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OFFSITE DRAINAGE CONCEPT STUDY  
Part B - Concept Designs

OUTER LOOP HIGHWAY  
(Buckeye Road to Northern Avenue)  
Revised December 10, 1987

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REMARKS

## TABLE OF CONTENTS

	<u>Page</u>
1.0 EXECUTIVE SUMMARY	1
2.0 INTRODUCTION	3
3.0 DRAINAGE CONCEPTS	4
3.1 Alternative No. 1	4
3.2 Alternative No. 2	16
3.3 Recommended Plan	21
4.0 HYDROLOGY	23
5.0 DESIGN CRITERIA	24
5.1 Design Frequency	24
5.2 Open Channels	24
5.3 Detention Basins	25
5.4 Storm Sewer Pipes	25
6.0 COST ESTIMATING	26
6.1 Open Channels	26
6.2 Detention Basins	26
6.3 Storm Sewer Pipes	27
7.0 REFERENCES	28
APPENDIX 1 - Hydraulic Design Data	
APPENDIX 2 - Cost Estimates	
APPENDIX 3 - HEC-1 Input/Output (Case A with Detention)	
APPENDIX 4 - HEC-1 Input/Output (Case B with Detention)	

## 1.0 EXECUTIVE SUMMARY

The WLB Group, Inc. was subcontracted by DeLeuw, Cather and Company, the Outer Loop Management Consultant for the Arizona Department of Transportation (ADOT), to conduct an offsite hydrology study and develop alternative drainage design concepts for the portion of the Outer Loop Highway along 99th Avenue between Buckeye Road and Northern Avenue. The drainage concept study report is in two parts; Part A (under separate cover) is the offsite hydrology report and this report, Part B, is the conceptual design and cost estimates.

The U.S. Army Corps of Engineers' HEC-1 computer program was used to simulate rainfall-runoff conditions within the study area. Presently, runoff flows southwesterly and enters either the Agua Fria River or the Papago Freeway Interceptor Channel, which outfalls into the Agua Fria River. The study area is complicated by the proposed Paradise Corridor, the proposed Grand Avenue Expressway, and the Glendale/Peoria Area Drainage Master Study. Three hydrologic models (cases A, B, and C) were developed to determine the effects of these features on the Outer Loop drainage (refer to Part A, Offsite Hydrology for an explanation of each case).

Two alternative drainage concepts and a recommended plan are presented in this report. In each Alternative and the Recommended Plan, Case A hydrology was used to develop the concept design south of the Grand Canal and Case B hydrology was used to design north of the Grand Canal. Preliminary designs and cost estimates were carried out for each alternative. The alternatives have essentially the same alignment with and without detention. Alternative No. 1 considers only open channels with no detention. Alternative No. 2 uses the same alignment with the addition of detention basins. The detention in Alternative No. 2 reduces the size of the channels and allows the practical use of closed

conduits to convey the flows to the Agua Fria River and New River. The recommended plan is a combination of Alternative No. 1 and Alternative No. 2. The following are the total estimated costs for each.

Alternative No. 1 = \$ 64,341,000.00

Alternative No. 2 = \$113,449,700.00

Recommended Plan = \$ 70,592,300.00

## 2.0 INTRODUCTION

This is Part B of the offsite Drainage Concept Study for the Outer Loop Highway between Buckeye Road and Northern Avenue. The study has been prepared in two parts. Part A - Offsite Hydrology (under separate cover) addresses the offsite hydrology and the peak discharges that reach the Outer Loop. This part. Part B - Concept Design, covers the drainage concepts and their estimated costs.

The purpose of the study is to determine the offsite flows that will reach the Outer Loop Highway and to investigate alternative conceptual drainage designs that will protect both the Outer Loop and adjacent property owners from flooding. This study establishes the peak discharge that will have to be contained along the Outer Loop and provides the concept design that will be used in the development of the final construction documents. In addition, this study will help determine right-of-way requirements for the proposed drainage facilities.

### 3.0 DRAINAGE CONCEPTS

Two alternative drainage concepts and a recommended plan are presented in this report for the Outer Loop Highway from the Papago Freeway to Northern Avenue. The two alternatives have essentially the same alignment with and without detention. Alternative No. 1 considers only open channels with no detention. Alternative No. 2 uses the same alignment with the addition of detention basins. The Recommended Plan is a combination of the concept design for Alternative No. 1 north of Grand Canal and Alternative No. 2 south of the Grand Canal. The hydraulic design data and the cost estimates for Alternative No. 1, No. 2, and the Recommended Plan are presented in Appendix 1 and 2, respectively.

There were no drainage concepts developed for the reach between the Papago Freeway and Buckeye Road for the reason that the design of the roadway in this section is still under study, and it is uncertain what will be required in the way of drainage facilities. Nonetheless, the hydrology was developed for this section and is included in Part A - Offsite Hydrology.

#### 3.1 Alternative No. 1 (Estimated Cost: \$64,341,000.00)

Alternative No. 1 is a system of open channels that collect flows along the Outer Loop and convey them to the Agua Fria River along Thomas Road and to New River along the Grand Canal. The following are descriptions of the major components of the drainage system.

Refer to the exhibit: Concept Design Alternative No. 1. The exhibit schematically shows the alignment and calls out the channel top widths. The design is based on concrete lined trapezoidal channel sections with 2:1 side slopes. The top widths shown are to the top of slope and do not include setbacks and maintenance roads.

Channel Along the Outer Loop from 1/4 mile South of Northern Avenue to the Grand Canal

This channel is designed along the east side of the Outer Loop to collect the overland flows that reach the Outer Loop, between Northern Avenue and the Grand Canal, and convey them south, to the channel along the Grand Canal.

The existing land use along this alignment is agricultural.

Channel Along the Grand Canal from New River to the Paradise Corridor

This part of the channel system is designed to convey stormwater flows to New River along the north side of the Grand Canal. The channel will carry flows from 3 sources.

1. The flows that are collected in the channel along the Outer Loop from 1/4 mile south of Northern Avenue to the Grand Canal.
2. The flows that will be collected along the north side of the Paradise Corridor from I-17 to the Grand Canal.
3. The overland flows that drain to the Grand Canal between the Paradise Corridor and New River.

The portion of this channel from the Outer Loop east to the future Paradise Corridor (approximately 83rd Avenue) is proposed to be constructed at the same time as the Outer Loop for several reasons. First, it will limit the flows that will reach the Outer Loop, south of

the Grand Canal, by collecting the overland flows on the north side of the Canal. The offsite hydrology was developed assuming the channel along the Grand Canal would be constructed between the Outer Loop and 83rd Avenue (i.e. the drainage area boundary was delineated along the Grand Canal between the Outer Loop and 83rd Avenue). If the channel is not constructed, some of the overland flows would be conveyed west in the Grand Canal and the remainder would flow over the Grand Canal and south to the Outer Loop drainage system. This would result in an undersized drainage system south of the Grand Canal.

Second, the City of Glendale is currently planning a park along the Grand Canal that could be integrated with the proposed channel.

Third, this area is rapidly being developed as residential property and acquiring the right-of-way for the channel at the same time with the Outer Loop will mean less disruption and relocation of residences. The existing land uses along the channel are primarily agricultural with the exception of the residential subdivision along the north side of the Grand Canal between 83rd and 87th Avenue.

The drainage channel along the Grand Canal is complicated by a 42 inch sanitary sewer that runs south in 99th Avenue. The top of this sewer pipe is approximately 10 feet deep and therefore the proposed channel is relatively shallow and wide at 99th Avenue to enable it to cross over the top of the sanitary sewer pipe.

The portion of the drainage channel that outlets into New River was widened considerably for the last several hundred feet to reduce the velocity. The channel is envisioned to have an earthen bottom with grouted riprap for bank protection. Transitions will have to be

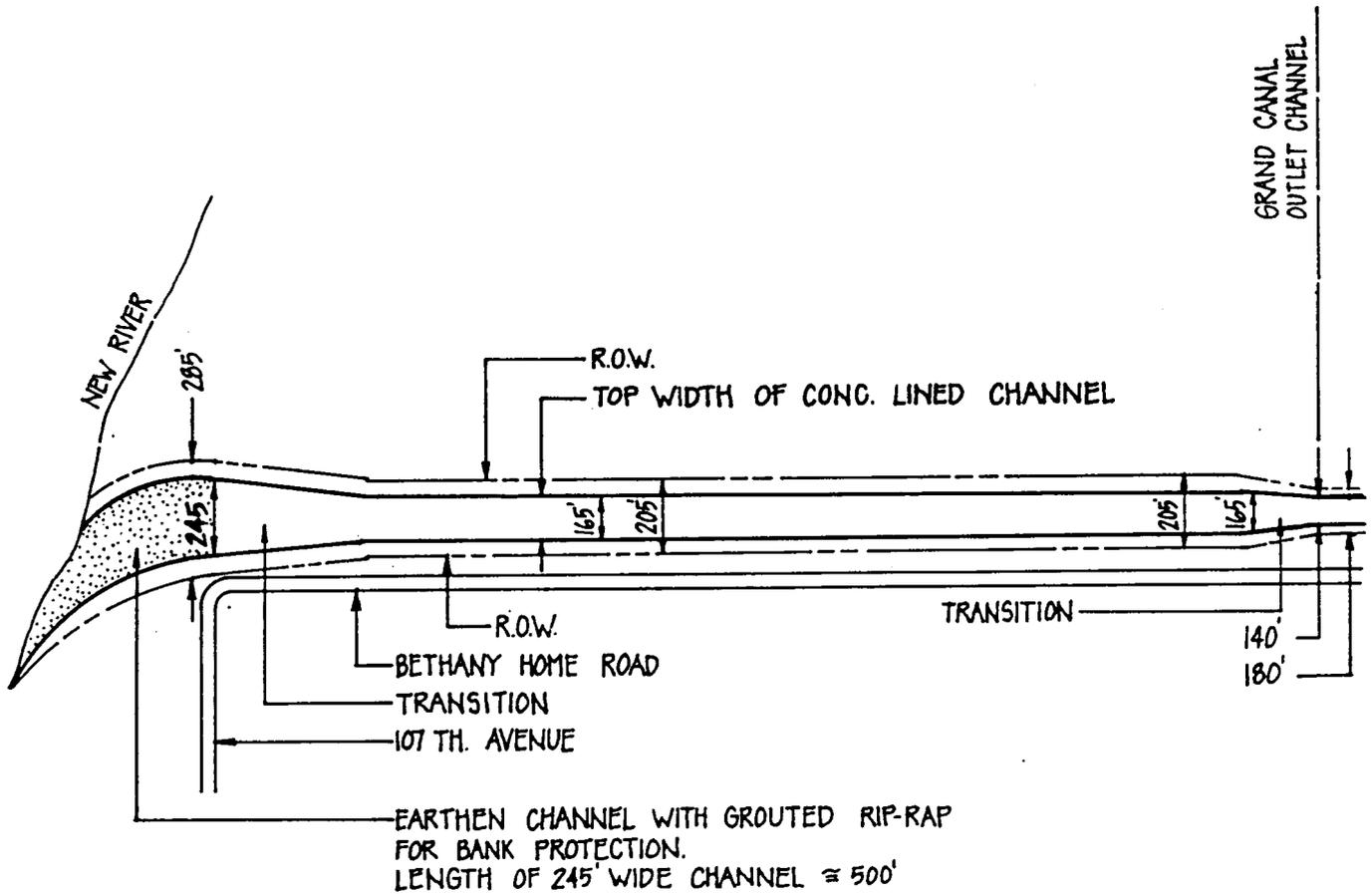
designed accordingly. Refer to the exhibit on the following page. This concept, however, may change depending upon completion of the channelization of New River. The Flood Control District of Maricopa County is currently in the beginning stages of acquiring an engineering firm to design the channelization plan. They hope to have a firm start design by March of 1988, with the intention of starting construction by March of 1989. The Outer Loop drainage channel plans should be coordinated with the Flood Control District to provide for the drainage channel outlet into New River. The widening of the channel outlet, to reduce velocity, would probably not have to be done if New River is channelized.

The drainage channel design of this section is also affected by an irrigation outlet channel at the end of the Grand Canal. Half way between 99th Avenue and 107th Avenue the Grand Canal terminates in a small reservoir which has an outlet channel that flows north to New River. The Salt River Project (SRP) needs this channel to allow them the capability of releasing excess flows at the end of the Grand Canal irrigation system. However, SRP has stated that if they could use the Outer Loop drainage channel to drain to New River, the outlet channel could be abandoned. For purposes of this study, it was assumed that the outlet channel to the north will be abandoned. In addition to the Grand Canal outlet channel, there is a Roosevelt Irrigation District (RID) canal that crosses the proposed drainage channel alignment at the end of the Grand Canal. The RID canal is presently piped in a 36" concrete pipe under the Grand Canal outlet channel. It has been assumed that this 36" pipe will have to be reconstructed as an inverted siphon under the proposed drainage channel.

# DRAINAGE CHANNEL OUTLET AT NEW RIVER

BASE DATA |  $Q = 10899$  cfs  
 $n = .03$   
 $s = .0007$   
 BOTTOM WIDTH = 200'  
 SIDE SLOPE = 2:1  
 NORMAL DEPTH = 9.3'  
 VELOCITY = 5.4 Ft/Sec.

VELOCITY IS LOWERED FROM 8.6 Ft/Sec TO 5.4 Ft/Sec.  
 AS A RESULT OF WIDENING CHANNEL.



NO SCALE



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### Grand Canal Reservoir Relocation:

There has been some discussion with the Salt River Project about the possibility of relocating the Grand Canal reservoir to the east of the Outer Loop Highway. ADOT could then use the existing right-of-way west of the Outer Loop for the drainage channel; providing that the relocated reservoir be designed to release waste water into the Outer Loop drainage channel. See the exhibit on the following page.

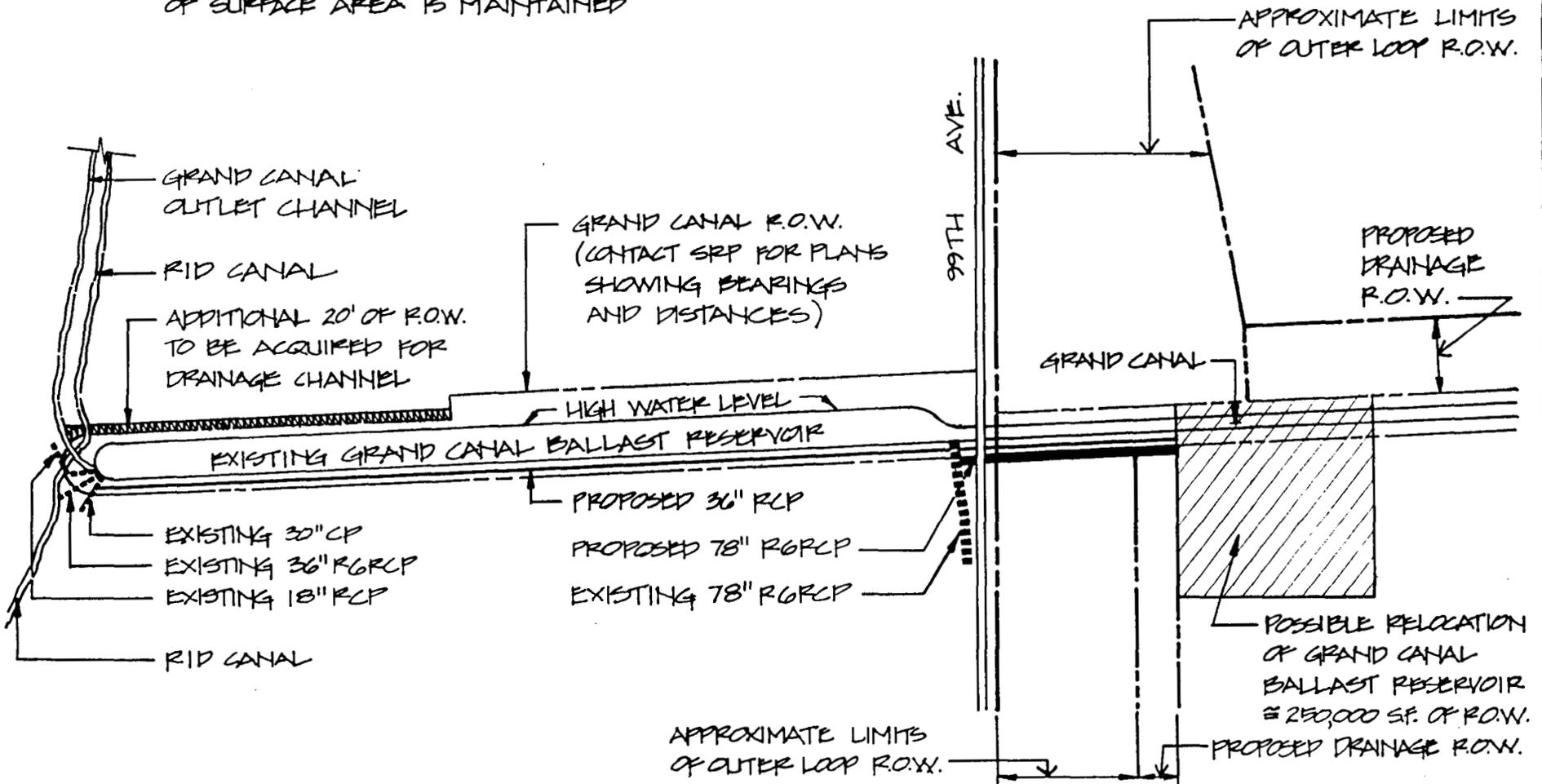
There would be cost savings associated with relocating the ballast reservoir. The surface area needed for the ballast reservoir is approximately 200,000 square feet. Assuming 50 foot setbacks, the right-of-way needed for the reservoir is approximately 250,000 square feet. West of the Outer Loop, the required right-of-way for the drainage channel, between 99th Avenue and the end of the Grand Canal, is approximately 432,000 square feet. The existing Salt River Project right-of-way covers this requirement except for about 20,000 square feet. Therefore, if ADOT relocates the reservoir, they will have to purchase approximately 270,000 square feet (250,000 + 20,000) of right-of-way which is 162,000 square feet less than the right-of-way requirement if the reservoir is not relocated.

