PRELIMINARY DRAINAGE REPORT

FOR

INTERSECTION IMPROVEMENTS

99TH AVENUE, BELL ROAD TO THUNDERBIRD ROAD

MCDOT W.O. #68807

AUGUST 1995

Prepared By:

Hendrich, Eberhart & Associates, Inc.
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Phoenix, Arizona 85020

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CERTIFICATE NO.
24971
TONY A.
BOKICH
Date Signed 8-23-95
ARIZONA, U.S.A.

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FLOOD CONTROL DISTRICT
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1.0 INTRODUCTION

1.1 PURPOSE

This report is intended to serve as documentation for the hydrologic and hydraulic analysis of the 99th Avenue watershed. The hydrology was submitted ahead of the complete drainage report so that the hydraulic analysis and preliminary design may be performed at a higher level of confidence. The review comments for the preliminary hydrology have been incorporated in this report.

1.2 PROJECT DESCRIPTION

The intent of the project is to study some of the existing intersections along 99th Avenue between Bell Road and Thunderbird Road and the associated drainage conditions along 99th Avenue in Sun City. The cross streets included in the study are Hutton Drive, Burns Drive, Greenway Road, Boswell Boulevard, and Thunderbird Road.

This project's scope includes the complete design of improvements at Thunderbird and Greenway Road and concept design at the other intersections.

2.0 HYDROLOGY

2.1 HYDROLOGIC FEATURES

2.1.1 General Watershed Description

Ninety-ninth Avenue is aligned generally north to south through the project limits and the direction of flow in the central portion of Sun City is north to south. The watershed centers on 99th Avenue with an average width of about 4000 feet. Lengthwise

the watershed extends northward from Thunderbird Road (the terminus) to Beardsley Road.

For the purpose of this study the watershed is divided into eight sub-areas with concentration points located at all six of the project intersections as well as at Bell Road and Del Webb Boulevard. The total basin area is 4.4 square miles 2.1 of which is upstream of Bell Road. (See the Watershed Diagram, Exhibit 1).

2.1.2 Beardsley Road Channel

East of 99th Avenue on the north side of Beardsley Road there is a berm which forces runoff from the north to a large culvert which drains diagonally across the intersection to a large channel. The Beardsley Road channel drains westward to the Agua Fria River. This channel and berm system diverts runoff from an area upstream that would otherwise drain into Sun City along 99th Avenue. The contributing watershed to the existing culvert is approximately 350 acres. The watershed is largely undeveloped except for a multi-family/commercial development (about 20 acres) and a large single and multi-family subdivision which is currently under construction. This subdivision, known as Parkridge I and II is approximately 100 acres in size and is providing retention of the 100-year, 2-hour storm. This leaves a net contributing area of approximately 250 acres. By using the results of a hydrology study of the Beardsley Road Channel performed by FCDMC, we can extropolate some runoff quantities for the concentration point at the culvert. The FCDMC Q's for a 1600 acre contributing area are as follows: Q_5 = 40 cfs, Q_{25} = 352 cfs, Q_{50} = 582 cfs. Since the time of concentration for this

WATERSHED SCHEMATIC FLOW DIAGRAM

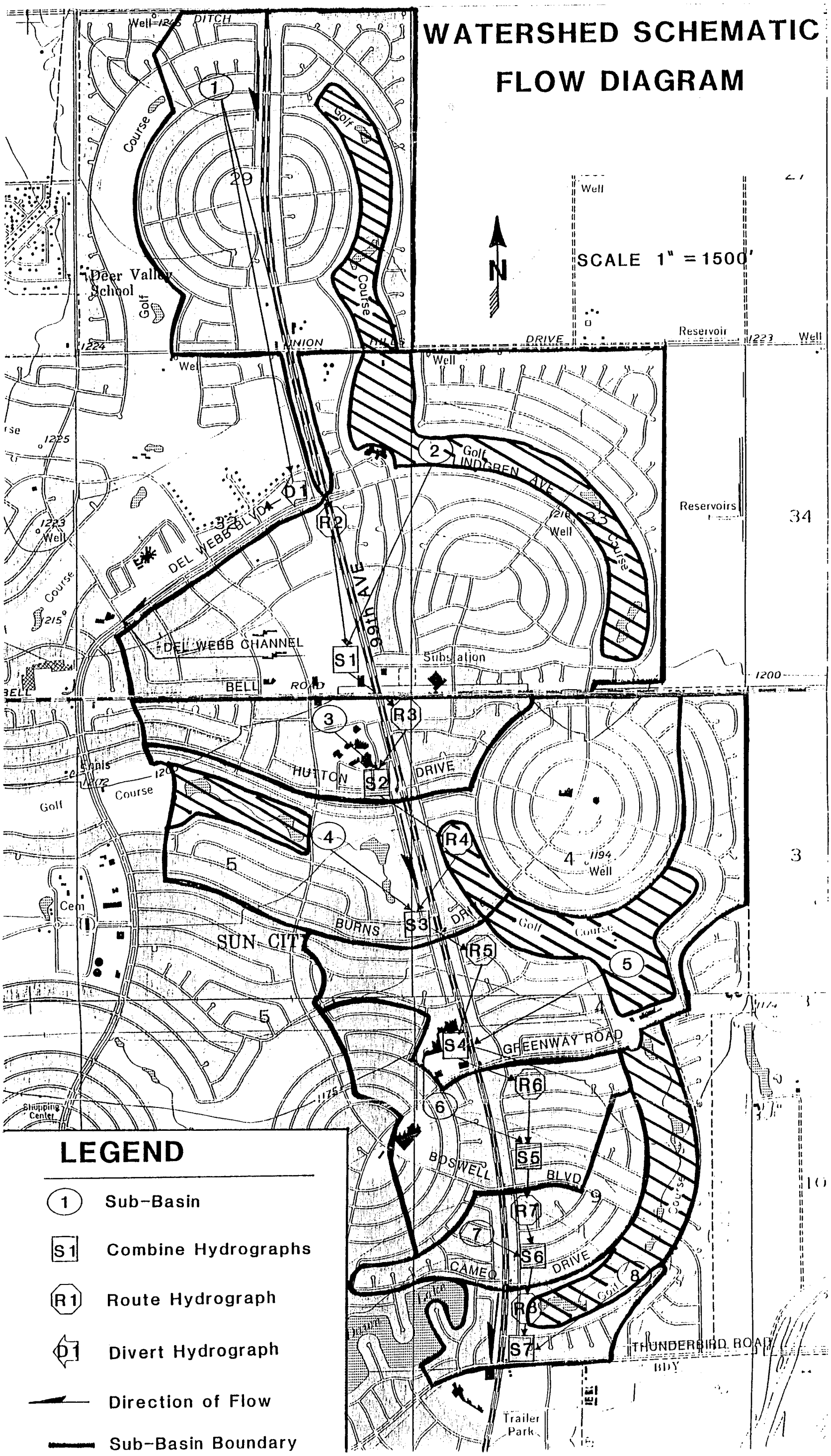


EXHIBIT 1

of the intersection and culvert. The calculations performed to quantify the flow split are also included in the Appendix.

TABLE 1

COMBINED OVERTOPPING AND PIPE FLOW at DEL WEBB BOULEVARD

HW ELEV. (ft.)	HW DEPTH (ft.)	INCOMING FLOW (cfs)	PIPE FLOW TO DEL WEBB CHANNEL (cfs)	OVERTOPPING FLOW (cfs)	DEPTH OF OVERTOPPING FLOW (ft.)
1209.8	5.45	503	503	0	0.0
1210.7	6.35	700	594	105	0.9
1210.9	6.55	800	612	184	1.1
1211.1	6.75	900	630	270	1.3

The results of this analysis were used to divert flow out of the watershed in the HEC-1 modeling.

2.1.4 Other Existing Drainage Features

The developed areas on either side of 99th Avenue have storm drain systems which drain into the 99th Avenue channel. All of the streets have curb and gutter. Some of the collector streets transition from normal crown to inverted crown approaching 99th Avenue. On such streets there is usually a single catch basin in the center of the street at the point where the pavement sloping down from 99th Avenue meets the center of the collector street forming a sump condition.

There are three existing golf courses which lie partially or completely within the project watershed. They are River View

area is much larger, we will double the cfs/ac. ratios for our purposes. This is a conservative approach. This yields Q_5 = .05 cfs/ac. = 13 cfs/250 ac., Q_{25} = 110 cfs, Q_{50} = 182 cfs. The capacity of the 3-42" RCP culvert with 4.5 feet of headwater is approximately 225 cfs. Therefore, the Beardsley Road Channel will divert the runoff up to and including the 50-year storm to the Agua Fria River and out of the 99th Avenue watershed.

2.1.3 Del Webb Boulevard Channel

The 99th Avenue channel begins at Union Hills Drive and drains south to Del Webb Boulevard. Where Del Webb Boulevard crosses 99th the open channel enters a five-barrel 48 inch pipe culvert. The culvert makes a curve to the west turning almost 90 degrees and outlets into the Del Webb Boulevard channel. The Del Webb channel drains south westerly out of the 99th Avenue watershed to the Agua Fria River.

The existing five barrel culvert has the capacity to intercept and divert up to 500 cfs before overtopping occurs. This flow rate is roughly equivalent to the runoff rate expected from the 10-year storm event. The Del Webb channel has a capacity far exceeding 500 cfs. Overtopping occurs when the runoff rate in the 99th Avenue channel exceeds the culvert capacity. The discharge which overtops the headwall drains southward down 99th Avenue. An overtopping analysis was performed in order to evaluate the flow split. As the flow rate increases, the ratio of overtopping flow to pipe flow increases rapidly. Table 1 and Figure 1 (in Appendix 1) illustrate the results of the overtopping analysis. Exhibits 4a and 4b are the plan view and cross-sections

and Palm Brook Country Clubs and Union Hills Golf Course. All three were constructed to retain all runoff from major storms. However, River View has a small lake near its southeast end which overflows into an adjacent street during heavy runoff. The Palm Brook and Union Hills courses have been excluded from the subbasin drainage. The eastern portion of River View, west of Boswell Boulevard, has been excluded as well.

2.2 ANALYTICAL APPROACH

2.2.1 Drainage Criteria

The criteria to be used for hydraulic design according to the scope of work is the 50-year storm. However, preliminary analysis indicates that designing for that magnitude of storm event is not practical or feasible. See Tables 5 and 6 for existing capacities. In light of that we modeled the 2, 5, 25 and 50-year storms in order to build rating curves at the intersections in an effort to determine a suitable design storm for the project. See Section 3.3 of this report for more information on design approach.

2.2.2 Hydrologic Parameters

The project hydrology was performed according to the Drainage Design Manual for Maricopa County, Volume I, Hydrology. The basic hydrologic data used to compute time of concentration and K_b are given in Table 2.

TABLE 2

HYDROLOGY TABLE
for HEC-1 Data Compilation, Existing Conditions

Conc. Point	Drng. Area (sq. mi.)	L (mi.)	Top Elev. (ft.)	Conc. Pt. Elev. (ft.)	Slope (ft/mi.)	Surface Types	Kb	Concentration Point Description
1	.713	1.97	1248.0	1213.0	17.8	A	0.023	99th Ave. @ Del Webb Blvd.
2	1.138	2.08	1248.0	1200.0	23.1	A	0.022	99th Ave. @ Bell Road.
3	.248	.91	1206.0	1193.0	14.3	A	0.026	99th Ave. @ Hutton Drive.
4	.689	1.33	1198.0	1183.0	11.3	A	0.023	99th Ave. @ Burns Drive.
5	.397	1.67	1198.0	1174.0	14.4	A	0.025	99th Ave. @ Greenway Road.
6	.327	.85	1181.0	1166.0	17.6	A	0.025	99th Ave. @ Boswell Blvd.
7	.200	.85	1178.0	1159.0	22.4	A	0.027	99th Ave. @ Cameo Drive.
8	.104	1.27	1182.0	1154.0	22.0	A	0.026	99th Ave. @ Thunderbird Road.

2.2.2.1 Rainfall Losses

The rainfall losses were computed with the Green and Ampt Method. The rainfall loss parameters are included in detail in the Appendix and the results are summarized in Table 3.

TABLE 3

SUMMARY OF GREEN & AMPT PARAMETERS for Existing Conditions

SUB-BASIN	IA	DTHETA	PSIF	XKSAT	RTIMP	BASIN AREA
1	0.107	0.150	7.7	0.09	56.0	0.713
2	0.105	0.190	6.6	0.14	54.4	1.138
3	0.067	0.170	6.8	0.11	85.0	0.248
4	0.122	0.210	6.4	0.17	49.6	0.689
5	0.097	0.250	5.7	0.18	61.9	0.397
6	0.098	0.250	5.7	0.20	62.8	0.327
7	0.110	0.230	6.2	0.18	51.0	0.200
8	0.110	0.250	5.6	0.21	55.0	0.104
9	0.107	0.150	7.7	0.09	56.0	0.435

2.2.2.2 Soils Data

The source for soils data is the Soil Survey of Maricopa County, Arizona, central part published by the U.S. Soil Conservation Service. Exhibit 2 is a General Soils Map which has the watershed and subbasins delineated on it. Table 4 is a soil survey Index for the soils found within the project watershed. The table provides a listing of the soil series (by map symbol), the soil texture and the Green and Ampt Parameters for the given soil texture.

TABLE 4

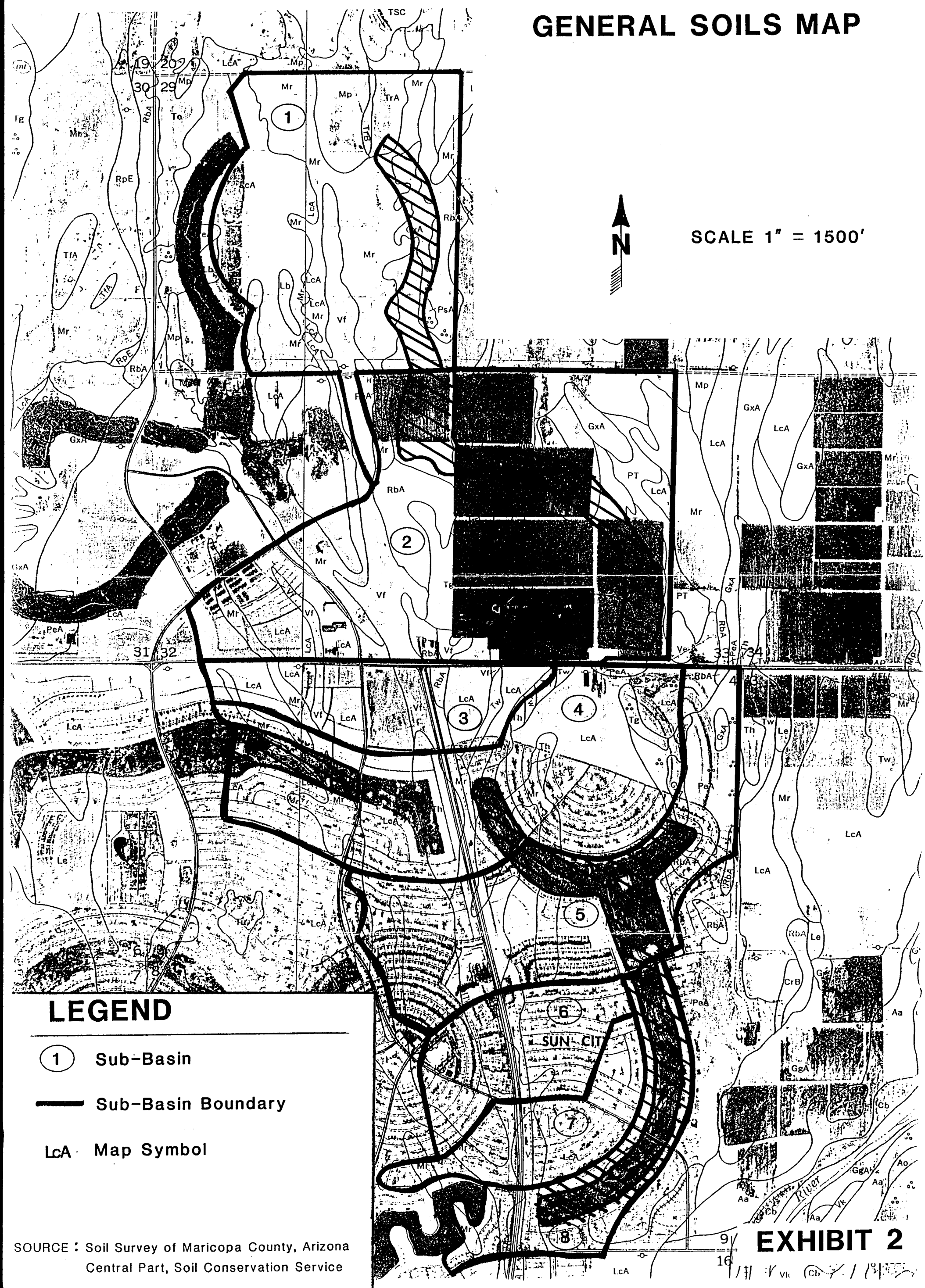
99th AVENUE WATERSHED SOIL SURVEY INDEX

SOIL SERIES (Map Symbol)	SOIL TEXTURE	GREEN & AMPT PARAMETERS		
		XKSAT	PSIF	DTHETA*
Mr	clay loam	0.04	8.2	0.15
Mp	clay loam	0.04	8.2	0.15
TrB	gravelly clay loam	0.04	8.2	0.15
TrA	gravelly clay loam	0.04	8.2	0.15
Tg	gravelly clay loam	0.04	8.2	0.15
Th	gravelly clay loam	0.04	8.2	0.15
Vf	clay	0.01	12.4	0.05
PsA	loam w/caliche @ 12"	0.20	6.1	0.25
PT	loam w/caliche @ 12"	0.20	6.1	0.20
LcA	loam	0.25	5.7	0.25
Lb	loam	0.25	5.7	0.25
Tw	loam	0.25	5.7	0.25
Lc	loam	0.25	5.7	0.25
GxA	gravelly loam	0.25	5.7	0.25
PeA	gravelly loam	0.25	4.3	0.25

*Normal moisture level.

Sources: 1.) Soil Survey of Maricopa County, Arizona, Central Part. U.S.S.C.S.
2.) Drainage Design Manual for Maricopa County, Arizona. Table 4.2.

GENERAL SOILS MAP



LEGEND

(1) Sub-Basin

Sub-Basin Boundary

LcA Map Symbol

SOURCE : Soil Survey of Maricopa County, Arizona
Central Part, Soil Conservation Service

2.2.2.3 Rainfall

The rainfall was computed using point rainfall data from the NOAA Atlas and Maricopa County's "PREFRE" and "MCUHP1" computer programs for computing the rainfall depths, distribution and areal reduction. A six-hour storm duration was used for all frequencies as per Table 2.1 of the Drainage Design Manual.

2.2.3 HEC-1 Modeling

The HEC-1 program used for this project was the 1990 release, Version 4.0. The Watershed Schematic Flow Diagram (Exhibit 1) illustrates the sub-basin orientation and routing pattern used to model the project watershed. There are eight watershed sub-basins. Sub-basin 1 is the hydraulically most distant from Thunderbird Road which is the outfall of the project watershed. The concentration point for sub-basin eight is the 99th Avenue channel at Thunderbird Road. All sub-basin concentration points are located along the channel. The channel routing was modeled with the Muskingum-Cunge Routing Method which is one of the methods recommended for urbanized concentrated flow routing by the Drainage Design Manual. The 2, 5, 25 and 50-year storm were modeled. The print-out for the 2-year storm is included in Appendix 1.

3.0 HYDRAULICS

3.1 EXISTING HYDRAULIC FEATURES

The existing hydraulic features of the project consist of the 99th Avenue Channel, the cross street culverts, the catch basins and storm drain systems. The following sections describe these features in more detail.

3.1.1 99th Avenue Channel

This drainage structure is a gunite lined channel which is located in the center median of 99th Avenue. It extends from Bell Road through Thunderbird Road continuing south to Grand Avenue then southeasterly to the New River. The channel varies slightly in cross-section depth and capacity from Bell Road to Thunderbird Road. The channel was originally built in 1970-71 as a part of the 99th Avenue roadway project by the Maricopa County Highway Department. With the exception of additional street crossings and culverts the channel is unchanged from that time.

The channel's cross-section is described approximately as having a 2 to 3 foot bottom width and 4.5 to 5:1 side slopes. The depth varies from approximately 4 feet to 5 feet and the bed slope varies from about 0.0020 to 0.0030 ft./ft. The average channel capacity in this reach is about 850 cfs flowing full. The channel section transitions into and out of the existing culverts by widening the bottom and steepening the sides keeping the top width and bed slope nearly constant.

The channel's cross-section downstream of Thunderbird Road has a slightly greater hydraulic capacity. The channel geometry is approximately as follows: 7 foot bottom width, 3.5 to 4:1 side

slopes, 4.5 foot depth and a bed slope of 0.0026 ft./ft. The average channel capacity in this reach is about 1210 cfs flowing full.

3.1.2 Crossroad Culverts

All of the existing culverts in the project limits are 2-barrel 10'x4' reinforced concrete box culverts. They were built according to the 1959 Arizona Highway Department Construction Standards for H-20 loading. The culverts all have straight headwalls without wings. Hendrich, Eberhart & Associates recommends that MCDOT analyze the existing culverts structurally before this project is finalized to assure that they are suitable for extension and continued use.

3.1.3 Street Drainage

Ninety-ninth Avenue was built as an inverted crown roadway so that the entire right-of-way drains to the channel in the center median except at some of the intersections. Most of the intersections have catch basins built over the culverts so the crossroad drainage enters the channel via the culvert. Some of the crossroads are crowned above the channel so that the runoff flows outward into the side street itself. It is collected there in existing catch basins and conveyed via storm drain pipe into the channel.

Throughout the project the top of the channel is separated from the travel lane by a 4 to 6 inch vertical curb. In some reaches there are catch basins adjacent to the curb which outlet into the

channel while elsewhere the curb is gapped periodically to allow street runoff to flow directly down the gunite slope into the channel.

3.2 ANALYSIS OF EXISTING FEATURES

3.2.1 99th Avenue Channel

The channel was analyzed for capacity by computing the normal depth flow at three stages: 1 foot of freeboard, flowing full and 1 travel lane open in each direction. For simplicity the channel capacity was analyzed at two locations, downstream of Burns Drive and Thunderbird Road. The channel's hydraulics at Burns Drive were used to build a tailwater rating curve for all the culvert analyses except for Thunderbird Road. The channel hydraulics at Thunderbird were used to evaluate the culvert at that location. Table 5 lists the results of the channel analyses at the two locations. Plots of existing channel cross-sections are given in Appendix II.

TABLE 5

EXISTING CHANNEL CAPACITIES

CROSS SECTION LOCATION	CHANNEL CAPACITY		
	w/ 1' of FREEBOARD (cfs)	w/ 0' of FREEBOARD (cfs)	w/ ONE LANE OPEN (cfs)
BURNS DR., 130' D.S. of CL	455	845	1075
T-BIRD RD., 125' D.S. of CL	700	1210	1425

3.2.2 Crossroad Culverts

The existing culverts are described in section 3.1.2. The culverts

were all analyzed to determine their capacity with a headwater elevation such that only one lane of traffic in each lane remained open. The purpose being to determine the minimum capacity for future culverts at each location. The culverts were analyzed for inlet and outlet control conditions. The procedures used were the HDS-5 design nomographs and the tailwater rating curves described in Section 3.2.1 lists the results of the existing culvert analysis. Profiles of existing culverts are included in Appendix II.

TABLE 6 EXISTING CULVERT DATA

CULVERT LOCATION	EXISTING CAPACITY* (cfs)	LENGTH (ft)	CULVERT SIZE
HUTTON DR.	500	102	2 - 10' x 4'
BURNS DR.	720	58	2 - 10' x 4'
GREENWAY RD.	700	80	2 - 10' x 4'
BOSWELL BLVD.	630	58	2 - 10' x 4'
CAMEO DR.	700	47	2 - 10' x 4'
T-BIRD RD.	720	58	2 - 10' x 4'

* The culvert's capacity is described as the flow through the culvert when depth inundates the roadway such that only one lane of traffic in each dir. remains open.

3.3 CULVERT DESIGN APPROACH

Two basic scenarios were explored for the design of new or extended culverts at each of the intersections. One scenario involved the design of new culverts based upon the improvement of the 99th Avenue channel at some future date. Since the existing channel and culvert system is incapable of containing the 5-year storm runoff at Thunderbird

Road it would be desirable to improve the drainage along 99th Avenue. However, it is beyond our scope of work to improve the entire corridor or even any part of the channel other than the areas disturbed by intersection improvements. So we briefly investigated the possibility of constructing new culverts now which would not decrease the present capacity and would potentially increase the capacity substantially in the future if channel improvements were to be made. The first design approach is as follows: assume that the existing channel was improved from Grand Avenue (or possibly for the New River) to Bell Road. The channel slope could be decreased slightly to allow greater depth at Thunderbird Road and continuing north . The increased depth (2.5 feet to 3 feet) would allow the construction of culverts with a 7 foot height instead of the present 4 feet. The channel walls could be steepened to increase the bottom width from 2 feet ± to 30 feet. The result would be culverts and a channel with capacities of almost 2300 cfs instead of the present 700 cfs.

This approach requires the assumption that the channel will be improved in the described fashion in the not-too-distant future (the cost may be prohibitive) but on the other hand it eliminates the undesirable alternative of extending or building new culverts which are extremely inadequate in terms of capacity. This design approach has been eliminated from detailed study because: it would be much costlier than the second approach; it requires assumptions about future channel improvements which may never occur; and it would not enhance the drainage capacity until channel improvements occurred.

The second design approach is the preferred approach. This scenario operates under the premise of maintaining the status quo. That is, the culverts for each of the intersection improvement alternatives are designed to maintain the capacity of the existing culvert while allowing one lane of traffic in each direction to remain open. Using this design method the culvert size may remain the same as existing (in some cases) which allows for extending the existing culvert. The culvert size may change though, because of two reasons: 1) The increased length may cause significant head loss resulting in the need for a larger culvert size to maintain the existing flow capacity or 2) The allowable headwater depth may be less at the new headwall location than at the existing location requiring a larger culvert to maintain capacity. In all of the developed intersection improvement alternatives, two of the culverts would be extended and the remainder would be replaced with larger culverts. The results of the preliminary designs are summarized in Table 7. The culvert design sheets and plan view drawings of all alternatives are included in Appendix II.

TABLE 7

PROPOSED CULVERT SIZES FOR SELECTED ALTERNATIVES

ALTERNATIVE	CULVERT LOCATION	DESIGN CAPACITY * (cfs)	DESIGN LENGTH (ft)	CULVERT SIZE
A	HUTTON DR.	500	1435	2 - 10' x 4'
	BURNS DR.	720	1434	3 - 10' x 4'
	GREENWAY RD.	700	1297	2 - 12' x 4'
	BOSWELL BLVD.	630	1435	2 - 10' x 4'
	T-BIRD RD.	720	1543	3 - 10' x 4'
C	HUTTON DR.	500	200	2 - 10' x 4'
	BURNS DR.	720	200	2 - 12' x 4'
	GREENWAY RD.	700	200	2 - 12' x 4'
	BOSWELL BLVD.	630	200	2 - 10' x 4'
	T-BIRD RD.	720	1013	2 - 12' x 4'
E	HUTTON DR.	500	948	2 - 10' x 4'
	BURNS DR.	720	893	3 - 10' x 4'
	GREENWAY RD.	700	1142	2 - 12' x 4'
	BOSWELL BLVD.	630	891	2 - 10' x 4'
	T-BIRD RD.	720	896	2 - 12' x 4'

* The culvert's capacity is described as the flow through the culvert when the depth inundates the roadway such that only one lane of traffic in each direction remains open.

4.0 RESULTS OF ANALYSIS

The results of the hydrologic analysis as computed with HEC-1 are tabulated in Table 8. Results shown are for the 2, 5, 25 and 50-year flows at the five intersections included in the study plus Cameo Drive. The table shows that the peak flows at Thunderbird Road are approximately twice the magnitude of the flows at Hutton Drive for all storm frequencies computed. At all locations existing culverts are 2-10' x 5' CBC's.

TABLE 8

PEAK FLOW RATING TABLE
for
PROJECT INTERSECTIONS ALONG 99th AVENUE

INTERSECTION	CONC. POINT	CUMULATIVE DRAINAGE AREA (sq. mi.)	FLOOD FREQUENCY			
			2 YEAR (cfs)	5 YEAR (cfs)	25 YEAR (cfs)	50 YEAR (cfs)
HUTTON DRIVE	3	2.10	348	637	1141	1407
BURNS DRIVE	4	2.79	484	910	1669	2034
GREENWAY ROAD	5	3.19	554	1042	1915	2338
BOSWELL BLVD.	6	3.51	631	1180	2172	2638
CAMEO DRIVE	7	3.71	670	1256	2317	2813
T-BIRD ROAD	8	3.82	683	1284	2366	2882

The results of the hydraulic analysis reveals that the channel and culverts are capable of safely passing the 2 to 4-year storm runoff only. Exhibit 3 illustrates the peak flows at each intersection for the 2, 5, 25, and 50-year storms. In addition, the existing channel and culverts capacities are plotted on the graph as O's or X's, respectively.

5.0 CONCLUSIONS AND RECOMMENDATIONS

The drainage facilities for 99th Avenue from Bell Road to Grand Avenue are very inadequate. The channel has a history of overtopping on a regular basis and the culverts have even less capacity than the channel. The street drainage is adequate only as long as the channel is not flowing full. The solution to the drainage deficiencies may be an improved channel and culvert system or a new storm drain system or a combination of the two. However, these types of improvements would involve major reconstruction of the channel and culverts and minor reconstruction of the cross streets and 99th Avenue as well.

Therefore, to remain within the intention of the original scope of work we recommend that the drainage improvements be designed to maintain or

99th AVENUE PEAK FLOW RATING CURVES

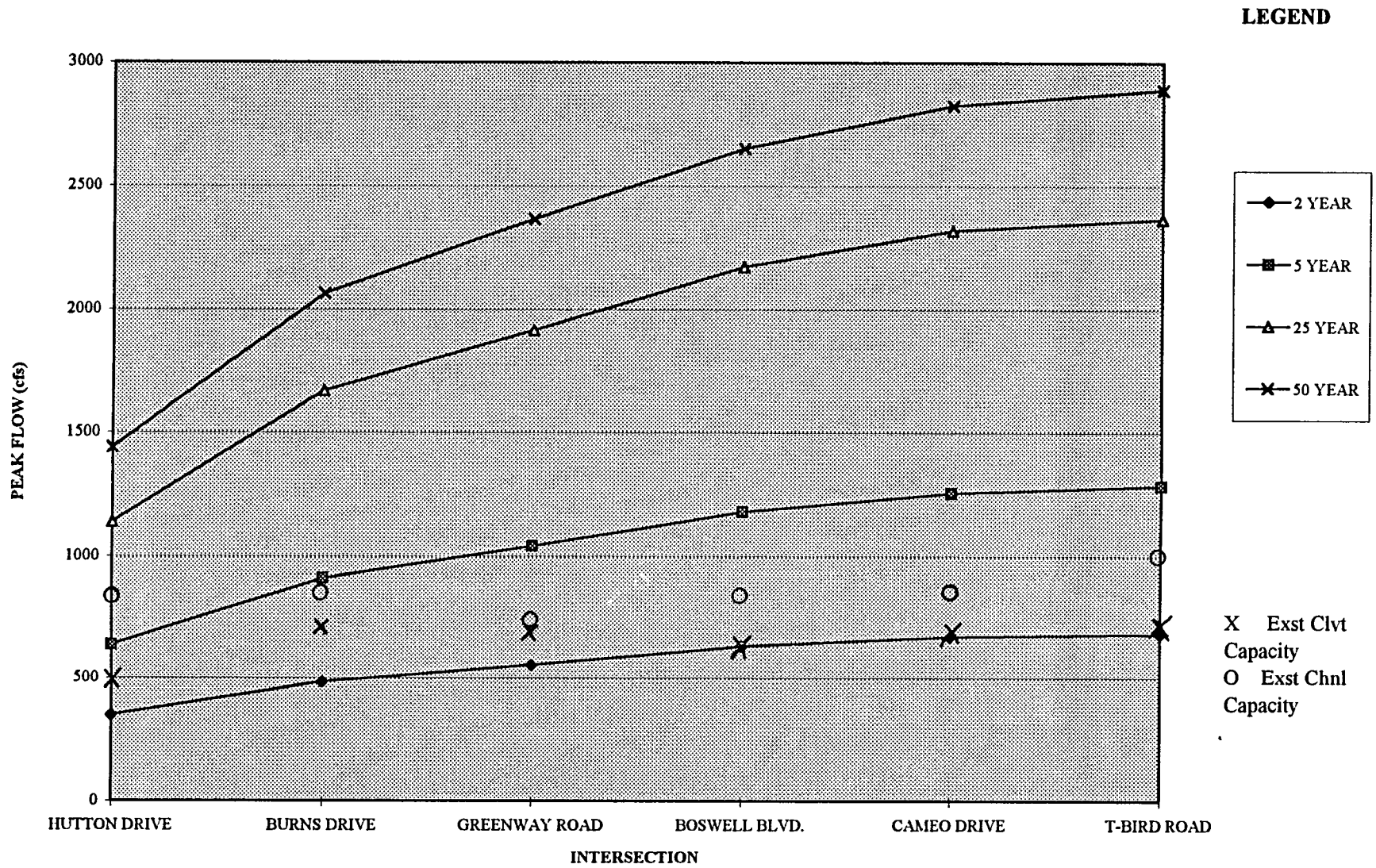


EXHIBIT 3

APPENDIX I
HYDROLOGY

SOILS DATA

SUBBASIN 1

WEIGHTED INITIAL ABSTRACTION (IA)

Land Use	Area	Area	IA	Wgtd. IA
type	sq. miles	percent	inches	inches
RESIDENTIAL	0.666	93.41	0.11	0.103
COMMERCIAL	0.047	6.59	0.06	0.004
Total	0.713	100	AVG. =	0.107

HYDRAULIC CONDUCTIVITY (XKSAT)

Map Unit	Area	Area	XKSAT	log(Ks)* (%area)
type	sq. miles	percent	inches	inches
CLAY	0.063	8.8	0.01	-0.177
CLAY LOAM	0.365	51.2	0.04	-0.716
LOAM	0.231	32.4	0.25	-0.195
SANDY LOAM	0.047	6.6	0.40	-0.026
LOAM w/ CALICHE	0.007	1.0	0.20	-0.007
Total	0.713	100	Log AVG. =	0.08

SUBBASIN 1

WEIGHTED DTHETA

Land Use	Area	Area	DTHETA condition	DTHETA
type	sq. miles	percent		
RESIDENTIAL	0.666	93.41	NORMAL	0.15
COMMERCIAL	0.047	6.59	NORMAL	0.15
Total	0.713	100	Wghtd. DTHETA=	0.150

VEGETATIVE COVER AREA and XKSAT adj.

Land Use	Area	Area	Percent Veg. Cover
type	sq. miles	percent	percent
RESIDENTIAL	0.666	93.41	29
COMMERCIAL	0.047	6.59	9
Total	0.713	AVG.=	27.7%
		XKSAT adj.=	0.09

SUBBASIN 1

NATURAL IMPERVIOUS COVER **RTIMP** (%)

Map Unit	Area	Area	Rock Outcrop	%R.O.* (%area)
	sq. miles	percent	percent	
CLAY	0.063	8.84		
CLAY LOAM	0.365	51.19		
LOAM	0.231	32.40		
SANDY LOAM	0.047	6.59		
LOAM w/ CALICHE	0.007	0.98		
Total	0.713	100	**%R.O. =**	

MAN-MADE IMPERVIOUS COVER **RTIMP** (%)

Land Use	Area	Area	% Imp. Area Inc. ROW
type	sq. miles	percent	percent
RESIDENTIAL	0.666	93.41	55
COMMERCIAL	0.047	6.59	70
Total	0.713	100	
		AVG. =	**55.99%**

LG Card

IA	DTHETA	PSIF	XKSAT	RTIMP
0.107	**0.150**	**7.7**	**0.09**	**56.0**

SUBBASIN 2

WEIGHTED INITIAL ABSTRACTION (IA)

Land Use	Area	Area	IA	Wgtd. IA
type	sq. miles	percent	inches	inches
RESIDENTIAL	0.987	86.73	0.11	0.095
COMMERCIAL	0.151	13.27	0.07	0.009
Total	1.138	100	AVG. =	0.105

HYDRAULIC CONDUCTIVITY (XKSAT)

Map Unit	Area	Area	XKSAT	log(Ks)* (%area)
type	sq. miles	percent	inches	inches
CLAY	0.166	14.6	0.01	-0.292
CLAY LOAM	0.200	17.6	0.04	-0.246
LOAM	0.664	58.3	0.25	-0.351
SANDY LOAM	0.068	6.0	0.40	-0.024
LOAM w/ CALICHE	0.040	3.5	0.20	-0.025
Total	1.138	100	Log AVG. =	0.12

SUBBASIN 2

WEIGHTED DTHETA

Land Use	Area	Area	DTHETA condition	DTHETA
type	sq. miles	percent		
RESIDENTIAL	0.987	86.73	NORMAL	19%
COMMERCIAL	0.151	13.27	NORMAL	19%
Total	1.138	100	Wghtd. DTHETA=	0.190

VEGETATIVE COVER AREA and XKSAT adj.

Land Use	Area	Area	Percent Veg. Cover
type	sq. miles	percent	percent
RESIDENTIAL	0.987	86.73	32
COMMERCIAL	0.151	13.27	8
Total	1.138	AVG.=	28.8%
		XKSAT adj.=	0.14

SUBBASIN 2

NATURAL IMPERVIOUS COVER **RTIMP** (%)

Map Unit	Area	Area	Rock Outcrop	%R.O.* (%area)
	sq. miles	percent	percent	
CLAY	0.166	14.59		
CLAY LOAM	0.200	17.57		
LOAM	0.664	58.35		
SANDY LOAM	0.068	5.98		
LOAM w/ CALICHE	0.040	3.51		
Total	1.138	100	%R.O. =	

MAN-MADE IMPERVIOUS COVER **RTIMP** (%)

Land Use	Area	Area	% Imp. Area Inc. ROW
type	sq. miles	percent	percent
RESIDENTIAL	0.987	86.73	52
COMMERCIAL	0.151	13.27	70
Total	1.138	100	
		AVG. =	54.39%

LG Card

IA	DTHETA	PSIF	XKSAT	RTIMP
0.105	**0.190**	**6.6**	**0.14**	**54.4**

SUBBASIN 3

WEIGHTED INITIAL ABSTRACTION (IA)

Land Use	Area	Area	IA	Wgtd. IA
type	sq. miles	percent	inches	inches
RESIDENTIAL	0.169	68.15	0.07	0.048
COMMERCIAL	0.079	31.85	0.06	0.019
Total	0.248	100	AVG. =	0.067

HYDRAULIC CONDUCTIVITY (XKSAT)

Map Unit	Area	Area	XKSAT	log(Ks)* (%area)
type	sq. miles	percent	inches	inches
CLAY	0.047	19.0	0.01	-0.379
CLAY LOAM	0.026	10.5	0.04	-0.147
LOAM	0.167	67.3	0.25	-0.405
SANDY LOAM	0.008	3.2	0.40	-0.013
Total	0.248	100	Log AVG. =	0.11

SUBBASIN 3

WEIGHTED DTHETA

Land Use	Area	Area	DTHETA condition	DTHETA
type	sq. miles	percent		
RESIDENTIAL	0.169	68.15	NORMAL	0.17
COMMERCIAL	0.079	31.85	NORMAL	0.17
Total	0.248	100	Wghtd. DTHETA=	0.170

VEGETATIVE COVER AREA and XKSAT adj.

