45	135.25	1610.1
XSECTION 8	ADDHYD	.71	1	2	.08	.0	4.04	24.00	2.67	---	12.59	782.77	1107.2
XSECTION 6	RUNOFF	.05	1	2	.08	.0	4.04	24.00	2.57	---	12.51	75.57	1373.9
XSECTION 9	REACH	.05	1	2	.08	.0	4.04	24.00	2.56	---	12.75	69.90	1270.9
XSECTION 9	RUNOFF	.06	1	2	.08	.0	4.04	24.00	2.39	---	12.54	79.70	1265.1
XSECTION 9	ADDHYD	.12	1	2	.08	.0	4.04	24.00	2.47	---	12.60	143.87	1219.3
XSECTION 10	REACH	.12	1	2	.08	.0	4.04	24.00	2.46	---	12.73	139.84	1185.1
XSECTION 10	RUNOFF	.06	1	2	.08	.0	4.04	24.00	2.38	---	12.68	69.42	1102.0
XSECTION 10	ADDHYD	.18	1	2	.08	.0	4.04	24.00	2.43	---	12.71	208.88	1154.0
XSECTION 11	REACH	.18	1	2	.08	.0	4.04	24.00	2.43	---	12.87	200.19	1106.0
XSECTION 11	RUNOFF	.06	1	2	.08	.0	4.04	24.00	2.56	---	12.54	82.57	1310.7
XSECTION 11	ADDHYD	.24	1	2	.08	.0	4.04	24.00	2.46	---	12.74	259.30	1062.7
XSECTION 12	REACH	.24	1	2	.08	.0	4.04	24.00	2.46	---	12.89	252.23	1033.7
XSECTION 12	RUNOFF	.06	1	2	.08	.0	4.04	24.00	2.58	---	12.44	96.03	1524.3
XSECTION 12	ADDHYD	.31	1	2	.08	.0	4.04	24.00	2.48	---	12.51	266.13	866.9

```
                                                                                                                RECORD ID
EXECUTIVE CONTROL OPERATION INCREM
                                        MAIN TIME INCREMENT =    .08 HOURS

                                                                                                                RECORD ID
EXECUTIVE CONTROL OPERATION COMPUT
                                        FROM XSECTION   2
                                                          TO XSECTION  12
      STARTING TIME =    .00    RAIN DEPTH =  4.04    RAIN DURATION= 24.00    RAIN TABLE NO.= 1    ANT. MOIST. COND= 2
      ALTERNATE NO.= 1          STORM NO.= 1    MAIN TIME INCREMENT =    .08 HOURS

    ***  WARNING  REACH   7 ATT-KIN COEFF.(C) GREATER THAN 0.667, CONSIDER REDUCING MAIN TIME INCREMENT  ***

    ***  WARNING  REACH   8 ATT-KIN COEFF.(C) GREATER THAN 0.667, CONSIDER REDUCING MAIN TIME INCREMENT  ***

                                                                                                                RECORD ID
EXECUTIVE CONTROL OPERATION ENDCMP
                                        COMPUTATIONS COMPLETED FOR PASS   1


                                                                                                                RECORD ID
EXECUTIVE CONTROL OPERATION ENDJOB
1
```