This translates into a savings of \$730,000 at \$4.50/s.f. Right-of-way savings could even be greater if the ballast reservoir could be incorporated into the existing right-of-way being purchased for the interchange between the Outer Loop and Paradise Corridor.

# POSSIBLE RELOCATION OF GRAND CANAL BALLAST RESERVOIR

NOTE: CONFIGURATION OF BALLAST RESERVOIR CAN BE CHANGED PROVIDING THAT 200,000 SF. OF SURFACE AREA IS MAINTAINED

10



The Salt River Project would need to continue service to the irrigation delivery ditches located on the south and west side of the existing ballast reservoir. It is estimated that a 36" concrete pipe could service the west side and a 78" concrete pipe could service the southern lateral along 99th Avenue. This, however, would have to be confirmed and coordinated through the Salt River Project.

The estimated cost for the pipe is as follows:

78" RGRCP	L=560'	@ \$165/ft.	=	\$192,400.00
36" RGRCP	L=2760'	@ \$69/ft.	=	<u>\$190,440.00</u>
	Total			\$282,840.00
	+ 30% Appurtenances &			
	Contingencies		=	<u>\$ 84,852.00</u>
	Total			<u><u>\$367,692.00</u></u>

Excavation cost for the new ballast reservoir and the drainage channel are estimated as follows:

Ballast Reservoir	- Depth = 10 ft.	Side Slopes = 3:1
	Area = 200,000 s.f.	Volume = 64,636 c.y.
	Cost = 64636 x \$2.50/c.y.	= \$161,590.00

Drainage Channel	- Depth = 10 ft.	Side Slope = 2:1
	Volume = 69,689 c.y.	
	Cost = 69,689 x \$2.50/c.y.	= \$174,223.00

Total = \$335,813.00

Difference in Cost:

	<u>W/Reservoir Relocation</u>	<u>W/O Reservoir Relocation</u>
Right-of-Way	\$1,215,000	\$1,944,000
Irrigation Pipe	367,692	----
Excavation	<u>335,813</u>	<u>332,916</u>
	\$1,918,505	\$2,276,916

Savings = \$358,411

Other benefits from relocating the Grand Canal reservoir include possible cost savings by reduction and/or elimination of bridge costs and fill requirements on the Outer Loop, possible benefits to the Paradise Corridor - Outer Loop interchange, and the possibility of designing the drainage channel alignment to miss an existing house on the northwest end of the Grand Canal ballast reservoir.

### Channel Along the Outer Loop from the Grand Canal to Thomas Road

This channel is aligned along the east side of the Outer Loop to collect the overland flows between the Grand Canal and Thomas Road. The existing land use along the alignment is almost entirely agricultural with a few farm homes.

### Storm Sewer Pipe and Channel between Thomas Road and the Papago Freeway

Under existing conditions, the area south of the mid-section point between Thomas Road and McDowell Road (Encanto Boulevard extended) drains south to the Papago Freeway Channel. The Outer Loop Highway alignment between Encanto Boulevard extended and the Papago Freeway was moved 1/4 quarter mile east of 99th Avenue. This is referred to as Section 2. The concept design is to collect the flows south of Encanto Boulevard extended and convey them to the Papago Freeway Channel in a series of storm sewer pipes. The area north of Encanto Boulevard extended drains west under existing conditions to the Agua Fria. The concept design here is to collect these flows and carry them north to Thomas Road in an open channel. This channel will have to cross over the 60 inch sanitary sewer independently from the channel coming from the north along the Outer Loop. The channel coming from the north has too high of a water surface elevation to enable this channel to flow into it.

### Channel Along Thomas Road from the Agua Fria River to the Outer Loop

This channel serves as an outlet channel for the flows collected along the Outer Loop between the Grand Canal and Encanto Boulevard extended. The channel outfalls into the Agua Fria River approximately 2.5 miles west of the Outer Loop.

As was the case with the channel along the Grand Canal, the Thomas Road Outfall Channel is affected by the 60 inch sanitary sewer in 99th Avenue and, in addition, two irrigation canals west of 99th Avenue. The channel is relatively wide and shallow going under 99th Avenue to be able to cross over the 60 inch sanitary sewer. This shallow channel section is followed by an abrupt drop to enable the flows to pass under the irrigation canal that runs parallel with and just west of 99th Avenue. At this point the channel is approximately 20 feet deep and remains that deep for 1/2 mile downstream to cross under the RID Canal which crosses Thomas Road at 103rd Avenue extended.

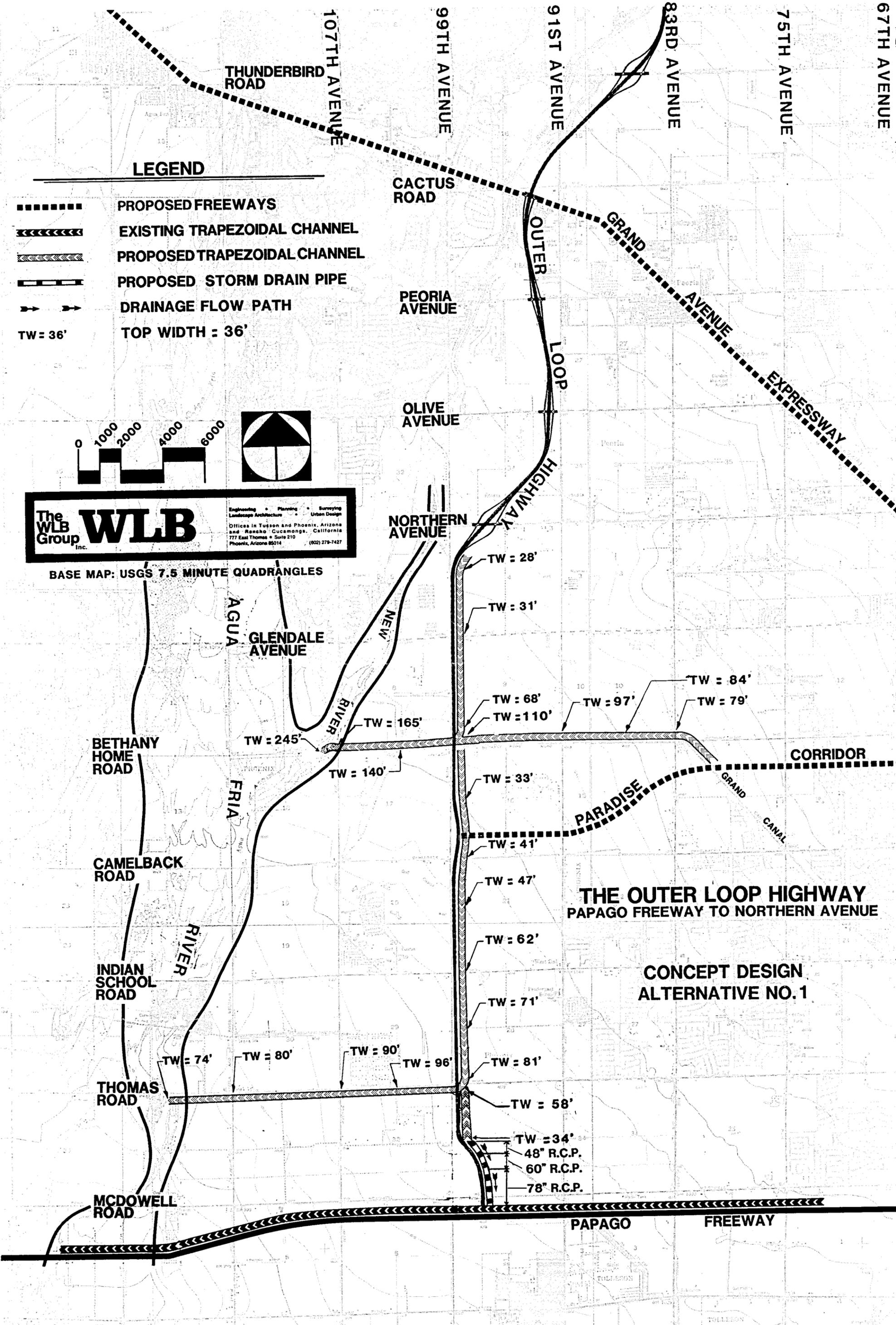
**LEGEND**

- PROPOSED FREEWAYS
- ===== EXISTING TRAPEZOIDAL CHANNEL
- ===== PROPOSED TRAPEZOIDAL CHANNEL
- ===== PROPOSED STORM DRAIN PIPE
- → DRAINAGE FLOW PATH
- TW = 36' TOP WIDTH : 36'



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BASE MAP: USGS 7.5 MINUTE QUADRANGLES



**THE OUTER LOOP HIGHWAY  
 PAPAGO FREEWAY TO NORTHERN AVENUE**

**CONCEPT DESIGN  
 ALTERNATIVE NO. 1**

- TW = 34'
- 48" R.C.P.
- 60" R.C.P.
- 78" R.C.P.

### 3.2 Alternative No. 2 (Estimated Cost: \$113,449,900.00)

Alternative No. 2 uses the same drainage system as Alternative No. 1 with the addition of three detention basins to reduce the size of the Thomas Road and Grand Canal channels. The detention basins reduce the peak discharges enough to have large diameter storm sewers replace the outlet channels along the Grand Canal and Thomas Road.

Refer to the exhibit: Drainage Concept Alternative No. 2. The exhibit shows the approximate location of the detention basins and comparing this with the exhibit for Alternative No. 1 will reveal the effect on the channels along Thomas Road and the Grand Canal.

The following is a description of each detention basin and its effect on the channel system described in Alternative No. 1. The detention basin design is based on using 4:1 side slopes with a setback of 50 feet from the property line to the top of slope.

#### Detention Basin No. 1

Area = 80 acres

Setback = 30 feet

Side Slope = 4:1

Depth = 23 feet

Required Volume = 1033 ac-ft

Depth of Water = 19 feet

Freeboard = 4.0 feet

Detention Basin No. 1 is an 80 acre basin located between 1320' north of Thomas Road and 1370' south of Indian School Road. The result of the basin is a reduction in the required conveyance capacity of the Thomas Road channel from 3,677 CFS down to 251 CFS, which can be contained in a 78" concrete pipe. It should be noted that the bottom of this basin and the invert of the 60 inch sanitary sewer in 99th Avenue are at approximately the same elevation which would require the 78 inch outlet pipe to be constructed under the sanitary sewer and run out to the Agua Fria at a relatively flat slope.

Detention Basin number 1 also effects the design of the drainage channel south of Thomas Road. In Alternative number 1 this channel flows from Encanto Boulevard extended north to the Thomas Road channel. The addition of detention basin number 1 would require the channel to outlet into the basin. The top of the basin is at elevation 1029  $\pm$ , while the southern most inlet to the channel at Encanto Boulevard extended is at natural ground elevation 1027  $\pm$ . Alternative number 2 calls for a 96" storm drain to be constructed from Encanto Boulevard extended to Thomas Road. Storm water runoff would be collected and conveyed north to a large manhole around Thomas Road. A concrete lined channel will convey flows north from Thomas Road to Detention Basin number 1. The Detention Basin will then be drained by a 78" storm drain which flows south back to the manhole. From there storm water will be conveyed west in a 78" storm drain to the Agua Fria River. Two 60" stubouts have been provided by the Flood Control District of Maricopa County through the soil cement dike at the Agua Fria River and will have to be connected to the 78" pipe. Refer to the exhibit, Concept Design Alternative No. 2.

To prevent backflow out of the inlet at Encanto Boulevard extended, Detention Basin number 1 was designed to have a peak water surface elevation during the 100-year storm of 1025.0 feet. This elevation provides 2.0 feet of freeboard before water would flow out of the Encanto Boulevard inlet.

Detention Basin No. 2 and No. 3:

Basin No. 2:

Area = 120 acres  
Setback = 30 feet  
Side Slope = 4:1  
Depth = 18 feet  
Required Volume = 1532 ac-ft  
Depth of Water = 15.5 feet  
Freeboard = 2.5 feet

Basin No. 3:

Area = 100 acres  
Setback = 30 feet  
Side Slope = 4:1  
Depth = 20 feet  
Required Volume = 1582 ac-ft  
Depth of Water = 19.1  
Freeboard = 0.9 feet

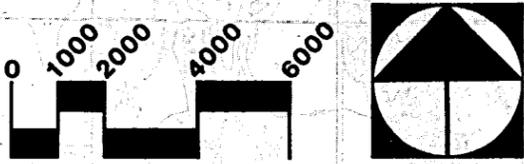
Detention Basin No. 2 and No. 3 both act to reduce the peak discharges along the Grand Canal channel. The result is 1) a much smaller channel between 83rd Avenue and the Outer Loop; sized only to collect the overland flows that reach the Grand Canal, and 2) a reduction in peak discharge west of the Outer Loop from 10,868 CFS down to 872 CFS which can be conveyed in a 120 inch concrete pipe. This 120 inch storm sewer outlet will require an inverted siphon under the 42 inch sanitary sewer to completely drain the basin. The invert of the sanitary sewer is about equal to the invert of the basin. Therefore the outlet pipe has to go under the sanitary sewer.

Appendix No. 3 is the HEC-1 input/output for Case A (refer to Part A - Offsite Hydrology) with the addition of Detention Basin No. 1. Case A is the existing hydrologic case which is being used for the concept design south of the Grand Canal.

Appendix No. 4 is the HEC-1 input/output for Case B (refer to Part A - Offsite Hydrology) with the addition of detention basin No. 2 and No. 3. Case B is the hydrologic model with the Paradise Corridor in place and conveying flows to the Outer Loop along the Grand Canal. Case B is being used for the concept design north of the Grand Canal.

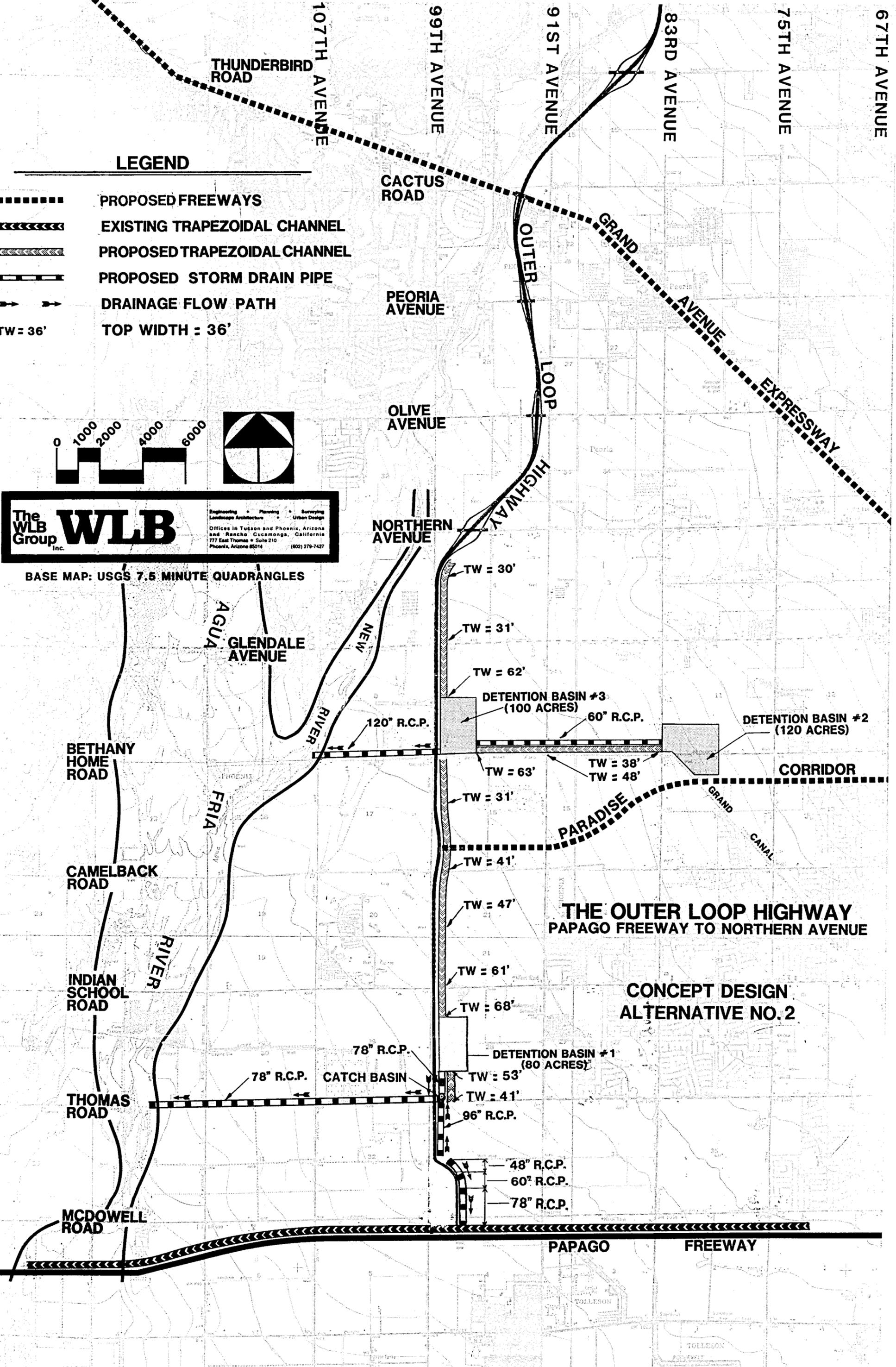
**LEGEND**

- PROPOSED FREEWAYS
- ===== EXISTING TRAPEZOIDAL CHANNEL
- ===== PROPOSED TRAPEZOIDAL CHANNEL
- ===== PROPOSED STORM DRAIN PIPE
- → DRAINAGE FLOW PATH
- TW = 36' TOP WIDTH = 36'



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BASE MAP: USGS 7.5 MINUTE QUADRANGLES



**THE OUTER LOOP HIGHWAY  
 PAPAGO FREEWAY TO NORTHERN AVENUE**

**CONCEPT DESIGN  
 ALTERNATIVE NO. 2**

**PAPAGO  
 FREEWAY**

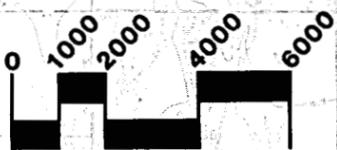
### 3.3 Recommended Plan (Estimated Cost: \$70,592,300.00)

The recommended plan is a combination of Alternative No. 1 and Alternative No. 2. The drainage system north of the Grand Canal is taken from Alternative No. 1 with no detention. The size of the basins were too large and the length of the downsized conveyance structures too short to economically justify using the detention scheme. The estimated cost for the system north of the Grand Canal is \$32,689,100 without detention and \$75,545,000 with detention. The predominant factor in the cost differential is the right-of-way for the detention basins. At our estimated cost of \$4.50 per square foot, the right-of-way for Detention Basins No. 2 and No. 3 would cost over 43 million dollars.