Land Use	Area	Area	Percent Veg. Cover
type	sq. miles	percent	percent
RESIDENTIAL	0.169	68.15	10
COMMERCIAL	0.079	31.85	3
Total	0.248	AVG.=	7.8%
		XKSAT adj.=	0.11

SUBBASIN 3

NATURAL IMPERVIOUS COVER **RTIMP** (%)

Map Unit	Area	Area	Rock Outcrop	%R.O.* (%area)
	sq. miles	percent	percent	
CLAY	0.047	18.95		
CLAY LOAM	0.026	10.48		
LOAM	0.167	67.34		
SANDY LOAM	0.008	3.23		
Total	0.248	100	**%R.O. =**	

MAN-MADE IMPERVIOUS COVER **RTIMP** (%)

Land Use	Area	Area	% Imp. Area Inc. ROW
type	sq. miles	percent	percent
RESIDENTIAL	0.169	68.15	85
COMMERCIAL	0.079	31.85	85
Total	0.248	100	
		AVG. =	**85.00%**

LG Card

IA	DTHETA	PSIF	XKSAT	RTIMP
0.067	**0.170**	**6.8**	**0.11**	**85.0**

SUBBASIN 4

WEIGHTED INITIAL ABSTRACTION (IA)

Land Use	Area	Area	IA	Wgtd. IA
type	sq. miles	percent	inches	inches
RESIDENTIAL	0.618	89.70	0.11	0.099
COMMERCIAL	0.020	2.90	0.07	0.002
GOLF COURSE	0.045	6.53	0.20	0.013
G. C. LAKES	0.006	0.87	1.00	0.009
Total	0.689	100	AVG. =	0.122

HYDRAULIC CONDUCTIVITY (XKSAT)

Map Unit	Area	Area	XKSAT	log(Ks)* (%area)
type	sq. miles	percent	inches	inches
CLAY LOAM	0.184	26.7	0.04	-0.373
LOAM	0.477	69.2	0.25	-0.417
CLAY	0.028	4.1	0.01	-0.081
Total	0.689	100	Log AVG. =	0.13

SUBBASIN 4

WEIGHTED DTHETA

Land Use	Area	Area	DTHETA condition	DTHETA
type	sq. miles	percent		
RESIDENTIAL	0.618	89.70	NORMAL	0.21
COMMERCIAL	0.020	2.90	NORMAL	0.21
GOLF COURSE	0.045	6.53	NORMAL	0.21
G. C. LAKES	0.006	0.87	NORMAL	0.21
Total	0.689	100	Wghtd. DTHETA=	0.210

VEGETATIVE COVER AREA and **XKSAT adj.**

Land Use	Area	Area	Percent Veg. Cover
type	sq. miles	percent	percent
RESIDENTIAL	0.618	89.70	31
COMMERCIAL	0.020	2.90	5
GOLF COURSE	0.045	6.53	80
G. C. LAKES	0.006	0.87	
Total	0.689	AVG.=	33.2%
		XKSAT adj.=	0.17

SUBBASIN 4

NATURAL IMPERVIOUS COVER **RTIMP** (%)

Map Unit	Area	Area	Rock Outcrop	%R.O.* (%area)
	sq. miles	percent	percent	
CLAY LOAM	0.184	26.71		
LOAM	0.477	69.23		
CLAY	0.028	4.06		
Total	0.689	100	%R.O. =	

MAN-MADE IMPERVIOUS COVER **RTIMP** (%)

Land Use	Area	Area	% Imp. Area Inc. ROW
type	sq. miles	percent	percent
RESIDENTIAL	0.618	89.70	53
COMMERCIAL	0.020	2.90	70
GOLF COURSE	0.045	6.53	
G. C. LAKES	0.006	0.87	
Total	0.689	100	
		AVG. =	49.57%

LG Card

IA	DTHETA	PSIF	XKSAT	RTIMP
0.122	0.210	6.4	0.17	49.6

SUBBASIN 5

WEIGHTED INITIAL ABSTRACTION (IA)

Land Use	Area	Area	IA	Wgtd. IA
type	sq. miles	percent	inches	inches
RESIDENTIAL	0.365	91.94	0.10	0.092
COMMERCIAL	0.032	8.06	0.06	0.005
Total	0.397	100	AVG. =	0.097

HYDRAULIC CONDUCTIVITY (XKSAT)

Map Unit	Area	Area	XKSAT	log(Ks)* (%area)
type	sq. miles	percent	inches	inches
SANDY LOAM	0.014	3.5	0.40	-0.014
CLAY LOAM	0.107	27.0	0.04	-0.377
LOAM	0.276	69.5	0.25	-0.419
Total	0.397	100	Log AVG. =	0.16

SUBBASIN 5

WEIGHTED DTHETA

Land Use	Area	Area	DTHETA condition	DTHETA
type	sq. miles	percent		
RESIDENTIAL	0.365	91.94	NORMAL	0.25
COMMERCIAL	0.032	8.06	NORMAL	0.25
Total	0.397	100	Wghtd. DTHETA=	0.250

VEGETATIVE COVER AREA and XKSAT adj.

Land Use	Area	Area	Percent Veg. Cover
type	sq. miles	percent	percent
RESIDENTIAL	0.365	91.94	27
COMMERCIAL	0.032	8.06	3
Total	0.397	AVG.=	25.1%
		XKSAT adj.=	0.18

SUBBASIN 5

NATURAL IMPERVIOUS COVER **RTIMP** (%)

Map Unit	Area	Area	Rock Outcrop	%R.O.* (%area)
	sq. miles	percent	percent	
SANDY LOAM	0.014	3.53		
CLAY LOAM	0.107	26.95		
LOAM	0.276	69.52		
Total	0.397	100	**%R.O. =**	

MAN-MADE IMPERVIOUS COVER **RTIMP** (%)

Land Use	Area	Area	% Imp. Area Inc. ROW
type	sq. miles	percent	percent
RESIDENTIAL	0.365	91.94	59
COMMERCIAL	0.032	8.06	95
Total	0.397	100	
		AVG. =	**61.90%**

LG Card

IA	DTHETA	PSIF	XKSAT	RTIMP
0.097	**0.250**	**5.7**	**0.18**	**61.9**

SUBBASIN 6

WEIGHTED INITIAL ABSTRACTION (IA)

Land Use	Area	Area	IA	Wgtd. IA
type	sq. miles	percent	inches	inches
RESIDENTIAL	0.307	93.88	0.10	0.094
COMMERCIAL	0.020	6.12	0.06	0.004
Total	0.327	100	AVG. =	0.098

HYDRAULIC CONDUCTIVITY (XKSAT)

Map Unit	Area	Area	XKSAT	log(Ks)* (%area)
type	sq. miles	percent	inches	inches
CLAY LOAM	0.069	21.1	0.04	-0.295
LOAM	0.258	78.9	0.25	-0.475
Total	0.327	100	Log AVG. =	0.17

SUBBASIN 6

WEIGHTED DTHETA

Land Use	Area	Area	DTHETA condition	DTHETA
type	sq. miles	percent		
RESIDENTIAL	0.307	93.88	NORMAL	0.25
COMMERCIAL	0.020	6.12	NORMAL	0.25
Total	0.327	100	Wghtd. DTHETA=	0.250

VEGETATIVE COVER AREA and XKSAT adj.

Land Use	Area	Area	Percent Veg. Cover
type	sq. miles	percent	percent
RESIDENTIAL	0.307	93.88	25
COMMERCIAL	0.020	6.12	
Total	0.327	AVG.=	23.5%
		XKSAT adj.=	0.20

SUBBASIN 6

NATURAL IMPERVIOUS COVER **RTIMP** (%)

Map Unit	Area	Area	Rock Outcrop	%R.O.* (%area)
	sq. miles	percent	percent	
CLAY LOAM	0.069	21.10		
LOAM	0.258	78.90		
Total	0.327	100	**%R.O. =**	

MAN-MADE IMPERVIOUS COVER **RTIMP** (%)

Land Use	Area	Area	% Imp. Area Inc. ROW
type	sq. miles	percent	percent
RESIDENTIAL	0.307	93.88	61
COMMERCIAL	0.020	6.12	90
Total	0.327	100	
		AVG. =	**62.77%**

LG Card

IA	DTHETA	PSIF	XKSAT	RTIMP
0.098	**0.250**	**5.7**	**0.20**	**62.8**

SUBBASIN 7

WEIGHTED INITIAL ABSTRACTION (IA)

Land Use	Area	Area	IA	Wgtd. IA
type	sq. miles	percent	inches	inches
RESIDENTIAL	0.200	100.00	0.11	0.110
Total	0.200	100	AVG. =	0.110

HYDRAULIC CONDUCTIVITY (XKSAT)

Map Unit	Area	Area	XKSAT	log(Ks)* (%area)
type	sq. miles	percent	inches	inches
CLAY	0.017	8.5	0.01	-0.170
CLAY LOAM	0.033	16.5	0.04	-0.231
LOAM	0.150	75.0	0.25	-0.452
Total	0.200	100	Log AVG. =	0.14

SUBBASIN 7

WEIGHTED DTHETA

Land Use	Area	Area	DTHETA condition	DTHETA
type	sq. miles	percent		
RESIDENTIAL	0.200	100.00	NORMAL	0.23
Total	0.200	100	Wghtd. DTHETA=	0.230

VEGETATIVE COVER AREA and **XKSAT adj.**

Land Use	Area	Area	Percent Veg. Cover
type	sq. miles	percent	percent
RESIDENTIAL	0.200	100.00	33
Total	0.200	AVG.=	33.0%
		XKSAT adj.=	0.18

SUBBASIN 7

NATURAL IMPERVIOUS COVER **RTIMP** (%)

Map Unit	Area	Area	Rock Outcrop	%R.O.* (%area)
	sq. miles	percent	percent	
CLAY	0.017	8.50		
CLAY LOAM	0.033	16.50		
LOAM	0.150	75.00		
Total	0.200	100	**%R.O. =**	

MAN-MADE IMPERVIOUS COVER **RTIMP** (%)

Land Use	Area	Area	% Imp. Area Inc. ROW
type	sq. miles	percent	percent
RESIDENTIAL	0.200	100.00	51
Total	0.200	100	
		AVG. =	**51.00%**

LG Card

IA	DTHETA	PSIF	XKSAT	RTIMP
0.110	**0.230**	**6.2**	**0.18**	**51.0**

SUBBASIN 8

WEIGHTED INITIAL ABSTRACTION (IA)

Land Use	Area	Area	IA	Wgtd. IA
type	sq. miles	percent	inches	inches
RESIDENTIAL	0.104	100.00	0.11	0.110
Total	0.104	100	AVG. =	0.110

HYDRAULIC CONDUCTIVITY (XKSAT)

Map Unit	Area	Area	XKSAT	log(Ks)* (%area)
type	sq. miles	percent	inches	inches
CLAY	0.013	12.5	0.01	-0.250
CLAY LOAM	0.020	19.2	0.04	-0.269
LOAM	0.071	68.3	0.25	-0.411
Total	0.104	100	Log AVG. =	0.12

SUBBASIN 8

WEIGHTED DTHETA

Land Use	Area	Area	DTHETA condition	DTHETA
type	sq. miles	percent		
RESIDENTIAL	0.104	100.00	NORMAL	0.25
Total	0.104	100	Wghtd. DTHETA=	0.250

VEGETATIVE COVER AREA and XKSAT adj.

Land Use	Area	Area	Percent Veg. Cover
type	sq. miles	percent	percent
RESIDENTIAL	0.104	100.00	80
Total	0.104	AVG.=	80.0%
		XKSAT adj.=	0.21

SUBBASIN 8

NATURAL IMPERVIOUS COVER **RTIMP** (%)

Map Unit	Area	Area	Rock Outcrop	%R.O.* (%area)
	sq. miles	percent	percent	
CLAY	0.013	12.50		
CLAY LOAM	0.020	19.23		
LOAM	0.071	68.27		
Total	0.104	100	**%R.O. =**	

MAN-MADE IMPERVIOUS COVER **RTIMP** (%)

Land Use	Area	Area	% Imp. Area Inc. ROW
type	sq. miles	percent	percent
RESIDENTIAL	0.104	100.00	55
Total	0.104	100	
		AVG. =	**55.00%**

LG Card

IA	DTHETA	PSIF	XKSAT	RTIMP
0.110	**0.250**	**5.6**	**0.21**	**55.0**

RAINFALL DATA

*** O U T P U T D A T A ***

REVISED JUNE 1988 TO UPDATE COMPUTATION OF SHORT-DURATION VALUES

PRECIPITATION FREQUENCY VALUES FOR PUEBLO FUTURO, ARIZONA
PRIMARY ZONE NUMBER= 7
SHORT-DURATION ZONE NUMBER= 8

POINT VALUES

RETURN PERIOD

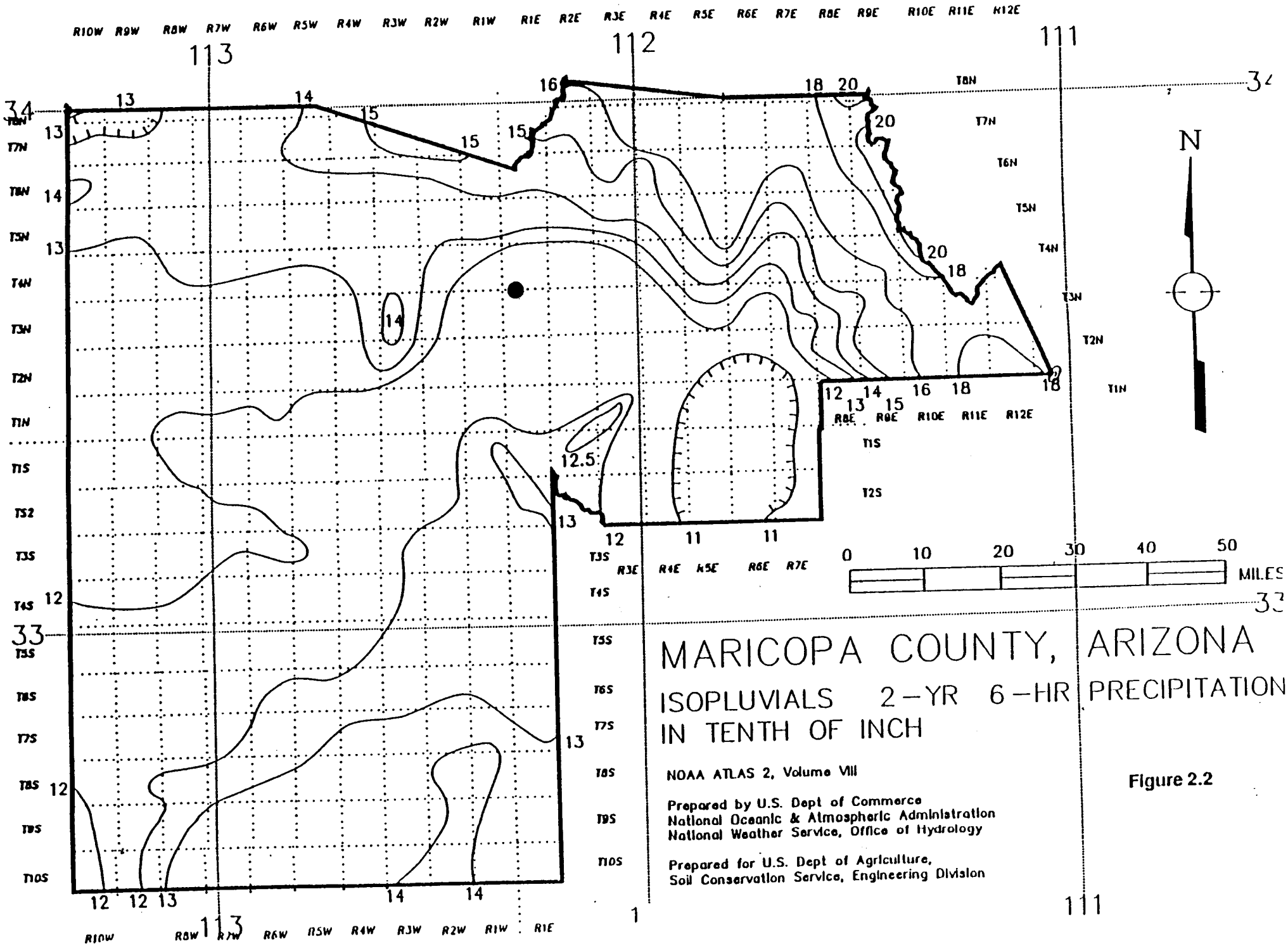
DURATION	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR	500-YR	
5-MIN	.32	.42	.48	.58	.65	.73	.90	5-MIN
10-MIN	.48	.63	.74	.88	1.00	1.11	1.38	10-MIN
15-MIN	.58	.79	.93	1.13	1.28	1.43	1.78	15-MIN
30-MIN	.76	1.06	1.25	1.52	1.73	1.94	2.42	30-MIN
1-HR	.93	1.30	1.55	1.89	2.16	2.42	3.03	1-HR
2-HR	1.02	1.43	1.70	2.08	2.37	2.66	3.33	2-HR
3-HR	1.07	1.51	1.80	2.20	2.51	2.82	3.53	3-HR
6-HR	1.18	1.66	1.99	2.43	2.78	3.12	3.91	6-HR
12-HR	1.28	1.83	2.19	2.69	3.08	3.46	4.35	12-HR
24-HR	1.39	2.00	2.40	2.96	3.38	3.81	4.79	24-HR

* IF YOUR SITE IS IN ARIZONA OR NEW MEXICO, PLEASE CONSULT THE
FOLLOWING PAPER FOR REVISED DEPTH-AREA VALUES:
DEPTH-AREA RATIOS IN THE SEMI-ARID SOUTHWEST UNITED STATES
NOAA TECHNICAL MEMORANDUM NWS HYDRO-40
ZEHR AND MYERS
AUGUST 1984

INPUT DATA

PROJECT NAME=PUEBLO FUTURO, ARIZONA
ZONE= 7 SHORT-DURATION ZONE= 8
LATITUDE= .00 LONGITUDE= 100.00 ELEVATION= 0
2-YR, 6-HR PCPN= 1.18 100-YR, 6-HR PCPN= 3.12
2-YR, 24-HR PCPN= 1.39 100-YR, 24-HR PCPN= 3.81

* * * * E N D O F R U N * * * *


MARICOPA COUNTY, ARIZONA
ISOPLUVIALS 2-YR 6-HR PRECIPITATION
IN TENTH OF INCH
NOAA ATLAS 2, Volume VIII
Prepared by U.S. Dept of Commerce
National Oceanic & Atmospheric Administration
National Weather Service, Office of Hydrology
Prepared for U.S. Dept of Agriculture,
Soil Conservation Service, Engineering Division
N
0 10 20 30 40 50
MILES
113
112
111
34
33
32
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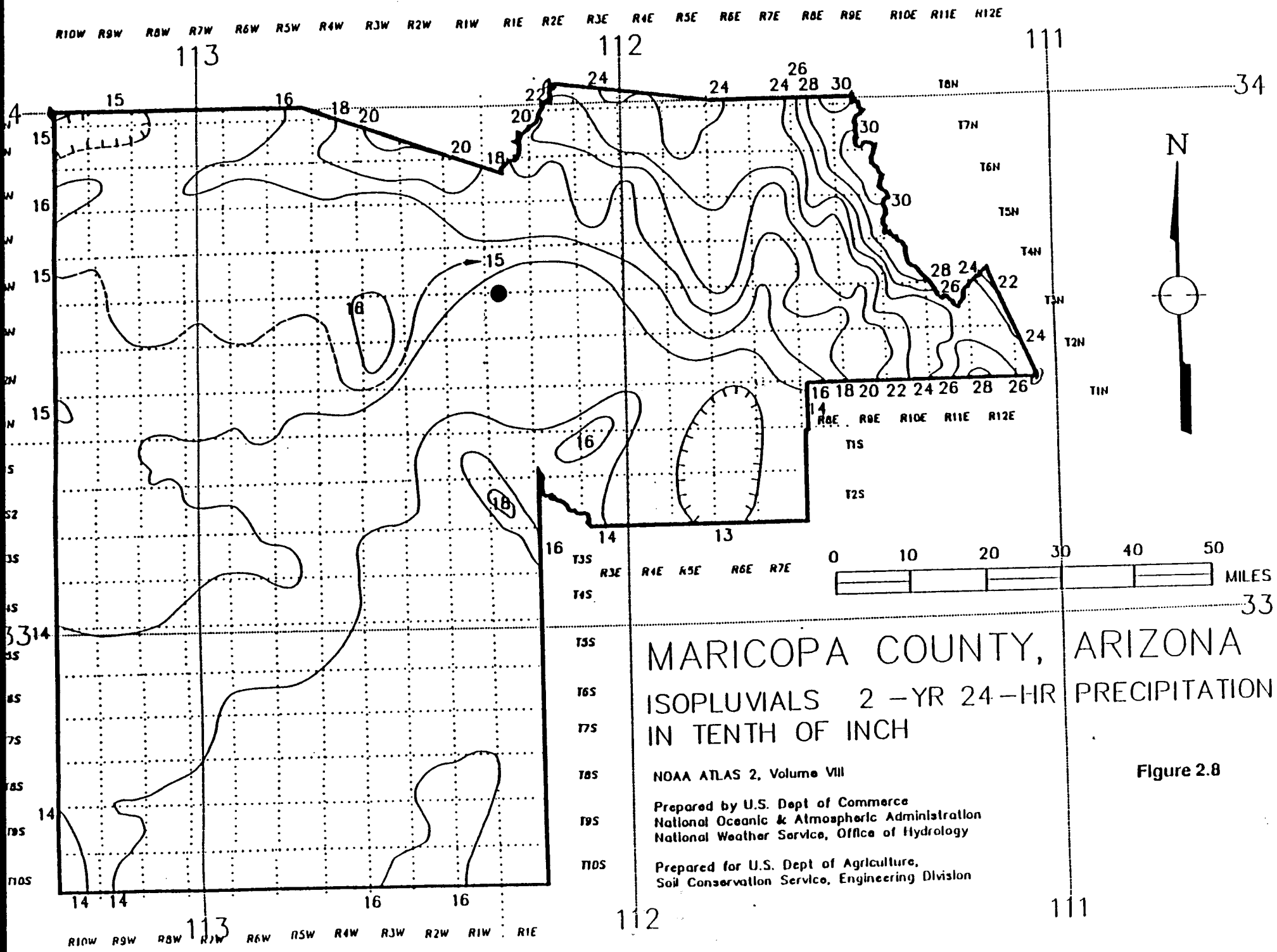
T8N T7N T6N T5N T4N T3N T2N T1N T1S T2S T3S T4S T5S T6S T7S T8S T9S T10S
12.5

Figure 2.2


MARICOPA COUNTY, ARIZONA
ISOPLUVIALS 2 -YR 24-HR PRECIPITATION
IN TENTH OF INCH
NOAA ATLAS 2, Volume VIII
Prepared by U.S. Dept of Commerce
National Oceanic & Atmospheric Administration
National Weather Service, Office of Hydrology
Prepared for U.S. Dept of Agriculture,
Soil Conservation Service, Engineering Division
N
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T8N T7N T6N T5N T4N T3N T2N T1N T1S T2S T3S T4S T5S T6S T7S T8S T9S T10S
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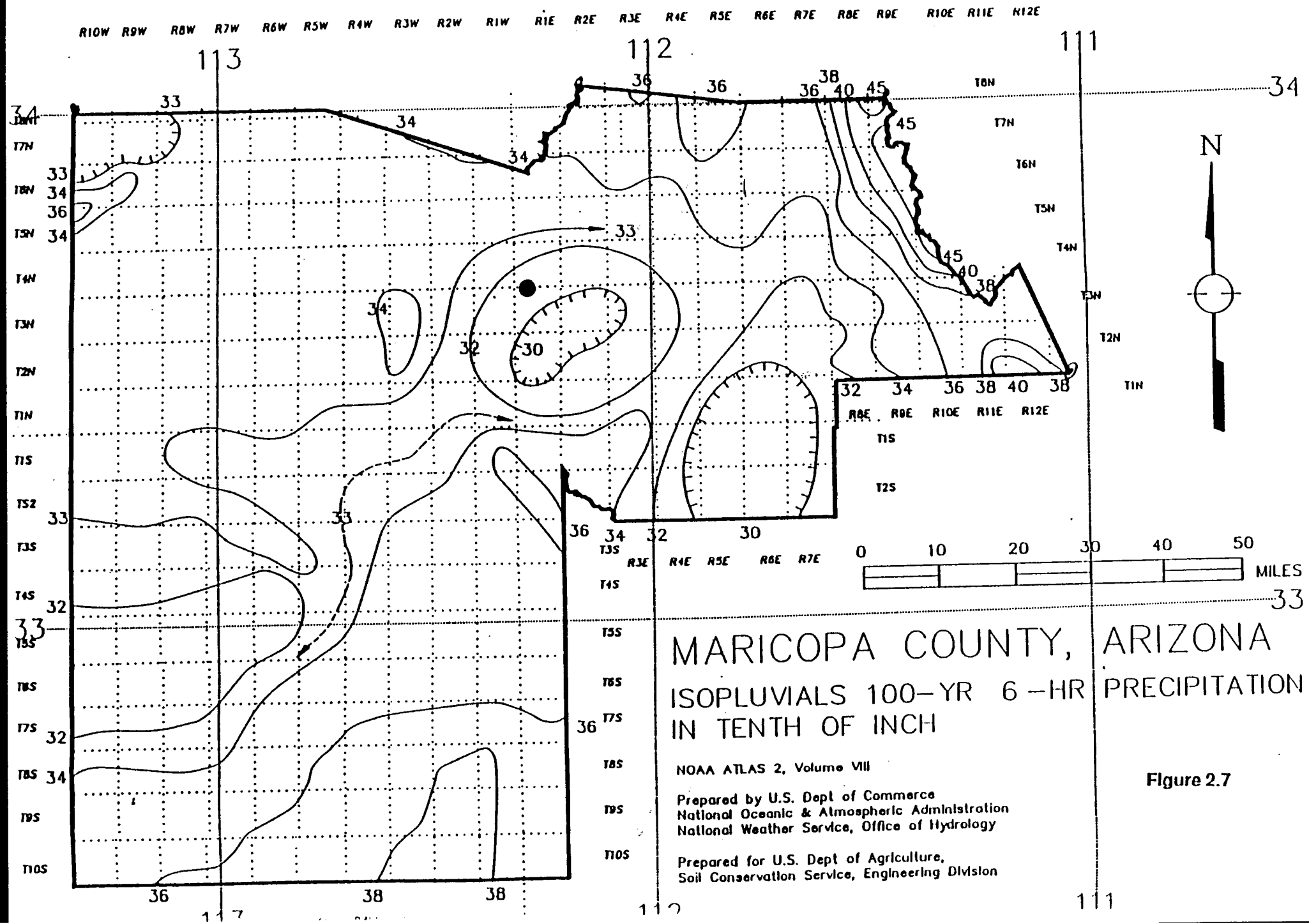
34 33

Figure 2.8


MARICOPA COUNTY, ARIZONA
ISOPLUVIALS 100-YR 6-HR PRECIPITATION
IN TENTH OF INCH
NOAA ATLAS 2, Volume VIII
Prepared by U.S. Dept of Commerce
National Oceanic & Atmospheric Administration
National Weather Service, Office of Hydrology
Prepared for U.S. Dept of Agriculture,
Soil Conservation Service, Engineering Division
N
0 10 20 30 40 50
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T8N T7N T6N T5N T4N T3N T2N T1N T1S T2S T3S T4S T5S T6S T7S T8S T9S T10S
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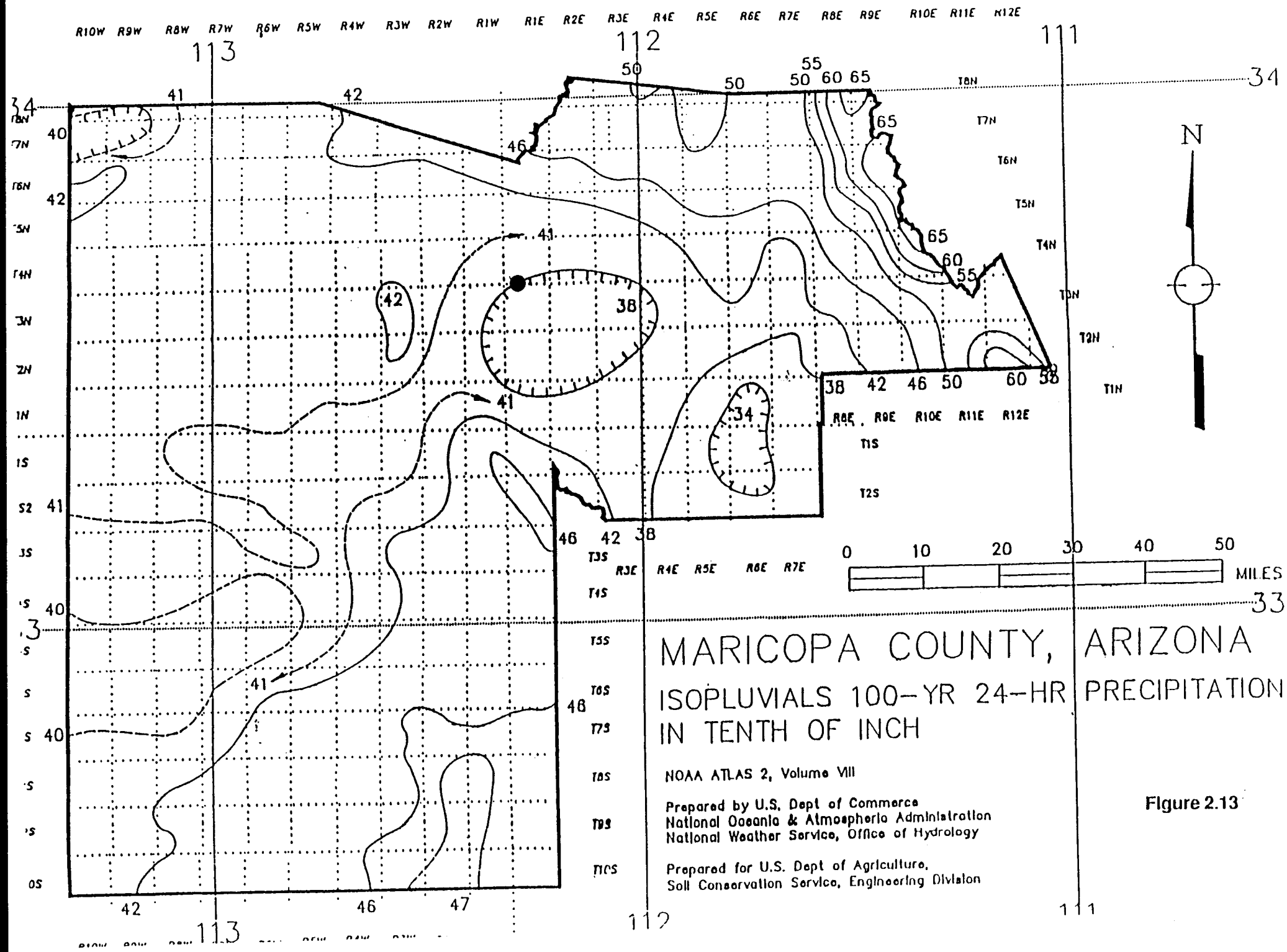
Figure 2.7


MARICOPA COUNTY, ARIZONA
ISOPLUVIALS 100-YR 24-HR PRECIPITATION
IN TENTH OF INCH
NOAA ATLAS 2, Volume VIII
Prepared by U.S. Dept of Commerce
National Oceanic & Atmospheric Administration
National Weather Service, Office of Hydrology
Prepared for U.S. Dept of Agriculture,
Soil Conservation Service, Engineering Division
N
0 10 20 30 40 50
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T8N T7N T6N T5N T4N T3N T2N T1N T1S T2S T3S T4S T5S T6S T7S T8S T9S T10S
113
112
111
34
33

Figure 2.13

DEL WEBB CHANNEL SPLIT-FLOW ANALYSIS

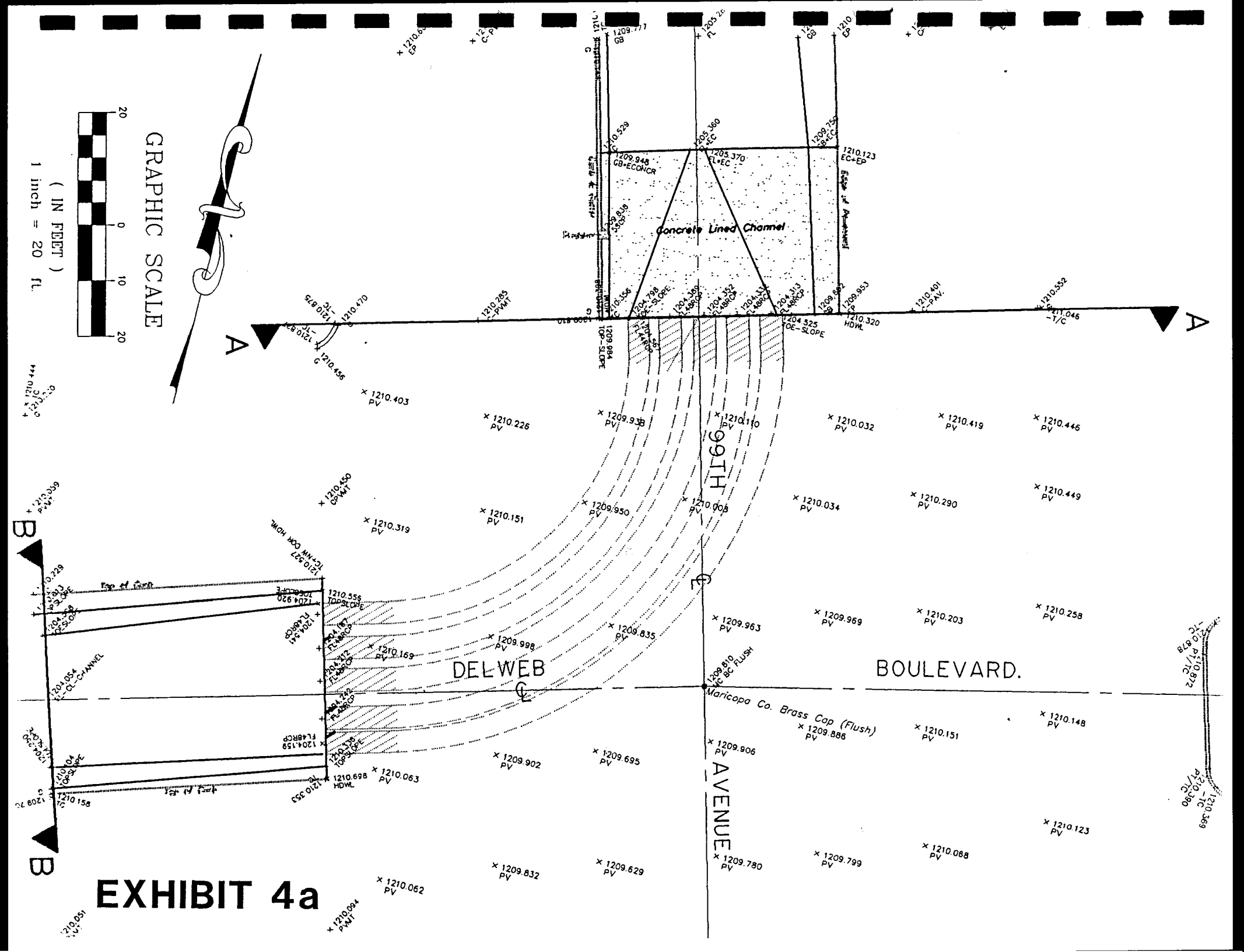
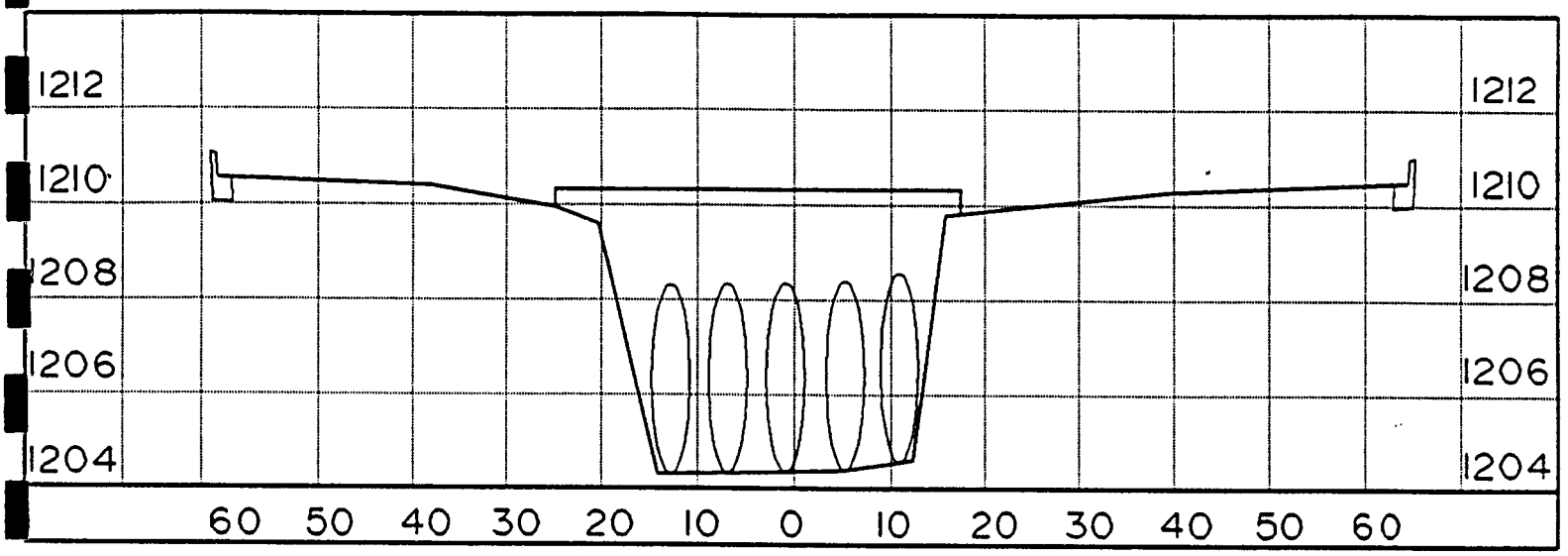
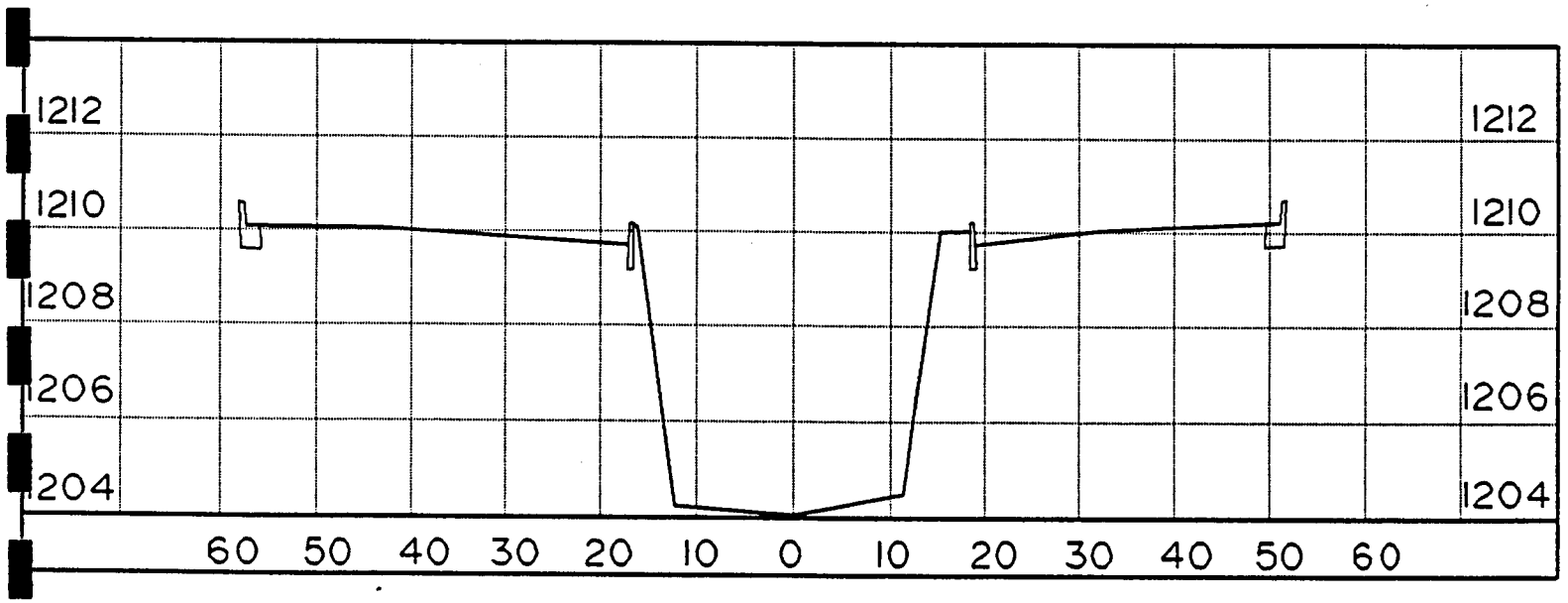

GRAPHIC SCALE
(IN FEET)
1 inch = 20 ft.
Concrete Lined Channel
99TH
AVENUE
DEL WEB
BOULEVARD.
Maricopa Co. Brass Cap (Flush)
A
B

EXHIBIT 4a



SECTION A-A

1"=4' VERT.
1"=20' HORZ.