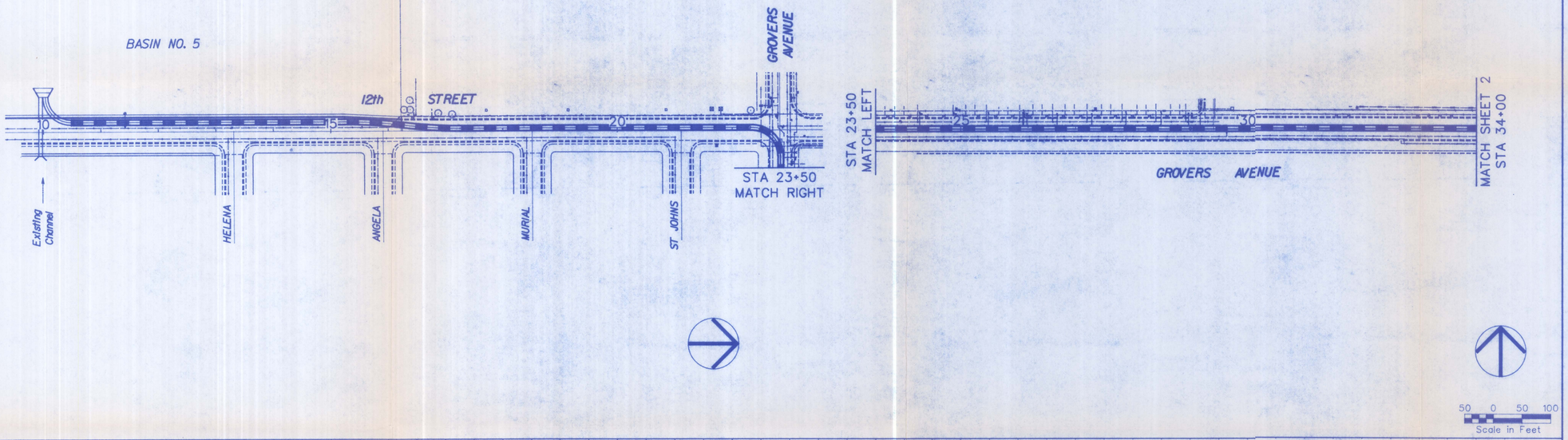
SUMMARY TABLE 2 - SELECTED MODIFIED ATT-KIN REACH ROUTINGS IN ORDER OF STANDARD EXECUTIVE CONTROL INSTRUCTIONS
(A STAR(*) AFTER VOLUME ABOVE BASE(IN) INDICATES A HYDROGRAPH TRUNCATED AT A VALUE EXCEEDING BASE + 10% OF PEAK
A QUESTION MARK(?) AFTER COEFF.(C) INDICATES PARAMETERS OUTSIDE ACCEPTABLE LIMITS, SEE PREVIOUS WARNINGS)

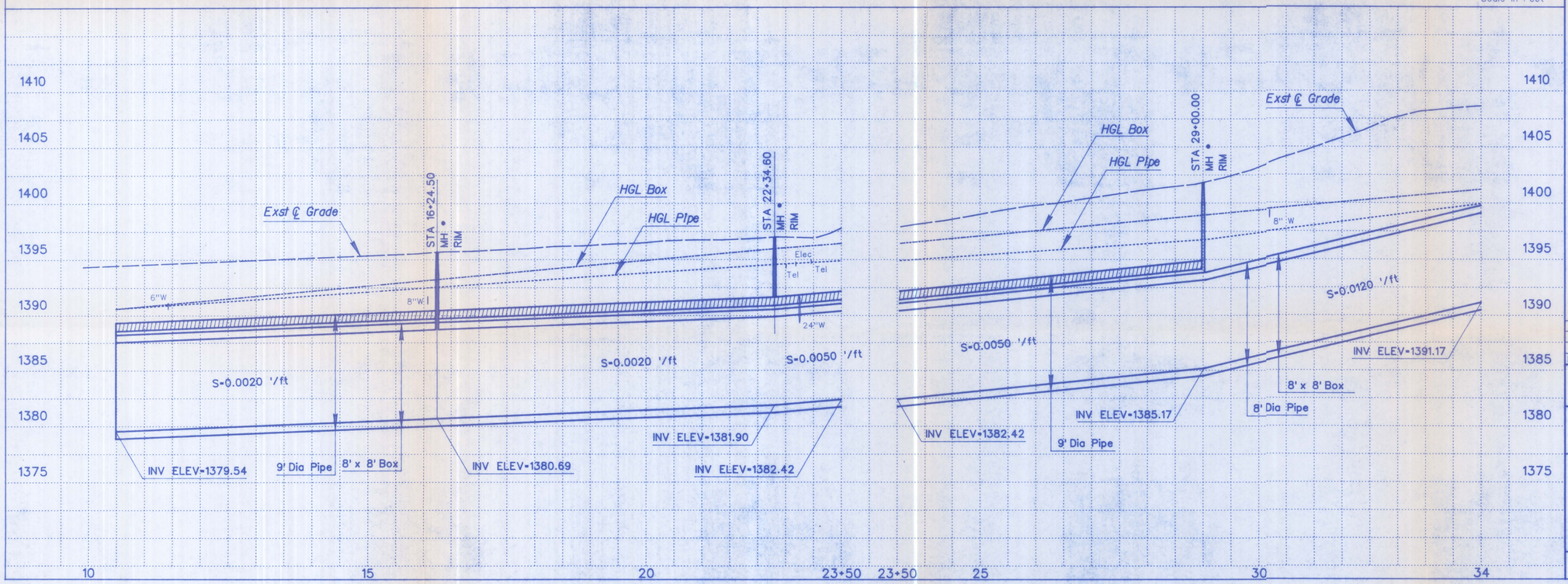
		HYDROGRAPH INFORMATION							ROUTING PARAMETERS									PEAK	
						OUTFLOW+			VOLUME	MAIN	ITER-	Q AND A			PEAK	S/Q	ATT-	TRAVEL TIME	
XSEC	REACH	INFLOW		OUTFLOW		INTERV.AREA		BASE-	ABOVE	TIME	ATION	EQUATION		LENGTH	RATIO	@PEAK	KIN	STOR-	KINE-
ID	LENGTH (FT)	PEAK (CFS)	TIME (HR)	PEAK (CFS)	TIME (HR)	PEAK (CFS)	TIME (HR)	FLOW (CFS)	BASE (IN)	INCR (HR)	#	COEFF (X)	POWER (M)	FACTOR (K*)	O/I (Q*)	(K) (SEC)	COEFF (C)	AGE (HR)	MATIC (HR)
ALTERNATE		1	STORM	1															