The recommended plan south of the Grand Canal is Alternative No. 2 with detention. The scheme with detention is recommended because it is seen as being more palatable to the land owners along Thomas Road and the public in general to have an underground storm sewer in Thomas as opposed to an open channel. The estimated cost of the two alternative drainage systems south of the Grand Canal are close enough to disregard cost as a prevailing factor in the selection. The estimated cost for the system south of the Grand Canal is \$31,654,900 without detention and \$39,008,200 with detention. That is approximately a 23% difference that could be reduced significantly. If the detention basin right-of-way was reduced to \$2.50 per square foot instead of the \$4.50 per square foot used in the cost estimate. The alternative with detention would cost \$30,936,600.

**LEGEND**

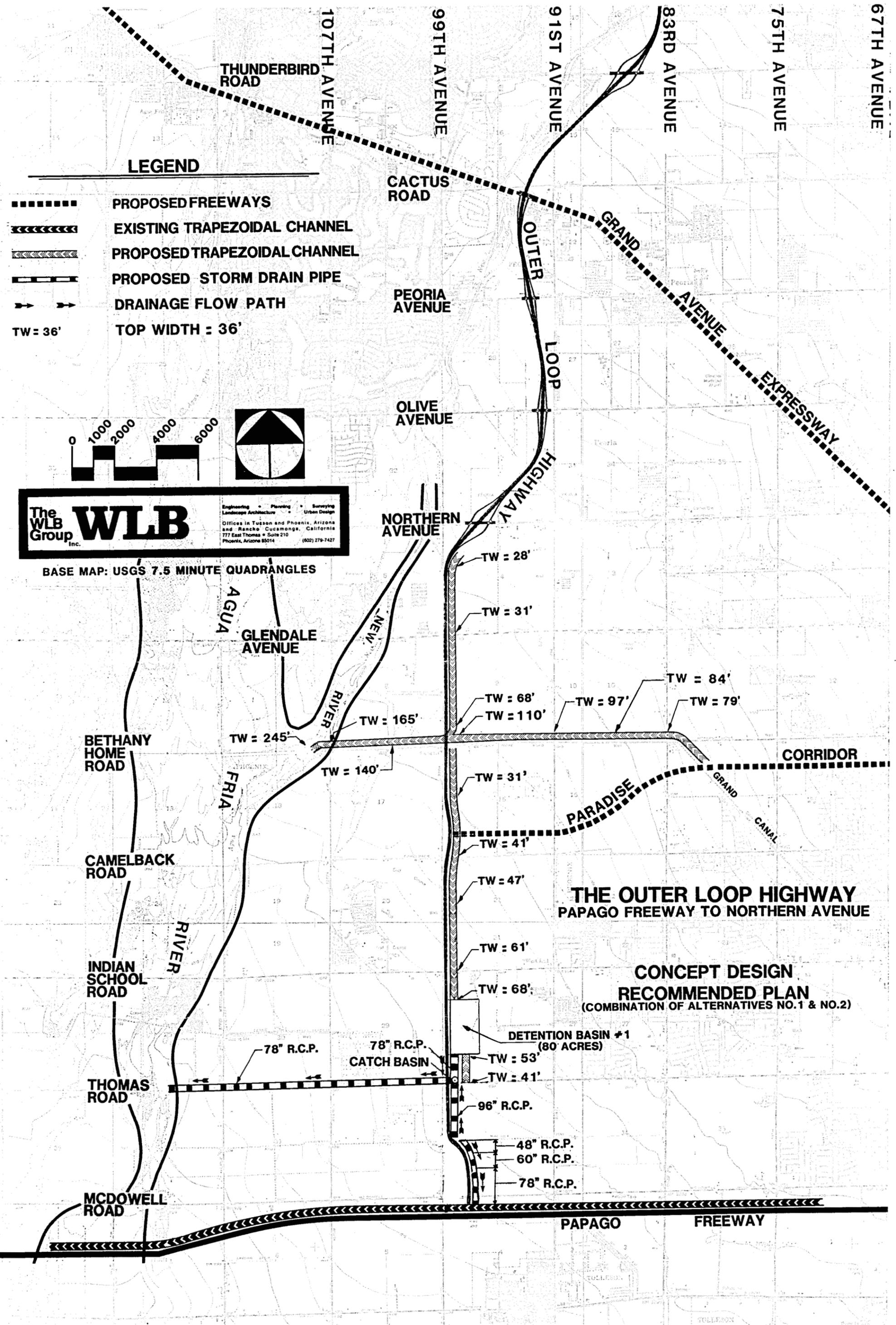
- PROPOSED FREEWAYS
- ===== EXISTING TRAPEZOIDAL CHANNEL
- ===== PROPOSED TRAPEZOIDAL CHANNEL
- PROPOSED STORM DRAIN PIPE
- → → DRAINAGE FLOW PATH
- TW = 36' TOP WIDTH = 36'



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BASE MAP: USGS 7.5 MINUTE QUADRANGLES



**THE OUTER LOOP HIGHWAY  
 PAPAGO FREEWAY TO NORTHERN AVENUE**

**CONCEPT DESIGN  
 RECOMMENDED PLAN  
 (COMBINATION OF ALTERNATIVES NO.1 & NO.2)**

DETENTION BASIN #1  
 (80 ACRES)

CATCH BASIN

48" R.C.P.  
 60" R.C.P.  
 78" R.C.P.

78" R.C.P.  
 78" R.C.P.  
 96" R.C.P.

TW = 28'  
 TW = 31'  
 TW = 68'  
 TW = 110'  
 TW = 97'  
 TW = 84'  
 TW = 79'

TW = 245'  
 TW = 165'  
 TW = 140'

TW = 31'  
 TW = 41'  
 TW = 47'

TW = 61'  
 TW = 68'

TW = 53'  
 TW = 41'

PAPAGO FREEWAY

#### 4.0 HYDROLOGY

The hydrologic analysis, which established the design peak discharges, is summarized in Part A - Offsite Hydrology (under separate cover). The offsite hydrology report included three cases; Case A, B, and C which correspond to different assumptions concerning the effects of the future Paradise Corridor and the future Grand Avenue Expressway. The concept drainage designs presented in this report are based on Case A for the Outer Loop south of the Grand Canal and Case B north of the Grand Canal.

Case A is the existing conditions rainfall-runoff model that assumes no Paradise Corridor and no Grand Avenue Expressway. This case was used for the concept design south of the Grand Canal to make sure that the Outer Loop has adequate protection in the interim after the Outer Loop is constructed and before the Paradise Corridor is built.

Case B was used for the concept drainage design north of the Grand Canal. Case B includes the Paradise Corridor. This case was used north of the Grand Canal to provide an adequate drainage outfall for the future Paradise Corridor.

Case C was a model that included both the Paradise Corridor and the Grand Avenue Expressway as high level facilities. This case was not considered due to the fact that the Grand Avenue Expressway will not be built until some time in the future.

## 5.0 DESIGN CRITERIA

The following is the general criteria used in sizing the various drainage facilities considered in this report. It should be pointed out that the design is only conceptual; using elevation data from the USGS quadrangle maps, neglecting minor hydraulic losses at bridges and junctions, and only considering conflicts with major sanitary sewers and irrigation canals.

### 5.1 Design Frequency

The rainfall frequency used for the alternative designs was the 100-year, 24-hour storm. Peak discharges for both the 50-year and the 100-year storm were included in the Offsite Hydrology report.

### 5.2 Open Channels

The conceptual open channel design was carried out using normal depth calculations with the following channel parameters.

Channel Type: Trapezoidal  
Side Slope: 2:1  
Free Board: 2 foot minimum  
Mannings 'N' Value: 0.018 (Gunitite Lined)

In areas where the drainage channels cross existing irrigation canals, the channels were lowered to allow the water to pass under the canal at normal depth; thereby avoiding a backwater condition. The depth of the canals and the depth of water in the channels is typically about 10 feet each. Therefore, where the channels cross irrigation canals they had to be about 20 feet deep to flow freely under the canals.

The channels were all designed for subcritical flow. The channel slopes were designed to be less than or equal to 0.75 times critical slope to keep the flow out of the range of hydraulic instability.

### 5.3 Detention Basins

The detention basins were designed assuming a 30 foot setback and 4:1 side slopes. The area and depth of each basin is given in Section 3.2 of this report. For purposes of this study the basins were assumed to be flat across the bottom with no low flow channel. However, low flow channels will have to be included in the final design to adequately provide for drainage through the basins.

### 5.4 Storm Sewer Pipes

The material for the storm sewer pipe was assumed to be concrete ( $N = .012$ ). Computations for the energy grade line and hydraulic grade line are given in Appendix 1. The tailwater elevations for the Thomas Road and Bethany Home Road storm drains were assumed to be equal to the 10-year water surface elevation in the Agua Fria River and New River respectively. These elevations were obtained from the Flood Insurance Study for Unincorporated Maricopa County.

## 6.0 COST ESTIMATE

The estimated cost for each alternative and the recommended plan includes both the right-of-way costs and the construction costs. The right-of-way cost was estimated at \$4.50 per square foot. The construction costs were increased by 30% for appurtenances and to cover contingencies. The unit costs were obtained from DeLeuw, Cather and Company (Outer Loop Management Consultant). The cost breakdowns for both alternatives and the recommended plan are provided in Appendix 2. The following is an explanation of the method of estimating costs for open channels, detention basins, and storm sewer pipe.

### 6.1 Open Channels

The estimated cost of open channels includes the cost of right-of-way, excavation, channel lining, and bridges. All other costs were assumed to be covered in the 30% increase for appurtenances and contingencies. The right-of-way width was assumed to be the channel top width plus 20 feet on each side for maintenance.

The excavation costs were estimated using a unit cost of \$2.50 per cubic yard. Concrete channel lining was estimated at \$20.00 per square yard and bridges at \$50.00 per square foot. The amount of bridge construction was determined by assuming a bridge at each mile point and one for each property owner between the mile points. Typically, there were 2 to 4 property owners per mile.

### 6.2 Detention Basins

The estimated cost of detention basins includes right-of-way and excavation. The cost of fencing, low flow channels, headwalls, etc. was assumed to be included in the 30% increase for appurtenances and contingencies. The excavation costs were estimated at \$2.50 per cubic yard.

### 6.3 Storm Sewer Pipe

The storm sewer cost was based on mainline concrete pipe cost alone with a 30% increase for appurtenances and contingencies that was assumed to cover the cost of inlets, manholes, etc. The following unit costs were used in the estimate.

<u>Pipe Size (In.)</u>	<u>Unit Cost (\$/Ft.)</u>
48	98
60	140
78	165
84	180
96	215
120	450

## 7.0 REFERENCES

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APPENDIX 1  
HYDRAULIC DESIGN DATA

# **ALTERNATIVE NO. 1**

# STORM DRAIN DESIGN ALTERNATIVE NO 1

## ENCANTO BLVD. EXTENDED TO PAPAGO INTERCEPTOR CHANNEL

LOCATION		STORM DRAIN PROFILE					STORM DRAIN DESIGN				ENERGY GRADE LINE / HYDRAULIC GRADE LINE				REMARKS				
FROM NODE	TO NODE	GROUND ELEVATIONS		DRAIN ELEVATIONS		LENGTH (FT)	SLOPE (FT/FT)	Q (GFS)	DIA. (IN)	V (FPS)	SI	HI	V <sup>2</sup> /2g (FT)	Hm (FT)		EOL ELEV		HGL ELEV	
		OUTLET (FT)	INLET (FT)	OUTLET (FT)	INLET (FT)											OUTLET (FT)	INLET (FT)	OUTLET (FT)	INLET (FT)
Encanto Boulevard Extended To Papago Interceptor Channel																			Assume W.S. Elev. = 1008.0' at Top of Pipe in I-10 Channel.
I-10 Channel	RID Canal	(1020.0) 1001.0	(1022.0) 1012.0	1008.0	1010.0	1000	.0020	344	78	10.4	.00366	3.66	1.68	1.68	1009.68	1013.38	1008.0	1011.7	Elev.(1020.0) Is At Top of I-10 Channel Invert Elev.=1001.0'
RID Canal	1320' North	(1022.0) 1012.0	1024.0	1010.0	1015.3	1320	.0040	344	78	10.4	.00366	4.83	1.68	—	1013.68	1018.18	1011.7	1016.5	Elev.(1022.0) Is At Top of RID Canal Invert Elev.=1012.0'
1320' North	1980' North	1024.0	1025.0	1015.3	1017.9	660	.0039	178	60	9.1	.00376	2.61	1.29	—	1018.18	1020.78	1016.5	1019.1	
1980' North	Encanto Blvd.	1025.0	1027.0	1017.9	1020.5	660	.0039	89	48	7.1	.00325	2.15	.78	—	1020.78	1022.88	1019.1	1021.2	Hydraulic Grade Line Checks O.K.

Estimated Elevation of RID Canal Invert = 1012.0 ft. This will have to be Surveyed for Confirmation. Design and Pipe Size may change depending on this Elevation.  
 ( ) Ground Elevations in Parentheses are Top of Bank Elevations from either the I-10 Channel or the RID Canal.



# CHANNEL DESIGN

ALTERNATIVE NO. 1 (No Detention)

ALIGNMENT ALONG OUTER LOOP  
BETWEEN THOMAS AND GRAND CANAL

**( Concrete Lined Trapezoidal Channel - 2:1 Side Slope )**

MINIMUM FREEBOARD OF 2 FEET

LOCATION		CHANNEL PROFILE						CHANNEL DESIGN						REMARKS	
FROM	TO	GROUND ELEVATION		INVERT ELEVATION		LENGTH	SLOPE	DISCHARGE	MANNINGS	BOTTOM WIDTH	TOP WIDTH	NORMAL DEPTH	CRITICAL DEPTH		VELOCITY
		OUTLET	INLET	OUTLET	INLET										
THOMAS ROAD	OSBORN ROAD EXTENDED	1028.0	1030.0	1016.5	1019.9	2640	.0013	3687	.018	35	81	7.8	6.2	9.4	
OSBORN ROAD EXTENDED	INDIAN SCHOOL ROAD	1030.0	1032.0	1019.9	1023.1	2640	.0012	3063	.018	30	71	7.7	6.0	8.8	
INDIAN SCHOOL ROAD	CAMPBELL AVENUE EXTENDED	1032.0	1036.0	1023.1	1026.8	2640	.0014	2401	.018	26	62	6.9	5.6	8.8	
CAMPBELL AVENUE EXTENDED	CAMELBACK ROAD	1036.0	1042.0	1026.8	1032.8	2640	.0023	1650	.018	10	47	6.9	6.4	10.0	
CAMELBACK ROAD	MISSOURI AVENUE EXTENDED	1042.0	1047.0	1033.8	1038.4	2640	.0017	791	.018	8	41	6.2	4.9	6.9	
MISSOURI AVENUE EXTENDED	GRAND CANAL	1047.0	1056.0	1040.7	1047.3	2640	.0025	432	.018	8	33	3.8	3.4	7.3	
THOMAS ROAD	ENCANTO BLVD. EXTENDED	1028.0	1026.0	1016.0	1020.0	2640	.0015	331	.018	10	46	3.8	2.9	5.8	

Crown Elev. of 60 in. Sanitary Sewer @ 99th and Thomas = 1015.5 + Also Drop of 6.5 ft. To get under irrigation ditch @ 99th Avenue.

Drop of 1.0 ft. at Camelback Road.  
Drop of 2.3 ft. at Missouri Avenue.

Channel will outlet into channel under irrigation ditch @ 99th Avenue and Thomas Road.





## **ALTERNATIVE NO. 2**

**STORM DRAIN DESIGN  
ALTERNATIVE NO 2  
THOMAS ROAD ALIGNMENT**

LOCATION		STORM DRAIN PROFILE					STORM DRAIN DESIGN				ENERGY GRADE LINE / HYDRAULIC GRADE LINE				REMARKS				
FROM NOOE	TO NOOE	GROUND ELEVATION		CROWN ELEVATION		LENGTH	SLOPE	Q	DIA.	V	SI	HI	V <sup>2</sup> /2g	Hm		EOL		HGL	
		OUTLET	INLET	OUTLET	INLET											(FT)	(FT)	(FT)	(FT)
AGUA FRIA RIVER	Detention Basin No. 1	① 1004.2 Top of Dike	1028.0	997.5	1025	15320	② .0010 AVE.	233	78	70	.0067	256	.77	.77	997.8	1023.4	997.0	③ 10226	PIPE UNDER 60" SANITARY SEWER.
<p>78" PIPE WILL HAVE TO BE CONNECTED TO THE 2-60" STUB-OUTS BUILT BY THE FLOOD CONTROL DISTRICT IN THE AGUA FRIA RIVER SOIL CEMENT DIKE.</p> <p>① APPROXIMATE INVERT OF THE AGUA FRIA RIVER IS 990.0</p> <p>② THIS IS AN AVERAGE PIPE SLOPE. THE PIPE SLOPES AT .0019% FROM THE DETENTION BASIN TO THE 60" SANITARY SEWER CROSSING AT 99<sup>TH</sup> AVE. AND SLOPES AT .0007% TO THE AGUA FRIA RIVER.</p> <p>③ 10-YEAR WSEL IN THE AGUA FRIA RIVER</p>																		INV. ELEV. OF SOUTH SIDE OF DETENTION BASIN No. 1 = 1006.0 ±.	

