Loop 303 Corridor/White Tanks Area Drainage Master Plan Update
Contract FCD 99-40

VOLUME III

Level II Alternatives Analysis Report

Prepared for:

Flood Control District of Maricopa County

June 2004

Prepared by:

URS

Registered Professional Engineer (Civil)
CERTIFICATE NO.
33656
ELLIOT
SILVERSTON
Date Signed 11/18/05
ARIZONA, U.S.A.

LEVEL II
ALTERNATIVES ANALYSIS
REPORT
CONTRACT FCD-99-40

Prepared for
FLOOD CONTROL DISTRICT OF
MARICOPA COUNTY

URS Job No. E1-00001526
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Comment Responses for Level II Report Phase One – General Comments

1. **Page 1-1: Correct to read draft or correct to latest revision.** *All references to the Data Collection Report and the Draft Level 1 Alternative Analysis Report have been changed to show a May 2004 submittal.*
2. **Figure 2.1: Will these be in color for the final submittal?** *All color figures are included in the June 2004 submittal.*
3. **Page 2-5: This date is not correct.** *The date has been corrected to July 19, 2001 for the effective FIRM.*
4. **Page 2-6: Add the cities of Buckeye, Avondale, El Mirage, and Litchfield Park.** *These cities have been added to the areas in Maricopa County.*
5. **Page 2-7: Delete last sentence of second paragraph.** *Removed sentence about basins being held in escrow.*
6. **Page 2-7: Site which report and date.** *Report date has been corrected to "Parsons Brinckerhoff, dated July 23, 1999."*
7. **Page 2-7: What storm event is stated in the report?** *The analysis is for the* 50-year, 24-hour storm event
8. **Page 2-8: Is the 30 minute runoff hydrograph reasonable?** *Without a detailed check of the Parsons Brinckerhoff backup data and calculations, URS cannot say if this is reasonable or not.*
9. **Page 3-1: Syntax**
10. **Table 3.1: Do you have a CD file and hard copy of the HEC-1 runs?** *A digital and hard copy of the HEC-1 runs will be included in this submittal.*
11. **Page 3-5: Syntax**
12. **Page 3-6: Syntax**
13. **Page 3-14: Figure 3.1A calls out a "WVRD" not a "WVRC", please be consistent.** *Sentence has been corrected to read "West Valley Regional Drain".*
14. **Page 4-1: Is the baseline alternative really considered to be a zero dollar cost?** *The sentence has been revised to state that the cost is very small when compared with the cost of the other alternatives.*
15. **Page 4-1: Syntax**
16. **Page 4-1: Remove "Culverts required at smaller roadway crossing were not evaluated at this time."** *Sentence has been removed.*
17. **Page 4-2: Add text**
18. **Page 4-2: We did not provide quantities for land acquisition.** *Sentence has been revised to state that URS developed costs based on FCDMC data.*
19. **Page 4-2: Did you subtract for hard scaping?** *Hard scape quantities were considered negligible in the hydroseed quantity calculation.*
20. **Page 4-3: Need to list District maximum cost share and some verbage to that effect.**
21. **Table 4.1B: $1.40 is more than what Flood Control District can cost share. Split out these two costs.** *A new table shows the cost share split at $1.00 per square foot.*
22. **Page 5-1: Explain why a section 404 permit is needed.** *Section 404 permit information is detailed in Section 3.3 of the Level II Phase One Report. The first sentence of the paragraph has been revised to state this.*
23. **Page 7-2: Syntax.** *Added draft.*

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1.0 INTRODUCTION

1.1 PROJECT DESCRIPTION

This technical memorandum documents the methods and criteria used to develop and evaluate the preferred alternative solution to existing and future flood control problems previously documented by the "Data Collection Report," dated May 2003, for the Loop 303 Corridor/White Tanks Area Drainage Master Plan Update (Loop 303 ADMP Update) project. This memorandum will be included as a separate section in the final submittal of the Alternative Analysis Report. The Loop 303 ADMP Update covers an approximate 220-square-mile watershed west of metropolitan Phoenix. See the "Level I Alternative Analysis Report," dated May 2003 for a more detailed project description.

1.1.1 Location

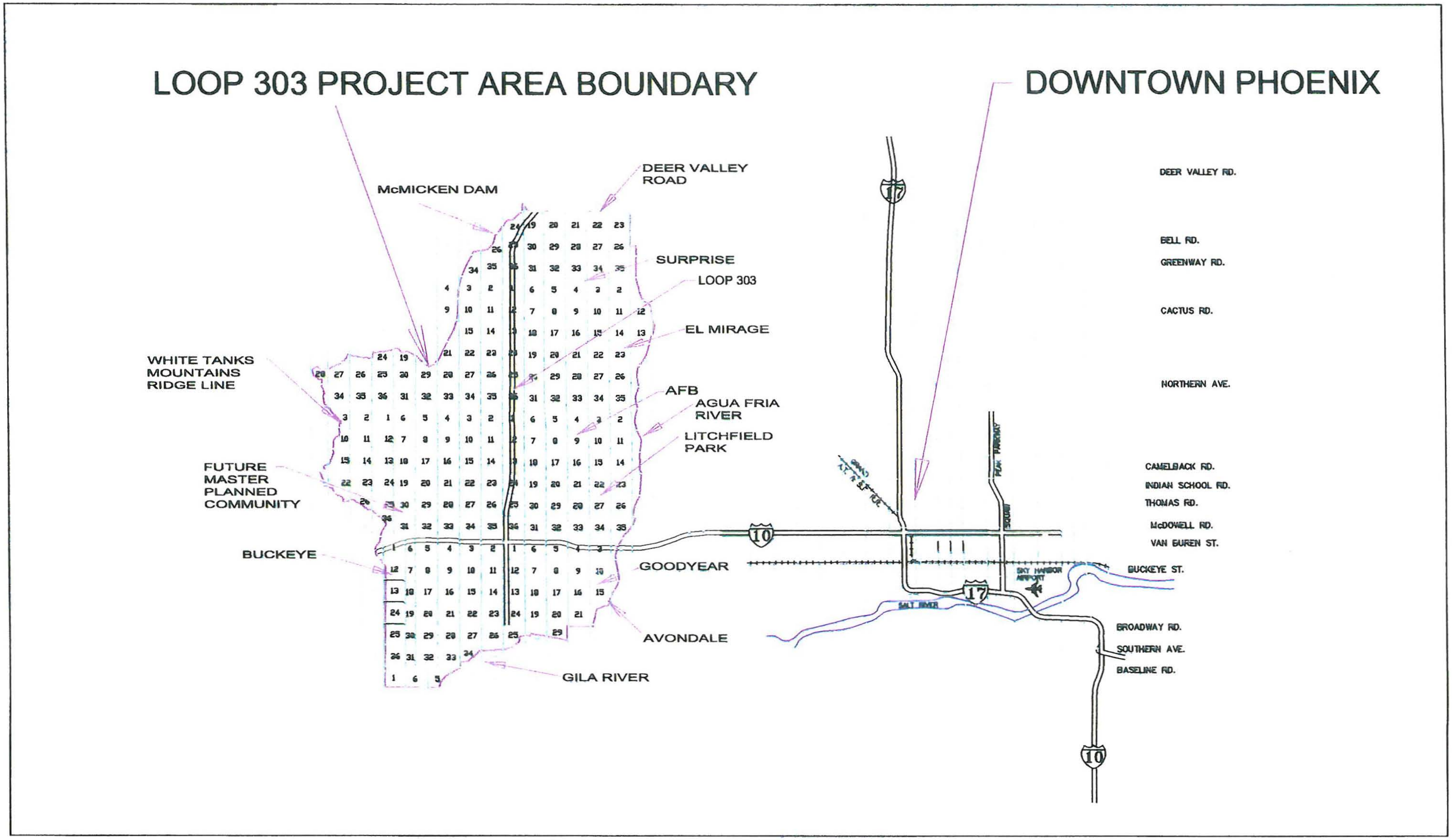
The study area boundary is defined by the ridgeline in the White Tanks Mountains on the west, the Gila River on the south, the Aqua Fria River on the east, and the McMicken Dam/Deer Valley Road on the north. The study area spans across the majority of Townships 1N-4N and Ranges 1W-3W which includes the cities of Goodyear, Glendale, Buckeye, Litchfield Park, El Mirage, Avondale, Sun City, Peoria, and Surprise, as well as unincorporated Maricopa County as seen on Figure 1.1.

1.1.2 Purpose

As stated in the Data Collection Report and the Level I Alternative Analysis Report, the first of two major objectives for the Loop 303 ADMP Update project is to develop a plan to control runoff to prevent flood damage in the watershed both existing and in the future. The second objective is to develop an implementation plan to manage the interim condition due to discontinuous short-term development. The plan shall develop and identify preliminary costs, alignments, typical sections, right-of-way requirements, aesthetic/landscape themes, major utility conflicts, and potential project participants for implementation of the preferred alternatives.

At the second committee meeting, June 1, 2000, the stakeholders agreed to choose Bullard Wash channelization with a diversion channel to the ADOT basins at I-10 as the preferred solution for this portion of the ADMP Update watershed. Therefore, the purpose of this Technical Memorandum is to provide an analysis that is focused on the Bullard Wash outfall from approximately McDowell Road south to the existing Bullard Wash outfall channel. This first phase (Phase I) of the Level II analysis will also consider a diversion channel from Bullard Wash

P:\FCDMC\E152600\SUBMITTALS\RE-SUBMIT\LEVEL II\LEVEL II A TECH MEMO\5-2003\CAD\FIGURE 1.1.DWG



VICINITY MAP

JUNE, 2003
Figure 1.1

at I-10 east to the existing ADOT basins as well as any improvements required at the ADOT basins. Since upstream inflow will vary significantly depending on which alternative is selected in the upper watershed, this Technical Memorandum will present three options based on a sensitivity analysis. This analysis will vary the inflow hydrographs at Bullard and I-10 based on the order of magnitude expected per each of the three recommended alternatives assumed upstream. These alternatives were recommended as a result of the Level I analysis and can be seen on Figures 2.1, 2.2, 2.3, and 2.4. Note that Figure 2.4 represents the baseline or "Do Nothing" alternative.

The reason for accelerating the Level II analysis in this area of the watershed is to provide cooperation with impending development adjacent to Bullard Wash throughout this area and to comply with the request of the local jurisdiction and the development community.

The first phase of the update study conducted under the Level I portion of the project identifies several alternatives for an overall flood control backbone system within the Loop 303 ADMP Update study area. For more information, see the Draft Level I report. The second portion of the update study, conducted under the Level II portion of the project, will consist of two phases. The first phase (Phase I) of the Level II analysis will focus on development in the vicinity of and adjacent to the Bullard Wash from approximately Thomas Road south to the existing Bullard Wash outfall channel. At the end of the Level II Phase I analysis, there will be one recommended alternative for flood control in the Bullard Wash area that will include a significant multi-use and aesthetic element. This technical memorandum will address the Level II Phase I analysis and the results associated with it. The Level II Phase I analysis will be referred to simply as Phase I from this point forward.

The final objective of this technical memorandum is to document the methods and analysis used to determine the recommended Phase I flood control alternative.

1.1.3 Alternative Comparison of Options

A weighted matrix of criteria was used to determine the relative feasibility for each alternative considered under Phase I. This matrix was based on the matrix used in the Level I portion of the analysis. Based on the evaluation results, one alternative was identified as being potentially more feasible than the other three under consideration. This alternative is discussed in detail under Section 5 of this technical memorandum.

1.2 SCOPE OF WORK

The scope of work does not specifically separate the Level II analysis into Phase I and Phase II. The tasks listed are for the entire project area. It should be noted, however, that these items described in the scope will be specific to the Bullard Wash south of Thomas Road under the Phase I portion of the analysis. All other areas will be addressed under the Level II Phase II portion of the analysis. For more detail, refer to the scope of work entitled "Loop 303 Corridor/ White Tanks Area Drainage Master Plan Update," Contract FCD 99-40.

2.0 LEVEL II PHASE I – THE BULLARD WASH

2.1 AREA DESCRIPTION AND BACKGROUND

Upon submission of the Level I Report, dated May 2003, to the Flood Control District of Maricopa County (FCDMC), URS Corporation (URS) and its subconsultants proceeded with Phase I of the Level II portion of the Loop 303 ADMP Update. Phase I focuses on the Bullard Wash region of the project area. As stated in Section 1, this area extends south from Thomas Road downstream to the recently constructed Bullard Wash outfall channel. Phase I will also evaluate the existing ADOT basins located approximately 1 mile east of the Bullard Wash/I-10 crossing as a facility to convey diverted flows from Bullard Wash and to the Agua Fria River. The balance of the project area and the associated alternatives will be analyzed under the Level II Phase II portion of the project. Phase II will be addressed under separate cover and is beyond the scope of this technical memorandum.

The three recommended alternatives developed under Level I were presented to the FCDMC staff and stakeholders at the second stakeholders meeting held at the FCDMC office on June 1, 2000.

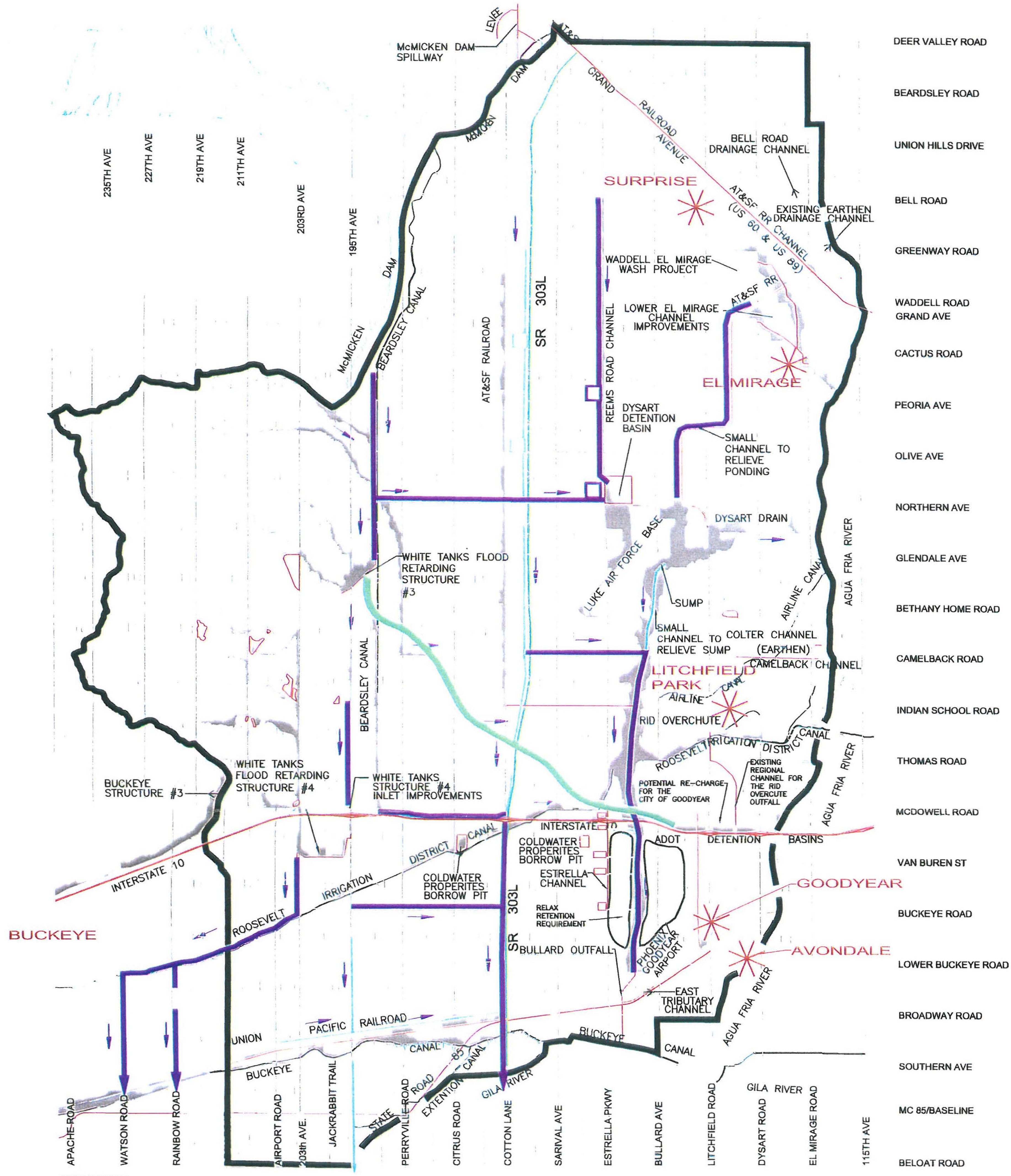
2.1.1 Changes to the Recommended Alternatives

During the second stakeholders meeting, the committee accepted the recommended alternatives with some suggested changes for further study under the Level II analysis per the scope. As indicated in Section 2.1 above, the Bullard Wash channelization with diversion to the ADOT basins and ultimately the Agua Fria River was recommended as the preferred alternative. This will be further developed under the Level III portion of the project. Subsequent to the second stakeholders meeting, additional minor changes were made at the request of various FCDMC staff. It was decided that upon completion of the suggested revisions to the alternatives, URS and its subconsultants would proceed with the Phase I portion of the analysis. Each recommended alternative and the changes associated with it are briefly described below.

Recommended Alternative #1 – See Figure 2.1

- The railroad tracks shown along Cotton Lane from Indian School Road to approximately Greenway Road were removed from the exhibits since large sections of this abandoned facility have been removed.

- Added a basin/park to the channel along Loop 303 north of Northern Avenue.



LEGEND:

= PROPOSED LARGE REGIONAL OUTFALL CHANNEL

= PROPOSED MEDIUM TO LARGE LOCAL COLLECTOR CHANNEL

= PROPOSED SMALL COLLECTOR CHANNEL

= DIRECTION OF FLOW

= PROPOSED LARGE, MEDIUM OR SMALL BASIN/PARK

= PROJECT AREA BOUNDARY

= PROPOSED LOOP 303 PARKWAY ALIGNMENT

= EXISTING RAIL ROAD

= EXISTING STRUCTURE OR FACILITY

= FLOODPLAIN IDENTIFIED BY THE ORIGINAL WHITE TANKS ADMP, 1992

N

MARICOPA COUNTY
N.T.S.

RECOMMENDED ALTERNATIVE #1

June 2003

Loop 303 Corridor/White Tanks ADMP Update

FIGURE 2.1

URS

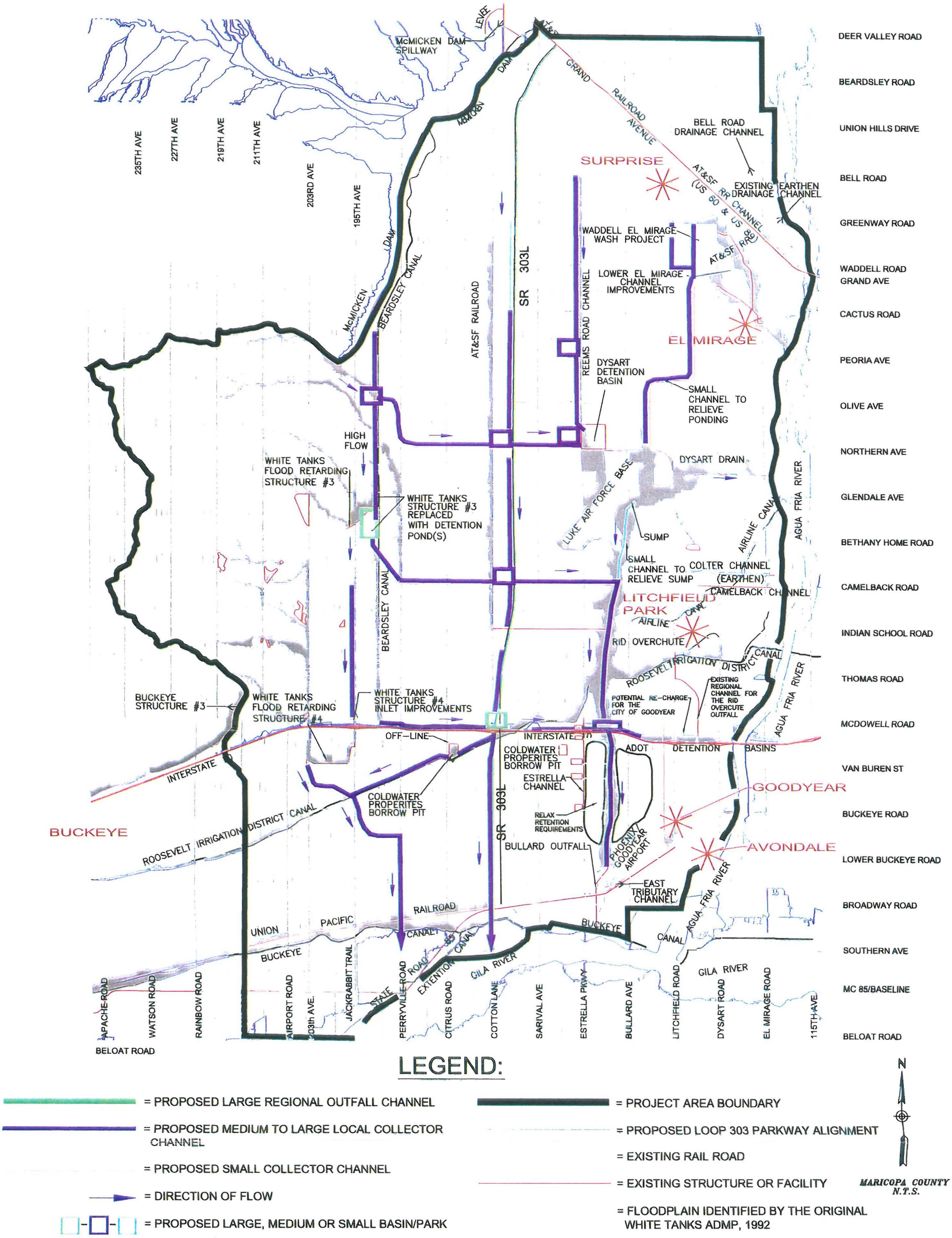
- Show the Loop 303 channel as a smaller channel due to added basin/parks.
- Add a basin/park at the northwest corner of Reems Road and Northern Avenue.
- Eliminate the Northern Avenue channel adjacent to the Dysart Drain East of Reems Road.
- Propose a large regional drainage channel cutting through several sections on a southeasterly diagonal alignment from the White Tanks FRS #3 to the existing ADOT basins.
- Remove the large outfall channel shown at the El Mirage and Cactus intersection.

Recommended Alternative #2 – See Figure 2.2

- The railroad tracks shown along Cotton Lane from Indian School Road to approximately Greenway Road were removed from the exhibits since large sections of this abandoned facility have been removed.
- Remove the basin/park at the northwest corner of Jackrabbit Road and Camelback Road.
- Show a channel from White Tanks FRS #3 to the Camelback Road channel.
- Show a medium to large collector at the intersection of El Mirage and Cactus.
- Show a medium to large collector from Waddell and Dysart along the railroad tracks to the Dysart Drain.
- Add a basin/park at the northwest corner of Reems and Peoria.
- Add a basin/park at the northwest corner of Reems Road and Northern Avenue.

Recommended Alternative #3 – See Figure 2.3

- The railroad tracks shown along Cotton Lane from Indian School Road to approximately Greenway Road were removed from the exhibits since large sections of this abandoned facility have been removed.
- Show a medium to large channel along the El Mirage Wash from Greenway Road to Cactus Road.



RECOMMENDED ALTERNATIVE #2

June 2003

Loop 303 Corridor/White Tanks ADMP Update

Flood Control District of Maricopa County

FIGURE 2.2

URS

- Show a small channel along the Loop 303 with large basin/parks.

- Add a basin/park at the northwest corner of Reems Road and Northern Avenue.

See Figure 2.4 for the Baseline Alternative. For a detailed description of the process used to develop the recommended alternatives, including the aesthetics and multi-use considerations associated with each, see the Data Collection Report and the Draft Level I Alternative Analysis Report, dated February 2002.

2.1.2 Level II Phase I – Bullard Wash Area

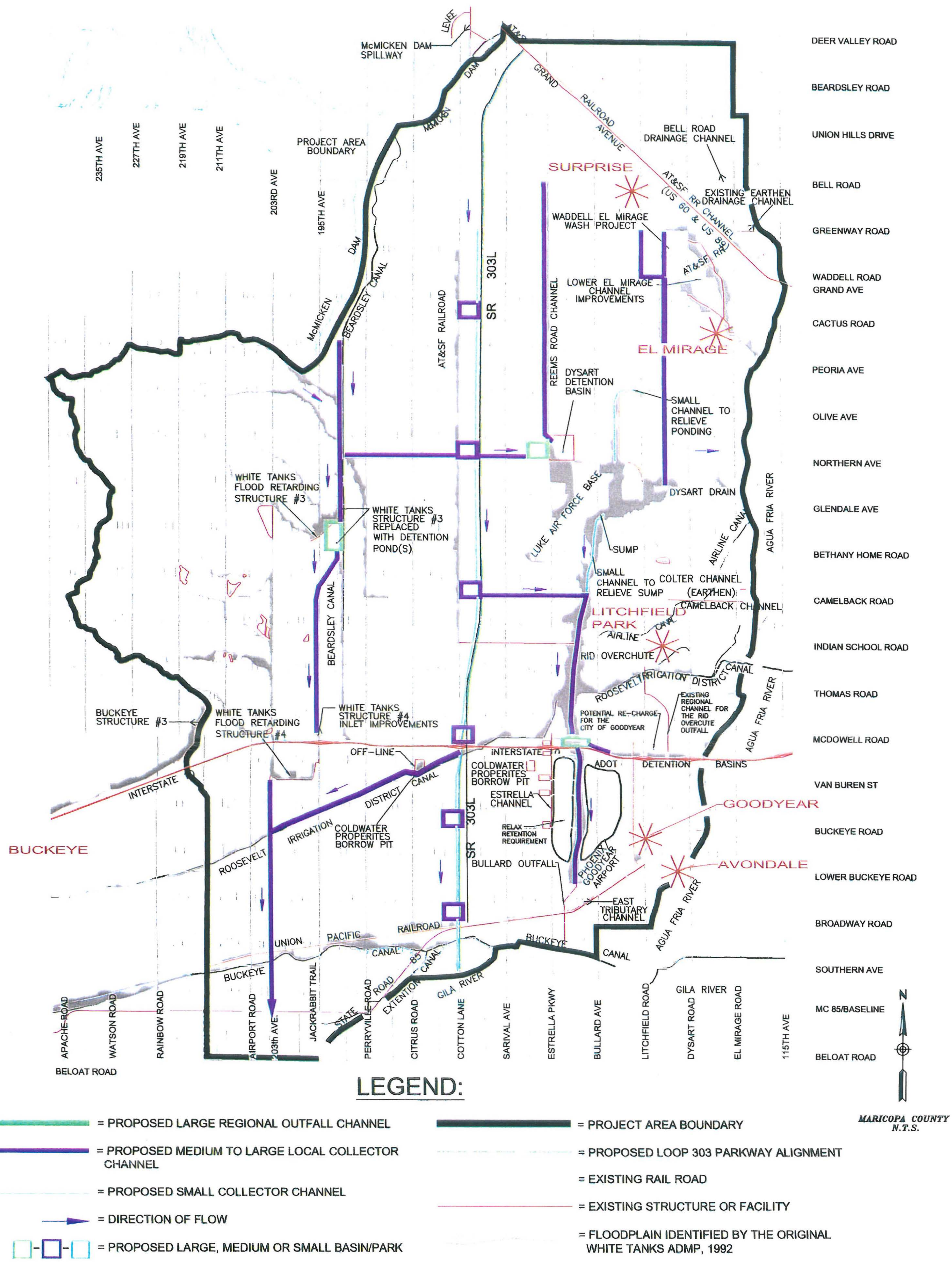
Phase I focuses on the portion of the Bullard Wash that lies south of Thomas Road and extends downstream to the existing Bullard Wash outfall channel. This section of Bullard Wash is located at approximately the half section line between Estrella Parkway and Bullard Avenue.

Bullard Wash North of I-10 to Thomas Road

This particular reach of Bullard Wash is of interest due to the immediate need by proposed/ongoing developments in the area for direction regarding the appropriate engineering countermeasures required to adequately protect proposed residential and commercial properties from frequent flooding. Current published Federal Emergency Management Agency (FEMA) floodplain maps will require modification to reflect improvements to Dysart Drain, changes in existing conditions hydrologic modeling upstream and changes in soils modeling in the White Tanks Mountains, all of which have occurred since the time of the original study. As a result, the 100-year, 24-hour design discharges adjacent to developments along the Bullard Wash in this reach have changed significantly.

Bullard Wash South of I-10 to the Gila/Salt River

This portion of the Bullard Wash is of interest from both a planning and implementation prospective as well as from an engineering perspective. The discharge through this reach is not expected to change since the existing Bullard Wash outfall channel has been constructed for a specific 100-year, 24-hour design flow rate. Proposed flood control facilities will be used upstream to restrict the 100-year, 24-hour peak discharge in this reach to the design flow used to construct the existing Bullard Wash outfall channelization from south of Yuma to the outfall just north of the Gila River.



RECOMMENDED ALTERNATIVE #3

June 2003

Loop 303 Corridor/White Tanks ADMP Update

Flood Control District of Maricopa County

FIGURE 2.3

URS

Some of the key issues associated with this reach of the Bullard Wash include implementation of the City of Goodyear's (COG) vision for the Bullard Wash Corridor as a regional multi-use facility. COG is planning to incorporate the following multi-uses into the corridor at a minimum:

- Stormwater conveyance/flood control
- Aesthetic park/open space and trail corridor
- Playing fields and other uses consistent with this type of facility adjacent to the corridor

2.1.3 The City of Goodyear's Bullard Wash Multi-Use Corridor/Plan

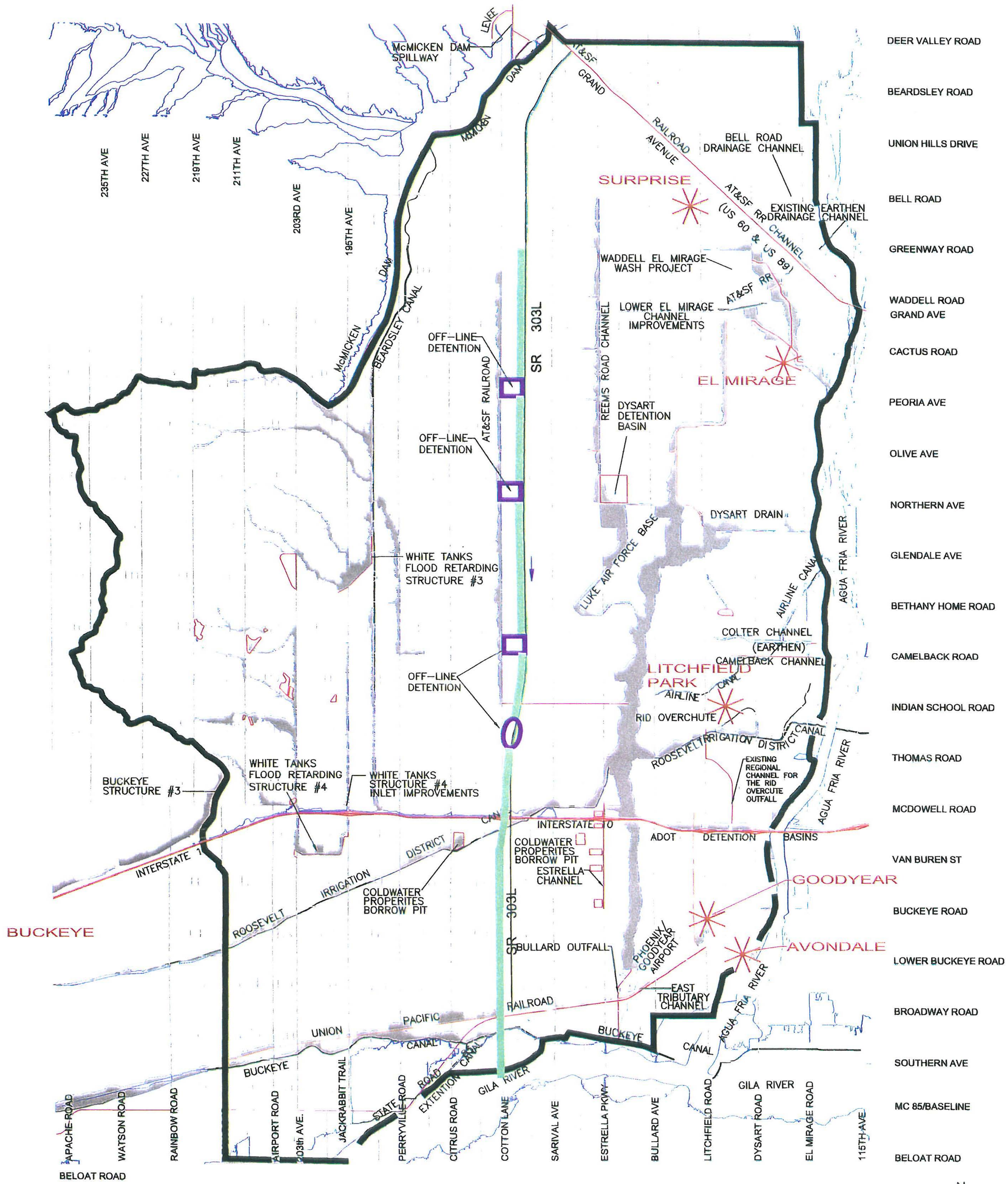
In a document detailing COG's plan for parks and trails along the Bullard Wash corridor, received by URS during the data collection phase of this project, COG presents a typical cross section through the Bullard Wash. This section is shown on Figure 2.6.

The City of Goodyear Parks and Recreation Department has proposed this cross section as a typical section to be used as a multi-use/greenbelt type facility throughout the Bullard Wash corridor. The City must require a contiguous corridor to ensure consistency from an aesthetic viewpoint and to provide the required conveyance capacity to the existing outfall channel.

2.1.4 Proposed Development in the Phase I Bullard Wash Study Area

Several developments in the area south of Thomas Road are proposing channel corridors through their property to accommodate the Bullard Wash. Some of these developments directly address the corridor and show a proposed cross section while others show only the open space with no proposed cross section. The following is a list of proposed developments known to date that are affected by the Bullard Wash corridor. This list may change and should not be considered comprehensive. See Figure 2.5 for a map of the corridor and the proposed developments adjacent to it.

- Goodyear Planned Regional Center (GPRC) – 556 acres located within Section 32, T2N, R1W. GPRC is a planned regional center that proposes both residential and commercial land uses. The GPRC proposed development plan shows an approximately 330-foot corridor for the channelization of Bullard Wash. The plan also shows a typical proposed cross section through the Bullard Wash corridor. See Figure 2.6 for the proposed cross section.
- Snyders of Hanover – 35 acres located in the northeast corner of Section 5, T1N, R1W. This is a commercial development and is impacted on its west property line by the existing



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BASELINE ALTERNATIVE

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Flood Control District of Maricopa County

FIGURE 2.4

URS

PROPOSED IMPROVEMENTS FOR THE BULLARD WASH CORRIDOR

Recommended Alternatives 1 - 3

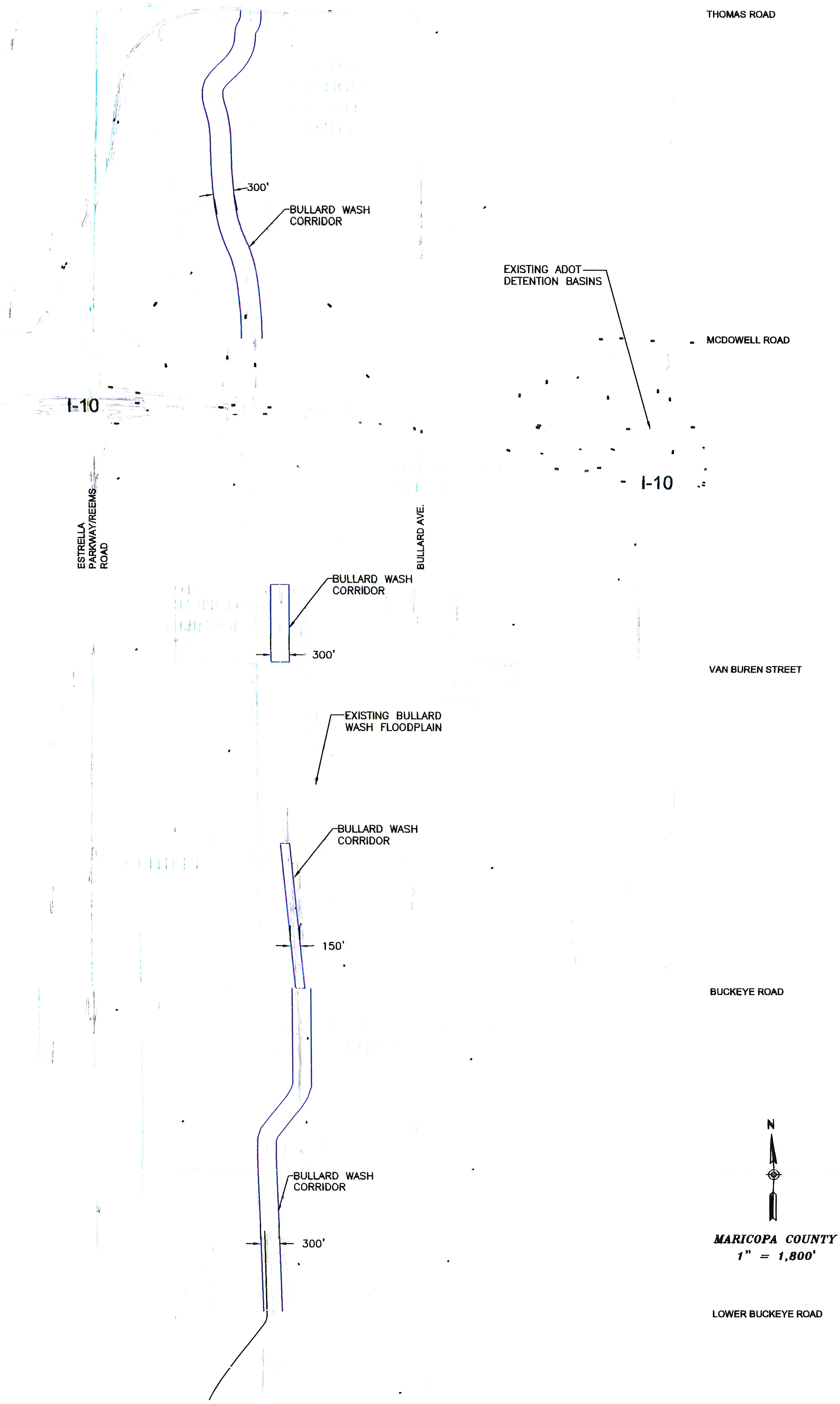

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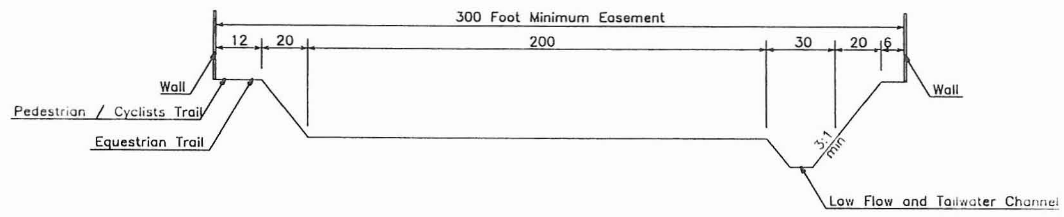
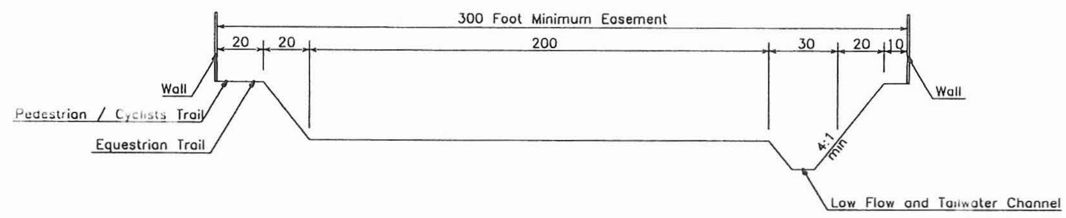
FIGURE 2.5

URS

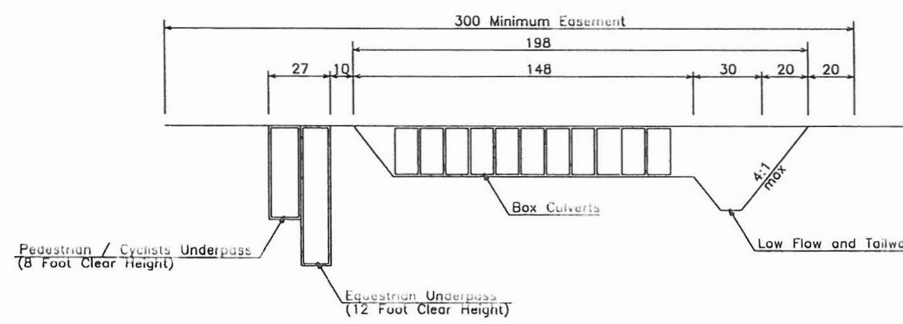
MODIFIED CITY OF GOODYEAR



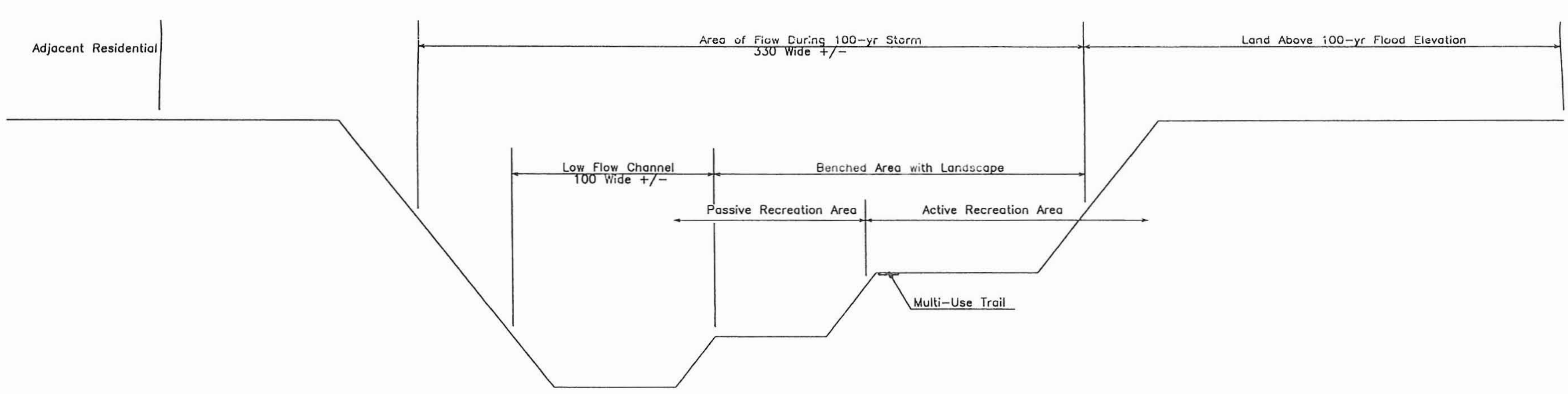
CITY OF GOODYEAR



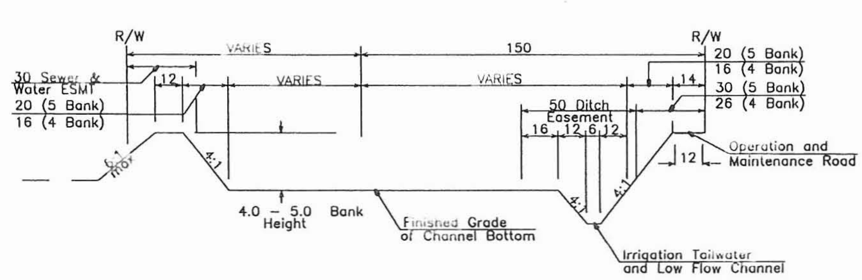
CITY OF GOODYEAR (AT UNDERPASS)



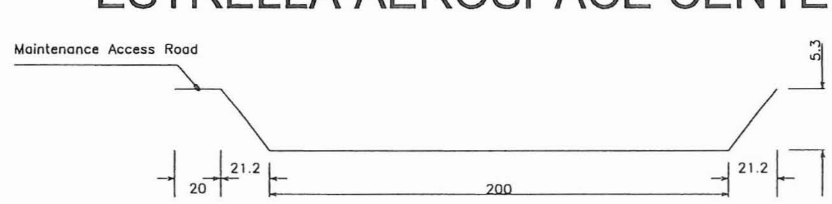
GOODYEAR PRC



RANCHO MIRAGE



ESTRELLA AEROSPACE CENTER



TYPICAL CROSS SECTIONS - BULLARD WASH

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FIGURE 2.6

URS

- Bullard Wash floodplain. The final drainage report for the proposed development showed the construction of a berm around the majority of the site to protect it from the existing floodplain. The report does not appear to directly address the issue of a Conditional Letter of Map Revision (CLOMR) or LOMR scour or other issues commonly associated with building a dike along a floodplain. See Figure 2.6.

- Rancho Mirage – 56.5 acres located within Section 5, T1N, R1W. Rancho Mirage has proposed channelization plans for of approximately 1/4-mile of the Bullard Wash corridor adjacent to it. The proposed channelization plans have been submitted to FEMA as part of a CLOMR. See Figure 2.6 for the typical cross section.

- Centerra – 296 acres located within Section 8, T1N, R1W. Centerra is a Planned Area Development within COG. The Final Plat for Centerra shows a 150-foot wide land tract labeled "Tract E" that has been dedicated to COG for the Bullard Wash as a drainage easement. It will be assumed that the proposed cross section in this area will be identical to the COG section shown on Figure 2.6.

2.1.5 Existing Floodplain and Recent Development

At the time of the original WTADMS/ADMP, there was not a detailed floodplain study on the Bullard Wash. During the WTADMS/ADMP, a detailed study was conducted by the WLB Group and the results were published by FEMA. The current Flood Insurance Rate Map(s) (FIRM) are dated July 19, 2001.

Since the detailed study was conducted on the Bullard Wash, improvements to the existing Dysart Drain upstream were made that significantly increased its conveyance capacity. As a result of the increased capacity along the Dysart Drain, a large amount of discharge previously contributing to the Bullard Wash Floodplain delineated and published on the current FEMA FIRM panels was cut off. This change was accompanied by the fact that several developments along the Bullard Wash Corridor are being proposed and are planning to encroach on the existing floodplain, by channelizing/improving the corridor.

The Rancho Mirage development, located on the north side of Van Buren and adjacent to the Bullard Wash on the west, is proposing channelization improvements along the Bullard Wash corridor. The improvements extend along the Rancho Mirage project boundary for approximately 1/4 mile and involve channelization, berming and the placement of fill within the floodplain.

In a joint effort between COG, the Rancho Mirage developer (Marwest Enterprises, LLC) and its consulting engineers, a CLOMR was requested from FEMA. The CLOMR was for the approximately 4-mile reach of Bullard Wash from approximately 1,700 feet downstream of Lower Buckeye Road to approximately 3,400 feet upstream of McDowell Road. FEMA approved the CLOMR and will make a final determination on revising the effective Flood Insurance Study (FIS) report and FIRM panels once the channelization project as-built is completed and the updated hydrology reflecting the Dysart Drain improvements are submitted for approval.

Due to the current restudy of the entire White Tanks Mountains/Loop 303 ADMS study area by FCDMC, the existing conditions hydrology in the majority of the watershed is expected to change and may also have significant impacts to the Bullard Wash Floodplain delineations. Therefore, a new CLOMR/LOMR will likely be required for the Bullard Wash to reflect the Rancho Mirage channelization plans and the updated existing conditions hydrologic model. The reasons for the expected changes within the new existing conditions hydrologic model are discussed in more detail in Section 2.1.6 of this report.