4	2800	134	12.5	106	13.0	---	---	0	3.05	.08	1	.035	1.66	.525	.789	1812	.15	.16	.53
4	1600	154	12.6	135	12.8	233	12.9	0	2.47	.08	1	.035	1.66	.174	.877	981	.26	.24	.28
7	950	306	12.9	306	13.0	---	---	0	2.58	.08	1	.260	1.54	.011	.998	199	.84?	.08	.06
5	1700	236	12.5	231	12.6	336	12.6	0	2.94	.08	1	.220	1.54	.052	.978	434	.50	.16	.12
7	1300	135	12.6	133	12.7	---	---	0	1.10	.08	1	.260	1.54	.038	.986	363	.57	.08	.10
13	1700	202	12.6	198	12.7	---	---	0	.00	.08	1	.260	1.54	.046	.980	412	.52	.08	.11
8	1400	674	12.7	674	12.7	780	12.6	0	2.61	.08	0	1.84	1.81	.000	1.000	30	1.00?	.00	.00
9	1950	75	12.5	70	12.7	143	12.6	0	2.57	.08	1	.220	1.54	.128	.925	743	.32	.16	.21
10	1300	143	12.6	140	12.7	209	12.7	0	2.47	.08	1	.220	1.54	.043	.977	396	.53	.08	.11
11	1400	209	12.7	200	12.9	259	12.7	0	2.43	.08	1	.140	1.54	.058	.958	501	.45	.16	.14
12	1300	259	12.7	252	12.9	264	12.5	0	2.46	.08	1	.100	1.60	.037	.973	426	.50	.16	.12