## STORM DRAIN DESIGN ALTERNATIVE NO 2

### ENCANTO BLVD. EXTENDED TO PAPAGO INTERCEPTOR CHANNEL

LOCATION		STORM DRAIN PROFILE					STORM DRAIN DESIGN		ENERGY GRADE LINE / HYDRAULIC GRADE LINE							REMARKS			
FROM NODE	TO NODE	GROUND ELEVATIONS		CROWN ELEVATIONS		LENGTH (FT)	SLOPE (FT/FT)	Q (CFS)	DIA. (IN)	V (FPS)	S <sub>f</sub> (FT)	H <sub>f</sub> (FT)	H <sub>m</sub> (FT)	EGL ELEV.	HGL ELEV.		HGL ELEV.	EGL ELEV.	
		OUTLET (FT)	INLET (FT)	OUTLET (FT)	INLET (FT)									OUTLET (FT)	INLET (FT)		OUTLET (FT)	INLET (FT)	
Encanto Boulevard Extended To Papago Interceptor Channel																		Assume W.S. Elev. = 1008.0' at Top of Pipe in I-10 Channel	
I-10 Channel	RID Canal	(1020.0)	(1022.0)	1008.0	1010.0	1000	.0020	344	78	10.4	.00366	3.66	1.68	1.68	1009.68	1013.38	1008.0	1011.7	Elev.(1020.0) Is At Top of I-10 Channel Invert Elev.=1001.0'
RID Canal	1320' North	(1022.0)	1024.0	1010.0	1015.3	1320	.0040	344	78	10.4	.00366	4.83	1.68	—	1013.68	1018.18	1011.7	1016.5	Elev.(1022.0) Is At Top of RID Canal Invert Elev.=1012.0'
1320' North	1980' North	1024.0	1025.0	1015.3	1017.9	660	.0039	178	60	9.1	.00376	2.61	1.29	—	1018.18	1020.78	1016.5	1019.1	
1980' North	Encanto Blvd.	1025.0	1027.0	1017.9	1020.5	660	.0039	89	48	7.1	.00325	2.15	.78	—	1020.78	1022.88	1019.1	1021.2	Hydraulic Grade Line Checks O.K.

Estimated Elevation of RID Canal Invert = 1012.0 ft. This will have to be Surveyed for Confirmation. Design and Pipe Size may change depending on this Elevation.  
 ( ) Ground Elevations in Parentheses are Top of Bank Elevations from either the I-10 Channel or the RID Canal.

**STORM DRAIN DESIGN  
ALTERNATIVE NO 2  
ENCANTO BOULEVARD TO THOMAS ROAD**

LOCATION		STORM DRAIN PROFILE						STORM DRAIN DESIGN			ENERGY GRADE LINE/ HYDRAULIC GRADE LINE						REMARKS
FROM NODE	TO NODE	GROUND ELEVATION	GROUND ELEVATION	LENGTH	SLOPE	Q	DIA.	V	SI	HI	V <sup>2</sup> /2g	Hm	SSL	SSL	HGL	SSL	
		OUTLET	INLET										OUTLET	INLET	OUTLET	INLET	
(FT)	(FT)	(FT)	(FT)	(FT)	(FT/FT)	(GFS)	(IN)	(FPS)	(FT)	(FT)	(FT)	(FT)	(FT)	(FT)	(FT)	(FT)	
THOMAS ROAD TO ENCANTO BLVD. EXTENDED																	INV. ELEV. ON SOUTH SIDE OF DETENTION BASIN No.1 = 1006±.
Thomas Road	Encanto Blvd. Extended	1028.0	1027.0	1019.4	1021.5	1320	.0016	331	96	6.6	.0012	1.5	.7				FLOW CONVEYED TO DETENTION. BASIN No.1
		NOTE: THIS PIPE FLOWS PARTIALLY FULL.															

**STORM DRAIN DESIGN  
ALTERNATIVE NO 2  
GRAND CANAL ALIGNMENT**

LOCATION		STORM DRAIN PROFILE					STORM DRAIN DESIGN				ENERGY GRADE LINE / HYDRAULIC GRADE LINE				REMARKS				
FROM NODE	TO NODE	GROUND ELEVATION		CROWN ELEVATION		LENGTH	SLOPE	Q	DIA.	V	S <sub>f</sub>	H <sub>i</sub>	V <sup>2</sup> /2g	H <sub>m</sub>		E.G.L.		H.G.L.	
		OUTLET	INLET	OUTLET	INLET											OUTLET	INLET	OUTLET	INLET
(FT)	(FT)	(FT)	(FT)	(FT)	(FT)	(FT/FT)	(GFS)	(IN)	(FPS)	FEET	(FT)	(FT)	(FT)	(FT)	(FT)	(FT)	(FT)	(FT)	
NEW RIVER	Detention Basin No. 3	① 1031.0	1059.0	1045.0	1049.0	6000	.0007	871	120	11.1	.00235	14.1	1.9	1.9	1041.9	1057.9	1040.0	1056.0	INV. ELEV. OF DETENTION BASIN No. 3 = 1039.0.
Detention Basin No. 3	Detention Basin No. 2	1059.0	1085.0	1044.0	1072.0	8500	.0033	152	60	7.7	.00229	24.6	.9	.9	1058.8	1083.9	1057.9	1082.5	PIPE UNDER 42" SAN. SEWER, INV. OF DETENTION BASIN No. 2 = 1067.0.
		① APPROXIMATE INVERT OF NEW RIVER. ② 10-YEAR WSEL IN NEW RIVER																	







## **RECOMMENDED PLAN**

**STORM DRAIN DESIGN  
RECOMMENDED PLAN  
THOMAS ROAD ALIGNMENT**

LOCATION		STORM DRAIN PROFILE					STORM DRAIN DESIGN			ENERGY GRADE LINE / HYDRAULIC GRADE LINE							REMARKS		
FROM NODE	TO NODE	GAUGING OUTLET (FT)	ELEVATION (FT)	CROWN (FT)	ELEVATION (FT)	LENGTH (FT)	SLOPE (FT/FT)	Q (GFS)	DIA. (IN)	V (FPS)	SI (FT)	HI (FT)	V <sup>2</sup> /2g (FT)	Hm (FT)	E.G.L. OUTLET (FT)	ELEV. INLET (FT)		H.L. (FT)	ELEV. INLET (FT)
AGUA FRIA RIVER	Detention Basin No. 1	① 1004.2 <small>Top of Dike</small>	1028.0	997.5	1012.5	15320	② .0010 AVE.	233	78	7.0	.0007	25.6	.77	.77	997.8	1023.4		997.0	③ 1022.6
<p>78" PIPE WILL HAVE TO BE CONNECTED TO THE 2-60" STUB-OUTS BUILT BY THE FLOOD CONTROL DISTRICT IN THE AGUA FRIA RIVER SOIL CEMENT DIKE.</p> <p>① APPROXIMATE INVERT OF THE AGUA FRIA RIVER IS 990.00.</p> <p>② THIS IS AN AVERAGE PIPE SLOPE. THE PIPE SLOPES AT .0019% FROM THE DETENTION BASIN TO THE 60" SANITARY SEWER CROSSING AT 99<sup>TH</sup> AVE. AND SLOPES AT .0007% TO THE AGUA FRIA RIVER.</p> <p>③ 10-YEAR WSEL IN THE AGUA FRIA RIVER.</p>																			INV. ELEV. OF SOUTH SIDE OF DETENTION BASIN No. 1 = 1006.0 ±.



# STORM DRAIN DESIGN RECOMMENDED PLAN

## ENCANTO BLVD. EXTENDED TO PAPAGO INTERCEPTOR CHANNEL

LOCATION		STORM DRAIN PROFILE					STORM DRAIN DESIGN				ENERGY GRADE LINE/ HYDRAULIC GRADE LINE				REMARKS				
FROM NODE	TO NODE	GROUND ELEVATION		GROUND ELEVATION		LENGTH	SLOPE	Q	DIA.	V	S <sub>f</sub>	H <sub>i</sub>	V <sup>2</sup> /2g	H <sub>m</sub>		E.O.L.	ELEV.	H.O.L.	ELEV.
		OUTLET	INLET	OUTLET	INLET											OUTLET	INLET	OUTLET	INLET
(FT)	(FT)	(FT)	(FT)	(FT)	(FT)	(FT/FT)	(CFS)	(IN)	(FPS)	(FT)	(FT)	(FT)	(FT)	(FT)	(FT)	(FT)	(FT)	(FT)	
Encanto Boulevard	Papago Interceptor Channel																		Assume W.S. Elev. = 1008.0' at Top of Pipe in I-10 Channel.
I-10 Channel	RID Canal	(1020.0) 1001.0	(1022.0) 1012.0	1008.0	1010.0	1000	.0020	344	78	10.4	.00366	3.66	1.68	1.68	1009.68	1013.38	1008.0	1011.7	Elev.(1020.0) Is At Top of I-10 Channel Invert Elev.=1001.0'
RID Canal	1320' North	(1022.0) 1012.0	1024.0	1010.0	1015.3	1320	.0040	344	78	10.4	.00366	4.83	1.68	—	1013.68	1018.18	1011.7	1016.5	Elev.(1022.0) Is At Top of RID Canal Invert Elev.=1012.0'
1320' North	1980' North	1024.0	1025.0	1015.3	1017.9	660	.0039	178	60	9.1	.00376	2.61	1.29	—	1018.18	1020.78	1016.5	1019.1	
1980' North	Encanto Blvd.	1025.0	1027.0	1017.9	1020.5	660	.0039	89	48	7.1	.00325	2.15	.78	—	1020.78	1022.88	1019.1	1021.2	Hydraulic Grade Line Checks O.K.

Estimated Elevation of RID Canal Invert = 1012.0 ft. This will have to be Surveyed for Confirmation. Design and Pipe Size may change depending on this Elevation.  
 ( ) Ground Elevations in Parentheses are Top of Bank Elevations from either the I-10 Channel or the RID Canal.

# CHANNEL DESIGN

RECOMMENDED PLAN

ALIGNMENT ALONG THE OUTER LOOP FROM  
THOMAS ROAD TO THE GRAND CANAL

**( Concrete Lined Trapezoidal Channel - 2:1 Side Slope )**  
MINIMUM FREEBOARD OF 2 FEET

LOCATION		CHANNEL PROFILE						CHANNEL DESIGN						REMARKS	
FROM	TO	GROUND ELEVATION		INVERT ELEVATION		LENGTH	SLOPE	DISCHARGE	MANNINGS	BOTTOM WIDTH	TOP WIDTH	NORMAL DEPTH	CRITICAL DEPTH		VELOCITY
		OUTLET	INLET	OUTLET	INLET										
DETENTION BASIN #1	SOUTH TO THOMAS ROAD	1029.0	1028.0	1018.3	1020.9	1320	.0020	825	.018	10	53	5.1	4.4	7.9	
DETENTION BASIN #1	NORTH TO INDIAN SCHOOL RD.	1031	1032.0	1020.2	1021.9	1320	.0013	3023	.018	25	68	8.0	6.4	9.2	
INDIAN SCHOOL RD.	CAMPBELL AVE. EXTENDED	1032.0	1036.0	1021.9	1026.1	2640	.0016	2401	.018	20	61	7.4	6.2	9.5	
CAMPBELL AVE. EXTENDED	CAMELBACK ROAD	1036.0	1042.0	1026.8	1032.8	2640	.0023	1650	.018	10	47	6.9	6.4	10.0	
CAMELBACK ROAD	MISSOURI AVE. EXTENDED	1042.0	1047.0	1033.8	1038.4	2640	.0017	791	.018	8	41	5.8	4.9	7.6	
MISSOURI AVE. EXTENDED	GRAND CANAL	1047.0	1056.0	1041.2	1047.8	2640	.0025	432	.018	8	31	3.8	3.4	7.3	

Invert Elev. on North side of Detention Basin #1 = 1008 ±

Drop of 0.7 ft. at Campbell Avenue Extended.

Drop of 1.0 ft. at Camelback Road.

Drop of 2.8 ft. at Missouri Avenue Extended.





APPENDIX 2  
COST ESTIMATES

**ALTERNATIVE NO. 1**

COST ESTIMATE - ALTERNATIVE NO. 1

STORM SEWER COST

LOCATION		SIZE	LENGTH	UNIT COST	COST
From	To	In.	Ft.	\$/L.F.	\$
Encanto Boulevard to 660' south		48	660	98.00	\$ 64,680.00
660' south to 1320' south of Encanto Boulevard		60	660	140.00	92,400.00
1320' south to RID Canal		78	1320	165.00	217,800.00
RID Canal to I-10 Channel		78	1000	165.00	<u>165,000.00</u>
				Subtotal	\$ 539,880.00
				Plus 30% (Appurtenances and Contingencies)	<u>\$ 161,964.00</u>
				Total	<u>\$ 701,844.00</u>

COST ESTIMATE - ALTERNATIVE NO. 1

THOMAS ROAD CHANNEL - AGUA FRIA RIVER TO THE OUTER LOOP

LOCATION From	To	DESCRIPTION	UNIT	QUANTITY	UNIT COST	COST
Agua Fria River	115th Ave.	Excavation	C.Y.	65,674	2.50	164,185.00
		Channel Lining	S.Y.	27,278	20.00	545,555.00
		Bridges	S.F.	2 @ 3,600	50.00	360,000.00
				1 @ 7,200	50.00	360,000.00
Construction Cost						1,429,740.00
30% (Appurtenances and Contingencies)						428,922.00
Total Construction Cost						1,858,662.00
		ROW	S.F.	353,400	4.50	1,590,300.00
Total Cost						3,448,962.00
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115th Ave.	107th Ave.	Excavation	C.Y.	136,013	2.50	340,032.00
		Channel Lining	S.Y.	50,658	20.00	1,013,160.00
		Bridges	S.F.	4 @ 4,000	50.00	800,000.00
				1 @ 8,000	50.00	400,000.00
Construction Cost						2,553,192.00
30% (Appurtenances and Contingencies)						765,958.00
Total Construction Cost						3,319,150.00
		ROW	S.F.	633,600	4.50	2,851,200.00
Total Cost						6,170,350.00

COST ESTIMATE - ALTERNATIVE NO. 1

THOMAS ROAD CHANNEL - AGUA FRIA RIVER TO THE OUTER LOOP

LOCATION		DESCRIPTION	UNIT	QUANTITY	UNIT COST	COST	
From	To						
107th Ave.	Rid Canal	Excavation	C.Y.	86,250	2.50	215,625.00	
		Channel Lining	S.Y.	28,215	20.00	564,300.00	
		Bridges	S.F.	1 @ 4,500	50.00	225,000.00	
		Construction Cost					1,004,925.00
		30% (Appurtenances and Contingencies)					301,478.00
		Total Construction Cost					1,306,403.00
		ROW		S.F.	343,200	4.50	1,544,400.00
Total Cost					2,850,803.00		
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Rid Canal	99th Ave.	Excavation	C.Y.	107,751	2.50	269,378.00	
		Channel Lining	S.Y.	30,791	20.00	615,827.00	
		Bridges	S.F.	2 @ 5,300	50.00	530,000.00	
		Construction Cost					1,415,205.00
		30% (Appurtenances and Contingencies)					424,562.00
		Total Construction Cost					1,839,767.00
		ROW		S.F.	359,040	4.50	1,615,680.00
Total Cost					3,455,447.00		

TOTAL COST OF THOMAS ROAD CHANNEL - AGUA FRIA RIVER TO THE OUTER LOOP \$15,925,562.00

COST ESTIMATE - ALTERNATIVE NO. 1

OUTER LOOP CHANNEL - 1/2 MILE SOUTH OF THOMAS ROAD TO GRAND CANAL

LOCATION		DESCRIPTION	UNIT	QUANTITY	UNIT COST	COST
From	To					
Thomas Rd.	Osborn Rd. Extended	Excavation	C.Y.	65,218	2.50	163,044.00
		Channel Lining	S.Y.	25,353	20.00	507,053.00
		Bridges	S.F.	1 @ 8,100	50.00	405,000.00
				2 @ 4,050	50.00	405,000.00
		Construction Cost				
30% (Appurtenances and Contingencies)						444,029.00
Total Construction Cost						1,924,126.00
		ROW	S.F.	319,440	4.50	1,437,480.00
Total Cost						3,361,606.00
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Osborn Rd. Extended	Indian School Rd.	Excavation	C.Y.	49,575	2.50	123,938.00
		Channel Lining	S.Y.	22,049	20.00	440,989.00
		Bridges	S.F.	1 @ 3,550	50.00	177,500.00
				1 @ 7,100	50.00	355,000.00
		Construction Cost				
30% (Appurtenances and Contingencies)						329,228.00
Total Construction Cost						1,426,655.00
		ROW	S.F.	293,040	4.50	1,318,680.00
Total Cost						2,745,335.00

COST ESTIMATE - ALTERNATIVE NO. 1

OUTER LOOP CHANNEL - 1/2 MILE SOUTH OF THOMAS ROAD TO GRAND CANAL

LOCATION		DESCRIPTION	UNIT	QUANTITY	UNIT COST	COST
From	To					
Indian	Campbell Ave	Excavation	C.Y.	38,116	2.50	95,290.00
School Rd.	Extended	Channel Lining	S.Y.	19,302	20.00	386,040.00
		Bridges	S.F.	1 @ 3,100	50.00	155,000.00
					Construction Cost	636,330.00
					30% (Appurtenances and Contingencies)	190,899.00
					Total Construction Cost	827,229.00
		ROW	S.F.	269,280	4.50	1,211,760.00
					Total Cost	2,038,989.00
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Campbell	Camelback	Excavation	C.Y.	25,547	2.50	63,868.00
Ave. Ext.	Rd.	Channel Lining	S.Y.	15,001	20.00	300,021.00
		Bridges	S.F.	2 @ 2,350	50.00	235,000.00
				1 @ 4,700	50.00	235,000.00
					Construction Cost	833,889.00
					30% (Appurtenances and Contingencies)	250,167.00
					Total Construction Cost	1,084,056.00
		ROW	S.F.	229,680	4.50	1,033,560.00
					Total Cost	2,117,616.00