2.1.6 Existing Conditions Hydrology

There are significant differences between the original hydrologic model and the one being prepared as part of the restudy that will dramatically affect Bullard Wash. Reasons for these differences include, but are not limited to, the following items:

- New soil parameters describing the hydrologic characteristics associated with the soils in the entire White Tanks Mountains watershed area.
- There is extensive development and proposed development in the cities of Buckeye, Avondale, El Mirage, Surprise, Goodyear, Litchfield Park, unincorporated Maricopa County and other areas within the project area. Several of these developments have constructed channels to concentrate and route offsite sheet flow through and around their property lowering times of concentration and changing the way existing hydrographs are combining. Such changes to routing of hydrographs and their resultant combinations can significantly impact resultant downstream peak flow rates.
- Discontinuous development throughout the area.

For more detailed analysis and explanation of the existing conditions hydrology and the modeling changes associated with it, refer to the existing conditions hydrology report prepared and submitted under separate cover by EEC Inc.

2.1.7 ADOT Detention Basins

The existing ADOT detention basins located adjacent to I-10 on the north between Bullard Avenue and Dysart Road have become a very important aspect of the Loop 303 ADMP Update. These basins were first proposed as part of the I-10 construction project in a study conducted by Dibble and Associates Consulting Engineers in January 1976. Dibble was contracted by the Division of Highways, Department of Transportation to design and prepare construction plans for the Ehrenberg-Phoenix Highway, portion of I-10 under the Project No. I-IG-10-2(37)C.

Background

The original intent of the ADOT basins was twofold. First, they were to provide storage for off-site stormwater generated by the 50-year storm event, and second, they were to provide borrow requirements for the I-10 highway project. Part of the ADOT basin design included an outlet pipe that was to also act as a storm drain for street drainage generated along Dysart Road and Van Buren downstream of the ADOT basins. The existing pipe is a 48-inch storm drain that conveys flow south from the ADOT basins along Dysart Road and then east along Van Buren to the Agua Fria River.

The original basin design provided a volume of approximately 1,000 acre-feet. The 50-year, 12-hour inflow volume was the design event used to develop the basins. The actual inflow volume was not directly stated in the original study; however, the report indicates that the basin design for one of the alternatives studied provided 773 acre-feet of volume that was sufficient to handle the peak flow from the 12-hour duration storm. In addition, the original basins were to provide a minimum free board of 1.3 feet.

The report also studied several outlet storm drain sizes and configurations. The report states that the starting 50-year water surface elevation (WSEL) in the Agua Fria River was estimated by the US Army Corps of Engineers (COE) to be approximately 970.5 feet. By comparison, the 100-year WSEL published on the most recent Flood Insurance Rate Map (FIRM), Panel Number 2080 of 4350, effective date July 19, 2001, shows the water surface to be approximately 969 feet at the outlet.

Recent Studies

A new hydrologic study involving the ADOT basins was recently completed and submitted to ADOT by Parsons Brinckerhoff, dated July 23, 1999. This study was performed to document the volume of stormwater draining to the ADOT basins in the existing condition and evaluate the existing 48-inch outlet storm drain.[1]

According to the Parsons Brinckerfoff Hydrology Study (July 1999), the HEC-1 model predicts a total of 416 acre-feet of runoff draining to the ADOT basins from a contributing watershed of approximately 7.9 square miles. This is based on the 50-year, 24-hour storm event. Because of modeling limitations of HEC-1 and the fact that most of the runoff from the watershed enters the middle two basins, the maximum WSEL will be higher than the instantaneous WSEL shown on the HEC-1 model output for all four basins. This is due to the HEC-1 model's inability to model runoff transfer between basins as a function of time. The model assumes water is instantly distributed to all four basins and that the outlet storm drain begins to accept flow as soon as runoff enters the basin system. In reality, the water must travel from the middle two basins through pipes to the outer two basins. If a worst-case condition is assumed, then negligible flow is transferred from the middle basins to the outer basins and the WSEL at the peak rate of inflow would be higher than calculated by HEC-1.

Parsons Brinckerhoff prepared two models. One model calculates the instantaneous WSEL in the middle two basins (984.7 feet) and the other calculates the WSEL across all four basins (979.7 feet). Neither model is assumed to be 100% accurate but should provide a range across which the actual WSEL's in the basins might vary. The maximum WSEL reported is conservative since the model neglects any flow transfer to the outer basins.

The Parsons Brinckerhoff models are a combination of the original WTADMS model (WLB Group) and the RID overchute model (FCDMC).

The Parsons Brinckerhoff study also shows an analysis of the existing 48-inch storm drain system/ADOT basin outfall. According to this analysis, the entire runoff hydrograph contributing flow to the storm drain inlets at the Dysart Road/I-10 interchange is only 30 minutes long. The outflow hydrograph from the detention basins shows the storm drain is just beginning to accept flow during this 30-minute period.

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[1] The study does not reflect the existing conditions model changes prepared by EEC Inc. and described in Section 2.1.6.

It should be noted that the Parsons Brinckerhoff study used spot elevations from as-built drawings to develop the stage-storage curves. Since the as-built drawings were completed in 1976, the basins may have more or less capacity than the study shows. Also affecting basin capacity estimates is the maximum overtopping elevation assumed by the study. In the Parsons Brinckerhoff study, an elevation of 984 feet was used. By comparison, a more recent study of the basins by SunCor for the Palm Valley development showed the basins to have almost double the capacity Parsons Brinckerhoff estimated. This is due to the fact that the Palm Valley report assumed a maximum ponding elevation within the basins of 988 feet. According to the best available data at this time, URS has determined this elevation to be approximately 986 feet.

2.1.8 Existing Utilities

The information available to date regarding utilities existing in the Bullard Wash region of the Loop 303 ADMP Update project does not suggest any major conflicts will be encountered. Table 2.1 contains an inventory of the major utilities that may be crossed by proposed flood control alignments in the Phase I area. This Table is a working document and will be updated as more information becomes available.

Table 2.1

Existing Utility Inventory

Alignment: Pebble Creek Parkway to Bullard, From Thomas Road to Southern Avenue

	UTILITY							
Crossroad/Location	Sewer	Water	Gas	Electric	Irrigation	MCI WorldCom	Storm Drain/Outlet	AT&T
	d= ( ) in	d= ( ) in	d= ( ) in	d= ( ) in	d= ( ) in	Fiberoptic	d= ( ) in	
Dysart Road							48	
Mc Dowel Road	12							
Van Buren Street	21	24					48	
Yuma Road		16						
Intermediate Crossing	12	16						
Lower Buckeye Road								
Train Tracks						yes		
Broadway Road	15							

Alignment: I-10 Basin at Bullard Wash to ADOT Basins

	UTILITY							
Crossroad/Location	Sewer	Water	Gas	Electric	Irrigation	MCI WorldCom	Culvert/Connection	AT&T
	d= ( ) in	d= ( ) in	d= ( ) in	d= ( ) in	d= ( ) in	Fiberoptic		
Bullard Ave.		16						
Basin 'A' to Basin 'B'							1-48 RCP	
Basin 'B' to Basin 'C'							2-77x121 HERCP	
Basin 'C' to Basin 'D'							2-84 RCP	

3.0 LEVEL II PHASE I PROJECT ALTERNATIVES

3.1 SENSITIVITY ANALYSIS

The alternatives and their associated components presented in this technical memorandum have been evaluated and sized hydraulically using a sensitivity analysis. This type of analysis greatly simplifies the unknowns in the upstream portion of the project watershed area. Since the watershed area draining to the Bullard wash has not yet been analyzed in detail, there are many different ways stormwater runoff may be managed and conveyed to the Bullard Wash area and therefore several unknowns.

Using the existing condition hydrology model (WTAF2003.DAT) submitted with "White Tanks/Agua Fria, Area Drainage Master Study Update Hydrology – Draft," dated August 9, 2000, prepared by EEC Inc., HEC-1 Model QI cards were substituted for the combined inflow hydrographs at the Bullard Wash and I-10 intersection and at the ADOT detention basins. All downstream routings from these two locations were retained. By adjusting up or down the QI records at the Bullard Wash/I-10 intersection, several different magnitudes of inflow were modeled at this location without specific knowledge of how such flow would be managed upstream. The sensitivity analysis keeps inflow to the ADOT basins from the north constant and varies additional inflow from the Bullard Wash Corridor to the west with different flow values analyzed at that location. The goal was to limit the flow south of I-10 in the Bullard Wash to a maximum target flow that will not result in a discharge in excess of the 3,200 cfs at approximately lower Buckeye Road used to design the recently constructed Bullard Wash Outfall channel, while effectively managing the balance of the stormwater.

The alternatives accomplish this by diverting the target flow south and using a combination detention basin and outlet channel to manage the balance of the stormwater. The outflow channel may not be required at lower discharges if a large enough detention basin is proposed. The cost trade-off would be construction of an outlet channel and required right-of-way vs. more right-of-way for a larger basin. At larger flow rates, an outlet channel of significant size will be required. The lower flow values would be assuming large diversions of upstream flow to other outfalls. An example might be to use a large regional channel along the Loop 303 to discharge most of the flow south to the Gila/Salt River as in the baseline alternative. Another example might be to use several upstream west to east diversions out to the Agua Fria River in combination with several detention facilities.

The basin proposed at I-10 and Bullard Wash is sized to limit discharges south as not to surcharge the existing outfall channel at lower Buckeye Road. In addition, the basin must sufficiently attenuate discharges east to the ADOT basins since the adverse slope of the natural ground will require a relatively large channel section.

Since the construction of a large channel outfall from the ADOT basins east to the Agua Fria River is not feasible due to the density of existing development, any proposed outfall improvements will be limited. This results in more storage volume required upstream at I-10 and at the ADOT basins.

Due to existing slopes and development, additional pipe outfalls must either parallel the existing 48-inch SD/outfall under Dysart Road and Van Buren or be placed between the existing Wal-Mart and the westbound off-ramp from I-10 to Dysart Road. Since the off-ramp is several feet above existing grade, any proposed culvert(s) would likely lie partially beneath the off-ramp fill slope. This would result in high cost due to construction complexities as well as impacts to local business resulting from disruptions to normal traffic patterns. In either case, a large (volumetric) capacity outfall channel is not seen as a cost-effective or feasible alternative.

3.1.1 Discharge Rates

The discharge rates used in the sensitivity analysis were determined by multiplying the existing conditions hydrograph at the Bullard Wash/I-10 intersection by a variety of factors. The results of this are tabulated and presented on Table 3.1. The existing conditions flow rate of approximately 4,276 cfs is the baseline value with various discharges higher and lower. The discharge rates from the sensitivity analysis selected for the evaluation of the three recommended alternatives were based on a qualitative evaluation that used the schematic representations of each alternative to approximately determine an appropriate flow rate.

Since Alternative #1 proposed a large inflow channel from the White Tanks #3 FRS (West Valley Regional Drain, WVRD) and will also be accepting a large inflow from the Bullard Wash a relatively large discharge (10,691 cfs) was used for this evaluation.

Alternative #2 proposes potentially large inflow channels along Camelback Road and I-10. The Camelback Road channel will be accepting some magnitude of controlled outflow from the proposed White Tanks #3 FRS approximately equal to 1,500 cfs. Since these channels will increase the existing condition discharge at I-10 and Bullard Wash to something larger than existing but less than the rate used in Alternative #1, the discharge of 6,415 cfs was selected.

Table [illegible].1

Sensitivity Analysis

Existing Inflow (cfs)	Sensitivity Factor (X 4,276)	Modeled Inflow (cfs)	Modeled Inflow Volume (ac-ft)	[1]HEC-1 Filename
4,276	N/A	N/A	N/A	N/A
	0.10	428	231	10BS8001.dat
	0.50	2,138	1,150	10BS8002.dat
	1.00	4,276	2,302	10BS8003.dat
	1.50	6,415	3,452	10BS8004.dat
	2.50	10,691	5,755	10BS8005.dat
	4.00	17,105	9,207	10BS8006.dat
	5.00	21,382	11,509	10BS8007.dat

1. See attached output files.

Finally, Alternative #3 proposes a channel along Camelback Road but none along I-10. Also, the Camelback Road channel will likely be smaller than the one shown in Alternative #3 since it does not accept flow from the White Tanks #3 FRS. Additionally, the detention basin proposed at Loop 303 and Camelback Road may help to limit discharges on the Bullard Wash to a magnitude consistent with the existing condition. For these reasons a discharge equal to the existing condition flow rate (4,276 cfs) was selected.

Table 3.2 shows each discharge used with the sensitivity analysis and an approximate detention basin size required at I-10 and Bullard Wash to effectively control the floodwater and limit the downstream impacts.

The actual alternatives studied in this are described below:

3.1.2 Recommended Alternative #1

The key features to this alternative are briefly pointed out below. The points below are for the Phase I Bullard Wash area only and do not address the balance of the Loop 303 ADMP project area. See Tables 3.3 and 3.4 for a complete list of the hydraulic characteristics associated with Recommended Alternative #1.

- A 218 ac-ft detention basin located at I-10 and Bullard Wash restricting flow to the Bullard Wash south of I-10 to a maximum of 3,200 cfs.

- Improvements to existing ADOT basins providing a minimum total volume of 4,662 ac-ft of volume.

- A large earthen regional inflow channel, WVRD, at I-10 and Bullard continuing to the ADOT basins.

- An inflow channel from the Bullard Wash north of I-10 and south of Thomas Road.

- A channel along Bullard Wash from I-10 south to the existing Bullard Wash outfall channel.

See Figure 3.1 for an illustration of Recommended Alternative #1 and its proposed components.

3.1.3 Recommended Alternative #2

The key features to this alternative are briefly pointed out below. The points below are for the Phase I Bullard Wash area only and do not address the balance of the Loop 303 ADMP project

Table 3.2

Sensitivity Analysis Results

Existing Inflow (cfs)	Sensitivity Factor (X 4,276)	Modeled Inflow (cfs)	Modeled Inflow Volume (ac-ft)	Provided[1] Basin Volume (ac-ft)	HEC-1 Filename	Provided[2] Basin Volume (ac-ft)	HEC-1 Filename
4,276	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	0.10	428	231	0	10BS8001.dat	N/A	N/A
	0.50	2,138	1,150	0	10BS8002.dat	N/A	N/A
	1.00	4,276	2,302	29	10BS8003.dat	1,539	ADBS8003-3.dat
	1.50	6,415	3,452	152	10BS8004.dat	2,274	ADBS8004-2.dat
	2.50	10,691	5,755	218	10BS8005.dat	4,662	ADBS8005-1.dat
	4.00	17,105	9,207	1,281	10BS8006.dat	N/A	N/A
	5.00	21,382	11,509	2,048	10BS8007.dat	N/A	N/A

1. I-10 and Bullard Wash Basin
2. ADOT basin(s)

Table 3.3

Proposed Detention Basin Alternatives

Alternative ID	Proposed Channel	Typical Basin Section North-South Dimension[1] (ft)	West-East Dimension[1] (ft)	Side Slopes H:V	Basin Depth[2] (f/f)	Ponding Depth[2] (ft)	Combined Inflow (cfs)	Outflow To Bullard (cfs)	To/From ADOT (cfs)	Inflow Volume (ac-ft)	Provided[3] Volume (ac-ft)	Peak Stage (ft)	HEC-1 Filename
Existing	I-10 and Bullard	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	ADOT	617	8646	varies	16.0	8.6	2461	N/A	67	732	1029.0	982.6	10BS8001.dat
1	I-10 and Bullard	905	1,642	4:1	7.0	7.0	10,691	3,200	7,491	5,755	217.5	991.96	ADBS8005-1.dat
	ADOT	1,307	10,074	4:1	18.0	13.5	8,040	N/A	74	3,549	4,662.0	985.51	ADBS8005-1.dat
2	I-10 and Bullard	884	1,619	4:4	5.0	5.0	6,415	3,200	3,080	3,452	151.8	990.00	ADBS8004-2.dat
	ADOT	808	8,782	4:1	18.0	13.2	3,448	N/A	74	1,718	2,274.0	985.21	ADBS8004-2.dat
3	I-10 and Bullard	468	734	4:1	4.0	3.9	4,276	3,200	1,029	2,302	28.9	989.86	ADBS8003-3.dat
	ADOT	617	8,646	4:1	16.0	9.7	2,461	N/A	70	970	1,539.1	983.66	ADBS8003-3.dat

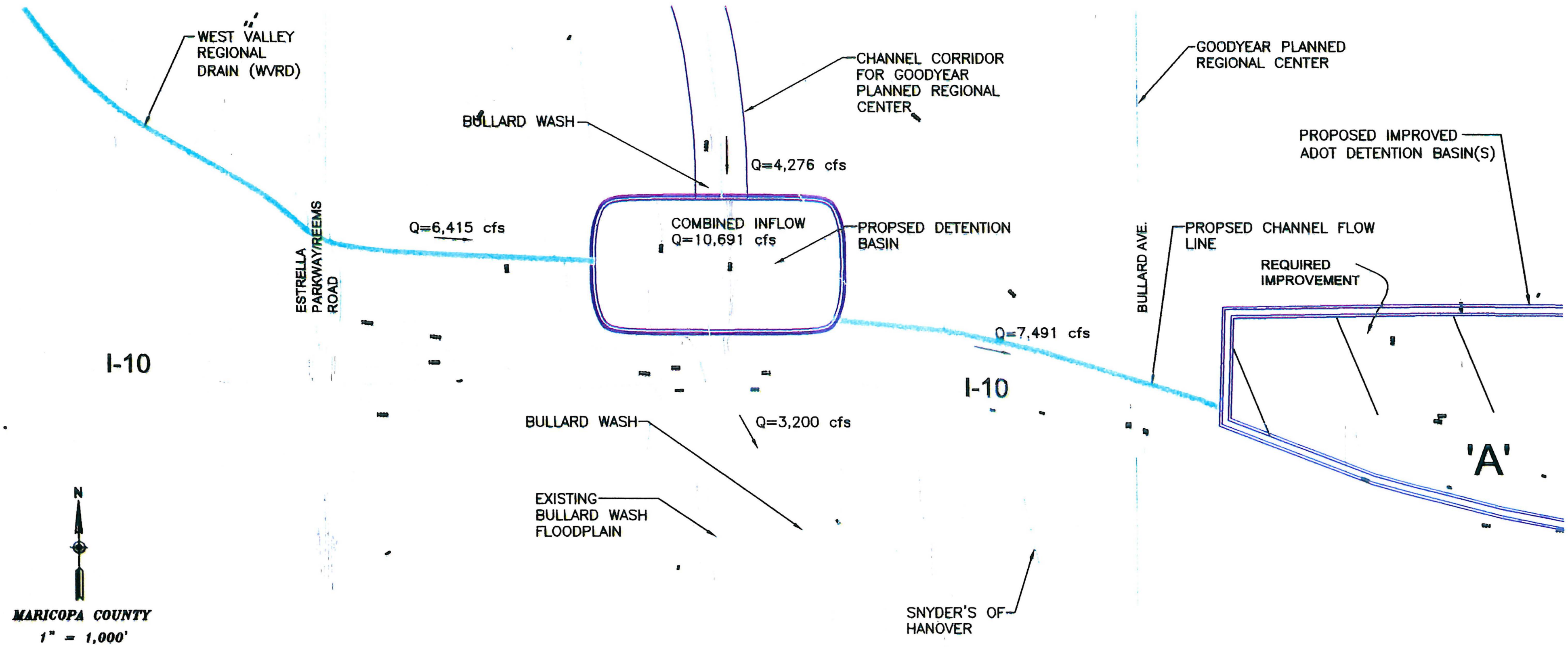
1. These are the minimum dimensions - they may be wider in areas where the bank elevations are not equal to the adjacent natural ground.
2. Basin depths given for the ADOT basins are average depths. The ADOT basins have been modeled using a single composite basin but but will be constructed as discontinuous basins connected by equalizer pipes and may have varying bottom elevations.
3. Does not include freeboard.

Proposed Channel Alternatives

Alternative ID	Proposed Channel	Typical Channel Section Top Width[2] (ft)	Cover	Side[3] Slopes H:V	Longitudinal Slope (f/f)	Length (ft)	Design Discharge (cfs)	Velocity (f/s)	Depth (ft)	Drop Structure(s) (Y/N)
1	Bullard North	262	grass	varies	0.002	5,579	4,276	4.91	6.30	N
	Bullard South	254	grass	varies	0.003	14,142	3,200	5.11	5.30	N
	I-10	382	grass	10:1	0.002	2,639	7,491	5.54	4.60	N
	West Valley Regional Drain[1]	306	grass	6:1	0.004	N/A	6,415	8.48	5.00	Y
2	Bullard North	264	grass	varies	0.002	5,579	6,415	5.75	7.21	N
	Bullard South	253	grass	varies	0.003	14,142	3,200	5.15	5.31	N
	I-10	170	grass	6:1	0.002	3,582	3,215	5.54	5.00	N
3	Bullard North	262	grass	varies	0.002	5,579	4,276	4.91	6.28	N
	Bullard South	253	grass	varies	0.003	14,142	3,200	5.20	5.29	N
	I-10	79	grass	4:1	0.002	3,988	1,076	4.97	5.00	N

1. This will be studied in more detail under Level II Phase II.
2. This is the minimum top width - it will be wider in areas where the channel bank elevations are not equal to the adjacent natural ground.
3. Side slopes that vary have been based on the City of Goodyear proposed channel corridor or a modified version.

PROPOSED BASIN DESIGN I-10 AND BULLARD WASH
Recommended Alternative # 1



June 2003

Loop 303 Corridor/White Tanks ADMP Update

FIGURE 3.1A

Flood Control District of Maricopa County

URS

PROPOSED ADOT BASIN IMPROVEMENTS
Recommended Alternative # 1

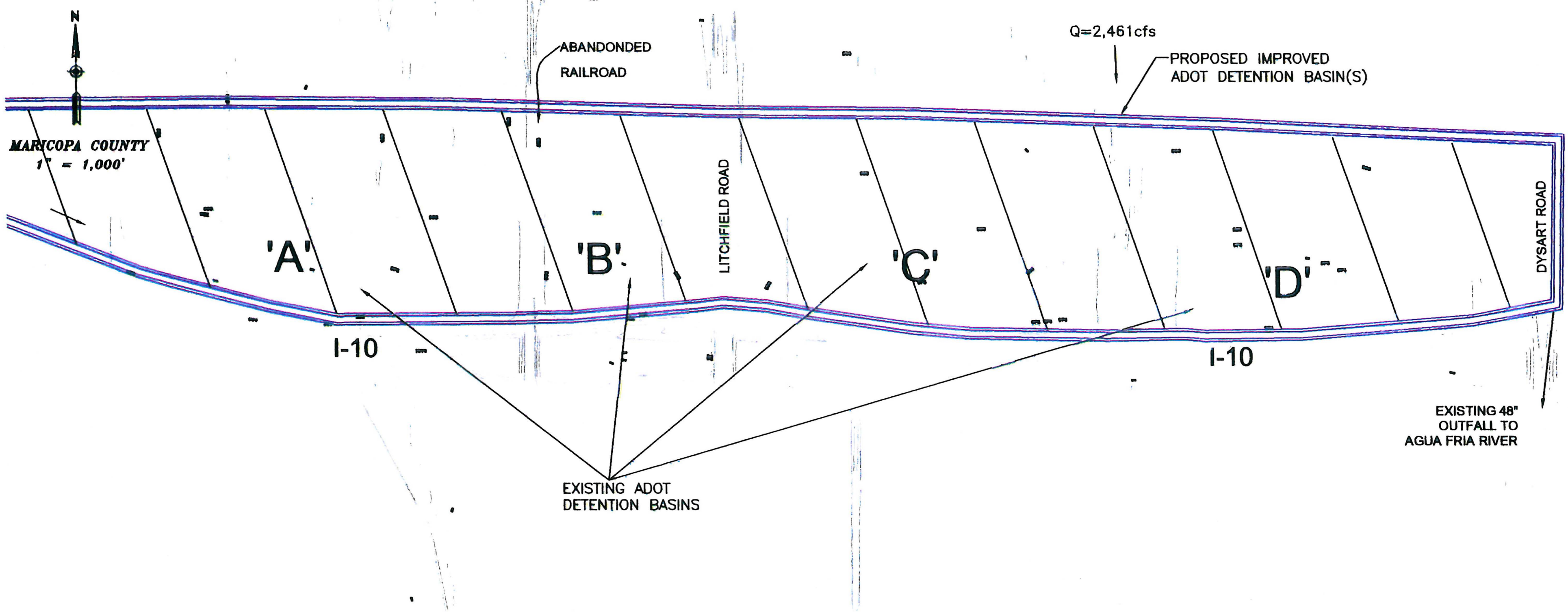


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FIGURE 3.1B

Flood Control District of Maricopa County

URS

area. See Tables 3.3 and 3.4 for a complete list of the hydraulic characteristics associated with Recommended Alternative #2.

- A 152 ac-ft detention basin located at I-10 and Bullard Wash restricting flow to the Bullard Wash south of I-10 to a maximum of 3,200 cfs.

- An improvement to existing ADOT basins providing a minimum total volume of 2,274 ac-ft of volume.

- An outfall channel connecting the proposed detention basin at I-10 and Bullard continuing to the ADOT basins.

- An inflow channel from the Bullard Wash north of I-10 and south of Thomas Road.

- A channel along Bullard Wash from I-10 south to the existing Bullard Wash outfall channel.

See Figure 3.2 for an illustration of Recommended Alternative #2 and its proposed components.

3.1.4 Recommended Alternative #3

The key features to this alternative are briefly pointed out below. The points below are for the Phase I Bullard Wash area only and do not address the balance of the Loop 303 ADMP project area. See Tables 3.3 and 3.4 for a complete list of the hydraulic characteristics associated with Recommended Alternative #3.

- A 29 ac-ft detention basin located at I-10 and Bullard Wash restricting flow to the Bullard Wash south of I-10 to a maximum of 3,200 cfs.

- An improvement to existing ADOT basins providing a minimum total volume of 1,539 ac-ft of volume.

- An outfall channel connecting the proposed detention basin at I-10 and Bullard continuing to the ADOT basins.

- An inflow channel from the Bullard Wash north of I-10 and south of Thomas Road.

- A channel along Bullard Wash from I-10 south to the existing Bullard Wash outfall channel.

See Figure 3.3 for an illustration of Recommended Alternative #3 and its proposed components.

PROPOSED BASIN DESIGN I-10 AND BULLARD WASH
Recommended Alternative # 2

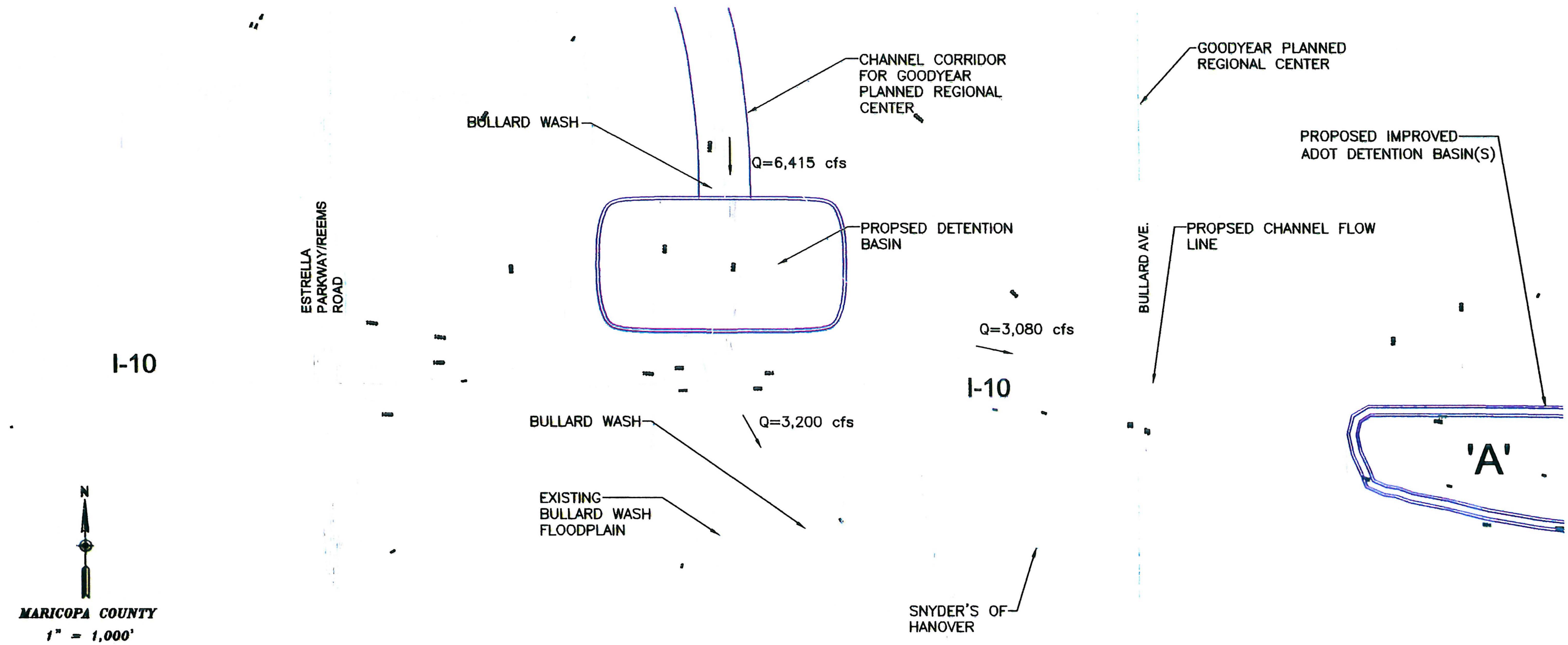

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FIGURE 3.2A

URS

PROPOSED ADOT BASIN IMPROVEMENTS
Recommended Alternative # 2

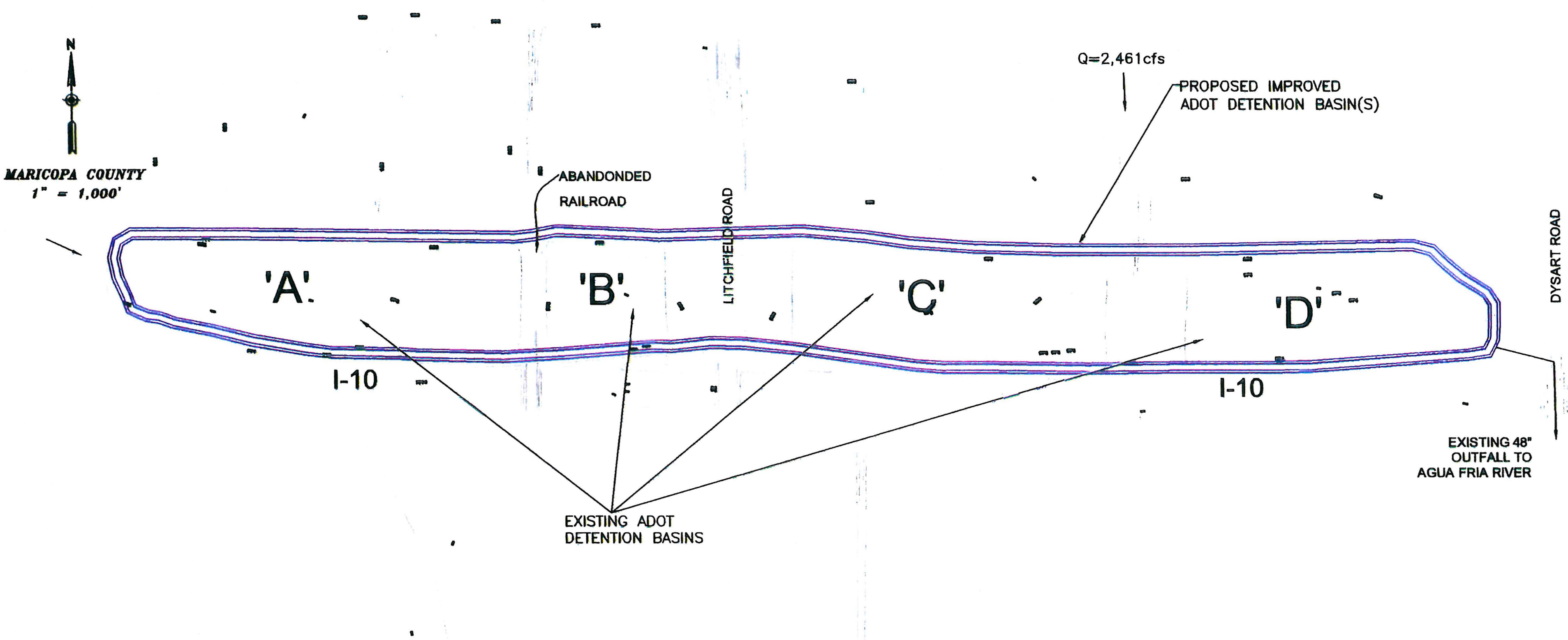

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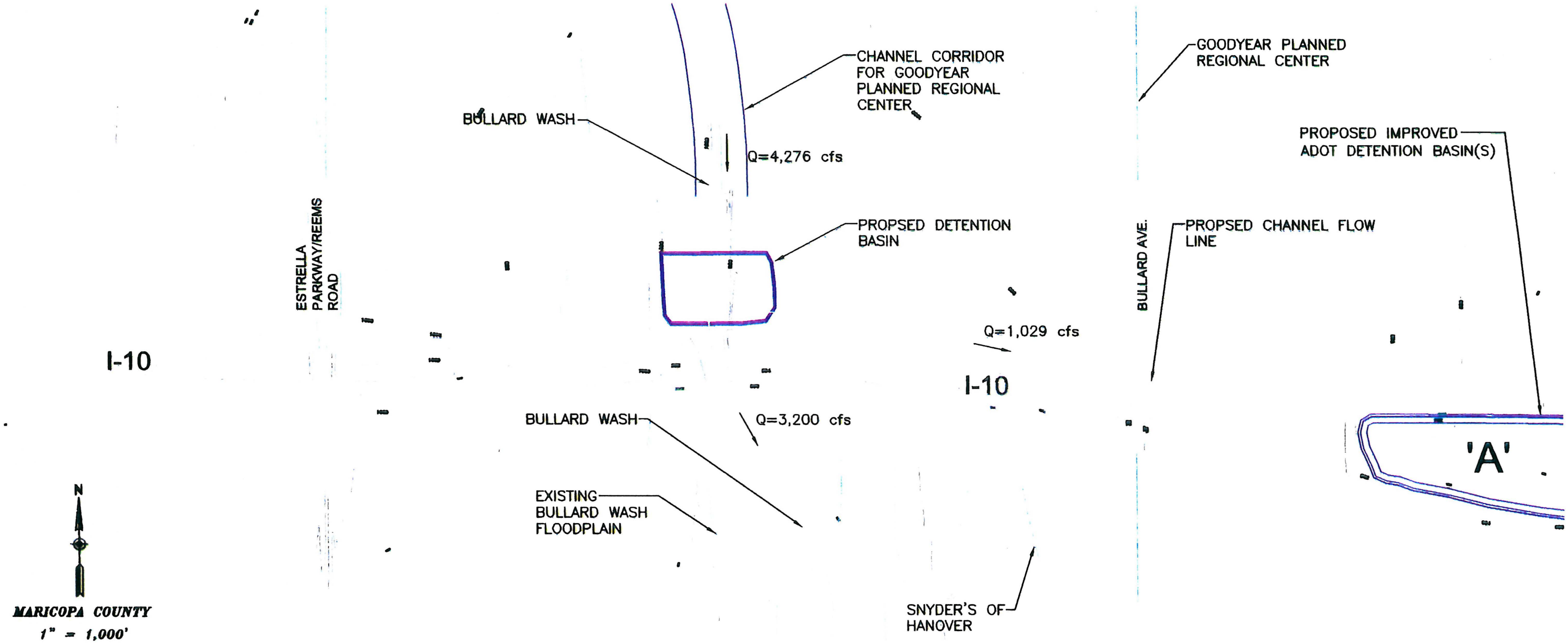
FIGURE 3.2B

URS

PROPOSED BASIN DESIGN I-10 AND BULLARD WASH
Recommended Alternative # 3



June 2003

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FIGURE 3.3A

Flood Control District of Maricopa County

URS

PROPOSED ADOT BASIN IMPROVEMENTS
Recommended Alternative # 3

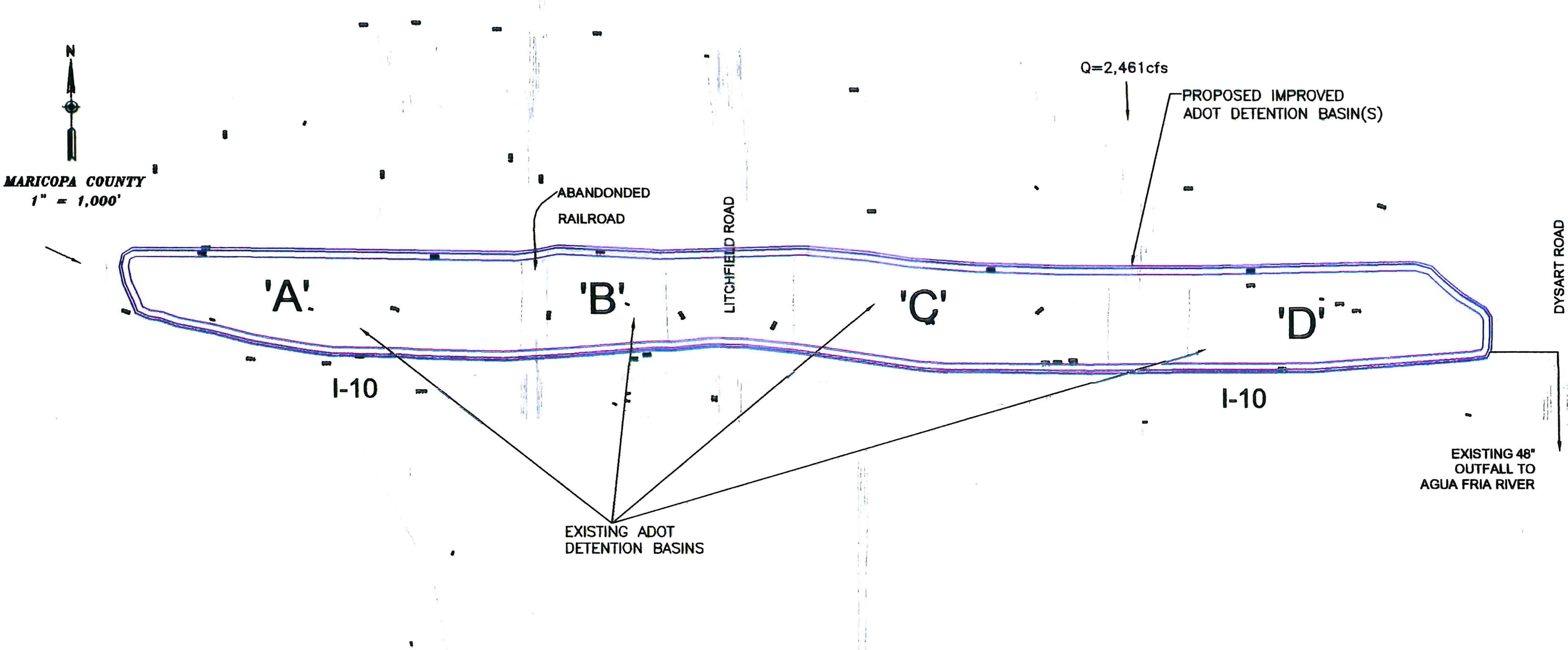

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FIGURE 3.3B

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3.2 ENVIRONMENTAL IMPACTS

The ecological and cultural aspects of the project area environment are characterized in the Data Collection and Level I Analysis reports. The environmental overview in the Data Collection Report can be consulted for more detailed description of the affected environment and information about the data sources used in the environmental analysis. An additional field reconnaissance was conducted on July 25, 2000, in support of the Phase 1 analysis for Bullard Wash from Thomas Road to Lower Buckeye Road.

3.2.1 Ecological Resources

Much of the Phase I analysis area is dominated by agricultural fields, watered with extensive canal systems to deliver surface water from large storage reservoirs, as well as deep wells that tap ground water. Residential and commercial development, as well as construction of I-10, has altered some of these agricultural lands.

Alternative 1

Alternative 1 would involve conversion of land currently in agricultural production, or land that has previously been developed or disturbed by prior commercial development and construction of highways and streets. A corridor approximately 300 to 400 feet wide would be required for the regional channel connecting White Tanks FRS #3 to Bullard Wash. This corridor would cross primarily agricultural land. The channel along Bullard Wash north and south of I-10 would require a similar corridor and also would cross through agricultural fields. The basin to be built at Bullard Wash north of I-10 would encompass approximately 32 acres, all of which is agricultural fields. Other major elements of Alternative 1 are the ADOT basins east of Bullard Wash and north of I-10. These are highly disturbed, and the connecting channel from Bullard Wash, approximately 350 to 400 feet wide, would be through agricultural lands. Any potential outfall channel connecting the ADOT basins to the Agua Fria River would be through a commercially developed or otherwise disturbed zone. The Agua Fria River itself has been channelized and its banks have been hardened.

Native vegetation has been removed from the study area. Vegetation consists of agricultural crops or species that invade disturbed environments and is not representative of the Lower Colorado River Valley subdivision that dominated the landscape prior to urban and agricultural development. No impacts to sensitive vegetation communities are expected within the study area.

Any wildlife species that utilize these areas are those that are tolerant of agricultural land and highly disturbed environments. Such species are likely to thrive in the area after flood control projects are completed but may be directly or indirectly impacted during construction of the project. A pipe is delivering water to one of the ADOT basins and a small pond has formed. Several species of birds and one species of fish were observed at this pond. The source of the water is not known, and alteration of the ADOT basins for flood detention basins could remove this water supply and pond. Further analysis is needed to determine specific impacts to wildlife associated with development of the ADOT basins.

Alternative 1 is not expected to result in significant impacts to threatened, endangered, or otherwise sensitive species of plants and animals. Agricultural land and irrigation canals could provide habitat components to a number of sensitive species of animals; but none of these species are expected to breed within the study area. Therefore, any impacts to the sensitive species that potentially utilize portions of the study area are not significant.

Alternative 2

The extent of ground disturbance associated with Alternative 2 is somewhat smaller than for Alternative 1. The channel leading into Bullard Wash from the west would be only about half as wide, but the basin at Bullard Wash north of I-10 would be only a fraction of an acre smaller than for Alternative 1. The channel connecting Bullard Wash to the ADOT basins would be about half as wide as for Alternative 1, but changes to the basins and construction of an outlet to the Agua Fria would involve similar disturbances. In sum, Alternative 2 will disturb a few acres less than Alternative 1 but the areas to be disturbed are highly modified and are not sensitive habitats. The impacts are expected to be essentially the same as for Alternative 1 and native vegetation communities, wildlife, and sensitive species of plants and animals are not significant.

Alternative 3

The extent of ground disturbance associated with Alternative 3 is less than for Alternatives 1 and 2. The channel along Bullard Wash will be the same size for all alternatives, but the basin at Bullard Wash north of I-10 will require only about 7 to 8 acres. The channel connecting eastward to the ADOT basins also is expected to be only about 80 feet wide. Alterations of the ADOT basins and the connection to the Agua Fria River would be similar to Alternatives 1 and 2. Although Alternative 3 will disturb fewer acres than Alternatives 1 and 2, this disturbance would be in previously modified areas that lack sensitive habitats. Therefore, impacts to native vegetation communities, wildlife, and sensitive species of plants and animals are expected to be similar to those of Alternatives 1 and 2 and not significant.

Baseline Alternative

The Baseline Alternative would involve no new facilities along Bullard Wash or use of the ADOT basins. Therefore, the Baseline Alternative would have no significant impacts on native vegetation communities, wildlife, and sensitive species of plants and animals. Because Alternatives 1, 2 and 3 also are not expected to have significant impacts, the Baseline Alternative offers no real advantages from an ecological perspective.

3.2.2 Cultural Resources

The cultural resources of the study area are primarily archaeological remnants of approximately a millennium of occupation by the Hohokam and sites and buildings related to the early historic occupation of the region by Euro-American settlers.

Alternative 1

The Data Collection Report indicates there are no recorded archaeological or historical sites within the Bullard Wash Phase 1 analysis area. The closest recorded resource is a farm well, circa 1920s-1930s. However, the extent of prior survey in the Bullard Wash vicinity also is limited, but the ADOT basins were inventoried in 1988 and no archaeological or historical resources were reported.

The areas that would be disturbed by Alternative 1 are north of the zone that was intensively occupied and farmed by the Hohokam. Therefore, archaeological remnants of the Hohokam occupation or earlier occupations are likely to have consisted primarily of scatters of artifacts on the ground or only shallowly buried features such as hearths. The previous agricultural and commercial development of the area probably has obliterated any such archaeological remnants that might have been present. Reconnaissance of the area indicates the potential for historic buildings and structures is low throughout the Bullard Wash analysis area.

In sum, there are no archaeological and historical sites recorded within areas that would be disturbed by Alternative 1. Prior studies, although limited, indicate that the potential for unrecorded cultural resources is low. Therefore, Alternative 1 is projected to have a low potential for significant impacts on cultural resources, and there is good potential for satisfactorily mitigating any adverse impacts if any were identified.

Alternative 2

The extent of ground disturbance associated with Alternative 2 is similar to but somewhat less than for Alternative 1. Potential impacts of Alternative 2 on cultural resources are essentially the same as for Alternative 1 and are considered to be low.

Alternative 3

The extent of ground disturbance associated with Alternative 3 is less than for Alternatives 1 and 2, and the potential for encountering unrecorded cultural resources is proportionately lower. However, because the potential impacts of Alternatives 1 and 2 on cultural resources are low, Alternative 3 offers little advantage from a cultural resource perspective.

Baseline Alternative

The Baseline Alternative would involve no new facilities along Bullard Wash or use of the ADOT basins. Therefore, the Baseline Alternative would have no impacts on cultural resources. However, because the potential impacts of Alternatives 1, 2 and 3 on cultural resources are low, the Baseline Alternative offers little advantage from a cultural resource perspective.

3.3 ENVIRONMENTAL PERMITTING

Although no ecological or cultural resource issues have been identified as important considerations in selecting among the alternatives being considered for the Bullard Wash area, implementation of any alternative other than the no action baseline alternative will require additional environmental permitting. The extent of environmental study that will be required during subsequent stages of project planning will vary with the extent of requirements to comply with various federal or state regulations.

There appears to be no potential for needing to acquire rights-of-way across federal lands, which would lead to a need to conduct an environmental analysis in compliance with the National Environmental Policy Act (NEPA). However, any federal funding that might be used for the project would also entail such a requirement. In the absence of federal funding, the potential for having to comply with NEPA appears to be low. If a NEPA document were required, scoping with the lead federal agency would be required to determine whether an environmental assessment or more complex environmental impact statement would be warranted.

All of the action alternatives would connect with the Bullard Wash Outfall structure, which may be considered a jurisdictional water of the United States, and although the potential for other jurisdictional waters is low it cannot be entirely discounted. Therefore, implementation of any alternative may require a permit from the US Army Corps of Engineers in compliance with Section 404 of the Clean Water Act. Such a permit will require delineation of jurisdictional waters, as well as biological and cultural resource surveys. The extent of disturbance within jurisdictional waters will need to be calculated to determine whether the selected plan could be constructed under a nationwide permit or whether an individual permit would be required. Obtaining an individual permit requires more time, consideration of alternatives, and certification under Section 401 of the Clean Water Act, a program administered by the Arizona Department of Environmental Quality.

All alternatives also entail discharges to the Agua Fria River and Gila River. Therefore, a storm water discharge permit also is likely to be required in accordance with the National Pollutant Discharge Elimination System implemented under the provisions of the Clean Water Act.

Acquisition of land or rights-of-way across state land probably will be required. This will entail requirements to conduct studies to comply with state regulations such as the Arizona State Historic Preservation Act, Arizona Antiquities Act, and Arizona Native Plant Law that requires salvage of protected native plant species.

3.4 LANDSCAPE AESTHETICS AND MULTI-USE

3.4.1 Recommended Alternative #1

Description

This alternative has six different flood control facilities. These facilities consist of four various sized channels, a basin, and improvements to the existing ADOT basins.

There are several opportunities for multi-use within the various channel configurations and basins. The following outlines the proposed landscape aesthetics and multi-use opportunities for each channel and basin.

Bullard Channel North

(Thomas Road south to a proposed detention basin located just north of I-10 at Bullard Wash)

Landscape Aesthetics

- ***Structure Shape:*** This meandering channel has an overall width of approximately 330 feet with an access road on one side and a multi-use path on the other. There is a meandering low flow channel at the bottom of the channel approximately 24 feet in width with a 200-foot open space area adjacent to the low flow channel.