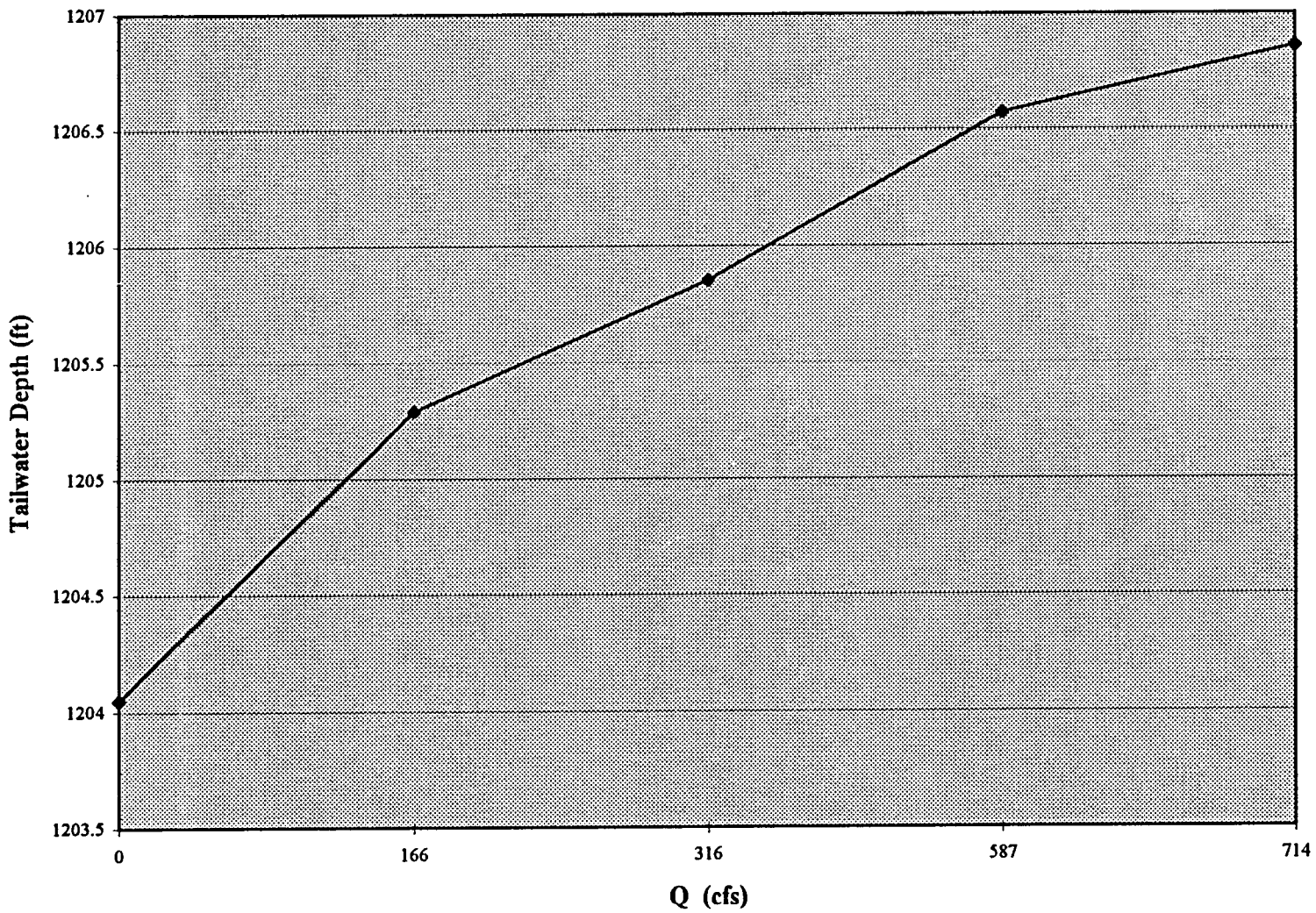


SECTION B-B

1"=4' VERT.
1"=20' HORZ.

EXHIBIT 4b

Del Webb Channel Tailwater



DEL WEBB
CHANNEL

TAILWATER
ANALYSIS

2 YR

NATURAL CHANNELS

VARIABLES LIST:
Y - FLOW ELEVATION Q - FLOWRATE S - CHANNEL SLOPE

VARIABLE TO BE SOLVED (Y,Q OR S) ? Y Enter up to 20 cross-section points.
Enter <Return> only for distance to end.

Q (CFS) ? 166
S (FT/FT) ? .004

CROSS-SECTION POINTS

DIST	ELEV	COEFF	DIST	ELEV	COEFF
0.	10.1	.016			
22	9.7	.016			
23	10.16	.016			
24	10.1	.015			
28	4.25	.015			
40	4.05	.015			
51	4.5	.015			
55	10.0	.016			
59	10.23	.016			
73	10.06	.016			

RESULTS
==========
Y= 5.29 FT
A= 25.47 SF
P= 25.25 FT
V= 6.52 FPS
F= 1.12 SUPER-CRITICAL FLOW

<Shift> <Prt Sc> print <Return> repeat <Space Bar> back to menu

NATURAL CHANNELS

VARIABLES LIST:
Y - FLOW ELEVATION Q - FLOWRATE S - CHANNEL SLOPE

VARIABLE TO BE SOLVED (Y,Q OR S) ? Y Enter up to 20 cross-section points.
Enter <Return> only for distance to end.

Q (CFS) ? 166
S (FT/FT) ? .004

CROSS-SECTION POINTS

DIST	ELEV	COEFF	DIST	ELEV	COEFF
0.	10.1	.016			
22	9.7	.016			
23	10.16	.016			
24	10.1	.015			
28	4.25	.015			
40	4.05	.015			
51	4.5	.015			
55	10.0	.016			
59	10.23	.016			
73	10.06	.016			

RESULTS
==========
Y= 5.29 FT
A= 25.47 SF
P= 25.25 FT
V= 6.52 FPS
F= 1.12 SUPER-CRITICAL FLOW

<Shift> <Prt Sc> print <Return> repeat <Space Bar> back to menu

NATURAL CHANNELS

VARIABLES LIST:

Y - FLOW ELEVATION Q - FLOWRATE S - CHANNEL SLOPE

VARIABLE TO BE SOLVED (Y,Q OR S) ? Y

Enter up to 20 cross-section points.
Enter <Return> only for distance to end.

Q (CFS) ? 316
S (FT/FT) ? .0036

5 YR.

CROSS-SECTION POINTS

DIST	ELEV	COEFF	DIST	ELEV	COEFF
0	10.1	.016			
22	9.7	.016			
23	10.16	.016			
24	10.1	.015			
28	4.25	.015			
40	4.05	.015			
51	4.5	.015			
55	10	.016			
59	10.23	.016			
73	10.06	.016			

RESULTS

==========

Y= 5.85 FT
A= 39.17 SF
P= 26.61 FT
V= 8.07 FPS
F= 1.14 SUPER-CRITICAL FLOW

<Shift> <Prt Sc> print <Return> repeat <Space Bar> back to menu

NATURAL CHANNELS

VARIABLES LIST:

Y - FLOW ELEVATION Q - FLOWRATE S - CHANNEL SLOPE

VARIABLE TO BE SOLVED (Y,Q OR S) ? Y

Q (CFS) ? 587

S (FT/FT) ? .0036

Enter up to 20 cross-section points.
Enter <Return> only for distance to end.

CROSS-SECTION POINTS

DIST	ELEV	COEFF	DIST	ELEV	COEFF
0	10.1	.016			
22	9.7	.016			
23	10.16	.016			
24	10.1	.015			
28	4.25	.015			
40	4.05	.015			
51	4.5	.015			
55	10	.016			
59	10.23	.016			
73	10.06	.016			

25 YR.

RESULTS

==========

Y= 6.57 FT

A= 57.69 SF

P= 28.38 FT

V= 10.18 FPS

F= 1.21 SUPER-CRITICAL FLOW

<Shift> <Prt Sc> print <Return> repeat <Space Bar> back to menu

NATURAL CHANNELS

VARIABLES LIST:

Y - FLOW ELEVATION Q - FLOWRATE S - CHANNEL SLOPE

VARIABLE TO BE SOLVED (Y,Q OR S) ? Y

Enter up to 20 cross-section points.
Enter <Return> only for distance to end.

Q (CFS) ? 714
S (FT/FT) ? .0036

CROSS-SECTION POINTS

DIST	ELEV	COEFF	DIST	ELEV	COEFF
0	10.1	.016			
22	9.7	.016			
23	10.16	.016			
24	10.1	.015			
28	4.25	.015			
40	4.05	.015			
51	4.5	.015			
55	10.	.016			
59	10.23	.016			
73	10.06	.016			

50 YR.

RESULTS

==========

Y= 6.86 FT
A= 65.28 SF
P= 29.09 FT
V= 10.94 FPS
F= 1.23 SUPER-CRITICAL FLOW

<Shift> <Prt Sc> print <Return> repeat <Space Bar> back to menu

NATURAL CHANNELS

VARIABLES LIST:

Y - FLOW ELEVATION Q - FLOWRATE S - CHANNEL SLOPE

VARIABLE TO BE SOLVED (Y,Q OR S) ? Q

Enter up to 20 cross-section points.
Enter <Return> only for distance to end.

Y (FT) ? 9.5
S (FT/FT) ? .0036

CROSS-SECTION POINTS

DIST	ELEV	COEFF	DIST	ELEV	COEFF
24	10.1	.05			
28	4.25	.015			
40	4.05	.015			
51	4.5	.015			
55	10	.016			
59	10.23	.016			
73	10	.016			

RESULTS
==========

Q= 2287.02 CFS
A= 140.19 SF
P= 35.55 FT
V= 16.31 FPS
F= 1.33 SUPER-CRITICAL FLOW

<Shift> <Prt Sc> print <Return> repeat <Space Bar> back to menu

DEL WEBB
CHANNEL
CAPACITY
ANALYSIS

NATURAL CHANNELS

VARIABLES LIST:
Y - FLOW ELEVATION Q - FLOWRATE S - CHANNEL SLOPE

VARIABLE TO BE SOLVED (Y,Q OR S) ? Y Enter up to 20 cross-section points.
Enter <Return> only for distance to end.

Q (CFS) ? 200
S (FT/FT) ? .0036

CROSS-SECTION POINTS

DIST	ELEV	COEFF	DIST	ELEV	COEFF
0	10.1	.016			
22	9.7	.016			
23	10.16	.016			
24	10.1	.015			
28	4.25	.015			
40	4.05	.015			
51	4.5	.015			
55	10	.016			
59	10.23	.016			
73	10.06	.016			

RESULTS
==========
Y= 5.46 FT
A= 29.51 SF
P= 25.66 FT
V= 6.78 FPS
F= 1.09 SUPER-CRITICAL FLOW

<Shift> <Prt Sc> print <Return> repeat <Space Bar> back to menu

---

NATURAL CHANNELS

VARIABLES LIST:
Y - FLOW ELEVATION Q - FLOWRATE S - CHANNEL SLOPE

VARIABLE TO BE SOLVED (Y,Q OR S) ? Y Enter up to 20 cross-section points.
Enter <Return> only for distance to end.

Q (CFS) ? 250
S (FT/FT) ? .0036

CROSS-SECTION POINTS

DIST	ELEV	COEFF	DIST	ELEV	COEFF
0	10.1	.016			
22	9.7	.016			
23	10.16	.016			
24	10.1	.015			
28	4.25	.015			
40	4.05	.015			
51	4.5	.015			
55	10	.016			
59	10.23	.016			
73	10.06	.016			

RESULTS
==========
Y= 5.63 FT
A= 33.87 SF
P= 26.09 FT
V= 7.38 FPS
F= 1.11 SUPER-CRITICAL FLOW

<Shift> <Prt Sc> print <Return> repeat <Space Bar> back to menu

---

NATURAL CHANNELS

VARIABLES LIST:
Y - FLOW ELEVATION Q - FLOWRATE S - CHANNEL SLOPE

VARIABLE TO BE SOLVED (Y,Q OR S) ? Y Enter up to 20 cross-section points.
Enter <Return> only for distance to end.

```
Q (CFS)    ? 450
S (FT/FT)  ? .0036
```

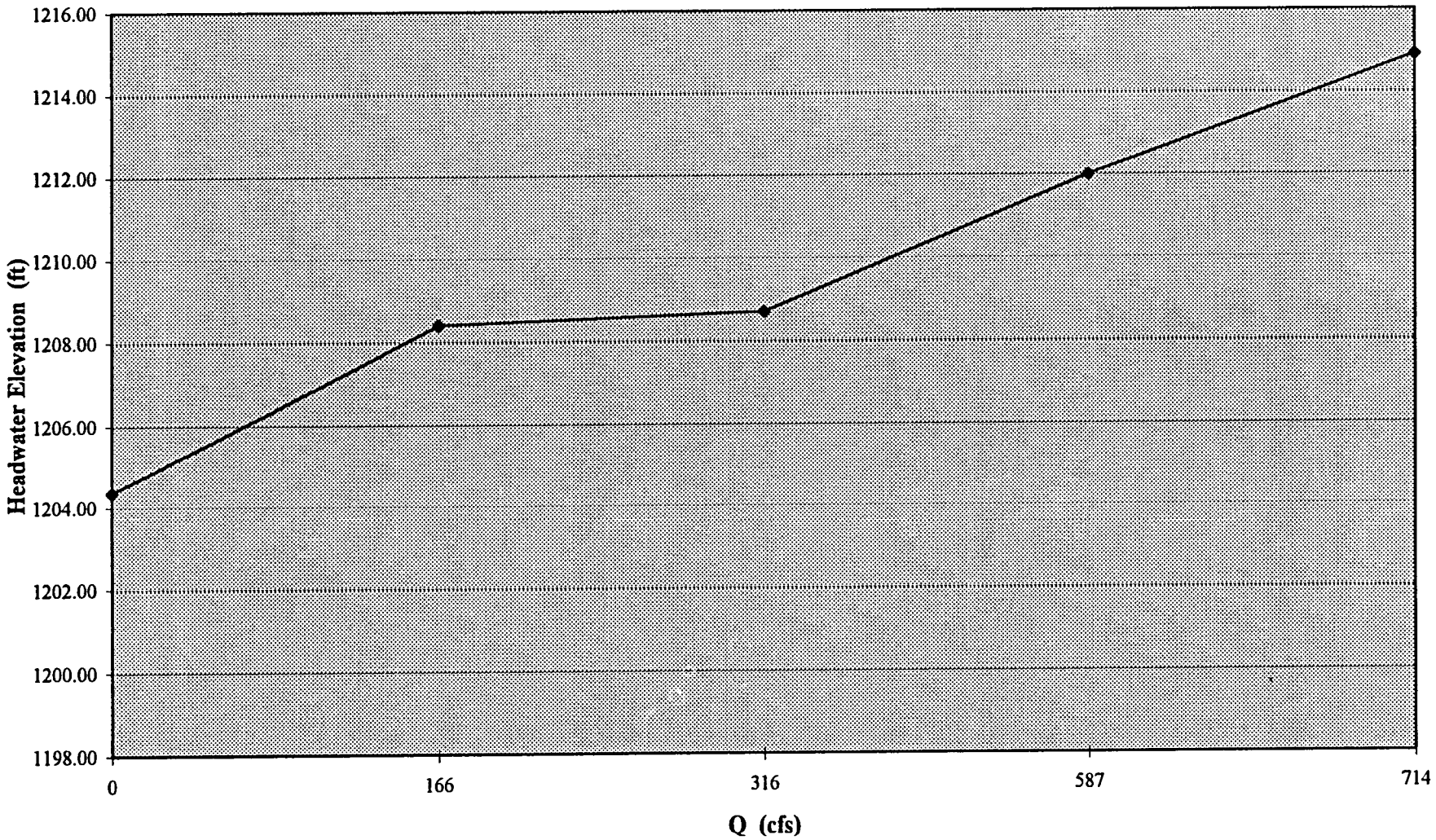
CROSS-SECTION POINTS

DIST	ELEV	COEFF	DIST	ELEV	COEFF
0	10.1	.016			
22	9.7	.016			
23	10.16	.016			
24	10.1	.015			
28	4.25	.015			
40	4.05	.016			
51	4.5	.015			
55	10.0	.016			
59	10.23	.016			
73	10.06	.016			

```
    RESULTS
================
Y=       6.26 FT
A=      49.69 SF
P=      27.62 FT
V=       9.06 FPS
F=       1.15   SUPER-CRITICAL FLOW
```

<Shift> <Prt Sc> print <Return> repeat <Space Bar> back to menu

Del Webb Culvert/Channel Headwater



99TH AVE. CHANNEL @
DEL WEBB BLVD. CULVERT.
- HEADWATER ANALYSIS -

CULVERTS

DIAMETER (IN)	? 48
LENGTH (FT)	? 130
FRICTION COEFF (FT^1/6)	? .013
ENT+EXIT COEFF	? .5
INLET CONTROL COEFF	? .5
INV ELEV OUT (FT)	? 1204.25
INV ELEV IN (FT)	? 1204.35
TAILWATER ELEV (FT)	? 1205.3
ELEV INCREMENT (FT)	? .1

RESULTS

HEADWATER (FT)		FLOWRATE (CFS)
1208.35	OC	29.86
1208.45	OC	42.23
1208.55	OC	51.72
1208.65	OC	59.72
1208.75	OC	66.76
1208.85	OC	73.14
1208.95	OC	79.00
1209.05	IC	82.85
1209.15	IC	84.37
1209.25	IC	85.87
1209.35	IC	87.33
1209.45	IC	88.78
1209.55	IC	90.20
1209.65	IC	91.60
1209.75	IC	92.97
1209.85	IC	94.33

2 YR.

Q = 166 cfs

Q/bbl. = 33 cfs

HW_2 = 1208.4'

<Shift> <Prt Sc> print <Return> repeat <Space Bar> back to menu

---

CULVERTS

DIAMETER (IN)	? 48
LENGTH (FT)	? 130
FRICTION COEFF (FT^1/6)	? .013
ENT+EXIT COEFF	? .5
INLET CONTROL COEFF	? .5
INV ELEV OUT (FT)	? 1204.25
INV ELEV IN (FT)	? 1204.35
TAILWATER ELEV (FT)	? 1206.6
ELEV INCREMENT (FT)	? .25

RESULTS

HEADWATER (FT)		FLOWRATE (CFS)
1208.35	OC	29.86
1208.60	OC	55.86
1208.85	OC	73.14
1209.10	IC	79.72
1209.35	IC	83.62
1209.60	IC	87.33
1209.85	IC	90.90
1210.10	IC	94.33
1210.35	IC	97.64
1210.60	IC	100.84
1210.85	IC	103.95
1211.10	IC	106.96
1211.35	IC	109.89
1211.60	IC	112.75
1211.85	IC	115.53
1212.10	IC	118.25

25 YR.

Q = 587 cfs

Q/bbl. = 117 cfs

HW_{25} = 1212.0

<Shift> <Prt Sc> print <Return> repeat <Space Bar> back to menu

---

CULVERTS

DIAMETER (IN)	? 48
LENGTH (FT)	? 130
FRICTION COEFF (FT^1/6)	? .013
ENT+EXIT COEFF	? .5

RESULTS

HEADWATER (FT)		FLOWRATE (CFS)
1208.35	OC	29.86
1208.75	OC	66.76
1209.15	IC	75.63

99TH AVE.

CULVERTS

		RESULTS		
DIAMETER (IN)	? 48	HEADWATER (FT)		FLOWRATE (CFS)
LENGTH (FT)	? 130	==========		
		1208.35	OC	29.86
FRICTION COEFF (FT^1/6)	? .013	1208.55	OC	51.72
ENT+EXIT COEFF	? .5	1208.75	OC	66.76
INLET CONTROL COEFF	? .5	1208.95	OC	79.00
		1209.15	IC	84.37
INV ELEV OUT (FT)	? 1204.25	1209.35	IC	87.33
INV ELEV IN (FT)	? 1204.35	1209.55	IC	90.20
TAILWATER ELEV (FT)	? 1205.9	1209.75	IC	92.97
ELEV INCREMENT (FT)	? .2	1209.95	IC	95.67
		1210.15	IC	98.29
		1210.35	IC	100.84
		1210.55	IC	103.34
		1210.75	IC	105.77
		1210.95	IC	108.14
		1211.15	IC	110.47
		1211.35	IC	112.75

<Shift> <Prt Sc> print <Return> repeat <Space Bar> back to menu

---

5 YR.

$Q = 316$ cfs

$Q/bbl. = 63$ cfs

$HW_5 = 1208.70'$

CULVERTS

		RESULTS		
DIAMETER (IN)	? 48	HEADWATER (FT)		FLOWRATE (CFS)
LENGTH (FT)	? 130	==========		
		1208.35	OC	29.86
FRICTION COEFF (FT^1/6)	? .013	1208.85	IC	70.41
ENT+EXIT COEFF	? .5	1209.35	IC	78.92
INLET CONTROL COEFF	? .5	1209.85	IC	86.60
		1210.35	IC	93.66
INV ELEV OUT (FT)	? 1204.25	1210.85	IC	100.21
INV ELEV IN (FT)	? 1204.35	1211.35	IC	106.37
TAILWATER ELEV (FT)	? 1206.9	1211.85	IC	112.18
ELEV INCREMENT (FT)	? .5	1212.35	IC	117.71
		1212.85	IC	122.99
		1213.35	IC	128.06
		1213.85	IC	132.93
		1214.35	IC	137.63
		1214.85	IC	142.17
		1215.35	IC	146.57
		1215.85	IC	150.85

<Shift> <Prt Sc> print <Return> repeat <Space Bar> back to menu

---

50 YR.

$Q = 714$ cfs

$Q/bbl. = 143$ cfs

$HW_{50} = 1214.9'$

CULVERTS

		RESULTS		
DIAMETER (IN)	? 48	HEADWATER (FT)		FLOWRATE (CFS)
LENGTH (FT)	? 130	==========		
		1208.35	OC	29.86
FRICTION COEFF (FT^1/6)	? .013	1208.55	OC	51.72
ENT+EXIT COEFF	? .5	1208.75	OC	66.76
INLET CONTROL COEFF	? .5	1208.95	OC	79.00
		1209.15	IC	84.37
INV ELEV OUT (FT)	? 1204.25	1209.35	IC	87.33
INV ELEV IN (FT)	? 1204.35	1209.55	IC	90.20
TAILWATER ELEV (FT)	? 1206.2	1209.75	IC	92.97
ELEV INCREMENT (FT)	? .2	1209.95	IC	95.67
		1210.15	IC	98.29
		1210.35	IC	100.84
		1210.55	IC	103.34
		1210.75	IC	105.77
		1210.95	IC	108.14
		1211.15	IC	110.47
		1211.35	IC	112.75

Q = 450 cfs/5 bbl.
HW = 1209.55'

<Shift> <Prt Sc> print <Return> repeat <Space Bar> back to menu

---

CULVERTS

		RESULTS		
DIAMETER (IN)	? 48	HEADWATER (FT)		FLOWRATE (CFS)
LENGTH (FT)	? 130	==========		
		1208.35	OC	29.86
FRICTION COEFF (FT^1/6)	? .013	1208.55	OC	51.72
ENT+EXIT COEFF	? .5	1208.75	OC	66.76
INLET CONTROL COEFF	? .5	1208.95	IC	78.92
		1209.15	IC	82.08
INV ELEV OUT (FT)	? 1204.25	1209.35	IC	85.12
INV ELEV IN (FT)	? 1204.35	1209.55	IC	88.06
TAILWATER ELEV (FT)	? 1206.5	1209.75	IC	90.90
ELEV INCREMENT (FT)	? .2	1209.95	IC	93.66
		1210.15	IC	96.33
		1210.35	IC	98.94
		1210.55	IC	101.47
		1210.75	IC	103.95
		1210.95	IC	106.37
		1211.15	IC	108.73
		1211.35	IC	111.04

Q = 565 cfs/5 bbl.
HW = 1211.40'

<Shift> <Prt Sc> print <Return> repeat <Space Bar> back to menu

---

CULVERTS

		RESULTS		
DIAMETER (IN)	? 48	HEADWATER (FT)		FLOWRATE (CFS)
LENGTH (FT)	? 130	==========		
		1208.35	OC	29.86
FRICTION COEFF (FT^1/6)	? .013	1208.55	OC	51.72
ENT+EXIT COEFF	? .5	1208.75	OC	66.76

CULVERTS

DIAMETER (IN)	? 48
LENGTH (FT)	? 130
FRICTION COEFF (FT^1/6)	? .013
ENT+EXIT COEFF	? .5
INLET CONTROL COEFF	? .5
INV ELEV OUT (FT)	? 1204.25
INV ELEV IN (FT)	? 1204.35
TAILWATER ELEV (FT)	? 1205.6
ELEV INCREMENT (FT)	? .1

RESULTS

HEADWATER (FT)		FLOWRATE (CFS)
1208.35	OC	29.86
1208.45	OC	42.23
1208.55	OC	51.72
1208.65	OC	59.72
1208.75	OC	66.76
1208.85	OC	73.14
1208.95	OC	79.00
1209.05	IC	82.85
1209.15	IC	84.37
1209.25	IC	85.87
1209.35	IC	87.33
1209.45	IC	88.78
1209.55	IC	90.20
1209.65	IC	91.60
1209.75	IC	92.97
1209.85	IC	94.33

Q = 235 cfs / 5 bbl.
HW = 1208.50'

<Shift> <Prt Sc> print <Return> repeat <Space Bar> back to menu

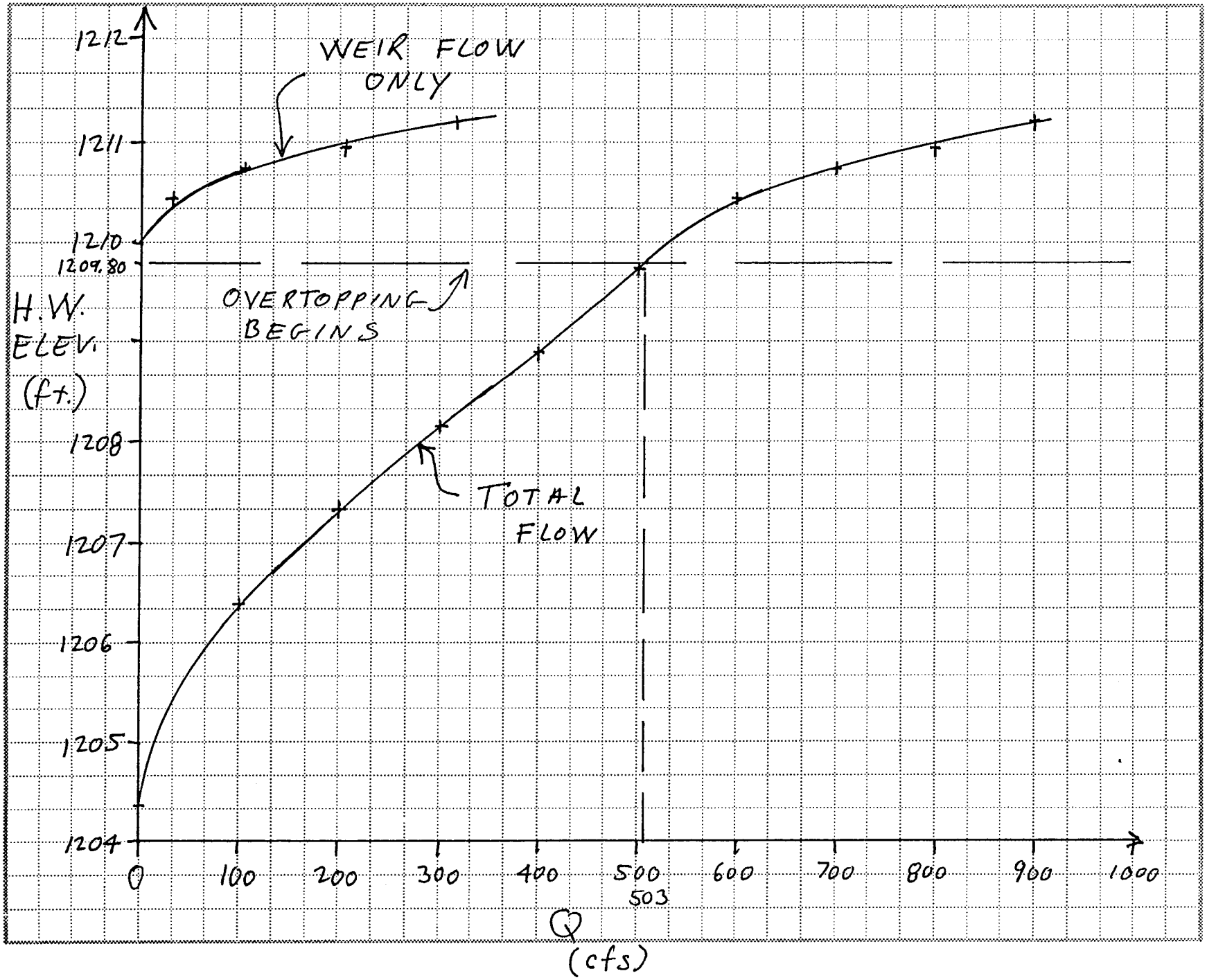


FIGURE 1

CLIENT	McDOT
PROJECT	99th Ave.
DESIGN FOR	
JOB NO.	94154
SHEET	OF
DESIGNER	TMB
DATE	Ap 95
CHECKER	
DATE	

Hendrich, Eberhart & Associates, Inc.
CONSULTING ENGINEERS

99th AVE.
OVERTOPPING
ANALYSIS OF
DEL WEBB BLVD.
CULVERT.

SECTION A-A

NATURAL CHANNELS

VARIABLES LIST:
Y - FLOW ELEVATION Q - FLOWRATE S - CHANNEL SLOPE

VARIABLE TO BE SOLVED (Y,Q OR S) ? Q Enter up to 20 cross-section points.
Enter <Return> only for distance to end.

Y (FT) ? 10.1
S (FT/FT) ? .00373

CROSS-SECTION POINTS

DIST	ELEV	COEFF	DIST	ELEV	COEFF
0	11.1	.016			
.1	10.55	.016			
22	10.4	.016			
36	9.95	.016			
36.1	10.32	.016			
79	10.4	.016			
79.1	9.8	.016			
101	10.28	.016			
126	10.47	.016			
126.1	10.88	.016			

RESULTS
==========
Q= 3.65 CFS
A= 2.41 SF
P= 18.82 FT
V= 1.51 FPS
F= 0.74 SUB-CRITICAL FLOW

<Shift> <Prt Sc> print <Return> repeat <Space Bar> back to menu

---

NATURAL CHANNELS

VARIABLES LIST:
Y - FLOW ELEVATION Q - FLOWRATE S - CHANNEL SLOPE

VARIABLE TO BE SOLVED (Y,Q OR S) ? Q Enter up to 20 cross-section points.
Enter <Return> only for distance to end.

Y (FT) ? 10.3
S (FT/FT) ? .00373

CROSS-SECTION POINTS

DIST	ELEV	COEFF	DIST	ELEV	COEFF
0	11.1	.016			
.1	10.55	.016			
22	10.4	.016			
36	9.95	.016			
36.1	10.32	.016			
79	10.4	.016			
79.1	9.8	.016			
101	10.28	.016			
126	10.47	.016			
126.1	10.88	.016			

RESULTS
==========
Q= 16.57 CFS
A= 7.66 SF
P= 36.30 FT
V= 2.16 FPS
F= 0.82 SUB-CRITICAL FLOW

<Shift> <Prt Sc> print <Return> repeat <Space Bar> back to menu

---

NATURAL CHANNELS

VARIABLES LIST:
Y - FLOW ELEVATION Q - FLOWRATE S - CHANNEL SLOPE

VARIABLE TO BE SOLVED (Y,Q OR S) ? Q Enter up to 20 cross-section points.
Enter <Return> only for distance to end.

```
Y (FT)     ? 10.6
S (FT/FT)  ? .00373                          CROSS-SECTION POINTS
                                     DIST  ELEV  COEFF   DIST  ELEV  COEFF
                                     -----------------   -----------------
                                     0     11.1  .016
                                     .1    10.55 .016
    RESULTS                          22    10.4  .016
=================                    36    9.95  .016
Q=     104.68 CFS                    36.1  10.32 .016
A=      36.97 SF                     79    10.4  .016
P=     126.89 FT                     79.1  9.8   .016
V=       2.83 FPS                    101   10.28 .016
F=       0.92   SUB-CRITICAL FLOW    126   10.47 .016
                                     126.1 10.88 .016

<Shift> <Prt Sc> print         <Return> repeat         <Space Bar> back to menu
-------------------------------------------------------------------------------


                              NATURAL CHANNELS

VARIABLES LIST:
        Y - FLOW ELEVATION     Q - FLOWRATE      S - CHANNEL SLOPE

VARIABLE TO BE SOLVED (Y,Q OR S) ? Q       Enter up to 20 cross-section points.
                                          Enter <Return> only for distance to end.
Y (FT)     ? 10.9
S (FT/FT)  ? .00373                          CROSS-SECTION POINTS
                                     DIST  ELEV  COEFF   DIST  ELEV  COEFF
                                     -----------------   -----------------
                                     0     11.1  .016
                                     .1    10.55 .016
    RESULTS                          22    10.4  .016
================                     36    9.95  .016
Q=     308.76 CFS                    36.1  10.32 .016
A=      74.77 SF                     79    10.4  .016
P=     127.48 FT                     79.1  9.8   .016
V=       4.13 FPS                    101   10.28 .016
F=       0.94   SUB-CRITICAL FLOW    126   10.47 .016
                                     126.1 10.88 .016

<Shift> <Prt Sc> print         <Return> repeat         <Space Bar> back to menu
-------------------------------------------------------------------------------


                              NATURAL CHANNELS

VARIABLES LIST:
        Y - FLOW ELEVATION     Q - FLOWRATE      S - CHANNEL SLOPE

VARIABLE TO BE SOLVED (Y,Q OR S) ? Q       Enter up to 20 cross-section points.
                                          Enter <Return> only for distance to end.
Y (FT)     ? 11.1
S (FT/FT)  ? .00373                          CROSS-SECTION POINTS
                                     DIST  ELEV  COEFF   DIST  ELEV  COEFF
                                     -----------------   -----------------
                                     0     11.1  .016
                                     .1    10.55 .016
    RESULTS                          22    10.4  .016
================                     36    9.95  .016
```

```
Q=     494.08 CFS                    36.1  10.32 .016
A=      99.99 SF                     79    10.4  .016
P=     127.69 FT                     79.1  9.8   .016
V=       4.94 FPS                    101   10.28 .016
F=       0.98   SUB-CRITICAL FLOW    126   10.47 .016
                                     126.1 10.88 .016

<Shift> <Prt Sc> print        <Return> repeat        <Space Bar> back to menu
--------------------------------------------------------------------------------
```

99th Ave.
Overtopping
Analysis of
Del Webb Blvd.
Culvert.

SECTION C-C

NATURAL CHANNELS

VARIABLES LIST:
Y - FLOW ELEVATION Q - FLOWRATE S - CHANNEL SLOPE

VARIABLE TO BE SOLVED (Y,Q OR S) ? Q Enter up to 20 cross-section points.
Enter <Return> only for distance to end.

Y (FT) ? 10.1
S (FT/FT) ? .00486

CROSS-SECTION POINTS

DIST	ELEV	COEFF	DIST	ELEV	COEFF
0	10.45	.016			
22	10.3	.016			
43	10.03	.016			
63	10.01	.016			
82	9.95	.016			
100	10.15	.016			
120	10.32	.016			
120.1	10.82	.016			

RESULTS
==========
Q= 6.81 CFS
A= 5.08 SF
P= 57.95 FT
V= 1.34 FPS
F= 0.80 SUB-CRITICAL FLOW

<Shift> <Prt Sc> print <Return> repeat <Space Bar> back to menu

DO NOT USE

USE HYB RESULTS

NATURAL CHANNELS

VARIABLES LIST:
Y - FLOW ELEVATION Q - FLOWRATE S - CHANNEL SLOPE

VARIABLE TO BE SOLVED (Y,Q OR S) ? Q Enter up to 20 cross-section points.
Enter <Return> only for distance to end.