COST ESTIMATE - ALTERNATIVE NO. 1

OUTER LOOP CHANNEL - 1/2 MILE SOUTH OF THOMAS ROAD TO GRAND CANAL

LOCATION From	To	DESCRIPTION	UNIT	QUANTITY	UNIT COST	COST
Camelback Rd.	Missouri	Excavation	C.Y.	19,563	2.50	48,908.00
	Avenue	Channel Lining	S.Y.	13,104	20.00	262,073.00
	Extended	Bridges	S.F.	2 @ 1,850	50.00	185,000.00
					Construction Cost	495,981.00
					30% (Appurtenances and Contingencies)	148,794.00
					Total Construction Cost	644,775.00
		ROW	S.F.	213,840	4.50	962,280.00
					Total Cost	1,607,055.00
Missouri Avenue Extended	Grand Canal	Excavation	C.Y.	12,690	2.50	31,724.00
		Channel Lining	S.Y.	10,611	20.00	212,223.00
		Bridges	S.F.	2 @ 1,450	50.00	145,000.00
					Construction Cost	388,947.00
					30% (Appurtenances and Contingencies)	116,684.00
					Total Construction Cost	505,632.00
		ROW	S.F.	192,720	4.50	867,240.00
					Total Cost	1,372,872.00

COST ESTIMATE - ALTERNATIVE NO. 1

OUTER LOOP CHANNEL - 1/2 MILE SOUTH OF THOMAS ROAD TO GRAND CANAL

LOCATION		DESCRIPTION	UNIT	QUANTITY	UNIT COST	COST
From	To					
Thomas Road	Encanto	Excavation	C.Y.	24,640	2.50	61,600.00
	Boulevard	Channel Lining	S.Y.	14,740	20.00	294,800.00
	Extended	Bridges	S.F.	2 @ 2,300	50.00	230,000.00
Construction Cost						586,400.00
30% (Appurtenances and Contingencies)						175,920.00
Total Construction Cost						762,320.00
		ROW	S.F.	227.040	4.50	1,021,680.00
Total Cost						1,784,000.00

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TOTAL COST OF OUTER LOOP CHANNEL 1/2 MILE SOUTH OF THOMAS ROAD TO GRAND CANAL \$15,027,473.00

COST ESTIMATE ALTERNATIVE NO. 1

OUTER LOOP CHANNEL - GRAND CANAL TO NOTHERN AVENUE

LOCATION		DESCRIPTION	UNIT	QUANTITY	UNIT COST	COST
From	To					
Grand Canal	Glendale Ave.	Excavation	C.Y.	92,365	2.50	230,912.00
		Channel Lining	S.Y.	42,787	20.00	855,741.00
		Bridges	S.F.	3 @ 3,400	50.00	510,000.00
Construction Cost						1,596,653.00
30% (Appurtenances and Contingencies)						478,996.00
Total Construction Cost						2,075,649.00
		ROW	S.F.	570,240	4.50	2,566,080.00
Total Cost						4,641,729.00
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Glendale Ave.	Orangewood Avenue Extended	Excavation	C.Y.	10,812	2.50	27,030.00
		Channel Lining	S.Y.	9,824	20.00	196,480.00
		Bridges	S.F.	1 @ 3,100 2 @ 1,550	50.00 50.00	155,000.00 155,000.00
Construction Cost						533,510.00
30% (Appurtenances and Contingencies)						160,053.00
Total Construction Cost						693,563.00
		ROW	S.F.	187,440	4.50	843,480.00
Total Cost						1,537,043.00

COST ESTIMATE - ALTERNATIVE NO. 1

OUTER LOOP CHANNEL - GRAND CANAL TO NORTHERN AVENUE (CONT.)

LOCATION From	To	DESCRIPTION	UNIT	QUANTITY	UNIT COST	COST
Orangewood	1/4 mile	Excavation	C.Y.	3,868	2.50	9,670.00
Avenue	South of	Channel Lining	S.Y.	4,190	20.00	83,800.00
Extended	Northern	Bridges	S.F.	1 @ 1,400	50.00	70,000.00
					Construction Cost	163,470.00
					30% (Appurtenances and Contingencies)	49,041.00
					Total Construction Cost	212,511.00
		ROW	S.F.	89.760	4.50	403,920.00
					Total Cost	616,431.00

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TOTAL COST OUTER LOOP CHANNEL -- GRAND CANAL TO NORTHERN AVENUE \$ 6,795,203.00

COST ESTIMATE - ALTERNATIVE NO. 1

GRAND CANAL CHANNEL - NEW RIVER TO PARADISE CORRIDOR

LOCATION From	To	DESCRIPTION	UNIT	QUANTITY	UNIT COST	COST
New River	Grand Canal Outfall	Excavation	C.Y.	224,741	2.50	561,852.00
		Channel Lining	S.Y.	69,210	20.00	1,384,200.00
		Grouted Riprap	S.Y.	2,778	25.00	69,450.00
		Bridges	S.F.	1 @ 8,250	50.00	412,500.00
					30% (Appurtenances and Contingencies)	728,400.00
					Total Construction Cost	3,156,402.00
		ROW	S.F.	890,350	4.50	4,006,575.00
					Total Cost	7,162,977.00
Grand Canal	99th Ave.	Excavation	C.Y.	133,166	2.50	332,916.00
Outfall		Channel Lining	S.Y.	38,456	20.00	769,120.00
		Bridges	S.F.	-----	50.00	-----
					Construction Cost	1,102,036.00
					30% (Appurtenances and Contingencies)	330,611.00
					Total Construction Cost	1,432,647.00
		ROW	S.F.	432,000	4.50	1,944,000.00
					Total Cost	3,376,647.00

COST ESTIMATE - ALTERNATIVE NO. 1

GRAND CANAL CHANNEL - NEW RIVER TO PARADISE CORRIDOR

LOCATION		DESCRIPTION	UNIT	QUANTITY	UNIT COST	COST
From	To					
99th Ave.	91st Ave.	Excavation	C.Y.	176,000	2.50	440,000.00
		Channel Lining	S.Y.	67,303	20.00	1,346,060.00
		Bridges	S.F.	1 @ 11,000 1 @ 5,500	50.00 50.00	550,000.00 275,000.00
Construction Cost						2,611,060.00
30% (Appurtenances and Contingencies)						783,318.00
Total Construction Cost						3,394,378.00
		ROW	S.F.	792,000	4.50	3,564,000.00
Total Cost						6,958,378.00
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91st Ave.	87rd Ave. Extended	Excavation	C.Y.	77,080	2.50	192,700.00
		Channel Lining	S.Y.	29,776	20.00	595,520.00
		Bridges	S.F.	1 @ 9,700	50.00	485,000.00
Construction Cost						1,273,220.00
30% (Appurtenances and Contingencies)						381,966.00
Total Construction Cost						1,655,186.00
		ROW	S.F.	361,680	4.50	1,627,560.00
Total Cost						3,282,746.00

COST ESTIMATE - ALTERNATIVE NO. 1

GRAND CANAL - NEW RIVER TO PARADISE CORRIDOR

LOCATION From	To	DESCRIPTION	UNIT	QUANTITY	UNIT COST	COST
87th Ave. Extended	83rd Ave.	Excavation	C.Y.	71,679	2.50	179,198.00
		Channel Lining	S.Y.	26,402	20.00	528,040.00
		Bridges	S.F.	1 @ 8,400	50.00	420,000.00
Construction Cost						1,127,238.00
30% (Appurtenances and Contingencies)						338,171.00
Total Construction Cost						1,465,409.00
		ROW	S.F.	327,360	4.50	1,473,120.00
Total Cost						2,938,529.00
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83rd Ave.	Paradise Corridor	Excavation	C.Y.	62,919	2.50	157,296.00
		Channel Lining	S.Y.	23,737	20.00	474,747.00
		Bridges	S.F.	-----	50.00	-----
Construction Cost						632,043.00
30% (Appurtenances and Contingencies)						189,613.00
Total Construction Cost						821,656.00
		ROW	S.F.	300,000	4.50	1,350,000.00
Total Cost						2,171,656.00

TOTAL COST OF GRAND CANAL CHANNEL - NEW RIVER TO PARADISE CORRIDOR \$25,890,933.00

OUTER LOOP COST ESTIMATE SUMMARY

ALTERNATIVE NO. 1

STORM SEWER	\$ 701,844.00
THOMAS ROAD CHANNEL - AGUA FRIA RIVER TO THE OUTER LOOP	15,925,562.00
OUTER LOOP CHANNEL - 1/2 MILE SOUTH OF THOMAS ROAD TO GRAND CANAL	15,027,473.00
OUTER LOOP CHANNEL - GRAND CANAL TO NORTHERN AVENUE	6,795,203.00
GRAND CANAL CHANNEL NEW RIVER TO PARADISE CORRIDOR	<u>\$25,890,933.00</u>
TOTAL COST ALTERNATIVE NO. 1	<u>\$64,341,015.00</u>

## **ALTERNATIVE NO. 2**

ALTERNATIVE NO. 2

DETENTION BASIN #1

80 ACRE BASIN = 3,484,800 Square feet

ROW COST = \$15,681,600.00  
@ 4 50/S.F.

EXCAVATION COST  
@ 2.50/S.Y. = 1578 Ac-Ft x 43,560 Ft/Ac = 68,737,680 C.F.  
- 27 C.F./C.Y.  
= 2,545,840 C.Y.  
x \$2.50/C.Y.  
= \$ 6,364,600.00

30% CONTINGENCIES  
& APPURTENANCES = \$ 1,909,380.00

CONSTRUCTION COST= \$ 8,273,980.00

TOTAL COST = \$23,955,580.00

ALTERNATIVE NO. 2

DETENTION BASIN #2

120 ACRE BASIN = 5,227,200 Square feet

ROW COST = \$23,522,400.00  
@ 4.50/S.F.

EXCAVATION COST  
@ 2.50/S.Y. = 1613 Ac-Ft x 43,560 S.F./Ac = 70,262,280. C.F.  
- 27 C.F./C.Y.  
= 2,602,307 C.Y.  
x \$2.50/C.Y.

= \$ 6,505,767.00

30% CONTINGENCIES  
& APPURTENANCES = \$ 1,951,730.00

CONSTRUCTION COST= \$ 8,457,497.00

TOTAL COST = \$31,979,897.00

ALTERNATIVE NO. 2

DETENTION BASIN #3

100 ACRE BASIN = 4,356,000 Square feet

ROW COST = \$19,602,000.00  
@ 4.50/S.F.

EXCAVATION COST  
@ 2.50/S.Y. = 1663 Ac-Ft x 43,560 S.F./Ac = 72,440,000. C.F.  
- 27 C.F./C.Y.  
= 2,683,000 C.Y.  
x \$2.50/C.Y.

= \$ 6,707,500.00

30% CONTINGENCIES  
& APPURTENANCES = \$ 2,012,250.00

CONSTRUCTION COST= \$ 8,719,750.00

TOTAL COST = \$28,321,750.00

TOTAL DETENTION BASIN COST \$84,257,200

COST ESTIMATE - ALTERNATIVE NO. 2

STORM SEWER COST

LOCATION From To	SIZE In.	LENGTH Ft.	UNIT COST \$/L.F.	COST \$
Thomas Road to 1/2 mile south	96	2640	215.00	\$ 567,600.00
Encanto Boulevard to 660' south	48	660	98.00	\$ 64,680.00
660' south to 1320' south of Encanto Boulevard	60	660	140.00	92,400.00
1320' south to RID Canal	78	1320	165.00	217,800.00
RID Canal to I-10 Channel	78	1000	165.00	<u>165,000.00</u>
			Subtotal	\$1,107,480.00
			Plus 30% (Appurtenances and Contingencies)	<u>\$ 332,224.00</u>
			Total	\$1,439,700.00
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Agua Fria River to Detention Basin #1	78	15320	165.00	\$2,527,800.00
			Plus 30% (Appurtenances and Contingencies)	<u>\$ 758,340.00</u>
			Total	\$3,286,140.00

COST ESTIMATE - ALTERNATIVE NO. 2.

STORM SEWER COST

LOCATION		SIZE	LENGTH	UNIT COST	COST
From	To	In.	Ft.	\$/L.F.	\$
New River to Outer Loop on Bethany Home Rd.		120	5600	450.00	\$2,520,000.00
		Plus 30% (Appurtenances and Contingencies)			\$ 756,000.00
ROW Cost		26.0' Wide	5600	4.50	<u>\$ 655,200.00</u>
				Total	\$3,931,200.00

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Detention Basin #2 to Detention Basin #3		60	9400	140.00	\$1,316,000.00
		Plus 30% (Appurtenances and Contingencies)			<u>\$ 394,800.00</u>
				Total	\$1,710,800.00

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TOTAL STORM SEWER COST \$10,367,800.00

COST ESTIMATE - ALTERNATIVE NO. 2

OUTER LOOP CHANNEL - THOMAS ROAD TO GRAND CANAL

LOCATION From	To	DESCRIPTION	UNIT	QUANTITY	UNIT COST	COST
Thomas Rd.	Detention Basin #1	Excavation	C.Y.	12,418	2.50	31,045.00
		Channel Lining	S.Y.	7,304	20.00	146,080.00
		Bridges	S.F.	1 @ 2,650	50.00	132,500.00
					Construction Cost	309,625.00
					30% (Appurtenances and Contingencies)	92,888.00
					Total Construction Cost	402,513.00
			ROW	S.F.	122,760	4.50
				Total Cost	954,900.00	
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Detention Basin #1	Indian School Rd.	Excavation	C.Y.	23,460	2.50	58,650.00
		Channel Lining	S.Y.	10,520	20.00	210,400.00
		Bridges	S.F.	1 @ 3,300	50.00	165,000.00
					Construction Cost	434,050.00
					30% (Appurtenances and Contingencies)	130,215.00
					Total Construction Cost	564,265.00
			ROW	S.F.	142,560	4.50
				Total Cost	1,205,785.00	
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Indian School Rd.	Campbell Ave Extended	Excavation	C.Y.	39,780	2.50	99,249.00
		Channel Lining	S.Y.	19,116	20.00	382,322.00
		Bridges	S.F.	1 @ 2,750	50.00	137,500.00
					Construction Cost	619,071.00
					30% (Appurtenances and Contingencies)	185,721.00
					Total Construction Cost	804,793.00
			ROW	S.F.	266,640	4.50
				Total Cost	2,004,673.00	

COST ESTIMATE - ALTERNATIVE NO. 2

OUTER LOOP CHANNEL - THOMAS ROAD TO GRAND CANAL

LOCATION		DESCRIPTION	UNIT	QUANTITY	UNIT COST	COST
From	To					
Campbell Ave	Camelback	Excavation	C.Y.	25,547	2.50	63,868.00
Extended	Rd.	Channel Lining	S.Y.	15,001	20.00	300,020.00
		Bridges	S.F.	2 @ 2,350	50.00	235,000.00
				1 @ 4,700	50.00	235,000.00
					Construction Cost	833,888.00
					30% (Appurtenances and Contingencies)	250,166.00
					Total Construction Cost	1,084,054.00
		ROW	S.F.	229,680	4.50	1,033,560.00
					Total Cost	2,117,614.00
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Camelback	Missouri Ave	Excavation	C.Y.	19,563	2.50	48,908.00
Rd.	Extended	Channel Lining	S.Y.	13,104	20.00	262,073.00
		Bridges	S.F.	2 @ 1,850	50.00	185,000.00
					Construction Cost	495,981.00
					30% (Appurtenances and Contingencies)	143,794.00
					Total Construction Cost	644,775.00
		ROW	S.F.	213,840	4.50	962,280.00
					Total Cost	1,607,055.00

COST ESTIMATE - ALTERNATE NO. 2

OUTER LOOP CHANNEL - THOMAS ROAD TO GRAND CANAL

LOCATION From	To	DESCRIPTION	UNIT	QUANTITY	UNIT COST	COST
Missouri Ave	Grand Canal	Excavation	C.Y.	11,115	2.50	27,788.00
Extended		Channel Lining	S.Y.	9,955	20.00	199,105.00
		Bridges	S.F.	2 @ 1,500	50.00	150,000.00
					Construction Cost	376,893.00
					30% (Appurtenances and Contingencies)	113,068.00
					Total Construction Cost	489,961.00
		ROW	S.F.	187,440	4.50	843,480.00
					Total Cost	1,333,441.00

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TOTAL COST OUTER LOOP CHANNEL - THOMAS ROAD TO GRAND CANAL \$ 9,223,500.00

COST ESTIMATE - ALTERNATIVE NO. 2  
 OUTER LOOP CHANNEL - GRAND CANAL TO NORTHERN AVENUE

LOCATION From	To	DESCRIPTION	UNIT	QUANTITY	UNIT COST	COST
Detention Basin #3	Glendale Ave.	Excavation	C.Y.	42,093	2.50	105,233.00
		Channel Lining	S.Y.	19,641	20.00	392,820.00
		Bridges	S.F.	1 @ 3,100	50.00	155,000.00
					Construction Cost	653,053.00
					30% (Appurtenances and Contingencies)	195,916.00
					Total Construction Cost	848,969.00
ROW			S.F.	269,280	4.50	1,211,760.00
					Total Cost	2,060,729.00
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Glendale Ave.	Orangewood Avenue Extended	Excavation	C.Y.	10,812	2.50	27,031.00
		Channel Lining	S.Y.	9,824	20.00	196,481.00
		Bridges	S.F.	1 @ 2,900	50.00	145,000.00
2 @ 1,450	50.00			145,000.00		
					Construction Cost	513,512.00
					30% (Appurtenances and Contingencies)	154,054.00
					Total Construction Cost	667,566.00
ROW			S.F.	187,440	4.50	843,480.00
					Total Cost	1,511,046.00