- ***Over-bank Areas:*** A minimum of 30 feet would be located at the top of the channel on both sides. This area would be used to incorporate landscape berming, channel access points, meandering multi-use path, and buffer plantings.

- ***Side Slopes:*** The side slopes warp and vary from 4:1 to 5:1 creating a meandering toe of slope. The side slopes would blend into earth berming located in the over-bank areas. Plantings would be located in the channel bottom, on the side slopes, and at the top of the channel.

- ***Low Flow Channel:*** A 24-foot wide meandering low flow channel is located in the bottom of the channel. This low flow channel could be designed using various materials and shape to create a feature in the landscape.

- ***Landscape Theme:*** Based upon the *Landscape Aesthetics Assessment and Multi-Use Opportunity Assessment* dated July 6, 2000, this channel passes through three different landscape character units. These character units are described as the PAD, Commercial, and Neighborhood.

The section of channel that passes through the PAD would be developed with an Urban Theme. An urban theme would integrate the proposed facilities as an extension of the subdivision's character. The landscape would be characterized by plantings of specimen exotic and native trees, installation of shrubs, and the introduction of turf at various locations. These plantings would occur throughout the channel sides and bottom. It would also incorporate concrete pathways. Walls and other structures that might be included within this area would incorporate stucco and tile materials and colors associated with the adjacent developments. Earth contouring would also be a component of the landscape. This would predominantly occur within the 200-foot area and along the side slopes of the channel.

The urban theme begins at Camelback Road and extends south to a point just south of Thomas Road. Within this stretch, the channel passes through an existing golf course. This golf course is typical in that it is comprised of large amounts of turf; earth contouring; water features; mature trees, shrubs, and palms; and concrete cart paths. The proposed landscape treatments for the urban theme will need to respond to this existing condition. This can be accomplished through the development of transition zones at Indian School Road and Thomas Road. The transition zones would introduce palm trees and increase the amount of earth contouring. The length of these transition zones would vary.

Another section of the channel passes through an area identified as commercial development. This area extends from a point just south of Thomas Road and extends south to McDowell Road. This section would be developed in a similar manner to the Urban Theme. Larger groupings of trees would be installed to screen the adjacent commercial buildings and assist in bringing down the scale of the building. Lesser amounts of turf would be installed thus increasing the amount of shrub plantings.

The last section of this channel passes through an area identified as Neighborhood. A Neighborhood Theme is described as a continuation of the residential "yard." This theme incorporates large shade tree species and shrubs as accents; turf use in special areas; and hardscape elements utilizing a variety of materials from brick to wood. The neighborhood theme begins at McDowell Road and extends south to I-10.

- ***Structural Components:*** Structural components located within the channel would be designed to blend with the surrounding environment. This could include the use of form liners, integral color, shape/size of structure, construction material, etc.

Multi-Use Opportunities

- A concrete multi-use path would be located along the east side of the channel within the over-bank area. This path would be one segment of a multi-use path that would extend from Camelback Road to the Gila River. This multi-use path would also have side paths that branch off the main path and meander throughout the 200-foot channel bottom utilizing low flow channel crossings. This would allow users to experience other aspects of the channel.

- Large turf areas would be located in the channel bottom between the low flow channel and the multi-use path. These turf areas would provide valuable open space for users to fly kites, play Frisbee golf, to have pick-up softball and football games.

- Interpretive sites would be located within the section of the channel that goes through the golf course to interpret the game of golf.

Bullard Channel South

(Proposed basin at the intersection of Bullard Wash and I-10 south to the existing Bullard Wash Channel)

Landscape Aesthetics

- ***Structure Shape:*** This meandering channel has an overall width of approximately 300 feet with an access road on one side and a multi-use path on the other. There is a meandering low flow channel approximately 24 feet in width with a 200-foot open space area adjacent to the low flow channel located at the bottom of the channel.

- ***Over-bank Areas:*** A minimum of 30 feet would be located at the top of the channel on both sides. This area would be used to incorporate landscape berming, channel access points, meandering multi-use path, and buffer plantings.

- ***Side Slopes:*** The side slopes warp and vary from 4:1 to 6:1 creating a meandering toe of slope. The side slopes would blend into earth berming located at the top of the channel. Plantings would be located in the channel bottom, on the side slopes, and at the top of the channel.

- ***Low Flow Channel:*** A 24-foot wide meandering low flow channel is located in the bottom of the channel. This low flow channel could be designed using various materials and shape to create a feature in the landscape.

- ***Landscape Theme:*** Based upon the *Landscape Aesthetics Assessment and Multi-Use Opportunity Assessment,* this channel passes through one landscape character unit. This character unit is described as the PAD.

  An urban theme would integrate the proposed facilities as an extension of the subdivision's character. The landscape would be characterized by plantings of specimen exotic and native trees, installation of shrubs, and the introduction of turf at various locations. These plantings would occur throughout the channel sides and bottom. It would also incorporate concrete pathways. Walls and other structures that might be included within this area would incorporate stucco and tile materials and colors associated with the adjacent developments. Earth contouring would also be a component of the landscape. This would predominantly occur within the 200-foot area and along the side slopes of the channel.

- ***Structural Components:*** Structural components located within the channel would be designed to blend with the surrounding environment. This could include the use of form liners, integral color, shape/size of structure, construction material, etc.

Multi-Use Opportunities

- Bullard Channel South is very similar to Bullard Channel North. It is a wide channel and lends itself to many of the same multi-use opportunities.

- Large turf areas for various activities would also be located within this segment similar to Bullard Channel North.

- An interpretive site would be located in the vicinity of Goodyear Airport. This interpretive site would interpret the various aircraft flown in and out of Goodyear Airport, the importance of the airport, and its past history.

I-10 to ADOT Basins Channel

(Proposed basin just north of I-10 east to the existing ADOT basins)

Landscape Aesthetics

- ***Structure Shape:*** This meandering channel has an overall width of approximately 382 feet in width with a 250-foot channel bottom. This channel has an access road on one side and a multi-use trail on the other side.

- ***Over-bank Areas:*** A minimum of 30 feet would be located at the top of the channel on both sides. This area would be used to incorporate landscape berming, channel access points, meandering multi-use path, and buffer plantings.

- ***Side Slopes:*** The side slopes warp and vary from 4:1 to 12:1 creating a meandering toe of slope. The side slopes would blend into earth berming located at the top of the channel. Plantings would be located in the channel bottom, on the side slopes, and at the top of the channel.

- ***Landscape Theme:*** Based upon the *Landscape Aesthetics Assessment and Multi-Use Opportunity Assessment*, this channel passes through two landscape character units. These character units are described as Commercial and Neighborhood.

A portion of this channel passes through an area identified as commercial development. This area occurs at the intersection of Bullard Avenue and I-10. This section of the channel would be developed in a similar manner to the Urban Theme. Larger groupings of trees would be installed to screen the adjacent commercial buildings and assist in bringing down the scale of the building. Lesser amounts of turf would be installed thus increasing the amount of shrub plantings.

The remaining portions of the channel pass through an area identified as Neighborhood. A Neighborhood Theme is described as a continuation of the residential "yard." This theme incorporates large shade tree species and shrubs as accents; turf use in special areas; and hardscape elements utilizing a variety of materials from brick to wood.

- ***Structural Components:*** Structural components located within the channel would be designed to blend with the surrounding environment. This could include the use of form liners, integral color, shape/size of structure, construction material, etc.

Multi-Use Opportunities

- An access road and a multi-use path are located within the over-bank areas of this channel. This multi-use path would be constructed of concrete and could connect the multi-use path along Bullard Wash with the Agua Fria River. This multi-use path should be similar to the pathway located along Bullard Wash. Various paths would branch off of the main path to allow users to access the 250-foot channel bottom.
- Various activities would take place in the open turf areas.

West Valley Regional Drain

(White Tanks FCS #3 southeast to proposed basin just north of I-10 and Bullard Wash)

Only a portion of the channel as it enters the basin would be constructed as a part of this alternative. The length of channel to be constructed as a part of this alternative has not been determined.

Landscape Aesthetics

- ***Structure Shape:*** This meandering channel has an overall width of approximately 306 feet in width. An access road occurs on one side and a multi-use path occurs on the other side. The bottom width of the channel is 225 feet wide.

- ***Over-bank Areas:*** A minimum of 30 feet would be located at the top of the channel on both sides. This area would be used to incorporate landscape berming, channel access points, meandering multi-use path, and buffer plantings.

- ***Side Slopes:*** The side slopes warp and vary from 4:1 to 12:1 creating a meandering toe of slope. The side slopes would blend into earth berming located at the top of the channel. Plantings would be located in the channel bottom, on the side slopes, and at the top of the channel.

- ***Landscape Theme:*** Based upon the *Landscape Aesthetics Assessment and Multi-Use Opportunity Assessment*, this channel passes through two landscape character units, Commercial and Neighborhood.

  A portion of this channel passes through an area identified as commercial development. This area occurs along McDowell Road east of Estrella Parkway. This section of the channel would be developed in a similar manner to the Urban Theme. Larger groupings of trees would be installed to screen the adjacent commercial buildings and assist in bringing down the scale of the building. Lesser amounts of turf would be installed thus increasing the amount of shrub plantings.

  The remaining portions of the channel pass through an area identified as Neighborhood. This theme incorporates large shade tree species and shrubs as accents; turf use in special areas; and hardscape elements utilizing a variety of materials from brick to wood.

- ***Structural Components:*** Structural components located within the channel would be designed to blend with the surrounding environment. This could include the use of form liners, integral color, shape/size of structure, construction material, etc.

Multi-Use Opportunities

- The West Valley Regional Drain, in conjunction with the Bullard Wash Channel and the I-10/ADOT Basin Channel, provides a multi use path from the White Tanks Mountains to the

Gila River and the Agua Fria River. Again, this multi-use path would have sections of pathway branch-off and meander throughout the bottom of the channel.

- The section within this alternative would provide open turf areas for various activities.

I-10/Bullard Wash Basin

(Intersection of I-10 and Bullard Wash)

Landscape Aesthetics

- ***Structure Shape:*** The I-10/Bullard Wash Basin is a 34.0-acre earthern-lined basin with a meandering top edge. The depth of the basin is 7 feet.

- ***Over-bank Areas:*** A minimum of 60 feet would be located around the perimeter of the basin. This area would be used to incorporate landscape berming and buffer plantings. This will help blend the basin into the surrounding area.

- ***Side Slopes:*** The side slopes warp and vary from 4:1 to 12:1 creating a meandering toe of slope. The side slopes would blend into earth berming located at the top of the basin. Plantings would be located in the basin bottom, on the side slopes, and at the top of the basin.

- ***Landscape Theme:*** Based upon the *Landscape Aesthetics Assessment and Multi-Use Opportunity Assessment*, this basin would incorporate a recreational theme. Large open space turf areas would be developed. Large groupings of canopy trees would occur around the edges of the basin and down the side slopes.

- ***Structural Components:*** Structural components located within the basin would be designed to blend with the surrounding environment. This could include the use of form liners, integral color, shape/size of structure, construction material, etc.

Multi-Use Opportunities

- A regional soccer / softball complex could be developed for the area. In addition, other activities could be accommodated such as a BMX course, various court sports, and just open space for users to use as they wish.

- A multi-use path would be constructed around the perimeter of the basin. Located within the pathway could be distance markers for runners to keep track of how far they have run.

ADOT Basins

(North side of I-10 from Dysart Road to Litchfield Road and from Litchfield Road to approximately ¼ mile east of Bullard Avenue)

Landscape Aesthetics

- ***Structure Shape:*** The ADOT Basin is a 302.0-acre earthern-lined basin with a meandering top edge. The depth of the basin is 18 feet.

- ***Over-bank Areas:*** A minimum of 60 feet would be located around the perimeter of the basin. This area would be used to incorporate landscape berming and buffer plantings. This will help blend the basin into the surrounding area.

- ***Side Slopes:*** The side slopes warp and vary from 4:1 to 12:1 creating a meandering toe of slope. The side slopes would blend into earth berming located at the top of the basin. Plantings would be located in the basin bottom, on the side slopes, and at the top of the basin.

- ***Landscape Theme:*** Based upon the *Landscape Aesthetics Assessment and Multi-Use Opportunity Assessment*, this basin would incorporate a recreational theme. Large open space turf areas would be provided for various recreational activities. Earth contouring would take place around the top of the basin as well as modifying the side slopes. Earth contouring would also occur in the basin bottom. Large groupings of canopy trees would occur around the edges of the basin, down the side slopes, and at various locations in the bottom of the basin.

- ***Structural Components:*** Structural components located within the basin would be designed to blend with the surrounding environment. This could include the use of form liners, integral color, shape/size of structure, construction material, etc.

Multi-Use Opportunities

- There are many recreational activities that could be incorporated into these basins because of there size. Examples of recreational activities that could be provided range from a regional baseball/softball/soccer complex to the construction of a golf course to large park open space.

- A multi-use path would be constructed around the perimeter of the basin. Various multi-use paths would also be incorporated throughout the bottom of the basin.

Cost

See Section 4.0 for the cost analysis.

3.4.2 Recommended Alternative #2

Description

This alternative has five different flood control facilities. These facilities consist of three various sized channels, a basin, and improvements to the existing ADOT basins.

There are several opportunities for multi-use within the various channel configurations and basins.

The following outlines the proposed landscape aesthetics and multi-use opportunities for each channel and basin.

Bullard Channel North

(Thomas Road south to a proposed detention basin located just north of I-10 at Bullard Wash)

Refer to Recommended Alternative #1 for a description of Bullard Wash North Channel Landscape Aesthetics and Multi-Use opportunities.

Bullard Channel South

(Proposed basin at the intersection of Bullard Wash and I-10 south to the existing Bullard Wash Channel)

Refer to Recommended Alternative #1 for a description of Bullard Wash North Channel Landscape Aesthetics and Multi-Use opportunities.

I-10 to ADOT Basins Channel

(Proposed basin just north of I-10 east to the existing ADOT basins)

Landscape Aesthetics

- ***Structure Shape:*** This meandering channel has an overall width of approximately 170 feet. This channel has an access road on ones side and a multi-use trail on the other side.

- ***Over-bank Areas:*** A minimum of 30 feet would be located at the top of the channel on both sides. This area would be used to incorporate landscape berming and buffer plantings.

- ***Side Slopes:*** The side slopes warp and vary from 4:1 to 12:1 creating a meandering toe of slope. The side slopes would blend into earth berming located at the top of the channel. Plantings would be located in the channel bottom, on the side slopes, and at the top of the channel.

- ***Landscape Theme:*** Based upon the *Landscape Aesthetics Assessment and Multi-Use Opportunity Assessment*, this channel passes through two landscape character units. These character units are described as Commercial and Neighborhood.

  A portion of this channel passes through an area identified as commercial development. This area occurs at the intersection of Bullard Avenue and I-10. This section of the channel would be developed in a similar manner to the Urban Theme. Larger groupings of trees would be installed to screen the adjacent commercial buildings and assist in bringing down the scale of the building. Lesser amounts of turf would be installed thus increasing the amount of shrub plantings.

  The remaining portions of the channel pass through an area identified as Neighborhood. A Neighborhood Theme is described as a continuation of the residential "yard." This theme incorporates large shade tree species and shrubs as accents; turf use in special areas; and hardscape elements utilizing a variety of materials from brick to wood.

- ***Structural Components:*** Structural components located within the channel would be designed to blend with the surrounding environment. This could include the use of form liners, integral color, shape/size of structure, construction material, etc.

Multi-Use Opportunities

- Refer to Recommended Alternative #1 for a description of I-10 to ADOT Basins Channel Multi-Use opportunities.

I-10/Bullard Wash Basin

(Intersection of I-10 and Bullard Wash)

Landscape Aesthetics

- ***Structure Shape:*** The I-10/Bullard Wash Basin is a 32.8-acre earthern-lined basin with a meandering top edge. The depth of the basin is 7 feet.

- ***Over-bank Areas:*** A minimum of 60 feet would be located around the perimeter of the basin. This area would be used to incorporate landscape berming and buffer plantings. This will help blend the basin into the surrounding area.

- ***Side Slopes:*** The side slopes warp and vary from 4:1 to 12:1 creating a meandering toe of slope. The side slopes would blend into earth berming located at the top of the basin. Plantings would be located in the basin bottom, on the side slopes, and at the top of the basin.

- ***Landscape Theme:*** Based upon the *Landscape Aesthetics Assessment and Multi-Use Opportunity Assessment*, this basin would incorporate a recreational theme. Large open space turf areas would be developed. Large groupings of canopy trees would occur around the edges of the basin and down the side slopes.

- ***Structural Components:*** Structural components located within the basin would be designed to blend with the surrounding environment. This could include the use of form liners, integral color, shape/size of structure, construction material, etc.

Multi-Use Opportunities

- Refer to Recommended Alternative #1 for a description of I-10 and Bullard Basin Multi-Use opportunities.

ADOT Basins

(North side of I-10 from Dysart Road to Litchfield Road and from Litchfield Road to approximately ¼ mile east of Bullard Avenue)

Landscape Aesthetics

- ***Structure Shape:*** The ADOT Basin is a 162.8-acre earthern-lined basin with a meandering top edge. The depth of the basin is 18 feet.

- ***Over-bank Areas:*** A minimum of 60 feet would be located around the perimeter of the basin. This area would be used to incorporate landscape berming and buffer plantings. This will help blend the basin into the surrounding area.

- ***Side Slopes:*** The side slopes warp and vary from 4:1 to 12:1 creating a meandering toe of slope. The side slopes would blend into earth berming located at the top of the basin. Plantings would be located in the basin bottom, on the side slopes, and at the top of the basin.

- ***Landscape Theme:*** Based upon the *Landscape Aesthetics Assessment and Multi-Use Opportunity Assessment*, this basin would incorporate a recreational theme. Large open space turf areas would be provided for various recreational activities. Earth contouring would take place around the top of the basin as well as modifying the side slopes. Earth contouring would also occur in the basin bottom. Large groupings of canopy trees would occur around the edges of the basin, down the side slopes, and at various locations in the bottom of the basin.

- ***Structural Components:*** Structural components located within the basin would be designed to blend with the surrounding environment. This could include the use of form liners, integral color, shape/size of structure, construction material, etc.

Multi-Use Opportunities

- Refer to Recommended Alternative #1 for a description of the existing ADOT Basins Multi-Use opportunities.

Cost

See Section 4.0 for the cost analysis.

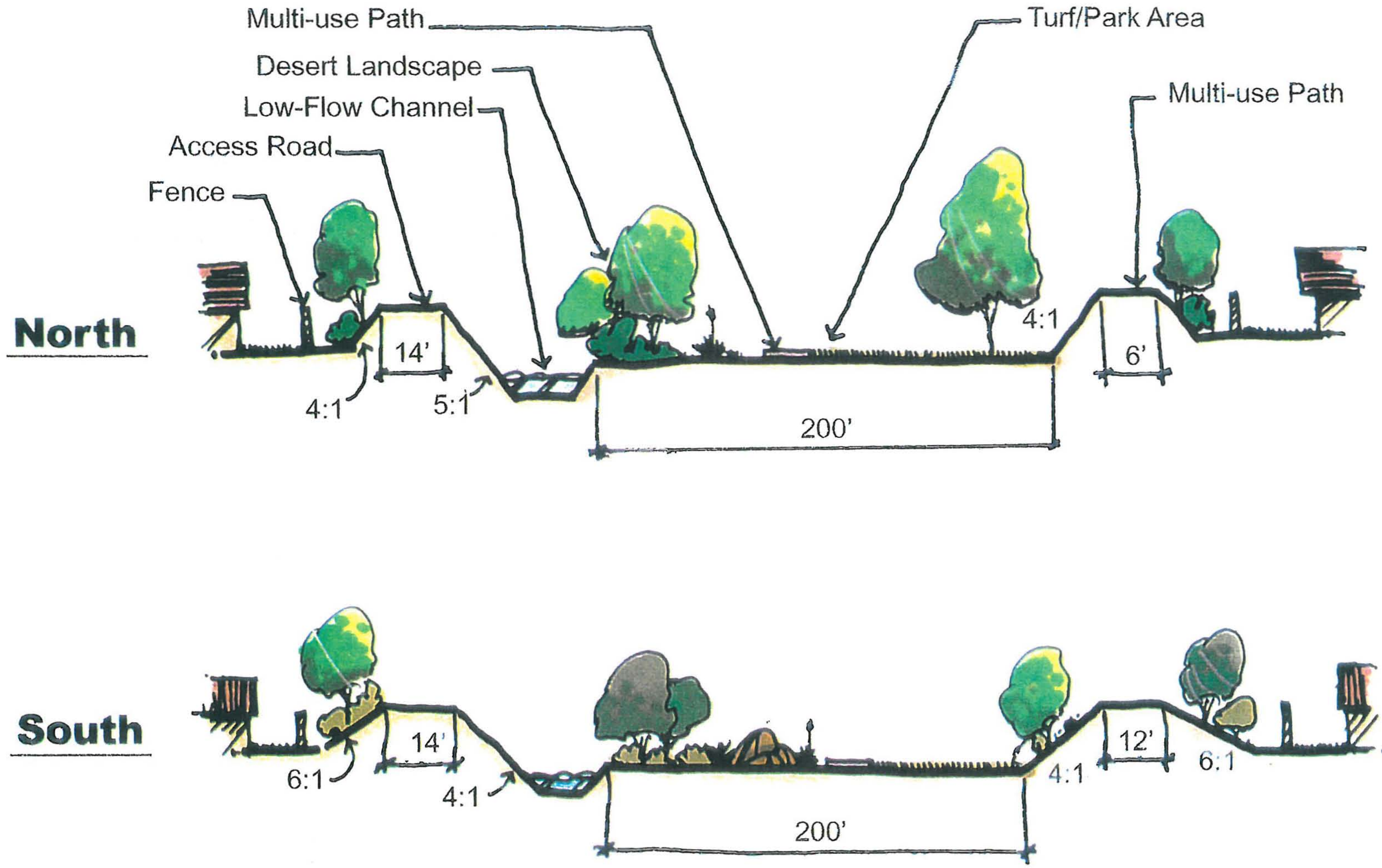

Figure 3.4 A. Bullard Wash

September 2000

LOGAN SIMPSON DESIGN INC.

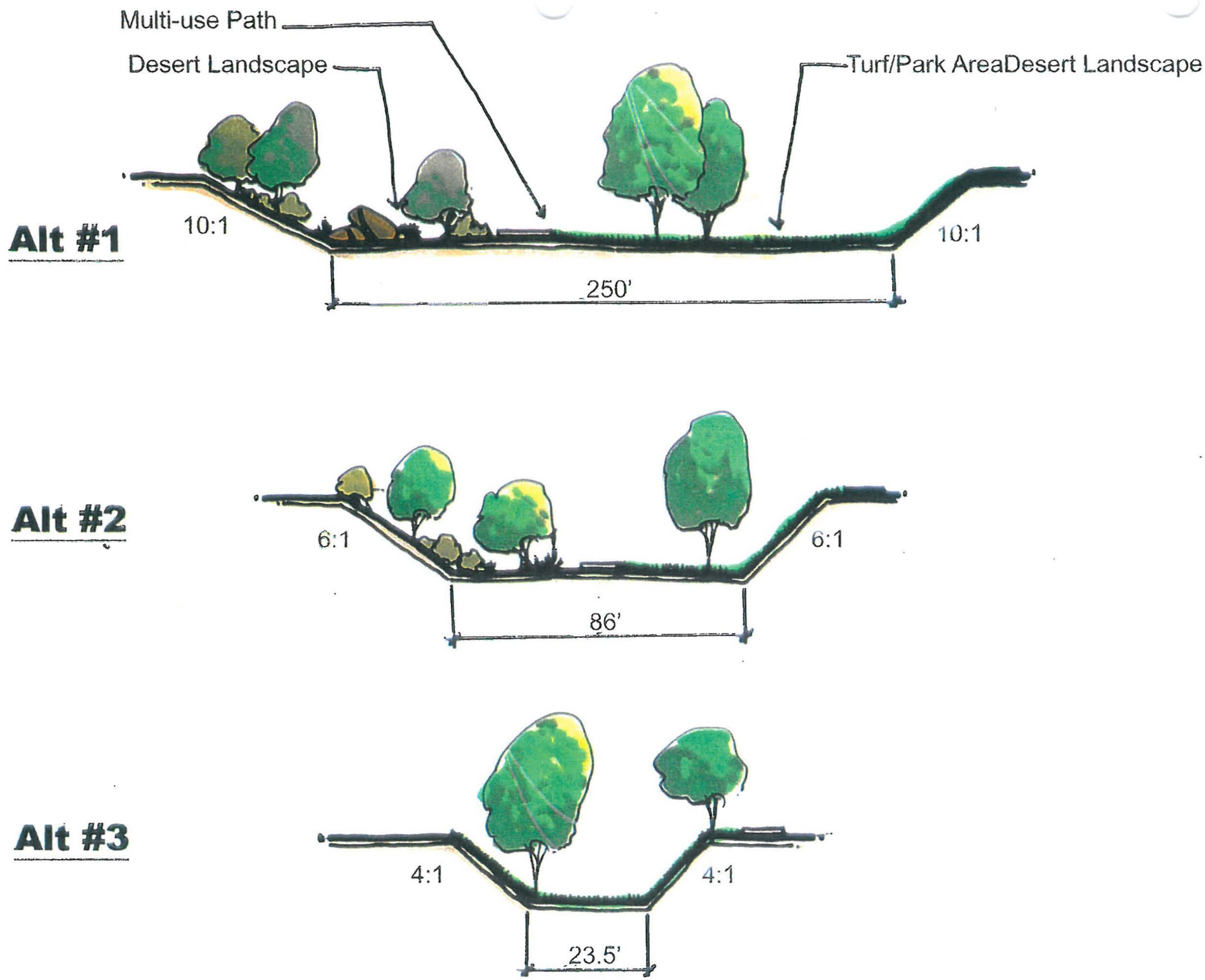

Figure 3.4 B. I-10 to ADOT Channel

September 2000

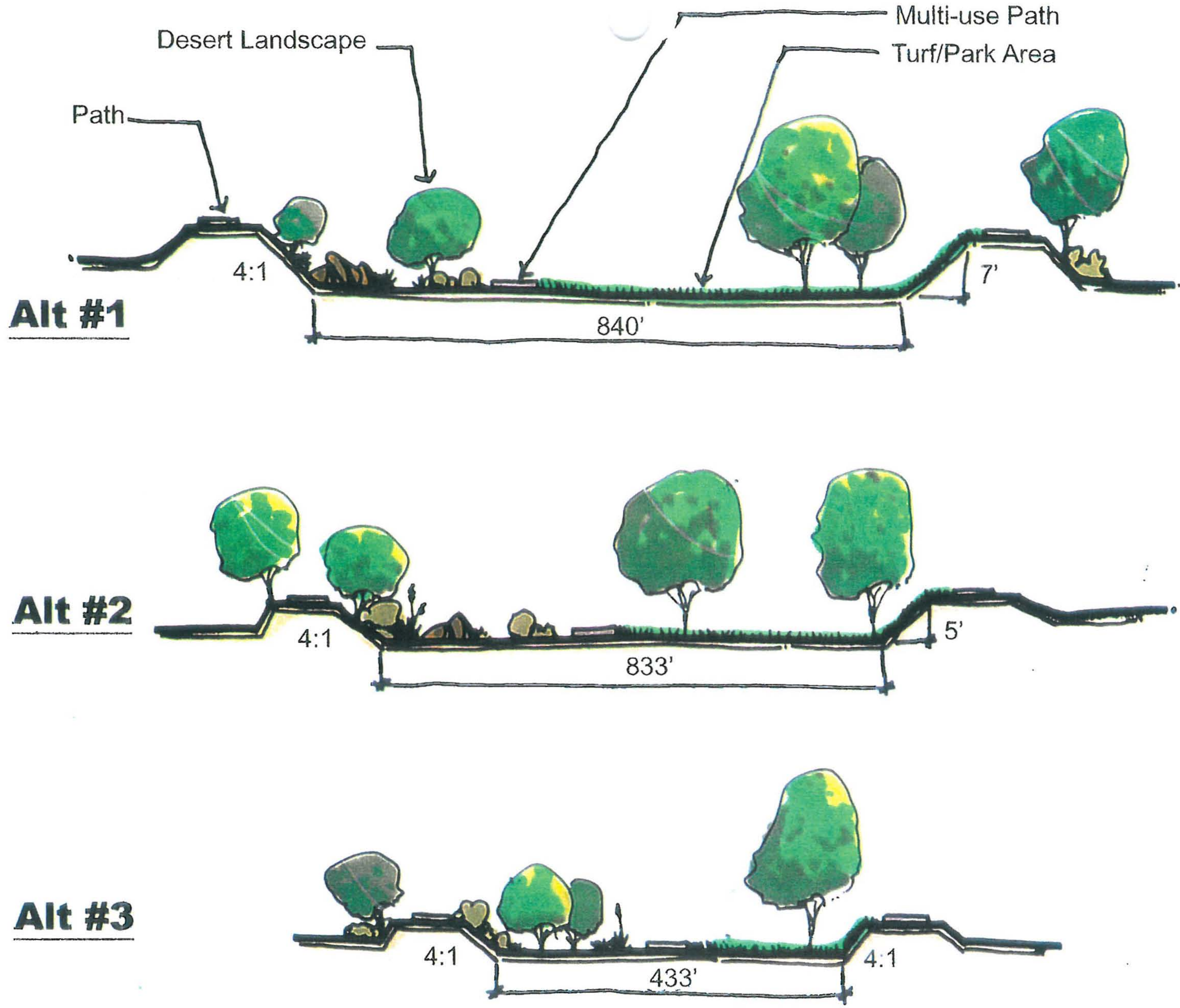

Figure 3.4 C. Basins

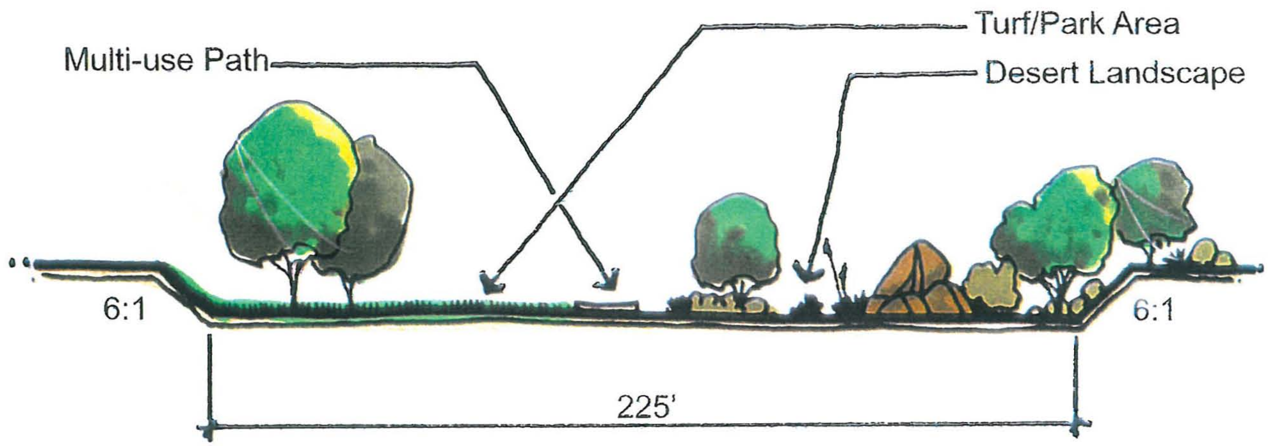

Figure 3.4 D. West Valley Regional Flood Control Channel

September 2000

Loop 303 ADMP Corridor/White Tanks ADMP Update

Flood Control District of Maricopa County

Logan Simpson Design Inc.

3.4.3 Recommended Alternative #3

Description

This alternative has five different flood control facilities. These facilities consist of three various sized channels, a basin, and improvements to the existing ADOT basins.

There are several opportunities for multi-use within the various channel configurations and basins.

The following outlines the proposed landscape aesthetics and multi-use opportunities for each channel and basin.

Bullard Channel North

(Thomas Road south to a proposed detention basin located just north of I-10 at Bullard Wash)

Refer to Recommended Alternative #1 for a description of Bullard Wash North Channel Landscape Aesthetics and Multi-Use opportunities.

Bullard Channel South

(Proposed basin at the intersection of Bullard Wash and I-10 south to the existing Bullard Wash Channel)

Refer to Recommended Alternative #1 for a description of Bullard Wash North Channel Landscape Aesthetics and Multi-Use opportunities.

I-10 to ADOT Basins Channel

(Proposed basin just north of I-10 east to the existing ADOT basins)

Landscape Aesthetics

- ***Structure Shape:*** This meandering channel has an overall width of approximately 79 feet with a 23.5-foot channel bottom. This channel has an access road on ones side and a multi-use trail on the other side.

- ***Over-bank Areas:*** A minimum of 30 feet would be located at the top of the channel on both sides. This area would be used to incorporate landscape berming and buffer plantings.

- ***Side Slopes:*** The side slopes warp and vary from 4:1 to 12:1 creating a meandering toe of slope. The side slopes would blend into earth berming located at the top of the channel. Plantings would be located in the channel bottom, on the side slopes, and at the top of the channel.

- ***Landscape Theme:*** Based upon the *Landscape Aesthetics Assessment and Multi-Use Opportunity Assessment*, this channel passes through two landscape character units. These character units are described as Commercial and Neighborhood.

  A portion of this channel passes through an area identified as commercial development. This area occurs at the intersection of Bullard Avenue and I-10. This section of the channel would be developed in a similar manner to the Urban Theme. Larger groupings of trees would be installed to screen the adjacent commercial buildings and assist in bringing down the scale of the building. Lesser amounts of turf would be installed thus increasing the amount of shrub plantings.

  The remaining portions of the channel pass through an area identified as Neighborhood. A Neighborhood Theme is described as a continuation of the residential "yard." This theme incorporates large shade tree species and shrubs as accents; turf use in special areas; and hardscape elements utilizing a variety of materials from brick to wood.

- ***Structural Components:*** Structural components located within the channel would be designed to blend with the surrounding environment. This could include the use of form liners, integral color, shape/size of structure, construction material, etc.

Multi-Use Opportunities

- Refer to Recommended Alternative #1 for a description of I-10 to ADOT Basins Channel Multi-Use opportunities.

I-10/Bullard Wash Basin

(Intersection of I-10 and Bullard Wash)

Landscape Aesthetics

- ***Structure Shape:*** The I-10/Bullard Wash Basin is a 7.8-acre earthern-lined basin with a meandering top edge. The depth of the basin is 4 feet.

- ***Over-bank Areas:*** A minimum of 60 feet would be located around the perimeter of the basin. This area would be used to incorporate landscape berming and buffer plantings. This will help blend the basin into the surrounding area.

- ***Side Slopes:*** The side slopes warp and vary from 4:1 to 12:1 creating a meandering toe of slope. The side slopes would blend into earth berming located at the top of the basin. Plantings would be located in the basin bottom, on the side slopes, and at the top of the basin.

- ***Landscape Theme:*** Based upon the *Landscape Aesthetics Assessment and Multi-Use Opportunity Assessment*, this basin would incorporate a recreational theme. Large open space turf areas would be developed. Earth contouring would take place around the top of the basin as well as modifying the side slopes. This will help blend the basin into the surrounding area. Large groupings of canopy trees would occur around the edges of the basin and down the side slopes.

- ***Structural Components:*** Structural components located within the basin would be designed to blend with the surrounding environment. This could include the use of form liners, integral color, shape/size of structure, construction material, etc.

ADOT Basins

(North side of I-10 from Dysart Road to Litchfield Road and from Litchfield Road to approximately ¼ mile east of Bullard Avenue)

Landscape Aesthetics

- ***Structure Shape:*** The ADOT Basin is a 122.4-acre earthern-lined basin with a meandering top edge. The depth of the basin is 16 feet.

- ***Over-bank Areas:*** A minimum of 60 feet would be located around the perimeter of the basin. This area would be used to incorporate landscape berming and buffer plantings. This will help blend the basin into the surrounding area.

- ***Side Slopes:*** The side slopes warp and vary from 4:1 to 12:1 creating a meandering toe of slope. The side slopes would blend into earth berming located at the top of the basin. Plantings would be located in the basin bottom, on the side slopes, and at the top of the basin.

- ***Landscape Theme:*** Based upon the *Landscape Aesthetics Assessment and Multi-Use Opportunity Assessment*, this basin would incorporate a recreational theme. Large open space turf areas would be provided for various recreational activities. Earth contouring would take place around the top of the basin as well as modifying the side slopes. Earth contouring would also occur in the basin bottom. Large groupings of canopy trees would occur around the edges of the basin, down the side slopes, and at various locations in the bottom of the basin.

- ***Structural Components:*** Structural components located within the basin would be designed to blend with the surrounding environment. This could include the use of form liners, integral color, shape/size of structure, construction material, etc.

Multi-Use Opportunities

- Refer to Recommended Alternative #1 for a description of the existing ADOT Basins Multi-Use opportunities.

Cost

See Section 4.0 for the cost analysis.

3.4.4 Proposed Plant Palette

Urban Theme

Botanical Name	**Common Name**
Trees	
Cercidium spp.	Palo Verde
Dalbergia sissoo	Sissoo Tree
Eucalyptus spp.	Eucalyptus
Fraxinus velutina	Ash
Phoenix dactyliferia	Date palm
Pistacia chinensis	Pistache

Pinus spp.	Pine
Prosopis spp.	Mesquite
Quercus spp.	Oak
Washingtonia robusta	Mexican Fan Palm
Shrubs	
Agave spp.	Agave
Bougainvillea spp.	Bougainvillea
Buddleia marrubiifolia	Butterfly Bush
Caesalpinia pulcherrrima	Red Bird of Paradise
Cassia Spp.	Cassia
Cotoneaster spp.	Cotoneaster
Calliandra spp.	Calliandra
Dalea spp.	Dalea
Dasylirion wheeleri	Desert Spoon
Encelia farinosa	Brittlebush
Gazania rigens	Gazania
Hesperaloe parviflora	Hesperaloe
Juniperus spp.	Juniper
Justicia spp.	Justicia
Lantana spp.	Lantana
Leucophyllum spp.	Texas Ranger
Nerium oleander	Oleander
Salvia spp.	Salvia
Yucca spp.	Yucca

Neighborhood Theme

Botanical Name	**Common Name**
Trees	
Cercidium spp.	Palo Verde
Dalbergia sissoo	Sissoo Tree
Eucalyptus spp.	Eucalyptus
Fraxinus velutina	Ash

Jacaranda mimosifolia	Jacaranda
Pistacia chinensis	Pistache
Pinus spp.	Pine
Prosopis spp.	Mesquite
Rhus lancea	African Sumac
Quercus spp.	Oak
Ulmus spp.	Elm
Shrubs	
Agave spp.	Agave
Bougainvillea spp.	Bougainvillea
Buddleia marrubiifolia	Butterfly Bush
Caesalpinia pulcherrrima	Red Bird of Paradise
Cassia Spp.	Cassia
Cotoneaster spp.	Cotoneaster
Calliandra spp.	Calliandra
Dalea spp.	Dalea
Dasylirion wheeleri	Desert Spoon
Dodonea viscosa	Hopseed Bush
Encelia farinosa	Brittlebush
Euonymus spp.	Euonymus
Gazania rigens	Gazania
Hesperaloe parviflora	Hesperaloe
Juniperus spp.	Juniper
Justicia spp.	Justicia
Lantana spp.	Lantana
Leucophyllum spp.	Texas Ranger
Lonicera japonica	Hall's Honeysuckle
Nerium oleander	Oleander
Photinia fraseri	Photinia
Pyracantha spp.	Pyracantha
Salvia spp.	Salvia

Yucca spp.	Yucca

Recreational Theme

Botanical Name	**Common Name**
Trees	
Cercidium spp.	Palo Verde
Dalbergia sissoo	Sissoo Tree
Eucalyptus spp.	Eucalyptus
Fraxinus velutina	Ash
Pinus spp.	Pine
Prosopis spp.	Mesquite
Shrubs	
Agave spp.	Agave
Bougainvillea spp.	Bougainvillea
Caesalpinia pulcherrrima	Red Bird of Paradise
Cassia Spp.	Cassia
Cotoneaster spp.	Cotoneaster
Calliandra spp.	Calliandra
Dalea spp.	Dalea
Dasylirion wheeleri	Desert Spoon
Gazania rigens	Gazania
Hesperaloe parviflora	Hesperaloe
Juniperus spp.	Juniper
Justicia spp.	Justicia
Lantana spp.	Lantana
Leucophyllum spp.	Texas Ranger
Nerium oleander	Oleander
Salvia spp.	Salvia
Yucca spp.	Yucca

4.0 COST/QUANTITIES

4.1 QUANTITIES

A cost estimate was prepared as part of the Phase I analysis. Quantities were computed for the major components associated with each recommended alternative described in Section 3. A contingency of 30% was set based on the fact that only major components of each alternative have been sized at this time. Many smaller components that may be required as part of the more detailed design phase of the project are not yet known and have not been evaluated. One example of what these components may include is inlet/outlet details whose exact dimensions have not been calculated at this level of analysis.

Several simplifying assumptions were made to facilitate a quick yet informative cost comparison between the alternatives. It should be recognized that these assumptions might change as the level of detail regarding the analysis inputs increases during the following levels of analysis. As the level of detail increases with each phase of the study, the contingency associated with the cost estimate will decrease.

The cost estimate provided should not be used actual final cost information. As described above, the level of detail for this phase of the study does not require a final dollar amount, rather an approximate order of magnitude and relative difference for the comparison of the recommended alternatives.

The baseline alternative is the 'do nothing' alternative for this area and the relative cost associated with it is very small compared with the cost associated with the other alternatives. However, the Bullard Wash corridor south of I-10 and at the existing outfall channel has been designed based on the original discharge presented in the original ADMP by the WLB Group. Existing conditions hydrology recently updated by EEC shows that discharges along this reach of the Bullard Wash have increased significantly for reasons stated in section 2. Given this information, the 'do nothing' alternative would certainly result in higher water surface elevations along the Bullard Wash in this area and could potentially cause existing and proposed developments to be prone to flooding.

Several assumptions/limitations were used at this level of analysis to simplify the computation of quantities used with the cost estimate. These assumptions and limitations are listed below:

- Culverts were sized for major roadway crossings only.

- Detailed quantities regarding inlet/outlet aprons, filter fabric, towdowns and other details were not considered but are assumed to be included in the 30% contingency.

- All facilities were considered to be earthen with grass linings.

- Velocities in channels were limited to a maximum of 5-6 f/s to minimize erosion during large runoff events.

- The costs associated with land in dollars per acre were based on the numbers provided URS by the FCDMC.

- If channel slopes did not produce velocities of more than 6 f/s, drop structures were not designed.

- Cut and Fill quantities were calculated using the average end area method and applied along proposed channel reaches and within proposed detention basins. No correction factors were used at this level of analysis.

- Hydroseed quantities were based on the approximate required footprint and landscaping for a given facility.

- Land acquisition quantities were based on the approximate required footprint for a given facility. In the case of the ADOT basins, only right of way outside the limits of the existing right of way was considered a land acquisition quantity.

- Analysis regarding the need for energy dissipators in proposed detention basins was not performed at this time.

Hydraulic Analysis

The channels sized for each alternative were analyzed using the Manning Equation and normal depth computations. The detention basin sizing and routing was performed using HEC-1. See Table 4.1 for the quantity/cost estimate regarding the three recommended alternatives.

4.2 AESTHETICS AND MULTI-USE UNIT COSTS

The unit costs listed below will apply to each of the three proposed alternatives.

Cost for landscape aesthetics and multi-use features are based upon a typical area for each channel and basin. Costs include plantings, irrigation, hardscape features, and labor.

- Bullard Channel North average square foot cost is $1.40.
- Bullard Channel South average square foot cost is $1.40.
- I-10 to ADOT Basins Channel average square foot cost is $1.40.
- West Valley Regional Flood Control Structure average square foot cost is $1.35.
- I-10 and Bullard Basin average square foot cost is $1.30.
- ADOT Basin Improvement average square foot cost is $1.40.

Tables 4.1A through 4.1D show the comparative cost estimate breakdown of each alternative and includes the MCFCD costs.

Table 4.1 A
Loop 303 ADMP Update
Comparitive Cost Estimate
for Alternatives 1-3

Cost Summary	
Alternative	**Approximate Total Cost**
Alternative #1	$80,200,000
Alternative #2	$45,400,000
Alternative #3	$36,500,000
Baseline Alternative	$0

1 Costs attributed to aesthetics to be paid by others.

Table 4.1 B
/Loop 303 ADMP Update
Quantities/Cost
for Alternative #1

Alternative #1 ITEM	UNIT	UNIT COST	QUANTITY	APPROX. COST (MCFCD)	APPROX. COST (Others[5])
Cut	Cu. Yd.	$2.00	6,459,217	$12,900,000	
Fill	Cu. Yd.	$4.00	90,425	$400,000	
Hydroseed[1]	Acre	$2,000.00	502	$1,000,000	
Landscape/Aesthetic Features					
Bullard Channel North	SF	$1.40	1,672,704	$1,700,000	$700,000
Bullard Channel South	SF	$1.40	4,181,760	$4,200,000	$1,700,000
I-10 Channel	SF	$1.40	1,568,160	$1,600,000	$600,000
I-10/Bullard Basin	SF	$1.30	1,437,480	$1,400,000	$400,000
ADOT Basin[4]	SF	$1.40	13,024,440	$13,000,000	$5,200,000
Land Acquisition[2]	Acre	Varies	384	$14,500,000	
6' Reinforced Concrete Pipe Culvert[1]	Lin. Ft.	$175.00	1,500	$300,000	
10' x 4' Concrete Box Culvert[1]	Lin. Ft.	$250.00	3,600	$900,000	
10' x 5' Concrete Box Culvert[1]	Lin. Ft.	$335.00	2,640	$900,000	
Concrete in Headwalls	Cu. Yd.	$250.00	867	$200,000	
Reinforcing Steel in Head Walls	Lb.	$0.75	66,028	$50,000	
			Total:	$53,100,000	$8,600,000

30% CONTINGENCY:	$18,500,000
TOTAL COST:	$80,200,000

1 See Memorandum Dated May 16, 2000 - 25 barrels - simplified analysis.
(COP monitered unit costs for the MAG Pay Items) pg.03, 21, 35, 48
2 Land Values in this Area Ranged From $25,000 to $40,000 per Acre
3 Costs attributed to aesthetics are beyond what is required for FCDMC.
4 Includes area covered by existing basins as well as additional area required for improvement.
5 FCDMC Max is $1.00/SF, therefore the remainder of cost per SF paid by others.

Table 4.1 C
Loop 303 ADMP Update
Quantities/Cost
for Alternative #2

Alternative #2 ITEM	UNIT	UNIT COST	QUANTITY	APPROX. COST (MCFCD)	APPROX. COST (Others[5])
Cut	Cu. Yd.	$2.00	2,708,880	$5,400,000	
Fill	Cu. Yd.	$4.00	65,614	$300,000	
Hydroseed[1]	Acre	$2,000.00	327	$700,000	
Landscape/Aesthetic Features					
Bullard Channel North	SF	$1.40	4,181,760	$4,200,000	$1,700,000
Bullard Channel South	SF	$1.40	1,672,704	$1,700,000	$700,000
I-10 Channel	SF	$1.40	740,520	$700,000	$300,000
I-10/Bullard Basin	SF	$1.30	1,372,140	$1,400,000	$400,000
ADOT Basin[4]	SF	$1.40	6,272,640	$6,300,000	$2,500,000
Land Acquisition[2]	Acre	Varies	209	$6,700,000	
7' Reinforced Concrete Pipe Culvert[1]	Lin. Ft.	$225.00	1,560	$400,000	
10' x 5' Concrete Box Culvert[1]	Lin. Ft.	$335.00	3,840	$1,300,000	
Concrete in Headwalls	Cu. Yd.	$250.00	734	$200,000	
Reinforcing Steel in Head Walls	Lb.	$0.75	52,038	$40,000	
			Total:	$29,300,000	$5,600,000

30% CONTINGENCY:	$10,500,000
TOTAL COST:	$45,400,000

1 See Memorandum Dated May 16, 2000 - 26 barrels - simplified analysis.
(COP monitered unit costs for the MAG Pay Items) pg.03, 21, 35, 48
2 Land Values in this Area Ranged From $25,000 to $40,000 per Acre
3 Costs attributed to aesthetics are beyond what is required for FCDMC.
4 Includes area covered by existing basins as well as additional area required for improvement.
5 FCDMC Max is $1.00/SF, therefore the remainder of cost per SF paid by others.