SUMMARY TABLE 3 - DISCHARGE (CFS) AT XSECTIONS AND STRUCTURES FOR ALL STORMS AND ALTERNATES

XSECTION/ STRUCTURE ID	DRAINAGE AREA (SQ MI)	STORM NUMBERS..... 1
XSECTION 1	.25	
ALTERNATE 1		135.42
XSECTION 2	.00	
ALTERNATE 1		203.14
XSECTION 3	.13	
ALTERNATE 1		153.98
XSECTION 4	.29	
ALTERNATE 1		306.77
XSECTION 5	.25	
ALTERNATE 1		338.56
XSECTION 6	.05	
ALTERNATE 1		75.57
XSECTION 7	.58	
ALTERNATE 1		441.86
XSECTION 8	.71	
ALTERNATE 1		782.77
XSECTION 9	.12	
ALTERNATE 1		143.87
XSECTION 10	.18	
ALTERNATE 1		208.88
XSECTION 11	.24	
ALTERNATE 1		259.30
XSECTION 12	.31	
ALTERNATE 1		266.13
XSECTION 13	.62	
ALTERNATE 1		675.32

MAIN - UNEXPECTED RECORD FOUND(IGNORED) >>> <<<
END OF 1 JOBS IN THIS RUN





CONCEPT SUBMITTAL
MARCH 23, 1994

NO.	REVISION	BY	DATE
3			
2			
1			

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
ENGINEERING DIVISION

CAMPO BELLO DRIVE LATERAL
FCD NO. 93-22

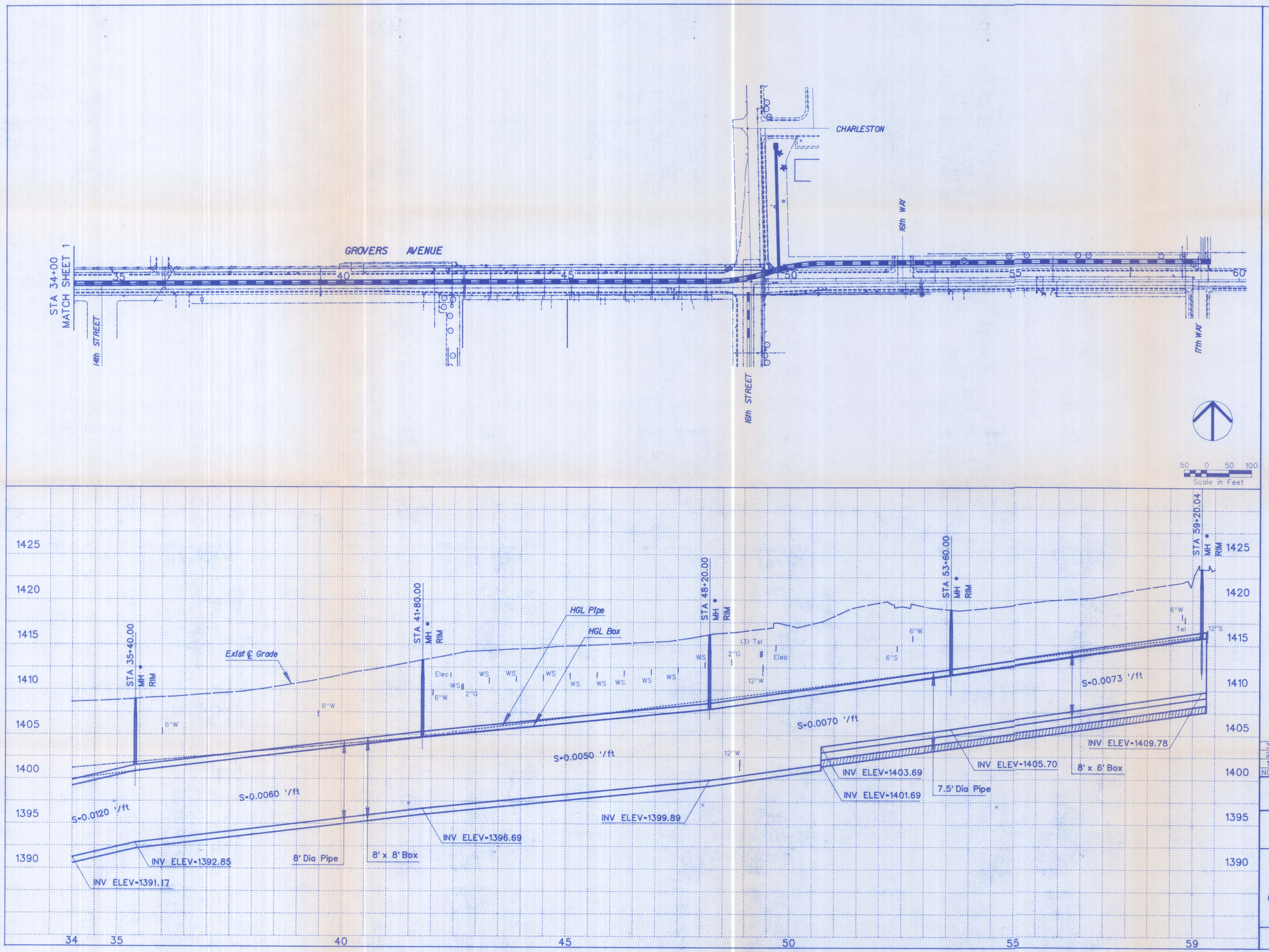
PRELIMINARY
NOT FOR
CONSTRUCTION

	BY	DATE
DESIGNED	J. BERGHIAN	3/08/94
DRAWN	J. GRIBBLE	3/08/94
CHECKED	L. MALDONADO	3/08/94

PROJECT ENGINEERING CONSULTANTS, LTD.
3130 N. 35th Avenue, Suite 1
Phoenix, Arizona 85017 (602) 484-7691

PLAN AND PROFILE SHEET
STA 10+48.50 to STA 34+00

SHEET 1 OF 2



CONCEPT SUBMITTAL
MARCH 23, 1994

NO.	REVISION	BY	DATE
3			
2			
1			

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
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CAMPO BELLO DRIVE LATERAL
FCD NO. 93-22

		BY	DATE
PRELIMINARY NOT FOR CONSTRUCTION	DESIGNED	J. BERGHIAN	3/08/94
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PROJECT ENGINEERING CONSULTANTS, LTD.
3030 N. 35th Avenue, Suite 1
Phoenix, Arizona 85017 (602) 484-7691

PLAN AND PROFILE SHEET
STA 34+00 to STA 59+20.04

SHEET 2 OF 2