Y (FT) ? 10.4
S (FT/FT) ? .00486

CROSS-SECTION POINTS

DIST	ELEV	COEFF	DIST	ELEV	COEFF
.1	10.45	.016			
22	10.3	.016			
43	10.03	.016			
63	10.01	.016			
82	9.95	.016			
100	10.15	.016			
120	10.32	.016			
120.1	10.82	.016			

RESULTS
==========
Q= 94.29 CFS
A= 30.85 SF
P= 112.69 FT
V= 3.06 FPS
F= 1.03 SUPER-CRITICAL FLOW

<Shift> <Prt Sc> print <Return> repeat <Space Bar> back to menu

NATURAL CHANNELS

VARIABLES LIST:
Y - FLOW ELEVATION Q - FLOWRATE S - CHANNEL SLOPE

VARIABLE TO BE SOLVED (Y,Q OR S) ? Q Enter up to 20 cross-section points.
Enter <Return> only for distance to end.

```
Y (FT)     ? 10.6
S (FT/FT)  ? .00486
```

CROSS-SECTION POINTS

DIST	ELEV	COEFF	DIST	ELEV	COEFF
0	10.95	.016			
.1	10.45	.016			
22	10.3	.016			
43	10.03	.016			
63	10.01	.016			
82	9.95	.016			
100	10.15	.016			
120	10.32	.016			
120.1	10.82	.016			

```
    RESULTS
================
Q=     220.62 CFS
A=      54.65 SF
P=     120.34 FT
V=       4.04 FPS
F=       1.05   SUPER-CRITICAL FLOW

<Shift> <Prt Sc> print        <Return> repeat        <Space Bar> back to menu
-------------------------------------------------------------------------------
```

NATURAL CHANNELS

```
VARIABLES LIST:
        Y - FLOW ELEVATION     Q - FLOWRATE      S - CHANNEL SLOPE

VARIABLE TO BE SOLVED (Y,Q OR S) ? Q        Enter up to 20 cross-section points.
                                            Enter <Return> only for distance to end.
Y (FT)     ? 10.9
S (FT/FT)  ? .00486
```

CROSS-SECTION POINTS

DIST	ELEV	COEFF	DIST	ELEV	COEFF
0	10.95	.016			
.1	10.45	.016			
22	10.3	.016			
43	10.03	.016			
63	10.01	.016			
82	9.95	.016			
100	10.15	.016			
120	10.32	.016			
120.1	10.82	.016			

```
    RESULTS
================
Q=     496.08 CFS
A=      90.67 SF
P=     120.87 FT
V=       5.47 FPS
F=       1.11   SUPER-CRITICAL FLOW

<Shift> <Prt Sc> print        <Return> repeat        <Space Bar> back to menu
-------------------------------------------------------------------------------
```

DEL WEBB
CULVERT
OVERTOPPING
ANALYSIS

CURRENT DATE: 08-08-1995 FILE DATE: 08-08-1995
CURRENT TIME: 13:43:31 FILE NAME: DWEBB

FHWA CULVERT ANALYSIS
HY-8, VERSION 4.0

C U L V	SITE DATA INLET ELEV. (FT)	OUTLET ELEV. (FT)	CULVERT LENGTH (FT)	CULVERT SHAPE, MATERIAL, INLET BARRELS SHAPE MATERIAL	SPAN (FT)	RISE (FT)	MANNING n	INLET TYPE
1	1204.35	1204.25	130.00	5 RCP	4.00	4.00	.012	CONVENTIONAL
2								
3								
4								
5								
6								

SUMMARY OF CULVERT FLOWS (CFS) FILE: DWEBB DATE: 08-08-1995

ELEV (FT)	TOTAL	1	2	3	4	5	6	ROADWAY	ITR
1204.35	0	0	0	0	0	0	0	0	1
1206.38	100	100	0	0	0	0	0	0	1
1207.33	200	200	0	0	0	0	0	0	1
1208.14	300	300	0	0	0	0	0	0	1
1208.89	400	400	0	0	0	0	0	0	1
1209.77	500	500	0	0	0	0	0	0	1
1209.80	503	503	0	0	0	0	0	0	1
1210.72	700	594	0	0	0	0	0	105	3
1210.91	800	612	0	0	0	0	0	184	3
1211.09	900	628	0	0	0	0	0	269	3
1211.25	1000	642	0	0	0	0	0	355	3
1209.80	503	503	0	0	0	0	0	OVERTOPPING	

SUMMARY OF ITERATIVE SOLUTION ERRORS FILE: DWEBB DATE: 08-08-1995

HEAD ELEV(FT)	HEAD ERROR(FT)	TOTAL FLOW(CFS)	FLOW ERROR(CFS)	% FLOW ERROR
1204.35	0.00	0	0	0.00
1206.38	0.00	100	0	0.00
1207.33	0.00	200	0	0.00
1208.14	0.00	300	0	0.00
1208.89	0.00	400	0	0.00
1209.77	0.00	500	0	0.00
1209.80	0.00	503	0	0.00
1210.72	-0.00	700	1	0.20
1210.91	-0.01	800	4	0.54
1211.09	-0.00	900	3	0.38
1211.25	-0.00	1000	3	0.26

<1> TOLERANCE (FT) = 0.010 <2> TOLERANCE (%) = 1.000

CURRENT DATE: 08-08-1995 FILE DATE: 08-08-1995
CURRENT TIME: 13:43:31 FILE NAME: DWEBB

PERFORMANCE CURVE FOR CULVERT # 1 - 5 (4 BY 4) RCP

DIS-CHARGE FLOW (cfs)	HEAD-WATER ELEV. (ft)	INLET CONTROL DEPTH (ft)	OUTLET CONTROL DEPTH (ft)	FLOW TYPE <F4>	NORMAL DEPTH (ft)	CRITICAL DEPTH (ft)	OUTLET VEL. (fps)	OUTLET DEPTH (ft)	TAILWATER VEL. (fps)	TAILWATER DEPTH (ft)
0	1204.35	0.00	0.00	0-NF	0.00	0.00	0.00	0.00	0.00	-0.20
100	1206.38	1.78	2.03	2-M2c	1.91	1.31	5.60	1.31	5.77	1.02
200	1207.33	2.76	2.98	2-M2c	3.05	1.88	6.89	1.88	7.31	1.64
300	1208.14	3.54	3.79	6-FFn	4.00	2.33	4.77	4.00	8.34	2.14
400	1208.89	4.31	4.54	6-FFn	4.00	2.70	6.37	4.00	9.14	2.57
500	1209.77	5.20	5.42	6-FFn	4.00	3.02	7.96	4.00	9.79	2.96
503	1209.80	5.23	5.45	6-FFn	4.00	3.03	8.01	4.00	9.81	2.97
594	1210.71	6.20	6.36	6-FFn	4.00	3.27	9.45	4.00	10.83	3.05
612	1210.91	6.42	6.56	6-FFn	4.00	3.31	9.74	4.00	11.26	3.15
628	1211.09	6.62	6.74	6-FFn	4.00	3.34	9.99	4.00	11.65	3.25
642	1211.25	6.80	6.90	6-FFn	4.00	3.37	10.22	4.00	12.01	3.35

El. inlet face invert 1204.35 ft El. outlet invert 1204.25 ft
El. inlet throat invert 0.00 ft El. inlet crest 0.00 ft

***** SITE DATA ***** CULVERT INVERT **********

INLET STATION (FT)	0.00
INLET ELEVATION (FT)	1204.35
OUTLET STATION (FT)	130.00
OUTLET ELEVATION (FT)	1204.25
NUMBER OF BARRELS	5
SLOPE (V-FT/H-FT)	0.0008
CULVERT LENGTH ALONG SLOPE (FT)	130.00

***** CULVERT DATA SUMMARY **********

BARREL SHAPE	CIRCULAR
BARREL DIAMETER	4.00 FT
BARREL MATERIAL	CONCRETE
BARREL MANNING'S N	0.012
INLET TYPE	CONVENTIONAL
INLET EDGE AND WALL	SQUARE EDGE WITH HEADWALL
INLET DEPRESSION	NONE

CURRENT DATE: 08-08-1995 FILE DATE: 08-08-1995
CURRENT TIME: 13:43:31 FILE NAME: DWEBB

áá
áááááááááááááááááááááááááá TAILWATER áááááááááááááááááááááááááá
áá
áá

TAILWATER RATING CURVE

FLOW(CFS)	W.S.E.(FT)	DEPTH (FT)
0	1204.05	-0.20
100	1205.27	1.02
200	1205.89	1.64
300	1206.39	2.14
400	1206.82	2.57
500	1207.21	2.96
503	1207.22	2.97
700	1207.30	3.05
800	1207.40	3.15
900	1207.50	3.25
1000	1207.60	3.35

áá
áááááááááááááááááááááááááá ROADWAY OVERTOPPING DATA áááááááááááááááááááááááááá
áá

ROADWAY SURFACE PAVED
EMBANKMENT TOP WIDTH (FT) 50.00
***** USER DEFINED ROADWAY PROFILE

CROSS-SECTION COORD. NO.	X (FT)	Y (FT)
1	0.00	1211.10
2	0.10	1210.55
3	22.00	1210.40
4	36.00	1209.95
5	36.10	1210.32
6	79.00	1210.40
7	79.10	1209.80
8	101.00	1210.28
9	126.00	1210.47
10	126.10	1210.88

áá

PRELIMINARY DRAINAGE REPORT

FOR

INTERSECTION IMPROVEMENTS

99TH AVENUE, BELL ROAD TO THUNDERBIRD ROAD

MCDOT W.O. #68807

AUGUST 1995

Prepared By:

Hendrich, Eberhart & Associates, Inc.
7227 North 16th Street
Phoenix, Arizona 85020

94154

CLIENT MCDOT	JOB NO. 94154	
PROJECT 99th AVE	SHEET	OF
DESIGN FOR	DESIGNER TAB	DATE 5-22-95
Hendrich, Eberhart & Associates, Inc. CONSULTING ENGINEERS	CHECKER	DATE

TAIL WATER RATING FOR DEL WEBB CHANNEL DOWNSTREAM OF 99th AVE. — DEL WEBB BLVD. 5-BARREL 48" RCP CULVERT.

CHANNEL SECTION B-B 50' D.S. OF HDWL.

10.1/0 9.70/22 10.16/23 10.10/24 4.25/28

4.05/40 4.50/51 10.01/55 10.23/59 10.06/73

OVERTOPPING ANALYSIS FOR 99th AVE. CHANNEL @ DEL WEBB BLVD. - 5 BBL. 48" RCP CULVERT.

OVERTOPPING CROSS-SECTION TAKEN AT UPSTREAM HEADWALL

5-31-95 SECTION A-A

SLOPE = 0.373 %

A-A

11.1/0 10.55/0.1 10.40/22 9.95/36 10.32/36.1

10.40/79 9.80/79.1 10.28/101 10.47/126 10.88/126.1

SECOND OVERTOPPING CROSS-SECTION TAKEN 32' SOUTH OF SECTION A-A.

-1-95 SECTION C-C

SLOPE = 0.486 %

C-C

10.95/0

10.45/0.1 10.30/22 10.03/43 10.01/63 9.95/82

10.15/100 10.32/120 10.82/120.1

CLIENT MCCDT	JOB NO. 94154	
PROJECT 99th	SHEET OF	
DESIGN FOR	DESIGNER TAB	DATE 5-22-95
Hendrich, Eberhart & Associates, Inc. CONSULTING ENGINEERS	CHECKER	DATE

TABLE OF RUNOFF RATES FOR VARIOUS FREQUENCY FLOWS AT 99th AVE. AND DEL WEBB BLVD. UPSTREAM OF THE FIVE BARREL CULVERT.

	2 YR-6HR	5 YR-6HR	25 YR-6HR	50 YR-6HR
Q (cfs)	166	316	587	714

TABLE 9

RATIO OF PEAK FLOWS TO WATERSHED AREA
for
PROJECT INTERSECTIONS ALONG 99th AVENUE

INTERSECTION	CONC. POINT	SUB-BASIN AREA		PEAK FLOWS per ACRE							
				2 YEAR		5 YEAR		25 YEAR		50 YEAR	
		(sq. mi.)	(ac.)	(cfs)	(cfs/ac)	(cfs)	(cfs/ac)	(cfs)	(cfs/ac)	(cfs)	(cfs/ac)
HUTTON DRIVE	3	0.25	160	90	0.6	143	0.9	231	1.4	273	1.7
BURNS DRIVE	4	0.69	442	135	0.3	274	0.6	529	1.2	648	1.5
GREENWAY ROAD	5	0.40	256	71	0.3	133	0.5	251	1.0	309	1.2
BOSWELL BLVD.	6	0.32	205	95	0.5	171	0.8	303	1.5	364	1.8
CAMEO DRIVE	7	0.20	128	45	0.4	88	0.7	165	1.3	200	1.6
T-BIRD ROAD	8	0.11	70	14	0.2	28	0.4	56	0.8	69	1.0
BEARDSLEY RD.	9	0.39	250	N/A	N/A	13	0.05	110	0.44	182	0.73
FCD STUDY	N/A	2.50	1600	N/A	N/A	40	0.03	352	0.22	582	0.36

99TH-Q.XLS

8/23/95

HEC-1 PROGRAM OUTPUT
50-YEAR STORM

```
****************************************
*                                      *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *
*          SEPTEMBER 1990              *
*           VERSION 4.0                *
*                                      *
*  RUN DATE  08/10/1995  TIME  08:49:06 *
*                                      *
****************************************
```

```
****************************************
*                                      *
*   U.S. ARMY CORPS OF ENGINEERS       *
*   HYDROLOGIC ENGINEERING CENTER      *
*         609 SECOND STREET            *
*      DAVIS, CALIFORNIA 95616         *
*          (916) 756-1104              *
*                                      *
****************************************
```

```
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
  2           ID        99TH AVENUE DRAINAGE STUDY          MCDOT CONTRACT CY 1995-1
  3           ID        PROJECT LIMITS: BELL ROAD TO THUNDERBIRD ROAD
  4           ID        25 YEAR 6- HOUR STORM COMPUTED BY CLARK UNIT HYDROGRAPH METHOD
  5           ID        RAINFALL LOSSES COMPUTED GY GREEN & AMPT METHOD
  6           ID        ***************************************************************
  7           ID        **PRESENT**  PRESENT CONDITION = FULLY DEVELOPED CONDITION
  8           ID        ***************************************************************
  9           ID        STUDY BY HENDRICH, EBERHART & ASSOC.            TAB 3-29-1995
 10           ID        FILENAME = 99-50Yb.HC1
 11           ID        BASIN 1 DIVERSION "D1" REVISED 6-2-95 TO MODEL ACTUAL FLOW SPLIT
 12           ID        CONDITIONS AT DEL WEBB BLVD AND 99TH AS SURVEYED IN THE FIELD.
 13           ID        *REVISED 8-8-95,ADJUST DEL WEBB DIVERSION PER HY8 MODEL RESULTS.
 14           ID        *REVISED 7-3-95 TO EXCLUDE ALL OR PART OF THREE EXISTING GOLF
 15           ID        COURSES WHICH LIE WITHIN THE PROJECT WATERSHED LIMITS.
 16           ID
              *DIAGRAM
 17           IT      3                    300
 18           IO      4

 19           KK      1
 20           KM   SUB-BASIN 1
 21           KM   6-HOUR RAINFALL, PATTERN NO. 2.26 WAS USED TO FIND TC & R FOR THIS BASIN
 22           KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF .964
 23           BA    .713
 24           IN      15
 25           KM   RAINFALL DEPTH OF 2.78 WAS SPACIALLY REDUCED AS SHOWN BY THE PB RECORD
 26           PB   2.680
 27           KM   THE FOLLOWING PC RECORD USED A 6-HOUR STORM WITH A PATTERN No. OF 2.26
 28           PC    .000    .011    .017    .026    .038    .047    .058    .067    .077    .087
 29           PC    .100    .114    .134    .178    .266    .456    .688    .826    .892    .931
 30           PC    .949    .962    .974    .988   1.000
 31           LG    .107    .150   7.700    .110  56.000
 32           UC    .725    .540
 33           UA       0       5      16      30      65      77      84      90      94      97
 34           UA     100

 35           KK      D1
 36           KM   DIVERT FLOW FROM SUBBASIN 1
 37           DT      D1
 38           DI       0     300     400     503     700     800     900
 39           DQ       0     300     400     503     594     612     630

 40           KK      R2
 41           KM   ROUTE SUBBASIN 1 THROUGH REACH R2
 42           RD    3200    .004    .016            TRAP       2       4

 43           KK       2
 44           KM   SUB-BASIN 2
 45           KM   6-HOUR RAINFALL, PATTERN NO. 2.26 WAS USED TO FIND TC & R FOR THIS BASIN
 46           KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF .964
 47           BA   1.138
 48           LG    .105    .190   6.600    .140  54.400
 49           UC    .671    .396
 50           UA       0       5      16      30      65      77      84      90      94      97
```

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

  51          UA     100

  52          KK      S1
  53          KM   COMBINE HYDROGRAPHS (1,2) @ BELL ROAD
  54          HC       2

  55          KK      R3
  56          KM   ROUTE COMBINED HYDROGRAPHS (1,2) THROUGH REACH R3
  57          RD    1500    .005    .016            TRAP       2       4

  58          KK       3
  59          KM   SUB-BASIN 3
  60          KM   6-HOUR RAINFALL, PATTERN NO. 2.26 WAS USED TO FIND TC & R FOR THIS BASIN
  61          KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF .964
  62          BA    .248
  63          LG    .067    .170   6.800    .110  85.000
  64          UC    .533    .378
  65          UA       0       5      16      30      65      77      84      90      94      97
  66          UA     100

  67          KK      S2
  68          KM    COMBINE HYDROGRAPHS (1+2,3) @ HUTTON DRIVE
  69          HC       2

  70          KK      R4
  71          KM   ROUTE COMBINED HYDROGRAPHS (1+2,3) THROUGH REACH R4
  72          RD    2300    .004    .016            TRAP       2       4

  73          KK       4
  74          KM   SUB-BASIN 4
  75          KM   6-HOUR RAINFALL, PATTERN NO. 2.26 WAS USED TO FIND TC & R FOR THIS BASIN
  76          KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF .964
  77          BA    .689
  78          LG    .122    .210   6.400    .170  49.600
  79          UC    .696    .384
  80          UA       0       5      16      30      65      77      84      90      94      97
  81          UA     100

  82          KK      S3
  83          KM   COMBINE HYDROGRAPHS (1+2+3,4) @ BURNS DRIVE
  84          HC       2

  85          KK      R5
  86          KM   ROUTE COMBINED HYDROGRAPHS (1+2+3+4) THROUGH REACH R5
  87          RD    2100    .004    .016            TRAP       2       4

  88          KK       5
  89          KM   SUB-BASIN 5
  90          KM   6-HOUR RAINFALL, PATTERN NO. 2.26 WAS USED TO FIND TC & R FOR THIS BASIN
  91          KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF .964
  92          BA    .397
  93          LG    .097    .250   5.700    .180  61.900
  94          UC    .738    .673
  95          UA       0       5      16      30      65      77      84      90      94      97
  96          UA     100
```

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

 97           KK      S4
 98           KM   COMBINE HYDROGRAPHS (1+2+3+4,5) @ GREENWAY ROAD
 99           HC       2

100           KK      R6
101           KM   ROUTE COMBINED HYDROGRAPHS (1+2+3+4+5) THROUGH REACH R6
102           RD    1900    .004    .016            TRAP       2       4

103           KK       6
104           KM   SUB-BASIN 6
105           KM   6-HOUR RAINFALL, PATTERN NO. 2.26 WAS USED TO FIND TC & R FOR THIS BASIN
106           KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF .964
107           BA    .327
108           LG    .098    .250   5.700    .200  62.800
109           UC    .483    .274
110           UA       0       5      16      30      65      77      84      90      94      97
111           UA     100

112           KK      S5
113           KM   COMBINE HYDROGRAPHS (1+2+3+4+5,6) @ BOSWELL BLVD
114           HC       2

115           KK      R7
116           KM   ROUTE COMBINED HYDROGRAPHS (1+2+3+4+5+6) THROUGH REACH R7
117           RD    1500    .005    .016            TRAP       2       4

118           KK       7
119           KM   SUB-BASIN 7
120           KM   6-HOUR RAINFALL, PATTERN NO. 2.26 WAS USED TO FIND TC & R FOR THIS BASIN
121           KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF .964
122           BA    .200
123           LG    .110    .230   6.200    .180  51.000
124           UC    .471    .352
125           UA       0       5      16      30      65      77      84      90      94      97
126           UA     100

127           KK      S6
128           KM   COMBINE HYDROGRAPHS (1+2+3+4+5+6,7) @ CAMEO DRIVE
129           HC       2

130           KK      R8
131           KM   ROUTE COMBINED HYDROGRAPHS (1+2+3+4+5+6+7) THROUGH REACH R8
132           RD    1200    .005    .016            TRAP       2       4

133           KK       8
134           KM   SUB-BASIN 8
135           KM   6-HOUR RAINFALL, PATTERN NO. 2.26 WAS USED TO FIND TC & R FOR THIS BASIN
136           KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF .964
137           BA    .104
138           LG    .110    .250   5.600    .210  55.000
139           UC    .579    .888
140           UA       0       5      16      30      65      77      84      90      94      97
141           UA     100
```

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

  142         KK      S7
  143         KM   COMBINE HYDROGRAPHS (1+2+3+4+5+6+7,8) THUNDERBIRD ROAD
  144         HC       2
  145         ZZ
```

```
                SCHEMATIC DIAGRAM OF STREAM NETWORK
INPUT
 LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

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

  19          1
              .
              .
  37          .------->      D1
  35         D1
              V
              V
  40         R2
              .
              .
  43          .           2
              .           .
              .           .
  52         S1............
              V
              V
  55         R3
              .
              .
  58          .           3
              .           .
              .           .
  67         S2............
              V
              V
  70         R4
              .
              .
  73          .           4
              .           .
              .           .
  82         S3............
              V
              V
  85         R5
              .
              .
  88          .           5
              .           .
              .           .
  97         S4............
              V
              V
 100         R6
              .
              .
 103          .           6
              .           .
              .           .
 112         S5............
              V
              V
 115         R7
```

```
            .
            .
118         .          7
            .          .
            .          .
127        S6...........
            V
            V
130        R8
            .
            .
133         .          8
            .          .
            .          .
142        S7...........
```

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*            SEPTEMBER 1990             *
*             VERSION 4.0               *
*                                       *
*  RUN DATE  08/10/1995  TIME  08:49:06 *
*                                       *
*****************************************
```

```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616         *
*           (916) 756-1104              *
*                                       *
*****************************************
```

```
99TH AVENUE DRAINAGE STUDY          MCDOT CONTRACT CY 1995-1
PROJECT LIMITS: BELL ROAD TO THUNDERBIRD ROAD
25 YEAR 6- HOUR STORM COMPUTED BY CLARK UNIT HYDROGRAPH METHOD
RAINFALL LOSSES COMPUTED GY GREEN & AMPT METHOD
*****************************************************************
**PRESENT**  PRESENT CONDITION = FULLY DEVELOPED CONDITION
*****************************************************************
STUDY BY HENDRICH, EBERHART & ASSOC.            TAB 3-29-1995
FILENAME = 99-50Yb.HC1
BASIN 1 DIVERSION "D1" REVISED 6-2-95 TO MODEL ACTUAL FLOW SPLIT
CONDITIONS AT DEL WEBB BLVD AND 99TH AS SURVEYED IN THE FIELD.
*REVISED 8-8-95,ADJUST DEL WEBB DIVERSION PER HY8 MODEL RESULTS.
*REVISED 7-3-95 TO EXCLUDE ALL OR PART OF THREE EXISTING GOLF
COURSES WHICH LIE WITHIN THE PROJECT WATERSHED LIMITS.


18 IO        OUTPUT CONTROL VARIABLES
                   IPRNT          4  PRINT CONTROL
                   IPLOT          0  PLOT CONTROL
                   QSCAL         0.  HYDROGRAPH PLOT SCALE

   IT        HYDROGRAPH TIME DATA
                    NMIN          3  MINUTES IN COMPUTATION INTERVAL
                   IDATE      1   0  STARTING DATE
                   ITIME       0000  STARTING TIME
                      NQ        300  NUMBER OF HYDROGRAPH ORDINATES
                  NDDATE      1   0  ENDING DATE
                  NDTIME       1457  ENDING TIME
                   ICENT         19  CENTURY MARK

              COMPUTATION INTERVAL     .05 HOURS
                   TOTAL TIME BASE   14.95 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


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
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              **************
              *            *
19 KK         *          1 *
              *            *
              **************
                             SUB-BASIN 1
                             6-HOUR RAINFALL, PATTERN NO. 2.26 WAS USED TO FIND TC & R FOR THIS BASIN
                             THIS BASIN USED RAINFALL REDUCTION FACTOR OF .964
                             RAINFALL DEPTH OF 2.78 WAS SPACIALLY REDUCED AS SHOWN BY THE PB RECORD
                             THE FOLLOWING PC RECORD USED A 6-HOUR STORM WITH A PATTERN No. OF 2.26

24 IN            TIME DATA FOR INPUT TIME SERIES
                       JXMIN          15  TIME INTERVAL IN MINUTES
                      JXDATE      1    0  STARTING DATE
                      JXTIME           0  STARTING TIME

               SUBBASIN RUNOFF DATA

23 BA            SUBBASIN CHARACTERISTICS
                       TAREA         .71  SUBBASIN AREA

                 PRECIPITATION DATA

27 PB                  STORM        2.68  BASIN TOTAL PRECIPITATION

27 PI              INCREMENTAL PRECIPITATION PATTERN
                     .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                     .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                     .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                     .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                     .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                     .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                     .01      .01      .01      .01      .01      .02      .02      .02      .02      .02
                     .04      .04      .04      .04      .04      .05      .05      .05      .05      .05
                     .03      .03      .03      .03      .03      .01      .01      .01      .01      .01
                     .01      .01      .01      .01      .01      .00      .00      .00      .00      .00
                     .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                     .00      .00      .00      .00      .00      .00      .00      .00      .00      .00

31 LG            GREEN AND AMPT LOSS RATE
                      STRTL         .11  STARTING LOSS
                        DTH         .15  MOISTURE DEFICIT
                       PSIF        7.70  WETTING FRONT SUCTION
                      XKSAT         .11  HYDRAULIC CONDUCTIVITY
                      RTIMP       56.00  PERCENT IMPERVIOUS AREA

32 UC            CLARK UNITGRAPH
                         TC         .73  TIME OF CONCENTRATION
                          R         .54  STORAGE COEFFICIENT

33 UA            ACCUMULATED-AREA VS. TIME,  11 ORDINATES
                        .0       5.0      16.0      30.0      65.0      77.0      84.0      90.0      94.0      97.0
                     100.0

                                                   ***

                                          UNIT HYDROGRAPH PARAMETERS
                                     CLARK   TC=   .73 HR,       R=   .54 HR
```

SNYDER TP= .40 HR, CP= .43

UNIT HYDROGRAPH
64 END-OF-PERIOD ORDINATES

14.	50.	101.	163.	265.	405.	488.	502.	499.	491.
476.	456.	435.	413.	389.	359.	327.	298.	272.	248.
226.	206.	188.	171.	156.	142.	129.	118.	108.	98.
89.	81.	74.	68.	62.	56.	51.	47.	43.	39.
35.	32.	29.	27.	24.	22.	20.	18.	17.	15.
14.	13.	12.	11.	10.	9.	8.	7.	7.	6.
6.	5.	5.	4.						

*** ***

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              **************
              *            *
35 KK         *        D1  *
              *            *
              **************
```

DIVERT FLOW FROM SUBBASIN 1

DT	DIVERSION ISTAD	D1	DIVERSION HYDROGRAPH IDENTIFICATION					
DI	INFLOW	.00	300.00	400.00	503.00	700.00	800.00	900.00
DQ	DIVERTED FLOW	.00	300.00	400.00	503.00	594.00	612.00	630.00

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              **************
              *            *
40 KK         *        R2  *
              *            *
              **************
```

ROUTE SUBBASIN 1 THROUGH REACH R2

HYDROGRAPH ROUTING DATA

42 RD MUSKINGUM-CUNGE CHANNEL ROUTING

L	3200.	CHANNEL LENGTH
S	.0040	SLOPE
N	.016	CHANNEL ROUGHNESS COEFFICIENT
CA	.00	CONTRIBUTING AREA
SHAPE	TRAP	CHANNEL SHAPE
WD	2.00	BOTTOM WIDTH OR DIAMETER
Z	4.00	SIDE SLOPE

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*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

          **************
          *            *
43 KK     *         2  *
          *            *
          **************
                         SUB-BASIN 2
                         6-HOUR RAINFALL, PATTERN NO. 2.26 WAS USED TO FIND TC & R FOR THIS BASIN
                         THIS BASIN USED RAINFALL REDUCTION FACTOR OF .964

             SUBBASIN RUNOFF DATA

47 BA          SUBBASIN CHARACTERISTICS
                     TAREA        1.14  SUBBASIN AREA

               PRECIPITATION DATA

27 PB                STORM        2.68  BASIN TOTAL PRECIPITATION

27 PI            INCREMENTAL PRECIPITATION PATTERN
                     .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                     .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                     .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                     .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                     .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                     .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                     .01       .01       .01       .01       .01       .02       .02       .02       .02       .02
                     .04       .04       .04       .04       .04       .05       .05       .05       .05       .05
                     .03       .03       .03       .03       .03       .01       .01       .01       .01       .01
                     .01       .01       .01       .01       .01       .00       .00       .00       .00       .00
                     .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                     .00       .00       .00       .00       .00       .00       .00       .00       .00       .00

48 LG          GREEN AND AMPT LOSS RATE
                     STRTL         .10  STARTING LOSS
                       DTH         .19  MOISTURE DEFICIT
                      PSIF        6.60  WETTING FRONT SUCTION
                     XKSAT         .14  HYDRAULIC CONDUCTIVITY
                     RTIMP       54.40  PERCENT IMPERVIOUS AREA

49 UC          CLARK UNITGRAPH
                        TC         .67  TIME OF CONCENTRATION
                         R         .40  STORAGE COEFFICIENT

50 UA          ACCUMULATED-AREA VS. TIME,  11 ORDINATES
                       .0       5.0      16.0      30.0      65.0      77.0      84.0      90.0      94.0      97.0
                   100.0

                                                   ***

                                              UNIT HYDROGRAPH PARAMETERS
                                        CLARK   TC=   .67 HR,       R=   .40 HR
                                       SNYDER   TP=   .35 HR,      CP=   .48

                                                UNIT HYDROGRAPH
                                           48 END-OF-PERIOD ORDINATES
             32.      119.      241.      381.      651.      930.     1021.     1014.      979.      933.
            877.      817.      759.      696.      622.      548.      483.      426.      375.      331.
```

```
291.    257.    226.    199.    176.    155.    136.    120.    106.    93.
 82.     72.     64.     56.     50.     44.     39.     34.     30.    26.
 23.     20.     18.     16.     14.     12.     11.     10.

*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

          **************
          *            *
 52 KK    *        S1  *
          *            *
          **************
                         COMBINE HYDROGRAPHS (1,2) @ BELL ROAD

 54 HC          HYDROGRAPH COMBINATION
                      ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                          ***

*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

          **************
          *            *
 55 KK    *        R3  *
          *            *
          **************
                         ROUTE COMBINED HYDROGRAPHS (1,2) THROUGH REACH R3

             HYDROGRAPH ROUTING DATA

 57 RD          MUSKINGUM-CUNGE CHANNEL ROUTING
                          L       1500.  CHANNEL LENGTH
                          S       .0050  SLOPE
                          N        .016  CHANNEL ROUGHNESS COEFFICIENT
                         CA         .00  CONTRIBUTING AREA
                      SHAPE        TRAP  CHANNEL SHAPE
                         WD        2.00  BOTTOM WIDTH OR DIAMETER
                          Z        4.00  SIDE SLOPE

                                                          ***

*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

          **************
          *            *
 58 KK    *         3  *
          *            *
          **************
                         SUB-BASIN 3
                         6-HOUR RAINFALL, PATTERN NO. 2.26 WAS USED TO FIND TC & R FOR THIS BASIN
                         THIS BASIN USED RAINFALL REDUCTION FACTOR OF .964
```

SUBBASIN RUNOFF DATA

62 BA SUBBASIN CHARACTERISTICS

TAREA .25 SUBBASIN AREA

PRECIPITATION DATA

27 PB STORM 2.68 BASIN TOTAL PRECIPITATION

27 PI INCREMENTAL PRECIPITATION PATTERN

.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.01	.01	.01	.01	.01	.02	.02	.02	.02	.02
.04	.04	.04	.04	.04	.05	.05	.05	.05	.05
.03	.03	.03	.03	.03	.01	.01	.01	.01	.01
.01	.01	.01	.01	.01	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00

63 LG GREEN AND AMPT LOSS RATE

STRTL .07 STARTING LOSS
DTH .17 MOISTURE DEFICIT
PSIF 6.80 WETTING FRONT SUCTION
XKSAT .11 HYDRAULIC CONDUCTIVITY
RTIMP 85.00 PERCENT IMPERVIOUS AREA

64 UC CLARK UNITGRAPH

TC .53 TIME OF CONCENTRATION
R .38 STORAGE COEFFICIENT

65 UA ACCUMULATED-AREA VS. TIME, 11 ORDINATES

.0	5.0	16.0	30.0	65.0	77.0	84.0	90.0	94.0	97.0
100.0									

***

UNIT HYDROGRAPH PARAMETERS

CLARK TC= .53 HR, R= .38 HR
SNYDER TP= .30 HR, CP= .46

UNIT HYDROGRAPH
45 END-OF-PERIOD ORDINATES

9.	37.	78.	151.	223.	245.	243.	234.	221.	205.
189.	169.	148.	130.	114.	100.	87.	77.	67.	59.
51.	45.	39.	35.	30.	27.	23.	20.	18.	16.
14.	12.	10.	9.	8.	7.	6.	5.	5.	4.
4.	3.	3.	2.	2.					

*** ***

****
* *
67 KK * S2 *

```
          *           *
          **************
                         COMBINE HYDROGRAPHS (1+2,3) @ HUTTON DRIVE

 69 HC          HYDROGRAPH COMBINATION
                      ICOMP          2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                                  ***


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *           *
 70 KK    *        R4 *
          *           *
          **************
                        ROUTE COMBINED HYDROGRAPHS (1+2,3) THROUGH REACH R4

             HYDROGRAPH ROUTING DATA

 72 RD          MUSKINGUM-CUNGE CHANNEL ROUTING
                          L       2300.  CHANNEL LENGTH
                          S       .0040  SLOPE
                          N        .016  CHANNEL ROUGHNESS COEFFICIENT
                         CA         .00  CONTRIBUTING AREA
                      SHAPE        TRAP  CHANNEL SHAPE
                         WD        2.00  BOTTOM WIDTH OR DIAMETER
                          Z        4.00  SIDE SLOPE

                                                                  ***


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *           *
 73 KK    *         4 *
          *           *
          **************
                        SUB-BASIN 4
                        6-HOUR RAINFALL, PATTERN NO. 2.26 WAS USED TO FIND TC & R FOR THIS BASIN
                        THIS BASIN USED RAINFALL REDUCTION FACTOR OF .964

             SUBBASIN RUNOFF DATA

 77 BA          SUBBASIN CHARACTERISTICS
                      TAREA         .69  SUBBASIN AREA

                PRECIPITATION DATA

 27 PB                STORM        2.68  BASIN TOTAL PRECIPITATION

 27 PI            INCREMENTAL PRECIPITATION PATTERN
                     .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                     .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
```

.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.01	.01	.01	.01	.01	.02	.02	.02	.02	.02
.04	.04	.04	.04	.04	.05	.05	.05	.05	.05
.03	.03	.03	.03	.03	.01	.01	.01	.01	.01
.01	.01	.01	.01	.01	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00

```
78 LG          GREEN AND AMPT LOSS RATE
                     STRTL        .12  STARTING LOSS
                       DTH        .21  MOISTURE DEFICIT
                      PSIF       6.40  WETTING FRONT SUCTION
                     XKSAT        .17  HYDRAULIC CONDUCTIVITY
                     RTIMP      49.60  PERCENT IMPERVIOUS AREA

79 UC          CLARK UNITGRAPH
                        TC        .70  TIME OF CONCENTRATION
                         R        .38  STORAGE COEFFICIENT

80 UA          ACCUMULATED-AREA VS. TIME,  11 ORDINATES
                      .0      5.0     16.0     30.0     65.0     77.0     84.0     90.0     94.0     97.0
                   100.0

                                                  ***

                                          UNIT HYDROGRAPH PARAMETERS
                                   CLARK   TC=   .70 HR,       R=   .38 HR
                                  SNYDER   TP=   .35 HR,      CP=   .49

                                          UNIT HYDROGRAPH
                                     47 END-OF-PERIOD ORDINATES
            20.      70.     141.     224.     374.     548.     625.     622.     598.     571.
           538.     500.     463.     429.     387.     340.     298.     262.     230.     202.
           177.     156.     137.     120.     105.      92.      81.      71.      62.      55.
            48.      42.      37.      33.      29.      25.      22.      19.      17.      15.
            13.      11.      10.       9.       8.       7.       6.

*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

          **************
          *            *
 82 KK    *        S3  *
          *            *
          **************
                     COMBINE HYDROGRAPHS (1+2+3,4) @ BURNS DRIVE

 84 HC          HYDROGRAPH COMBINATION
                     ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                  ***

*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
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          **************
          *            *
85 KK     *        R5  *
          *            *
          **************
                        ROUTE COMBINED HYDROGRAPHS (1+2+3+4) THROUGH REACH R5

             HYDROGRAPH ROUTING DATA

87 RD          MUSKINGUM-CUNGE CHANNEL ROUTING
                          L       2100.  CHANNEL LENGTH
                          S       .0040  SLOPE
                          N        .016  CHANNEL ROUGHNESS COEFFICIENT
                         CA         .00  CONTRIBUTING AREA
                      SHAPE        TRAP  CHANNEL SHAPE
                         WD        2.00  BOTTOM WIDTH OR DIAMETER
                          Z        4.00  SIDE SLOPE

                                                                  ***


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
88 KK     *         5  *
          *            *
          **************
                        SUB-BASIN 5
                        6-HOUR RAINFALL, PATTERN NO. 2.26 WAS USED TO FIND TC & R FOR THIS BASIN
                        THIS BASIN USED RAINFALL REDUCTION FACTOR OF .964

             SUBBASIN RUNOFF DATA

92 BA          SUBBASIN CHARACTERISTICS
                     TAREA         .40  SUBBASIN AREA

               PRECIPITATION DATA

27 PB                STORM        2.68  BASIN TOTAL PRECIPITATION

27 PI            INCREMENTAL PRECIPITATION PATTERN
                    .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                    .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                    .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                    .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                    .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                    .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                    .01       .01       .01       .01       .01       .02       .02       .02       .02       .02
                    .04       .04       .04       .04       .04       .05       .05       .05       .05       .05
                    .03       .03       .03       .03       .03       .01       .01       .01       .01       .01
                    .01       .01       .01       .01       .01       .00       .00       .00       .00       .00
                    .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                    .00       .00       .00       .00       .00       .00       .00       .00       .00       .00

93 LG          GREEN AND AMPT LOSS RATE
```

```
                STRTL        .10  STARTING LOSS
                  DTH        .25  MOISTURE DEFICIT
                 PSIF       5.70  WETTING FRONT SUCTION
                XKSAT        .18  HYDRAULIC CONDUCTIVITY
                RTIMP      61.90  PERCENT IMPERVIOUS AREA

94 UC        CLARK UNITGRAPH
                   TC        .74  TIME OF CONCENTRATION
                    R        .67  STORAGE COEFFICIENT

95 UA        ACCUMULATED-AREA VS. TIME,  11 ORDINATES
                  .0      5.0     16.0     30.0     65.0     77.0     84.0     90.0     94.0     97.0
               100.0

                                                  ***

                                          UNIT HYDROGRAPH PARAMETERS
                                     CLARK   TC=   .74 HR,      R=   .67 HR
                                    SNYDER   TP=   .45 HR,     CP=   .41

                                          UNIT HYDROGRAPH
                                     78 END-OF-PERIOD ORDINATES
            6.      22.      45.      73.     117.     182.     225.     234.     237.     236.
          233.     226.     219.     210.     202.     190.     177.     164.     152.     141.
          131.     122.     113.     105.      97.      91.      84.      78.      72.      67.
           62.      58.      54.      50.      46.      43.      40.      37.      34.      32.
           30.      28.      26.      24.      22.      20.      19.      18.      16.      15.
           14.      13.      12.      11.      10.      10.       9.       8.       8.       7.
            7.       6.       6.       5.       5.       5.       4.       4.       4.       3.
            3.       3.       3.       3.       2.       2.       2.       2.

*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

          **************
          *            *
 97 KK    *        S4  *
          *            *
          **************
                    COMBINE HYDROGRAPHS (1+2+3+4,5) @ GREENWAY ROAD

 99 HC        HYDROGRAPH COMBINATION
                  ICOMP          2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                  ***

*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

          **************
          *            *
100 KK    *        R6  *
          *            *
          **************
                    ROUTE COMBINED HYDROGRAPHS (1+2+3+4+5) THROUGH REACH R6
```

```
            HYDROGRAPH ROUTING DATA

102 RD          MUSKINGUM-CUNGE CHANNEL ROUTING
                          L       1900.  CHANNEL LENGTH
                          S       .0040  SLOPE
                          N        .016  CHANNEL ROUGHNESS COEFFICIENT
                         CA         .00  CONTRIBUTING AREA
                      SHAPE        TRAP  CHANNEL SHAPE
                         WD        2.00  BOTTOM WIDTH OR DIAMETER
                          Z        4.00  SIDE SLOPE

                                                  ***


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
103 KK    *         6  *
          *            *
          **************
                         SUB-BASIN 6
                         6-HOUR RAINFALL, PATTERN NO. 2.26 WAS USED TO FIND TC & R FOR THIS BASIN
                         THIS BASIN USED RAINFALL REDUCTION FACTOR OF .964

            SUBBASIN RUNOFF DATA

107 BA          SUBBASIN CHARACTERISTICS
                      TAREA         .33  SUBBASIN AREA

                PRECIPITATION DATA

 27 PB                STORM        2.68  BASIN TOTAL PRECIPITATION

 27 PI            INCREMENTAL PRECIPITATION PATTERN
                      .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                      .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                      .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                      .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                      .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                      .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                      .01       .01       .01       .01       .01       .02       .02       .02       .02       .02
                      .04       .04       .04       .04       .04       .05       .05       .05       .05       .05
                      .03       .03       .03       .03       .03       .01       .01       .01       .01       .01
                      .01       .01       .01       .01       .01       .00       .00       .00       .00       .00
                      .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                      .00       .00       .00       .00       .00       .00       .00       .00       .00       .00

108 LG          GREEN AND AMPT LOSS RATE
                      STRTL         .10  STARTING LOSS
                        DTH         .25  MOISTURE DEFICIT
                       PSIF        5.70  WETTING FRONT SUCTION
                      XKSAT         .20  HYDRAULIC CONDUCTIVITY
                      RTIMP       62.80  PERCENT IMPERVIOUS AREA

109 UC          CLARK UNITGRAPH
                          TC         .48  TIME OF CONCENTRATION
                           R         .27  STORAGE COEFFICIENT
```

```
110 UA          ACCUMULATED-AREA VS. TIME,  11 ORDINATES
                      .0       5.0      16.0      30.0      65.0      77.0      84.0      90.0      94.0      97.0
                   100.0

                                                  ***

                                          UNIT HYDROGRAPH PARAMETERS
                                     CLARK   TC=   .48 HR,       R=   .27 HR
                                    SNYDER   TP=   .25 HR,      CP=   .49

                                            UNIT HYDROGRAPH
                                        34 END-OF-PERIOD ORDINATES
              19.       76.      163.      311.      416.      412.      388.      357.      322.      286.
             246.      205.      170.      142.      118.       98.       82.       68.       57.       47.
              39.       33.       27.       23.       19.       16.       13.       11.        9.        8.
               6.        5.        4.        4.