Table 4.1 D
Loop 303 ADMP Update
Quantities/Cost
for Alternative #3

Alternative #3 ITEM	UNIT	UNIT COST	QUANTITY	APPROX.COST	APPROX.COST
				(MCFCD)	(Others[5])
Cut	Cu. Yd.	$2.00	1,747,312	$3,500,000	
Fill	Cu. Yd.	$4.00	93,788	$400,000	
Hydroseed[1]	Acre	$2,000.00	281	$600,000	
Landscape/Aesthetic Features					
Bullard Channel North	SF	$1.40	4,181,760	$4,200,000	$1,700,000
Bullard Channel South	SF	$1.40	1,672,704	$1,700,000	$700,000
I-10 Channel	SF	$1.40	479,160	$500,000	$200,000
I-10/Bullard Basin	SF	$1.30	348,480	$300,000	$100,000
ADOT Basin[4]	SF	$1.40	5,575,680	$5,600,000	$2,200,000
Land Acquisition[2]	Acre	Varies	163	$4,900,000	
6' Reinforced Concrete Pipe Culvert[1]	Lin. Ft.	$175.00	1,500	$300,000	
10' x 5' Concrete Box Culvert[1]	Lin. Ft.	$335.00	3,120	$1,000,000	
Concrete in Headwalls	Cu. Yd.	$250.00	613	$200,000	
Reinforcing Steel in Head Walls	Lb.	$0.75	43,688	$30,000	
			Total:	$23,230,000	$4,900,000

30% CONTINGENCY:	$8,400,000
TOTAL COST:	$36,500,000

..e Memorandum Dated May 16, 2000 - 25 barrels - simplified analysis.
COP monitered unit costs for the MAG Pay Items) pg.03, 21, 35, 48
2 Land Values in this Area Ranged From $25,000 to $40,000 per Acre
3 Costs attributed to aesthetics are beyond what is required for FCDMC.
4 Includes area covered by existing basins as well as additional area required for improvement.
5 FCDMC Max is $1.00/SF, therefore the remainder of cost per SF paid by others.

5.0 WEIGHTED MATRIX

5.1 MATRIX DEVELOPMENT

The weighted matrix used to evaluate the three recommended alternatives presented in this report for the Bullard Wash region of the project area was developed as part of the Level I portion of analysis. Refer to section 3.2 of the "Loop 303 Corridor/White Tanks Area Drainage Master Plan Update, Draft Level I Alternatives Analysis Report" for a detailed explanation of the matrix and its development. With the exception of the 'Aesthetics/Multi-Use' and 'Capital Cost' categories, the relative importance of the categories has not changed since the Draft Level I Report. However, the relative importance factors associated with the two categories mentioned above have been changed to 10% and 15% respectively. This change was made based on the fact that the 'Capital Cost' category was given a relatively low relative importance. Likewise, the 'Aesthetic/Multi-Use' category was given a relative importance higher than all other categories except the 'Flood Reduction' category. Intuitively, these seem to be reversed and were therefore changed.

As explained in the Draft Level I Report, the weighted matrix is used to score each proposed alternative relative to the others. Although the categories shown in the matrix have not changed since the Draft Level I Report, the data available for determining a score in a given category is more detailed. For a detailed explanation of the categories found within the weighted matrix refer to the Draft Level I Report.

5.1.1 Explanation of Weighted Matrix Scores

A brief explanation of how each category on the weighted matrix was considered for scoring the alternatives follows below:

Permits

As discussed in Section 3.3, all alternatives are likely to require a Section 404 permit, and probably a NPDES permit under the Clean Water Act. The environmental permitting efforts are unlikely to vary substantially among the alternatives, and the potential for needing to comply with NEPA appears to be low for all alternatives. Although there is no significant variation among the alternatives regarding permitting requirements, implementation of any alternative will require additional funds and time for permitting, which are likely to entail jurisdictional water delineation, biological surveys, and cultural resource surveys.

Environment

All alternatives are projected to result in no significant impacts on native vegetation communities, wildlife, and sensitive species of plants and animals. The potential for any alternative to adversely effect cultural resources is projected to be low. Therefore, environmental factors are considered to be unimportant in choosing among the alternatives being considered.

Aesthetics and Multi-Use

Alternative #1 – This alternative provides a corridor from the White Tanks Mountains to the Gila and Agua Fria rivers. It also provides for small to large basins to be utilized as parks in the north part of the study area.

Alternative #2 – This alternative provides east – west corridors as well as north – south corridors. This alternative also provides a corridor from the White Tank Mountains to the Gila and Agua Fria Rivers. Also provided are a number of large basins for recreational uses. This alternative provides for the greatest possibilities of creating loop trails within the project area.

Alternative #3 – This alternative provides a number of large basins throughout the project site for recreational uses. This alternative provides few east – west corridors.

Baseline Alternative – This alternative only provides a north – south corridor and minimal basins are created for recreational uses.

Partnering Potential

Alternative #1 – The large channel section associated with the West Valley Regional Drain (WVRD) is proposed to cut through several sections on a diagonal alignment. Such an alignment will mean the channel may traverse several proposed developments. This may be an opportunity to partner with the local developers.

All of the alternatives propose multi-use and other improvements to both the existing ADOT basins and the Bullard Wash corridor. Such plans are consistent with the City of Goodyear plans for parks and recreation in these areas and may also provide partnering opportunities.

The baseline alternative is the 'do nothing' options and therefore provides no partnering potential.

Constructability

All of the alternatives proposed similar channel alignments and therefore must cross the same type of facilities. Alternative #1 has the added alignment and associated roadway/facility crossings due to the WVRD. While these added crossings would impact other areas of the project, they will not have a major impact on the immediate Bullard Wash region addressed by Phase I.

Flood Reduction

All of the alternatives will be designed to provide flood protection up to and including the 100-year storm event. The baseline alternative provides no protection against future flooding.

Traffic

Alternative #1 will cause more traffic impacts than Alternatives 2 and 3 since the WVRD will be crossing several interior subdivision streets as well as major roadways. This impact will be less for the immediate Bullard Wash region than for other areas within the Loop 303 ADMP project area. Other elements of Alternative 1 and Alternatives 2 and 3 will have impacts on only a few roads where proposed alignments of channels cross and are not perceived to be very significant. The Baseline Alternative will have no traffic impacts.

Right of Way

Alternative #1 will require significantly more right of way than 2 or 3 since the facilities associated with it are much larger. Alternative 2 will likewise require more right of way than Alternative 3 for the same reason. The Baseline Alternative will require no right of way.

Extent to Which Existing Facilities Are Used

All of the Alternatives make use of the existing facilities found within the Bullard Wash region. The Baseline Alternative does not use any existing facilities.

Capital Cost

The capital cost of each alternative relative to the others is as follows:

Alternative #1	Very High
Alternative #2	Medium
Alternative #3	Low
Baseline	No Cost

Operation and Maintenance

Alternative #1 – This alternative would appear to require higher level of operation and maintenance, as compared to Alternatives #2 and #3, due to larger basins and channels in the Bullard Wash region.

Alternative #2 – Operations and Maintenance costs for this alternative would be higher than Alternative #3 due to the larger sized channels and basins.

Alternative #3 – Operations and Maintenance costs for this alternative would be lower than those for Alternatives 1 and 2 since the proposed facilities are the smallest.

Baseline Alternative – Operations and Maintenance cost for this alternative would zero in the Bullard Wash region.

5.2 RESULTS

The results of the Weighted Matrix scores performed by the team members from EEC, LSD, and URS, respectively, show that of the four alternatives, the most feasible is Alternative #3 while the least feasible is the Baseline Alternative. Alternative #1 scored the lowest of the three proposed Recommended Alternatives 1-3.

See Table 5.1 for the detailed Weighted Matrix and scoring.

Table 5.1

Loop 303 Corridor/White Tanks Area Drainage Master Plan Update

Alternative Selection Matrix

Option	Permits[3]	Environment[3]	Aesthetics/[4] Multi Use	Partnering Potential	Constructability	Flood Reduction	Traffic	R/W	Extent to Which Existing Facilities are Used	Capital Cost	Operation &[4] Maintenance	Alternative Weighted Average
Relative Importance (1 - 5)[2]	5% (21.0)	10% (12.0)	10% (6.0)	10% (14.0)	8% (15.0)	20% (25.0)	2% (4.0)	10% (18.0)	5% (19.0)	15% (24.0)	5% (11.0)	
Scoring Values[1]	1-2-3-4-5	1-2-3-4-5	1-2-3-4-5	1-2-3-4-5	1-2-3-4-5	1-2-3-4-5	1-2-3-4-5	1-2-3-4-5	1-2-3-4-5	1-2-3-4-5	1-2-3-4-5	
Recommended Alternative #1	4.00	5.00	4.00	3.00	3.00	5.00	3.50	2.00	5.00	1.00	3.50	**3.5**
Recommended Alternative #2	4.00	5.00	3.50	2.00	3.50	5.00	4.00	2.50	5.00	2.50	3.50	**3.7**
Recommended Alternative #3	4.00	5.00	3.00	2.00	3.50	5.00	4.00	3.00	5.00	3.00	4.00	**3.8**
Baseline Alternative	5.00	5.00	1.00	0.00	5.00	0.00	5.00	5.00	0.00	5.00	5.00	**2.9**

1. Scoring Explanation:
   1 = Poor Value
   2 = Below Average
   3 = Average Value
   4 = Above Average
   5 = Excellent Value
2. The relative importance is a measure of how important each category is relative to all of the other categories
3. Category ratings by Dames and Moore
4. Category ratings by Logan Simpson Design

6.0 CONCLUSIONS AND RECOMMENDED ALTERNATIVE

6.1 CONCLUSION

A sensitivity analysis was used to evaluate three flood control alternatives in the Bullard Wash region of the Loop 303 ADMP Update project area.

The sensitivity analysis was used to predict flow rates and volumes on an order of magnitude that could reasonably be expected upon area wide implementation of any one of the three recommended flood control alternatives described in the Draft Level I Report. Sensitivity analysis was required since detailed hydraulic evaluation of the upper watershed area and its proposed flood control components was not yet available.

Using this range of discharges and volumes, three sets were selected as a basis for the design and analysis of three alternatives for flood control in the Bullard Wash Region of the Loop 303 ADMP Update project area. Channels, culverts and basins were designed and improvements to the existing ADOT basins were proposed to manage floodwater for each alternative.

Using the proposed facilities for each alternative, a quantity/cost estimate was performed to determine a relative difference between alternatives and the results were used in the weighted matrix.

6.2 RECOMMENDED ALTERNATIVE

From the results of the analysis, it is clear that the Baseline Alternative or the 'do nothing' alternative is not a feasible alternative. Although it has a relative cost of \$0 in the Bullard Wash area, the alternative does not accomplish many of the stated objectives in the project scope. The baseline alternative does not provide adequate flood protection for development in the Bullard Wash area, it does not provide sufficient multi-use corridors linking specific areas within the project area and it does not provide for the aesthetic improvements desired within the area.

Similarly, Alternative #1 was found to be a non-feasible alternative. This alternative will be approximately twice the cost of the next most expensive solution. Although the alternative offers good opportunity for aesthetic/multi-use improvements in the area so do Alternatives 2 and 3 at half or less than half of the estimated cost.

It should be noted that evaluating the alternatives based solely on the Bullard Wash area might be misleading if the very components of a given alternative that make it less desirable at the

Bullard Wash make it more desirable elsewhere in the watershed. Since the Bullard Wash options are tied to components upstream, possible advantages and disadvantages upstream must be considered.

For example, in the area outside of the Bullard Wash, Alternative #2 offers some advantages over Alternative #3, however, from the Bullard Wash analysis, this alternative would be considered less feasible. One such advantage might be the removal of a large amount of flow from the White Tanks #3 FRS that would otherwise require a larger basin or outfall at that location. Alternative #2 would also provide more west to east links or connections within the project area more effectively satisfying this scoped objective.

These advantages may be offset by the fact that Alternative #2 will require larger facilities to handle larger volumes of floodwater at the Bullard Wash.

Even with its possible advantages, Alternative #2 will likely require more operation and maintenance, larger land acquisition, and will probably be more costly than alternative #3 throughout the entire project area. Therefore any advantages of Alternative #2 over Alternative #3 found outside of the Bullard Wash region do not seem to provide a strong enough reason for its selection over Alternative #3.

Further disadvantages to Alternative #2 in the project area as a whole might be the larger north to south channel proposed along Loop 303. Public sensing in the area showed a large percentage of people did not like the concept of a large channel adjacent to the Loop 303.

Given all of the above information and the results of the Level II Phase I analysis, Alternative #3 is recommended for selection over the other three. If any components of the other three seem more desirable in areas outside of the Bullard Wash region, these may be incorporated with the upstream features of the alternative as a result of the Level II Phase II portion of the analysis.

7.0 REFERENCES

Section 1

Loop 303 Corridor/White Tanks Area Drainage Master Plan Update – Draft Data Collection Report, URS Greiner Woodward Clyde, February 2000.

White Tanks/Agua Fria Area Drainage Master Plan (WTAF ADMP), completed by The WLB Group, Inc., March 1995.

Drainage Channel Study for West Half of Estrella Freeway Loop 303 from Interstate 17, Technical Memorandum, dated August 1998, by Deleuw Cather & Company.

White Tanks/Agua Fria Area Drainage Master Study, Part A, Flood Study Technical Data Notebook, Flood Control District of Maricopa County, prepared by The WLB Group, October 1992.

White Tanks/Agua Fria Area Drainage Master Study, Part B, Area Drainage Master Plan, Flood Control District of Maricopa County, prepared by The WLB Group, December 1994.

Section 2

Loop 303 Corridor/White Tanks Area Drainage Master Plan Update – Draft Data Collection Report, URS Greiner Woodward Clyde, February 2000.

Loop 303 Corridor/White Tanks Area Drainage Master Plan Update, Draft Level I Alternative Analysis Report, URS Greiner Woodward Clyde, dated May 2000

Drainage Channel Study for West Half of Estrella Freeway Loop 303 from Interstate 17, Technical Memorandum, dated August 1998, by Deleuw Cather & Company.

Goodyear Planned Regional Center, City of Goodyear – City Council Action Form – rezoning proposal

Conceptual Drainage Report for Goodyear Planned Regional Center, Coe and VanLoo Consultants, Inc, dated August 1999

Final Drainage Report, Snyder's of Hanover, I-10 and Bullard Avenue, Goodyear Arizona, Primatech, LLC, dated January 1998

Final Plat for Rancho Mirage, Hook Engineering, dated May 1999

Centerra, Rezoning Request for Final Planned Area Development Plan, Goodyear, Arizona, Makai Development Services Inc., revise dated February 2000

Drainage Report for Preliminary Planned Area Development, Centerra LLC, Premier Engineering Corporation, dated February 2000

Master Drainage Report for Estrella Aerospace Center, Goodyear Arizona, Coe and VanLoo Consultants, Inc., dated February 2000

Conditional Letter of Map Revision (CLOMR) Technical Data Notebook for Bullard Wash; Maricopa County, Arizona Sections 2.68 through Section 6.32 (approximately Lower Buckeye Road to Thomas Road), JE Fuller Hydrology and Geomorphology Inc., dated June 1999

Master Drainage Study for Palm Valley, The WLB Group Inc., revise dated July 1999

Pebblecreek Phase II Master Drainage Report, B&R Engineering, Inc., revised dated August 1998

I-10/Litchfield Road Basins, Final Hydrology Study, Parsons Brinckerhoff, dated July 1999

Offsite Drainage Design Report, Dibble and Associates Consulting Engineers, dated January 1976

Section 3

Landscape Aesthetics Assessment and Multi-Use Opportunities Assessment, Logan Simpson Design Inc., Draft October 28, 2002.

Plans for the Construction of the Site Improvements for Wal-Mart Store Expansion, 955 East Rancho Santa Fe Blvd., Avondale, Arizona, by Unaway Associates West Inc, 11/99.

Drainage Channel Study for West Half of Estrella Freeway Loop 303 from Interstate 17, Technical Memorandum, dated August 1998, by Deleuw Cather & Company.

Section 4

Arizona Department of Transportation (ADOT) Construction Cost 1997 and 1999.

ADOT B-standards, B11.12, B11.14, B05.10.

City of Phoenix monitored unit costs for the MAG pay items, 3/16/00.

Loop 303 Corridor/White Tanks Area Drainage Master Plan Update Contract FCD 99-40

Level II Phase II Alternatives Analysis Report

Prepared for:

Flood Control District of Maricopa County

June 2004

Prepared by:

URS

Comment Responses for Level II Report Phase Two – General Comments

1. **Page 1-1: Is it a draft?** *Revised sentence to show most recent submittal date and eliminated "draft".*
2. **Page 1-2: Why a separate section? I thought this was the alternative analysis report?** *This statement has been removed.*
3. **Page 2-1: There is no need to list every feature. Just reference the figure. However, I do like these bullets and should be incorporated somehow.** *Description has remained and is in bulleted format.*
4. **Figure 2.1: Where is Figure 2.1?** *Figures 2.1 to 2.4 have been added to the report.*
5. **Table 2.1: Is this really needed? What information are you trying to convey?** *Table 2.1 has been removed and the remaining tables are renumbered accordingly.*
6. **Page 2-7: Syntax**
7. **Page 2-7: Syntax**
8. **Table 2.2:** *Removed and the remaining tables are renumbered accordingly.*
9. **Page 2-11: Manning's 'n' value should be 0.04.** *Per previously set criteria, 0.03 was agreed upon.*
10. **Page 2-12: Insert a graphic showing this feature location.** *Channel drawings will be shown in a set of drawings*
11. **Table 2.4A: What are the flows associated with the concentration points?** *The flow values for each alternative have been added to the concentration point tables.*
12. **Figure 2.5: Insert this figure before the northern channel.** *The figure as been relocated to Page 2-31.*
13. **Page 2-20: Why not 1 foot of freeboard?** *3 feet was used due to the level of uncertainty associated with the hydrology model at this point in the analysis. The value of 1 foot was used for the more detailed level III. Since Level II is comparing one alternative against another, consistency was the most important factor.*
14. **Table 2.6A: Suggest keeping this data and showing a graphic for each alternative. Then discuss the comparisons for the basin in question with a graphic showing where it is located.** *Figures 2.1 to 2.4 have been added to the report.*
15. **Page 2-22: I'm concerned about the depths suggested and how they be drained.** *Due to post stormdrain/daylighting issues associated with these depths; Level 3 basins are not as deep but have larger area footprints.*
16. **Table 2.7A: This set of tables should be after Page 2-25. Are they really needed? Can this be reduced to one table and add an appendix with the ADOT basin analysis.** *These tables have been moved and will not be taken out. They are important in that they show the differences between each. Most reports analyze them as composite; therefore this is good information for the reader. The ADOT basin analysis was included as Appendix D.*
17. **Page 2-25: Are these basins needed? If so, why?** *The basins allow an effective means of limiting flow to the existing Bullard channel while metering a portion east to the ADOT basins.*
18. **Page 2-27: Add a graphic showing the locations of basins A, B, C, and D.** *Text has been revised to reference Figures 2.1 to 2.4.*
19. **Page 2-28: Why not two RCPs?** *The preliminary analysis shows that only one is required.*
20. **Page 2-28: Syntax.**
21. **Page 2-29: Remove "draft" from all hydrology report references.** *Completed.*

22. **Figure 2.6: Add flow values to figure.** *Map has been modified to show flow values.*
23. **Page 2-30: Is the additional proposed basin just west of the existing Falcon Dunes detention basin needed?** *Recent as-built surveys indicate Falcon Dunes is significantly under capacity, therefore, this basin is needed.*
24. **Page 2-31: If this is the case, why should FCD be suggesting this as a regional project?** *These are existing facilities, not proposed. This section is indicating the result of placing the proposed facilities (already discussed) on these existing facilities. See introductory paragraph of Section 2.3.4.1.*
25. **Page 2-33: Check design inflow rate.** *The design flows have been checked and verified using the July 19, 2001 Flood Insurance Study.*
26. **Page 2-36: State what storm frequency.** *Frequency is not known. Value is from Army Corp of Engineers report.*
27. **Page 2-37: Reference a figure or graphic.** *Reference to Figures has been added.*
28. **Page 2-38: Insert a graphic with the alternatives and existing development. Delete the spreadsheet.** *Figures 2.7 to 2.10 have been added to show these two elements. The tables are still included so that the reader can reference the data to the figure.*
29. **Page 2-38: List the number of acres removed.** *The number of acres removed from the FEMA floodplain for each alternative has been added.*
30. **Page 2-39: Who attended the second committee meeting?** *Attendees have been listed.*
31. **Page 2-39: Why are the results of the second neighborhood meeting not available?** *This information has been added to the report.*
32. **Page 2-39-2-40: Remove Draft.** *Level 1 Alternatives Analysis Report no longer states draft and date has been corrected.*
33. **Table 2.11A: Need to clearly indicate the district's maximum cost for landscape aesthetics and what is being proposed.** *Table 2.11A has been revised to reflect the maximum cost of $1.00 per square foot.*
34. **Page 2-43: Use more pro-active recommendation statements.** *Terminology has been changed to be more pro-active where applicable.*
35. **Table 2.11B: See previous comments under alternative #1.** *Table 2.11B has been revised to reflect the maximum cost of $1.00 per square foot.*
36. **Table 2.11C: See previous comments under alternative #1.** *Table 2.11C has been revised to reflect the maximum cost of $1.00 per square foot.*
37. **Page 2-62: Syntax.** *Text was revised.*
38. **Page 2-65: This information should be listed on page 2-28.** *This was moved.*
39. **Page 2-68: Correct paragraph "Acceptability to Local Residents"** *Corrected.*
40. **Page 2-68: Correct to read, "is recommend by the consultant to be… as further…discussed in Section 4.0.** *Corrected to read "Is recommened by the cosultant."*
41. **Page 2-69-2-70: Remove paragraphs.** *Removed.*
42. **Page 3-6: Need?** *This table (2.14) was removed.*
43. **Page 3-5: Remove bold type.** *Removed.*
44. **Page 3-5: Note that District maximum is $1.0 per square foot and this is $1.00.** *Added: "Note that the Maricopa Flood Control District maximum spending allowance on landscape aesthetics is $1.00 per square foot."*
45. **Page 4-1: Explain this in a little more detail.** *More detail has been added to this section.*

LEVEL II
PHASE II ALTERNATIVES
ANALYSIS REPORT
Loop 303 Corridor/White Tanks
Area Drainage Master Plan Update
Contract FCD 99-40

Prepared for
Flood Control District of Maricopa
County

URS Job No. E1-00001526
June 2004

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1.0 INTRODUCTION

1.1 PROJECT DESCRIPTION

The draft technical memorandum submitted previously documents the methods and criteria used to develop and evaluate the preferred alternative solution to existing and future flood control problems. These alternatives were documented in the *Data Collection Report* for the Loop 303 Corridor/White Tanks Area Drainage Master Plan Update (Loop 303 ADMP Update) project. The Loop 303 ADMP Update covers an approximate 220-square-mile watershed west of metropolitan Phoenix. See the *Draft Level I Alternative Analysis Report* dated May 2000 and the Draft Level II Phase I Alternatives Technical Memorandum for a more detailed project description.

1.1.1 Location

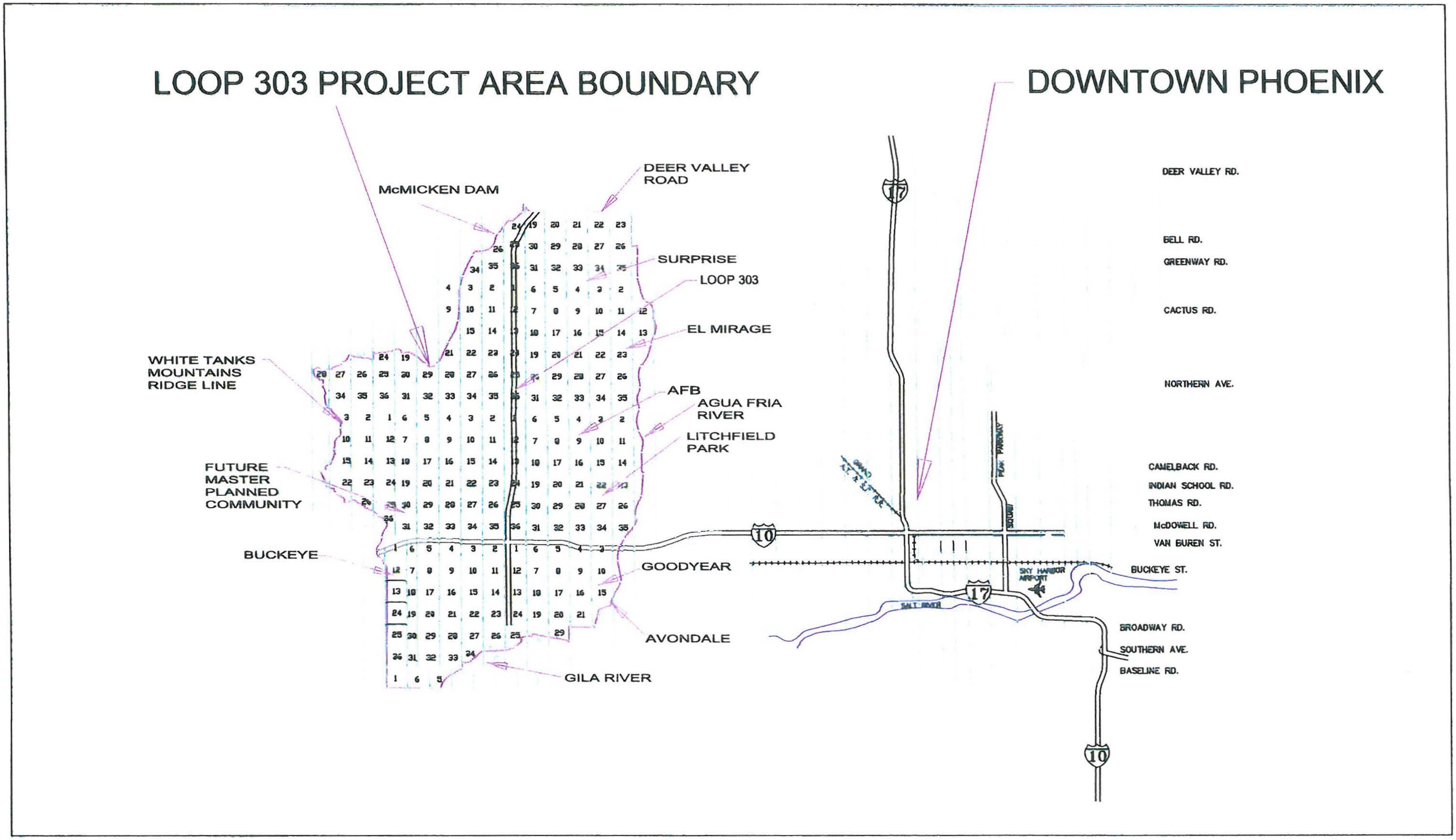
The study area boundary is defined by the ridgeline in the White Tanks Mountains on the west, the Gila River on the south, the Agua Fria River on the east, and the McMicken Dam / Deer Valley Road on the north. The study area spans across the majority of Townships 1N-4N and Ranges 1W-3W which includes the cities of Goodyear, Glendale, Buckeye, Litchfield Park, El Mirage, Avondale, Sun City, Peoria, and Surprise, as well as unincorporated Maricopa County. See Figure 1.1.

1.1.2 Purpose

The purpose of this report is to document the second portion of the update study, conducted under the Level II Phase II portion of the project. This report will focus on the second phase (Phase II) of the Level II analysis and will address the alternatives in the overall project area. In contrast, the draft technical memorandum submitted under separate cover focused specifically on development in the vicinity of and adjacent to the Bullard Wash from approximately Thomas Road south to the existing Bullard Wash outfall channel. At the end of the Level II Phase I analysis, one recommended alternative for flood control in the Bullard Wash area with a significant multi-use and aesthetic element was identified.

This report will identify a single recommended alternative for the balance of the study area. The Level II Phase II analysis will be referred to simply as Phase II from this point forward.

P:\FCDMC\E152600\SUBMITTALS\RE-SUBMIT\LEVEL II\LEVEL II B\5-2003\FIGURES\FIGURE 1.1.DWG



VICINITY MAP

JUNE, 2003
Figure 1.1

The proposed alternative presented in the *Drainage Channel Study for West Half of Estrella Freeway Loop 303 from Interstate 17 – Drainage Technical Memorandum*, dated August 1998, has been used as a benchmark / baseline for comparison of the three recommended alternatives (identified in the Level I report). Since the baseline only proposes a single channel along Loop 303, the Baseline Alternative for all other areas will be the no-build alternative. For more detail about the project purpose, see Section 2 of the *Draft Level I Alternative Analysis Report*, dated May 2000, and Section 1 of the Draft Level II Phase I Alternatives Technical Memorandum.

For a detailed discussion of the scope of work, see Section 1.2 in the Draft Level II Phase I Alternatives Technical Memorandum.

2.0 PROJECT ALTERNATIVES

2.1 AREA DESCRIPTION AND BACKGROUND

Upon submission of the Level I Report, dated May 2000, to the Flood Control District of Maricopa County (FCDMC), URS and its subconsultants proceeded with Phases I and II of the Level II portion of the Loop 303 ADMP Update. Phase I focused on the Bullard Wash region of the project area while Phase II addresses the entire project area. Detailed descriptions of the project area and background can be found in Section 1 of the *Draft Data Collection Report*, dated February 2000 (Data Collection); Section 2 of the *Draft Level I Alternative Analysis Report* (Level I), dated May 2000; and Section 1 of the Draft Level II Phase I Alternatives Technical Memorandum (Phase I), September 2000.

2.1.1 Changes to the Recommended Alternatives

The three recommended alternatives developed under Level I were presented to the FCDMC staff and stakeholders at the second stakeholders meeting held at the FCDMC office on June 1, 2000.

During the second stakeholders meeting, some changes were made to all three of the recommended alternatives presented in the Level I report. These changes and the reasons for them have been documented in Section 2.1.1 of the Phase I report. See Figures 2.1-2.4 for an illustration of the recommended alternatives.

The recommended alternative descriptions below are inclusive of the changes noted above.

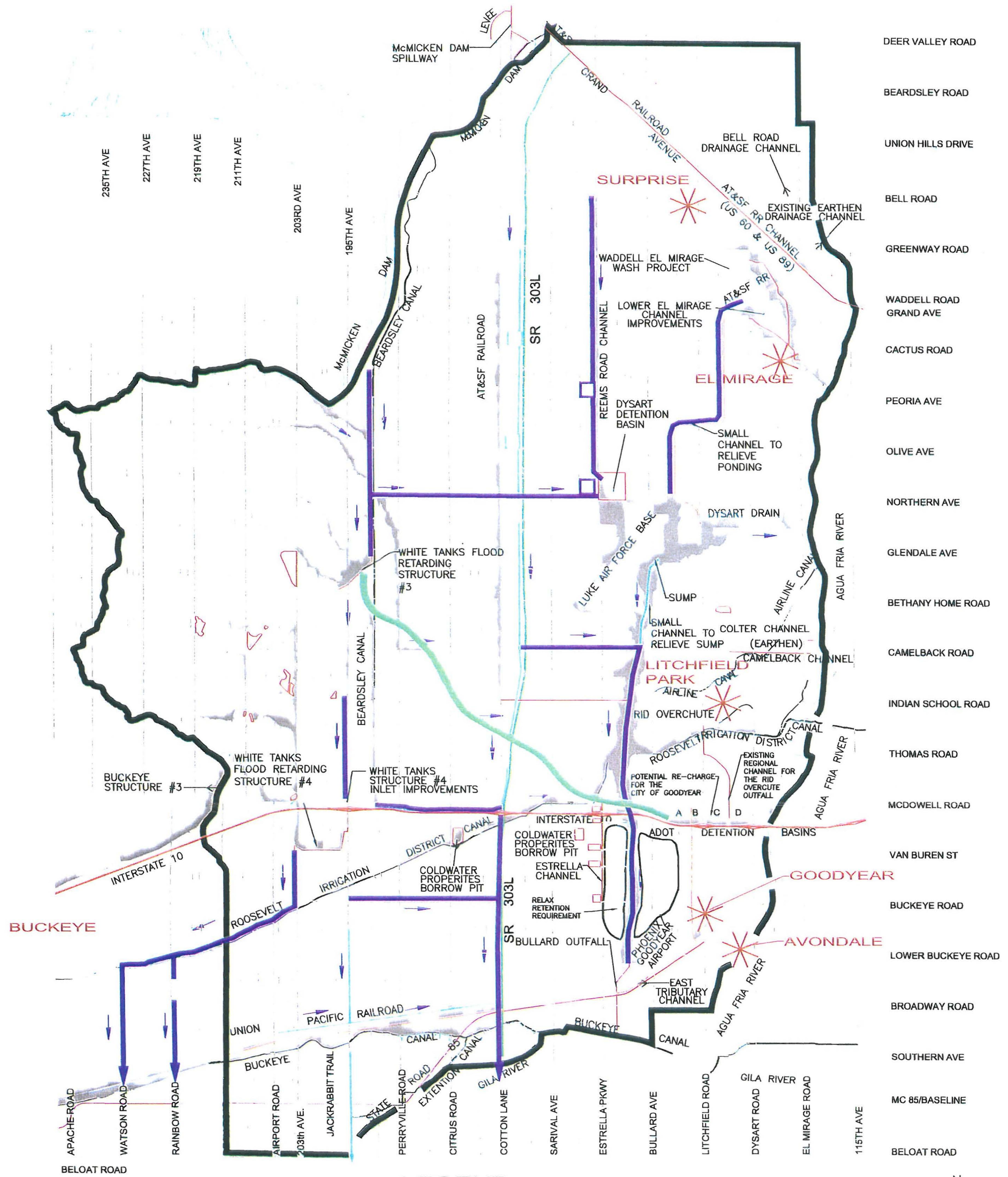
2.1.2 Description of the Recommended Alternatives – Key Features

Recommended Alternative 1 – See Figure 2.1

- Containment of flow breaks along the Beardsley Canal north of White Tanks Flood Retarding Structure #3 (WT FRS #3). The first break occurs near Olive Avenue and the second occurs near Northern Avenue.

- Containment of flow breaks along Jackrabbit Trail from WT FRS #3 just north of Indian School Road south to WT FRS #4 at Van Buren Street.

- A north-south outlet channel from WT FRS #4 along 203rd Avenue to a proposed east-west channel along the RID Canal.



LEGEND:

= PROPOSED LARGE REGIONAL OUTFALL CHANNEL

= PROPOSED MEDIUM TO LARGE LOCAL COLLECTOR CHANNEL

= PROPOSED SMALL COLLECTOR CHANNEL

= DIRECTION OF FLOW

= PROPOSED LARGE, MEDIUM OR SMALL BASIN/PARK

= PROJECT AREA BOUNDARY

= PROPOSED LOOP 303 PARKWAY ALIGNMENT

= EXISTING RAIL ROAD

= EXISTING STRUCTURE OR FACILITY

= FLOODPLAIN IDENTIFIED BY THE ORIGINAL WHITE TANKS ADMP, 1992

MARICOPA COUNTY
N.T.S.

RECOMMENDED ALTERNATIVE #1

June 2003

Loop 303 Corridor/White Tanks ADMP Update

FIGURE 2.1

URS

Flood Control District of Maricopa County

Key Features:

Large regional, multi-use drainage channel linking the White Tanks Mountains with the ADOT basins and Agua Fria River.

Small roadside channel along the west side of the Loop 303. North of I-10, this channel might convey local roadway drainage and may be used as a post storm drain outlet for adjacent developments' retention basins. South of I-10 the channel may be larger and used as regional drain outfall for local development.

Several multi-use channel corridors providing links throughout the project area with some regional basin/parks.

Overall emphasis on one very large regional outfall/collector channel with several smaller, feeder-type drains.

- Proposed north-south channels at either Watson Road and/or Rainbow Road to the Gila River. These channels will extend from the existing Roosevelt Irrigation District Canal south to the Gila River.

- Channelization of the Reems Road floodplain from Bell Road south to the Dysart Drain.

- A small north-south channel to relieve ponding at a sump caused by subsidence just east of Luke Air Force Base (LAFB). This low spot is generally located north of Bethany Home Road and West of Litchfield Road. The proposed channel is located within the existing Bullard Wash alignment.

- A proposed regional drainage channel cutting through several sections on a southeasterly diagonal alignment from the WT FRS #3 to the existing ADOT basins. This channel is called the West Valley Regional Drainage Channel (WVRDC).

- Improvement of the existing ADOT basins to detain increased volume of runoff conveyed by proposed channels.

- 4 Regional basins to attenuate peak flow rates.

Recommended Alternative 2 – See Figure 2.2

- Containment of flow breaks along Jackrabbit Trail from Camelback Road south to WT FRS #4.

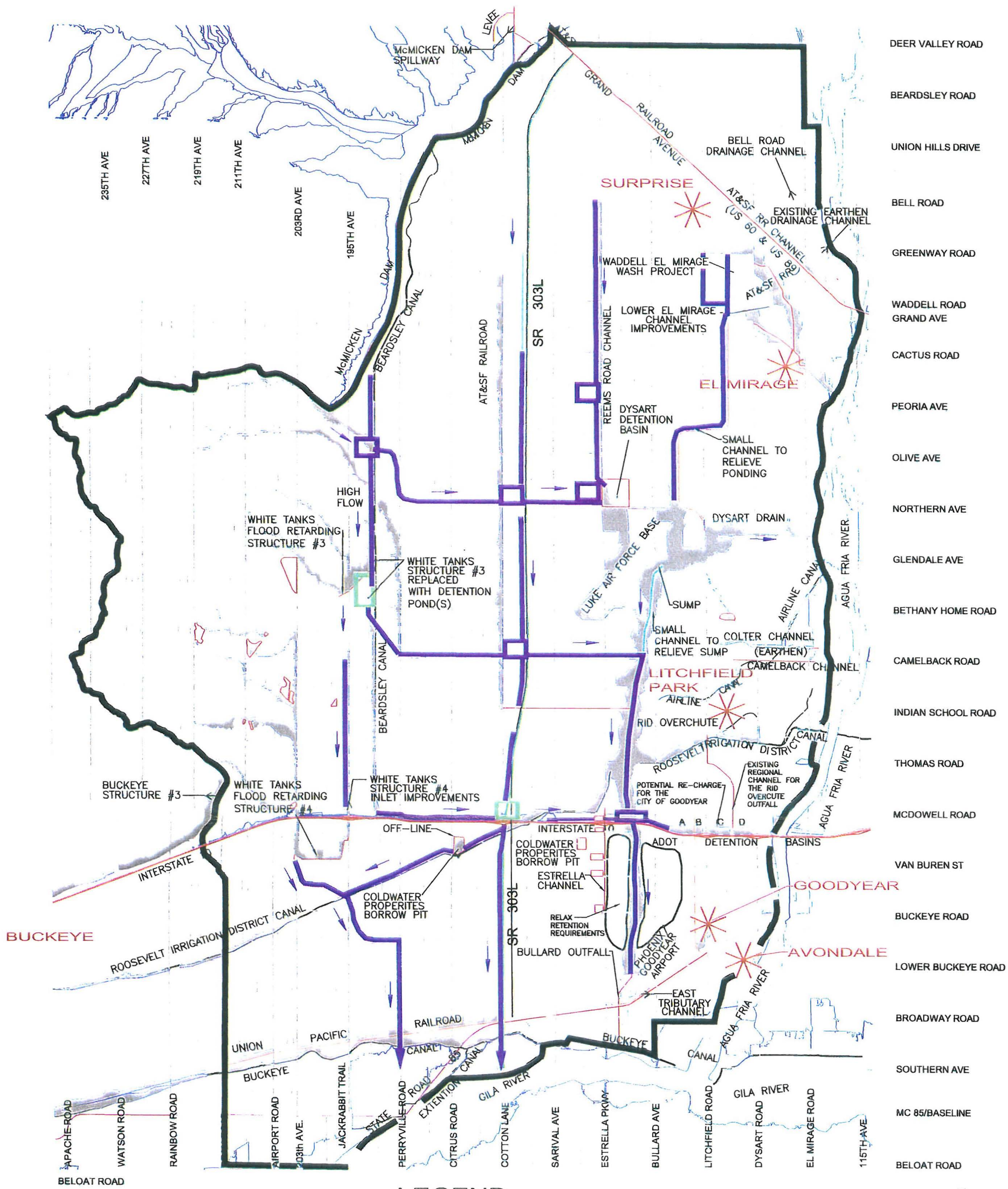
- A diagonal outlet channel from WT FRS #4 across Sections 8 and 16 to a proposed north-south channel along Perryville Road.

- A proposed west-east channel along the north side of I-10 from the Beardsley Canal to the proposed detention basin at the intersection of Loop 303 and I-10.

- A proposed west-east channel along the north side of I-10 from just west of Sarival Avenue to the existing ADOT detention ponds.

- A proposed west-east channel along Northern Avenue to the proposed detention basin at the northwest corner of Reems Road and Northern Avenue. The channel continues east to the existing Falcon Dunes Golf course / detention basin.

- A proposed channel along the west side of Loop 303 from Greenway Road to the Gila River.



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= EXISTING RAIL ROAD

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= FLOODPLAIN IDENTIFIED BY THE ORIGINAL WHITE TANKS ADMP, 1992

N

MARICOPA COUNTY
N.T.S.

RECOMMENDED ALTERNATIVE #2

June 2003

Loop 303 Corridor/White Tanks ADMP Update

FIGURE 2.2

URS

Flood Control District of Maricopa County

Key Features:

Several regional drainage channels constructed on a 2 to 3 mile grid to provide a positive outfall for development throughout the project area.

Several multi-use corridor links along proposed channels connected by regional basin/parks.

Proposed facilities will convey large amount of runoff South to the Gila/Salt rivers.

Use some west to east channels to tie into existing facilities that outfall to the Agua Fria River.

Overall emphasis on larger channels with fewer basin/parks.

- A proposed west east channel along Camelback Road to the proposed detention basin at the northwest intersection of Camelback Road and Loop 303. The channel continues east to the Bullard Wash.

- A small channel to relieve ponding along the upstream side of the existing AT&SF Railroad from Waddell Road south to Northern Avenue.

- A proposed channel within the Bullard Wash from the existing Bullard Wash outfall to Camelback Road.

- A proposed diagonal outfall channel in the proposed El Mirage Wash alignment to the Agua Fria River.

- A proposed southwest channel along the north side of the existing RID Canal south of I-10. The channel extends from the northeast at Loop 303 to the southwest at the proposed WT FRS #4 outfall channel.

- Use of the existing Coldwater Properties borrow pit south of I-10 just east of Citrus Road.

- Conversion of the existing WT FRS #3 from a dam to a detention pond(s).

- Improvement of the existing ADOT basins to detain increased volume of runoff conveyed by proposed channels.

- 8 regional basins to provide peak discharge attenuation.

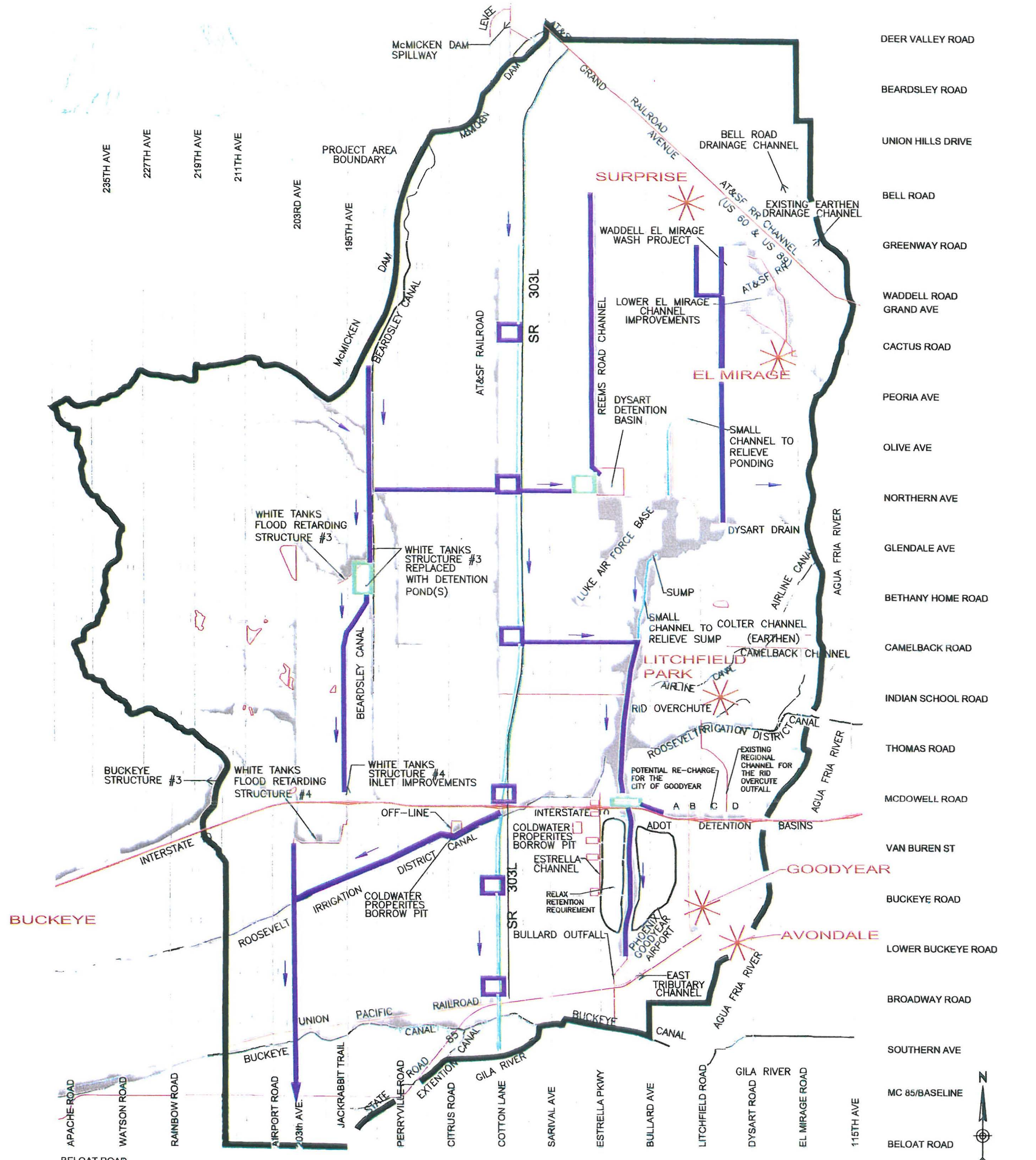
Recommended Alternative 3 – See Figure 2.3

- A proposed channel along the west side of Loop 303 from Greenway Road to the Gila River.

- A proposed north-south channel along Litchfield Road from Greenway Road to Waddell Road.

- A proposed north-south channel along the ½ section line between Litchfield Road and Dysart Road from Greenway Road to the Dysart Drain.

- A proposed west-east channel along Waddell Road from Litchfield Road to the 1/2 section line between Litchfield Road and Dysart Road.



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RECOMMENDED ALTERNATIVE #3

June 2003

Loop 303 Corridor/White Tanks ADMP Update

FIGURE 2.3

URS

Flood Control District of Maricopa County

Key Features:

Some north to south regional drainage channels with large diverts east to the Bullard Wash and Agua Fria River using basin/parks.

Small roadside channel along Loop 303 with several basin/parks and flow diversions east to the Agua Fria River.

Several multi-use corridor links along proposed channels connected by regional basin/parks.

Overall emphasis on smaller channels with more basin/parks.

- A proposed west-east channel along Camelback Road from the proposed detention basin at the northwest intersection of Camelback Road and Loop 303 to the Bullard Wash.

- A small channel to relieve ponding along the upstream side of the existing AT&SF Railroad from Waddell Road south to Northern Avenue.

- A small north-south channel to relieve ponding at a sump caused by subsidence just east of LAFB. The channel is located within the existing Bullard Wash.

- A proposed diagonal outfall channel in the proposed El Mirage Wash alignment to the Agua Fria River.

- A proposed southwest channel along the north side of the existing RID Canal south of I-10. The channel extends from the northeast at Loop 303 to the southwest at the proposed WT FRS #4 outfall channel along Tuthill Road.

- Use of the existing Coldwater Properties borrow pit south of I-10 just east of Citrus Road..

- A proposed west-east channel from the proposed detention basin at I-10 and the Bullard Wash to the existing ADOT detention basins.