COST ESTIMATE - ALTERNATIVE NO. 2  
 OUTER LOOP CHANNEL - GRAND CANAL TO NORTHERN AVENUE

LOCATION		DESCRIPTION	UNIT	QUANTITY	UNIT COST	COST
From	To					
Orangewood	1/4 Mile	Excavation	C.Y.	5,151	2.50	12,878.00
Avenue	South of	Channel Lining	S.Y.	4,894	20.00	97,877.00
Extended	Northern	Bridges	S.F.	1 @ 1,200	50.00	60,000.00
	Ave.					
					Construction Cost	170,755.00
					30% (Appurtenances and Contingencies)	51,227.00
					Total Construction Cost	221,982.00
		ROW	S.F.	95,900	4.50	431,550.00
					Total Cost	653,532.00

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TOTAL COST OUTER LOOP CHANNEL - GRAND CANAL TO NORTHERN AVENUE \$ 4,225,307.00

COST ESTIMATE - ALTERNATIVE NO. 2  
 GRAND CANAL CHANNEL - OUTER LOOP TO PARADISE CORRIDOR

LOCATION		DESCRIPTION	UNIT	QUANTITY	UNIT COST	COST
From	To					
Detention Basin #3	91st Ave.	Excavation	C.Y.	50,951	2.50	127,377.00
		Channel Lining	S.Y.	23,592	20.00	471,832.00
		Bridges	S.F.	1 @ 4,700	50.00	235,000.00
					Construction Cost	834,209.00
					30% (Appurtenances and Contingencies)	250,263.00
					Total Construction Cost	1,084,472.00
		ROW	S.F.	324,450	4.50	1,460,025.00
					Total Cost	2,544,497.00
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91st Ave.	1/2 Mile East	Excavation	C.Y.	26,938	2.50	67,344.00
		Channel Lining	S.Y.	15,396	20.00	307,914.00
		Bridges	S.F.	-----	50.00	-----
					Construction Cost	375,258.00
					30% (Appurtenances and Contingencies)	112,577.00
					Total Construction Cost	487,835.00
		ROW	S.F.	232,320	4.50	1,045,440.00
					Total Cost	1,533,275.00

COST ESTIMATE - ALTERNATIVE NO. 2  
 GRAND CANAL CHANNEL - OUTER LOOP TO PARADISE CORRIDOR

LOCATION		DESCRIPTION	UNIT	QUANTITY	UNIT COST	COST
From	To					
1/2 Mile	Detention	Excavation	C.Y.	16,867	2.50	42,167.00
East	Basin #2	Channel Lining	S.Y.	12,185	20.00	243,707.00
		Bridges	S.F.	-----	50.00	-----
					Construction Cost	285,874.00
					30% (Appurtenances and Contingencies)	85,762.00
					Total Construction Cost	371,636.00
		ROW	S.F.	205,920	4.50	926,640.00
					Total Cost	1,298,276.00

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TOTAL COST GRAND CANAL CHANNEL - OUTER LOOP TO PARADISE CORRIDOR \$ 5,376,048.00

OUTER LOOP COST ESTIMATE SUMMARY

ALTERNATIVE NO. 2

DETENTION BASIN	\$ 84,257,200.00
STORM SEWER	10,367,800.00
OUTER LOOP CHANNEL - THOMAS ROAD TO GRAND CANAL	9,223,500.00
OUTER LOOP CHANNEL - GRAND CANAL TO NOTHERN AVENUE	4,225,307.00
GRAND CANAL CHANNEL - OUTER LOOP TO PARADISE CORRIDOR	<u>5,376,048.00</u>
TOTAL COST ALTERNATIVE NO. 2	<u><u>\$113,449,900.00</u></u>

# **RECOMMENDED PLAN**

RECOMMENDED PLAN

DETENTION BASIN #1

80 ACRE BASIN = 3,484,800 Square feet

ROW COST = \$15,681,600.00  
@ 4.50/S.F.

EXCAVATION COST  
@ 2.50/S.Y. = 1578 Ac-Ft x 43,560 Ft/Ac = 68,737,680 C.F.  
- 27 C.F./C.Y.  
= 2,545,840 C.Y.  
x \$2.50/C.Y.  
= \$ 6,364,600.00

30% CONTINGENCIES  
& APPURTENANCES = \$ 1,909,380.00

CONSTRUCTION COST= \$ 8,273,980.00

TOTAL COST = \$23,955,580.00

TOTAL DETENTION BASIN COST \$23,955,580.00

COST ESTIMATE - RECOMMENDED PLAN

STORM SEWER COST

LOCATION	SIZE	LENGTH	UNIT COST	COST
From To	In.	Ft.	\$/L.F.	\$
Agua Fria River to Detention Basin #1	78	15320	165.00	\$2,527,800.00
			Plus 30% (Appurtenances and Contingencies)	<u>\$ 758,340.00</u>
			Total	<u><u>\$3,286,100.00</u></u>

COST ESTIMATE - RECOMMENDED PLAN

OUTER LOOP CHANNEL - THOMAS ROAD TO GRAND CANAL

LOCATION		DESCRIPTION	UNIT	QUANTITY	UNIT COST	COST
From	To					
Campbell Avenue Extended	Camelback Rd.	Excavation	C.Y.	25,547	2.50	63,868.00
		Channel Lining	S.Y.	15,001	20.00	300,020.00
		Bridges	S.F.	2 @ 2,350 1 @ 4,700	50.00 50.00	235,000.00 235,000.00
					Construction Cost	833,888.00
					30% (Appurtenances and Contingencies)	250,166.00
					Total Construction Cost	1,084,054.00
		ROW	S.F.	229,680	4.50	1,033,560.00
					Total Cost	2,117,614.00
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Camelback Rd.	Missouri Avenue Extended	Excavation	C.Y.	19,563	2.50	48,908.00
		Channel Lining	S.Y.	13,104	20.00	262,073.00
		Bridges	S.F.	2 @ 1,850	50.00	185,000.00
					Construction Cost	495,981.00
					30% (Appurtenances and Contingencies)	148,794.00
					Total Construction Cost	644,775.00
		ROW	S.F.	213,840	4.50	962,280.00
					Total Cost	1,607,055.00

COST ESTIMATE - RECOMMENDED PLAN

OUTER LOOP CHANNEL - THOMAS ROAD TO GRAND CANAL

LOCATION From	To	DESCRIPTION	UNIT	QUANTITY	UNIT COST	COST
Missouri Avenue Extended	Grand Canal	Excavation	C.Y.	11,115	2.50	27,788.00
		Channel Lining	S.Y.	9,955	20.00	199,105.00
		Bridges	S.F.	2 @ 1,500	50.00	150,000.00
					Construction Cost	376,893.00
					30% (Appurtenances and Contingencies)	113,068.00
					Total Construction Cost	489,961.00
		ROW	S.F.	187,440	4.50	843,480.00
					Total Cost	1,333,441.00

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TOTAL COST OUTER LOOP CHANNEL - THOMAS ROAD TO GRAND CANAL \$10,326,800.00

COST ESTIMATE - RECOMMENDED PLAN

OUTER LOOP CHANNEL - GRAND CANAL TO NORTHERN AVENUE

LOCATION		DESCRIPTION	UNIT	QUANTITY	UNIT COST	COST
From	To					
Grand Canal	Glendale Ave.	Excavation	C.Y.	92,365	2.50	230,912.00
		Channel Lining	S.Y.	42,787	20.00	855,741.00
		Bridges	S.F.	3 @ 3,400	50.00	510,000.00
Construction Cost						1,596,653.00
30% (Appurtenances and Contingencies)						478,996.00
Total Construction Cost						2,075,649.00
		ROW	S.F.	570,240	4.50	2,566,080.00
Total Cost						4,641,729.00
<hr/>						
Glendale Ave.	Orangewood Avenue Extended	Excavation	C.Y.	10,812	2.50	27,030.00
		Channel Lining	S.Y.	9,824	20.00	196,480.00
		Bridges	S.F.	1 @ 3,100	50.00	155,000.00
				2 @ 1,550	50.00	155,000.00
Construction Cost						533,510.00
30% (Appurtenances and Contingencies)						160,053.00
Total Construction Cost						693,563.00
		ROW	S.F.	187,440	4.50	843,480.00
Total Cost						1,537,043.00

COST ESTIMATE - RECOMMENDED PLAN

OUTER LOOP CHANNEL - GRAND CANAL TO NORTHERN AVENUE

LOCATION From	To	DESCRIPTION	UNIT	QUANTITY	UNIT COST	COST
Orangewood	1/4 Mile	Excavation	C.Y.	3,868	2.50	9,670.00
Avenue	South of	Channel Lining	S.Y.	4,190	20.00	83,800.00
Extended	Northern	Bridges	S.F.	1 @ 1,400	50.00	70,000.00
					Construction Cost	163,470.00
					30% (Appurtenances and Contingencies)	49,041.00
					Total Construction Cost	212,511.00
		ROW	S.F.	89,760	4.50	403,920.00
					Total Cost	616,431.00

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TOTAL COST OUTER LOOP CHANNEL - GRAND CANAL TO NORTHERN AVENUE \$ 6,795,203.00

COST ESTIMATE - RECOMMENDED PLAN

GRAND CANAL - NEW RIVER TO PARADISE CORRIDOR

LOCATION From	To	DESCRIPTION	UNIT	QUANTITY	UNIT COST	COST		
New River	Grand Canal Outfall	Excavation	C.Y.	224,741	2.50	561,852.00		
		Channel Lining	S.Y.	69,210	20.00	1,384,200.00		
		Grouted Riprap	S.Y.	2,778	25.00	69,450.00		
		Bridges	S.F.	1 @ 8,250	50.00	412,500.00		
		Construction Cost					2,428,002.00	
30% (Appurtenances and Contingencies)						728,400.00		
Total Construction Cost					3,156,402.00			
		ROW	S.F.	890,350	4.50	4,006,575.00		
					Total Cost	7,162,977.00		
<hr/>								
Grand Canal Outfall	99th Ave.	Excavation	C.Y.	133,166	2.50	332,916.00		
		Channel Lining	S.Y.	38,456	20.00	769,120.00		
		Bridges	S.F.	-----	50.00	-----		
		Construction Cost					1,102,036.00	
		30% (Appurtenances and Contingencies)						330,611.00
Total Construction Cost					1,432,647.00			
		ROW	S.F.	432,000	4.50	1,944,000.00		
					Total Cost	3,376,647.00		
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COST ESTIMATE - RECOMMENDED PLAN

GRAND CANAL - NEW RIVER TO PARADISE CORRIDOR

LOCATION From	To	DESCRIPTION	UNIT	QUANTITY	UNIT COST	COST
99th Ave.	91st Ave.	Excavation	C.Y.	176,000	2.50	440,000.00
		Channel Lining	S.Y.	67,303	20.00	1,346,060.00
		Bridges	S.F.	1 @ 11,000	50.00	550,000.00
			S.F.	1 @ 5,500	50.00	275,000.00
Construction Cost						2,611,060.00
30% (Appurtenances and Contingencies)						783,318.00
Total Construction Cost						3,394,378.00
		ROW	S.F.	792,000	4.50	3,564,000.00
Total Cost						6,958,378.00
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91st Ave.	87rd Ave. Extended	Excavation	C.Y.	77,080	2.50	192,700.00
		Channel Lining	S.Y.	29,776	20.00	595,520.00
		Bridges	S.F.	1 @ 9,700	50.00	485,000.00
			Construction Cost			
30% (Appurtenances and Contingencies)						381,966.00
Total Construction Cost						1,655,186.00
		ROW	S.F.	361,680	4.50	1,627,560.00
Total Cost						3,282,746.00

COST ESTIMATE - RECOMMENDED PLAN

GRAND CANAL - NEW RIVER TO PARADISE CORRIDOR

LOCATION		DESCRIPTION	UNIT	QUANTITY	UNIT COST	COST
From	To					
87th Ave. Extended	83rd Ave.	Excavation	C.Y.	71,679	2.50	179,198.00
		Channel Lining	S.Y.	26,402	20.00	528,040.00
		Bridges	S.F.	1 @ 8,400	50.00	420,000.00
						Construction Cost 1,127,238.00
						30% (Appurtenances and Contingencies) 338,171.00
						Total Construction Cost 1,465,409.00
		ROW	S.F.	327,360	4.50	1,473,120.00
						Total Cost 2,938,529.00
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83rd Ave.	Paradise Corridor	Excavation	C.Y.	62,919	2.50	157,296.00
		Channel Lining	S.Y.	23,737	20.00	474,747.00
		Bridges	S.F.	-----	50.00	-----
						Construction Cost 632,043.00
						30% (Appurtenances and Contingencies) 189,613.00
						Total Construction Cost 821,656.00
		ROW	S.F.	300,000	4.50	1,350,000.00
						Total Cost 2,171,656.00

TOTAL COST OF GRAND CANAL CHANNEL - NEW RIVER TO PARADISE CORRIDOR \$25,890,900.00

OUTER LOOP COST ESTIMATE SUMMARY

RECOMMENDED PLAN

DETENTION BASIN	\$23,956,900.00
STORM SEWER	4,725,800.00
OUTER LOOP CHANNEL - THOMAS ROAD TO GRAND CANAL	9,223,500.00
OUTER LOOP CHANNEL - GRAND CANAL TO NORTHERN AVENUE	6,795,200.00
GRAND CANAL CHANNEL - NEW RIVER TO PARADISE CORRIDOR	<u>\$25,890,900.00</u>
TOTAL COST RECOMMENDED PLAN	<u>\$70,592,300.00</u>

APPENDIX 3  
HEC-1 INPUT/OUTPUT (CASE A WITH DETENTION)

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*****
*
* FLOOD HYDROGRAPH PACKAGE (HEC-1)
* FEBRUARY 1981
* REVISED 14 JUN 85
*
* RUN DATE: Thu 14-JAN-1988
* TIME: 08:33:28.58
*
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*
* U.S. ARMY CORPS OF ENGINEERS
* THE HYDROLOGIC ENGINEERING CENTER
* 609 SECOND STREET
* DAVIS, CALIFORNIA 95616
*
* (916) 756-1104 OR (FTS) 448-3285
*
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THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC165, 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. THE VERSION RELEASED 31JAN85 CONTAINS NEW OPTIONS ON RL AND BA RECORDS, AND ADDS THE HL RECORD. SEE JANUARY 1985 INPUT DESCRIPTION FOR NEW DEFINITIONS.

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:::
::: FULL MICRO-COMPUTER IMPLEMENTATION :::
::: By: John R. Haestad :::
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HAESTAD METHODS
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LINE ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

85	KK	CP7							
86	KM	COMBINE HYDROGRAPHS AT CP7.							
87	HC	2							
88	KK	CP8A							
89	KM	ROUTE COMBINED HYDROGRAPH AT CP7 TO CP8. FIRST TO TRANSITION AT							
90	KM	CP8A THEN TO CP8.							
91	RK	3800	.0023	.018		15		2	
92	KK	CP8							
93	RK	1480	.0008	.018		25		2	
94	KK	A8							
95	KM	RUNOFF FROM SUBWATERSHED 8.							
96	BA	1.19							
97	LS	0	78	0					
98	UD	.83							
99	KK	CP8							
100	KM	COMBINE HYDROGRAPHS AT CP8.							
101	HC	2							
102	KK	CP9							
103	KM	ROUTE COMBINED HYDROGRAPH AT CP8 TO CP9.							
104	RK	5280	.0008	.018		25		2	
105	KK	A9							
106	KM	RUNOFF FROM SUBWATERSHED 9.							
107	BA	.2							
108	LS	0	78	0					
109	UD	.57							
110	KK	CP9							
111	KM	COMBINE HYDROGRAPHS AT CP9.							
112	HC	2							
113	KK	A9C							
114	KM	RUNOFF FROM SUBWATERSHED A9C.							
115	BA	.093							
116	LS		78						
117	UD	.43							
118	KK	CP9B							
119	KM	ROUTE FLOW AT CP9C TO CP9B.							
120	RK	660	.0043	.012		CIRC		5	
121	KK	A9B							
122	KM	RUNOFF FROM SUBWATERSHED A9B.							
123	BA	.093							
124	LS		78						
125	UD	.43							

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

126	KK	CP9B							
127	KM	ADD HYDROGRAPHS AT CP9B.							
128	HC	2							
129	KK	CP9A							
130	KM	ROUTE FLOW FROM CP9B TO CP9A.							
131	RK	1320 .0043 .012			CIRC		6.5		
132	KK	A9A							
133	KM	RUNOFF FROM SUBWATERSHED A9A.							
134	BA	.185							
135	LS	78							
136	UD	.49							
137	KK	CP9A							
138	KM	ADD HYDROGRAPHS AT CP9A.							
139	HC	2							
140	KK	CP9							
141	KM	ROUTE FLOW FROM CP9A TO CP9.							
142	RK	1000 .003 .012			CIRC		6.5		
143	KK	CP9							
144	KM	COMBINE HYDROGRAPHS AT CP9.							
145	HC	2							
146	KK	A12							
147	KM	RUNOFF FROM SUBWATERSHED 12.							
148	BA	3.14							
149	LS	0 83 0							
150	UD	1.69							
151	KK	CP13							
152	KM	ROUTE FLOW FROM CP12 TO CP13.							
153	RK	26400 .0025 .020				0	50		
154	KK	A11							
155	KM	RUNOFF FROM SUBWATERSHED 11.							
156	BA	3.30							
157	LS	0 81 0							
158	UD	1.69							
159	KK	CP13							
160	KM	ROUTE FLOW FROM CP11 TO CP13.							
161	RK	26400 .0025 .0200				0	50		
162	KK	A13							
163	KM	RUNOFF FROM SUBWATERSHED 13.							
164	BA	4.10							
165	LS	0 82 0							
166	UD	2.00							



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

208	KK	CP16									
209	KM	ROUTE COMBINED HYDROGRAPH AT CP15 TO CP16.									
210	RK	5280	.0015	.018		15		2			
211	KK	A16									
212	KM	RUNOFF FROM SUBWATERSHED A16.									
213	BA	5.31									
214	LS	0	81	0							
215	UD	1.91									
216	KK	CP16									
217	KM	COMBINE HYDROGRAPHS AT CP16.									
218	HC	2									
219	KK	CP17									
220	KM	ROUTE COMBINED HYDROGRAPH AT CP16 TO DET 1.									
221	RK	2640	.0032	.018		20		2			
222	KK	A17									
223	KM	RUNOFF FROM SUBWATERSHED 17.									
224	BA	6.28									
225	LS	0	82	0							
226	UD	2.78									
227	KK	CP17									
228	KM	COMBINE HYDROGRAPHS AT DET1.									
229	HC	2									
230	KK	A17A									
231	KM	RUNOFF FROM SUBWATERSHED A17A.									
232	BA	.50									
233	LS		78								
234	UD	.73									
235	KK	CP17									
236	KM	COMBINE HYDROGRAPHS AT DET1.									
237	HC	2									
238	KK	DET1									
239	KM	STORAGE ROUTING THROUGH DETENTION BASIN 1 TO CP17.									
240	RS	1	STOR	0	0						
241	SV	0	186	310	437	560	692	827	965	1105	1248
242	SV	1394									
243	SQ	0	162	174	185	196	206	215	224	233	242
244	SQ	250									
245	SE	1004	1010	1012	1014	1016	1018	1020	1022	1024	1026
246	SE	1028									
247	KK	CP19									
248	KM	ROUTE COMBINED HYDROGRAPH AT CP17 TO CP19.									
249	RK	15320	.0011	.018		CIRC	6.5				



SCHEMATIC DIAGRAM OF STREAM NETWORK

INPUT LINE	(V) ROUTING	(---) DIVERSION OR PUMP FLOW
NO.	(.) CONNECTOR	(←) RETURN OF DIVERTED OR PUMPED FLOW
14	A1	
	V	
	V	
22	CP2	
	.	
	.	
25	.	A2
	.	.
	.	.
38	CP2.....	
	V	
	V	
33	CP3	
	.	
	.	
36	.	A3
	.	.
	.	.
41	CP3.....	
	V	
	V	
44	CP4	
	.	
	.	
47	.	A4
	.	.
	.	.
52	CP4.....	
	V	
	V	
55	CP5	
	.	
	.	
58	.	A5
	.	.
	.	.
63	CP5.....	
	V	
	V	
66	CP6	
	.	
	.	
69	.	A6
	.	.
	.	.
74	CP6.....	
	V	
	V	
77	CP7	
	.	
	.	
80	.	A7
	.	.
	.	.