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
112 KK    *        S5  *
          *            *
          **************
                        COMBINE HYDROGRAPHS (1+2+3+4+5,6) @ BOSWELL BLVD

114 HC          HYDROGRAPH COMBINATION
                     ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                  ***


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *            *
115 KK    *        R7  *
          *            *
          **************
                        ROUTE COMBINED HYDROGRAPHS (1+2+3+4+5+6) THROUGH REACH R7

             HYDROGRAPH ROUTING DATA

117 RD          MUSKINGUM-CUNGE CHANNEL ROUTING
                          L       1500.  CHANNEL LENGTH
                          S       .0050  SLOPE
                          N        .016  CHANNEL ROUGHNESS COEFFICIENT
                         CA         .00  CONTRIBUTING AREA
                      SHAPE        TRAP  CHANNEL SHAPE
                         WD        2.00  BOTTOM WIDTH OR DIAMETER
                          Z        4.00  SIDE SLOPE

                                                  ***
```

```
*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

          **************
          *            *
118 KK    *          7 *
          *            *
          **************
                    SUB-BASIN 7
                    6-HOUR RAINFALL, PATTERN NO. 2.26 WAS USED TO FIND TC & R FOR THIS BASIN
                    THIS BASIN USED RAINFALL REDUCTION FACTOR OF .964

             SUBBASIN RUNOFF DATA

122 BA          SUBBASIN CHARACTERISTICS
                      TAREA          .20  SUBBASIN AREA

                PRECIPITATION DATA

 27 PB                STORM         2.68  BASIN TOTAL PRECIPITATION

 27 PI            INCREMENTAL PRECIPITATION PATTERN
                     .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                     .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                     .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                     .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                     .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                     .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                     .01       .01       .01       .01       .01       .02       .02       .02       .02       .02
                     .04       .04       .04       .04       .04       .05       .05       .05       .05       .05
                     .03       .03       .03       .03       .03       .01       .01       .01       .01       .01
                     .01       .01       .01       .01       .01       .00       .00       .00       .00       .00
                     .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                     .00       .00       .00       .00       .00       .00       .00       .00       .00       .00

123 LG          GREEN AND AMPT LOSS RATE
                      STRTL         .11  STARTING LOSS
                        DTH         .23  MOISTURE DEFICIT
                       PSIF        6.20  WETTING FRONT SUCTION
                      XKSAT         .18  HYDRAULIC CONDUCTIVITY
                      RTIMP       51.00  PERCENT IMPERVIOUS AREA

124 UC          CLARK UNITGRAPH
                         TC         .47  TIME OF CONCENTRATION
                          R         .35  STORAGE COEFFICIENT

125 UA          ACCUMULATED-AREA VS. TIME,  11 ORDINATES
                        .0       5.0      16.0      30.0      65.0      77.0      84.0      90.0      94.0      97.0
                     100.0

                                                  ***

                                          UNIT HYDROGRAPH PARAMETERS
                                   CLARK   TC=   .47 HR,       R=   .35 HR
                                  SNYDER   TP=   .26 HR,      CP=   .44

                                          UNIT HYDROGRAPH
                                     42 END-OF-PERIOD ORDINATES
```

```
          10.      39.      86.     161.     213.     216.     209.     197.     183.     166.
         146.     127.     110.      95.      83.      72.      62.      54.      47.      41.
          35.      31.      27.      23.      20.      17.      15.      13.      11.      10.
           9.       7.       6.       6.       5.       4.       4.       3.       3.       2.
           2.       2.


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


        **************
        *            *
 127 KK *        S6  *
        *            *
        **************
                      COMBINE HYDROGRAPHS (1+2+3+4+5+6,7) @ CAMEO DRIVE

 129 HC        HYDROGRAPH COMBINATION
                    ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                          ***


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


        **************
        *            *
 130 KK *        R8  *
        *            *
        **************
                      ROUTE COMBINED HYDROGRAPHS (1+2+3+4+5+6+7) THROUGH REACH R8

           HYDROGRAPH ROUTING DATA

 132 RD        MUSKINGUM-CUNGE CHANNEL ROUTING
                         L       1200.  CHANNEL LENGTH
                         S       .0050  SLOPE
                         N        .016  CHANNEL ROUGHNESS COEFFICIENT
                        CA         .00  CONTRIBUTING AREA
                     SHAPE        TRAP  CHANNEL SHAPE
                        WD        2.00  BOTTOM WIDTH OR DIAMETER
                         Z        4.00  SIDE SLOPE

                                                          ***


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


        **************
        *            *
 133 KK *         8  *
        *            *
        **************
                      SUB-BASIN 8
                      6-HOUR RAINFALL, PATTERN NO. 2.26 WAS USED TO FIND TC & R FOR THIS BASIN
```

THIS BASIN USED RAINFALL REDUCTION FACTOR OF .964

SUBBASIN RUNOFF DATA

137 BA SUBBASIN CHARACTERISTICS

TAREA	.10	SUBBASIN AREA

PRECIPITATION DATA

27 PB

STORM	2.68	BASIN TOTAL PRECIPITATION

27 PI INCREMENTAL PRECIPITATION PATTERN

.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.01	.01	.01	.01	.01	.02	.02	.02	.02	.02
.04	.04	.04	.04	.04	.05	.05	.05	.05	.05
.03	.03	.03	.03	.03	.01	.01	.01	.01	.01
.01	.01	.01	.01	.01	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00

138 LG GREEN AND AMPT LOSS RATE

STRTL	.11	STARTING LOSS
DTH	.25	MOISTURE DEFICIT
PSIF	5.60	WETTING FRONT SUCTION
XKSAT	.21	HYDRAULIC CONDUCTIVITY
RTIMP	55.00	PERCENT IMPERVIOUS AREA

139 UC CLARK UNITGRAPH

TC	.58	TIME OF CONCENTRATION
R	.89	STORAGE COEFFICIENT

140 UA ACCUMULATED-AREA VS. TIME, 11 ORDINATES

.0	5.0	16.0	30.0	65.0	77.0	84.0	90.0	94.0	97.0
100.0									

***

UNIT HYDROGRAPH PARAMETERS

CLARK TC= .58 HR, R= .89 HR

SNYDER TP= .42 HR, CP= .33

UNIT HYDROGRAPH

99 END-OF-PERIOD ORDINATES

2.	6.	13.	25.	40.	49.	52.	54.	54.	53.
52.	51.	49.	46.	44.	41.	39.	37.	35.	33.
31.	29.	28.	26.	25.	23.	22.	21.	20.	19.
18.	17.	16.	15.	14.	13.	13.	12.	11.	11.
10.	10.	9.	9.	8.	8.	7.	7.	6.	6.
6.	5.	5.	5.	5.	4.	4.	4.	4.	3.
3.	3.	3.	3.	3.	2.	2.	2.	2.	2.
2.	2.	2.	2.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	0.	0.	0.	0.	0.	

```
*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

          **************
          *            *
142 KK    *        S7  *
          *            *
          **************
                         COMBINE HYDROGRAPHS (1+2+3+4+5+6+7,8) THUNDERBIRD ROAD