- Conversion of the existing WT FRS #3 from a dam to a detention pond(s).

- 8 Regional Basins to provide peak discharge attenuation..

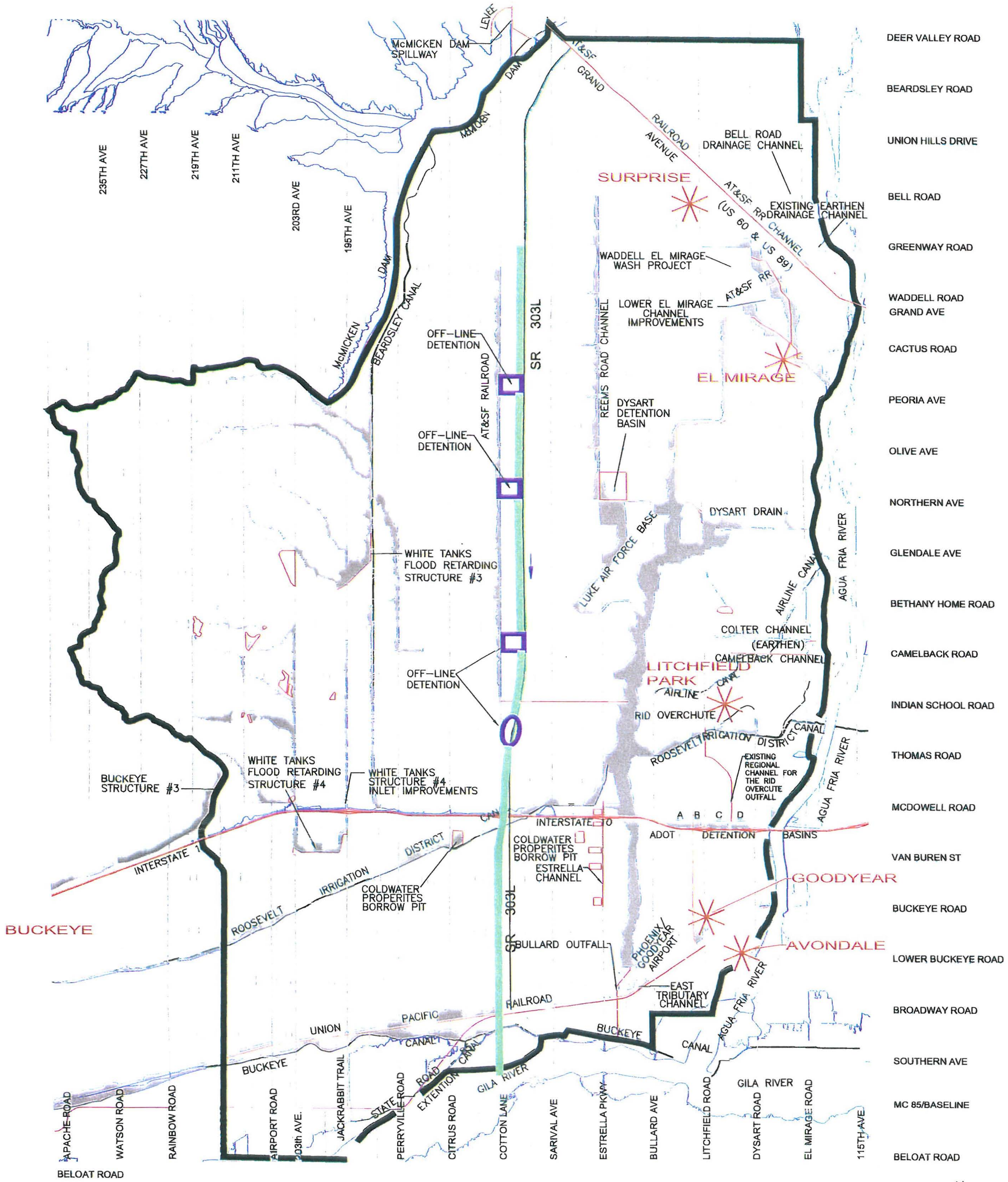
- Improvement of the existing ADOT basins to detain increased volume of runoff conveyed by proposed channels.

Baseline Alternative – See Figure 2.4

For a detailed description of the process used to develop the recommended alternatives, including the aesthetics and multi-use considerations associated with each, see the *Data Collection Report* dated May 2003 and the *Level I Alternative Analysis Report* dated June 2003.

2.1.3 Discarded Alternatives

As a result of public meetings, matrix evaluations, relative cost analysis, existing facility evaluations and other criteria, several alternatives were discarded during the Level I analysis. For a detailed description of all of the alternatives considered and those discarded, refer to Section 3 in the *Level I Alternative Analysis Report*.



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MARICOPA COUNTY
N.T.S.

BASELINE ALTERNATIVE

June 2003

Loop 303 Corridor/White Tanks ADMP Update

FIGURE 2.4

URS

Flood Control District of Maricopa County

Key Features:

Large regional, multi-use drain adjacent to the Loop 303 with large regional basin/parks. This alternative represents the baseline alternative against which all other alternatives will be compared.

This baseline alternative is presented in the "Estrella Corridor Study, MC 85 to Interstate 17 Drainage Technical Memorandum", by DeLeuw Cather and Company, dated August 17 1998.

2.1.4 Alternative Pros and Cons

Each of the proposed alternatives has several pros and cons associated with it. Based on the alternatives and their features described in the previous section, the following is a ranking of the pros/cons associated with each from 'most' to 'least' based on a weighted matrix.

Alternative Pros:

- Alternative(s) 2&3 (most)
- Alternative 1
- Baseline Alternative (least)

Alternative Cons:

- Alternative 1 (most)
- Alternative(s) 2&3
- Baseline Alternative (least)

This information was considered during the evaluation of each of the alternatives. The final result is provided in the weighted matrix that was developed and prepared as a quantitative evaluation tool.

From the perspective of the amount of land in acres required for each alternative the total acreage of land required is listed per alternative below. This can be seen as a 'Con' for alternatives 1 through 3 and a 'Pro' for the Baseline Alternative.

Table 2.1 shows a detailed summary of each alternative and its associated pros/cons.

Alternative 1 – 1,384 acres (Con)

Alternative 2 – 1,198 acres (Con)

Alternative 3 – 1,163 acres (Con)

Baseline Alternative – 290 acres (Pro)

2.2 HYDROLOGIC MODELS

As part of Phase II, the three proposed alternatives and the Baseline Alternative were modeled and compared using the U.S. Army Corps of Engineers HEC-1 hydrologic modeling software.

Table 2.1

"Pros" of Proposed Alternative

Proposed Alternative	Alternative provides strong multi-use and partnering potential	Eliminates flow breaks from the White Tanks Mountains along Beardsley Canal and Jackrabbit Trail	Diversion of flow from Bullard Wash to ADOT basins	Channel along the AT&SF Railroad relieves ponding	Opportunities for trails adjacent to channels connecting citities	Flow diversions from WT#3 makes conversion to detention easier	Alternative shows significant west-east flow diversions	Alternative shows significant number of proposed detention/park facilities	Proposed detention and/or channels may minimize Loop 303 channel	Runoff is removed from the Loop 303 watershed	Alternaitve uses existing borrow pit	Overland channels provide good trail corridors
1	●	●	●	●	●		●			●		●
2	●	●	●	●	●	●		●			●	●
3	●	●	●	●	●	●		●	●		●	
Baseline												

"Pros" of Proposed Alternative

Proposed Alternative	Fewer utility conflicts relative to other alternatives	Less impact from land subsidence	Relatively low or no negative impact to existing flood control facilities	No significant adverse impacts of proposed channel alignments on proposed development	Relatively large number of channels present more multi-use opportunities	Alternative does not require significant improvement to existing ADOT basins	Relatively small amount of land required for the alternative
1					●		
2	●	●		●	●		
3	●	●	●	●		●	
Baseline	●	●	●	●		●	●

Alternative "Cons"

Proposed Alternative	ADOT basins may require cleanup	Wal-Mart expansion may impede proposed outfall channel	Very few west-east outfall channels	The ADOT basins are involved in litigation and may not be usable until it is resolved	Very few attenuation park/detention basins are shown	No runoff is diverted from WT#3 making conversion to detention ponds more difficult	Lack of west-east collectors implies large channel in Loop 303 corridor	Overland flow paths may require more land acquisition or pass through existing development	Does not make significant use of existing flood control facilities	Large flow diversions from WT #3 will require large channels along Loop 303 and/or Bullard Wash	Relatively large number of utility conflicts	More impacts from land subsidence
1	●	●		●	●	●		●			●	●
2	●	●		●				●		●		
3	●	●	●	●			●			●		
Baseline			●		●		●		●			

Alternative "Cons"

Proposed Alternative	No runoff is diverted from WT#4 making conversion to detention ponds difficult	Adverse or flat natural slopes along the direction of flow for proposed facility	Relatively large amount of Right of Way required for alternative	Some potential adverse impacts to existing flood control facilities	Provides outfall for very few proposed and existing developments	Significant portions of proposed channel alignments 'cut through' proposed development	Fewer channels offer fewer opportunities for multi-use features	Relatively large amount of land required for the alternative
1	●	●	●	●		●		●
2	●			●				●
3	●						●	●
Baseline	●				●		●	

Using the draft existing condition hydrology model as a starting point, modifications were made to create a future condition hydrology model. From these two models, the function of the proposed channels and basins proposed by the three alternatives was simulated.

The Baseline Alternative was modeled by obtaining an electronic copy of the HEC-1 model prepared by DeLeuw, Cather & Company. See the *Estrella Corridor Study, MC 85 to Interstate 17, Drainage Technical Memorandum*, by DeLeuw, Cather & Company, dated August 1998. Since the DeLeuw Cather model was based on the original ADMS/ADMP hydrology prepared by the WLB Group, only the physical elements describing the proposed channel and basins were taken from the HEC-1 model and incorporated into the Draft Existing Condition Hydrology Model. This was done only for informational purposes, not an effort to re-size the facilities proposed by DeLeuw, Cather & Company.

All comparisons made between the proposed alternatives and the Baseline Alternative have been made using the facility sizes as specified by the DeLeuw, Cather & Company report.

2.2.1 Existing Condition Hydrology

The hydrologic model used to analyze the proposed alternatives was derived from the draft existing condition hydrology model documented in the *Draft Existing Condition Hydrology Report*, by URS dated June 2001. This model updates the original hydrologic model prepared by the WLB Group as part of the original ADMS/ADMP. As discussed in the *Draft Data Collection Report*, by URS dated February 2000, several changes in the watershed area due to recent development have created a need for the update to the original model. In addition to physical changes in the project area, the model also incorporates more recent and detailed soils mapping information and utilizes the current variable definitions published in the current FCDMC hydrology manual for Green and Ampt soil loss parameters.

It should be noted that the draft existing condition hydrology model is currently a working model and not a final product. Minor adjustments may be made to this model until the completion of the ADMP Update if more detailed information becomes available in any given location throughout the project area.

For more detail on the development of the draft hydrology model and the results associated with it, see the *Draft Existing Conditions Hydrology Report*.

2.2.2 Future Condition Hydrology

The future condition hydrology model was prepared by changing an input parameter associated with individual sub-basins and by adding retention diversions to all appropriate sub-basins.

The input parameter changed was the percent impervious (RTIMP variable in HEC-1). The percent impervious is the amount of area within a sub-basin that is impervious to infiltration from rainfall. In general as a sub-basin develops, the percent impervious will increase due to the construction of buildings, streets and other impervious structures.

The addition of retention diversions was done to simulate the effects of future development retaining storm water onsite. Using the onsite retention requirements for the city or agency where a particular sub-basin is located, the amount of storm water retention that would be required was estimated and input into the future condition model. In an effort to anticipate lost volume due to siltation, field construction or other unforeseen factors, only 80% of the required retention volume was entered into the future condition model.

The estimate of the percent impervious associated with a sub-basin in the future was calculated by determining the future land use of the sub-basin and choosing the corresponding value from a table provided by the FCDMC. In the case where a sub-basin contained multiple land uses, a weighted average value for the percent impervious was computed.

Land use data were obtained from the future land use plan for the area. This was provided electronically by the Maricopa Association of Government (MAG) dated 1995 and was supplemented by more current data where available. Using GIS, this information was overlaid with the sub-basin map and weighted RTIMP variables were calculated based on the land use definitions described above.

2.2.3 Proposed Condition Hydrology

The proposed condition hydrology models were developed by modifying the future condition HEC-1 input data set to model the proposed channels and basins associated with a particular alternative. This resulted in four models that described the three alternatives and the Baseline Alternative. Diversion operations were turned on or off and added when necessary to simulate a particular channel alignment. Channel routings were added to simulate the routing of discharges from one concentration point to the next along the proposed alignment. Where retention basins were proposed, stage – storage – discharge tables were entered to simulate the routed flow through the proposed basin.

The results of the initial analysis indicated that the discharges at channel concentration points were relatively small compared with those estimated by the existing condition model. This was an important point since these flow rates were based on the future condition model. Since the project area is so large, the development of the overall flood control concept would likely be completed in phases over a relatively long period of time. Similarly, the project area is still mostly undeveloped at present and ultimate build-out of the entire area could take several years. Since the future condition model assumes that the entire watershed is completely built-out, the presence of future onsite retention basins required within most new development significantly reduces discharges at downstream outfall locations.

Using these lower discharges to size the flood control facilities could result in significant surcharging during the interim condition and a reduced level of protection from floods to adjacent properties. This could occur if a channel or basin were built in an area where development has not yet taken place. If the facility were designed for the ultimate build-out condition, the maximum flow rates it could convey would be much lower than the actual flows running off from the undeveloped and un-retained adjacent property. In other words, the future condition model results in the lowest flows that could be anticipated in the area at some future time while the existing condition model results in the highest flows that could be expected during the interim condition.

For this level of analysis, the decision was made to size the proposed channels and basins using the existing condition hydrology model. The same modifications made to the future condition model to simulate proposed channels and basins were made to the existing condition model and run.

2.3 ANALYSIS OF PROPOSED ALTERNATIVE ELEMENTS

The analysis of the proposed alternatives was completed using a four-step process. These steps are listed below:

- The proposed condition hydrology model(s) were created by modifying the existing condition hydrology model to simulate the channels and basins associated with each of the alternatives.

- Using the flows from the models prepared in step one, initial sizes were estimated for the channels and basins and entered into the HEC-1 input file.

- The model was run and the flows were used to re-size the proposed channels and basins. These proposed sizes were then entered into the HEC-1 input file.

- The model was run and the flows were used to re-size the proposed channels and basins. The new channel and basin sizes were NOT entered into HEC-1 and re-run. This was considered a sufficient level of detail for this level of analysis.

2.3.1 Proposed Channel Analysis

Normal depth channel calculations were performed using Manning's equation to estimate the cross section required for each reach associated with a given channel. New channel sections were computed at each location where a change in discharge occurred.

Channel sections were assumed to be treated with a non-concrete lining and a Manning's roughness (n-value) of 0.03 was assigned assuming the channel may be lined with some type of grass or sod. The side slopes used for the channels were 6:1 to make aesthetic / multi-use applications more feasible along the proposed alignments. The flow velocities within channel reaches were limited to a maximum of 6 feet per second (f/s). This was considered to be the maximum velocity that a grass-type lining could withstand before significant scour begins. In reaches where the velocity exceeded 6 f/s, the channel slope was flattened relative to the existing grade until the velocity was acceptable. Drop structures were used to make up the vertical distance lost due to flattening the longitudinal channel slope. The length and height of the hydraulic jump associated with each drop structure was evaluated and the erosion treatment associated with each structure was carried out for the required distance. For the detailed data and calculation sheets regarding the hydraulic jump calculations, see the hydraulic jump tables located in Appendix A

2.3.1.1 Results of Channel Sizing

The results of the channel sizing have been tabulated and are presented on Table 2.2 for reference. Table 2.2 lists the channel name, the range of discharges within the channel, the range of channel top widths computed along the channel and the range of flow depths determined along the channel. For detail showing each channel and its reaches and the normal depth calculations, see the detailed data sheets in Appendix B.

The channel top widths shown in Table 2.2 are a function of three elements. These three elements include the depth of flow in the channel, 2 feet of freeboard and an additional 30 feet left and right of the channel banks. The 30 feet on either side of the channel banks is included to account for aesthetic and multi-use applications as well as a roadway for facility maintenance and access. In addition, 2 feet of freeboard was provided to account for potential berming and/or other aesthetic features that may be incorporated into the main channel alignment.

A brief summary and results comparison regarding the channel sizing for the three alternatives is presented below. Only channel alignments common to the three alternatives will be discussed in detail here. For all other proposed facilities, refer to the detailed calculation and data sheets

Table 2.2

Alternative Channel Comparison

Facility Name	Alternative #1 Discharge Range (cfs)	Alternative #1 [1]Top Width Range (ft)	Alternative #1 Range of Flow Depth (ft)	Alternative #2 Discharge Range (cfs)	Alternative #2 [1]Top Width Range (ft)	Alternative #2 Range of Flow Depth (ft)	Alternative #3 Discharge Range (cfs)	Alternative #3 [1]Top Width Range (ft)	Alternative #3 Range of Flow Depth (ft)	Baseline Discharge Range (cfs)	Baseline [1]Top Width Range (ft)	Baseline Range of Flow Depth (ft)
Beardsley Channel	313 - 6653	126 - 333	1.8 - 5.1	313 - 4994	126 - 270	1.8 - 5.5	313 - 6583	126 - 329	1.8 - 5.1	n/a	n/a	n/a
Jackrabbit Trail	923 - 1719	210 - 212	2.1 - 2.6	734 - 1519	148 - 188	2.1 - 2.5	953 - 2045	158 - 246	1.9 - 3.1	n/a	n/a	n/a
Jackrabbit-Perryville	948 - 1961	162 - 194	1.9 - 7	525 - 3254	140 - 260	2.3 - 6.8	n/a	n/a	n/a	n/a	n/a	n/a
Tuthill Channel	1474 - 2065	168 - 180	3.9 - 6.9	n/a	n/a	n/a	2469 - 3450	212 - 267	2.9 - 6.4	n/a	n/a	n/a
Loop 303 Channel	848 - 4450	144 - 250	3.1 - 5.7	485 - 3860	134 - 222	3.3 - 6.4	384 - 3447	129 - 228	2.6 - 7.0	1400 - 3900	88.0	7
Reems Channel	642 - 2066	138 - 214	3.1 - 4.8	657 - 1875	139 - 206	3.0 - 4.4	402 - 2365	196 - 232	2.7 - 3.6	n/a	n/a	n/a
AT & SF Railroad Channel	623 - 1913	142 - 200	6.8 - 3.3	1379 - 2674	171 - 246	3.0 - 7.0	1314 - 1702	161 - 185	3.0 - 7.0	n/a	n/a	n/a
El Mirage Channel	n/a	n/a	n/a	279 - 1142	124 - 160	2.9 - 5.9	1019 - 1841	127 - 185	2.3 - 6.8	n/a	n/a	n/a
Lower El Mirage Channel	n/a	n/a	n/a	657 - 1098	138 - 155	4.9 - 3.8	657 - 1250	139 - 165	3.5 - 5.2	n/a	n/a	n/a
Bullard Wash Channel	1856 - 3674	[3]192 - 228	4.1 - 4.9	1856 - 3560	[3]176 - 246	7.0 - 3.8	1911 - 3744	177 - 208	6.1 - 7.0	n/a	n/a	n/a
	[5]1864 - 3149	[4]300	2.8	[5]2660 - 3456	[4]300	2.8	[4]2394 - 3179	[4]300	2.8	n/a	n/a	n/a
Northern Channel	256 - 2341	121 - 202	2.7 - 4.3	923 - 3789	147 - 302	3.0 - 4.8	702 - 3691	140 - 271	2.7 - 4.3	n/a	n/a	n/a
Camelback Channel	1348 - 2319	158 - 189	5.3 - 6.9	485 - 4213	134 - 277	3.2 - 6.6	282 - 1063	125 - 158	3.0 - 5.8	n/a	n/a	n/a
I-10 Channel West	1275 - 1933	173 - 197	2.5 - 7.0	1455 - 1917	173 - 197	2.5 - 7.0	n/a	n/a	n/a	n/a	n/a	n/a
I-10 Channel East	n/a	n/a	n/a	79 - 327	113 - 125	2.0 - 3.0	n/a	n/a	n/a	n/a	n/a	n/a
Buckeye Channel	901 - 1554	154 - 187	3.1 - 6.4	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
RID Channel	n/a	n/a	n/a	338 - 1873	133 - 176	3.6 - 6.9	338 - 2390	133 - 194	3.6 - 6.5	n/a	n/a	n/a
WVRD Channel	1268 - 2565	178 - 226	2.5 - 4.7	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Union Pacific RxR Channel	620 - 2201	145 - 186	4.6 - 6.9	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

1. Includes 30 ft on either side of channel banks for aesthetics/landscaping and assumes 2 ft of freeboard above high WSEL in channel.
2. All channels designed with 6:1 side slopes.
3. North of I-10.
4. South of I-10 per City of Goodyear cross section.
5. This discharge will be maintained at or below 3,200 cfs during Level III.

located in Appendix B. Tables 2.3A-2.3D list the key concentration points used in each of the proposed alternative models to size the proposed channel reaches and detention basins. Refer to Figures 2.1-2.4 for a graphical representation of the features listed.

Beardsley Channel – The range of channel top widths determined along the Beardsley channel in alternatives 1 through 3 were as follows:

- 126 feet to 333 feet for Alternative 1
- 126 feet to 270 feet for Alternative 2
- 126 feet to 329 feet for Alternative 3

The top widths associated with Alternative 2 are much less in the downstream reaches than those shown for either Alternative 1 or 3 due to the proposed detention basin located at the Olive Road alignment in Alternative 2. The very similar channel top widths for alternatives 1 and 3 are indicative of the similarity between these two alternatives. Both alternatives consist of a single channel adjacent to the existing Beardsley Canal that conveys flow from the White Tanks Mountains south into the existing WT FRS #3.

As with the channel top widths above, the range of discharges and flow depths within the proposed channel reaches are also indicative of the similarity of alternatives 1 and 3 and of the proposed detention facility at Olive. The range of channel depths for the alternatives were as follows:

- 1.8 feet to 5.1 feet for Alternative 1
- 1.8 feet to 5.5 feet for Alternative 2
- 1.8 feet to 5.1 feet for Alternative 3

The range of discharge rates in the reaches were:

- 313 cfs to 6,550 cfs for Alternative 1
- 313 cfs to 4,994 cfs for Alternative 2
- 313 cfs to 6,580 cfs for Alternative 3

Jackrabbit Trail Channel – The range of channel top widths determined along the Jackrabbit Trail Channel in alternatives 1 through 3 were as follows:

Table 2.3A

Key Concentration Points

Proposed
Alternative #1

Facility Name	Existing Condition Model CP	Alternative 1 Model CP	Hec-1 Discharge (cfs)
Beardsley Channel	3A	BC1	313
	3	BC2	2829
	10	BC3	6435
	12	BC4	6455
	WT#3	BC5	6653
JackRabbit Trail Channel	CP30	JR1	923
	CP31	JR2	1417
	CP46	JR3	1719
JackRabbit - Perryville Channel	CP325	JP1	948
	CP342	JP2	1181
	CP355A	JP3	1168
	CP373	JP4	1282
	CP374	JP5	1755
	CP385	JP6	1952
	CP387	JP7	1961
Tuthill Road/203rd Avenue Channel	CP304	TC1	1474
	CP323	TC2	1497
	CP321	TC3	2065
Loop 303 Channel	CP131A	LP1	1278
Cactus Basin	CP145A	LP2	2387
	CP164A	LP3	1822
Olive Basin	CP177A	LP4	2089
	CP192A	LP5	848
	CP209A	LP6	1119
	CP219	LP7	1264
Camelback Basin	CP237	LP8	1879
	CP250	LP9	1096
	CP265	LP10	1142
	CP278	LP11	1270
I-10 Proposed Culvert	CP279	LP12	2815
	CP295	LP13	2738
	CP311	LP14	4217
	CP330	LP15	4450
	CP346A	LP16	4402
	CP378	LP17	4361
Reems Road Channel			

Table 2.3A

Key Concentration Points

Proposed
Alternative #1

Facility Name	Existing Condition Model CP	Alternative 1 Model CP	Hec-1 Discharge (cfs)
	CP122A	RM1	1115
	CP133	RM2	1091
	CP146	RM3	1561
Peoria Basin	CP165	RM4	2066
	CP179	RM5	642
Northern Basin	CP193	RM6	879
AT&SF Railroad Channel			
	CP152	RR1	623
	CP168	RR2	748
	CP183	RR3	1624
	CP181	RR4	1879
	CP195	RR5	1913
Bullard Wash Channel			
	CP224	BD1N	1856
	CP241	BD2N	3007
	CP253	BD3N	3268
	CP267	BD4N	3249
	CP286	BD1S	3645
	CP287	BD2S	3674
	CP298	BD3S	1864
	CP316	BD4S	1866
	CP334	BD5S	1880
	CP335	BD6S	2360
	CP364A	BLRD2	3149
Northern Channel			
	188	NR1	256
	CP190	NR2	1269
	CP191	NR3	2201
	CP192A	NR4	2341
	CP192A	NR5	1747
Northern & Reems basin	1I193	NR6	1890
Camelback Channel			
	CP238	CM1	1348
	CP239	CM2	1652
	CP240	CM3	1683
	R222	CM4	2319
I-10 Channel			
	CP273	10-1	#N/A
	CP274	10-2	#N/A
	CP275	10-3	#N/A
	CP276	10-4	#N/A

Table 2.3A

Key Concentration Points

Proposed
Alternative #1

Facility Name	Existing Condition Model CP	Alternative 1 Model CP	Hec-1 Discharge (cfs)
I-10 Channel continuted	CP277	10-5	#N/A
	CP279D	10-6	#N/A
	CP279C	10-7	#N/A
	CP279B	10-8	#N/A
	CP279A	10-9	#N/A
	1I279	10-10	#N/A
Buckeye Road Channel			
	CP308	BE1	901
	CP309	BE2	1415
	CP310	BE3	1397
	311	BE4	1554
Union Pacific Railroad Channel			
	CP351	UP1	620
	CP353	UP2	767
	CP354	UP3	809
	CP356	UP4	1677
	CP357	UP5	2201
	CP359	UP6	2433
	CP346C	UP7	2413
West Valley Regional Channel			
	CP215	WVR1	1268
	CP234	WVR2	1666
	CP248	WVR3	1931
	CP263	WVR4	2243
	CP264	WVR5	2428
	CP265	WVR6	2493
	CP265A	WVR7	2524
	CP283	WVR8	2565

Table 2.3B

Key Concentration Points

Proposed
Alternative #2

Facility Name	Existing Condition Model CP	Alternative 2 Model CP	Hec-1 Discharge (cfs)
Beardsley Channel			
	3A	BC1	313
	3	BC2	2838
	10	BC3	4823
	12	BC4	4906
	WT#3	BC5	4994
JackRabbit Trail Channel - North			
	CP28	JRS1	734
	CP30	JRS2	863
	CP31	JRS3	1182
	CP46	JRS4	1519
JackRabbit-Perryville Channel (JP-N)			
	N/A	JP1	525
	307	JP2	2360
	CP327	JP3	2637
	CP343	JP4	3037
	CP356	JP5	3046
	375	JP6	3239
	376	JP7	3254
Loop 303 Channel			
	CP131A	LP1	1282
	CP145A	LP2	2440
	CP164A	LP3	3601
Olive Basin	CP177A	LP4	3860
	CP192A	LP5	3708
	CP209A	LP6	485
	CP219	LP7	841
Camelback Basin	CP237	LP8	908
	CP250	LP9	614
	CP265	LP10	672
	CP278	LP11	1158
I-10 Proposed Basin	CP279	LP12	2681
	CP295	LP13	654
	CP311	LP14	654
	CP330	LP15	969
	CP346A	LP16	935
	CP378	LP17	1413
Reems Road Channel			
	CP122A	RM1	1115
	CP133	RM2	1062
	CP146	RM3	1455
Peoria Basin	CP165	RM4	1875
	CP179	RM5	657
Northern Basin	CP193	RM6	725
El Mirage, AT&SF RxR			

Table 2.3B

Key Concentration Points

Proposed
Alternative #2

Facility Name	Existing Condition Model CP	Alternative 2 Model CP	Hec-1 Discharge (cfs)
	CP137	EM2	1081
	CP138	EM2	1081
	1I138A	EM3	1081
	CP138A	EM4	1142
	CP152	RR1	1379
	CP168	RR2	1505
	CP183	RR3	2254
	CP181	RR4	2639
	CP195	RR5	2674
Lower El Mirage Wash Channel			
	CP139	LE1	657
	CP156	LE2	708
	CP157	LE3	983
	CP172	LE4	1019
	CP173	LE5	1098
Bullard Wash Channel			
Bullard LAFB	CP224	BD1N	1856
	CP241	BD2N	2865
	CP253	BD3N	3202
	CP267	BD4N	3174
	CP286	BD1S	3526
	CP287	BD2S	3560
	CP298	BD3S	2660
	CP316	BD4S	2881
	CP334	BD5S	2922
	CP335	BD6S	2917
Northern Channel			
	CP189	NR1	2167
	CP190	NR2	2640
	CP191	NR3	3588
	R191	NR4	3789
	CP192A	NR5	975
	1I193	NR6	923
Camelback Channel			
	CP233	CM1	3062
	CP234	CM2	3356
	CP235	CM3	3502
	CP236	CM4	3844
	CP237	CM5	4213
	CP238	CM6	485
	CP239	CM7	845
	CP240	CM8	850
	R222	CM9	1417
I-10 Channel West			
	CP273	10W1	1275

Table 2.3B

Key Concentration Points

Proposed
Alternative #2

Facility Name	Existing Condition Model CP	Alternative 2 Model CP	Hec-1 Discharge (cfs)
I-10 Channel West continued	CP274	10W2	1455
	CP275	10W3	1467
	CP 276	10W4	1612
	CP 277	10W5	1909
	CP 279D	10W6	1912
	CP 279C	10W7	1917
	CP 279B	10W8	1912
	CP 279A	10W9	1916
I-10 Channel East	CP285B	I10E1	79
	CP285A	I10E2	137
	CP285	I10E3	178
RID Channel	CP294A	RI1	338
	CP294	RI2	456
	CP293	RI3	1256
	CP293A	RI4	1230
	CP306	RI5	1873
	N/A	RI6	1835

Table 2.3 C

Key Concentration Points

Proposed
Alternative #3

Facility Name	Existing Condition Model CP	Alternative 3 Model CP	Hec-1 Discharge (cfs)
Beardsley Channel			
	CP3A	BC1	313
	CP3	BC2	2837
	CP10	BC3	6383
	CP12	BC4	6382
	WT#3	BC5	6583
JackRabbit Trail Channel - North			
	CP232	JR1	953
	CP28	JR2	1459
	CP30	JR3	1560
	CP31	JR4	1840
	CP46	JR5	2045
Tuthill Road/203rd Avenue Channel			
	CP304	TC1	2471
	CP323	TC2	2469
	CP324	TC3	2586
	CP340	TC4	2718
	CP351	TC5	2879
	CP352A	TC6	2920
	CP372	TC7	3214
	CP382	TC8	3450
Loop 303 Channel			
	CP131A	LP1	1290
Cactus Basin	CP145A	LP2	2447
	CP164A	LP3	1828
	CP177A	LP4	2097
Northern Basin	CP192A	LP5	2017
	CP209A	LP6	457
	CP219	LP7	690
Camelback Basin	CP237	LP8	1375
	CP250	LP9	560
	CP265	LP10	608
	CP278	LP11	839
I-10 Proposed Basin	CP279	LP12	1359
	CP295	LP13	384
	CP311	LP14	546
	CP330	LP15	673
	CP346A	LP16	729
	CP378	LP17	415
Reems Road Channel			
	CP122A	RM1	1115
	CP133	RM2	1062

Table 2.3 C

Key Concentration Points

Proposed
Alternative #3

Facility Name	Existing Condition Model CP	Alternative 3 Model CP	Hec-1 Discharge (cfs)
	CP146	RM3	1440
Peoria Basin	CP165	RM4	1913
	CP179	RM5	2360
Northern Basin	CP193	RM6	2365
El Mirage Imp's and AT&SF Railroad Channel	CP137	EM1N	1019
	CP138	EM1N	1019
	CP153	RR1	1314
	CP152	RR2	1472
	CP168	RR3	1700
	CP183	RR4	1702
	CP195	RR5	1329
El Mirage Main Channel South	184	EM1S	1578
	CP197	EM2S	1546
	202	EM3S	1841
Lower El Mirage Wash Channel	CP139	LE1	657
	CP156	LE2	792
	CP157	LE3	1125
	CP172	LE4	1157
	CP173	LE5	1250
Bullard Wash Channel *Bullard LAFB*	CP224	BD1N	1911
	CP241	BD2N	3110
	CP253	BD3N	3351
	CP267	BD4N	3336
	CP286	BD1S	3711
	CP287	BD2S	3744
	CP298	BD3S	2394
	CP316	BD4S	2596
	CP334	BD5S	2678
	CP335	BD6S	2678
Northern Channel	188	NR1	1552
	CP190	NR2	2526
	CP191	NR3	3496
	CP192A	NR4	3691
	CP192	NR5	702
	1I193	NR6	705
Camelback Channel	CP238	CM1	282

Table 2.3 C

Key Concentration Points

Proposed
Alternative #3

Facility Name	Existing Condition Model CP	Alternative 3 Model CP	Hec-1 Discharge (cfs)
	CP239	CM2	574
	CP240	CM3	728
	R222	CM4	1063
RID Channel	CP294A	RI1	338
	CP294	RI2	467
	CP293	RI3	1435
	CP293A	RI4	1416
	CP306	RI5	2170
	305	RI6	2390

Table 2.3D

Key Concentration Points

Baseline Alternative

Facility Name	Existing Condition Model CP	Baseline Alternative Model CP	Hec-1 Discharge (cfs)
Loop 303 Channel			
	CP131A	LP1	1168
	CP145A	LP2	2424
	CP164A	LP3	3846
Olive Basin	CP177A	LP4	2224
	CP192A	LP5	3002
	CP209A	LP6	2718
	CP219	LP7	2740
Camelback Basin	CP237	LP8	3354
	CP250	LP9	2026
	CP265	LP10	2020
	CP278	LP11	2140
I-10 Proposed Basin	CP279	LP12	2107
	CP295	LP13	2080
	CP311	LP14	2037
	CP330	LP15	2114
	CP346A	LP16	2085
	CP378	LP17	2761

- 210 feet to 212 feet for Alternative 1
- 148 feet to 188 feet for Alternative 2
- 158 feet to 246 feet for Alternative 3

The channels proposed for the three alternatives have been designed to convey runoff to the WT FRS #4. The difference is in how far north each channel extends. The channel for Alternative 1 begins at Indian School Road, the channel for Alternative 2 begins at Camelback Road and the channel for Alternative 3 begins at the WT FRS #3. As a result of the variable channel lengths, the top widths, depths and discharges also vary.

The maximum top width associated with Alternative 3 is much larger than Alternative 1 or 2. This is due to the increased amount of runoff conveyed south by the extension of the channel all of the way north to the WT FRS #3. Since the majority of the runoff generated in sub-area 232 is intercepted by the Alternative 3 channel, the discharges are higher than in alternative 1 or 2.

The range of channel depths for the alternatives were as follows:

- 2.1 feet to 2.6 feet for Alternative 1
- 2.1 feet to 2.5 feet for Alternative 2
- 1.9 feet to 3.1 feet for Alternative 3

Note that the depth of 1.9 feet occurs in the upstream portion of the proposed Alternative 3 channel where only the flow from the portion of sub-area 232 that has been cut off by the alignment is being conveyed south. In alternatives 1 and 2, the channel begins south where there is a concentration point conveying a much larger discharge from the White Tanks Mountains and requires a larger top width.

The range of discharge rates in the reaches were:

- 923 cfs to 1,719 cfs for Alternative 1
- 734 cfs to 1,519 cfs for Alternative 2
- 953 cfs to 2,045 cfs for Alternative 3

Table [illegible].4

Baseline Alternative – Channel Properties

Location		[2]BW (ft)	[2]TW (ft)	[2]Side Slope (H:V)	[2]Long Slope (ft/ft)	[3]DC&C Q (cfs)	[4]URS Q (cfs)	[1]Depth (ft)
Thunderbird	(LP1)	60	88	2:1	0.002	1,800	1168.0	7
Cactus	(LP2)	60	88	2:1	0.002	3,300	2424.0	7
Peoria*	(LP3)	60	88	2:1	0.002	2,200	1791.0	7
Olive	(LP4)	60	88	2:1	0.002	2,700	2224.0	7
Northern*	(LP5)	60	88	2:1	0.002	1,400	1427.0	7
Glendale*	(LP6)	60	88	2:1	0.002	3,800	2718.0	7
Bethany Home	(LP7)	60	88	2:1	0.002	3,900	2740.0	7
Camelback	(LP8)	60	88	2:1	0.002	2,200	1578.0	7
Indian School	(LP9)	60	88	2:1	0.002	2,800	2026.0	7
Thomas*	(LP10)	60	88	2:1	0.002	1,500	1002.0	7
McDowell	(LP11)	60	88	2:1	0.002	3,200	2140.0	7
I-10	(LP12)	60	88	2:1	0.002	3,200	2107.0	7
Roosevelt	(LP13)	60	88	2:1	0.002	3,200	2080.0	7
Yuma	(LP14)	60	88	2:1	0.002	3,300	2037.0	7
Lower Buckeye	(LP15)	60	88	2:1	0.002	3,700	2114.0	7
Broadway	(LP16)	60	88	2:1	0.002	3,700	2085.0	7

*Proposed off-line detention at this location.

[1] Includes freeboard.

[2] Channel properties from Deleuw Cather "Estrella Corridor Study," 08/17/98. Max value .1.

[3] From "Estrella Corridor Study" by Deleuw Cather & Company, 08/17/98.

[4] From URS Loop 303 ADMP update Baseline Alt. HEC-1.

Loop 303 Channel – The range of channel top widths determined along the Loop 303 Channel in alternatives 1 through 3 were as follows:

- 144 feet to 250 feet for Alternative 1
- 134 feet to 230 feet for Alternative 2
- 129 feet to 228 feet for Alternative 3
- 88 feet for the Baseline Alternative

For the Baseline Alternative, the top width of 88 feet was specified by the DeLeuw, Cather & Company report. The report showed several different discharges along the proposed channel alignment; however, the value of 88 feet was the only value calculated for a top width.

URS performed normal depth calculations with the channel section proposed by DeLeuw, Cather & Company and found that the channel section could convey approximately 3,900 cfs at a depth of approximately 5.75 feet. This leaves approximately 1.25 feet of freeboard in the proposed baseline channel section at the location where the discharges are the greatest.

Using a rating curve, the range of flow depths for the discharges reported by the DeLeuw, Cather & Company study within the proposed Baseline channel are shown below. Table 2.4 shows a detailed summary of the proposed Baseline Alternative channel and associated discharges.

As would be expected, the maximum top width associated with Alternative 1 is larger than with either Alternative 2 or 3. This is due to the fact that in both alternatives 2 and 3, there are more detention basins proposed along the channel alignment.

The range of channel depths for the alternatives were as follows:

- 3.1 feet to 5.7 feet for Alternative 1
- 3.3 feet to 6.4 feet for Alternative 2
- 2.6 feet to 7.0 feet for Alternative 3
- 3.3 feet to 5.8 feet for the Baseline Alternative

The range of depths shown in Alternative 3 would suggest that some additional flow could be either diverted east at either Northern Avenue or Camelback Road. Another way of limiting the depth of flow in Alternative 3 would be to build larger detention basins along the channel alignment.

The range of discharge rates in the reaches were:

- 848 cfs to 4,450 cfs for Alternative 1
- 485 cfs to 3,860 cfs for Alternative 2
- 384 cfs to 3,447 cfs for Alternative 3

The maximum discharge shown for Alternative 3 is somewhat lower than those shown for alternatives 1 and 2. This is due to the relatively large number of detention facilities proposed along the alignment and is indicative of the attenuation that takes place at each of these locations.

It is also important to note that the minimum discharges do not necessarily occur at the upper most reaches along the channel. These minimum discharge values may actually occur downstream of a large proposed detention facility where the flow has been attenuated and a significant portion of it diverted east.

Reems Road Channel – The range of channel top widths determined along the Reems Road Channel in alternatives 1 through 3 were as follows:

- 138 feet to 214 feet for Alternative 1
- 139 feet to 206 feet for Alternative 2
- 196 feet to 232 feet for Alternative 3

The maximum top width shown with Alternative 3 is the result of only one proposed detention basin along the Reems Road Channel alignment instead of two proposed detention facilities in alternatives 1 and 2. The maximum top width for Alternative 1 is larger than for Alternative 2. This is due to the fact that there is no proposed detention basin at the intersection of Northern Avenue and the Loop 303 roadway. Both alternatives 2 and 3 propose a detention basin at this location.

The range of channel depths for the alternatives were as follows:

- 3.1 feet to 4.8 feet for Alternative 1
- 3.0 feet to 4.4 feet for Alternative 2
- 2.7 feet to 3.6 feet for Alternative 3

The range of discharge rates in the reaches were:

- 642 cfs to 2,066 cfs for Alternative 1
- 657 cfs to 1,875 cfs for Alternative 2
- 402 cfs to 2,365 cfs for Alternative 3

AT&SF Railroad Channel – The range of channel top widths determined along the AT&SF Railroad Channel in alternatives 1 through 3 were as follows:

- 142 feet to 200 feet for Alternative 1
- 171 feet to 246 feet for Alternative 2
- 161 feet to 185 feet for Alternative 3

The maximum top width shown with Alternative 3 is lower than in alternative 1 or 2. This is due to the diversion of flow south from the railroad tracks at the 1/2-mile between Peoria Avenue and Olive Avenue. Alternative 2 has the largest maximum top width due to the additional channelization and conveyance of flow upstream at the Litchfield Road alignment just north of Waddell / Thunderbird Road. The channel located 1/2-mile east of this channel also results in the concentration and conveyance of additional discharge downstream to the AT&SF Railroad channel.

The range of channel depths for the alternatives were as follows:

- 3.3 feet to 6.8 feet for Alternative 1
- 3.0 feet to 7.0 feet for Alternative 2
- 3.0 feet to 7.0 feet for Alternative 3

The range of discharge rates in the reaches were:

- 623 cfs to 1,913 cfs for Alternative 1
- 1,379 cfs to 2,674 cfs for Alternative 2
- 1,314 cfs to 1,702 cfs for Alternative 3

Bullard Wash Channel North of I-10 – The results of the preliminary analysis is prepared for this facility and included in this report are described below. However, this facility is currently under design by others. The range of channel top widths determined along the Bullard Wash Channel north of I-10 in alternatives 1 through 3 were as follows:

- 192 feet to 228 feet for Alternative 1
- 176 feet to 246 feet for Alternative 2
- 177 feet to 208 feet for Alternative 3

The maximum top width shown with Alternative 2 is higher than in Alternative 1 or 3. This is due to the extension of the Camelback Road channel west of Loop 303 to the WT FRS #3. The additional channel reaches result in the concentration and conveyance to the east of additional storm water that does not happen with either Alternative 1 or 3.

The range of channel depths for the alternatives were as follows:

- 4.1 feet to 4.9 feet for Alternative 1
- 3.8 feet to 7.0 feet for Alternative 2
- 6.1 feet to 7.0 feet for Alternative 3

The range of discharge rates in the reaches were:

- 1,856 cfs to 3,674 cfs for Alternative 1
- 1,856 cfs to 3,560 cfs for Alternative 2
- 1,911 cfs to 3,744 cfs for Alternative 3

Bullard Wash Channel South of I-10 – The channel top widths for all of the alternatives in this area are 300 feet. Although the flow-rates vary somewhat in these reaches, the maximum flow rate cannot exceed the design flow of 3,200 cfs used for the existing outfall channel beginning just south of Lower Buckeye Road. Using the cross section provided by the City of Goodyear and described under Section 2.1.3 of the Draft Level II Phase I Technical Memorandum, by URS dated September 2000, the preliminary discharges were entered using a normal depth calculation. The results of these calculations are shown below.

The range of channel depths for the alternatives were as follows:

- 5.0 feet to 5.4 feet for Alternative 1
- 5.1 feet to 5.5 feet for Alternative 2
- 4.7 feet to 5.3 feet for Alternative 3

The range of discharge rates in the reaches were:

- 1,864 cfs to 3,149 cfs for Alternative 1
- 2,660 cfs to 3,456 cfs for Alternative 2
- 2,394 cfs to 3,179 cfs for Alternative 3

The maximum flow rates should be equal to or less than 3,200 cfs. Although the flow rate shown for Alternative 2 is slightly higher than 3,200 cfs, it will be reduced during the more detailed analysis under the Level III portion of the ADMP Update. The minimum discharge flow rates are contingent upon the type of structure used at the intersection of I-10 and the Bullard Wash channel. At this location, several options are available for metering flow south along Bullard Wash and also diverting flow to the east along the north side of I-10 to the existing ADOT detention basins. See Figure 2.5, on the previous page, for the typical channel section in Bullard Wash recommended by the City of Goodyear.

Northern Avenue Channel – The range of channel top widths determined along the Northern Avenue Channel in alternatives 1 through 3 were as follows:

- 121 feet to 202 feet for Alternative 1
- 147 feet to 302 feet for Alternative 2
- 140 feet to 271 feet for Alternative 3

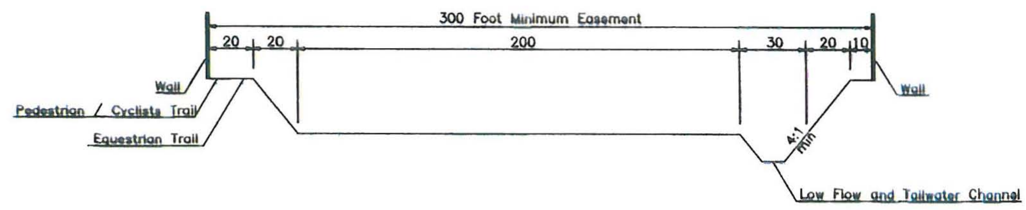
The maximum top width for Alternative 1 is much smaller than Alternative 2 or 3. This is due to the fact that there is no discharge from the Beardsley Channel being diverted east along Northern Avenue as in alternatives 2 and 3.