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85      .
      CP7.....
      V
      V
88      CP8A
      V
      V
92      CP8
      .
      .
94      .      A8
      .
      .
99      CP8.....
      V
      V
102     CP9
      .
      .
105     .      A9
      .
      .
110     CP9.....
      .
      .
113     .      A9C
      .      V
      .      V
118     .      CP9B
      .
      .
121     .      .      A9B
      .      .
      .      .
126     .      CP9B.....
      .      V
      .      V
129     .      CP9A
      .
      .
132     .      .      A9A
      .      .
      .      .
137     .      CP9A.....
      .      V
      .      V
140     .      CP9
      .
      .
143     CP9.....
      .
      .
146     .      A12
      .      V
      .      V
151     .      CP13
      .
      .
154     .      .      A11
      .      .      V
      .      .      V
159     .      .      CP13
      .      .
      .      .
162     .      .

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167	.	CP13.....	.
	.	V	.
	.	V	.
170	.	CP14	.
	.	.	.
	.	.	.
173	.	A10	.
	.	V	.
	.	V	.
178	.	CP14	.
	.	.	.
	.	.	.
181	.	.	A14
	.	.	.
	.	.	.
186	.	CP14.....	.
	.	.	.
	.	.	.
189	.	CP14.....	.
	.	V	.
	.	V	.
192	.	CP18	.
	.	.	.
	.	.	.
195	.	A18	.
	.	.	.
	.	.	.
200	.	CP18.....	.
	.	.	.
	.	.	.
203	.	A15	.
	.	V	.
	.	V	.
208	.	CP16	.
	.	.	.
	.	.	.
211	.	.	A16
	.	.	.
	.	.	.
216	.	CP16.....	.
	.	V	.
	.	V	.
219	.	CP17	.
	.	.	.
	.	.	.
222	.	.	A17
	.	.	.
	.	.	.
227	.	CP17.....	.
	.	.	.
	.	.	.
230	.	.	A17A
	.	.	.
	.	.	.
235	.	CP17.....	.
	.	V	.
	.	V	.
238	.	DET1	.
	.	V	.
	.	V	.
247	.	CP19	.
	.	.	.
	.	.	.
250	.	.	A19







0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00

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			BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
				6-HOUR	24-HOUR	72-HOUR			
HYDROGRAPH AT	A1	2731.	14.40	1522.	439.	439.	7.45		
ROUTED TO	CP2	2730.	14.40	1520.	436.	436.	7.45		
HYDROGRAPH AT	A2	2629.	14.60	1560.	457.	457.	7.79		
2 COMBINED AT	CP2	5232.	14.50	3031.	883.	883.	15.24		
ROUTED TO	CP3	5230.	14.50	3031.	882.	882.	15.24		
HYDROGRAPH AT	A3	2279.	14.60	1345.	393.	393.	6.70		
2 COMBINED AT	CP3	7315.	14.50	4293.	1257.	1257.	21.94		
ROUTED TO	CP4	7314.	14.60	4294.	1255.	1255.	21.94		
HYDROGRAPH AT	A4	2405.	14.20	1292.	370.	370.	5.80		
2 COMBINED AT	CP4	5393.	14.50	5471.	1580.	1580.	27.74		
ROUTED TO	CP5	5376.	14.60	5472.	1590.	1590.	27.74		
HYDROGRAPH AT	A5	1132.	13.70	510.	143.	143.	3.19		
2 COMBINED AT	CP5	10107.	14.50	5911.	1728.	1728.	30.93		
ROUTED TO	CP6	10102.	14.50	5912.	1725.	1725.	30.93		
HYDROGRAPH AT	A6	1274.	13.30	450.	124.	124.	2.23		
2 COMBINED AT	CP6	10531.	14.50	6275.	1836.	1836.	33.16		
ROUTED TO	CP7	10527.	14.50	6277.	1834.	1834.	33.16		
HYDROGRAPH AT	A7	874.	13.20	298.	82.	82.	1.47		
2 COMBINED AT	CP7	10794.	14.50	6515.	1909.	1909.	34.63		
ROUTED TO	CP8A	10788.	14.50	6514.	1906.	1906.	34.63		
ROUTED TO	CP8	10781.	14.50	6512.	1904.	1904.	34.63		
HYDROGRAPH AT	A8	710.	12.90	189.	52.	52.	1.19		
2 COMBINED AT	CP8	10876.	14.50	6641.	1950.	1950.	35.82		
ROUTED TO	CP9	10871.	14.60	6644.	1945.	1945.	35.82		
HYDROGRAPH AT	A9	161.	12.60	32.	9.	9.	0.20		
2 COMBINED AT	CP9	10875.	14.60	6661.	1953.	1953.	36.02		

HYDROGRAPH AT	A9C	89.	12.40	15.	4.	4.	0.09
ROUTED TO	CP98	89.	12.50	15.	4.	4.	0.09
HYDROGRAPH AT	A9B	89.	12.40	15.	4.	4.	0.09
2 COMBINED AT	CP98	176.	12.50	30.	8.	8.	0.19
ROUTED TO	CP9A	176.	12.50	30.	8.	8.	0.19
HYDROGRAPH AT	A9A	164.	12.50	30.	8.	8.	0.19
2 COMBINED AT	CP9A	337.	12.50	60.	16.	16.	0.37
ROUTED TO	CP9	334.	12.50	60.	16.	16.	0.37
2 COMBINED AT	CP9	10090.	14.60	6680.	1967.	1967.	36.39
HYDROGRAPH AT	A12	1309.	13.00	595.	166.	166.	3.14
ROUTED TO	CP13	1184.	15.10	568.	159.	159.	3.14
HYDROGRAPH AT	A11	1260.	13.00	574.	161.	161.	3.30
ROUTED TO	CP13	1134.	15.10	548.	154.	154.	3.30
HYDROGRAPH AT	A13	1417.	14.10	729.	207.	207.	4.10
3 COMBINED AT	CP13	3363.	14.90	1755.	516.	516.	10.54
ROUTED TO	CP14	3362.	15.00	1756.	514.	514.	10.54
HYDROGRAPH AT	A10	2623.	13.00	1194.	334.	334.	6.33
ROUTED TO	CP14	2377.	15.10	1142.	319.	319.	6.33
HYDROGRAPH AT	A14	1536.	14.30	848.	245.	245.	5.29
2 COMBINED AT	CP14	3705.	14.90	1911.	561.	561.	11.62
2 COMBINED AT	CP14	6785.	15.00	3567.	1052.	1052.	22.16
ROUTED TO	CP18	6769.	15.10	3563.	1045.	1045.	22.16
HYDROGRAPH AT	A18	416.	12.00	107.	29.	29.	0.70
2 COMBINED AT	CP18	6794.	15.10	3612.	1071.	1071.	22.86
HYDROGRAPH AT	A15	791.	13.20	266.	74.	74.	1.77
ROUTED TO	CP16	786.	13.30	264.	73.	73.	1.77
HYDROGRAPH AT	A16	1821.	14.00	909.	258.	258.	5.31
2 COMBINED AT	CP16	2401.	13.70	1169.	330.	330.	7.06
ROUTED TO	CP17	2396.	13.70	1169.	330.	330.	7.06
HYDROGRAPH AT	A17	1632.	15.00	1040.	312.	312.	6.28
2 COMBINED AT	CP17	3608.	14.20	2168.	635.	635.	13.36
HYDROGRAPH AT	A17A	331.	12.00	80.	22.	22.	0.50
2 COMBINED AT	CP17	3667.	14.10	2232.	656.	656.	13.86

ROUTED TO	DET1	233.	23.20	231.	99.	99.	13.86	1023.21	23.70
ROUTED TO	CP19	233.	23.70	231.	92.	92.	13.86		
HYDROGRAPH AT	A19	460.	13.50	187.	52.	52.	1.32		
2 COMBINED AT	CP19	506.	13.90	341.	143.	143.	15.18		

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

APPENDIX 4  
HEC-1 INPUT/OUTPUT (CASE B WITH DETENTION)

```

*****
*
* FLOOD HYDROGRAPH PACKAGE (HEC-1) *
* FEBRUARY 1981 *
* REVISED 14 JUN 85 *
*
* RUN DATE: Mon 07-DEC-1987 *
* TIME: 14:17:24.00 *
*
*****

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*****
*
* U.S. ARMY CORPS OF ENGINEERS *
* THE HYDROLOGIC ENGINEERING CENTER *
* 609 SECOND STREET *
* DAVIS, CALIFORNIA 95616 *
*
* (916) 756-1104 DR (FTS) 448-3285 *
*
*****

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X X XXXXXXX XXXXX X
X X X X X XX
X X X X X
XXXXXXXX XXXX X XXXXX X
X X X X X
X X X X X
X X XXXXXXX XXXXX XXX

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THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1BS, 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. THE VERSION RELEASED 31JAN85 CONTAINS NEW OPTIONS ON RL AND BA RECORDS, AND ADDS THE HL RECORD. SEE JANUARY 1985 INPUT DESCRIPTION FOR NEW DEFINITIONS.

```

::::::::::::::::::::::::::::::::::::::::::
::::::::::::::::::::::::::::::::::::::::::
:::
::: FULL MICRO-COMPUTER IMPLEMENTATION :::
::: By: John R. Haestad :::
:::
::::::::::::::::::::::::::::::::::::::::::
::::::::::::::::::::::::::::::::::::::::::

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=====
HAESTAD METHODS
=====

LINE	ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
1	ID CASEB100.DET 100-YEAR STORM DATA
2	ID HEC-1 MODEL FOR THE OUTER LOOP DRAINAGE STUDY, PAFAGO FREEWAY TO
3	ID NORTHERN AVENUE SECTION. DRAINAGE AREA DELINEATIONS WERE MADE ASSUMING
4	ID THAT THE PARADISE CORRIDOR CHANNEL IS IN PLACE AND GRAND AVENUE IS A
5	ID LOW LEVEL FACILITY. DETENTION PROVIDED ON THE PARADISE CORRIDOR
6	ID AND THE OUTER LOOP.
	*DIAGRAM
7	IT 615JUNE86 1200 300
8	IO 5
9	JD .09
10	PH .71 1.40 2.45 2.64 2.82 3.10 3.40 3.71
11	JD 10
12	JD 20
13	JD 30
14	JD 40
15	KK B1
16	KM SUBWATERSHED 1 IN THE OUTER LOOP DRAINAGE STUDY.
17	KM THE HYPOTHETICAL DATA CARD IS USED TO INPUT STORM RAINFALL DATA COMPUTED
18	KM FROM THE ADDENDUM TO ADOT'S "HYDROLOGIC DESIGN FOR HIGHWAY DRAINAGE IN
19	KM ARIZONA" APRIL 1975.
20	BA 3.82
21	LS 0 86 0
22	UD 1.62
23	KK CP2
24	KM ROUTE FLOW FROM SUBWATERSHED 1 (B1) TO CONCENTRATION POINT 2 (CP2).
25	RK 5280 .00094 .018 30 1
26	KK B2
27	KM RUNOFF FROM SUBWATERSHED 2.
28	BA 3.94
29	LS 0 87 0
30	UD 1.50
31	KK CP2
32	KM COMBINE HYDROGRAPHS AT CP2.
33	HC 2
34	KK CP3
35	KM ROUTE COMBINED HYDROGRAPH AT CP2 TO CP3.
36	RK 5280 .00094 .018 12 2
37	KK B3
38	KM RUNOFF FROM SUBWATERSHED 3.
39	BA 3.54
40	LS 0 85 0
41	UD 1.56
42	KK CP3
43	KM COMBINE HYDROGRAPHS AT CP3.
44	HC 2



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

86	KK	CP7							
87	KM	COMBINE HYDROGRAPHS AT CP7.							
88	HC	2							
89	KK	CP8A							
90	KM	ROUTE COMBINED HYDROGRAPH AT CP7 TO CP8. FRIST TO TRANSITION AT							
91	KM	CP8A THEN TO CP8.							
92	RK	3800 .0023 .018				15		2	
93	KK	CP8							
94	RK	1480 .0008 .018				25		2	
95	KK	B8							
96	KM	RUNOFF FROM SUBWATERSHED 8.							
97	BA	1.19							
98	LS	0 78 0							
99	UD	.83							
100	KK	CP8							
101	KM	COMBINE HYDROGRAPHS AT CP8.							
102	HC	2							
103	KK	CP9							
104	KM	ROUTE COMBINED HYDROGRAPH AT CP8 TO CP9.							
105	RK	5280 .0008 .018				25		2	
106	KK	B9							
107	KM	RUNOFF FROM SUBWATERSHED 9.							
108	BA	.20							
109	LS	0 78 0							
110	UD	.57							
111	KK	CP9							
112	KM	COMBINE HYDROGRAPHS AT CP9.							
113	HC	2							
114	KK	B9C							
115	KM	RUNOFF FROM SUBWATERSHED B9C.							
116	BA	.093							
117	LS	78							
118	UD	.43							
119	KK	CP9B							
120	KM	ROUTE FLOW AT CP9C TO CP9B.							
121	RK	660 .0043 .012 CIRC						5	
122	KK	B9B							
123	KM	RUNOFF FROM SUBWATERSHED B9B.							
124	BA	.093							
125	LS	78							
126	UD	.43							

LINE	ID.....	1.....	2.....	3.....	4.....	5.....	6.....	7.....	8.....	9.....	10
127	KK	CP9B									
128	KM	ADD HYDROGRAPHS AT CP9B.									
129	HC	2									
130	KK	CP9A									
131	KM	ROUTE FLOW FROM CP9B TO CP9A.									
132	RK	1320	.0043	.012		CIRC	6.5				
133	KK	B9A									
134	KM	RUNOFF FROM SUBWATERSHED B9A.									
135	BA	.185									
136	LS	78									
137	UD	.49									
138	KK	CP9A									
139	KM	ADD HYDROGRAPHS AT CP9A.									
140	HC	2									
141	KK	CP9									
142	KM	ROUTE FLOW FROM CP9A TO CP9.									
143	RK	1000	.003	.012		CIRC	6.5				
144	KK	CP9									
145	KM	COMBINE HYDROGRAPHS AT CP9.									
146	HC	2									
147	KK	B20									
148	KM	RUNOFF FROM B20.									
149	BA	1.51									
150	LS	77									
151	UD	.77									
152	KK	CP21									
153	KM	ROUTE FLOW TO CP21.									
154	RK	6600	.0015	.018			15		2		
155	KK	B21									
156	KM	RUNOFF FROM SUBWATERSHED B21.									
157	BA	3.61									
158	LS	0	81	0							
159	UD	1.91									
160	KK	CP21									
161	KM	ADD HYDROGRAPHS AT CP21.									
162	HC	2									
163	KK	CP22									
164	KM	ROUTE FLOW FROM CP21 TO CP22.									
165	RK	5280	.0025	.012			25		2		

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

166	KK	B22							
167	KM	RUNOFF FROM SUBWATERSHED 22.							
168	BA	5.57							
169	LS	0	83	0					
170	UD	2.96							
171	KK	CP22							
172	KM	COMBINE HYDROGRAPHS AT CP22.							
173	HC	2							
174	KK	B22A							
175	KM	RUNOFF FROM SUBWATERSHED B22A.							
176	BA	.50							
177	LS		78						
178	UD	.73							
179	KK	CP22							
180	KM	COMBINE HYDROGRAPHS AT CP22.							
181	HC	2							
182	KK	CP25							
183	KM	ROUTE FLOW FROM CP22 TO CP25.							
184	RK	14500	.0014	.012		35		2	
185	KK	B10							
186	KM	RUNOFF FROM SUBWATERSHED 10.							
187	BA	3.63							
188	LS	0	85	0					
189	UD	1.59							
190	KK	CP11							
191	KM	ROUTE FLOW FROM CP10 TO CP11.							
192	RK	5200	.0008	.018		15		2	
193	KK	B11							
194	KM	RUNOFF FROM SUBWATERSHED 11.							
195	BA	3.85							
196	LS	0	85	0					
197	UD	1.59							
198	KK	CP11							
199	KM	COMBINE HYDROGRAPHS AT CP11.							
200	HC	2							
201	KK	CP12							
202	KM	ROUTE COMBINED HYDROGRAPH AT CP11 TO CP12.							
203	RK	5200	.0008	.018		15		2	
204	KK	B12							
205	KM	RUNOFF FROM SUBWATERSHED 12.							
206	BA	3.16							
207	LS	0	86	0					
208	UD	1.64							