144 HC          HYDROGRAPH COMBINATION
                     ICOMP          2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                                  ***
```

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	1	630.	4.40	164.	67.	67.	.71		
DIVERSION TO	D1	562.	4.40	159.	65.	65.	.71		
HYDROGRAPH AT	D1	69.	4.40	5.	2.	2.	.71		
ROUTED TO	R2	68.	4.55	5.	2.	2.	.71		
HYDROGRAPH AT	2	1109.	4.30	253.	103.	103.	1.14		
2 COMBINED AT	S1	1150.	4.40	258.	105.	105.	1.85		
ROUTED TO	R3	1145.	4.40	258.	105.	105.	1.85		
HYDROGRAPH AT	3	273.	4.25	66.	27.	27.	.25		
2 COMBINED AT	S2	1407.	4.40	324.	131.	131.	2.10		
ROUTED TO	R4	1399.	4.45	324.	131.	131.	2.10		
HYDROGRAPH AT	4	648.	4.30	144.	58.	58.	.69		
2 COMBINED AT	S3	2034.	4.40	468.	190.	190.	2.79		
ROUTED TO	R5	2029.	4.45	468.	190.	190.	2.79		
HYDROGRAPH AT	5	309.	4.45	88.	36.	36.	.40		
2 COMBINED AT	S4	2338.	4.45	556.	226.	226.	3.19		
ROUTED TO	R6	2334.	4.45	556.	226.	226.	3.19		
HYDROGRAPH AT	6	364.	4.20	74.	30.	30.	.33		
2 COMBINED AT	S5	2638.	4.40	629.	256.	256.	3.51		
ROUTED TO	R7	2637.	4.45	629.	256.	256.	3.51		
HYDROGRAPH AT	7	200.	4.20	42.	17.	17.	.20		
2 COMBINED AT	S6	2813.	4.45	671.	273.	273.	3.71		
ROUTED TO	R8	2813.	4.45	671.	273.	273.	3.71		
HYDROGRAPH AT	8	69.	4.45	21.	9.	9.	.10		
2 COMBINED AT	S7	2882.	4.45	692.	282.	282.	3.82		

SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
(FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)

ISTAQ	ELEMENT	DT (MIN)	PEAK (CFS)	TIME TO PEAK (MIN)	VOLUME (IN)	INTERPOLATED TO COMPUTATION INTERVAL DT (MIN)	PEAK (CFS)	TIME TO PEAK (MIN)	VOLUME (IN)
R2	MANE	1.05	68.00	271.95	.07	3.00	67.94	273.00	.07

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2516E+01 EXCESS= .0000E+00 OUTFLOW= .2510E+01 BASIN STORAGE= .1999E-02 PERCENT ERROR= .2

R3	MANE	1.89	1147.57	266.05	1.31	3.00	1145.03	264.00	1.31

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1294E+03 EXCESS= .0000E+00 OUTFLOW= .1294E+03 BASIN STORAGE= .6340E-03 PERCENT ERROR= .0

R4	MANE	2.99	1399.99	265.81	1.45	3.00	1398.94	267.00	1.45

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1624E+03 EXCESS= .0000E+00 OUTFLOW= .1624E+03 BASIN STORAGE= .1428E-02 PERCENT ERROR= .0

R5	MANE	2.48	2030.75	265.68	1.58	3.00	2029.30	267.00	1.58

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2346E+03 EXCESS= .0000E+00 OUTFLOW= .2345E+03 BASIN STORAGE= .8669E-03 PERCENT ERROR= .0

R6	MANE	2.17	2335.53	268.85	1.64	3.00	2334.02	267.00	1.64

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2794E+03 EXCESS= .0000E+00 OUTFLOW= .2794E+03 BASIN STORAGE= .1099E-02 PERCENT ERROR= .0

R7	MANE	1.53	2636.95	267.30	1.69	3.00	2636.86	267.00	1.69

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3162E+03 EXCESS= .0000E+00 OUTFLOW= .3162E+03 BASIN STORAGE= .6301E-03 PERCENT ERROR= .0

R8	MANE	1.20	2813.50	266.87	1.70	3.00	2813.16	267.00	1.70

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3371E+03 EXCESS= .0000E+00 OUTFLOW= .3371E+03 BASIN STORAGE= .4592E-03 PERCENT ERROR= .0

*** NORMAL END OF HEC-1 ***

APPENDIX II
HYDRAULICS

EXISTING CULVERT ANALYSIS

PROJECT: 99th Ave. #94154 DESIGNER: TAB

HUTTON DR. EXISTING CULVERT DATE: 7-31-95

HYDROLOGIC AND CHANNEL INFORMATION

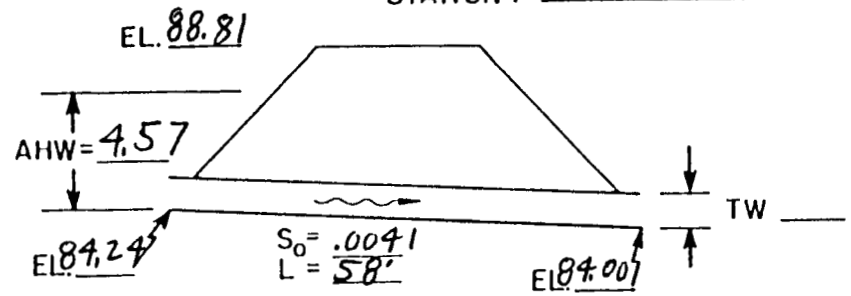
Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION: HUTTON



MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. $\frac{HW}{D}$	HW	OUTLET CONTROL $HW = H + h_o - LS_o$: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
2-10'X4' HDWL	560		1.14	4.57	.4	1.2	3.0	3.5	3.9	3.9	.24	4.9	4.9			TOO HIGH
"	540				.4	1.1	2.8	3.4	3.9	3.9	.24	4.8	4.8			TOO HIGH
"	500		1.05	4.20	.4	.95	2.7	3.4	3.75	3.75	.24	4.5	4.5			O.K.

SUMMARY & RECOMMENDATIONS: 1 LANE INUNDATION UPSTREAM OF BOX CULVERT. CAPACITY = 500 cfs.

Figure 7

PROJECT: 99th Ave. #94154 DESIGNER: TAB

BURNS DR. EXISTING CULVERT DATE: 7-31-95

HYDROLOGIC AND CHANNEL INFORMATION

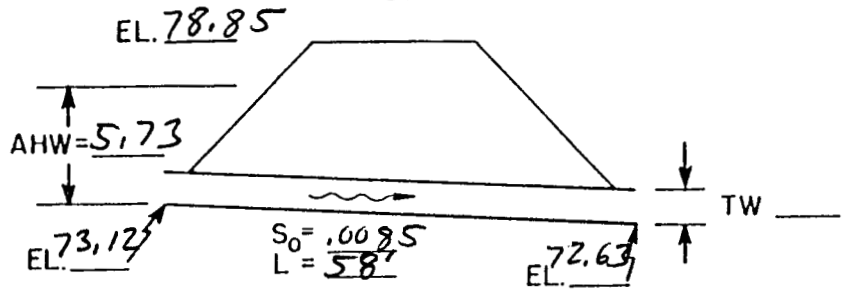
Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION: BURNS DR.



MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL HW=H + h_o − LS_o: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
2-10'X4' HDWL	720		1.43	5.73	.4	1.9	3.5	3.75	4.3	4.3	.5	5.7	5.73			O.K.

SUMMARY & RECOMMENDATIONS: 1 LANE INUNDATION UPSTREAM OF BOX CULVERT.

Figure 7

PROJECT: 99th Ave. #94154 DESIGNER: TAB

GREENWAY RD. EXISTING CULVERT DATE: 7-31-95

HYDROLOGIC AND CHANNEL INFORMATION

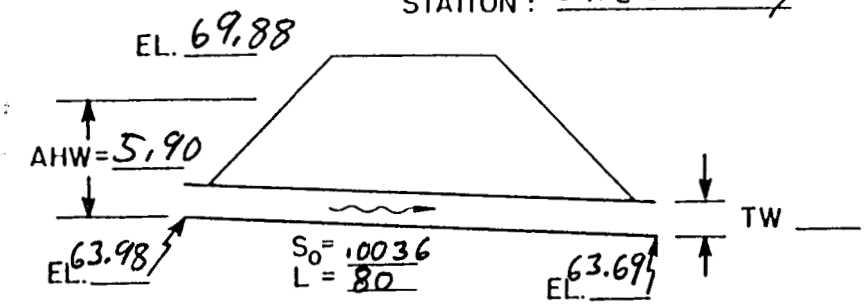
Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION: GREENWAY



MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION										CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
			INLET CONT.		OUTLET CONTROL $HW=H+h_o-LS_o$											
			$\frac{HW}{D}$	HW	K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW				
2-10'X4' HDWL	720		1.48	5.9	.4	2.0	3.5	3.75	4.4	4.4	.29	6.1	6.1			TOO HIGH
"	650		1.30	5.2	.4	1.6	3.2	3.6	4.2	4.2	.29	5.5	5.5			TOO LOW
"	700		1.42	5.7	.4	1.9	3.4	3.7	4.3	4.3	.29	5.9	5.9			O.K.

SUMMARY & RECOMMENDATIONS: 1 LANE INUNDATION UPSTREAM OF BOX CULVERT. CAPACITY = 700 cfs

Figure 7

PROJECT: 99th Ave. #94154 DESIGNER: TAB

BOSWELL BLVD. EXISTING CULVERT DATE: 7-31-95

HYDROLOGIC AND CHANNEL INFORMATION

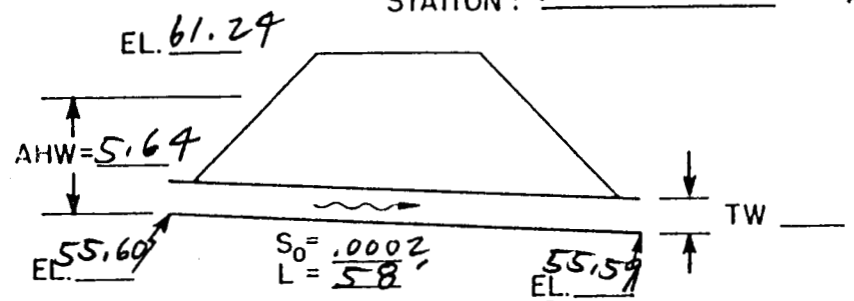
Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION: BOSWELL BLVD



MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT.		OUTLET CONTROL HW=H + h_o − LS_o								CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
			$\frac{HW}{D}$	HW	K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW				
2-10'X4' HDWL	700		1.41	5.64	.4	1.8	3.4	3.7	4.3	4.3	.01	6.1	6.1			TOO HIGH
"	650		1.33	5.3	.4	1.55	3.2	3.6	4.2	4.2	0	5.75	5.75			TOO HIGH
"	630		1.30	5.2	.4	1.45	3.2	3.6	4.1	4.1	0	5.6	5.6			O.K.
"																

SUMMARY & RECOMMENDATIONS: 1 LANE INUNDATION UPSTREAM OF BOX CULVERT. CAPACITY = 630 cfs

Figure 7

PROJECT: 99th Ave. #94154 DESIGNER: TAB

CAMEO DR. EXISTING CULVERT DATE: 7-31-95

HYDROLOGIC AND CHANNEL INFORMATION

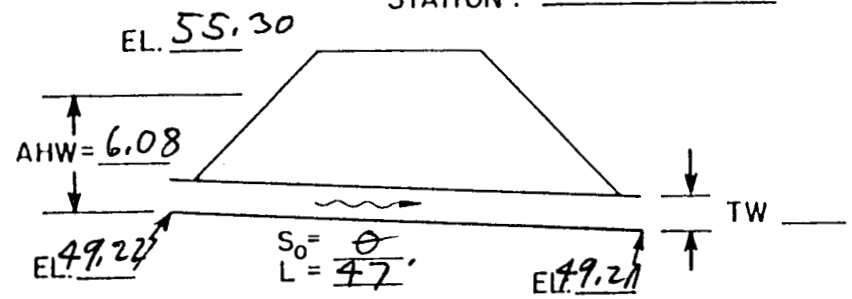
Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION: CAMEO DR.



MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT.		OUTLET CONTROL $HW = H + h_o - LS_o$								CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
			$\frac{HW}{D}$	HW	K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW				
2-10'X4' HDWL	740		1.52	6.1	.4	2.0	3.5	3.75	4.4	4.4	0	6.4	6.4			TOO HIGH
"	720		1.46	5.8	.4	1.9	3.5	3.75	4.4	4.4	0	6.3	6.3			TOO HIGH
"	700		1.41	5.6	.4	1.8	3.4	3.7	4.3	4.3	0	6.1	6.1			O.K.

SUMMARY & RECOMMENDATIONS: 1 LANE INUNDATION UPSTREAM OF BOX CULVERT.

Figure 7

PROJECT: 99th Ave. #94154 DESIGNER: TAB

Thunderbird Rd. EXISTING CULVERT DATE: 7-31-95

HYDROLOGIC AND CHANNEL INFORMATION

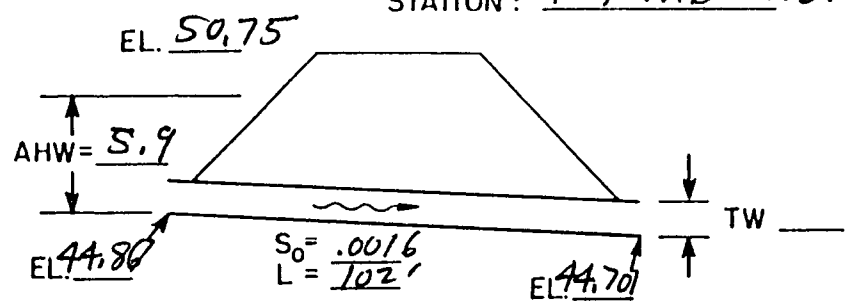
Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION: T-BIRD RD.



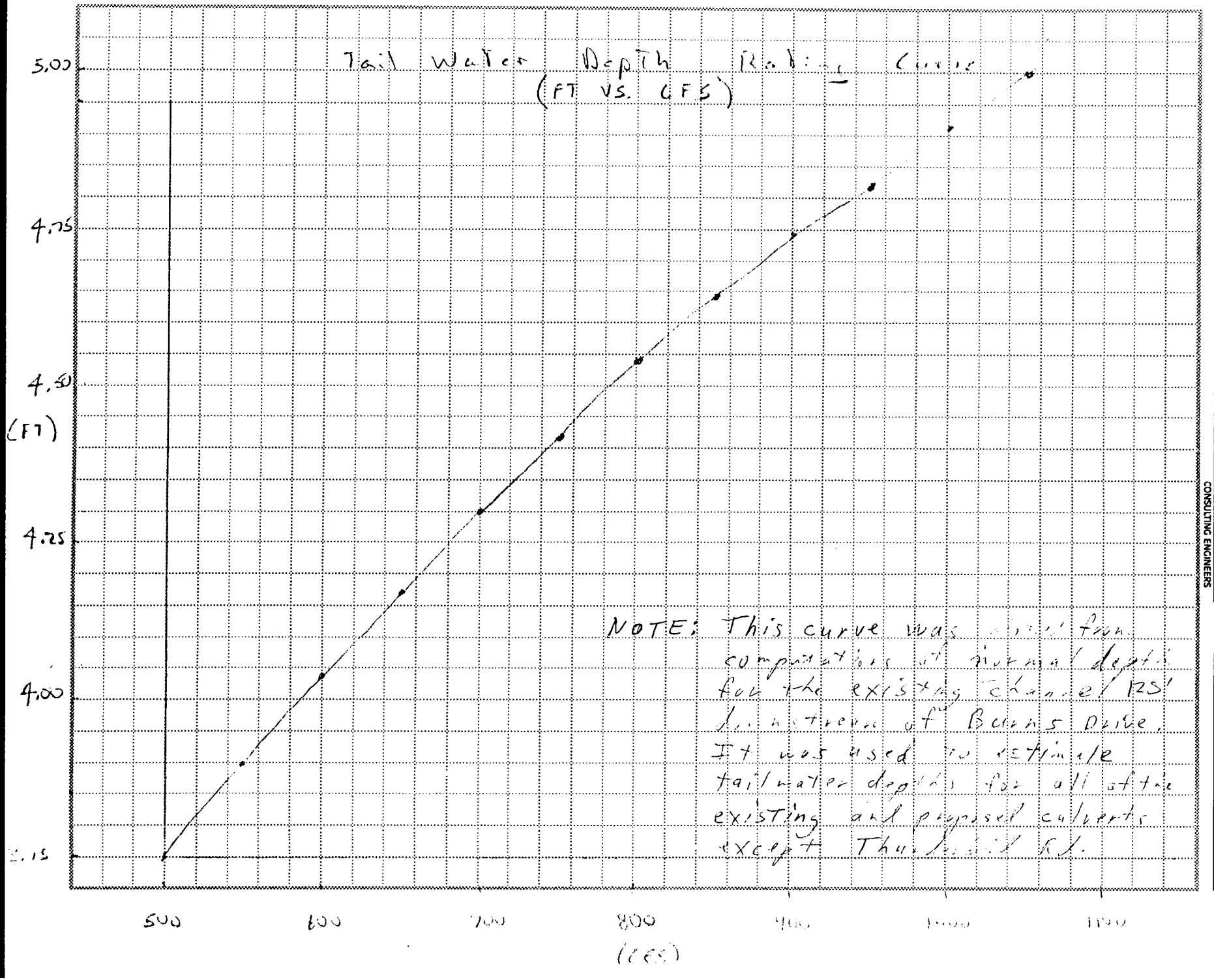
MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT.		OUTLET CONTROL HW=H + h_o − LS_o								CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
			HW/D	HW	K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW				
2-10'X4' HDWL	720		1.47	5.9	.4	2.1	3.5	3.75	3.7	3.75	.16	5.7	5.9			O.K.

SUMMARY & RECOMMENDATIONS: 1 LANE INUNDATION UPSTREAM OF BOX CULVERT. CAPACITY = 720 cfs

Figure 7



CLIENT

PROJECT

DESIGN FOR

Hendrich, Eberhart & Associates, Inc.
CONSULTING ENGINEERS

JOB NO.

SHEET OF

DESIGNER

DATE

CHECKER

DATE

EXISTING CHANNEL ANALYSIS

130' Downstream of Burns Drive ℄

NATURAL CHANNELS

VARIABLES LIST:
Y - FLOW ELEVATION Q - FLOWRATE S - CHANNEL SLOPE

VARIABLE TO BE SOLVED (Y,Q OR S) ? Q Enter up to 20 cross-section points.
Enter <Return> only for distance to end.

Y (FT) ? 76.7
S (FT/FT) ? .0024

CROSS-SECTION POINTS

DIST	ELEV	COEFF	DIST	ELEV	COEFF
0	78.5	.018			
33.9	77.96	.018			
54.8	73.1	.016			
57.3	73.1	.016			
78.2	77.7	.018			
112.5	78.3	.018			

1' Freeboard

RESULTS
==========
Q= 455.17 CFS
A= 66.31 SF
P= 35.14 FT
V= 6.86 FPS
F= 0.87 SUB-CRITICAL FLOW

<Shift> <Prt Sc> print <Return> repeat <Space Bar> back to menu

---

NATURAL CHANNELS

VARIABLES LIST:
Y - FLOW ELEVATION Q - FLOWRATE S - CHANNEL SLOPE

VARIABLE TO BE SOLVED (Y,Q OR S) ? Q Enter up to 20 cross-section points.
Enter <Return> only for distance to end.

Y (FT) ? 77.7
S (FT/FT) ? .0024

CROSS-SECTION POINTS

DIST	ELEV	COEFF	DIST	ELEV	COEFF
0	78.5	.018			
33.9	77.96	.018			
54.8	73.1	.016			
57.3	73.07	.016			
78.2	77.67	.018			
112.5	78.33	.018			

0' Freeboard

RESULTS
==========
Q= 843.88 CFS
A= 105.76 SF
P= 45.77 FT
V= 7.98 FPS
F= 0.91 SUB-CRITICAL FLOW

<Shift> <Prt Sc> print <Return> repeat <Space Bar> back to menu

---

130' Downstream of Burns Dr. ℄

NATURAL CHANNELS

VARIABLES LIST:

Y - FLOW ELEVATION Q - FLOWRATE S - CHANNEL SLOPE

VARIABLE TO BE SOLVED (Y,Q OR S) ? Q

Enter up to 20 cross-section points.