The range of channel depths for the alternatives were as follows:

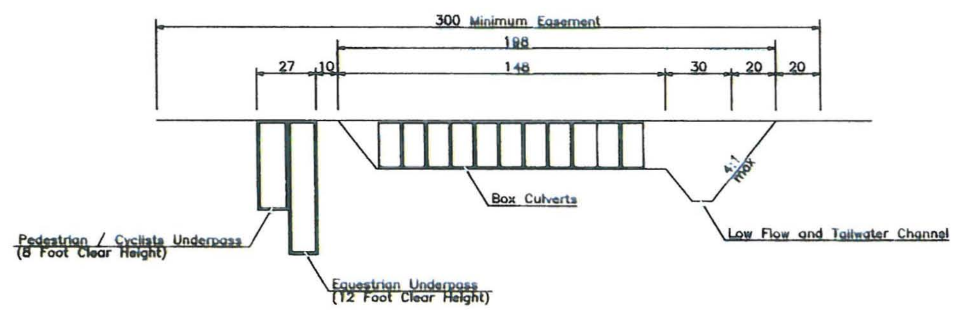
- 2.7 feet to 4.3 feet for Alternative 1
- 3.0 feet to 4.8 feet for Alternative 2
- 2.7 feet to 4.3 feet for Alternative 3

The range of discharge rates in the reaches were:

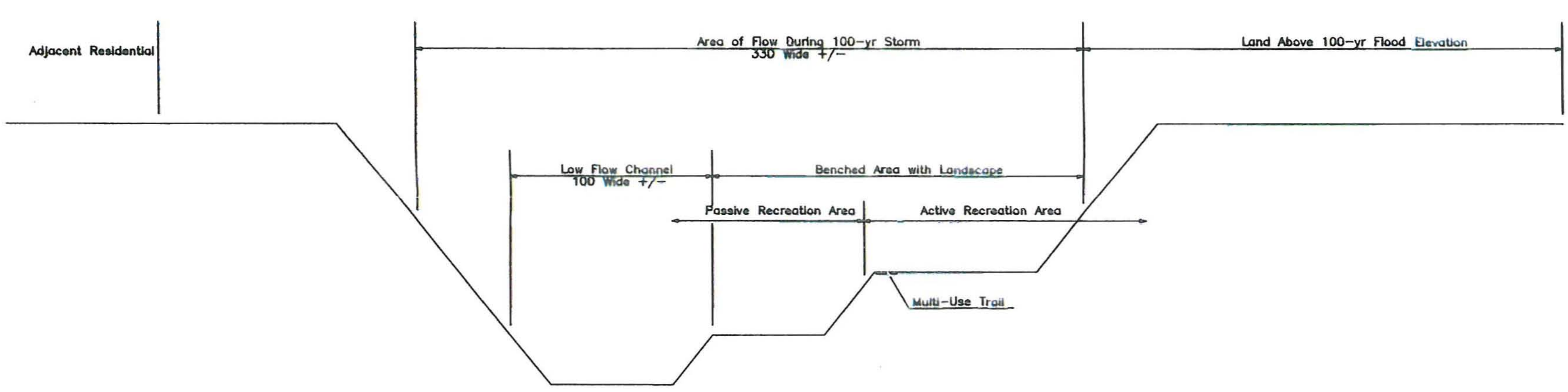
CITY OF GOODYEAR



CITY OF GOODYEAR (AT UNDERPASS)



GOODYEAR PRC



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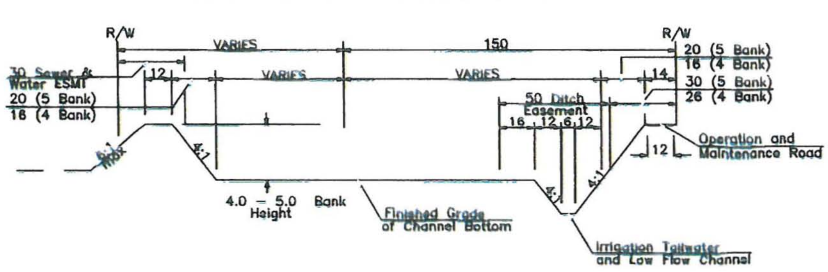
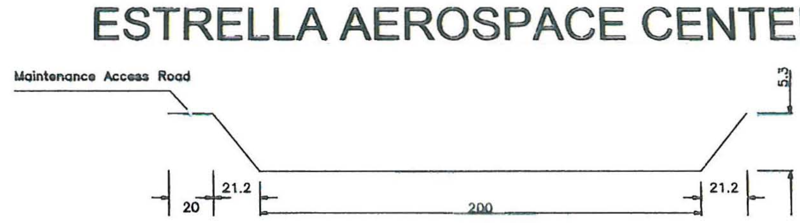


ESTRELLA AEROSPACE CENTER



TYPICAL CROSS SECTIONS - BULLARD WASH

June 2003

Loop 303 Corridor/White Tanks ADMP Update

FIGURE 2.5

Flood Control District of Maricopa County

URS

- 256 cfs to 2,341 cfs for Alternative 1
- 923 cfs to 3,789 cfs for Alternative 2
- 702 cfs to 3,691 cfs for Alternative 3

The maximum flow rate shown for Alternative 2 is higher than either Alternative 1 or Alternative 3. The additional detention basin proposed along the Loop 303 channel located at Cactus Road in Alternative 1 helps attenuate peaks and results in a lower discharge along the Northern Avenue Channel downstream. Also, in Alternative 1, no flow is diverted from the Beardsley Channel that helps lower the discharges along the Northern Avenue Channel.

Camelback Road Channel – The range of channel top widths determined along the Camelback Road Channel in alternatives 1 through 3 were as follows:

- 158 feet to 189 feet for Alternative 1
- 134 feet to 277 feet for Alternative 2
- 125 feet to 158 feet for Alternative 3

The maximum top width for Alternative 2 is much larger than Alternative 1 or 3. This is due to the extension of the channel west to the WT FRS #3. alternatives 1 and 3 only go as far west as the proposed Loop 303 Channel.

The maximum top width for Alternative 3 is smaller than Alternative 1 or 2. This is due to the proposed detention facility located at the Loop 303 Channel west. Although Alternative 1 also shows a detention facility at this location, the channel continues to the west and conveys a larger amount of flow east.

The range of channel depths for the alternatives were as follows:

- 5.3 feet to 6.9 feet for Alternative 1
- 3.2 feet to 6.6 feet for Alternative 2
- 3.0 feet to 5.8 feet for Alternative 3

The range of discharge rates in the reaches were:

- 1,348 cfs to 2,319 cfs for Alternative 1
- 485 cfs to 4,213 cfs for Alternative 2
- 282 cfs to 1,063 cfs for Alternative 3

Again, note the larger discharge shown for Alternative 2. This is a result of the extension of the channel west of the Loop 303 Channel. The lower minimum discharges associated with alternatives 2 and 3 are a result of the proposed detention facility at the intersection of the Loop 303 Channel and the Camelback Road Channel.

2.3.2 Proposed Basin Analysis

The analysis of the proposed detention basins was done using the HEC-1 hydrology model to perform modified PULS / storage indication calculations through a proposed basin at a given location.

In order to determine basin geometry, the inflow hydrograph was plotted for the most upstream basin on a given channel. By superimposing a triangular shape hydrograph representing the routed hydrograph over the inflow hydrograph, the difference in volume was computed. The routed hydrograph was estimated by assuming a lag time for the desired peak outflow. The desired peak outflow was estimated by inspection of the elements in the vicinity of the proposed basin and a determination was made as to the order of magnitude of flow rates that these elements might handle.

Using the volume estimated above, a simple rectangular detention basin was assumed using a stage – area – volume relationship. In addition, an outlet rating curve was prepared using a simple weir equation to simulate some type of outlet spillway. These curves may be re-calculated at Level III for pipes or any combination of out fall structure(s) required. At this level of analysis, consistency was the most important element to ensure a proper comparison between the alternatives.

The basin depths and footprints were determined in part based upon the relative land cost. If a proposed basin was in a portion of the project area where the cost per acre of land was relatively high, the footprint was minimized by digging the basin deeper to achieve the required volume. If the proposed basin was located within in an area where the cost per acre of land was relatively low, the depths were kept shallower and the footprint area was expanded. Deeper basins are not as desirable since they are more difficult to drain and could pose more of a safety hazard to surrounding populations.

All of the basins were modeled with a minimum of 3 feet of freeboard. The additional freeboard was included to account for possible lost volume due to aesthetic / multi-use applications that may require berming and the placement of other structures when constructed. Side slopes of 4:1 were used to minimize the amount of land required by the proposed basin facilities; however, by using these relatively steep side slopes, steps may be required to safely access the basins for incorporated multi-use facilities. Side slopes may be flattened to 6:1 in lieu of providing steps for access into a basin / multi-use park. The flatter side slopes would simply result in a larger footprint requiring more land.

An additional 30-foot tract of land was added to the calculated proposed detention basin footprint area to account for other aesthetic / multi-use applications used to tie the feature in with the adjacent land use. Also included in the additional 30-foot tract of land would be any required access roadway for maintenance purposes.

The relatively deep basins will most likely require pumping, drywells or a combination to safely drain within the specified time period following a storm. This analysis and the specifics such as drain times; number of pumps and/or dry wells, etc., is not considered at this level of analysis. These parameters will be considered in more detail during the Level III portion of the analysis.

2.3.2.1 Results of Basin Sizing

Only basins that are proposed as a part of two or more alternatives will be presented in this section. This will allow a direct comparison. For detailed information regarding all of the proposed basins such as peak inflow / outflow rates, peak stage and storage, see Table(s) 2.5A-2.5D. Refer to Figures 2.1-2.4 for a graphical representation of the features listed below.

Loop 303 and Cactus Road – Both alternatives 1 and 3 propose a detention basin at the intersection of Loop 303 and Cactus Road.

The approximate basin footprints are as follows:

- 33.2 AC for Alternative 1
- 42.8 AC for Alternative 3

The approximate basin depths (including freeboard) are as follows:

- 18 feet for Alternative 1
- 13 feet for Alternative 3

The approximate peak stage within the basins is as follows:

Table 2.[illegible]A

Alternative #1 – Proposed Basin Summary and Design Characteristics

Channel	Basin Location	Max. Depth Including freeboard* (ft)	Max. Volume Including freeboard (ac-ft)	Qin (cfs)	Qout (cfs)	[1]Peak Stage (ft)	Peak Storage (ac-ft)	Side Slopes H:V	Footprint DIMS X' by X'	Additional Area for Aesthetics** (ac-ft)	Total Footprint Area (ac-ft)
Loop 303											
	Cactus (LP2)	18	471.0	2387	344	13.7	434.5	4:1	1143 x 1143	3.23	33.2
	Olive (LP4)	20	295.3	2089	369	15.7	224.0	4:1	883 x 883	2.52	20.4
Reems											
	Peoria (RM4)	18	371.8	2066	413	15.6	381.0	4:1	1019 x 1019	2.89	26.7
	Northern (NR-RM)	22	361.8	2494	464	17.1	273.0	4:1	928 x 928	2.64	22.4

*Used 3 ft freeboard to account for volume lost in final design due to aesthetic/multi-use features.
**Add 30 ft to top DIMS.
1. Interpolated from HEC-1 output file.
2. For a graphical represenation of alternative #1, refer to Figure 2.1 in section 2.1.2 entitled 'Description of the Recommended Alternatives.'

Table [illegible]B

Alternative #2 – Proposed Basin Summary and Design Characteristics

Channel	Basin Location	Max. Depth Including freeboard* (ft)	Max. Volume Including freeboard (ac-ft)	Qin (cfs)	Qout (cfs)	[1]Peak Stage (ft)	Peak Storage (ac-ft)	Side Slopes H:V	Footprint DIMS X' by X'	Additional Area for Aesthetics** (ac)	Total Footprint Area (ac)
Beardsley											
	Olive (BC2)	14	350.0	2838	660	9.0	218.0	4:1	1110 x 1110	3.14	31.4
Loop 303											
	Northern (NR-LP)	21	970.6	6083	1463	17.3	787.0	4:1	1491 x 1491	4.19	55.2
	Camelback (CM-LP)	23	834.0	4674	1109	19.8	700.0	4:1	1337 x 1337	3.77	44.8
	I-10 (LP12)	16	716.4	2681	655	12.8	565.0	4:1	1450 x 1450	4.08	52.3
Reems											
	Peoria (RM4)	18	357.7	1875	477	15.3	298.8	4:1	996 x 996	2.83	25.6
	Northern (RM6)	23	823.6	1283	517	17.9	712.5	4:1	1335 x 1335	3.76	40.6
Bullard											
	I-10 (BD2S)	14	132.2	3560	3174	10.7	71.7	4:1	695 x 695	2.00	13.1

*Used 3 ft freeboard to account for volume lost in final design due to aesthetic/multi-use features.
**Add 30 ft to top DIMS.
1. Interpolated from HEC-1 output file.
2. For a graphical represenation of alternative #2, refer to Figure 2.2 in section 2.1.2 entitled 'Description of the Recommended Alternatives.'

Table [illegible]C

Alternative #3 – Proposed Basin Summary and Design Characteristics

Channel	Basin Location	Max. Depth Including freeboard* (ft)	Max. Volume Including freeboard (ac-ft)	Qin (cfs)	Qout (cfs)	[1]Peak Stage (ft)	Peak Storage (ac-ft)	Side Slopes H:V	Footprint DIMS X' by X'	Additional Area for Aesthetics** (ac)	Total Footprint Area (ac)
Loop 303											
	Cactus (LP2)	13	501.6	2447	574	10.1	383.0	4:1	1353 x 1353	3.8	42.8
	Northern (LP5)	21	736.7	5282	933	17.9	613.0	4:1	1318 x 1318	3.7	43.6
	Camelback (LP8)	22	398.9	1375	258	15.8	313.0	4:1	975 x 975	2.8	24.6
	I-10 (LP12)	16	524.7	1359	286	13.0	373.0	4:1	1274 x 1274	3.6	40.9
	Yuma (LP14)	16	372.3	546	116	12.2	277.0	4:1	1076 x 1076	3.0	29.6
	MC-85 (LP16)	13	125.5	729	174	9.7	90.3	4:1	703 x 703	2.0	13.3
Reems											
	Northern (NR-RM)	22	1057.7	3427	675	17.4	824.0	4:1	1528 x 1528	4.3	57.9
Bullard											
	I-10 (BD2S)	14	132.2	3744	2568	10.5	143.0	4:1	696 x 696	2.0	13.1

*Used 3 ft freeboard to account for volume lost in final design due to aesthetic/multi-use features.
**Add 30 ft to top DIMS.
1. Interpolated from HEC-1 output file.
2. For a graphical represenation of alternative #3, refer to Figure 2.3 in section 2.1.2 entitled 'Description of the Recommended Alternatives.'

Tab... D

Baseline Alternative – Proposed Basin Summary and Design Characteristics***

Channel	Basin Location	Max. Depth Including freeboard* (ft)	Max. Volume Including freeboard (ac ft)	Qin [1]RPT/URS (cfs)	Qout [1]RPT/URS (cfs)	[2]Peak Stage* RPT/URS (ft)	Peak Storage RPT/URS (ac-ft)	Side Slopes H:V	Footprint DIMS X' by X'	Additional Area for Aesthetics** (ac)	Total Footprint Area (ac)
Loop 303											
PBASIN	Peoria (LP3)	30	488.0	4700/3846	2200/1791	N/A / 18	N/A /	4:1	740 x 1240	N/A	11.5
NBASIN	Northern (LP5)	30	488.0	2900/3002	1400/1427	N/A / 3	N/A /	4:1	740 x 1240	N/A	11.5
CBASIN	Camelback (LP8)	30	488.0	4700/3354	2200/1578	N/A / 24	N/A /	4:1	740 x 1240	N/A	11.5
TBASIN	Thomas (LP10)	30	488.0	3200/2020	1500/1002	N/A / 21	N/A /	4:1	740 x 1240	N/A	11.5

*Average stage is 21 ft.
**Add 30 ft to top DIMS.
***Bottom width is 500 ft by 1000 ft, D=30; SS=4:1; see "Estrella Corridor Study," Deleuw Cather & Company, 08/17/98.
1. RPT = Deleuw Cather Study, URS = Level II Phase II Alternative Analysis.
2. Interpolated from HEC-1 output file.
3. For a graphical represenation of the baseline alternative, refer to Figure 2.4 in section 2.1.2 entitled 'Description of the Recommended Alternatives.'

- 13.7 feet for Alternative 1
- 10.1 feet for Alternative 3

Loop 303 and Northern Avenue – Both alternatives 2 and 3 propose a detention basin at the intersection of Loop 303 and Northern Avenue.

The approximate basin footprints are as follows:

- 55.2 AC for Alternative 2
- 43.6 AC for Alternative 3

The approximate basin depths (including freeboard) are as follows:

- 21 feet for Alternative 2
- 21 feet for Alternative 3

The basin proposed for Alternative 2 is larger than Alternative 3 since the basin located upstream at Cactus Road in Alternative 3 is not proposed as part of Alternative 2.

The approximate peak stage within the basins is as follows:

- 17.3 feet for Alternative 2
- 17.9 feet for Alternative 3

Reems Road and Peoria Avenue – Both alternatives 1 and 2 propose a detention basin at the intersection of Reems Road and Peoria Avenue.

The approximate basin footprints are as follows:

- 26.7 AC for Alternative 1
- 25.6 AC for Alternative 2

The approximate basin depths (including freeboard) are as follows:

- 18 feet for Alternative 1
- 18 feet for Alternative 2

Due to the slight difference in the inflow hydrograph, the basin proposed with Alternative 1 must provide a larger storage volume.

The approximate peak stage within the basins is as follows:

- 15.6 feet for Alternative 1
- 15.3 feet for Alternative 2

Reems Road and Northern Avenue – Alternatives 1 through 3 propose a detention basin at the intersection of Reems Road and Northern Avenue.

The approximate basin footprints are as follows:

- 22.4 AC for Alternative 1
- 40.6 AC for Alternative 2
- 57.9 AC for Alternative 3

The approximate basin depths (including freeboard) are as follows:

- 22 feet for Alternative 1
- 23 feet for Alternative 2
- 22 feet for Alternative 3

The approximate peak stage within the basins is as follows:

- 17.1 feet for Alternative 1
- 17.9 feet for Alternative 2
- 17.4 feet for Alternative 3

The relatively small footprint associated with the proposed detention basin for Alternative 1 is a result of three basins upstream that help to attenuate the inflow. More importantly, the proposed Northern Avenue Channel does not accept flow from the proposed Beardsley Channel as it does in alternatives 2 and 3.

Loop 303 and Camelback Road – Alternatives 2 and 3 propose a detention basin at the intersection of Loop 303 and Camelback Road.

The approximate basin footprints are as follows:

- 44.8 AC for Alternative 2
- 24.6 AC for Alternative 3

The approximate basin depths (including freeboard) are as follows:

- 23 feet for Alternative 2
- 22 feet for Alternative 3

The approximate peak stage within the basins is as follows:

- 19.8 feet for Alternative 2
- 15.8 feet for Alternative 3

The proposed basin for Alternative 3 is much smaller than Alternative 2. This is due to the fact that the proposed channel along Camelback Road in Alternative 2 extends west to the WT FRS #3 and the proposed channel for Alternative 3 begins at Loop 303. Therefore, the additional volume conveyed by the Camelback Channel from the west in Alternative 2 requires a larger basin at this location.

Loop 303 and I-10 – Alternatives 2 and 3 propose a detention basin at the intersection of Loop 303 and I-10.

The approximate basin footprints are as follows:

- 52.3 AC for Alternative 2
- 40.9 AC for Alternative 3

The approximate basin depths (including freeboard) are as follows:

- 16 feet for Alternative 2
- 16 feet for Alternative 3

The approximate peak stage within the basins is as follows:

- 12.8 feet for Alternative 2
- 13.0 feet for Alternative 3

The proposed basin for Alternative 2 is much larger than Alternative 3. This is due to the additional runoff volume conveyed from the west by the channel proposed along I-10 at this location. Alternative 3 does not propose a channel along I-10. In addition, the portion of volume conveyed by the proposed Camelback Road channel west of Loop 303 and diverted south in the proposed Loop 303 channel is not present in Alternative 3 since this channel section is not proposed as a part of that alternative.

Bullard Wash and I-10 – Alternatives 2 and 3 propose a detention basin at the intersection of Bullard Wash and I-10.

The approximate basin footprints are as follows:

- 13.1 AC for Alternative 2
- 13.1 AC for Alternative 3

The approximate basin depths (including freeboard) are as follows:

- 14 feet for Alternative 2
- 14 feet for Alternative 3

The approximate peak stage within the basins is as follows:

- 10.7 feet for Alternative 2
- 10.5 feet for Alternative 3

2.3.3 Alternatives Impact on ADOT Basins

In order to determine the actual impact of the proposed alternatives on the existing I-10 / ADOT detention basins, the volume and other characteristics of the basins must be determined. Several different sources are available documenting these characteristics. URS consulted all of these sources and then computed stage – area – volume relations using the current 2-foot contour interval (2-foot CI) topography provided by the FCDMC. Four sources of information regarding the ADOT basins have been consulted and reproduced for reference in Tables 2.5A-2.5E.

URS has used the following data to develop stage – storage – discharge tables for use in the HEC-1 input file regarding the ADOT basins.

- Basin connector pipes / outfalls were assumed unchanged since the basins were constructed. Therefore, this information was used to describe the outflow characteristics. The information was taken from the original WLB ADMP HEC-1 model.
- The current 2-foot CI mapping was used to develop stage – storage curves. Mounds formed by dumped dirt and open pits recently dug and fenced have occurred since the basins were constructed in the late 1970's. In addition, connector / outfall pipe inverts are given in the

WLB ADMP model. These inverts are lower, than the minimum contours shown on the 2-foot CI mapping data. Therefore, the pipe inverts were incorporated into the stage – storage curves by assuming that they are the first point on the curve having "zero" area.

The stage – storage – discharge curves developed for the ADOT basins for the ADMP Update were the basis for the "URS" column of data shown in Tables 2.5A-2.5E. This data was modified when necessary during the Level II Phase II analysis to simulate improvements required in the existing ADOT basins to ensure the adequate performance of an alternative when additional discharge was conveyed to the existing ADOT basins.

It is generally accepted that although these basins were constructed as part of the original I-10 construction and were designed to accept storm water runoff generated by the 50-year, 24-hour storm event, they have significant excess volume in terms of the 100-year, 24-hour storm event. The reason for this appears to be the fact that the basins were also a source of borrow material used to construct the I-10 roadway.

From the Draft Existing Condition Hydrology model prepared by URS, the existing basins provide approximately 1,125 AF of volume. Presently, the basins are storing approximately 700 AF of runoff volume generated on the contributing watershed area. This area includes a large portion of the Palm Valley development directly north of the basins. This portion of the Palm Valley development has been permitted to drain all storm water runoff generated onsite to the existing ADOT basins. This portion of Palm Valley does not provide onsite retention or detention. See the *Master Drainage Study for Palm Valley*, revised July 1999.

The amount of volume provided by the basins is given for a maximum WSEL of approximately 986 feet. This elevation is the elevation at which runoff might begin overtopping portions of the basins when they are modeled as a single basin. The value is based on the 2-foot CI data. Although the eastern two basins will probably not overtop at WSEL's of 986 feet, the western two will and, therefore, when modeled as a single basin, 986 feet is a conservative estimate for the maximum overtopping elevation. This elevation does not account for any freeboard.

The Draft Existing Condition Hydrology model prepared by URS models the basins separately with HEC-1. From the model, a range of peak stage elevations was shown to be 978.8 feet in the western-most basin to 986.8 feet in the eastern-most basin. Since the 2-foot CI data indicate that overtopping in the eastern-most basin will not occur until elevation 988 feet, the WSEL of 986.8 feet does not overflow. For detailed information on the individual existing ADOT basins and their capacities see Tables 2.6A-2.6E.

Table 2.[illegible]

Existing ADOT Basin(s) Capacity

ADOT Basins Analyzed as a Single Facility

Design Storm (Yr-Duration)	Q_{in} Peak (cfs)	Q_{out} Peak (cfs)	Peak[1,10] Stage (ft)	Max.[2] Ponding Elevation (ft)	Peak Storage (ac-ft)	Max. Storage (ac-ft)	Data Source (Design Report)
50-24	965[3]	58[4]	982.1	983.4	810[5]	1020	Offsite Drainage Design Report, I-IG-10-2(37)C, Ehrenberg-Phoenix, Highway, Bullard-Dysart Road, Dibble and Associates, January, 1976.
100-24	1,861	67	979.3 - 982.8	Varies[8,9]	514.2	1541.6	White Tanks/Agua Fria Area Drainage Master Study, Part A: Flood Study Technical Data Notebook, By: The WLB Group, Inc., October 1992
100-24	2,100[6]/3,600[7]	62[6]/67[7]	981[6]/982.5[7]	988	510[6]/650[7]	1350.0	Palm Valley Phase I, Golf Course LOMR, RID Canal Overchute to ADOT Detention Basins, by The WLB Group, 2/298.
100-24	4,303	99	979.7	984	416.0	725.0	I-10/Litchfield Road Basins, Final Hydrology Study, by Parsons Brinckerhoff, 7/23/99.
100-24	2,797	77	978.8 - 986.8	986	700.6	1125.7	URS Draft Existing Condition Hydrology, 6/29/01.

1. May not include freeboard.
2. Overflow elevation. Freeboard is equal to peak stage minus max. ponding elevation.
3. Sum of discharges 1-3 from Hydrologic Design Data Sheets, SCS Method, 50-year, 24-hour event.
4. From stage-storage-discharge curve for Alternate 3, 48" pipe.
5 From stage-storage-discharge curve for Alternate 3, 48" pipe.
6. Existing discharge.
7. Post development discharge.
8. See Flood Study Technical Data Notebook for the White Tanks/Agua Fria ADMS, Appendix I, Vol. 10 of 15 by WLB, dated 5/28/92.
9. Max. ponding elevations are: Basin A = 988.8'; Basin B = 987.3'; Basin C = 988.6'; Basin D = 990.5'.
10. WLB and URS values represent the range from lowest to highest WSEL computed within the 4 basins - these models look at each basin individually.

Table [illegible]B

Existing
ADOT Basin(s)
Capacity

ADOT Basins "A"

Design Storm (Yr-Duration)	Q_{in} Peak (cfs)	Q_{out} Peak (cfs)	Peak[1] Stage (ft)	Max.[2] Ponding Elevation (ft)	Peak Storage (ac-ft)	Max. Storage (ac-ft)	Data Source (Design Report)
50-24	n/a	n/a	n/a	n/a	n/a	n/a	Offsite Drainage Design Report, I-IG-10-2(37)C, Ehrenberg-Phoenix, Highway, Bullard-Dysart Road, Dibble and Associates, January, 1976.
100-24	618	55	981.18	988.8	106.5	423.01	WLB[8]
100-24	n/a	n/a	n/a	n/a	n/a	n/a	PV
100-24	n/a	n/a	n/a	n/a	n/a	n/a	PB
100-24	245	23	978.75	986	25.9	265.17	URS

1. Does not include freeboard.
2. Overflow elevation. Freeboard is equal to peak stage minus max. ponding elevation.
3. Sum of discharges 1-3 from Hydrologic Design Data Sheets, SCS Method, 50-year, 24-hour event.
4. From stage-storage-discharge curve for Alternate 3, 48" pipe.
5 From stage-storage-discharge curve for Alternate 3, 48" pipe.
6. Existing discharge.
7. Post development discharge.
8. See Flood Study Technical Data Notebook for the White Tanks/Agua Fria ADMS, Appendix I, Vol. 10 of 15 by WLB, dated 5/28/92.

Table [illegible]C

Existing
ADOT Basin(s)
Capacity

ADOT Basins "B"

Design Storm (Yr-Duration)	Q_{in} Peak (cfs)	Q_{out} Peak (cfs)	Peak[1] Stage (ft)	Max.[2] Ponding Elevation (ft)	Peak Storage (ac-ft)	Max. Storage (ac-ft)	Data Source (Design Report)
50-24	n/a	n/a	n/a	n/a	n/a	n/a	Offsite Drainage Design Report, I-IG-10-2(37)C, Ehrenberg-Phoenix, Highway, Bullard-Dysart Road, Dibble and Associates, January, 1976.
100-24	212	65	980.06	987.3	39	132.52	WLB[8]
100-24	n/a	n/a	n/a	n/a	n/a	n/a	PV
100-24	n/a	n/a	n/a	n/a	n/a	n/a	PB
100-24	692	252	981.9	988	56	136.43	URS

1. Does not include freeboard.
2. Overflow elevation. Freeboard is equal to peak stage minus max. ponding elevation.
3. Sum of discharges 1-3 from Hydrologic Design Data Sheets, SCS Method, 50-year, 24-hour event.
4. From stage-storage-discharge curve for Alternate 3, 48" pipe.
5 From stage-storage-discharge curve for Alternate 3, 48" pipe.
6. Existing discharge.
7. Post development discharge.
8. See Flood Study Technical Data Notebook for the White Tanks/Agua Fria ADMS, Appendix I, Vol. 10 of 15 by WLB, dated 5/28/92.

Table [illegible]D

Existing
ADOT Basin(s)
Capacity

ADOT Basins "C"

Design Storm (Yr-Duration)	Q_{in} Peak (cfs)	Q_{out} Peak (cfs)	Peak[1] Stage (ft)	Max.[2] Ponding Elevation (ft)	Peak Storage (ac-ft)	Max. Storage (ac-ft)	Data Source (Design Report)
50-24	n/a	n/a	n/a	n/a	n/a	n/a	Offsite Drainage Design Report, I-IG-10-2(37)C, Ehrenberg-Phoenix, Highway, Bullard-Dysart Road, Dibble and Associates, January, 1976.
100-24	649	376	979.28	988.6	122.6	453.25	WLB[8]
100-24	n/a	n/a	n/a	n/a	n/a	n/a	PV
100-24	n/a	n/a	n/a	n/a	n/a	n/a	PB
100-24	1400	460	983.43	986	237.7	324.54	URS

1. Does not include freeboard.
2. Overflow elevation. Freeboard is equal to peak stage minus max. ponding elevation.
3. Sum of discharges 1-3 from Hydrologic Design Data Sheets, SCS Method, 50-year, 24-hour event.
4. From stage-storage-discharge curve for Alternate 3, 48" pipe.
5 From stage-storage-discharge curve for Alternate 3, 48" pipe.
6. Existing discharge.
7. Post development discharge.
8. See Flood Study Technical Data Notebook for the White Tanks/Agua Fria ADMS, Appendix I, Vol. 10 of 15 by WLB, dated 5/28/92.

Table 2.6E

Existing
ADOT Basin(s)
Capacity

ADOT Basins "D"

Design Storm (Yr-Duration)	Q_{in} Peak (cfs)	Q_{out} Peak (cfs)	Peak[1] Stage (ft)	Max.[2] Ponding Elevation (ft)	Peak Storage (ac-ft)	Max. Storage (ac-ft)	Data Source (Design Report)
50-24	n/a	n/a	n/a	n/a	n/a	n/a	Offsite Drainage Design Report, I-IG-10-2(37)C, Ehrenberg-Phoenix, Highway, Bullard-Dysart Road, Dibble and Associates, January, 1976.
100-24	382	67	982.8	990.5	246.1	532.82	WLB[8]
100-24	n/a	n/a	n/a	n/a	n/a	n/a	PV
100-24	n/a	n/a	n/a	n/a	n/a	n/a	PB
100-24	460	77	986.8	988	381	399.54	URS

1. Does not include freeboard.
2. Overflow elevation. Freeboard is equal to peak stage minus max. ponding elevation.
3. Sum of discharges 1-3 from Hydrologic Design Data Sheets, SCS Method, 50-year, 24-hour event.
4. From stage-storage-discharge curve for Alternate 3, 48" pipe.
5 From stage-storage-discharge curve for Alternate 3, 48" pipe.
6. Existing discharge.
7. Post development discharge.
8. See Flood Study Technical Data Notebook for the White Tanks/Agua Fria ADMS, Appendix I, Vol. 10 of 15 by WLB, dated 5/28/92.

2.3.3.1 Proposed Alternatives and the ADOT Basins

Each proposed alternative has incorporated the use of the ADOT basins as a main outfall for storm water runoff generated upstream and conveyed by proposed flood control channels. The results of the analysis are briefly discussed below. See Tables 2.7A-2.7C for a summary of the proposed / improved ADOT basins per alternative. Refer to Figures 2.1 – 2.4 for a graphical representation of the ADOT basins.

Alternative 1 – As part of Alternative 1, the proposed inflow at the existing ADOT basin 'A' (the western-most basin) is estimated at 4,555 cfs. This is almost 20 times the existing inflow of approximately 245 cfs. The reason for this large increase in inflow is due to the proposed West Valley Regional Drain (WVRD) channel that concentrates and conveys a large amount of flow from the upstream reaches in the watershed to the ADOT basins. This large inflow requires that the existing ADOT Basin 'A' be enlarged by approximately 815 AF. The basin connector / outfall pipes will also be improved by adding 6-60" RCP's.

The inflow to the existing ADOT Basin 'B', just east of Basin 'A', has increased from approximately 692 cfs to approximately 842 cfs. This increase requires that the basin be enlarged by approximately 30.5 AF. The basin connector / outfall pipes will also be improved by adding 4-60" RCP's.

The inflow to the existing ADOT Basin 'C', just east of Basin 'B', has increased from approximately 1,400 cfs to approximately 1,425 cfs. This increase requires that the basin be enlarged by approximately 81 AF. The basin connector / outfall pipes will also be improved by adding 3-60" RCP's.

The inflow to the existing ADOT Basin 'D', just east of Basin 'C', has increased from approximately 460 cfs to approximately 814 cfs. This increase requires that the basin be enlarged by approximately 74 AF. The basin existing outfall pipe to the Agua Fria River will also be improved by adding 5-60" RCP's.

Alternative 2 – As part of Alternative 2, the proposed inflow at the existing ADOT Basin 'A' (the western-most basin) is estimated at 525 cfs. The existing inflow to ADOT Basin 'A' is approximately 245 cfs. The increased inflow is due to the proposed detention basin located west at the intersection of the Bullard Wash and I-10. At this location, a large portion of the storm water routed through the basin is diverted to the ADOT basins. This increased inflow requires that the existing ADOT Basin 'A' be enlarged by approximately 75 AF. Preliminary analysis indicates that under Alternative 2, the basin connector / outfall pipes should be improved by adding a single 60" RCP.

Table 2.7A

Alternative #1 – ADOT Basin Improvements

Basin ID	[1]Existing Footprint (ac)	Existing Volume (ac-ft)	[1]Prop. Footprint (ac)	[2]Prop. Volume (ac-ft)	Additional Area Required (ac/sy)	Additional Volume Required (ac-ft/cy)	Peak Stage (ft)	Peak Storage (ac-ft)	Qin (cfs)	Qout (cfs)	Outlet Upgrade (Y or N)	Outlet Storage
[3]A	37.3	265.2	94.4	1079.8	57/	814.6/	985.0	983	4,555	838	Y	6-60" RCPs
B	13.0	109.0	13.6	139.5	0.6/	30.5/	982.8	97.6	842	833	Y	4-60" RCPs
C	35.5	324.5	36.1	405.8	0.6/	81.3/	983.2	307.4	1,425	814	Y	3-60" RCPs
D	31.6	334.7	32.3	409.0	0.7/	74.3/	983.4	325.6	814	713	Y	5-60" RCPs

1. Assumes 986 ft top of basin.
2. Includes freeboard.
3. Basins were not optimized. Peak stage of 986.3 ft in "A" was close to 986 ft max and therefore not changed. This is the value associated with 986.3 ft.

Table 2.7B

Alternative #2 – ADOT Basin Improvements

Basin ID	[1]Existing Footprint (ac)	Existing Volume (ac-ft)	[1]Prop. Footprint (ac)	[2]Prop. Volume (ac-ft)	Additional Area Required (ac/sy)	Additional Volume Required (ac-ft/cy)	Peak Stage (ft)	Peak Storage (ac-ft)	Qin (cfs)	Qout (cfs)	Outlet Upgrade (Y or N)	Outlet Storage
A	37.3	265.2	37.3	340.2	N/A	75/	984.3	278.6	525	166	Y	1-60" RCP
B	No IMPs	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N	N/A
C	No IMPs	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N	N/A
D	31.6	314.8	46.5	600.0	15/	285/	980.9	373.5	460	172	Y	1-60" RCP

1. Assumes 986 ft top of basin.
2. Includes freeboard.

Table 2.7C

Alternative #3 – ADOT Basin Improvements

Basin ID	[1]Existing Footprint (ac)	Existing Volume (ac-ft)	[1]Prop. Footprint (ac)	[2]Prop. Volume (ac-ft)	Additional Area Required (ac/sy)	Additional Volume Required (ac-ft/cy)	Peak Stage (ft)	Peak Storage (ac-ft)	Qin (cfs)	Qout (cfs)	Outlet Upgrade (Y or N)	Outlet Storage
A	37.3	265.2	N/A	N/A	N/A	N/A	981.1	90.6	305	55	N	N/A
B	13.0	109.0	N/A	N/A	N/A	N/A	981.9	56.0	688	254	N	N/A
C	35.5	324.5	N/A	N/A	N/A	N/A	983.5	239.4	1,375	460	N	N/A
D	31.6	334.7	31.6	375.0	N/A	60/	983.0	287.8	460	198	Y	1-60" RCP

1. Assumes 986 ft top of basin.
2. Includes freeboard.

Due to the effects of routing and timing, the combined peak inflow discharge at ADOT Basin 'B' remains relatively unchanged from the existing condition. However, the total inflow volume to ADOT Basin 'B' is somewhat higher. The existing basin can adequately handle this increase in volume and will not require improvement.

Similarly, the increased flow to ADOT Basin 'C', just east of Basin 'B', is adequately stored by Basin 'C'.

Due to the effects of routing and timing, the combined peak inflow discharge at ADOT Basin 'D' remains relatively unchanged from the existing condition. However, the volume increase to this basin requires that the basin be improved to adequately store the increase in runoff. This increase requires that the basin be enlarged by approximately 285 AF. Preliminary analysis shows that the basin existing outfall pipe to the Agua Fria River will also be improved by adding 1-60" RCP.

Alternative 3 – As part of Alternative 3, the proposed inflow at the existing ADOT Basin 'A' (the western-most basin) is estimated at 305 cfs. Although the peak inflow and volume have increased, the existing basin has enough capacity to adequately route the increased flow.

As in Alternative 2, this increase in flow is due to the proposed detention basin located west at the intersection of the Bullard Wash and I-10. At this location, a portion of the storm water routed through the basin is diverted to the ADOT basins.

Both ADOT Basins 'B' and 'C' also have adequate volume to safely route the higher discharges and volumes. Neither ADOT Basin 'B' or 'C' will require improvement.

Due to the effects of routing and timing, the combined peak inflow discharge at ADOT Basin 'D' remains relatively unchanged from the existing condition. However, the volume increase to this basin requires that the basin be improved to adequately store the increase in runoff. This increase requires that the basin be enlarged by approximately 60 AF. Preliminary analysis shows that the basin existing outfall pipe to the Agua Fria River will also be improved by adding 1-60" RCP.

2.3.4 Alternatives Impact to Existing Facilities

The impact of the proposed channels and basins associated with the individual alternatives on existing flood control facilities already in place in the ADMP Update area has been tabulated on Table 2.8. At this level of analysis, the concepts proposed for channels and basins in the Level I phase of analysis have been implemented and modeled for the recommended alternatives 1 through 3. Table 2.8 indicates the preliminary results of the proposed alternatives on existing facilities and provides a detailed summary. From this impact analysis, some changes may be required at Level III to eliminate any adverse impacts on existing facilities that may receive more discharge for a given alternative than under existing conditions.

Three sets of numbers were compiled for comparison at each facility already in existence in the ADMP Update area. These numbers included the original design discharge used to construct the facility, the revised existing discharge estimated by the Hydrology Update and finally the discharge estimated at the facility after the modeling of proposed channels and basins for each alternative was completed.

The proposed alternatives also resulted in the potential to remove some land from existing floodplains. The estimate of potential floodplain removal by each alternative follows:

- Alternative 1: 158,000 LF potentially removed
- Alternative 2: 177,000 LF potentially removed
- Alternative 3: 164,000 LF potentially removed

Baseline Alternative: 0 LF potentially removed

2.3.4.1 Proposed Alternatives and Existing Facilities

A brief discussion of each existing facility and the impacts to it by the proposed alternatives has been included below. For more detail, refer to Table 2.8. Although the existing condition flow rates at these facilities are given on Table 2.8, only general comments will be made regarding them here. For a detailed analysis and discussion of the draft existing condition flow rates and their impacts to the existing flood control facilities, refer to Section 5.2 of the *Existing Condition Hydrology Report* by URS. For reference, refer to the HEC-1 Key Map included with the *Existing Condition Hydrology Report* submitted under separate cover. This map has been provided here as Figure 2.6.

Reems Road Channel – The existing portion of the Reems Road channel from Bell Road south to approximately Hearn Road (1/2 mile north of Waddell Road) may require improvements to continue to provide adequate conveyance for the 100-year, 24-hour storm event. This was immediately evident by the large existing flow rate estimated by the *Existing Condition Hydrology Report* relative to the design flows used to construct the channel.

As discussed in the *Existing Condition Hydrology Report*, this change in discharge is due primarily to the fact that the contributing area to the existing upper-most channel reaches increased by approximately 30%. This was a result of significant regrading of the Reems Road alignment by the Sun City Grand development upstream. Another contributing factor to this large difference in discharge is a result of the assumption by the Existing Condition Hydrology model that onsite retention existing within sub-areas contributing to the runoff conveyed by the existing Reems Road channel are only 80% efficient. This assumption results in larger discharges downstream.

Table 2.8

Effect of Alternatives on Existing Facilities

Facility Name	Design Discharge/Inflow (cfs)	Peak Stage (ft)	Peak/Total Volume (ac-ft)	Proposed Alternative #1			Proposed Alternative #2			Proposed Alternative #3			Baseline Alternative			Draft Existing		
				Discharge (cfs)	Stage (ft)	Peak V (ac-ft)	Discharge (cfs)	Stage (ft)	Peak V (ac-ft)	Discharge (cfs)	Stage (ft)	Peak V (ac-ft)	Discharge (cfs)	Stage (ft)	Peak V (ac-ft)	Discharge (cfs)	Stage (ft)	Peak V (ac-ft)
Reems Road Channel																		
CP122A	414	n/a	n/a	1115	n/a	n/a	1115	n/a	n/a	1115	n/a	n/a	1115	n/a	n/a	911	n/a	n/a
CP133	743	n/a	n/a	1062	n/a	n/a	1062	n/a	n/a	1062	n/a	n/a	1062	n/a	n/a	1005	n/a	n/a
Falcon Dunes																		
CP194B	1840	1099.9	407/550	468	1096.9	211	521	1098.2	302	676	1098.8	342	598	1094.7	92	933	1097.0	207
Dysart Drain																		
Inflow from golf course	448	n/a	n/a	283	n/a	n/a	355	n/a	n/a	384	n/a	n/a	167	n/a	n/a	287	n/a	n/a
CP195	1772	n/a	n/a	2153	n/a	n/a	2730	n/a	n/a	1908	n/a	n/a	1097	n/a	n/a	1358	n/a	n/a
CP196	2300	n/a	n/a	2259	n/a	n/a	2755	n/a	n/a	1993	n/a	n/a	1227	n/a	n/a	1627	n/a	n/a
CP202	2287	n/a	n/a	2339	n/a	n/a	2829	n/a	n/a	2998	n/a	n/a	1316	n/a	n/a	1625	n/a	n/a
CP205	3984	n/a	n/a	2813	n/a	n/a	3301	n/a	n/a	3297	n/a	n/a	2031	n/a	n/a	2512	n/a	n/a
Colter Channel																		
CP242	1060	n/a	n/a	1054	n/a	n/a	1054	n/a	n/a	1054	n/a	n/a	1054	n/a	n/a	1054	n/a	n/a
CP243A	1161	n/a	n/a	1160	n/a	n/a	1160	n/a	n/a	1160	n/a	n/a	1160	n/a	n/a	1160	n/a	n/a
CP244B	1210	n/a	n/a	1160	n/a	n/a	1160	n/a	n/a	1160	n/a	n/a	1160	n/a	n/a	1159	n/a	n/a
CP245	1900	n/a	n/a	1132	n/a	n/a	1132	n/a	n/a	1132	n/a	n/a	1132	n/a	n/a	1130	n/a	n/a
Camelback Channel																		
242A	135	n/a	n/a	204	n/a	n/a	204	n/a	n/a	204	n/a	n/a	204	n/a	n/a	204	n/a	n/a
CP242B	505	n/a	n/a	678	n/a	n/a	678	n/a	n/a	678	n/a	n/a	678	n/a	n/a	678	n/a	n/a
CP243	603	n/a	n/a	650	n/a	n/a	650	n/a	n/a	650	n/a	n/a	650	n/a	n/a	650	n/a	n/a
CP245A	725	n/a	n/a	617	n/a	n/a	617	n/a	n/a	617	n/a	n/a	617	n/a	n/a	617	n/a	n/a
[3] *Indian School*																		
CP250A	510	n/a	n/a	268	n/a	n/a	268	n/a	n/a	268	n/a	n/a	268	n/a	n/a	478	n/a	n/a
CP251	560	n/a	n/a	482	n/a	n/a	482	n/a	n/a	482	n/a	n/a	482	n/a	n/a	1457	n/a	n/a
CP252	560	n/a	n/a	621	n/a	n/a	621	n/a	n/a	621	n/a	n/a	621	n/a	n/a	1597	n/a	n/a
CP253	3860	n/a	n/a	3268	n/a	n/a	2865	n/a	n/a	3110	n/a	n/a	2599	n/a	n/a	2606	n/a	n/a
RID Overchute																		
CP2712	1456	n/a	n/a	1339	n/a	n/a	1339	n/a	n/a	1339	n/a	n/a	1339	n/a	n/a	1339	n/a	n/a
Bullard Wash/Pebble Creek																		
CP253	3700	n/a	n/a	3249	n/a	n/a	3174	n/a	n/a	3351	n/a	n/a	2519	n/a	n/a	2606	n/a	n/a
CP267	3860	n/a	n/a	3645	n/a	n/a	3526	n/a	n/a	3711	n/a	n/a	2513	n/a	n/a	2525	n/a	n/a
Bullard Wash Outfall																		
[1]BLRD2	3200	n/a	n/a	3149	n/a	n/a	3414	n/a	n/a	3179	n/a	n/a	2440	n/a	n/a	2453	n/a	n/a
White Tanks 4 Inlet Channel																		
I10WT4	2206	n/a	n/a	2226	n/a	n/a	2020	n/a	n/a	2659	n/a	n/a	2216	n/a	n/a	2216	n/a	n/a
White Tanks 3																		
CPWT3	n/a	n/a	2655	n/a	n/a	1175	n/a	n/a	1175	n/a	n/a	1113	n/a	n/a	956	n/a	n/a	956
White Tanks 4																		
CPWT4	n/a	n/a	1036	n/a	n/a	767	n/a	n/a	767	n/a	n/a	[2]814	n/a	n/a	767	n/a	n/a	767

This value will be limited to 3,200 cfs. Any value shown that exceeds this will be refined during the Level III portion of the analysis.
2. Alternative 3 routes sub basin 232 to White Tanks FRS #4 - Alternatives 1, 2 and Baseline do not.
3. These are the ultimate discharges assuming Camelback Road Channel is in place. For the interim, the values are 1,250 cfs, 1,420 cfs, 2,670 cfs and 3,390 cfs.

The range of design discharges for the existing Reems Road Channel as well as those computed at the channel for alternatives 1 through 3 and the baseline are shown below.

- 414 cfs to 743 cfs – Facility Design Discharge Range
- 1,115 cfs to 1,062 cfs – Alternative 1
- 1,115 cfs to 1,062 cfs – Alternative 2
- 1,115 cfs to 1,062 cfs – Alternative 3
- 1,115 cfs to 1,062 cfs – Baseline Alternative

Note that the three alternatives and the Baseline Alternative result in identical discharges at this location. This is due to the fact that all of these alternatives are the same in this area of the project.

Falcon Dunes Detention Basin – With all of the alternatives, the peak inflow at Falcon Dunes has been significantly reduced. This is due primarily to the addition of the Loop 303 channel and the proposed basin at the northwest corner of Reems Road and Northern Avenue.

The range of design inflow rates for the existing Falcon Dunes as well as those computed at the basin for alternatives 1 through 3 and the baseline are shown below.

- 1,840 cfs – Facility Design Inflow Rate (approximate)
- 468 cfs – Alternative 1
- 521 cfs – Alternative 2
- 676 cfs – Alternative 3
- 598 cfs – Baseline Alternative

Dysart Drain – Generally, the flow rates on the existing Dysart Drain are lower west to the 1/2-mile point between Bullard Avenue and Litchfield Road and slightly higher to the east for alternatives 1 through 3. This is due to the fact that all three alternatives propose an additional inflow channel point from the north into the Dysart Drain at this location. The inflow channel runs north to south along the AT&SF Railroad alignment. The draft existing condition flow rates are actually lower along the drain than the design discharges.