LINE	ID	1	2	3	4	5	6	7	8	9	10
251	KK	DET3									
252	KM	ROUTE FLOW AT CP23 TO DET3.									
253	RK	9400	.0029	.012			CIRC	5			
254	KK	B15									
255	KM	RUNOFF FROM SUBWATERSHED 15.									
256	BA	6.33									
257	LS	0	83	0							
258	UD	1.69									
259	KK	DET3									
260	KM	ROUTE FLOW FROM CP15 TO DET3.									
261	RK	31680	.0027	.020				0	50		
262	KK	B19									
263	KM	RUNOFF FROM SUBWATERSHED 19.									
264	BA	5.29									
265	LS	0	80	0							
266	UD	2.20									
267	KK	DET3									
268	KM	COMBINE HYDROGRAPHS AT DET3.									
269	HC	2									
270	KK	DET3									
271	KM	COMBINE HYDROGRAPHS AT DET3.									
272	HC	2									
273	KK	B17									
274	KM	RUNOFF FROM SUBWATERSHED 17.									
275	BA	3.14									
276	LS	0	83	0							
277	UD	1.69									
278	KK	CP18									
279	KM	ROUTE FLOW FROM CP17 TO CP18.									
280	RK	26400	.0025	.020				0	50		
281	KK	B16									
282	KM	RUNOFF FROM SUBWATERSHED 16.									
283	BA	3.30									
284	LS	0	81	0							
285	UD	1.69									
286	KK	CP18									
287	KM	ROUTE FLOW FROM CP16 TO CP18.									
288	RK	26400	.0025	.0200				0	50		
289	KK	B18									
290	KM	RUNOFF FROM SUBWATERSHED 18.									
291	BA	4.10									
292	LS	0	82	0							
293	UD	2.00									



SCHEMATIC DIAGRAM OF STREAM NETWORK

INPUT LINE	(V) ROUTING	(---) DIVERSION OR PUMP FLOW
NO.	(.) CONNECTOR	((---)) RETURN OF DIVERTED OR PUMPED FLOW
15	B1	
	V	
	V	
23	CP2	
	.	
26	.	B2
	.	.
	.	.
31	CP2.....	
	V	
	V	
34	CP3	
	.	
	.	
37	.	B3
	.	.
	.	.
42	CP3.....	
	V	
	V	
45	CP4	
	.	
	.	
48	.	B4
	.	.
	.	.
53	CP4.....	
	V	
	V	
56	CP5	
	.	
	.	
59	.	B5
	.	.
	.	.
64	CP5.....	
	V	
	V	
67	CP6	
	.	
	.	
70	.	B6
	.	.
	.	.
75	CP6.....	
	V	
	V	
78	CP7	
	.	
	.	
81	.	B7
	.	.
	.	.
86	CP7.....	

	V		
	V		
89	CP8A		
	V		
	V		
93	CP8		
	.		
	.		
95	.	B8	
	.	.	
	.	.	
100	CP8.....		
	V		
	V		
103	CP9		
	.		
	.		
106	.	B9	
	.	.	
	.	.	
111	CP9.....		
	.		
	.		
114	.	B9C	
	.	V	
	.	V	
119	.	CP9B	
	.	.	
	.	.	
122	.	.	B9B
	.	.	.
	.	.	.
127	.	CP9B.....	
	.	V	
	.	V	
130	.	CP9A	
	.	.	
	.	.	
133	.	.	B9A
	.	.	.
	.	.	.
138	.	CP9A.....	
	.	V	
	.	V	
141	.	CP9	
	.	.	
	.	.	
144	CP9.....		
	.		
	.		
147	.	B20	
	.	V	
	.	V	
152	.	CP21	
	.	.	
	.	.	
155	.	.	B21
	.	.	.
	.	.	.
160	.	CP21.....	
	.	V	
	.	V	
163	.	CP22	
	.	.	
	.	.	
166	.	.	B22

171	CP22.....	
	.	
174		B22A
	.	
179	CP22.....	
	V	
	V	
182	CP25	
	.	
185		B10
	.	V
	.	V
190	CP11	
	.	
193		B11
	.	
198	CP11.....	
	V	
	V	
201	CP12	
	.	
204		B12
	.	
209	CP12.....	
	V	
	V	
212	CP13	
	.	
215		B13
	.	
220	CP13.....	
	V	
	V	
223	CP14	
	.	
226		B14
	.	
231	CP14.....	
	V	
	V	
234	DET2	
	.	
237		B23
	.	
242	DET2.....	
	V	
	V	
245	DET2	
	V	
	V	
251	DET3	

254	.	.	.	B15		
	.	.	.	V		
	.	.	.	V		
259	.	.	.	DET3		
	.	.	.	.		
262	.	.	.	.	B19	
	.	.	.	.	.	
	.	.	.	.	.	
267	.	.	.	DET3.....		
	.	.	.	.		
	.	.	.	.		
270	.	.	.	DET3.....		
	.	.	.	.		
	.	.	.	.		
273	.	.	.	B17		
	.	.	.	V		
	.	.	.	V		
278	.	.	.	CP18		
	.	.	.	.		
	.	.	.	.		
281	.	.	.	.	B16	
	.	.	.	.	V	
	.	.	.	.	V	
286	.	.	.	.	CP18	
	.	.	.	.	.	
	.	.	.	.	.	
289	.	.	.	.	.	B18
	.	.	.	.	.	.
	.	.	.	.	.	.
294	.	.	.	CP18.....		
	.	.	.	V		
	.	.	.	V		
297	.	.	.	DET4		
	.	.	.	.		
	.	.	.	.		
300	.	.	.	CP19.....		
	.	.	.	V		
	.	.	.	V		
303	.	.	.	DET3		
	.	.	.	V		
	.	.	.	V		
312	.	.	.	CP24		

(\*\*\*) RUNOFF ALSO COMPUTED AT THIS LOCATION

```

*****
*
* FLOOD HYDROGRAPH PACKAGE (HEC-1)
* FEBRUARY 1981
* REVISED 14 JUN 85
*
* RUN DATE: Mon 07-DEC-1987
* TIME: 14:17:56.72
*
*****

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*****
*
* U.S. ARMY CORPS OF ENGINEERS
* THE HYDROLOGIC ENGINEERING CENTER
* 609 SECOND STREET
* DAVIS, CALIFORNIA 95616
*
* (916) 756-1104 OR (FTS) 448-3285
*
*****

```

CASEB100.DET            100-YEAR STORM DATA  
HEC-1 MODEL FOR THE OUTER LOOP DRAINAGE STUDY, PAPAGO FREEWAY TO  
NORTHERN AVENUE SECTION. DRAINAGE AREA DELINEATIONS WERE MADE ASSUMING  
THAT THE PARADISE CORRIDOR CHANNEL IS IN PLACE AND GRAND AVENUE IS A  
LOW LEVEL FACILITY. DETENTION PROVIDED ON THE PARADISE CORRIDOR  
AND THE OUTER LOOP.

8 IO            OUTPUT CONTROL VARIABLES

```

IPRNT            5 PRINT CONTROL
IPLOT            0 PLOT CONTROL
QSCAL            0. HYDROGRAPH PLOT SCALE

```

```

VALUE EXCEEDS TABLE IN LOGLOG    24.00006    0.01667    24.00000

```

IT            HYDROGRAPH TIME DATA

```

NMIN            6 MINUTES IN COMPUTATION INTERVAL
IDATE          15JUN86 STARTING DATE
ITIME          1200 STARTING TIME
NQ             300 NUMBER OF HYDROGRAPH ORDINATES
NDDATE        16 86 ENDING DATE
NDTIME        1754 ENDING TIME

```

```

COMPUTATION INTERVAL    0.10 HOURS
TOTAL TIME BASE        29.90 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

```

9 JD            INDEX STORM NO. 1

```

STRM            3.71 PRECIPITATION DEPTH
TRDA            0.09 TRANSPOSITION DRAINAGE AREA

```

10 PI            PRECIPITATION PATTERN







**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			BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
				6-HOUR	24-HOUR	72-HOUR			
HYDROGRAPH AT	B1	1866.	13.80	818.	231.	186.	3.82		
ROUTED TO	CP2	1863.	13.80	816.	231.	186.	3.82		
HYDROGRAPH AT	B2	2135.	13.60	881.	248.	199.	3.94		
2 COMBINED AT	CP2	3952.	13.70	1687.	478.	383.	7.76		
ROUTED TO	CP3	3944.	13.70	1687.	478.	383.	7.76		
HYDROGRAPH AT	B3	1717.	13.70	732.	206.	166.	3.54		
2 COMBINED AT	CP3	5599.	13.70	2401.	681.	546.	11.30		
ROUTED TO	CP4	5595.	13.80	2404.	682.	547.	11.30		
HYDROGRAPH AT	B4	2018.	13.70	859.	242.	194.	4.00		
2 COMBINED AT	CP4	7450.	13.80	3220.	916.	735.	15.30		
ROUTED TO	CP5	7432.	13.90	3222.	916.	736.	15.30		
HYDROGRAPH AT	B5	1133.	13.80	510.	146.	117.	3.19		
2 COMBINED AT	CP5	8440.	13.90	3697.	1055.	847.	18.49		
ROUTED TO	CP6	8438.	13.90	3702.	1056.	848.	18.49		
HYDROGRAPH AT	B6	1275.	13.40	450.	125.	101.	2.23		
2 COMBINED AT	CP6	9328.	13.80	4111.	1175.	944.	20.72		
ROUTED TO	CP7	9328.	13.90	4114.	1176.	944.	20.72		
HYDROGRAPH AT	B7	875.	13.30	298.	83.	66.	1.47		
2 COMBINED AT	CP7	9877.	13.90	4377.	1254.	1006.	22.19		
ROUTED TO	CP8A	9870.	13.90	4376.	1254.	1006.	22.19		
ROUTED TO	CP8	9854.	13.90	4376.	1254.	1006.	22.19		
HYDROGRAPH AT	B8	711.	13.00	189.	52.	42.	1.19		
2 COMBINED AT	CP8	10073.	13.90	4532.	1302.	1045.	23.38		
ROUTED TO	CP9	10062.	14.00	4530.	1302.	1045.	23.38		

HYDROGRAPH AT	B9	161.	12.70	32.	9.	7.	0.20
2 COMBINED AT	CP9	10079.	14.00	4552.	1310.	1051.	23.50
HYDROGRAPH AT	B9C	89.	12.50	15.	4.	3.	0.09
ROUTED TO	CP9B	89.	12.60	15.	4.	3.	0.09
HYDROGRAPH AT	B9B	89.	12.50	15.	4.	3.	0.09
2 COMBINED AT	CP9B	176.	12.60	30.	8.	7.	0.19
ROUTED TO	CP9A	176.	12.60	30.	8.	7.	0.19
HYDROGRAPH AT	B9A	165.	12.60	30.	8.	7.	0.19
2 COMBINED AT	CP9A	337.	12.60	60.	16.	13.	0.37
ROUTED TO	CP9	335.	12.60	60.	16.	13.	0.37
2 COMBINED AT	CP9	10103.	14.00	4590.	1325.	1063.	23.95
HYDROGRAPH AT	B20	910.	12.90	229.	64.	51.	1.51
ROUTED TO	CP21	888.	13.00	227.	64.	51.	1.51
HYDROGRAPH AT	B21	1243.	14.10	620.	180.	144.	3.61
2 COMBINED AT	CP21	1653.	13.40	844.	243.	195.	5.12
ROUTED TO	CP22	1652.	13.50	844.	243.	195.	5.12
HYDROGRAPH AT	B22	1434.	15.30	946.	299.	240.	5.57
2 COMBINED AT	CP22	2682.	14.40	1760.	539.	433.	10.69
HYDROGRAPH AT	B22A	332.	12.90	80.	22.	18.	0.50
2 COMBINED AT	CP22	2729.	14.40	1825.	561.	450.	11.19
ROUTED TO	CP25	2720.	14.60	1809.	559.	449.	11.19
HYDROGRAPH AT	B10	1731.	13.70	749.	212.	170.	3.63
ROUTED TO	CP11	1728.	13.80	747.	212.	170.	3.63
HYDROGRAPH AT	B11	1835.	13.70	794.	224.	180.	3.85
2 COMBINED AT	CP11	3540.	13.80	1533.	435.	349.	7.48
ROUTED TO	CP12	3531.	13.80	1531.	434.	349.	7.48
HYDROGRAPH AT	B12	1532.	13.80	677.	191.	154.	3.16
2 COMBINED AT	CP12	5022.	13.80	2193.	624.	501.	10.64
ROUTED TO	CP13	5021.	13.90	2193.	624.	501.	10.64
HYDROGRAPH AT	B13	1326.	13.30	469.	131.	105.	1.00

2 COMBINED AT	CP13	6019.	13.00	2627.	752.	603.	12.44		
ROUTED TO	CP14	6011.	13.90	2630.	752.	604.	12.44		
HYDROGRAPH AT	B14	591.	13.00	157.	43.	35.	0.71		
2 COMBINED AT	CP14	6231.	13.00	2769.	794.	637.	13.15		
ROUTED TO	DET2	6226.	13.00	2764.	793.	637.	13.15		
HYDROGRAPH AT	B23	949.	13.50	363.	102.	82.	1.96		
2 COMBINED AT	DET2	7039.	13.00	3100.	891.	715.	15.11		
ROUTED TO	DET2	152.	14.00	152.	104.	83.	15.11	1002.48	26.00
ROUTED TO	DET3	152.	15.00	152.	103.	82.	15.11		
HYDROGRAPH AT	B15	2626.	13.90	1195.	341.	273.	6.33		
ROUTED TO	DET3	2387.	15.20	1144.	337.	271.	6.33		
HYDROGRAPH AT	B19	1538.	14.40	849.	252.	202.	5.29		
2 COMBINED AT	DET3	3709.	15.00	1913.	586.	470.	11.62		
2 COMBINED AT	DET3	3671.	15.10	1983.	674.	541.	26.73		
HYDROGRAPH AT	B17	1312.	13.90	595.	169.	136.	3.14		
ROUTED TO	CP18	1185.	15.20	568.	168.	135.	3.14		
HYDROGRAPH AT	B16	1261.	13.90	575.	164.	132.	3.30		
ROUTED TO	CP18	1136.	15.20	548.	163.	131.	3.30		
HYDROGRAPH AT	B18	1418.	14.20	729.	212.	170.	4.10		
3 COMBINED AT	CP18	3373.	15.00	1757.	540.	433.	10.54		
ROUTED TO	DET3	3372.	15.10	1758.	539.	433.	10.54		
2 COMBINED AT	CP19	6700.	15.10	3597.	1182.	949.	37.27		
ROUTED TO	DET3	872.	21.00	865.	514.	412.	37.27	1058.00	21.00
ROUTED TO	CP24	872.	21.00	865.	510.	409.	37.27		

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

COST ESTIMATE - RECOMMENDED PLAN

STORM SEWER COST

LOCATION From To	SIZE In.	LENGTH Ft.	UNIT COST \$/L.F.	COST \$
Thomas Road to 1/2 Mile South	96	2640	215.00	\$ 567,600.00
Encanto Boulevard to 660' south	48	660	98.00	\$ 64,680.00
660' south to 1320' south of Encanto Boulevard	60	660	140.00	92,400.00
1320' south to RID Canal	78	1320	165.00	217,800.00
RID Canal to I-10 Channel	78	1000	165.00	<u>165,000.00</u>
			Subtotal	\$1,107,480.00
			Plus 30% (Appurtenances and Contingencies)	<u>\$ 332,244.00</u>
			Total	<u><u>\$1,439,700.00</u></u>
			TOTAL STORMS SEWER COST	<u><u>\$4,725,800.00</u></u>

COST ESTIMATE - RECOMMENDED PLAN

OUTER LOOP CHANNEL - THOMAS ROAD TO GRAND CANAL

LOCATION From	To	DESCRIPTION	UNIT	QUANTITY	UNIT COST	COST
Thomas Rd.	Detention Basin #1	Excavation	C.Y.	12,418	2.50	31,045.00
		Channel Lining	S.Y.	7,304	20.00	146,080.00
		Bridges	S.F.	1 @ 2,650	50.00	132,500.00
					Construction Cost	309,625.00
					30% (Appurtenances and Contingencies)	92,888.00
					Total Construction Cost	402,513.00
			ROW	S.F.	122,760	4.50
				Total Cost	954,900.00	
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Detention Basin #1	Indian School Rd.	Excavation	C.Y.	23,460	2.50	58,650.00
		Channel Lining	S.Y.	10,520	20.00	210,400.00
		Bridges	S.F.	1 @ 3,300	50.00	165,000.00
					Construction Cost	434,050.00
					30% (Appurtenances and Contingencies)	130,215.00
					Total Construction Cost	564,265.00
			ROW	S.F.	142,560	4.50
				Total Cost	1,205,785.00	
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Indian School Rd.	Campbell Avenue Extended	Excavation	C.Y.	39,700	2.50	99,249.00
		Channel Lining	S.Y.	19,116	20.00	382,322.00
		Bridges	S.F.	1 @ 2,750	50.00	137,500.00
					Construction Cost	619,071.00
					30% (Appurtenances and Contingencies)	185,721.00
					Total Construction Cost	804,793.00
			ROW	S.F.	266,640	4.50
				Total Cost	2,004,673.00	