Enter <Return> only for distance to end.

Y (FT) ? 78.1
S (FT/FT) ? .0024

CROSS-SECTION POINTS

DIST	ELEV	COEFF	DIST	ELEV	COEFF
0	78.5	.018			
33.9	77.96	.018			
54.8	73.1	.016			
57.3	73.07	.016			
78.2	77.67	.018			
112.5	78.33	.018			

1 Lane Open Each Direction

RESULTS

Q= 1074.18 CFS
A= 128.73 SF
P= 76.50 FT
V= 8.34 FPS
F= 1.13 SUPER-CRITICAL FLOW

<Shift> <Prt Sc> print <Return> repeat <Space Bar> back to menu

125' Downstream of T-Bird Rd.

NATURAL CHANNELS

VARIABLES LIST:
Y - FLOW ELEVATION Q - FLOWRATE S - CHANNEL SLOPE

VARIABLE TO BE SOLVED (Y,Q OR S) ? Q

Enter up to 20 cross-section points.
Enter <Return> only for distance to end.

Y (FT) ? 48.5
S (FT/FT) ? .0035

CROSS-SECTION POINTS

DIST	ELEV	COEFF	DIST	ELEV	COEFF
0	50.23	.018			
37	49.65	.018			
56.4	45.02	.016			
63.6	44.83	.016			
80.2	49.48	.018			
118.1	50.25	.018			

RESULTS
==========
Q= 699.65 CFS
A= 75.15 SF
P= 35.80 FT
V= 9.31 FPS
F= 1.12 SUPER-CRITICAL FLOW

1' Freeboard

<Shift> <Prt Sc> print <Return> repeat <Space Bar> back to menu

---

NATURAL CHANNELS

VARIABLES LIST:
Y - FLOW ELEVATION Q - FLOWRATE S - CHANNEL SLOPE

VARIABLE TO BE SOLVED (Y,Q OR S) ? Q

Enter up to 20 cross-section points.
Enter <Return> only for distance to end.

Y (FT) ? 49.5
S (FT/FT) ? .0035

CROSS-SECTION POINTS

DIST	ELEV	COEFF	DIST	ELEV	COEFF
0	50.23	.018			
37	49.65	.018			
56.4	45.02	.016			
63.6	44.83	.016			
80.2	49.48	.018			
118.1	50.25	.018			

RESULTS
==========
Q= 1211.96 CFS
A= 113.92 SF
P= 44.72 FT
V= 10.64 FPS
F= 1.16 SUPER-CRITICAL FLOW

0' Freeboard

<Shift> <Prt Sc> print <Return> repeat <Space Bar> back to menu

---

125' Downstream of T-Bird. Rd.

NATURAL CHANNELS

VARIABLES LIST:
Y - FLOW ELEVATION Q - FLOWRATE S - CHANNEL SLOPE

VARIABLE TO BE SOLVED (Y,Q OR S) ? Q

Enter up to 20 cross-section points.
Enter <Return> only for distance to end.

Y (FT) ? 49.8
S (FT/FT) ? .0035

CROSS-SECTION POINTS

DIST	ELEV	COEFF	DIST	ELEV	COEFF
0	50.23	.018			
37	49.65	.018			
56.4	45.02	.016			
63.6	44.83	.016			
80.2	49.48	.018			
118.1	50.25	.018			

1 Lane Open

RESULTS
==========
Q= 1426.94 CFS
A= 130.07 SF
P= 69.71 FT
V= 10.97 FPS
F= 1.40 SUPER-CRITICAL FLOW

<Shift> <Prt Sc> print <Return> repeat <Space Bar> back to menu

PROPOSED CULVERT SIZING

PROJECT: 99th Ave. # 94154 DESIGNER: TAB

HUTTON DRIVE PROPOSED CULVERT DATE: 8-1-95

HYDROLOGIC AND CHANNEL INFORMATION

ALTERNATE A

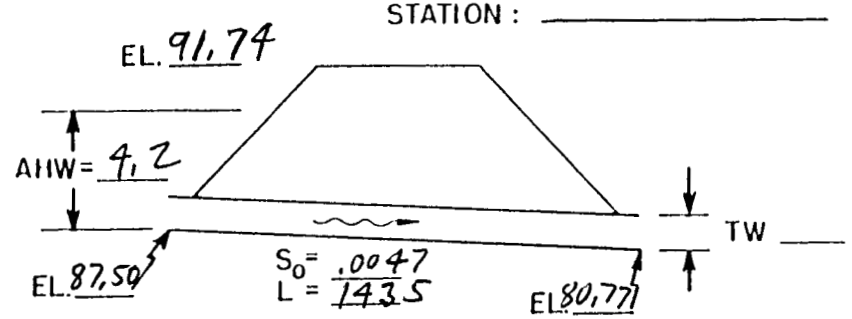
Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION : _____



MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION										CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
			INLET CONT.		OUTLET CONTROL $HW = H + h_o - LS_o$											
			$\frac{HW}{D}$	HW	K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW				
2-10'x4'	500		1.05	4.20	.4	3.5	2.7	3.3	3.8	3.8	6.73	0.5	4.2			O.K.

SUMMARY & RECOMMENDATIONS:

Figure 7

PROJECT: 99th Ave. # 94154 DESIGNER: TAB

BURNS DRIVE PROPOSED CULVERT DATE: 8-1-95

HYDROLOGIC AND CHANNEL INFORMATION

ALTERNATE 'A'

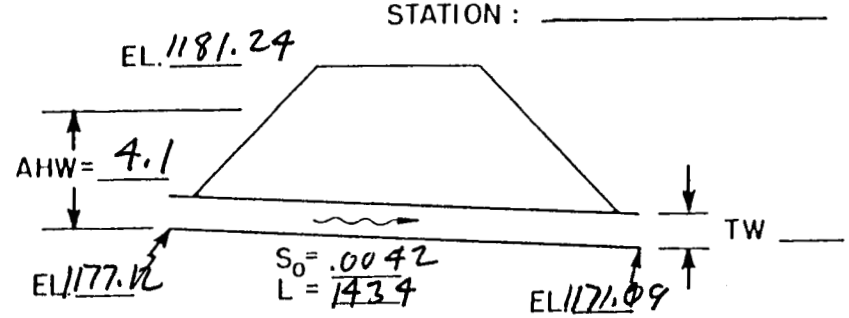
Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION : _____



MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT.		OUTLET CONTROL $HW=H+h_o-LS_o$								CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
			$\frac{HW}{D}$	HW	K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW				
2-10'x4'	720		1.43	5.73	.4											TOO HIGH
2-12'x4'	720		1.23	4.9	.4											TOO HIGH
3-10'x4'	720		1.03	4.1	.4	3.2	2.6	3.3	4.3	4.3	6.03	1.5	4.1			O.K.

SUMMARY & RECOMMENDATIONS:

Figure 7

PROJECT: 99th Ave. # 94154 DESIGNER: TAB

GREENWAY RD. PROPOSED CULVERT DATE: 8-1-95

HYDROLOGIC AND CHANNEL INFORMATION

ALTERNATE A

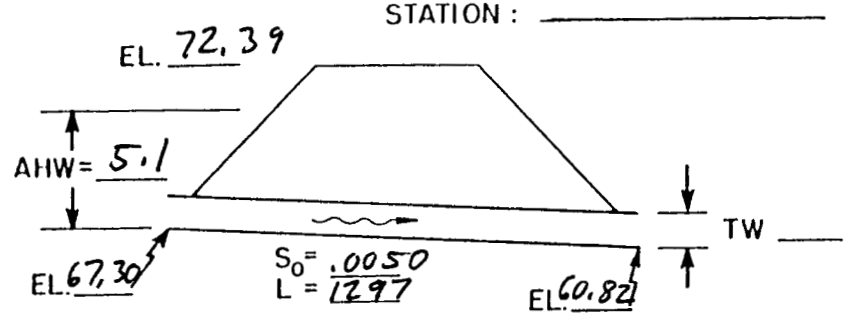
Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION : _____



MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION										CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
			INLET CONT.		OUTLET CONTROL $HW=H+h_o-LS_o$											
			$\frac{HW}{D}$	HW	K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW				
2-10'X4'	700		1.42	5.7	.4											TOO HIGH
2-12'X4'	700		1.20	4.8	.4	4.2	3.0	3.5	4.3	4.3	6.48	2.0	4.8			O.K.

SUMMARY & RECOMMENDATIONS:

Figure 7

PROJECT: 99th Ave. # 94154 DESIGNER: TAB

BOSWELL BOULEVARD PROPOSED CULVERT DATE: 8-1-95

HYDROLOGIC AND CHANNEL INFORMATION

ALTERNATE A

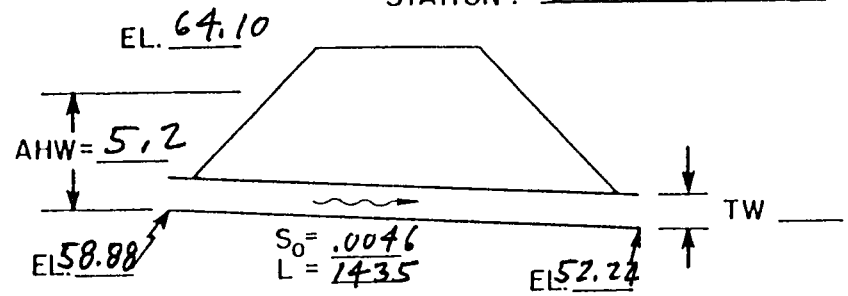
Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION : _____



MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION										CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
			INLET CONT.		OUTLET CONTROL $HW = H + h_o - LS_o$											
			$\frac{HW}{D}$	HW	K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW				
2-10'x4'	630		1.30	5.2	.4	5.6	3.1	3.6	4.1	4.1	6.66	3.0	5.2			O.K.

SUMMARY & RECOMMENDATIONS:

Figure 7

PROJECT: 99th Ave. # 94154 DESIGNER: TAB

T-BIRD ROAD PROPOSED CULVERT DATE: 8-1-95

HYDROLOGIC AND CHANNEL INFORMATION

ALTERNATE A

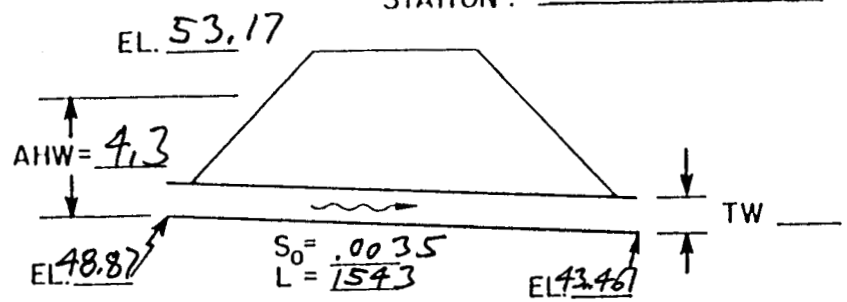
Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION : _____



MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL HW=H+h0-LS0: Ke	H	dc	(dc+D)/2	TW	h0	LS0	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
2-10'x4'	720		1.47	5.9	.4											TOO HIGH
3-10'x4'	720		1.03	4.1	.4	3.4	2.6	3.3	3.7	3.7	5.41	1.7	4.1			O.K

SUMMARY & RECOMMENDATIONS:

Figure 7

PROJECT: 99th Ave. # 94154 DESIGNER: TAB

HUTTON DRIVE PROPOSED CULVERT DATE: 8-1-95

HYDROLOGIC AND CHANNEL INFORMATION

ALTERNATE C

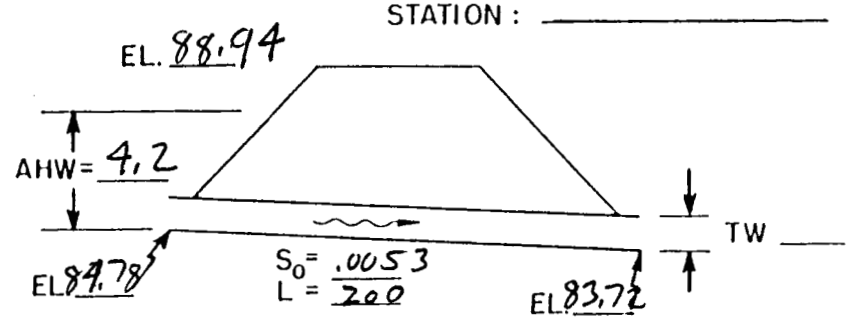
Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION : _____



MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION										CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
			INLET CONT.		OUTLET CONTROL $HW=H+h_o-LS_o$											
			$\frac{HW}{D}$	HW	K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW				
2-10'X4'	500		1.05	4.2	.4	1.2	2.7	3.3	3.8	3.8	1.06	3.9				O.K.

SUMMARY & RECOMMENDATIONS:

Figure 7

PROJECT: 99th Ave. # 94154 DESIGNER: TAB

BURNS DRIVE PROPOSED CULVERT DATE: 8-1-95

HYDROLOGIC AND CHANNEL INFORMATION

ALTERNATE C

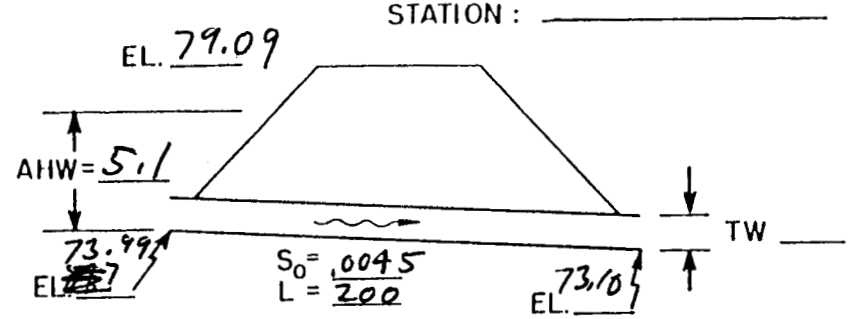
Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION : _____



MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT.		OUTLET CONTROL $HW = H + h_0 - LS_0$								CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
			$\frac{HW}{D}$	HW	K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_0	LS_0	HW				
2-10'x4'	720		1.5	6.0	.4						.9					TOO HIGH
2-12'x4'	720		1.25	5.0	.4	1.7	3.0	3.5	4.3	4.3	.9	5.1	5.1			O.K.

SUMMARY & RECOMMENDATIONS:

Figure 7

PROJECT: 99th Ave. # 94154 DESIGNER: TAB

GREENWAY RD. PROPOSED CULVERT DATE: 8-1-95

HYDROLOGIC AND CHANNEL INFORMATION

ALTERNATE C

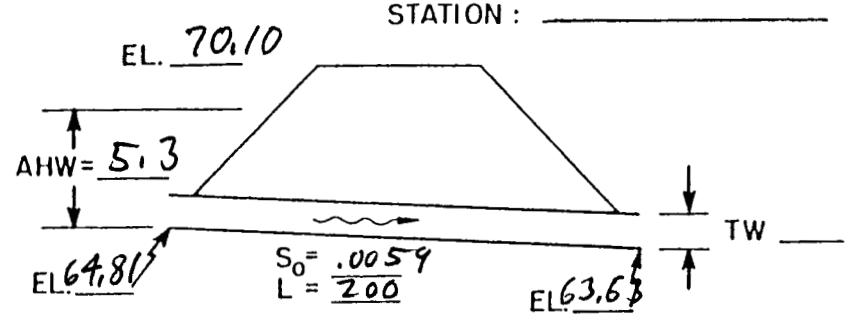
Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION : _____



MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION										CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
			INLET CONT.		OUTLET CONTROL $HW=H+h_o-LS_o$											
			$\frac{HW}{D}$	HW	K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW				
2-10'x4'	700		1.42	5.7	.4	2.4	3.4	3.7	4.3	4.3	1.18	5.5	5.7			TOO HIGH
2-12'x4'	700		1.20	4.8	.4	1.6	3.0	3.5	4.3	4.3	1.18	4.7	4.8			O.K.

SUMMARY & RECOMMENDATIONS:

Figure 7

PROJECT: 99th Ave. # 94154 DESIGNER: TAB

BOSWELL BOULEVARD PROPOSED CULVERT DATE: 8-1-95

HYDROLOGIC AND CHANNEL INFORMATION

ALTERNATE C

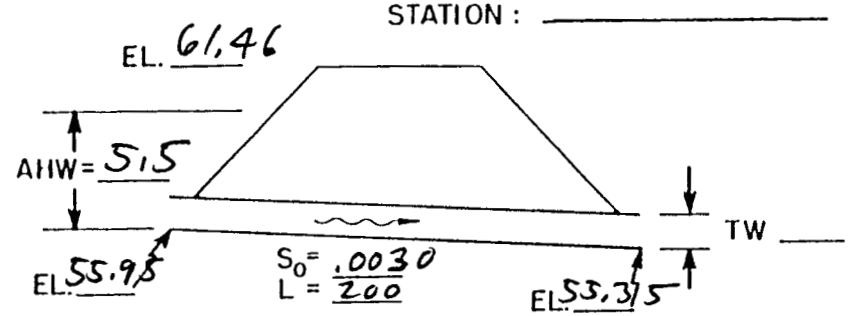
Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION : _____



MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION										CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
			INLET CONT.		OUTLET CONTROL $HW = H + h_o - LS_o$											
			$\frac{HW}{D}$	HW	K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW				
2-10'x4'	630		1.30	5.2	.4	1.9	3.1	3.6	4.1	4.1	.60	5.4	5A			O.K.

SUMMARY & RECOMMENDATIONS:

Figure 7

PROJECT: 99th Ave. # 94154 DESIGNER: TAB

T-BIRD ROAD PROPOSED CULVERT DATE: 8-1-95

HYDROLOGIC AND CHANNEL INFORMATION

ALTERNATE C

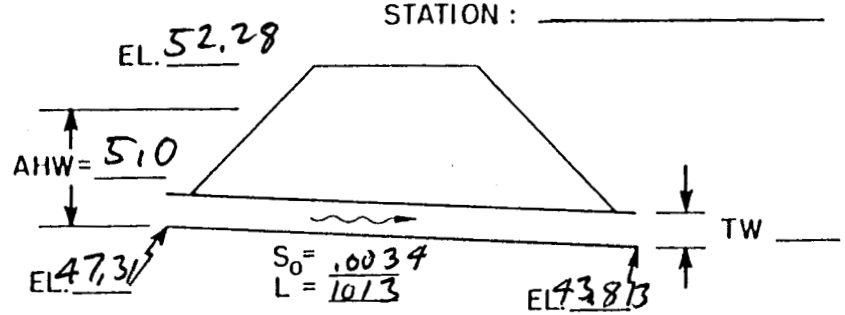
Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION : _____



MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION										CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
			INLET CONT.		OUTLET CONTROL $HW = H + h_0 - LS_0$											
			$\frac{HW}{D}$	HW	K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_0	LS_0	HW				
2-10'x4'	720		1.47	5.9	.4	5.6	3.4	3.7	3.7	3.7	3.48	5.9	5.9			TOO HIGH
2-12'x4'	720		1.25	5.0	.4	3.8	3.0	3.5	3.7	3.7	3.48	4.0	5.0			O.K.

SUMMARY & RECOMMENDATIONS:

Figure 7

PROJECT: 99th Ave. # 94154 DESIGNER: TAB

HUTTON DRIVE PROPOSED CULVERT DATE: 8-1-95

HYDROLOGIC AND CHANNEL INFORMATION

ALTERNATE E

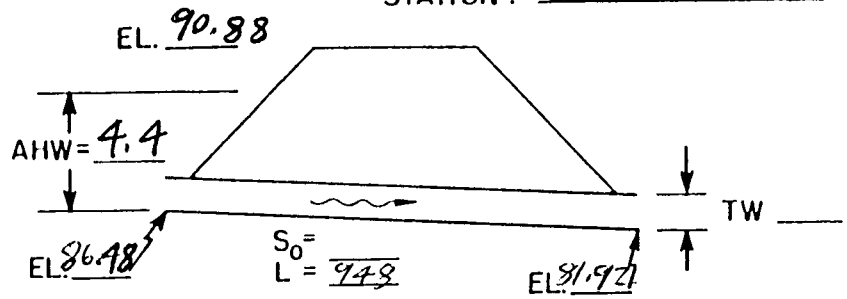
Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION : _____



MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION										CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
			INLET CONT.		OUTLET CONTROL $HW = H + h_o - LS_o$											
			$\frac{HW}{D}$	HW	K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW				
2-10'x4'	500		1.05	4.2	.4	1.2	2.1	3.0	3.8	3.8	4.56	0.4	4.2			O.K.

SUMMARY & RECOMMENDATIONS:

Figure 7

PROJECT: 99th Ave. # 94154 DESIGNER: TAB

BURNS DRIVE PROPOSED CULVERT DATE: 8-1-95

HYDROLOGIC AND CHANNEL INFORMATION

ALTERNATE E

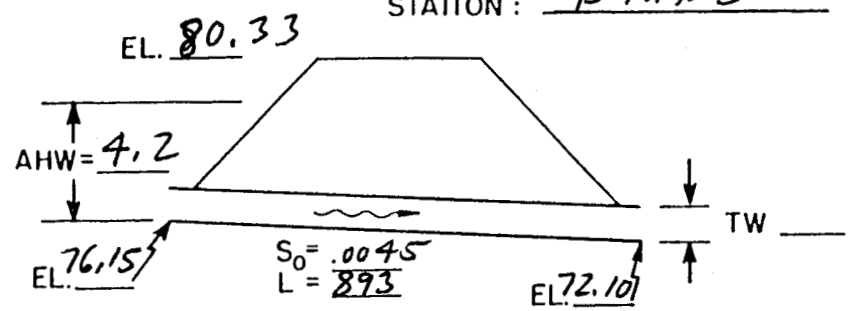
Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION: BURNS



MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT.		OUTLET CONTROL $HW = H + h_0 - LS_0$								CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
			$\frac{HW}{D}$	HW	K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_0	LS_0	HW				
2-12'x4'	720		1.23	4.9	.4						4.05					TOO HIGH
3-10'x4'	720		1.03	4.1	.4	2.3	2.7	3.4	4.4	4.4	4.05	2.7	4.1			O.K.

SUMMARY & RECOMMENDATIONS:

Figure 7

PROJECT: 99th Ave. # 94154 DESIGNER: TAB

GREENWAY RD. PROPOSED CULVERT DATE: 8-1-95

HYDROLOGIC AND CHANNEL INFORMATION

ALTERNATE E

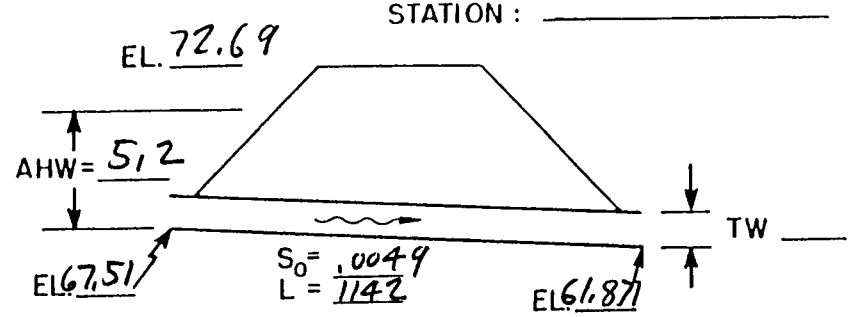
Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION : _____



MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT.		OUTLET CONTROL HW=H + h_o − LS_o								CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
			$\frac{HW}{D}$	HW	K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW				
2-10'x4'	700		1.42	5.7	.4											TOO HIGH
2-12'x4'	700		1.20	4.8	.4	3.9	3.0	3.5	4.3	4.3	5.64	2.5	4.8			O.K.

SUMMARY & RECOMMENDATIONS:

Figure 7

PROJECT: 99th Ave. # 94154 DESIGNER: TAB

BOSWELL BOULEVARD PROPOSED CULVERT DATE: 8-1-95

HYDROLOGIC AND CHANNEL INFORMATION

ALTERNATE E

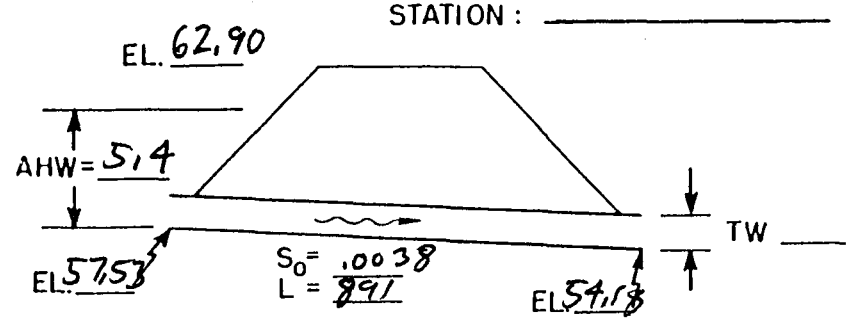
Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION : _____



MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION										CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
			INLET CONT.		OUTLET CONTROL $HW = H + h_0 - LS_0$											
			$\frac{HW}{D}$	HW	K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_0	LS_0	HW				
2-10'x4'	630		1.30	5.2	.4	4.0	3.1	3.6	4.1	4.1	3.35	4.7	5.2			O.K.

SUMMARY & RECOMMENDATIONS:

Figure 7

PROJECT: 99th Ave. # 94154 DESIGNER: TAB

T-BIRD ROAD PROPOSED CULVERT DATE: 8-1-95

HYDROLOGIC AND CHANNEL INFORMATION

ALTERNATE E

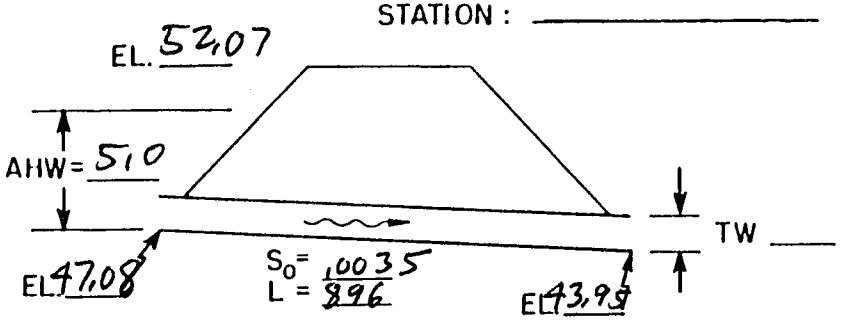
Q_1 = _____ TW_1 = _____

Q_2 = _____ TW_2 = _____

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION : _____



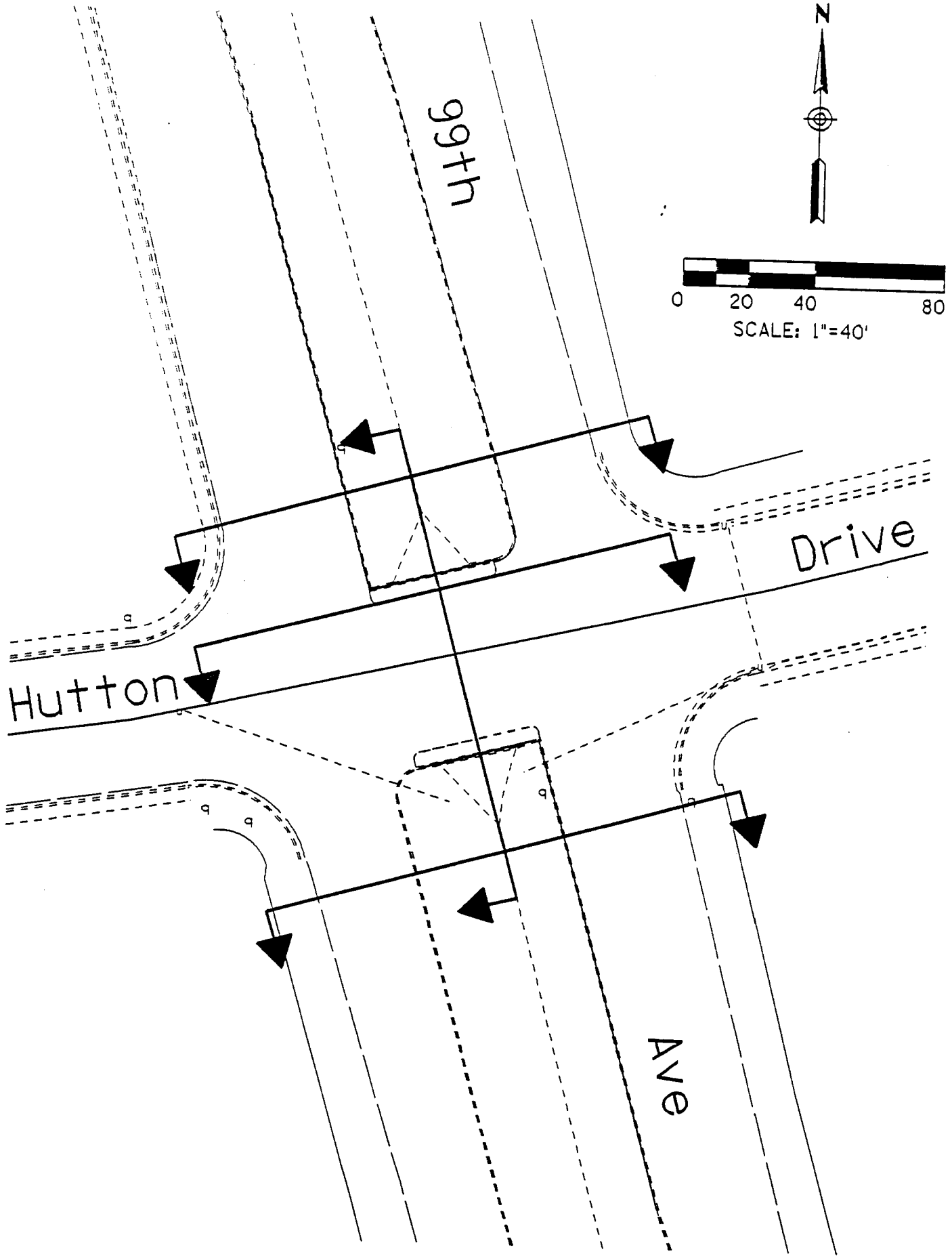
MEAN STREAM VELOCITY = _____

MAX. STREAM VELOCITY = _____

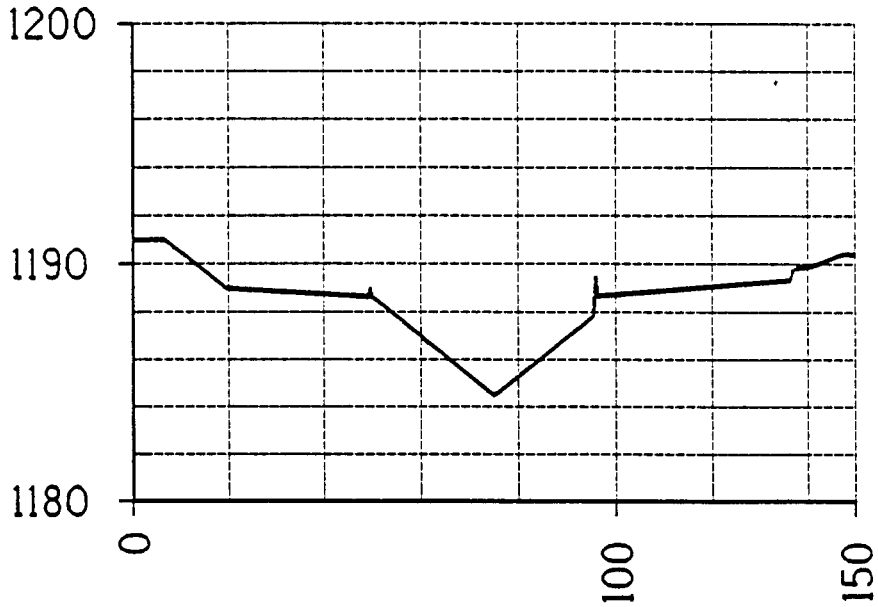
CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION										CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
			INLET CONT.		OUTLET CONTROL $HW = H + h_0 - LS_0$											
			$\frac{HW}{D}$	HW	K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_0	LS_0	HW				
2-10'X4'	720		1.47	5.9	.4											TOO HIGH
2-12'X4'	720		1.25	5.0	.4	3.5	3.0	3.5	3.7	3.7	3.13	4.0	5.0			O.K.

SUMMARY & RECOMMENDATIONS:

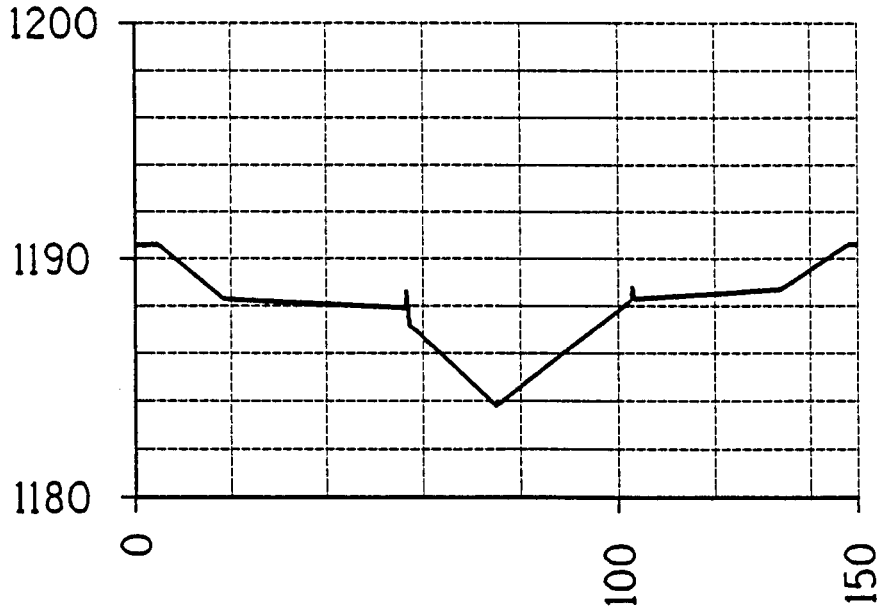
Figure 7


99th
Ave
Hutton
Drive
N
0
20
40
80
SCALE: 1"=40'

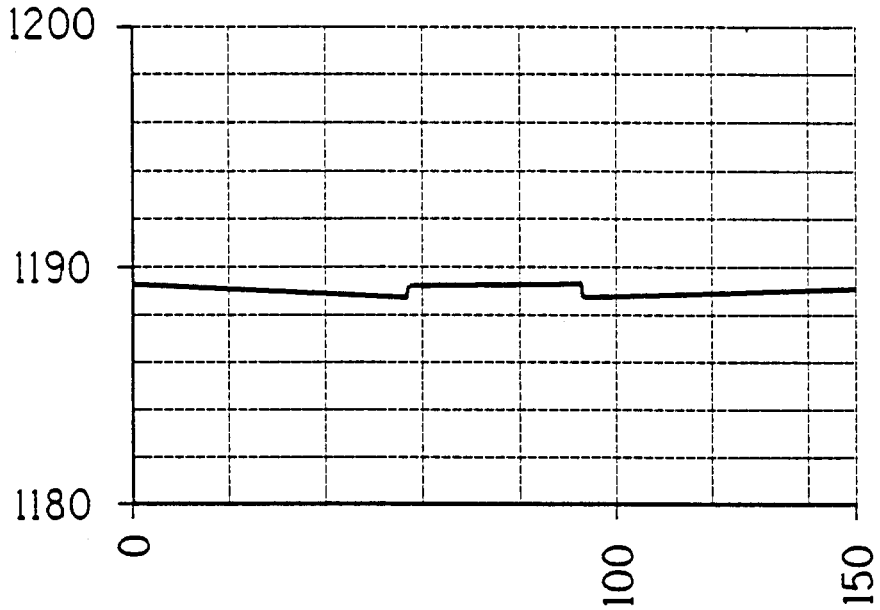
Hutton Drive (60' upstream)



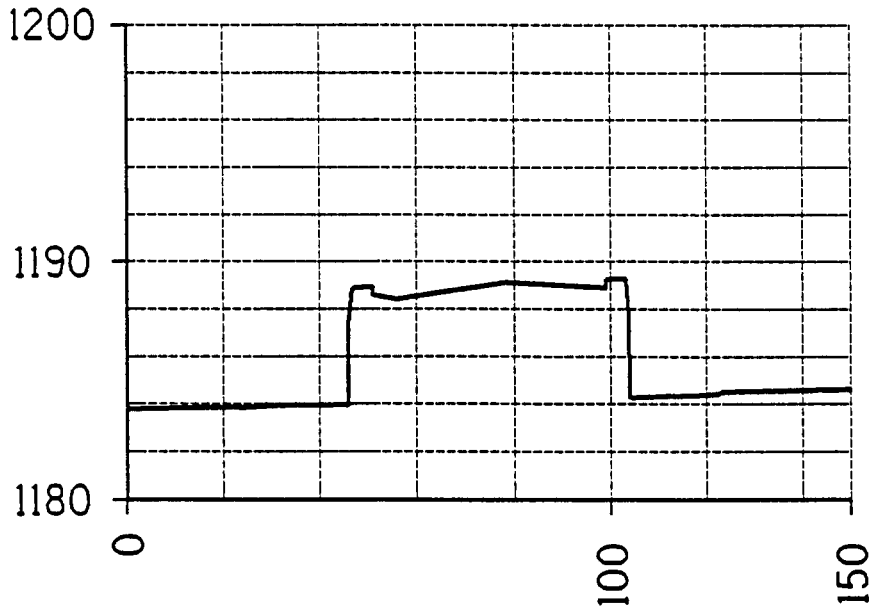
Hutton Drive (60' downstream)

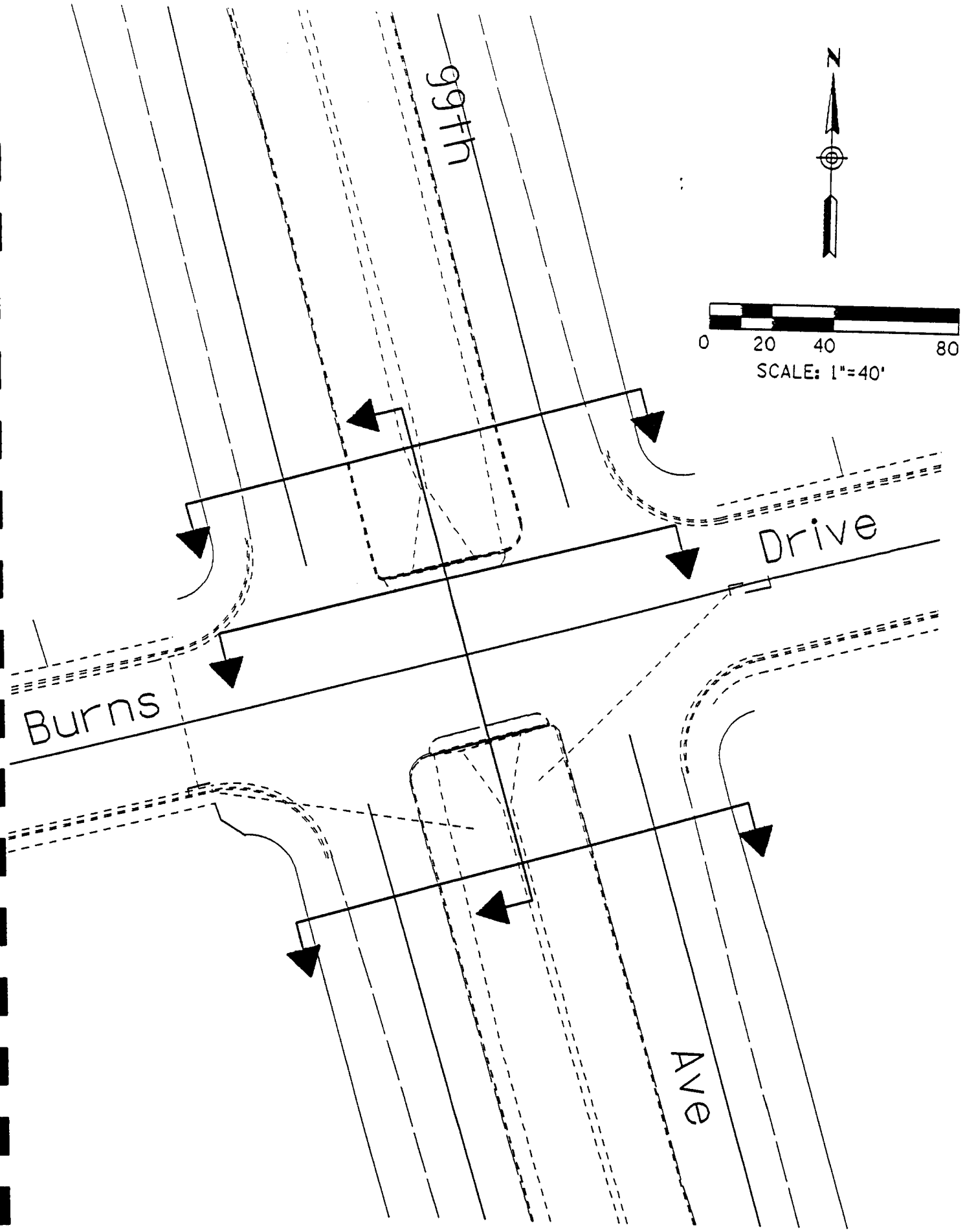


Hutton Drive (overtopping)

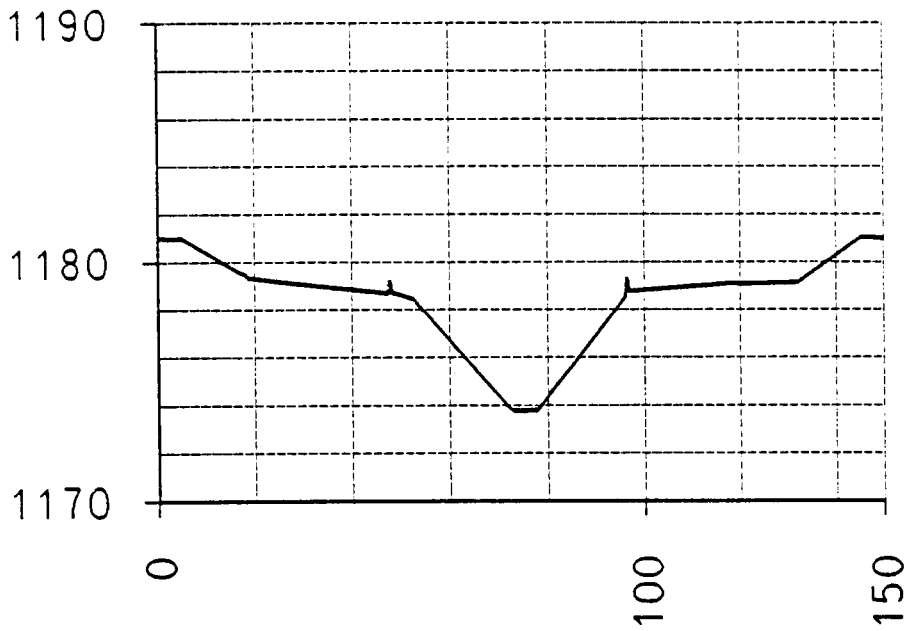


Hutton Drive (profile)

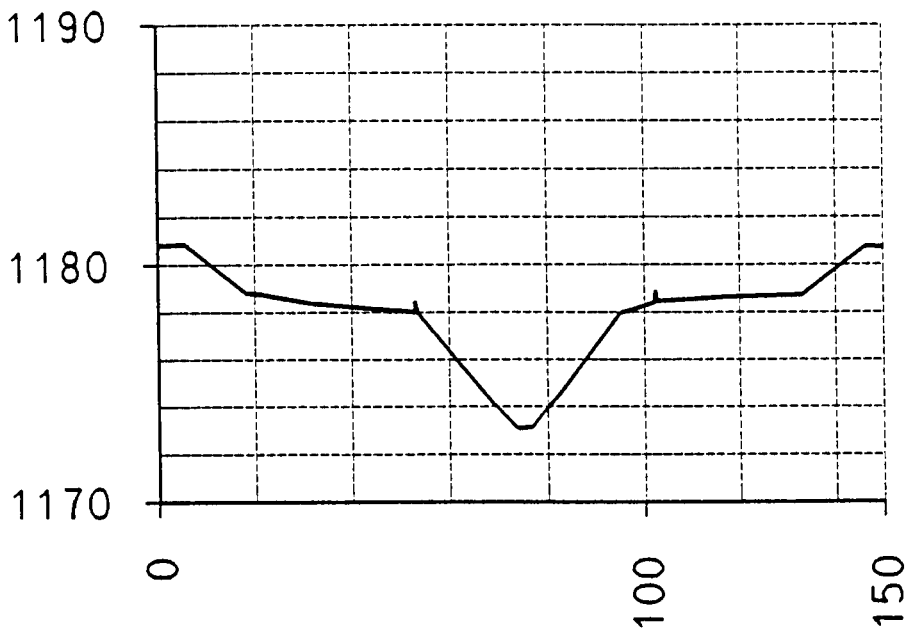



N
0
20
40
80
SCALE: 1"=40'
99th
Ave
Burns
Drive

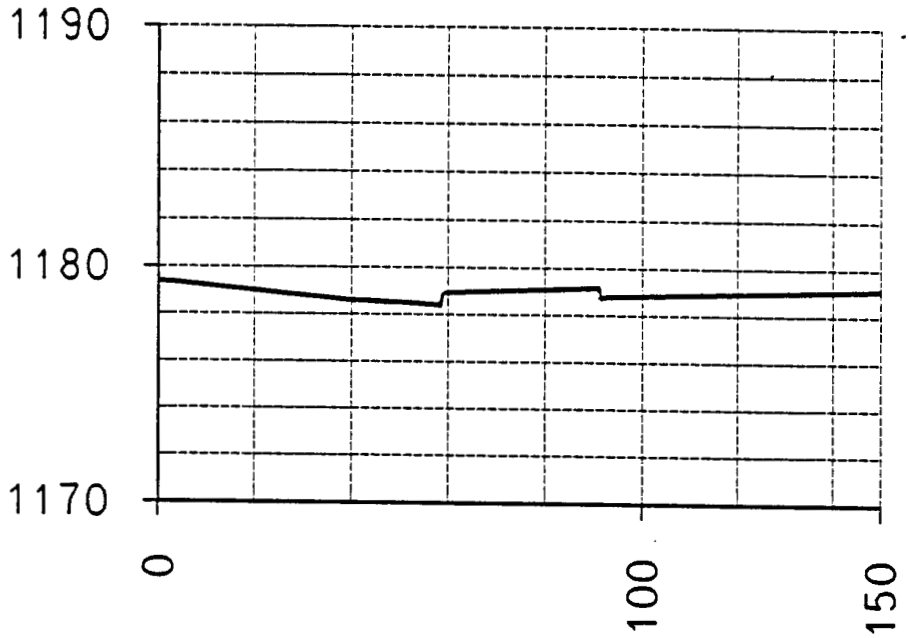
Burns Drive (70' upstream)



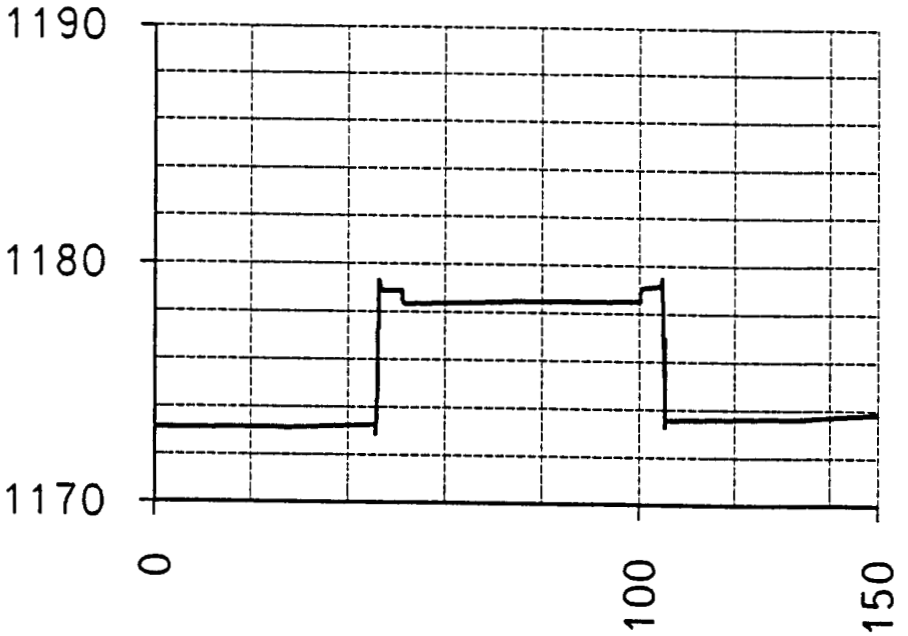
Burns Drive (70' downstream)



Burns Drive (overtopping)

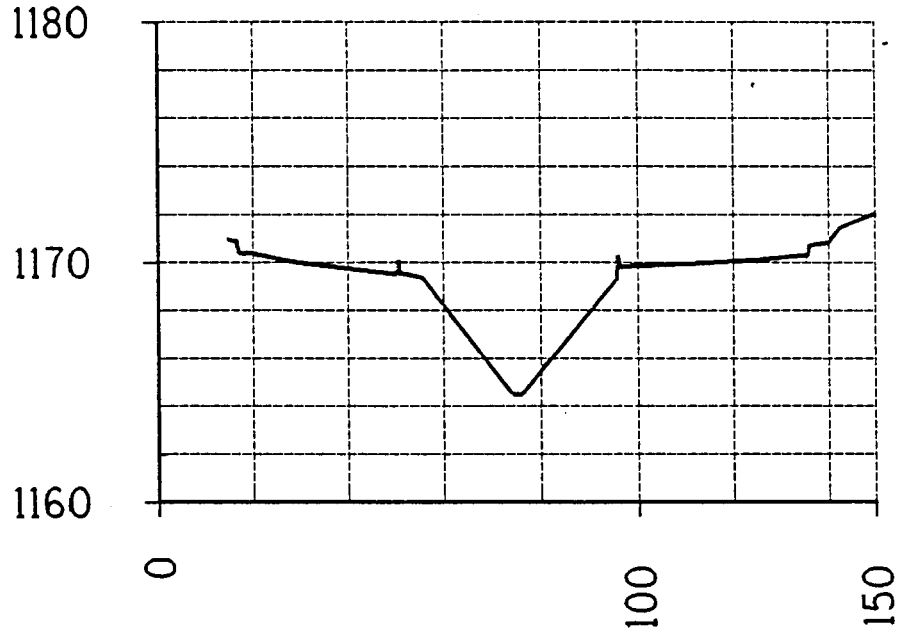


Burns Drive (profile)

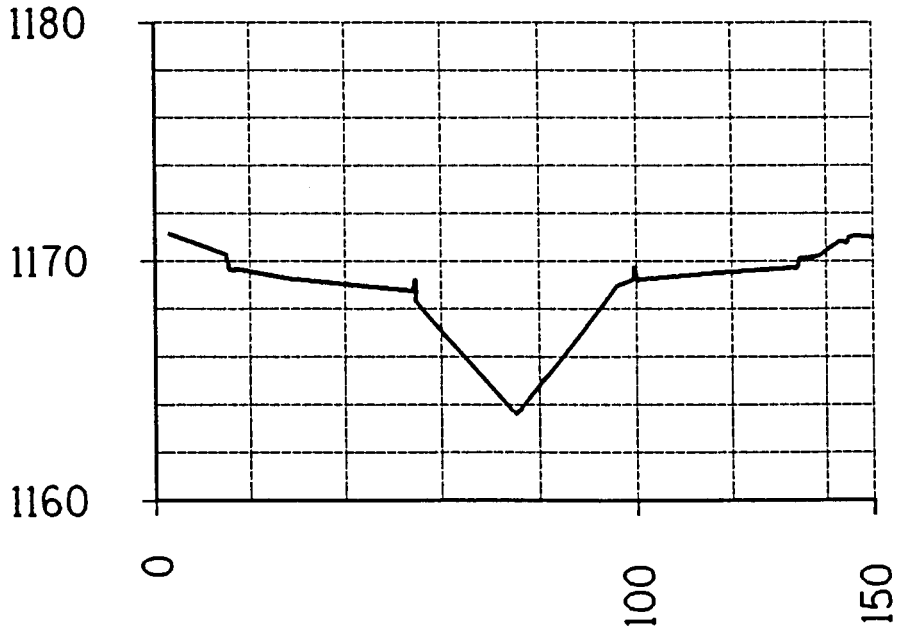


N
0
20
40
80
SCALE: 1"=40'
99th
Ave
Greenway
Road

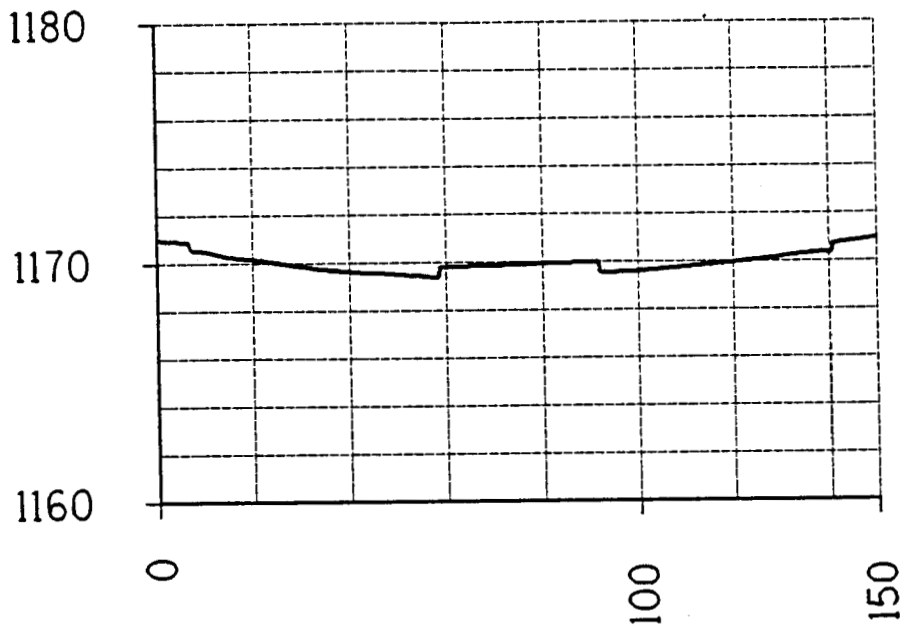
Greenway Road (65' upstream)



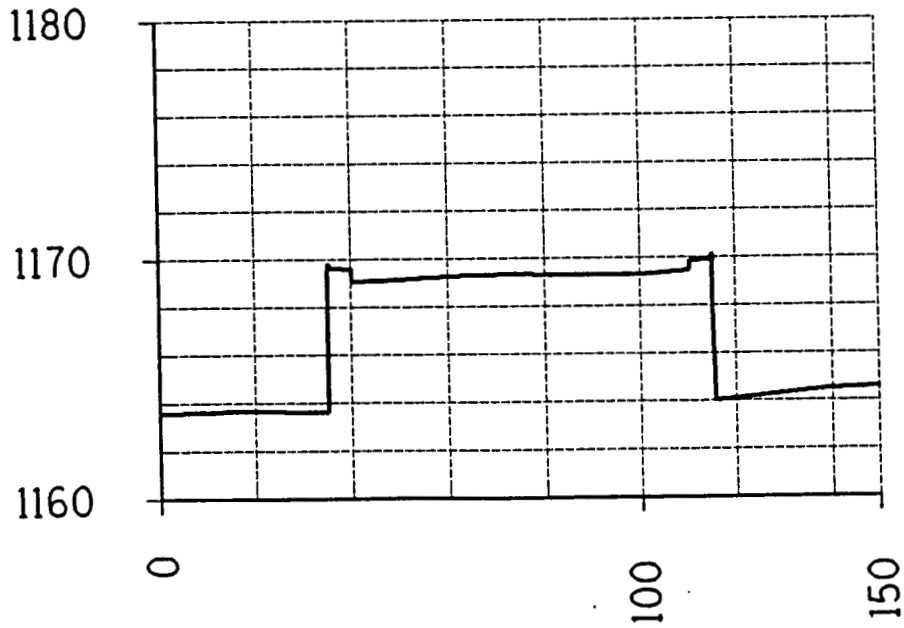
Greenway Rd (65' downstream)

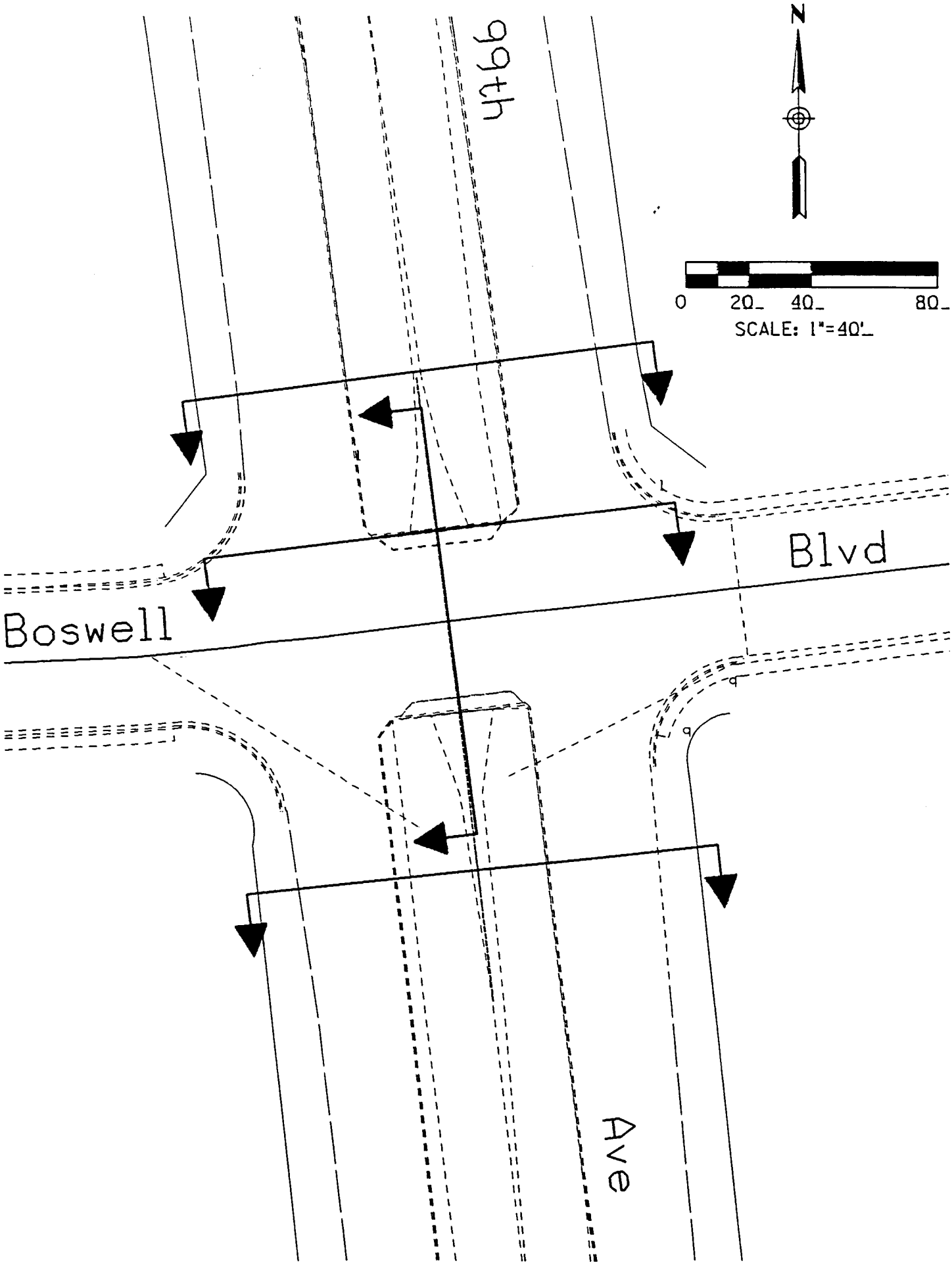


Greenway Rd (overtopping)

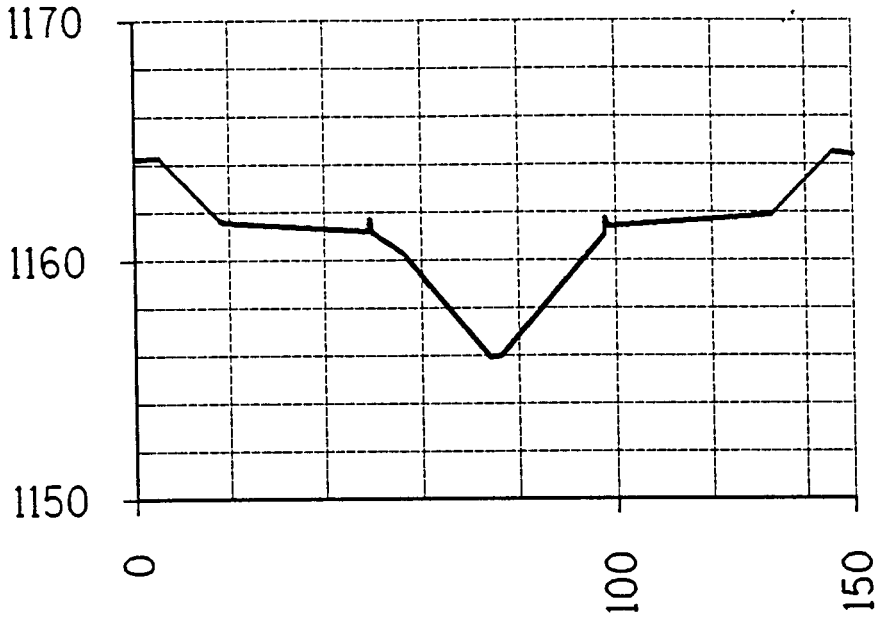


Greenway Rd (profile)

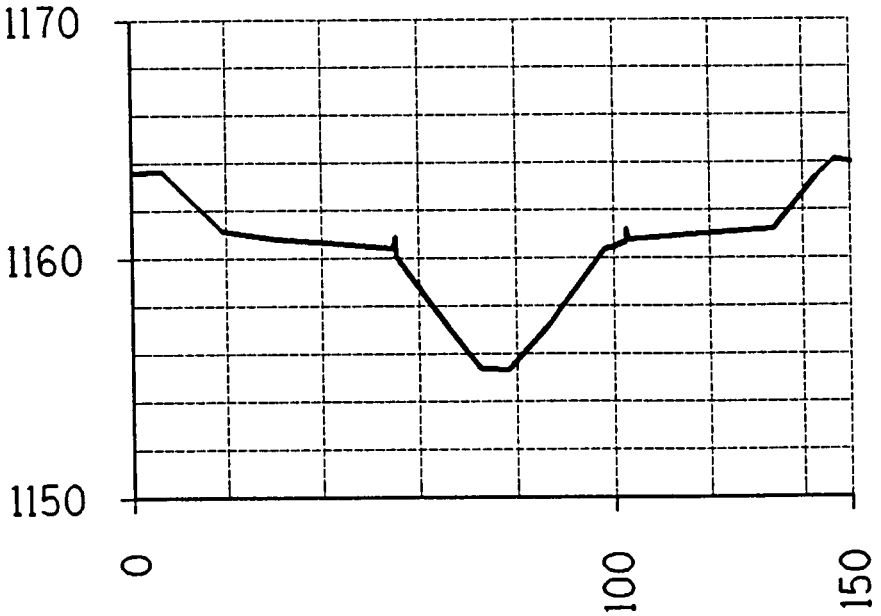



N
0
20
40
80
SCALE: 1"=40'
99th
Ave
Boswell
Blvd

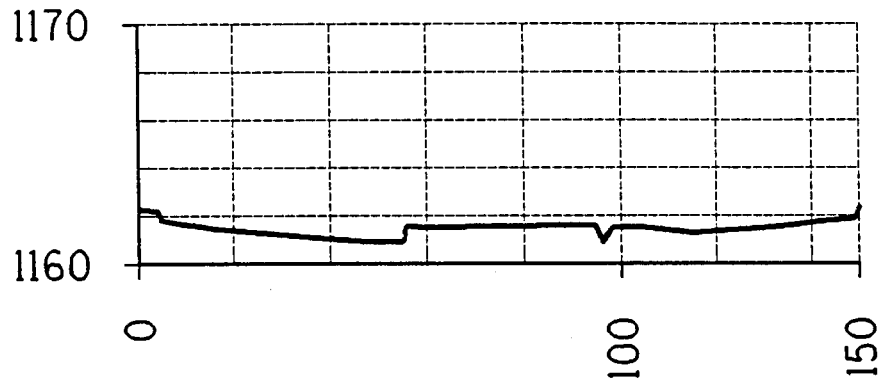
Boswell Blvd. (80' upstream)



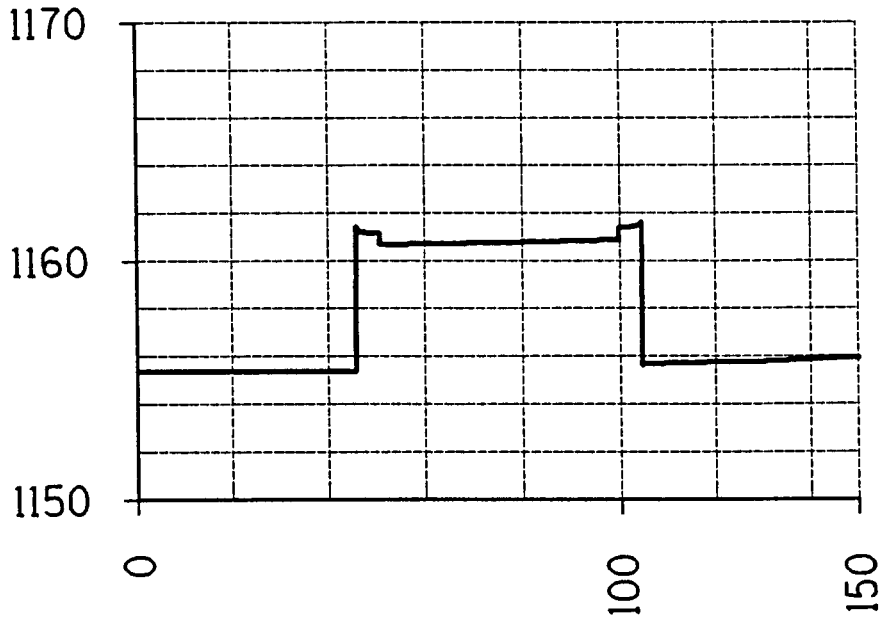
Boswell Blvd. (80' downstream)

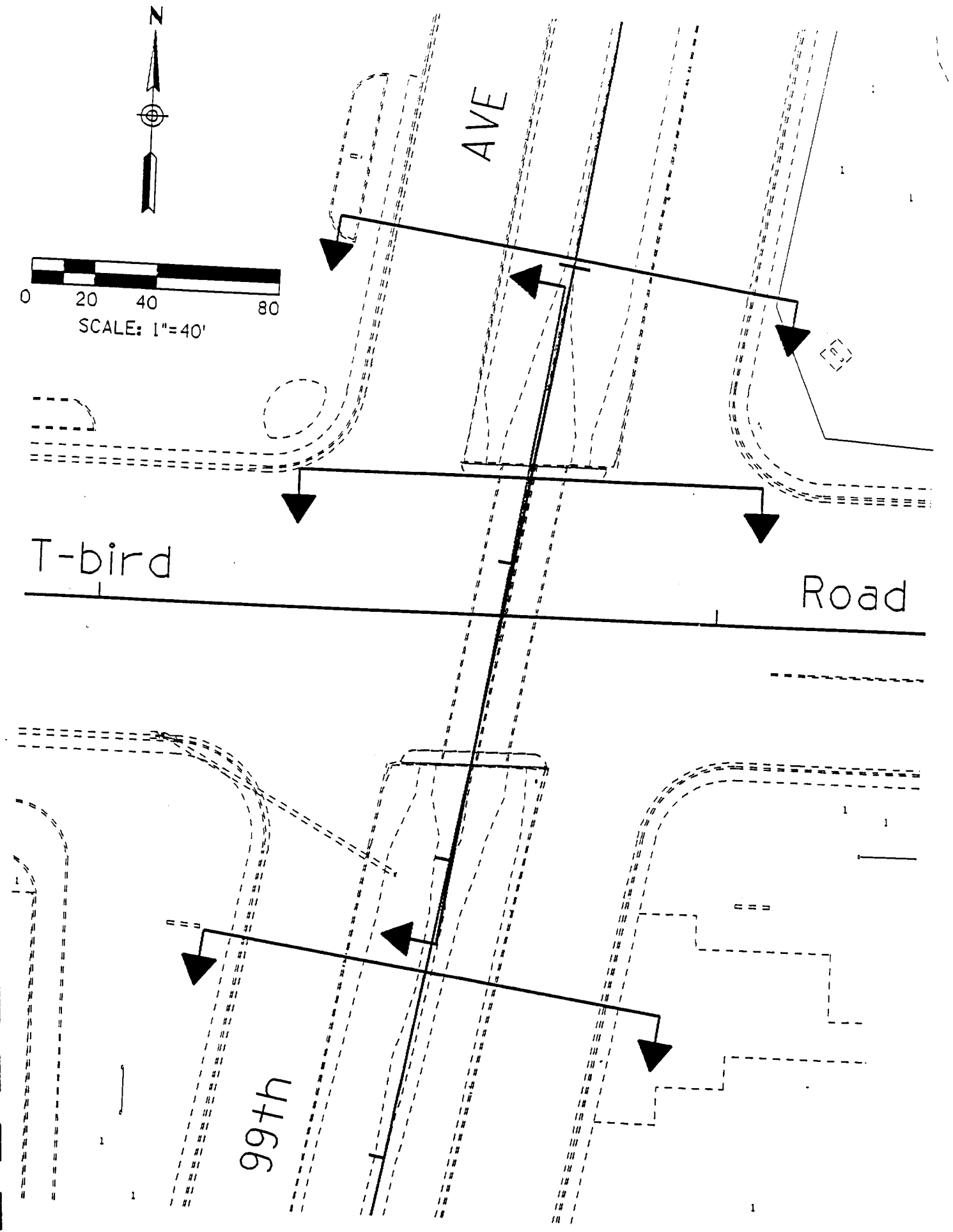


Boswell Blvd. (overtopping)

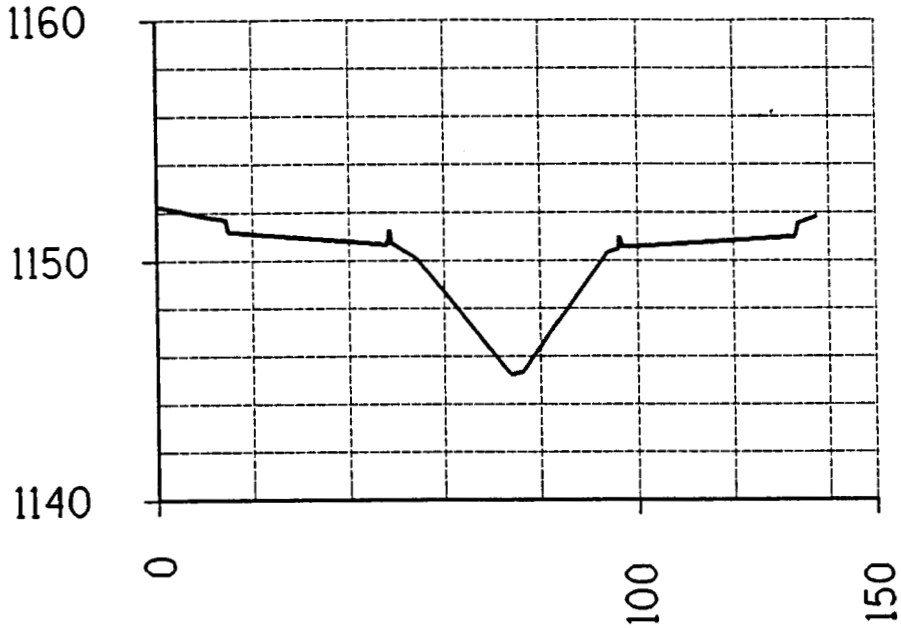


Boswell Blvd. (profile)

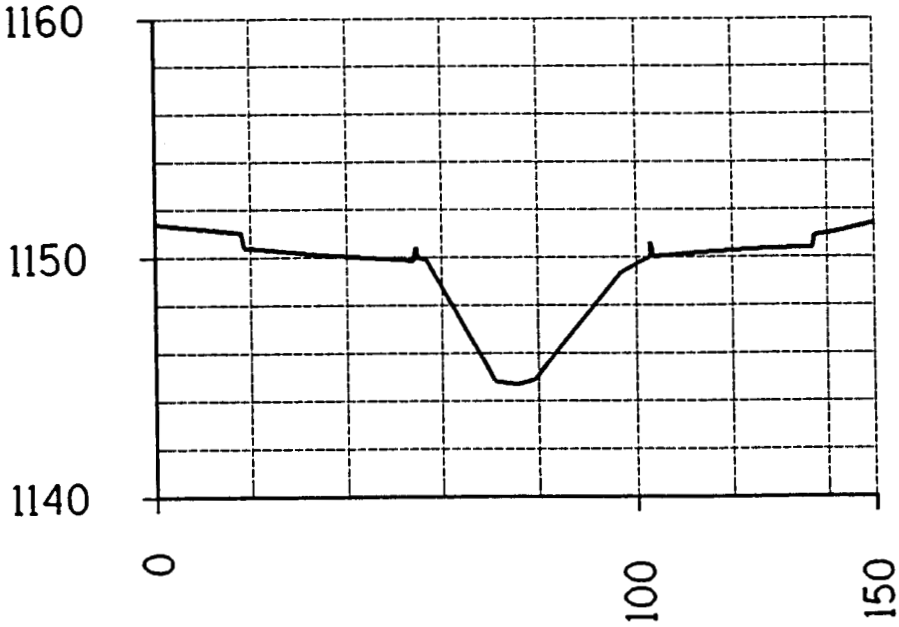



N
0
20
40
80
SCALE: 1"=40'
AVE
T-bird
Road
99th

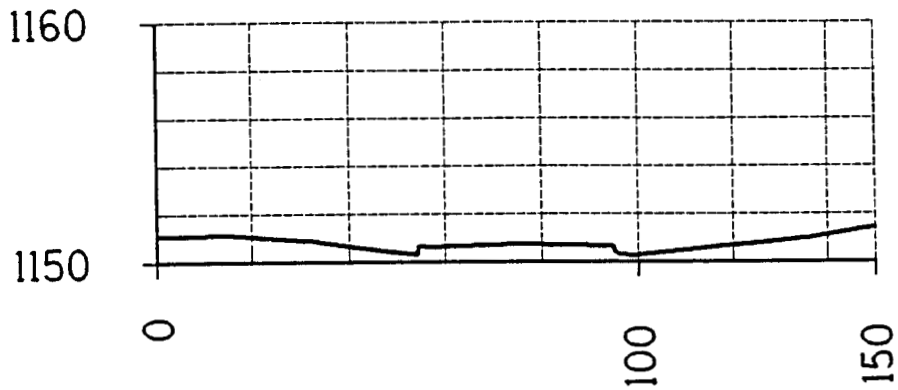
T-bird Road (120' upstream)



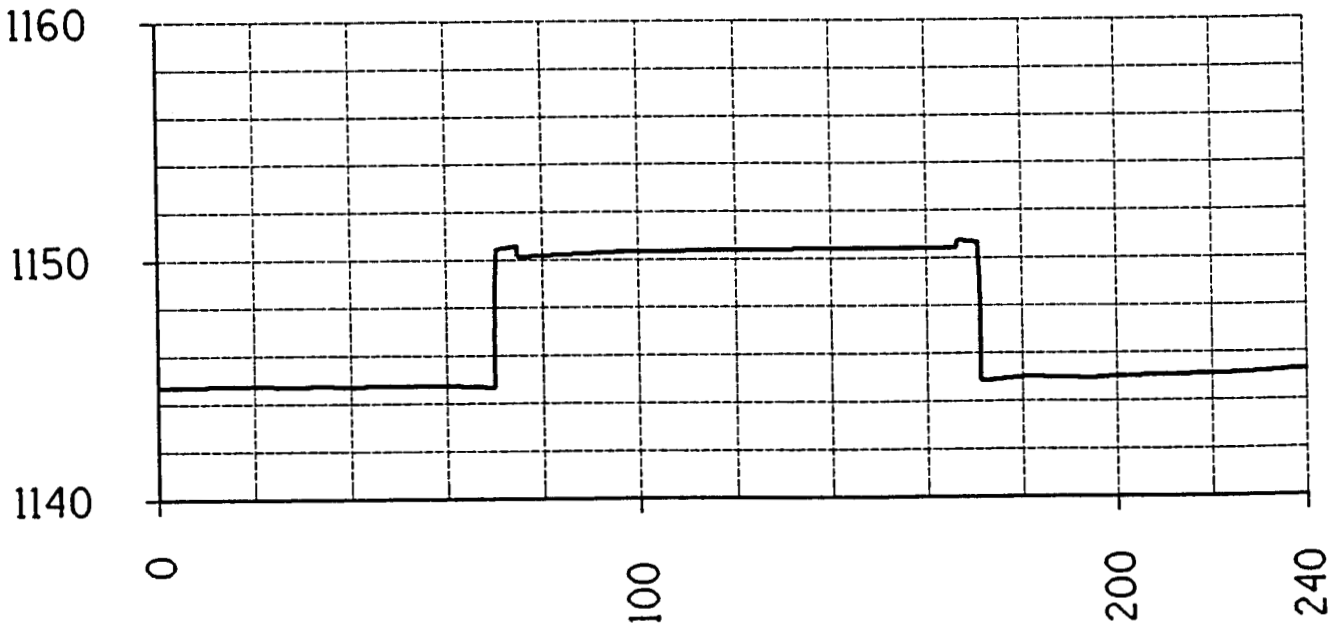
T-bird Road (120' downstream)

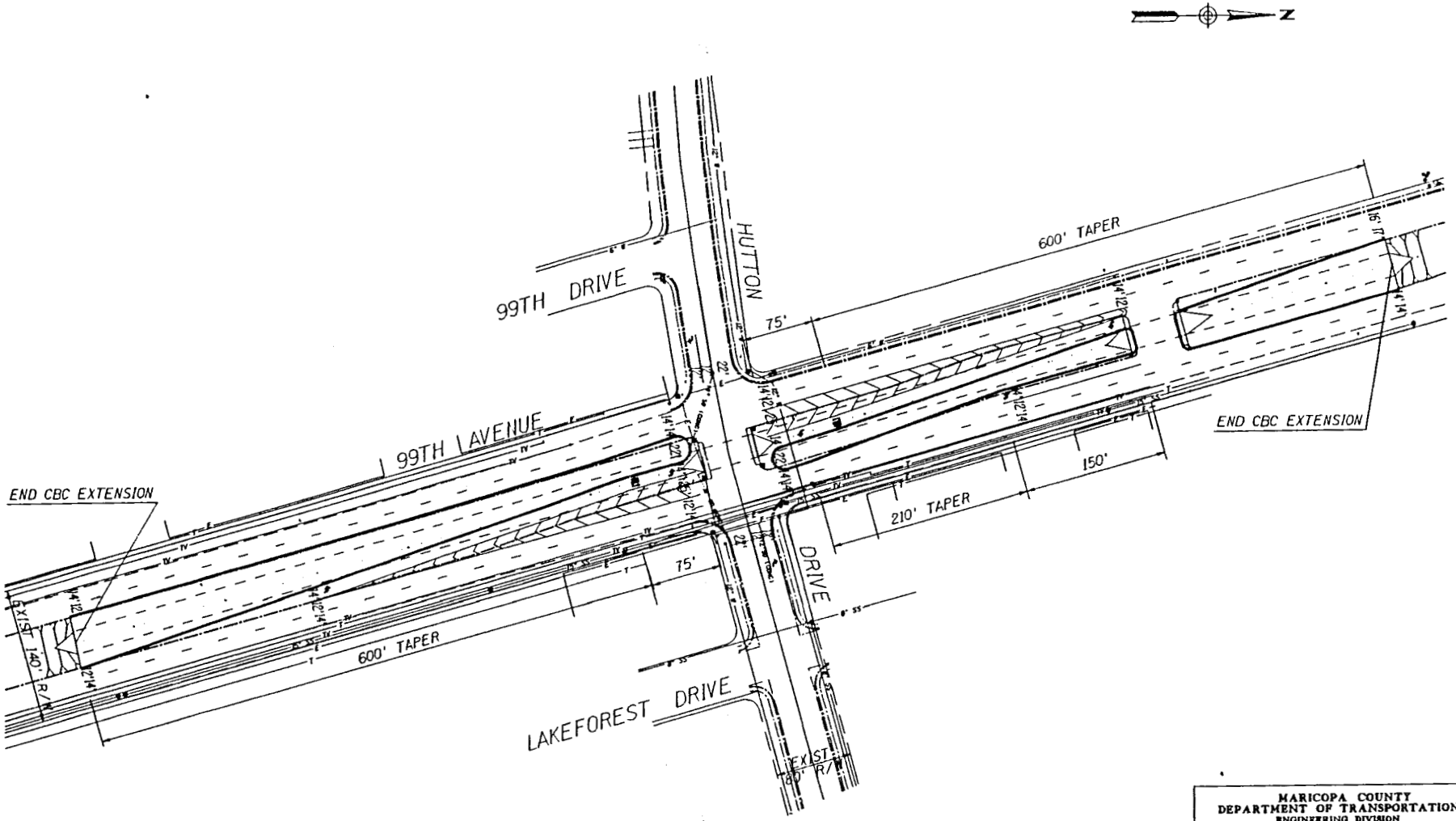


T-bird Road (overtopping)



T-bird Road (profile)





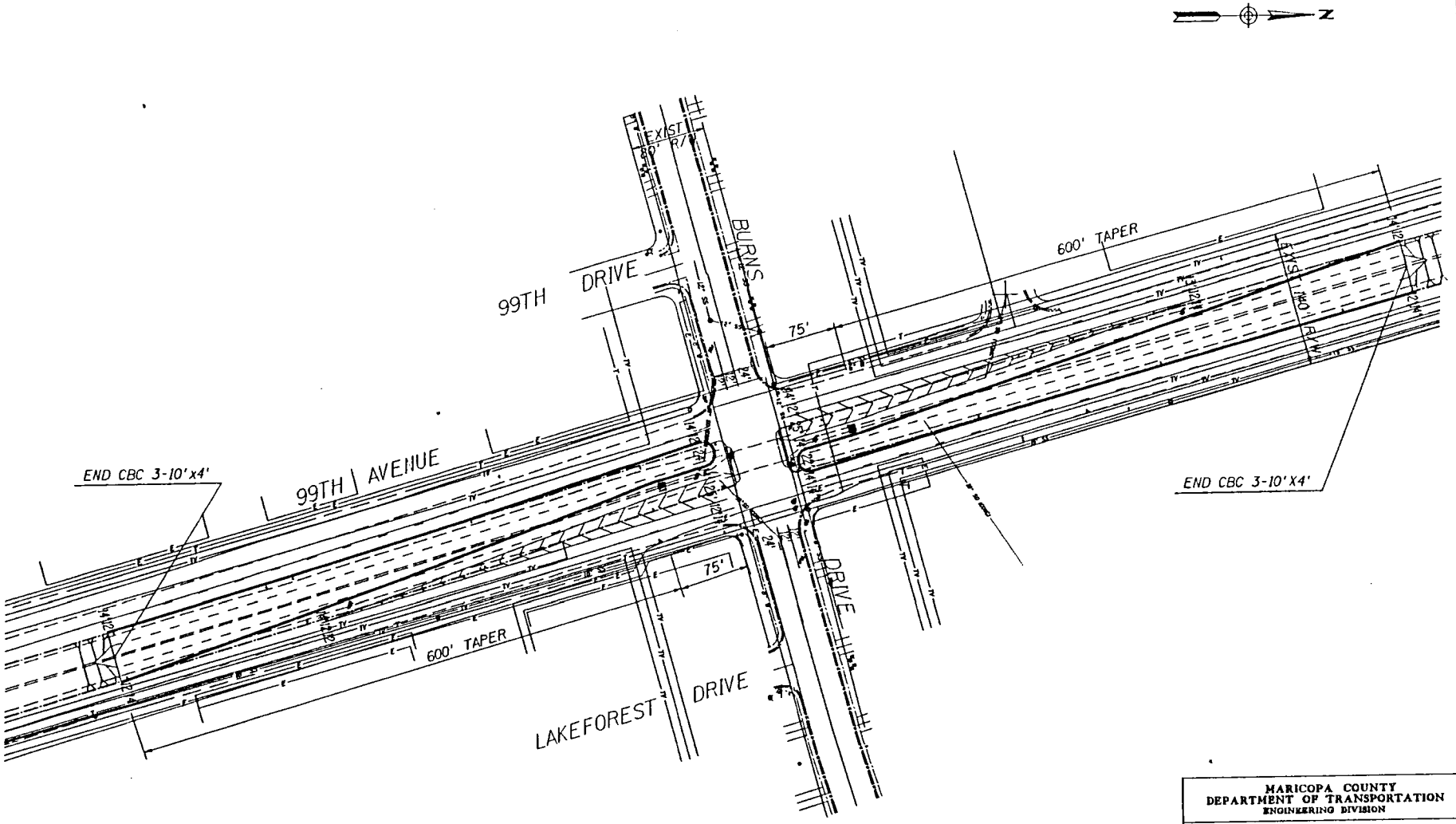
NOT TO SCALE

MARICOPA COUNTY
DEPARTMENT OF TRANSPORTATION
ENGINEERING DIVISION

HUTTON DRIVE - ALTERNATE "A"

Hendrich, Eberhart & Associates, Inc.
CONSULTING ENGINEERS

I:\94154\a-httn.dgn Aug. 10, 1995 06:49:25



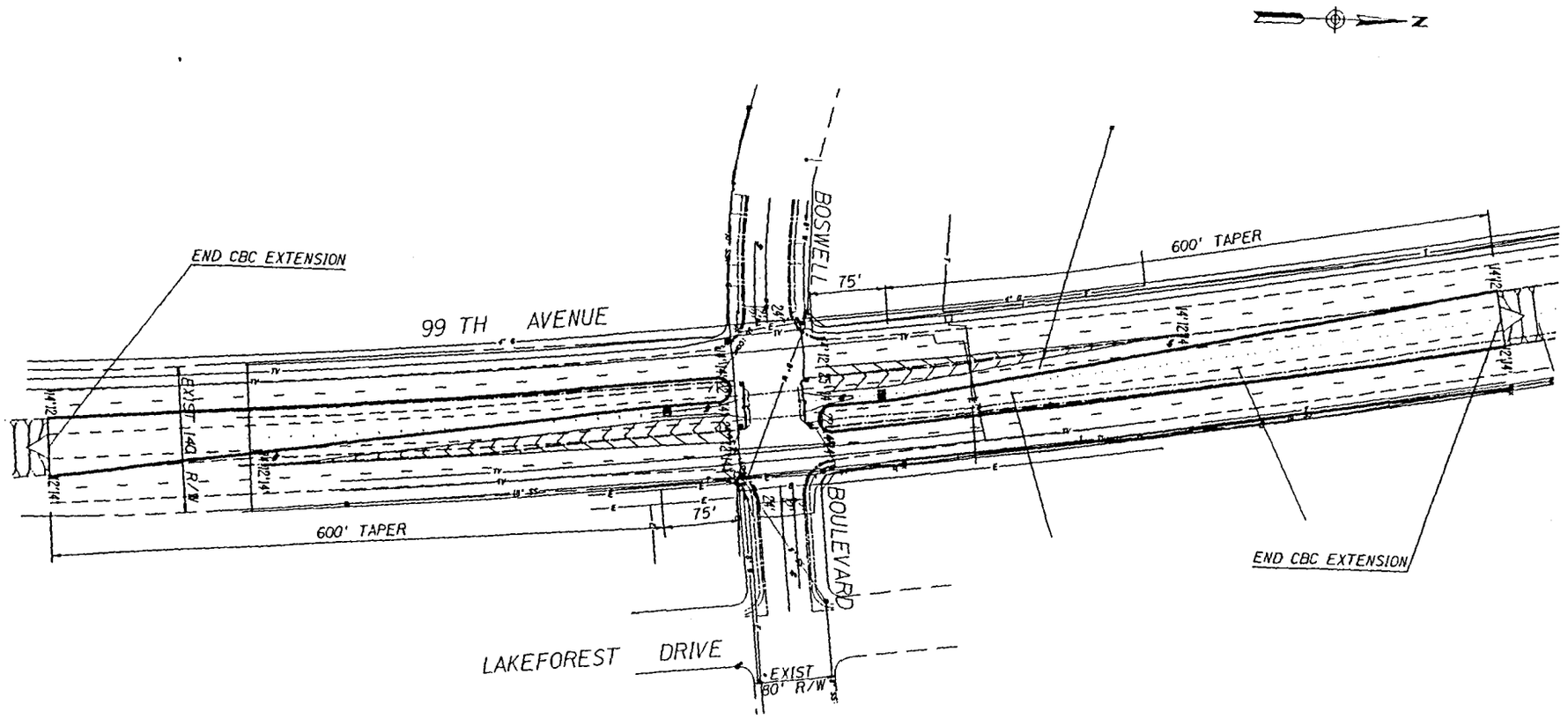
MARICOPA COUNTY
DEPARTMENT OF TRANSPORTATION
ENGINEERING DIVISION

BURNS DRIVE - ALTERNATE "A"

Hendrich, Eberhart & Associates, Inc.
CONSULTING ENGINEERS
POINTE BUSINESS PLAZA
7227 N. 16TH ST. SUITE 207
PHOENIX, ARIZONA 85020
MED TO 5003
FAX: (602) 943-3883

NOT TO SCALE

I:\94154\a-burns.dgn Aug. 10, 1995 06:37:55



MARICOPA COUNTY
DEPARTMENT OF TRANSPORTATION
ENGINEERING DIVISION

BOSWELL BOULEVARD - ALTERNATE "A"

Hendrich, Eberhart & Associates, Inc.
CONSULTING ENGINEERS

NOT TO SCALE

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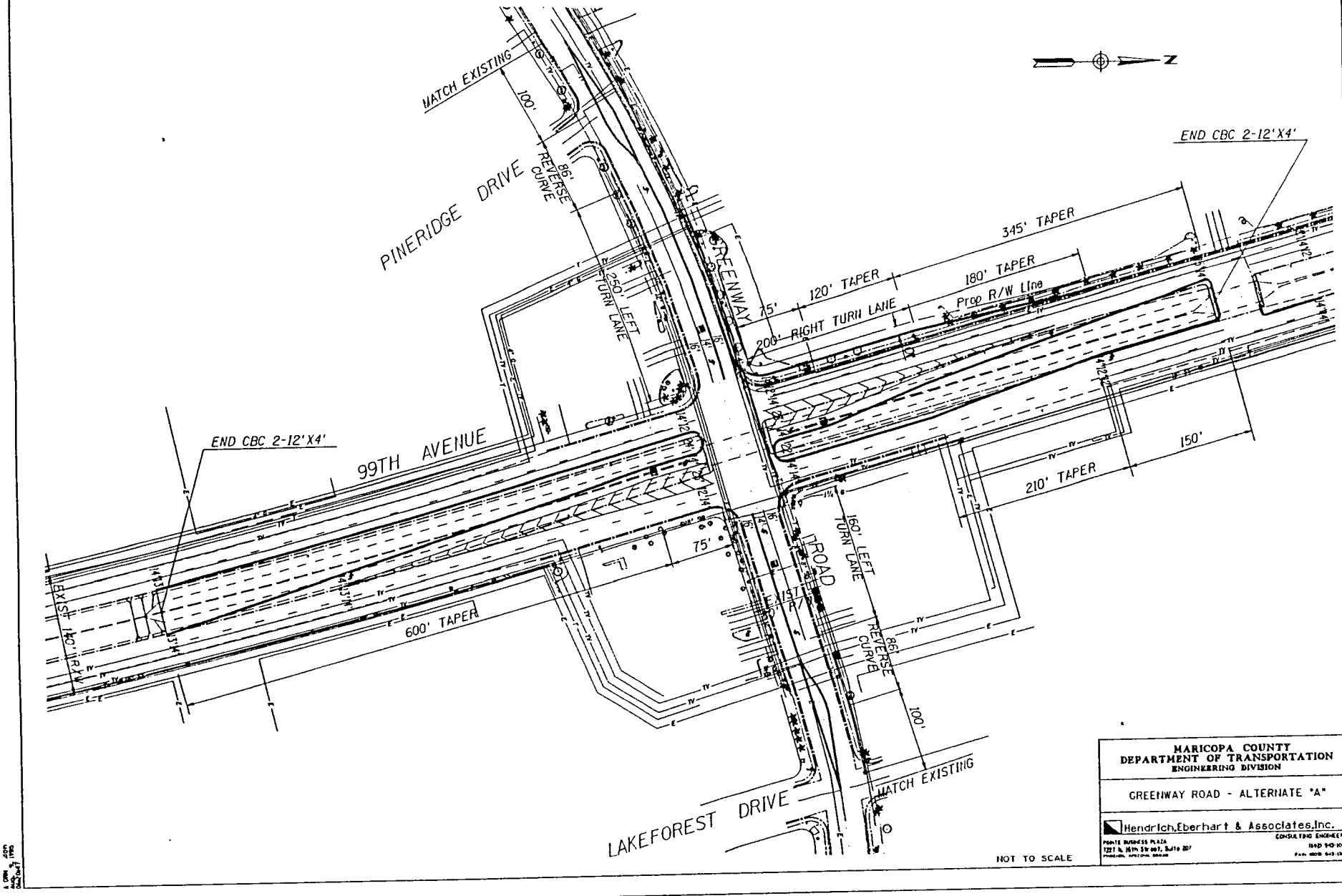

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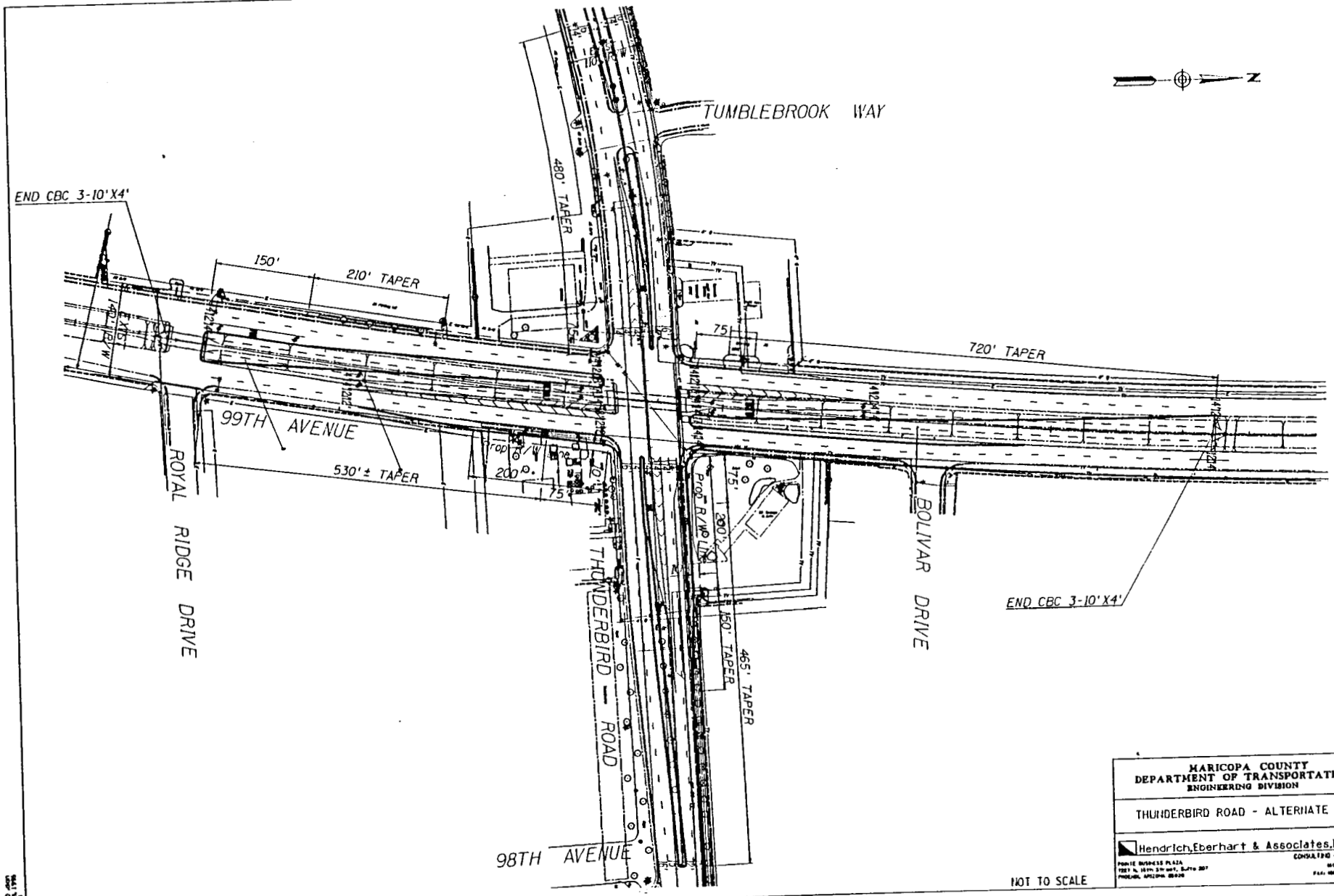

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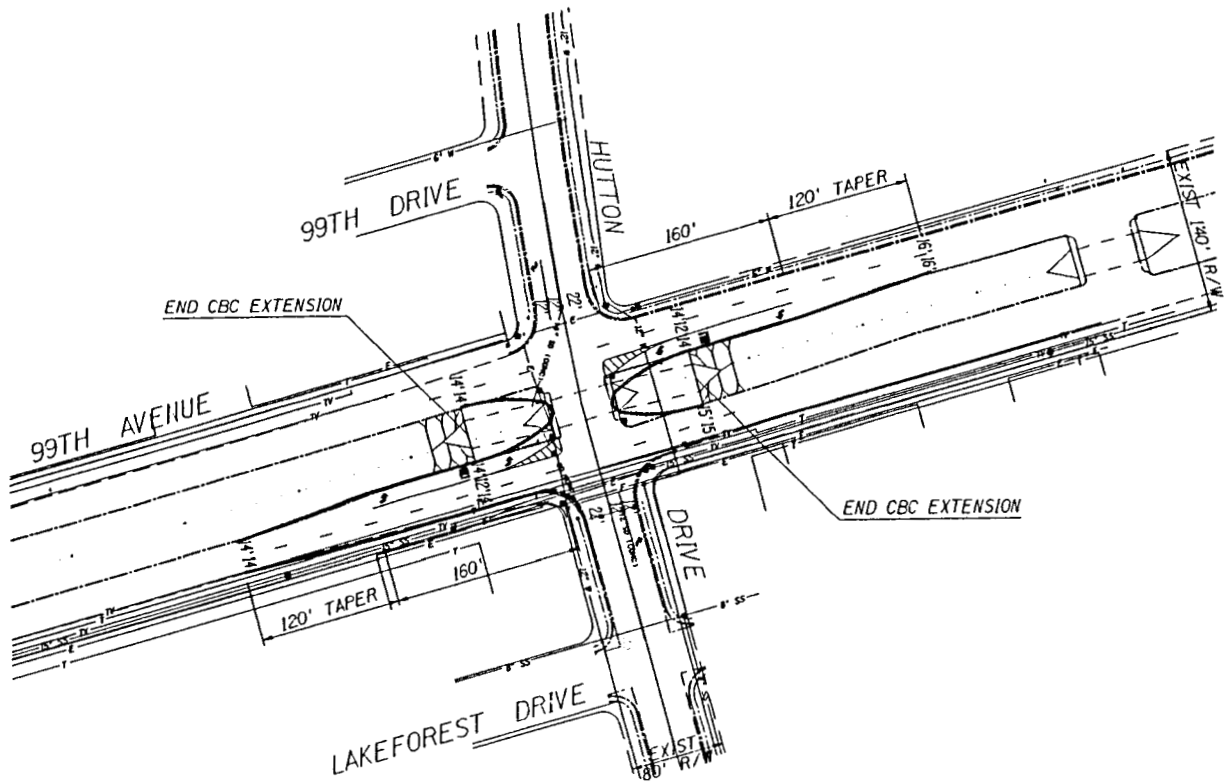

NOT TO SCALE

MARICOPA COUNTY
DEPARTMENT OF TRANSPORTATION
ENGINEERING DIVISION

HUTTON DRIVE - ALTERNATE "C"

Hendrich, Eberhart & Associates, Inc.
CONSULTING ENGINEERS
POINTE BUSINESS PLAZA
7201 N. 16TH STREET, SUITE 201
PHOENIX, ARIZONA 85020
PHONE (602) 943-1003
FAX: (602) 943-1303

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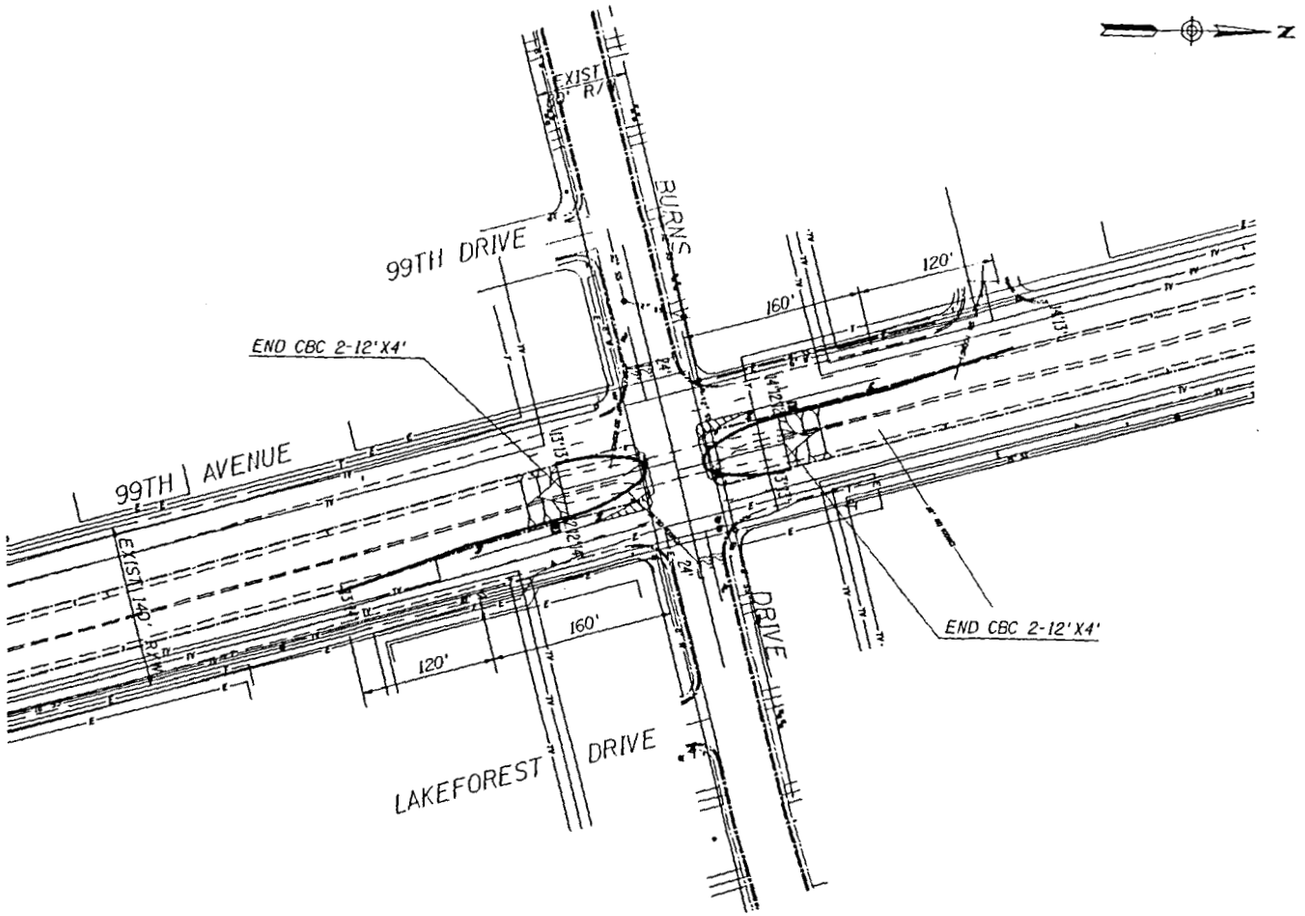

MARICOPA COUNTY
DEPARTMENT OF TRANSPORTATION
ENGINEERING DIVISION

BURNS DRIVE - ALTERNATE "C"

Hendrich, Eberhart & Associates, Inc.
CONSULTING ENGINEERS

NOT TO SCALE

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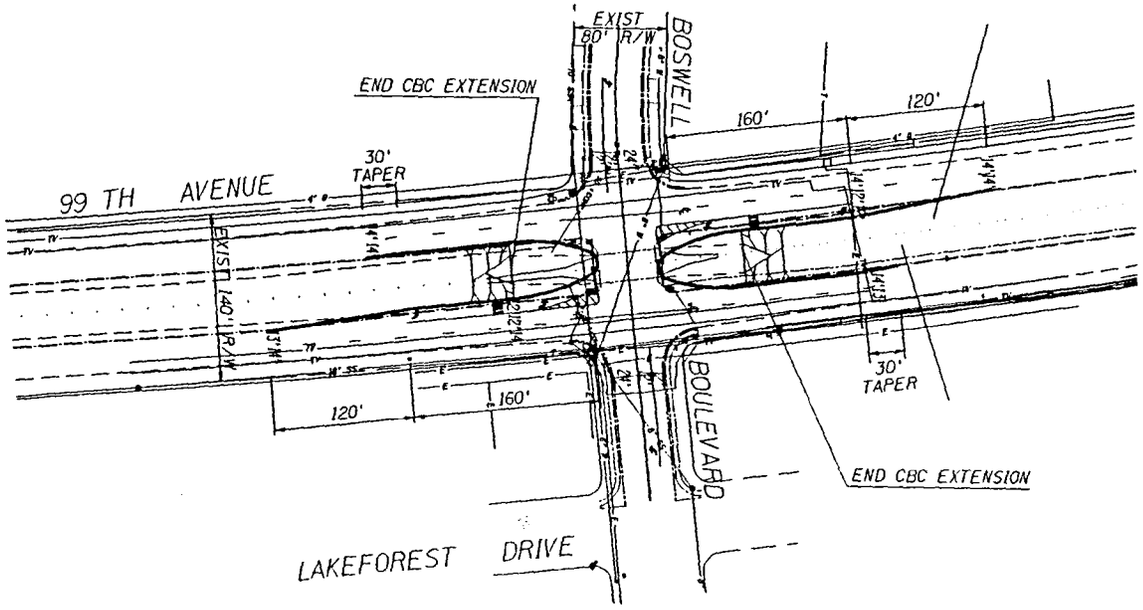

NOT TO SCALE

MARICOPA COUNTY
DEPARTMENT OF TRANSPORTATION
ENGINEERING DIVISION

BOSWELL BOULEVARD - ALTERNATE "C"

Hendrich, Eberhart & Associates, Inc.
CONSULTING ENGINEERS
POINTE BUSINESS PLAZA
PHOENIX, ARIZONA 85020
PHONE (602) 943-1003
FAX (602) 943-1303

C BOS
Aug 10, 1995
06:51:03

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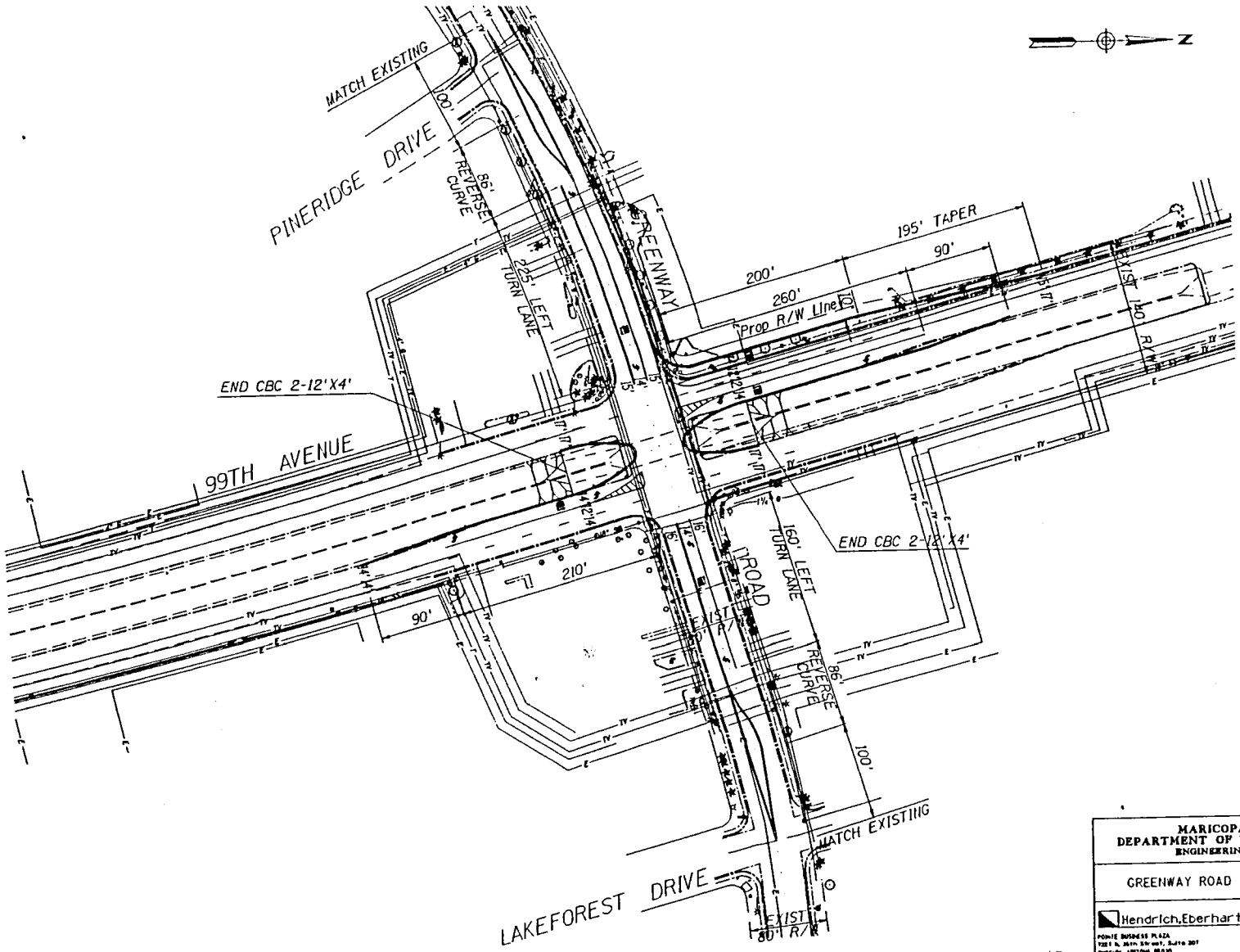

NOT TO SCALE

MARICOPA COUNTY
DEPARTMENT OF TRANSPORTATION
ENGINEERING DIVISION

GREENWAY ROAD - ALTERNATE "C"

Hendrich, Eberhart & Associates, Inc.
CONSULTING ENGINEERS
POINTE BUSINESS PLAZA
7201 N. 35th Street, Suite 207
PHOENIX, ARIZONA 85020
(602) 943-3003
FAX (602) 943-1383

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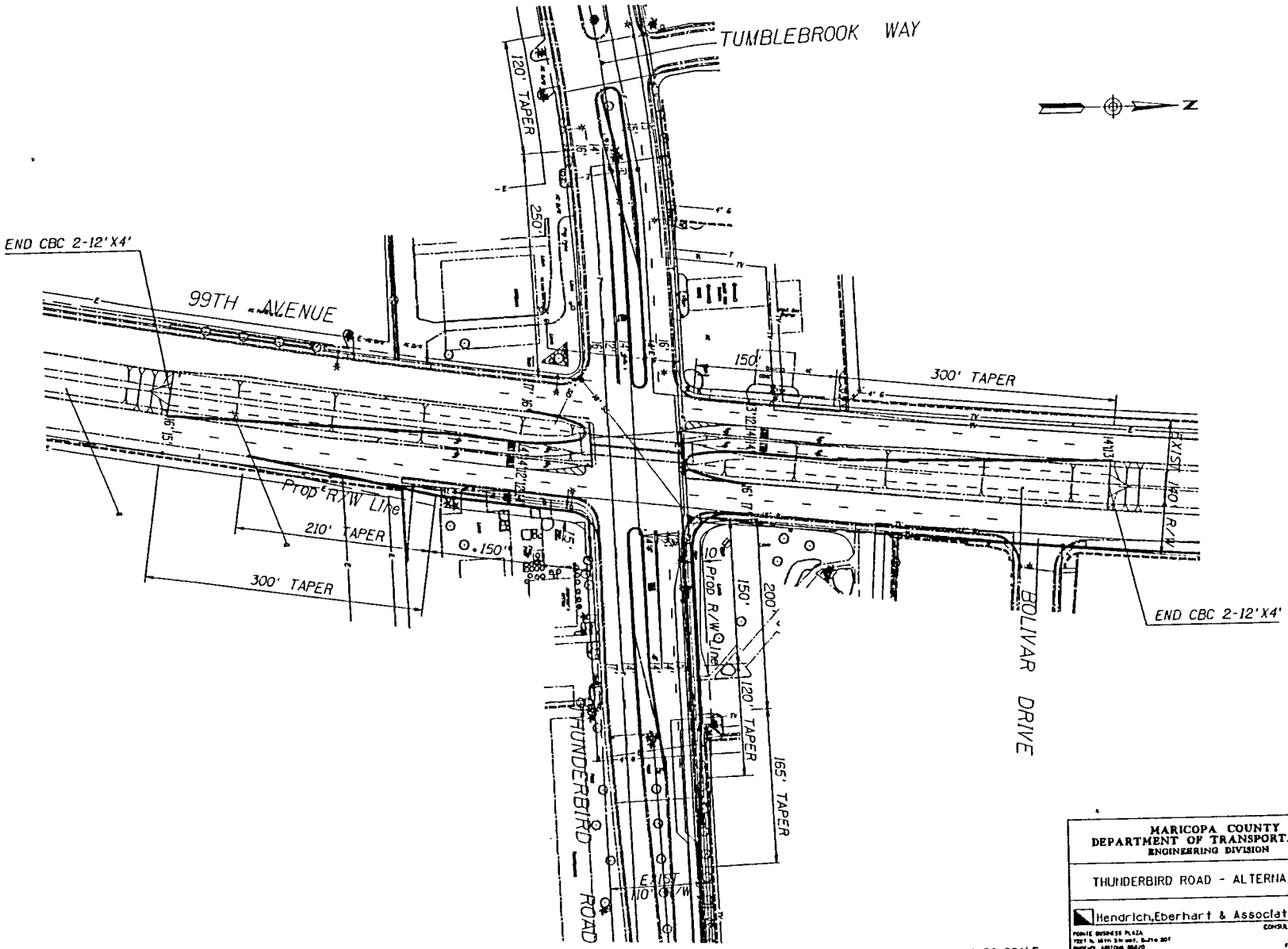

MARICOPA COUNTY
DEPARTMENT OF TRANSPORTATION
ENGINEERING DIVISION

THUNDERBIRD ROAD - ALTERNATE "C"

Hendrich, Eberhart & Associates, Inc.
CONSULTING ENGINEERS

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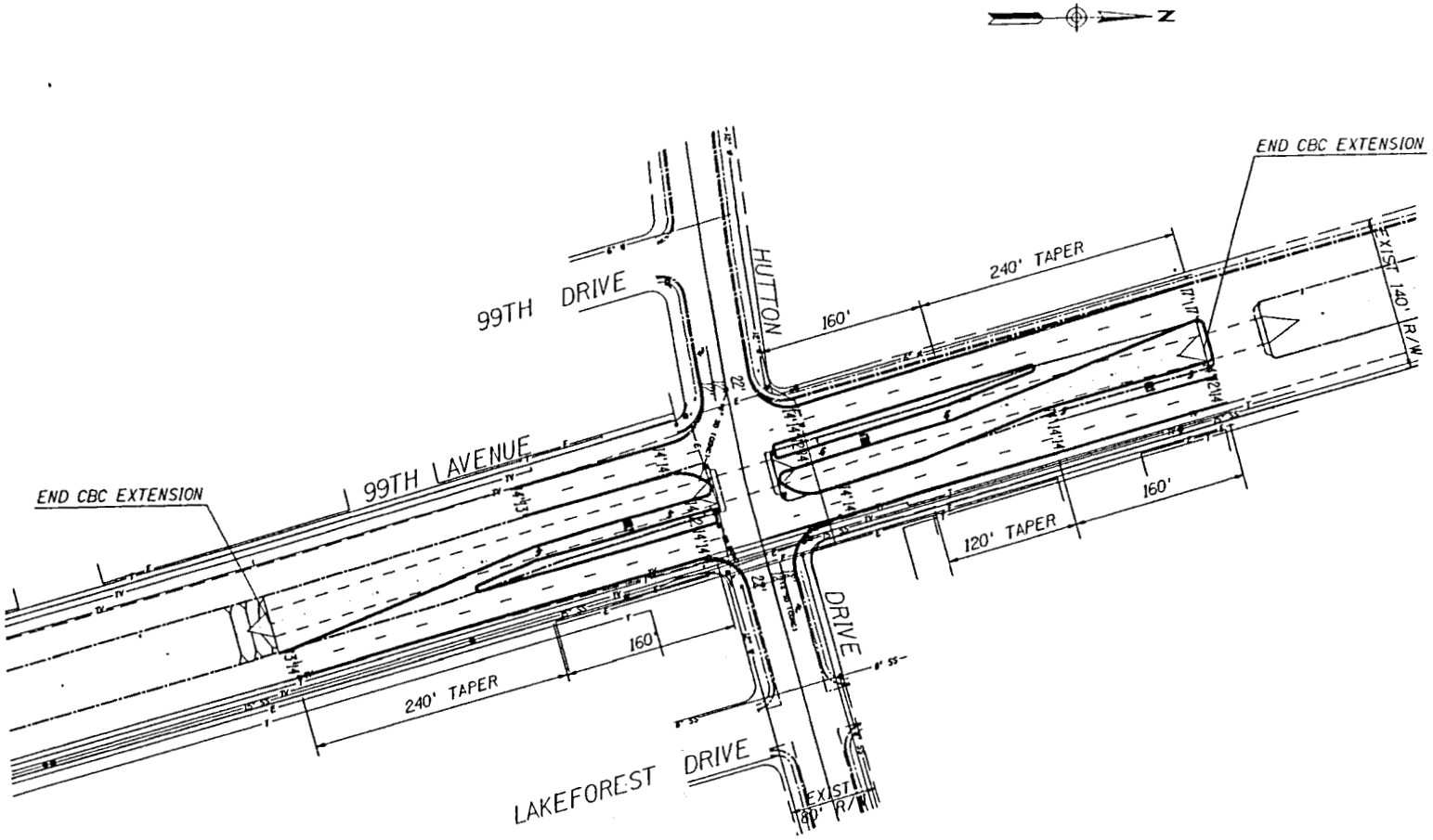

NOT TO SCALE

MARICOPA COUNTY
DEPARTMENT OF TRANSPORTATION
ENGINEERING DIVISION

HUTTON DRIVE - ALTERNATE "E"

Hendrich, Eberhart & Associates, Inc.
CONSULTING ENGINEERS
PONTE BUSINESS PLAZA
7207 N. 25th STREET, SUITE 207
PHONE: (602) 943-1063
FAX: (602) 943-1383

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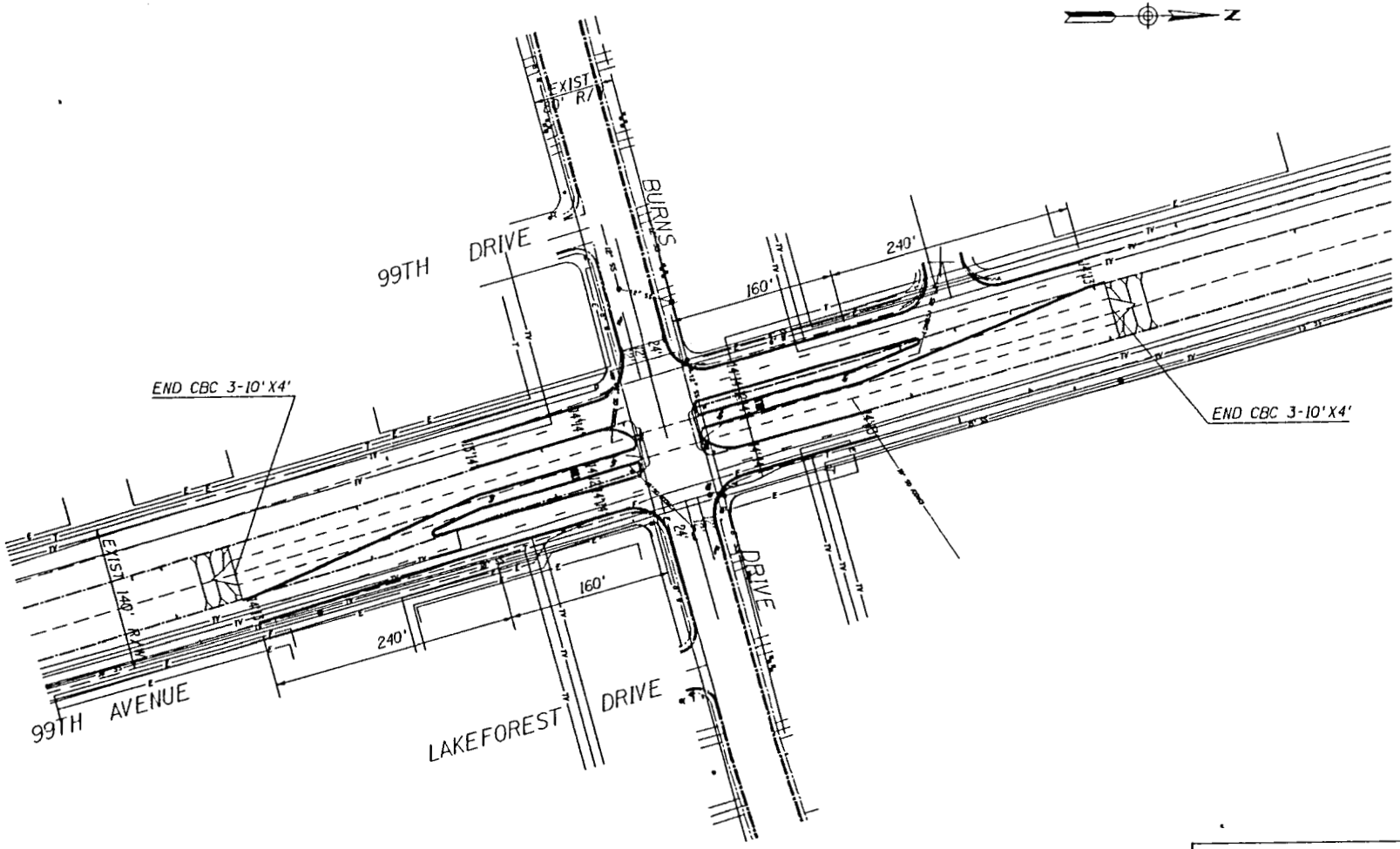

NOT TO SCALE

MARICOPA COUNTY
DEPARTMENT OF TRANSPORTATION
ENGINEERING DIVISION

BURNS DRIVE - ALTERNATE "E"

Hendrich, Eberhart & Associates, Inc.
CONSULTING ENGINEERS
POINTE BUSINESS PLAZA

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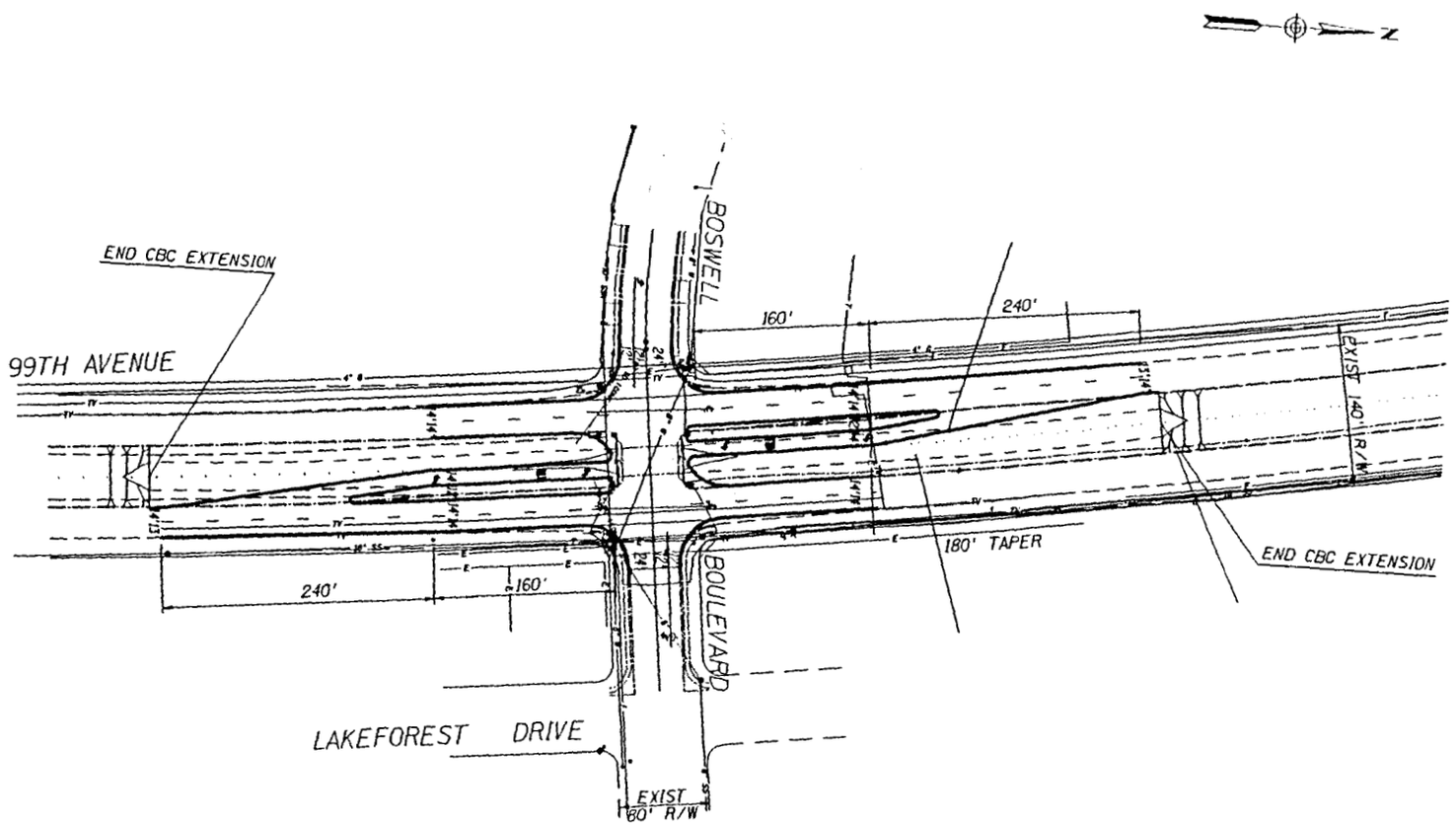

MARICOPA COUNTY
DEPARTMENT OF TRANSPORTATION
ENGINEERING DIVISION

BOSWELL BOULEVARD - ALTERNATE "E"

Hendrich, Eberhart & Associates, Inc.
CONSULTING ENGINEERS

NOT TO SCALE

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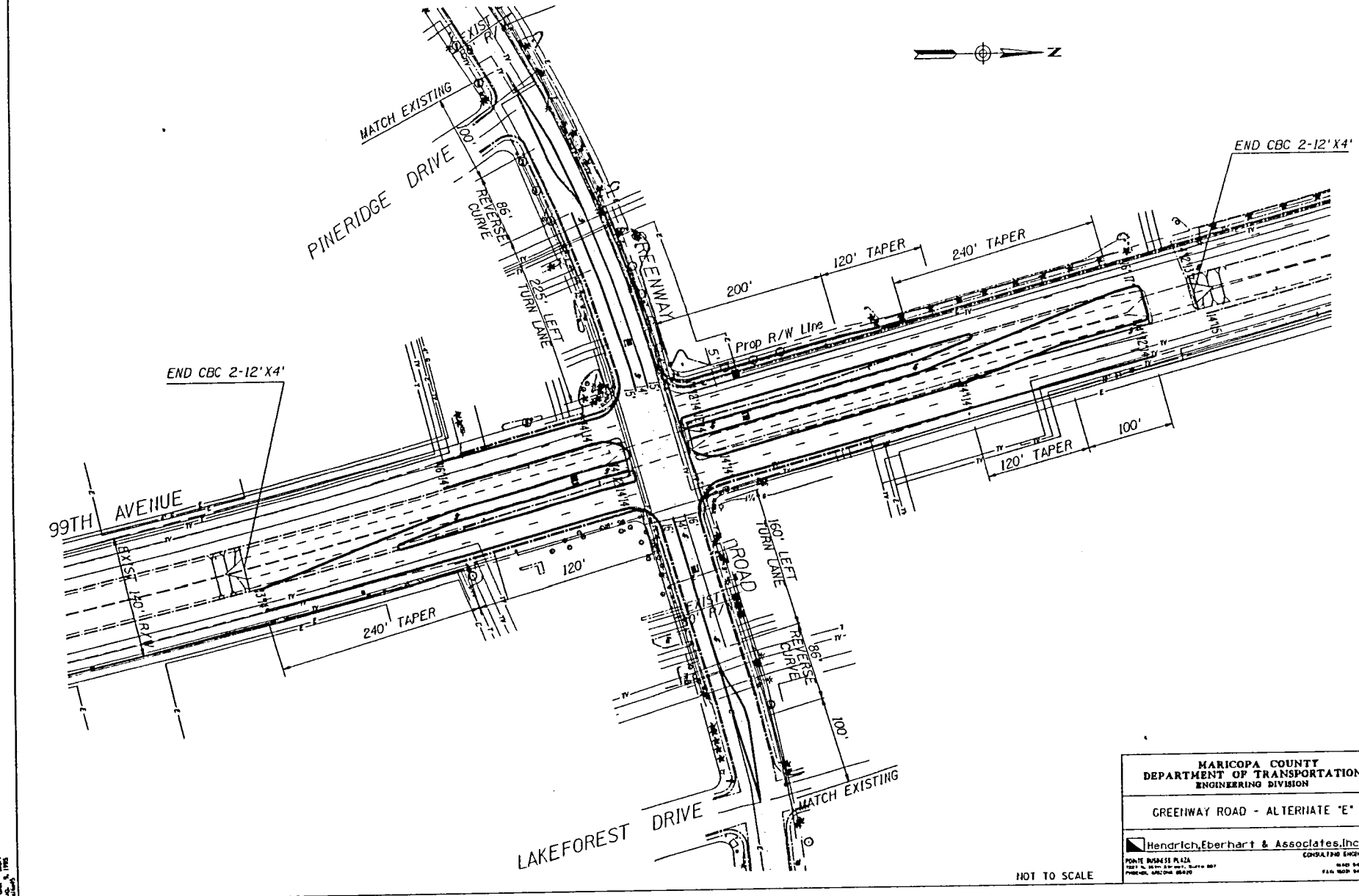

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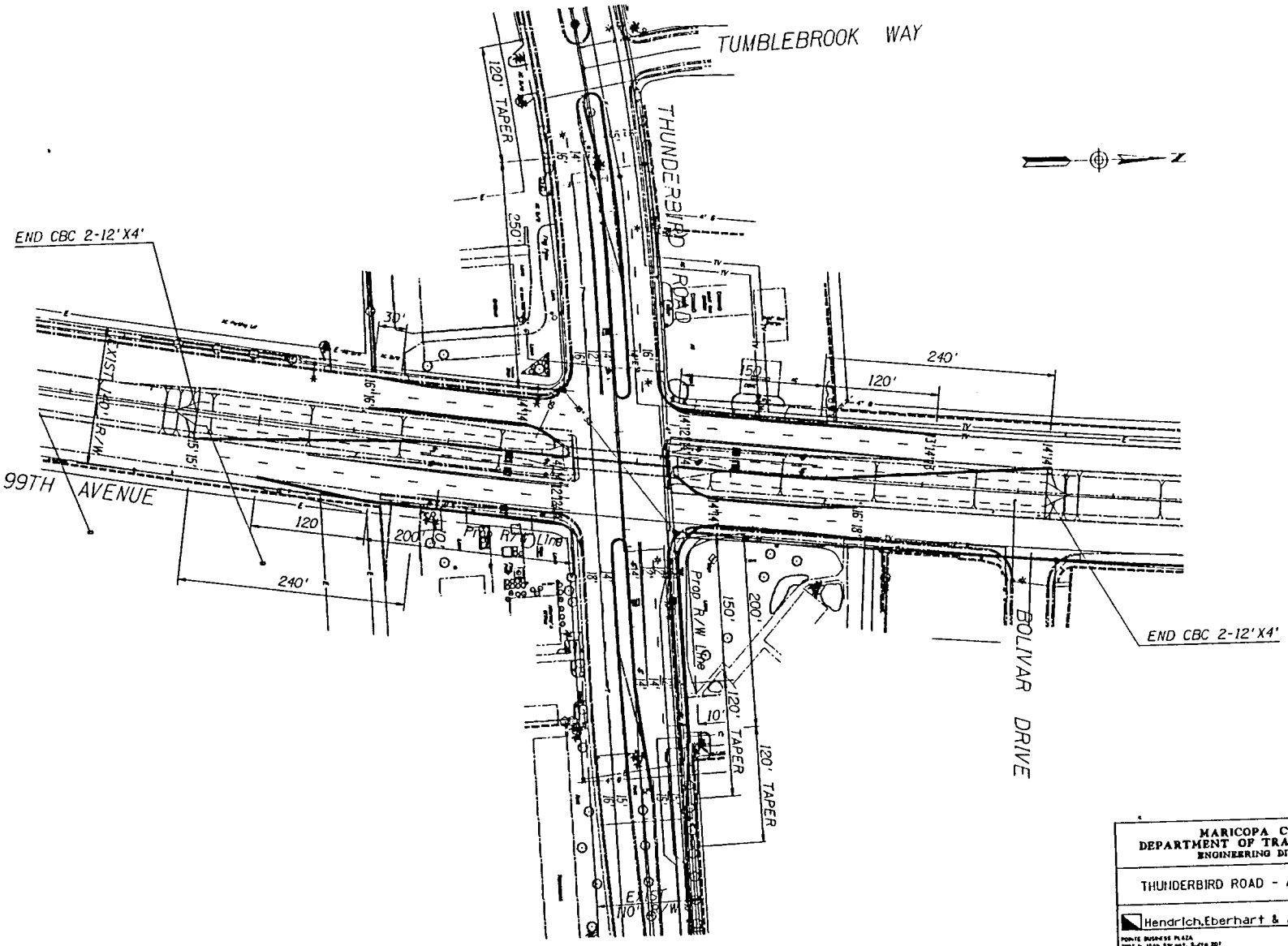

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