The channel reaches in which discharges increased may require detailed analysis during Level III to ensure that the drain will continue to provide adequate conveyance and freeboard during the

SUB BASIN MAP
LOOP 303 CORRIDOR/WHITE TANKS AREA DRAINAGE MASTER PLAN UPDATE
EXISTING CONDITION

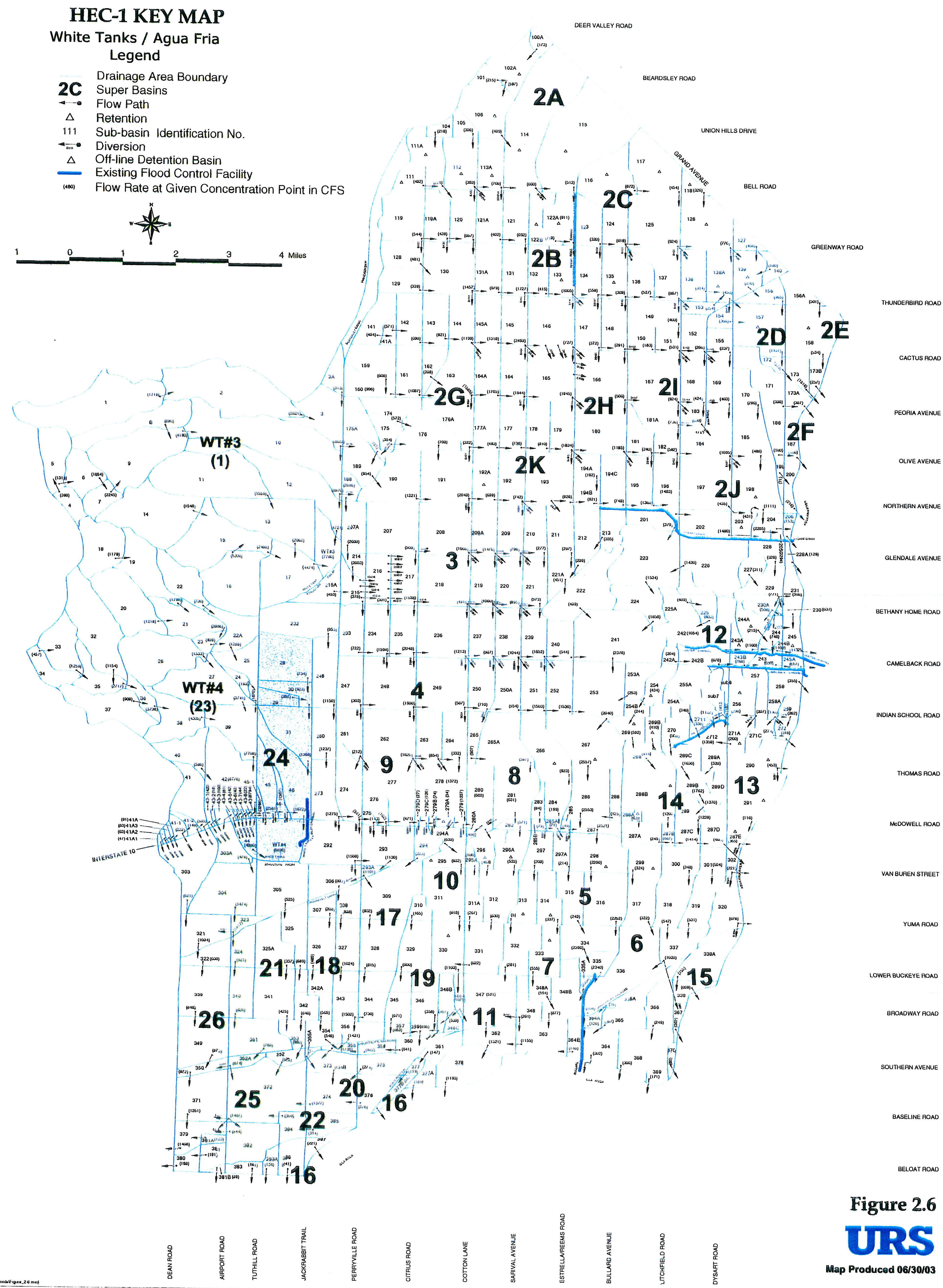


Figure 2.6

URS

Map Produced 06/30/03

100-year, 24-hour storm event. A detention basin upstream of the proposed channel tie-in point along the Dysart Drain may be required to attenuate the additional inflow to limit the flow rates.

The range of design inflow rates for the existing Dysart Drain as well as those computed at the channel for alternatives 1 through 3 and the baseline are shown below.

- 448 cfs to 3,984 cfs – Facility Design Inflow Rate
- 283 cfs to 2,813 cfs – Alternative 1
- 355 cfs to 3,301 cfs – Alternative 2
- 384 cfs to 3,297 cfs – Alternative 3
- 167 cfs to 2,031 cfs – Baseline Alternative

Colter Channel – The discharge rates computed for the Colter Channel by each of the alternatives as well as the draft existing condition hydrology are lower than the design discharges. The discharges computed for each of the proposed condition models are identical due the fact that no significant improvements are being proposed in the contributing watershed.

The range of design inflow rates for the existing Colter Channel as well as those computed at the channel for alternatives 1 through 3 and the baseline are shown below.

- 1,060 cfs to 1,900 cfs – Facility Design Inflow Rate
- 1,054 cfs to 1,132 cfs – Alternative 1
- 1,054 cfs to 1,132 cfs – Alternative 2
- 1,054 cfs to 1,132 cfs – Alternative 3
- 1,054 cfs to 1,130 cfs – Baseline Alternative

Camelback Channel – The discharge rates computed for the Camelback Channel by each of the alternatives as well as the draft existing condition hydrology are generally the same or slightly higher than the design discharges. The discharges computed for each of the proposed condition models are identical due the fact that no significant improvements are being proposed in the contributing watershed.

The range of design inflow rates for the existing Camelback Channel as well as those computed at the channel for alternatives 1 through 3 and the baseline are shown below.

- 135 cfs to 725 cfs – Facility Design Inflow Rate
- 204 cfs to 617 cfs – Alternative 1

- 204 cfs to 617 cfs – Alternative 2
- 204 cfs to 617 cfs – Alternative 3
- 204 cfs to 617 cfs – Baseline Alternative

Detailed analysis of this channel and the effects of the increased discharge may be required during the Level III portion of this analysis to ensure that the facility can continue to provide adequate flood protection consistent with its original design intent.

Note that the proposed alternatives do not change the discharge rates from those estimated by the draft hydrology model.

Indian School Road Channel – The discharge rates computed for the Indian School Road Channel by all of the alternatives are generally lower than the design discharges. The discharges computed for the proposed condition alternatives 1 through 3 are similar since there are no significant differences between the three. The variability in the discharges computed at the intersection of the Indian School Road Channel and the Bullard Wash is due to the additional discharge combining from the Bullard Wash north.

The Indian School Road Channel is an interim channel constructed by the Palm Valley / Pebble Creek development to provide flood control for downstream residents until the phases north of Indian School Road are developed and provide on-sight stormwater retention.

The range of design inflow rates for the existing Indian School Road Channel as well as those computed at the channel for alternatives 1 through 3 and the baseline are shown below.

- 510 cfs to 3,860 cfs – Facility Design Inflow Rate
- 268 cfs to 3,268 cfs – Alternative 1
- 268 cfs to 2,865 cfs – Alternative 2
- 268 cfs to 3,110 cfs – Alternative 3
- 268 cfs to 2,599 cfs – Baseline Alternative

Although the range of flows indicate that the existing Indian School Road Channel is adequately sized, when each concentration point is evaluated, inflow rates at the intersection of Indian School Road and Reems Road are approximately 10% higher for proposed alternatives. Finally, the existing condition discharges along this channel alignment are significantly higher than those shown above.

Detailed analysis of this channel and the effects of the increased discharge may be required during the Level III portion of this analysis to ensure that the facility can continue to provide adequate flood protection consistent with its original design intent.

RID Overchute – The discharge rates computed at the RID Overchute by each of the alternatives as well as the draft existing hydrology are lower than the design discharge rate. The reason for this is probably attributable to the effects of recent development in contributing watersheds east of the overchute. Onsite retention in these areas may be the reason for the lowering of this peak flow rate.

The design inflow rate for the existing RID Overchute as well as that computed at the facility for alternatives 1 through 3 and the baseline are shown below.

- 1,456 cfs – Facility Design Inflow Rate
- 1,339 cfs – Alternative 1
- 1,339 cfs – Alternative 2
- 1,339 cfs – Alternative 3
- 1,339 cfs – Baseline Alternative

Since the contributing watershed area is unchanged by any of the three alternatives or the baseline condition, the discharges are identical.

Bullard Wash Golf Course Channel through Pebble Creek – The discharge rates computed for the Bullard Wash Golf Course Channel by each of the alternatives as well as the draft existing condition hydrology are generally lower than the design discharges. This may be attributable to the onsite retention provided by recent development upstream.

The range of flow rates for the draft existing condition hydrology and baseline model is much lower than those shown by alternatives 1 through 3. This is a result of the proposed channels along Camelback and further upstream on Bullard Wash that concentrate and convey additional storm water runoff to this location.

The range of design inflow rates for the existing Bullard Wash Golf Course Channel as well as those computed at the channel for alternatives 1 through 3 and the baseline are shown below.

- 4,121 cfs – Facility (existing) Design Inflow Rate
- 3,249 cfs to 3,645 cfs – Alternative 1
- 3,174 cfs to 3,526 cfs – Alternative 2

- 3,351 cfs to 3,711 cfs – Alternative 3
- 2,513 cfs to 2,519 cfs – Baseline Alternative

Bullard Wash Outfall Channel – The discharge rate computed for the Bullard Wash Outfall Channel by all of the alternatives as well as the draft existing condition hydrology is approximately 3,200 cfs or lower.

Note that the discharge at this location is being controlled by alternatives 1 through 3 by a proposed drainage structure at the intersection of the Bullard Wash and I-10. Using this facility, the desired amount of discharge may be metered out to the Bullard Wash while the balance is diverted east to the existing ADOT basins. Although Alternative 2 estimates the discharge at the outfall channel downstream of I-10 to be greater than 3,200 cfs, it will be refined at Level III to be equal to or less than 3,200cfs.

Both the baseline model and the draft existing condition model show a lower discharge at this location. This may be the result of upstream retention provided onsite by recent development.

The design inflow rate for the existing Bullard Wash Outfall Channel as well as those computed at the channel for alternatives 1 through 3 and the baseline are shown below.

- 3,200 cfs – Facility Design Inflow Rate
- 3,149 cfs – Alternative 1
- 3,414 cfs – Alternative 2
- 3,179 cfs – Alternative 3
- 2,440 cfs – Baseline Alternative

WT FRS #4 Inlet Channel – The discharge rate computed for the WT FRS #4 Inlet Channel by the alternatives is generally higher or similar to the same as the design discharge.

The discharge rate estimated by the draft existing condition hydrology and baseline model(s) is approximately equal to the design discharge. These discharges are identical since there is no proposed improvement in this area for the Baseline Alternative.

The design inflow rate for the existing WT FRS #4 Inlet Channel as well as those computed at the channel for alternatives 1 through 3 and the baseline are shown below.

- 2,206 cfs – Facility Design Inflow Rate
- 2,226 cfs – Alternative 1

- 2,020 cfs – Alternative 2
- 2,659 cfs – Alternative 3
- 2,216 cfs – Baseline Alternative

Detailed analysis of this channel and the effects of any possible increase in discharge may be required during the Level III portion of this analysis to ensure that the facility can continue to provide adequate flood protection consistent with its original design intent.

WT FRS #3 – With each of the alternatives and the draft existing condition hydrology, the inflow volume at the WT FRS #3 is lower than the design volume. The design inflow volumes referenced by this report were taken directly from the U.S. Army Corps of Engineers report dated 1956. Since the calculations showing the assumptions and contributing drainage areas were not made available by this report, the reason for the difference in volume can not be specifically determined. However, the difference is probably a combination of different modeling techniques, soils parameters and assumptions. Additionally, flow splits modeled along the Beardsley Canal in the draft existing model may have not have existed or been ignored by the original design. This could account for a more conservative estimate of inflow volume.

The design inflow volume for the existing WT FRS #3 as well as that computed at the structure for alternatives 1 through 3 and the baseline is shown below.

- 2,655 AF – Facility Design Inflow Volume
- 1,175 AF – Alternative 1
- 1,175 AF – Alternative 2
- 1,113 AF – Alternative 3
- 956 AF – Baseline Alternative

The WT FRS #3 is currently being studied by Dames & Moore for possible rehabilitation or replacement with one or more detention facilities. Other hydrologic investigations and models have since been conducted in tandem with the Dames & Moore Study by FCDMC staff which produce more conservative inflow volume results and may be used for this designed improvement.

For detailed information regarding this study, refer to the *Hydrologic Analysis for White Tanks Flood Retarding Structure No. 3 Watershed* dated May 2000. Also, see Section 1.3 of the *Draft Existing Condition Hydrology* by URS dated June 2001.

WT FRS #4 – With each of the alternatives and the draft existing condition hydrology, the inflow volume at the WT FRS #4 is lower than the design volume. The design inflow volumes referenced by this report were taken directly from the U.S. Army Corps of Engineers report dated 1956. Since the calculations showing the assumptions and contributing drainage areas were not made available by this report, the reason for the difference in volume can not be specifically determined. However, the difference is probably a combination of different modeling techniques, soils parameters and assumptions. Additionally, flow splits modeled along the Jackrabbit Trail alignment in the draft existing model may have not have existed or been ignored by the original design. This could account for a more conservative estimate of inflow volume.

The design inflow volume for the existing WT FRS #4 as well as that computed at the structure for alternatives 1 through 3 and the baseline is shown below.

- 1,036 AF – Facility Design Inflow Volume
- 767 AF – Alternative 1
- 767 AF – Alternative 2
- 767 AF – Alternative 3
- 767 AF – Baseline Alternative

Since this level of analysis is specifically for comparison of the three alternatives, the above information has been used in an informative manner only. No steps will be taken to analyze the above structures any further at this time. If the Level III analysis of the final preferred alternative indicates that an existing structure may be undersized to handle the proposed discharge, improvements may be required and specified for that structure at that time.

2.4 EVALUATION OF THE PROPOSED ALTERNATIVES

Upon completion of the hydrologic models developed to evaluate the hydraulic performance of each of the three alternatives, an evaluation of each of the alternatives including the baseline was performed. The purpose of this evaluation was to provide input data required for the alternative evaluation matrix that was used to compare or rank each alternative relative to the next. The matrix was initially developed and used with the Level I Alternatives Analysis and with the Level II Phase I – Bullard Wash Analysis. The matrix has been refined slightly and was used again with this Level II Phase II analysis to provide a ranking of the alternatives relative to one another. See Section 2.5 for detail on the weighted matrix and evaluation procedure.

2.4.1 General Considerations

As a part of the evaluation of each of the three alternatives and the Baseline Alternative, several pieces of information were assembled and reviewed to determine the most desirable combination of channels and basins that would effectively reduce flooding and provide development with discharge outfalls. These considerations are briefly discussed below.

Major Utilities – All of the data collected describing major utilities in the project area were logged and evaluated relative to the three alternatives and the baseline. This was done to determine the impacts each alternative might have on existing utilities. The utility information is not necessarily comprehensive but is hopefully indicative of the major conflicts that could be expected in the project area.

URS has made several requests for utility information from the utility companies present in the project area since the start of the ADMP Update project. To date all data received has been used with this portion of the analysis. Site visits were also used to identify potential utility conflicts. See the Utility Conflicts data tables in Appendix C for a summary of the alternatives and the potential utility conflicts based on the information received.

Land Use – This category is important to both the aesthetic / multi-use elements of the ADMP Update as well as the type of channel recommended to convey the runoff.

One goal of the ADMP Update is to provide channels and basins that are aesthetically pleasing and effectively blend with the adjacent land uses as well as to tie adjacent land uses together as the channel moves downstream. For this purpose, the emphasis is on desired future land use and character.

Another impact that land use has on the proposed alternatives is that of existing uses that will not change in the future. For example, it may be simpler to place a channel in a rural area that will be fully developed in the future than through an alternative route that is currently built-out. An assumption the study team made is that the built-out area may restrict the channel top width and create several conflicts ranging from utilities to business access across such a channel.

Existing Flow Patterns – In general, the alternatives make use of the existing flow patterns within the project area. The natural fall of the land is generally to the southeast north of I-10 and to the south, south of I-10. In general, the proposed channels follow these patterns.

There are a few exceptions to this. In Alternative 1 the proposed channel along the Union Pacific Railroad along the Buckeye Canal may go against grade in some areas. Additionally, Alternative 2 proposes a channel along the north side of I-10 from Sarival to Bullard Wash that will require cutting through a small hill at the upper-most reach. Finally, all three alternatives propose a channel along the AT&SF Railroad in which a segment of the proposed channel would be required to go against grade in the area where the railroad turns 90 degrees from its north-south alignment and goes due west before turning 90 degrees back south. Refer to Figures 2.1 – 2.4 for a graphical representation of each of the proposed alternatives.

Existing Facilities – Each alternative was evaluated based upon its impacts to existing facilities. The alternatives usually showed a combination of both positive and negative impacts to the existing facilities. By evaluating these impacts, an overall impact was determined and compared with that of the other alternatives.

It was determined that although there were some negative impacts to the existing facilities, the overall impacts by all of the alternatives including the baseline were positive. During the Level III analysis, modifications will be made to ensure that there will be no significant adverse impacts to existing facilities or floodplains due to proposed channels or basins. See Table 2.9.

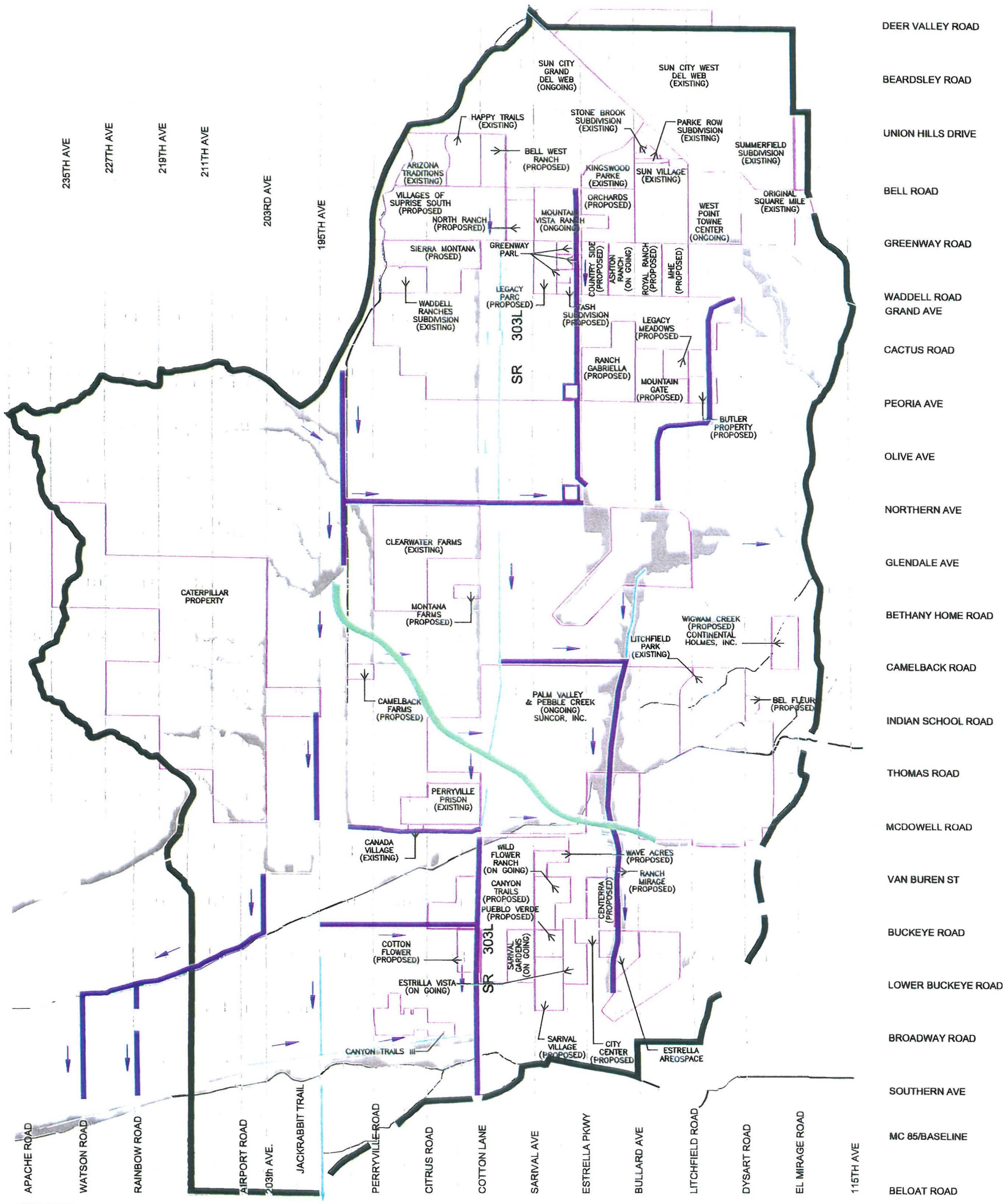
Effectiveness on Existing and Proposed Development – The impacts of each of the three alternatives on proposed development were evaluated only where the possibility of such development was known. Figures 2.7 – 2-9 show the three alternatives, as overlaid onto the existing development. Since the area is very large, it is difficult to include details about every proposed development. Note that proposed development shown as 'proposed' may or may not be built.

In general the alternatives provide a similar level of flood control and outfall opportunities for the existing and proposed developments. For example, the proposed Bullard Wash Channel will service the Goodyear Planned Regional Center, the Estrella Aerospace Center, Centerra, Rancho Mirage and other developments existing and proposed along the corridor. Likewise, the Reems Road Channel provides outfall and flood control for Rancho Gabriella, Mountain Vista and Greenway Parc. See Tables 2.9A-2.9D for detail.

Potential for Removal of Existing FEMA Flood Zones – The potential for the removal of existing FEMA flood zones by each of the three proposed alternatives was another general consideration when they were developed. A cursory examination of each alternative shows that they each have the potential for directly removing the approximate area of land from the existing floodplain delineations:

Alternative 1 – 1959 Acres

Alternative 2 – 1884 Acres



LEGEND:

= PROPOSED LARGE REGIONAL OUTFALL CHANNEL

= PROPOSED MEDIUM TO LARGE LOCAL COLLECTOR CHANNEL

= PROPOSED SMALL COLLECTOR CHANNEL

= DIRECTION OF FLOW

= PROPOSED LARGE, MEDIUM OR SMALL BASIN/PARK

= PROJECT AREA BOUNDARY

= PROPOSED LOOP 303 PARKWAY ALIGNMENT

= EXISTING RAIL ROAD

= EXISTING STRUCTURE OR FACILITY

= FLOODPLAIN IDENTIFIED BY THE ORIGINAL WHITE TANKS ADMP, 1992

N

MARICOPA COUNTY
N.T.S.

EXISTING DEVELOPMENT (ALTERNATIVE #1)

June 2003

Loop 303 Corridor/White Tanks ADMP Update

FIGURE 2.7

URS

Flood Control District of Maricopa County

Key Features:

Large regional, multi-use drainage channel linking the White Tanks Mountains with the ADOT basins and Agua Fria River.

Small roadside channel along the west side of the Loop 303. North of I-10, this channel might convey local roadway drainage and may be used as a post storm drain outlet for adjacent developments' retention basins. South of I-10 the channel may be larger and used as regional drain outfall for local development.

Several multi-use channel corridors providing links throughout the project area with some regional basin/parks.

Overall emphasis on one very large regional outfall/collector channel with several smaller, feeder-type drains.

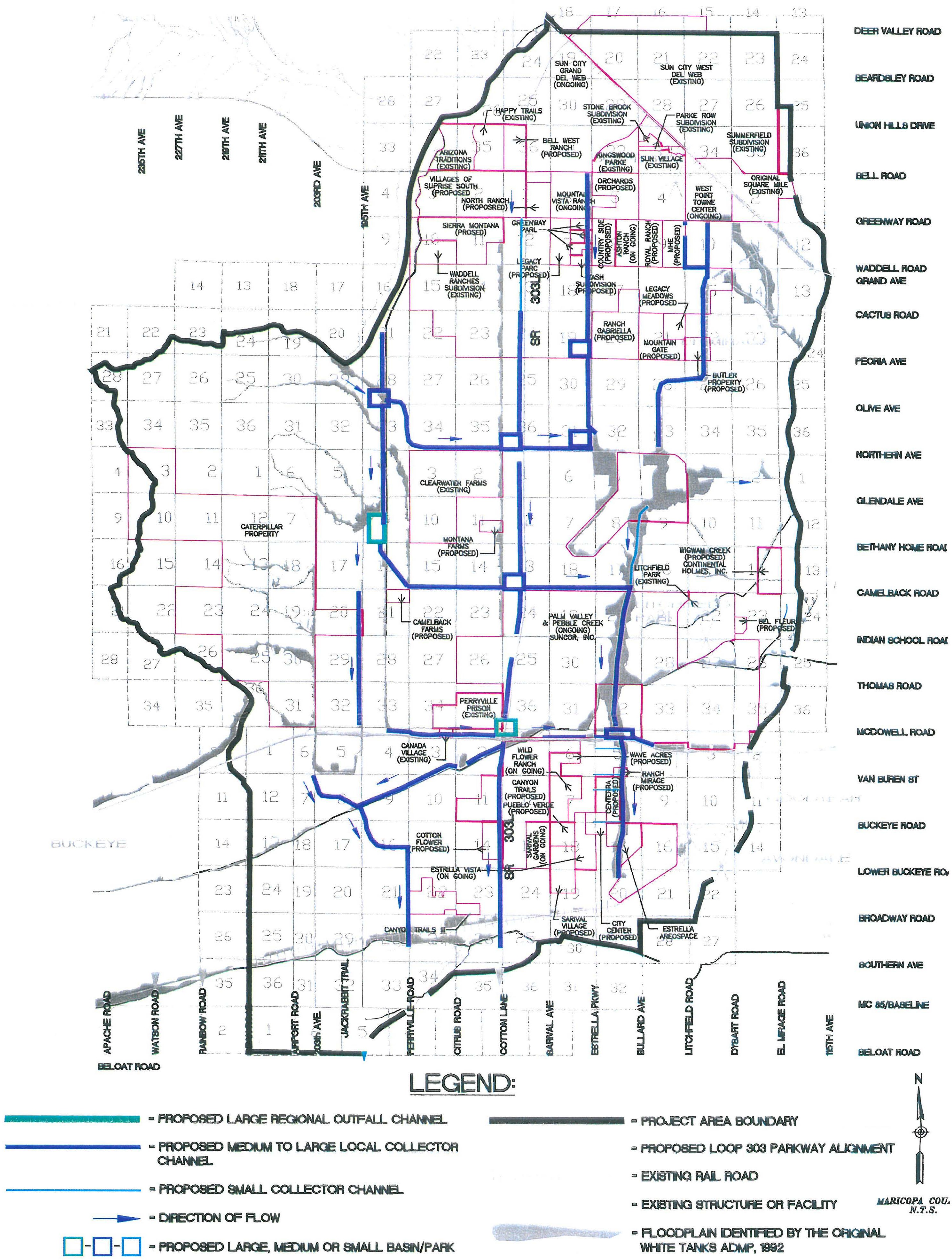
Table 2.9A

Effectiveness of Alternative Relative to Existing and Proposed Development

(E,O,P): Existing, On-going, Proposed
C/R/I/MIX: Commercial/Residential/Industrial/Mixed Use

Approx. Total No. Proposed/Existing Developments: 57

Facility	Development	(E,O,P) C/R/I/MIX
Beardsley Channel	Sonoran Ridge Estates	(P), R
Jackrabbit Trail Channel		
	DMB/Caterpillar Master Plan Community	(P), MIX
	Litchfield Heights	(P), R
	Pasqualetti Mountain Ranch	(P), R
Jackrabbit /Perryville Channel	Primrose Estates	(E), R
tuthill Channel	Blue Horizon	(P), R
Loop 303 Channel		
	North Ranch	(P), R
	Surprise Farms	(P), R
	Clearwater Farms	(E), R
	Montanna Farms	(E), R
	White Tanks Mountain Ranch	(P), R
	Pebble Creek	(O), R
	Perryville Prison	(E), I
	Canyon Trails	(O), R
	Cotton Flower	(O), R
	Estrella Industrial Park	(P), C
	Sarival Gardens	(O), R
	Canyon Trails III	(P), R
Reems Channel		
	Kingswood Park	(E), R
	Orchards	(P), R
	Sun City Grand	(E), R
	Mountain Vista Ranch	(E), R
	Greenway Park	(E), R
	Country Side	(P), R
	Tash Subdivision	(P), R
	Rancho Gabriella	(P), R
AT & SF Railroad Channel		
	Roseview	(E), R
	Legacy Meadows	(P), R
	Butler Property	(E), R
Bullard Wash Channel		
	Luke Air Force Base	(E), MIX
	Palm Valley/Pebble Creek	(O), R
	Goodyear Regional Center	(O), C/R
	Snyders of Hanover	(E), C
	Rancho Mirage	(O), R
	Southwest Specialty Foods	(P), C
	Centerra	(P), R
	Estrella Aerospace Center	(P), C/MIX
	City Center	(P), C/MIX
Northern Avenue Channel	White Tanks Foothills	(P), R
	White Tanks Mountain Ranch	(P), R
	Sonoran ridge Estates	(E), R
	Clearwater Farms	(E), R
Camelback Road Channel	Palm Valley/Pebble Creek	(O), R
	Litchfield Park	(E), C/MIX
I-10 Channel	Perryville Prison	(E), I
Buckeye Channel	Blue Horizon	(P), R
	Canyon Trails	(O), R
Union Pacific Railroad Channel	Canyon Trails III	(P), R
West Valley Regional Drain	Camelback Farms	(P), R
	Clearwater Farms	(E), R
	Palm Valley/Pebble Creek	(O), R
	Goodyear Regional Center	(P), MIX



EXISTING DEVELOPMENT (ALTERNATIVE #2)

June 2003

Loop 303 Corridor/White Tanks ADMP Update

FIGURE 2.8

URS

Flood Control District of Maricopa County

Key Features:

Large regional, multi-use drainage channel linking the White Tanks Mountains with the ADOT basins and Agua Fria River.

Small roadside channel along the west side of the Loop 303. North of I-10, this channel might convey local roadway drainage and may be used as a post storm drain outlet for adjacent developments' retention basins. South of I-10 the channel may be larger and used as regional drain outlet for local development.

Several multi-use channel corridors providing links throughout the project area with some regional basin/parks.

Overall emphasis on one very large regional outfall/collector channel with several smaller, feeder-type drains.

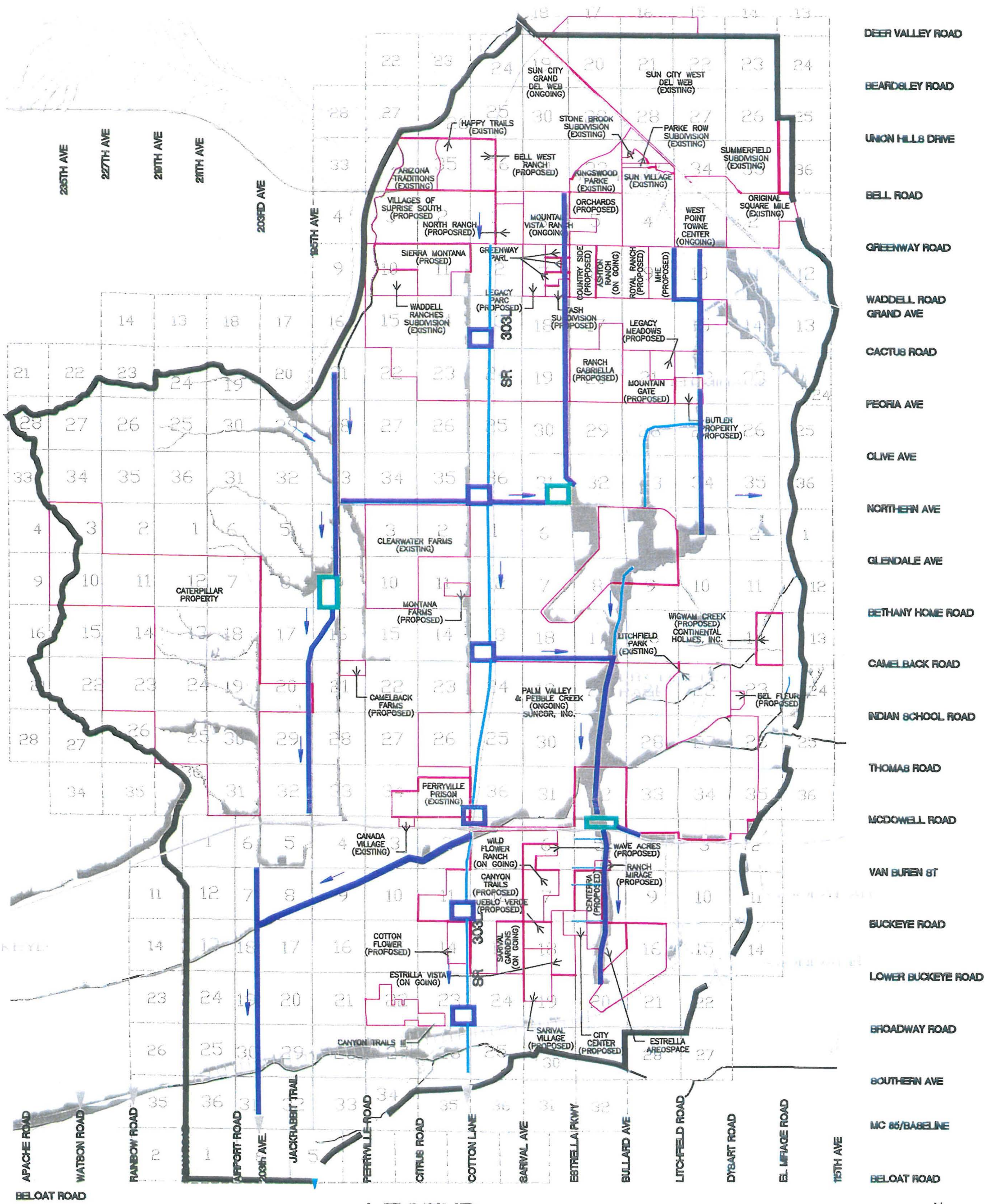
Table 2.9B

Effectiveness of Alternative Relative to Existing and Proposed Development

(E,O,P): Existing, On-going, Proposed
C/R/I/MIX: Commercial/Residential/Industrial/Mixed Use

Approx. Total No. Proposed/Existing Developments: 57

Facility	Development	(E,O,P) C/R/I/MIX
Beardsley Channel	Sonoran Ridge Estates	(P), R
Jackrabbit Trail Channel	DMB/Caterpillar Master Plan Community	(P), MIX
	Litchfield Heights	(P), R
	Pasqualetti Mountain Ranch	(P), R
Jackrabbit /Perryville Channel	Blue Horizon	(P), R
	Primrose Estates	(E), R
	Canyon Trails III	(P), R
Loop 303 Channel	North Ranch	(P), R
	Surprise Farms	(P), R
	Clearwater Farms	(E), R
	Montanna Farms	(E), R
	White Tanks Mountain Ranch	(P), R
	Pebble Creek	(O), R
	Perryville Prison	(E), I
	Canyon Trails	(O), R
	Cotton Flower	(O), R
	Estrella Industrial Park	(P), C
	Sarival Gardens	(O), R
	Canyon Trails III	(P), R
Reems Channel	Kingswood Park	(E), R
	Orchards	(P), R
	Sun City Grand	(E), R
	Mountain Vista Ranch	(E), R
	Greenway Park	(E), R
	Country Side	(P), R
	Tash Subdivision	(P), R
	Rancho Gabriella	(P), R
AT & SF Railroad Channel	Roseview	(E), R
	Legacy Meadows	(P), R
	Butler Property	(E), R
El Mirage Channel	West Point Towne Center	(O), R
	MHE	(P), R
	Roseview	(E), R
Bullard Wash Channel	Luke Air Force Base	(E), MIX
	Palm Valley/Pebble Creek	(O), R
	Goodyear Regional Center	(O), C/R
	Snyders of Hanover	(E), C
	Rancho Mirage	(O), R
	Southwest Specialty Foods	(P), C
	Centerra	(P), R
	Estrella Aerospace Center	(P), C/MIX
	City Center	(P), C/MIX
Northern Avenue Channel	White Tanks Foothills	(P), R
	White Tanks Mountain Ranch	(P), R
	Sonoran ridge Estates	(E), R
	Clearwater Farms	(E), R
Camelback Road Channel	Palm Valley/Pebble Creek	(O), R
	Litchfield Park	(E), C/MIX
	Camelback Farms	(P), R
I-10 Channel	Pebble Creek Phase II	(P), R
	Canada Village	(E), R
	Perryville Prison	(E), I
Lower El Mirage Wash	West Point Towne Center	(O), R
	Roseview	(E), R
RID Channel	Canyon Trails	(O), R
	Blue Horizon	(P), R



LEGEND:

- PROPOSED LARGE REGIONAL OUTFALL CHANNEL
- PROPOSED MEDIUM TO LARGE LOCAL COLLECTOR CHANNEL
- PROPOSED SMALL COLLECTOR CHANNEL
- DIRECTION OF FLOW
- PROPOSED LARGE, MEDIUM OR SMALL BASIN/PARK
- PROJECT AREA BOUNDARY
- PROPOSED LOOP 303 PARKWAY ALIGNMENT
- EXISTING RAIL ROAD
- EXISTING STRUCTURE OR FACILITY
- FLOODPLAIN IDENTIFIED BY THE ORIGINAL WHITE TANKS ADMP, 1992

EXISTING DEVELOPMENT (ALTERNATIVE #3)

June 2003

Loop 303 Corridor/White Tanks ADMP Update

FIGURE 2.9

URS

Flood Control District of Maricopa County

Key Features

Large regional, multi-use drainage channel linking the White Tanks Mountains with the ADOT basins and Agua Fria River.

Small roadside channel along the west side of the Loop 303. North of I-10, this channel might convey local roadway drainage and may be used as a post storm drain outlet for adjacent developments' retention basins. South of I-10 the channel may be larger and used as regional drain outfall for local development.

Several multi-use channel corridors providing links throughout the project area with some regional basin/parks.

Overall emphasis on one very large regional outfall/collector channel with several smaller, feeder-type drains.

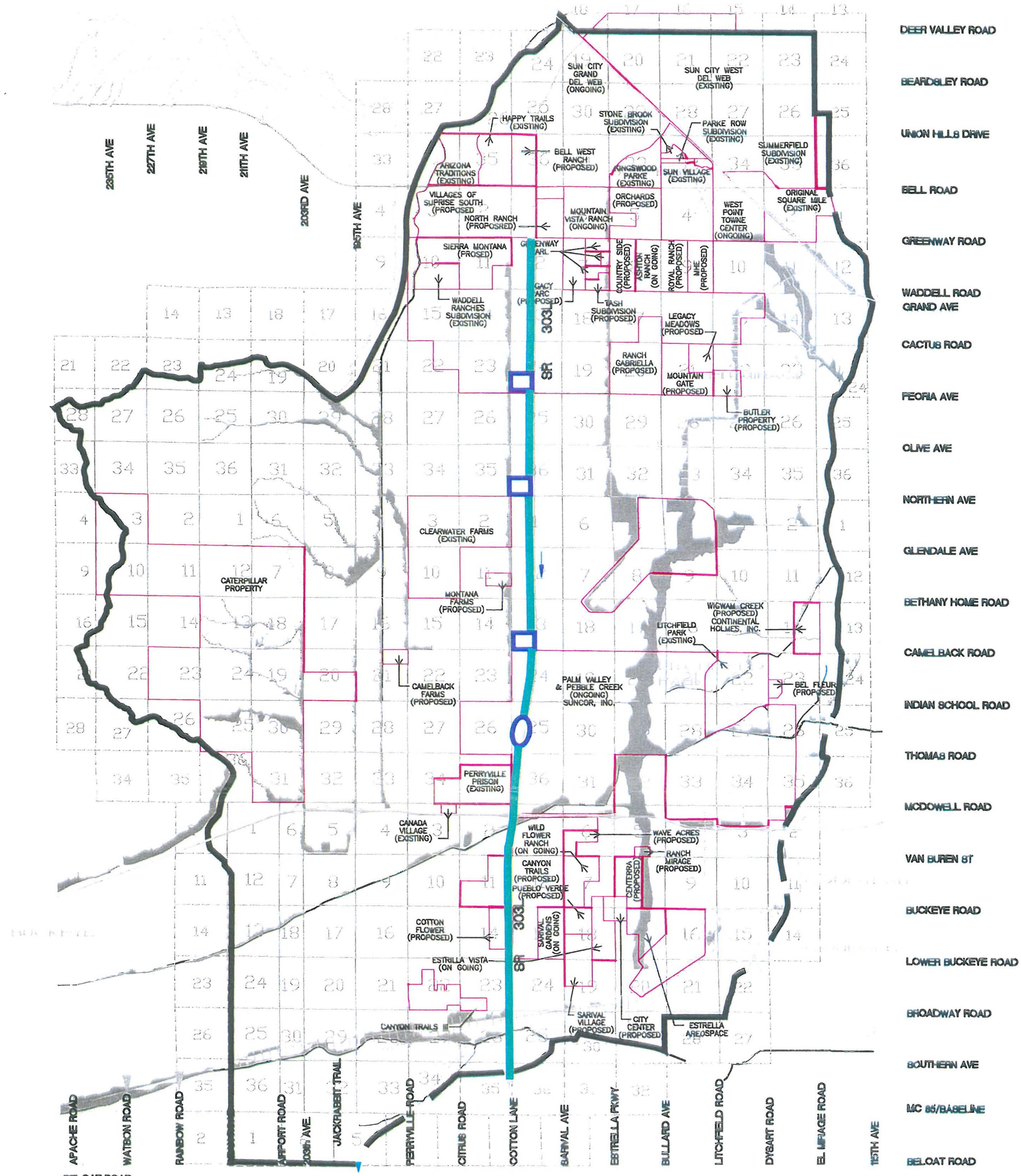
Table 2.9C

Effectiveness of Alternative Relative to Existing and Proposed Development

(E,O,P): Existing, On-going, Proposed
C/R/I/MIX: Commercial/Residential/Industrial/Mixed Use

Approx. Total No. Proposed/Existing Developments: 57

Facility	Development	(E,O,P) C/R/I/MIX
Beardsley Channel	Sonoran Ridge Estates	(P), R
Jackrabbit Trail Channel	DMB/Caterpillar Master Plan Community	(P), MIX
	Litchfield Heights	(P), R
	Pasqualetti Mountain Ranch	(P), R
Tuthill Channel	Primrose Estates	(E), R
	Blue Horizon	(P), R
Loop 303 Channel	North Ranch	(P), R
	Surprise Farms	(P), R
	Clearwater Farms	(E), R
	Montanna Farms	(E), R
	White Tanks Mountain Ranch	(P), R
	Pebble Creek	(O), R
	Perryville Prison	(E), I
	Canyon Trails	(O), R
	Cotton Flower	(O), R
	Estrella Industrial Park	(P), C
	Sarival Gardens	(O), R
	Canyon Trails III	(P), R
Reems Channel	Kingswood Park	(E), R
	Orchards	(P), R
	Sun City Grand	(E), R
	Mountain Vista Ranch	(E), R
	Greenway Park	(E), R
	Country Side	(P), R
	Tash Subdivision	(P), R
	Rancho Gabriella	(P), R
AT & SF Railroad Channel	Roseview	(E), R
	Legacy Meadows	(P), R
	Butler Property	(E), R
El Mirage Channel	West Point Towne Center	(O), R
	MHE	(P), R
	Roseview	(E), R
Bullard Wash Channel	Luke Air Force Base	(E), MIX
	Palm Valley/Pebble Creek	(O), R
	Goodyear Regional Center	(O), C/R
	Snyders of Hanover	(E), C
	Rancho Mirage	(O), R
	Southwest Specialty Foods	(P), C
	Centerra	(P), R
	Estrella Aerospace Center	(P), C/MIX
	City Center	(P), C/MIX
Northern Avenue Channel	White Tanks Foothills	(P), R
	White Tanks Mountain Ranch	(P), R
	Sonoran ridge Estates	(E), R
	Clearwater Farms	(E), R
Camelback Road Channel	Palm Valley/Pebble Creek	(O), R
	Litchfield Park	(E), C/MIX
I-10 Channel	Goodyear Regional Center	(O), C/R
	Palm Valley/Pebble Creek	(O), R
Lower El Mirage Wash	West Point Towne Center	(O), R
	Roseview	(E), R
RID Channel	Canyon Trails	(O), R
	Blue Horizon	(P), R



LEGEND:

- = PROPOSED LARGE REGIONAL OUTFALL CHANNEL
- = PROPOSED MEDIUM TO LARGE LOCAL COLLECTOR CHANNEL
- = PROPOSED SMALL COLLECTOR CHANNEL
- = DIRECTION OF FLOW
- = PROPOSED LARGE, MEDIUM OR SMALL BASIN/PARK
- = PROJECT AREA BOUNDARY
- = PROPOSED LOOP 303 PARKWAY ALIGNMENT
- = EXISTING RAIL ROAD
- = EXISTING STRUCTURE OR FACILITY
- = FLOODPLAIN IDENTIFIED BY THE ORIGINAL WHITE TANKS ADMP, 1992

N

MARICOPA COUNTY
N.T.S.

EXISTING DEVELOPMENT (BASELINE ALTERNATIVE)

June 2003

Loop 303 Corridor/White Tanks ADMP Update

FIGURE 2.10

URS

Flood Control District of Maricopa County

Key Features:

Large regional, multi-use drainage channel linking the White Tanks Mountains with the ADOT basins and Agua Fria River.

Small roadside channel along the west side of the Loop 303. North of I-10, this channel might convey local roadway drainage and may be used as a post storm drain outlet for adjacent developments' retention basins. South of I-10 the channel may be larger and used as regional drain outlet for local development.

Several multi-use channel corridors providing links throughout the project area with some regional basin/parks.

Overall emphasis on one very large regional outfall/collector channel with several smaller, feeder-type drains.

Table 2.9D

Effectiveness of Alternative Relative to Existing and Proposed Development

(E,O,P): Existing, On-going, Proposed
C/R/I/MIX: Commercial/Residential/Industrial/Mixed Use

Approx. Total No. Proposed/Existing Developments: 57

Facility	Development	(E,O,P) C/R/I/MIX
Loop 303 Channel		
	North Ranch	(P), R
	Surprise Farms	(P), R
	Clearwater Farms	(E), R
	Montanna Farms	(E), R
	White Tanks Mountain Ranch	(P), R
	Pebble Creek	(O), R
	Perryville Prison	(E), I
	Canyon Trails	(O), R
	Cotton Flower	(O), R
	Estrella Industrial Park	(P), C
	Sarival Gardens	(O), R
	Canyon Trails III	(P), R

Alternative 3 – 1937 Acres

Each alternative may also have the potential of indirectly removing other floodplains further downstream of the proposed channel alignments. The Baseline Alternative does not have the potential for directly removing any significant amount of floodplain relative to the three proposed alternatives.

Compatibility with Other Projects and Plans – All three alternatives will be fairly compatible with other proposed projects and plans. For example, the recently completed Bullard Wash Outfall Channel has been incorporated into all three alternatives as a tie-in point for the proposed channelization of the remainder of the wash corridor. In addition, the City of Goodyear has provided a typical section that they would like to use through this corridor. The section has been incorporated into the proposed channelization of the wash for all three alternatives.

Other plans such as the rehabilitation or replacement of the existing WT FRS #3 have been considered by all three alternatives. In some areas, such as the proposed Reems Road Channel, some improvements may be required to tie the existing facilities to those proposed. This is a result of a portion of the existing Reems Road Channel upstream of the proposed alternative channelization uses both the channel and the roadway to convey the 100-year, 24-hour design discharge. A transition section would be required to fully channelize this flow in the proposed downstream channel sections.

By providing a public forum at multiple neighborhood meetings for the public and private developers to offer input, the compatibility of each alternative with private development in the project area should be adequate. Any suggestions or concerns by private development in the area are being considered.

The Baseline Alternative is essentially the "Do Nothing" alternative in all areas outside of the Loop 303 corridor. Along the Loop 303 corridor, the proposed Baseline Alternative proposes a concrete flood control channel and four off-line detention basins. This alternative does not fit well with any of the plans mentioned above. It does not propose channels to tie into existing channel segments already constructed. Also, the fact that the Baseline Alternative proposes a concrete channel with no multi-use opportunities makes it incompatible with many of the plans being considered by the local jurisdictional agencies / cities.

2.4.2 Second Committee Meeting

During the second committee meeting held at the FCDMC office on June 1, 2000, some minor changes to each of the recommended alternatives were made and have since been presented in the Level II Phase I Technical Memorandum. For a detailed discussion of these changes, refer to the Draft Level II Phase I Technical Memorandum for the Bullard Wash – Thomas Road to Lower Buckeye, by URS dated September 2000. In attendance for this meeting were:

- Gene Rogge – Dames and Moore
- Andrew Cooper – City of Goodyear
- Lynn Thomas – FCDMC
- Mike Duncan – FCDMC
- Theresa Hoff – FCDMC
- Bobby Ohler – FCDMC
- Tom Johnson – FCDMC
- Greg Jone – FCDMC
- Scott Newhouse – FCDMC
- Joe Rumann – FCDMC
- Dan Sherwood – City of Glendale
- Zane Hoyt – LAFB
- Mike Smith – MCDOT
- Elliot Silverston – URS
- Rob Scrivo – URS
- Brad Remme – LSD
- Steve Lohide – LSD
- Greg Rodzenko – EEC

2.4.3 Results of Neighborhood Meeting No. 2

The results of the second neighborhood meeting(s) are presented below. For information regarding the results of the first neighborhood meeting and a brief discussion of them refer to Section 3.1.4 of the Level I Alternatives Analysis Report.

The second neighborhood meetings were held from 5:30-7:30 P.M. on August 28th and 30th, 2001, to present opportunities for the public to identify issues and concerns related to the 3 alternatives proposed with the Loop 303 Corridor/White Tanks ADMP Update.

Twenty-four people filled out the questionnaire. This represented approximately 41% of the total number of people in attendance for the two nights combined. The alternative most favored by the public was the recommended alternative 3 described in Section 2.1.2 above. The most commonly stated reason for the preference of this alternative was the fact that it has the least amount of negative impact to existing residential property.

The alternative most disliked by those who filled out questionnaires was recommended alternative 1 discussed in Section 2.1.2 above. The most common complaint stated in regard to this alternative was the fact that it had the most negative impact to existing residential property.

The comments received from the second neighborhood meeting have been noted and were one of many factors considered in the final matrix evaluation of the proposed alternatives and the baseline alternative.

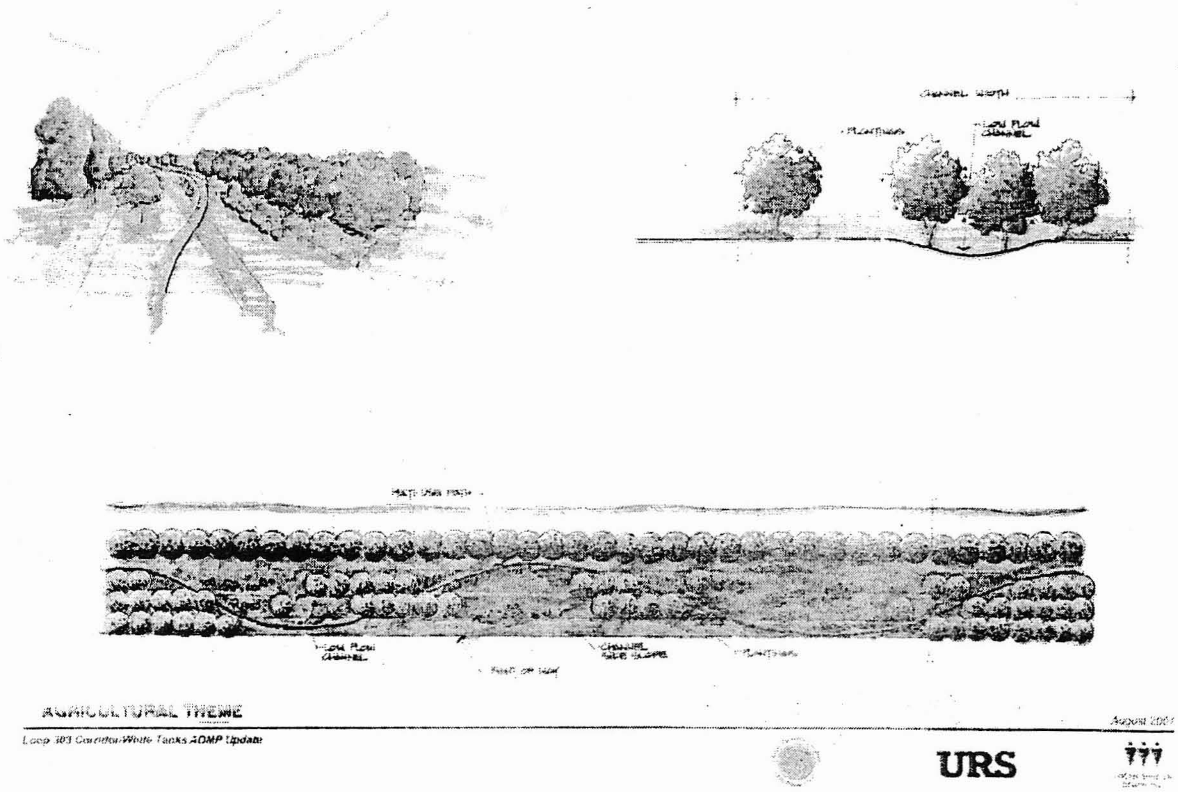
2.4.4 Environmental Impacts

The environmental impacts, ecological assessment and cultural resource assessment and historic / prehistoric themes are discussed at length in Section 3.1.5 of the *Level I Alternatives Analysis Report*, dated May 2003 and also in Sections 4.1 and 4.2 of the *Data Collection Report*, dated May 2003.

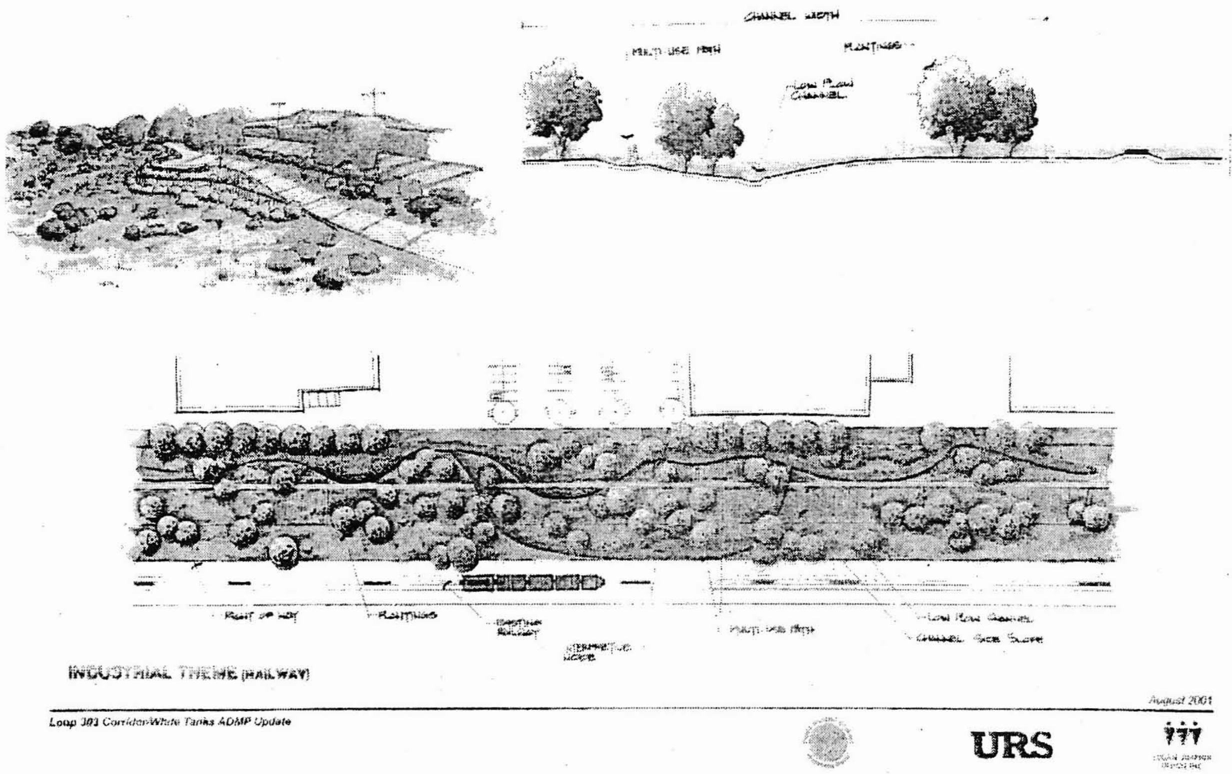
2.4.5 Typical Landscape Themes

Various landscape character themes were developed based upon the existing and proposed landscape character of the study area. Following is descriptions of the various landscape character themes.

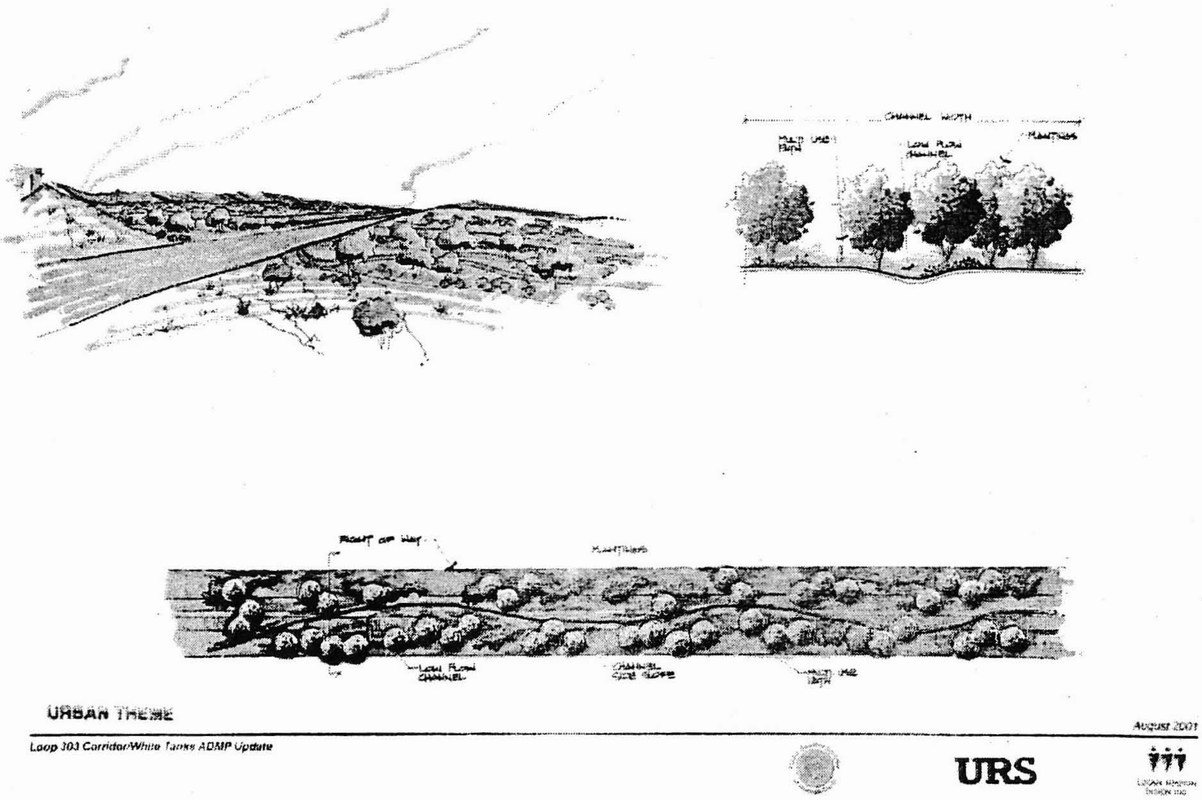
- **Agricultural Theme**: The landscape character theme associated with agriculture would be to reinforce the pastoral landscape through: (1) planting of large shade tree species with few shrubs and no turf; (2) creating linear windbreaks with tall trees; (3) creating small groves of trees representing the surrounding orchards; (4) maintaining open views to the surrounding area; (5) utilizing native material for pathways and trails such as stabilized decomposed granite; (6) incorporating, where appropriate, enhanced wildlife habitats and small ponds of water; and (7) creating a regular pattern of elements interwoven with occasional sinuous features such as pathways.



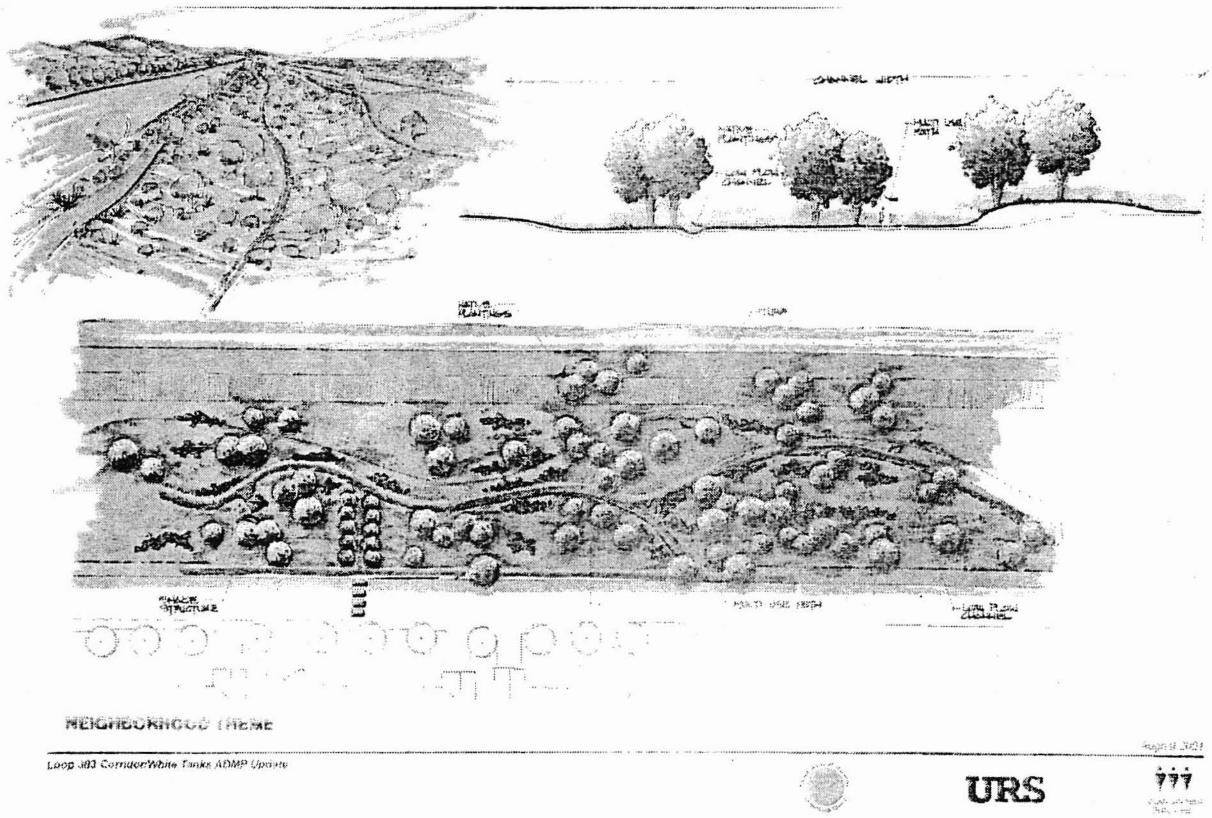
- **Industrial Theme**: The landscape character theme associated with the industrial area would be to visually mitigate the horizontal and vertical scale of the adjacent industrial or institutional land uses through: (1) planting of specimen and exotic / native trees, and shrubs, but no turf; (2) utilizing large, bold masses of plant material; (3) mimicking distinct features on a smaller scale and incorporating them into structures and hardscape elements; (4) interpreting industrial / institutional land uses in materials and colors; and (5) creating simple, yet bold pattern of elements.



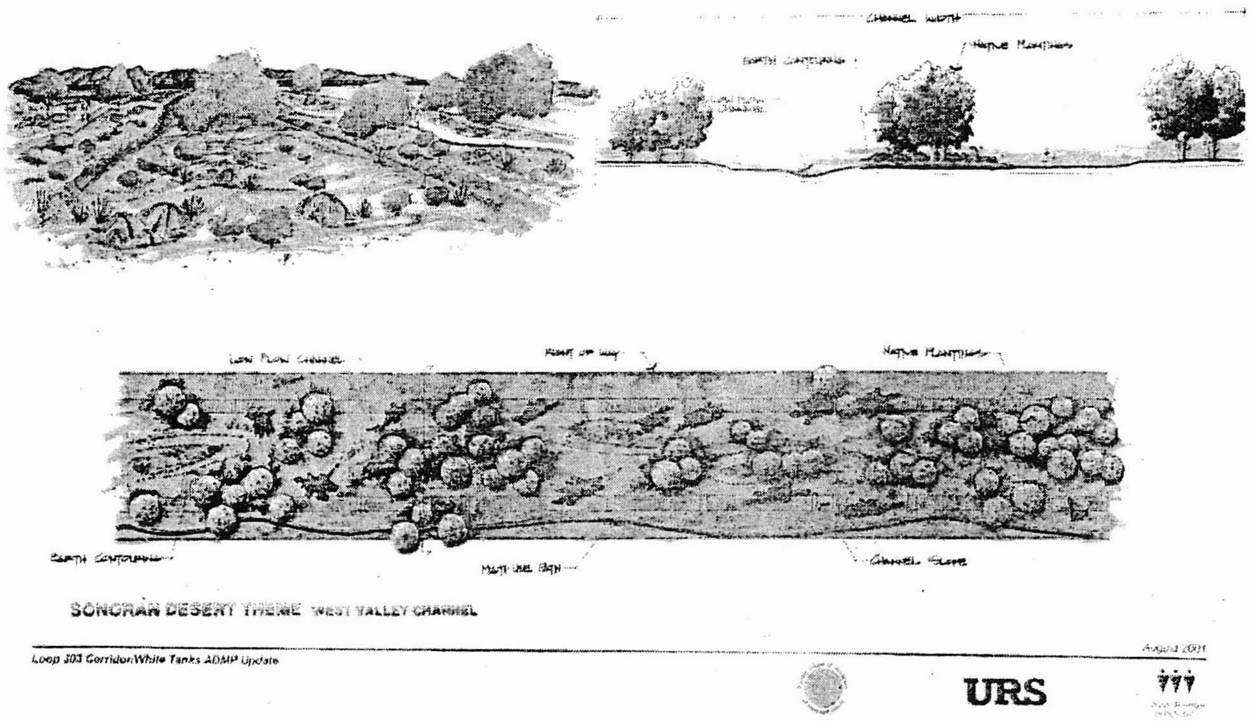
- **Urban Theme**: The landscape character theme associated with the urban area would be to integrate the proposed facilities as an extension of the subdivision's streetscape character through: (1) planting specimen exotic and native trees, installation of shrubs, and the introduction of turf at various locations; (2) repeating the adjacent hardscape elements utilizing small walls and concrete pathways; (3) incorporating stucco and tile materials and colors associated with adjacent development; (4) integrating the existing concrete block walls as art elements to add interest and identity to individual subdivisions; and (5) creating a well organized, repetitive pattern of elements.



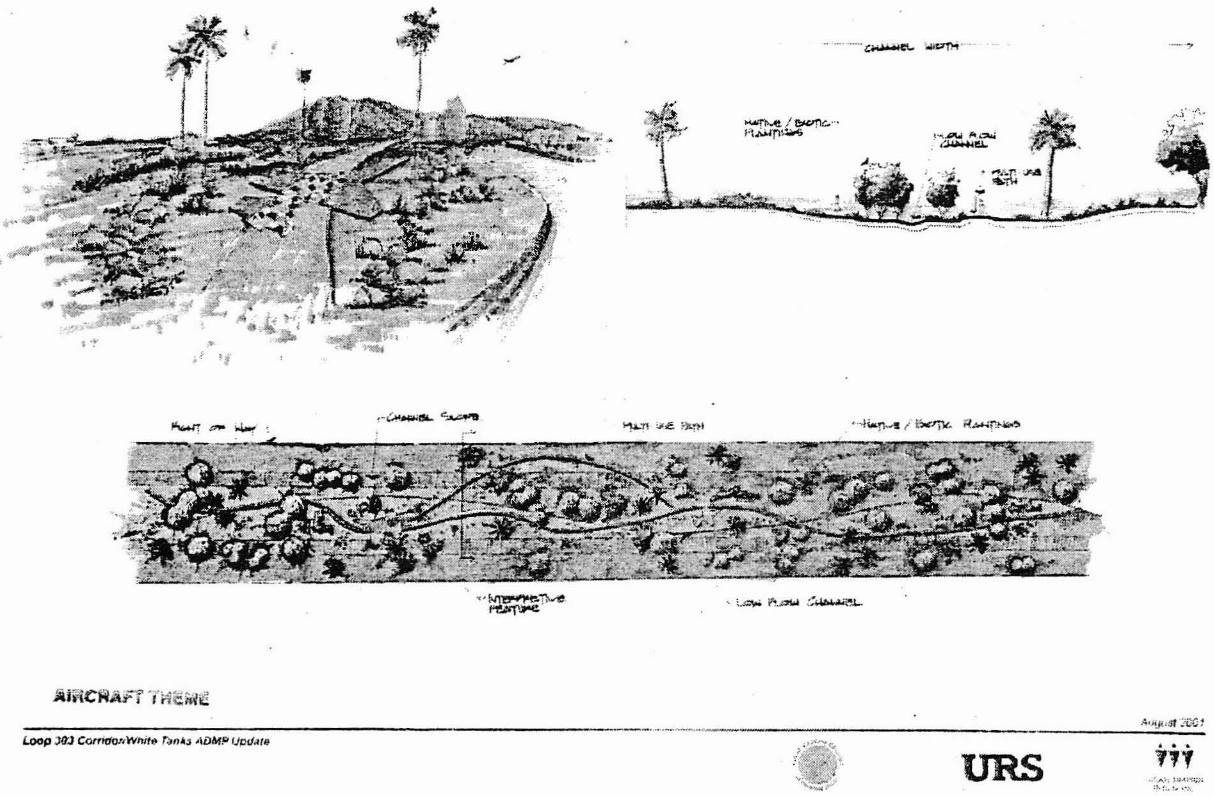
- **Neighborhood Theme**: The landscape character theme associated with the neighborhood area would be for the proposed facilities to be a continuation of the residential "yard" through: (1) planting of large shade tree species with shrubs used as accent plantings; (2) selective use of turf in special use areas; (3) utilizing a variety of materials such as brick, wood, and masonry in hardscape elements; (4) incorporating native materials for pathways and trails such as stabilized decomposed granite, and (5) creating an informal pattern of elements.



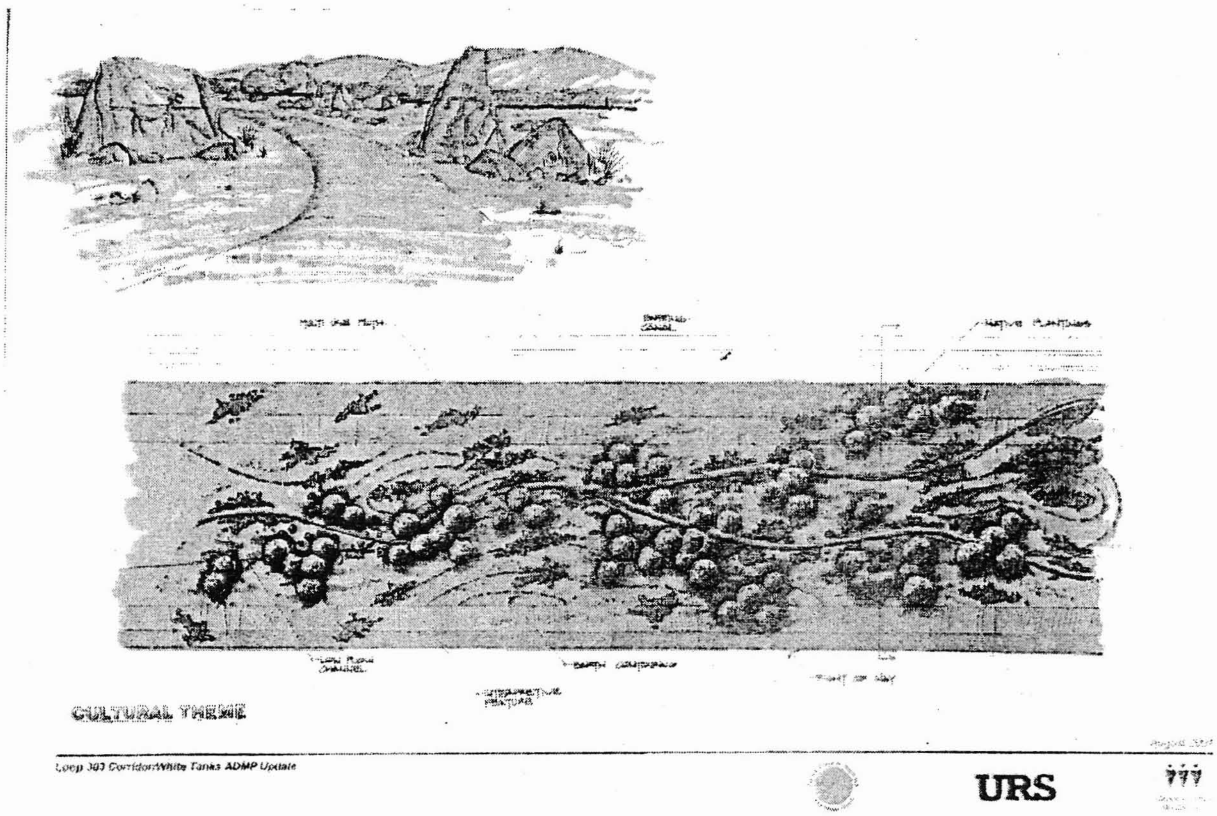
- **Sonoran Desert Theme**: The landscape character theme associated with the Sonoran Desert area would be to reinforce the native Sonoran Desertscrub Biotic Community through: (1) planting of native trees, shrubs, and grasses, but no turf; (2) maintaining open views to the surrounding area; (3) utilizing native material for pathways and trails such as stabilized decomposed granite; and (4) creating an irregular more organic pattern of elements.



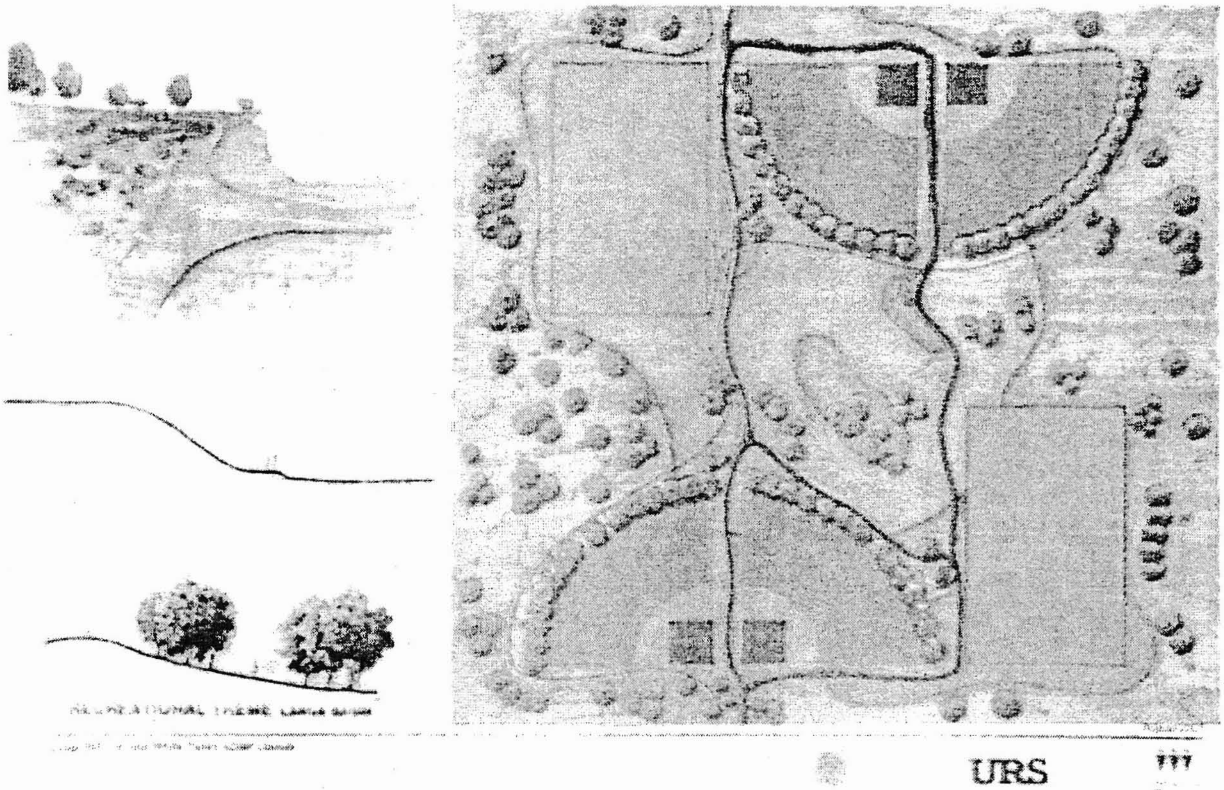
- **Aircraft Theme**: This theme would reinforce the various aircraft facilities in the area through: (1) incorporating flood control facilities with existing airports and flight paths; and (2) incorporating elements of the various airports and airfields (old propellers, hangar facilities, jet engines, metal and fabric, etc.) throughout the study area.



- **Cultural Theme**: This theme would reinforce the various cultural sites in the study area through: (1) incorporation of elements (Hohokam symbols, structures, etc.) found at the cultural sites; and (2) incorporation of interpretive sites regarding the early canals from the Hohokam to the present.



- **Recreational Theme**: This theme would reinforce the various canals, flood control facilities, basins, and washes that could be: (1) modified to include new flood control measures as well as multi-use opportunities; (2) loop systems utilizing existing and proposed canals, basins, and washes could be used for local and regional races as well as linkages to other areas within the study area; and (3) to interpret the importance of water to the valley and this area.



- **Railway Theme**: This theme would reinforce the various railway corridors in the area through: (1) incorporating flood control facilities with existing railway corridors; and (2) incorporating elements (railroad ties, steel rails, etc.) of the potentially abandoned railway corridors.

- **Historic / Heritage Theme**: This theme would reinforce the various historic / heritage elements / sites found in the study area through: (1) incorporation of historic elements (structures, cotton, etc.) discovered through research of the site; and (2) incorporation of interpretive sites regarding the history of water, cotton, aircraft, and Goodyear Tire and Rubber Company etc.

2.4.6 Future Landscape Character

Refer to table(s) 2.10A – 2.10C for a summary of each alternative (channels and basins) characteristics and the landscape/multi-use cost estimate for each.

Recommended Alternative 1

Landscape Aesthetics: This alternative has eighteen (18) different flood control facilities. These facilities consist of thirteen (13) various sized channels and five (5) basins; all requiring different landscape aesthetic treatments.

These flood control facilities are located within a number of different landscape characters and therefore would receive different landscape character themes. This is based upon the *Landscape Aesthetics Assessment and Multi-Use Opportunity Assessment* report dated July 6, 2000.

Multi-Use Opportunities: There are several opportunities for multi-use within the various channel configurations and basins.

The following outlines the proposed landscape aesthetics and multi-use opportunities for each channel and basin.

Beardsley Channel
(Cactus Road to White Tanks FCS #3)

Landscape Aesthetics

- ***Structure Shape:*** The Beardsley Channel is an earthen-lined meandering channel with a top width that varies from 66 feet to 273 feet and a depth that varies from 1.8 feet to 5.1 feet. The overall width of the channel (channel width plus over-bank area) varies from 126 feet to 333 feet.

- ***Over-bank Areas:*** A minimum of 30 feet is provided on both sides of the channel. This area at the top of the channel would include earth berming and plantings to provide buffering between the channel and adjacent property.

- ***Side Slopes:*** The side slopes warp and vary from 4:1 to 12:1 creating a meandering toe of slope. The side slopes would blend into the earth berming located in the over-bank areas. Where possible terracing would be incorporated into the side slopes. Plantings would be located on the side slopes.

- ***Channel Bottom:*** The channel bottom varies from 20 feet to 188 feet in width.

Table 2.10A

Recommended Alternative #1

Channel Name	Channel Limits	Side Slope	Overall Width of Channel	Bottom Width of Channel	[1] Top Width of Channel	Depth of Channel	Size of Basin	Depth of Basin	Landscape Theme(s)*	Landscape Aesthetics & Multi-Use Cost
Beardsley Channel	Cactus Road to White Tanks FCS #3	6:1	Varies 126 ft. to 333 ft.	Varies 20 ft. to 188 ft.	Varies 66 ft. to 273 ft.	Varies 1.8 ft. to 5.1 ft.	N/A	N/A	*Sonoran Desert Theme*	Sonoran Desert Theme $8.00 M ***Total Cost $8.00 M*** *FCDMC Funding ** $5.50 M* *Additional Funding*** $2.50 M*
Jackrabbit Trail Channel	Indian School Road to McDowell Road	6:1	Varies 210 ft. to 212 ft.	Varies 97 ft. to 101 ft.	Varies 150 ft. to 152 ft.	Varies 2.1 ft. to 2.6 ft.	N/A	N/A	*Urban Theme*	Urban Theme $3.70 M ***Total Cost $3.70 M*** *FCDMC Funding ** $2.30 M* *Additional Funding*** $1.40 M*
Jackrabbit – Perryville Channel	Yuma Road to the Gila River	6:1	Varies 162 ft. to 194 ft.	Varies 10 ft. to 86 ft.	Varies 114 ft. to 134 ft.	Varies 1.9 ft. to 7.0 ft.	N/A	N/A	*Urban Theme* north of MC85 *Sonoran Desert Theme* south of MC85 *Commercial Theme* at Broadway Road and Jackrabbit Trail intersection and MC85 and Jackrabbit Trail intersection	Urban Theme $1.98 M Sonoran Desert Theme $0.62 M Commercial Theme $2.23 M ***Total Cost $4.83 M*** *FCDMC Funding ** $3.04 M* *Additional Funding*** $1.79 M*
Tuthill Channel	White Tanks FCS #4 to Roosevelt Irrigation District (RID) Canal then west to Rainbow Road	6:1	Varies 168 ft. to 180 ft.	Varies 5 ft. to 46 ft.	Varies 108 ft. to 120 ft.	Varies 3.9 ft. to 6.9 ft.	N/A	N/A	*Urban Theme*	Urban Theme $3.18 M ***Total Cost $3.18 M*** *FCDMC Funding ** $1.83 M* *Additional Funding*** $1.35 M*
Loop 303 Channel	Greenway Road to the Gila River	6:1	Varies 144 ft. to 250 ft.	Varies 5 ft. to 98 ft.	Varies 84 ft. to 190 ft.	Varies 3.1 ft. to 5.7 ft.	N/A	N/A	*Urban Theme* from Greenway Road to Waddell Road *Industrial Theme* from Waddell Road to Peoria Avenue *Neighborhood Theme* from Peoria Avenue to Glendale Avenue *Agricultural Theme* from Glendale Avenue to Camelback Road *Commercial Theme* at the intersections of I-10 and SR303L, SR303L and Van Buren Street, and SR303L and Buckeye Road *Sonoran Desert Theme* from MC85 to Gila River	Urban Theme $10.10 M Industrial Theme $ 2.70 M Neighborhood Theme $ 4.20 M Agricultural Theme $ 2.60 M Commercial Theme $ 0.70 M Sonoran Desert Theme $ 1.20 M ***Total Cost $21.50 M*** *FCDMC Funding ** $12.90 M* *Additional Funding*** $8.60 M*
Reems Road Channel	Waddell Road to Northern Avenue	6:1	Varies 138 ft. to 214 ft.	Varies 5 ft. to 93 ft.	Varies 78 ft. to 154 ft.	Varies 3.1 ft. to 4.8 ft.	N/A	N/A	*Urban Theme* from Waddell Road to Peoria Avenue *Agricultural Theme* form Peoria Avenue to Northern Avenue *Commercial Theme* at the intersections of Waddell Road and Reems Road, Cactus Road and Reems Road, and Peoria Avenue and Reems Road.	Urban Theme $2.41 M Agricultural Theme $2.18 M Commercial Theme $0.28 M ***Total Cost $4.87 M*** *FCDMC Funding ** $2.98 M* *Additional Funding*** $1.89 M*
AT&SF Railroad Channel	Waddell Road southwest to Peoria Avenue then west one mile then south to Northern Avenue	6:1	Varies 142 ft. to 200 ft.	Varies 5 ft. to 76 ft.	Varies 82 ft. to 140 ft.	Varies 3.3 ft. to 6.8 ft.	N/A	N/A	*Industrial Theme* from Waddell Road to Peoria Avenue and from Olive Avenue to Northern Avenue. *Agricultural Theme* form Peoria Avenue to Olive Avenue	Industrial Theme $3.37 M Agricultural Theme $1.08 M ***Total Cost $4.45 M*** *FCDMC Funding ** $2.77 M* *Additional Funding*** $1.68 M*

Table 2.10A

Bullard Wash Channel	Camelback Road to existing Bullard Wash structure at Lower Buckeye Road	6:1 - Camelback Road to I-10 4:1 - I-10 to existing Bullard Wash	Varies 192 ft. to 228 ft. (Camelback Road to I-10) Follows City of Goodyear typical section (I-10 to existing Bullard Wash)	Varies 59 ft. to 87 ft. (Camelback Road to I-10) Follows City of Goodyear typical section (I-10 to existing Bullard Wash)	Varies 132 ft. to 168 ft. (Camelback Road to I-10) Follows City of Goodyear typical section (I-10 to existing Bullard Wash)	Varies 4.1 ft. to 4.9 ft. (Camelback Road to I-10) Follows City of Goodyear typical section (I-10 to existing Bullard Wash)	N/A	N/A	*Urban Theme* from Camelback Road to Thomas Road *Commercial Theme* from Thomas to McDowell Road *Neighborhood Theme* from McDowell to I-10	Urban Theme $3.13 M Commercial Theme $1.47 M Neighborhood Theme $1.52 M ***Total Cost*** ***$6.12 M*** *FCDMC Funding *** *$3.60 M* *Additional Funding**** *$2.52 M*
Northern Avenue Channel	Beardsley Canal to Reems Road	6:1	Varies 121 ft. to 202 ft.	Varies 5 ft. to 77 ft.	Varies 61 ft. to 142 ft.	Varies 2.7 ft. to 4.3 ft.	N/A	N/A	*Neighborhood Theme* from Beardsley Canal to Reems Road	Neighborhood Theme $5.70 M ***Total Cost*** ***$5.70 M*** *FCDMC Funding *** *$3.38 M* *Additional Funding**** *$2.32 M*
Camelback Channel	Cotton Lane to Bullard Wash Channel	6:1	Varies 158 ft. to 189 ft.	Varies 5 ft. to 30 ft.	Varies 98 ft. to 129 ft.	Varies 5.3 ft. to 6.9 ft.	N/A	N/A	*Agricultural Theme* from Cotton Lane to SR303L *Industrial Theme (with incorporation of Aircraft Theme)* from SR303L to just east of Sarival Road *Neighborhood Theme* from just east of Sarival Road to Bullard Wash Channel	Agricultural Theme $0.56 M Industrial Theme $0.88 M Neighborhood Theme $3.33 M ***Total Cost*** ***$4.77 M*** *FCDMC Funding *** *$2.88 M* *Additional Funding**** *$1.89 M*
Buckeye Channel	Just west of Perryville Road to Cotton Lane	6:1	Varies 154 ft. to 187 ft.	Varies 5 ft. to 66 ft.	Varies 94 ft. to 127 ft.	Varies 3.1 ft. to 6.4 ft.	N/A	N/A	*Urban Theme* from just west of Perryville Road to Cotton Lane	Urban Theme $2.40 M ***Total Cost*** ***$2.40 M*** *FCDMC Funding *** *$1.38 M* *Additional Funding **** *$1.02 M*
Union Pacific Railroad Channel	Just west of Jackrabbit Trail to Cotton Lane	6:1	Varies 145 ft. to 186 ft.	Varies 5 ft. to 26 ft.	Varies 85 ft. to 125 ft.	Varies 4.6 ft. to 6.9 ft.	N/A	N/A	*Commercial Theme* from Jackrabbit Trail to Perryville Road *Urban Theme (with incorporation of Railway Theme)* from Perryville Road to just east of Citrus Road	Commercial Theme $1.06 M Urban Theme $2.28 M ***Total Cost*** ***$3.34 M*** *FCDMC Funding *** *$1.96 M* *Additional Funding **** *$1.38 M*
West Valley Channel	White Tanks FCS #3 southeast to Interstate 10 ADOT basins	6:1	Varies 178 ft. to 226 ft.	Varies 61 ft. to 105 ft.	Varies 118 ft. to 166 ft.	Varies 2.5 ft. to 4.7 ft.	N/A	N/A	*Sonoran Desert Theme* from White Tanks FCS #3 southeast to Interstate 10 ADOT basins	Sonoran Desert Theme $10.37 M ***Total Cost*** ***$10.37 M*** *FCDMC Funding *** *$7.07 M* *Additional Funding **** *$3.30 M*
Olive Avenue and Loop 303 Basin	Northwest corner of Olive Avenue and SR303L	4:1	N/A	N/A	N/A	N/A	20.4 acres	20 ft.	*Recreational Theme*	Recreational Theme $1.24 M ***Total Cost*** ***$1.24 M*** *FCDMC Funding *** *$0.81 M* *Additional Funding **** *$0.43 M*
Cactus Road and Loop 303 Basin	Northwest corner of Cactus Road and SR303L	4:1	N/A	N/A	N/A	N/A	33.2 acres	18 ft.	*Recreational Theme*	Recreational Theme $2.03 M ***Total Cost*** ***$2.03 M*** *FCDMC Funding *** *$1.33 M* *Additional Funding **** *$0.70 M*

Table 2.10A

Peoria Avenue and Reems R[illegible] Basin	Northwest corner of Peoria Avenue and Reems Road	4:1	N/A	N/A	N/A	N/A	26.7 acres	18 ft.	*Recreational Theme*	Recreational Theme ***Total Cost*** *FCDMC Funding *** *Additional Funding ****	<u>$1.63 M</u> ***$1.63 M*** *$1.07 M* *$0.56 M*
Northern Avenue and Reems Road Basin	Northwest corner of Northern Avenue and Reems Road	4:1	N/A	N/A	N/A	N/A	22.4 acres	22 ft.	*Recreational Theme (with incorporation of Aircraft Theme)*	Recreational Theme ***Total Cost*** *FCDMC Funding *** *Additional Funding ****	<u>$1.37 M</u> ***$1.37 M*** *$0.90 M* *$0.47 M*
Interstate 10 Basins	North side of Interstate 10 between Dysart Road and Bullard Avenue	4:1	N/A	N/A	N/A	N/A	N/A	N/A	*Recreational Theme*	Recreational Theme ***Total Cost*** *FCDMC Funding *** *Additional Funding ****	<u>$5.91 M</u> ***$5.91 M*** *$3.88 M* *$2.03 M*

(1) Includes 24 feet for 2 feet of freeboard.

* See Section 2.4.4 Typical Landscape Themes for description of themes
** Flood Control District of Maricopa County maximum dollars available ($40,000 per acre)
*** Examples of additional funding would be City funds, Grants, Private funding, IGA.

- *Landscape Theme:* The landscape theme for this channel would follow the guidelines developed for the Sonoran Desert Theme. See Section 2.4.4 Typical Landscape Themes for a description of this landscape theme.

- *Structural Components:* Structural components located within the channel would be designed to blend with the surrounding environment. This could include the use of form liners, integral color, shape/size of structure, construction material, etc.

Multi-Use Opportunities

- A multi-use path would meander throughout the width of this channel offering the user the experience of walking or riding through the sonoran desert.

- Interpretive sites would be located throughout this segment of the channel that interpret the desert, surrounding mountains, and historic aspects of the area.

- A Flood Control maintenance road would meander along both sides of the channel. This maintenance road would also double as the multi-use path in some locations.

- Access points to/from adjacent properties would be provided.

- The multi-use path would be connected to the proposed multi-use trail along Peoria Avenue. This would provide future access from the White Tank Mountains to the Agua Fria River.

Jackrabbit Trail Channel

(Indian School Road to McDowell Road)

Landscape Aesthetics

- *Structure Shape:* The Jackrabbit Trail Channel is an earthen-lined meandering channel with an average width of 151 feet and a depth that varies from 2.1 feet to 2.6 feet. The overall width (channel plus over-bank area) of the channel averages 211 feet.

- *Over-bank Areas:* A minimum of 30 feet is provided on both sides of the channel. This area at the top of the channel would include earth berming and plantings to provide buffering between the channel and adjacent property.

- *Side Slopes:* The side slopes warp and vary from 4:1 to 12:1 creating a meandering toe of slope. The side slopes would blend into the earth berming located in the over-bank areas.

Where possible terracing would be incorporated into the side slopes. Plantings would be located on the side slopes.

- ***Channel Bottom:*** The channel bottom varies from 97 feet to 101 feet in width.

- ***Landscape Theme:*** The landscape theme for this channel would follow the guidelines developed for the Urban Theme. See Section 2.4.4 Typical Landscape Themes for a description of this landscape theme.

- ***Structural Components:*** Structural components located within the channel would be designed to blend with the surrounding environment. This could include the use of form liners, integral color, shape/size of structure, construction material, etc.

Multi-Use Opportunities

- A multi-use path would meander throughout the width of the channel.

- A Flood Control maintenance road would meander along both sides of the channel. This maintenance road would also double as the multi-use path in some locations.

- Large turf areas would be located within the channel, both in the bottom of the channel and on terraces located within the channel, for use by the community. These turf areas would provide valuable open space for users to fly kites, play Frisbee golf, to have pick-up softball and football games.

- Access points to/from adjacent properties would be provided.

Jackrabbit-Perryville Channel

(Yuma Road to Gila River)

Landscape Aesthetics

- ***Structure Shape:*** The Jackrabbit-Perryville Channel is an earthen-lined meandering channel with a top width that varies from 114 feet to 134 feet and a depth that varies from 1.9 feet to 7.0 feet. The overall width of the channel (channel width plus over-bank area) varies from 162 feet to 194 feet.

- ***Over-bank Areas:*** A minimum of 30 feet is provided on both sides of the channel. This area at the top of the channel would include earth berming and plantings to provide buffering between the channel and adjacent property.

- *Side Slopes:* The side slopes warp and vary from 4:1 to 12:1 creating a meandering toe of slope. The side slopes would blend into the earth berming located in the over-bank areas. Where possible terracing would be incorporated into the side slopes. Plantings would be located on the side slopes.

- *Channel Bottom:* The channel bottom width varies from 10 feet to 86 feet in width.

- *Landscape Theme:* There is three landscape themes identified for this channel. The channel would have an Urban Theme north of MC85 and a Sonoran Desert Theme south of MC 85. A Commercial Theme would be applied at the intersections of MC85 and Jackrabbit Trail and Broadway Road and Jackrabbit Trail. See Section 2.4.4 Typical Landscape Themes for a description of these landscape themes.

- *Structural Components:* Structural components located within the channel would be designed to blend with the surrounding environment. This could include the use of form liners, integral color, shape/size of structure, construction material, etc.

Multi-Use Opportunities

- A multi-use path would meander throughout the width and length of the channel. The character of the path as well as multi-use opportunities would change as it meanders throughout the length of this channel.

- The multi-use path would transition through commercial areas and meander through the native area south of MC 85. Here the user would experience native desert and riparian plantings.

- A Flood Control maintenance road would meander along both sides of the channel. This maintenance road would also double as the multi-use path in some locations.

- Large turf areas would be located north of MC 85. These turf areas would provide valuable open space for users to fly kites, play Frisbee golf, to have pick-up softball and football games.

- Interpretive sites would be located south of MC85 to interpret the native and riparian plantings as well as the surrounding area.

Tuthill Channel

(White Tanks FCS #4 to Roosevelt Irrigation District Canal then West to Rainbow Road)

Landscape Aesthetics

- ***Structure Shape:*** The Tuthill Channel is an earthen-lined meandering channel with a top width that varies from 108 feet to 120 feet and a depth that varies from 3.9 feet to 6.9 feet. The overall width of the channel (channel width plus over-bank area) varies from 168 feet to 180 feet.

- ***Over-bank Areas:*** A minimum of 30 feet is provided on both sides of the channel. This area at the top of the channel would include earth berming and plantings to provide buffering between the channel and adjacent property.

- ***Side Slopes:*** The side slopes warp and vary from 4:1 to 12:1 creating a meandering toe of slope. The side slopes would blend into the earth berming located in the over-bank areas. Where possible terracing would be incorporated into the side slopes. Plantings would be located on the side slopes.

- ***Channel Bottom:*** The channel bottom varies from 5 feet to 46 feet in width.

- ***Landscape Theme:*** The landscape theme for this channel would follow the guidelines developed for the Urban Theme. See Section 2.4.4 Typical Landscape Themes for a description of this landscape theme.

- ***Structural Components:*** Structural components located within the channel would be designed to blend with the surrounding environment. This could include the use of form liners, integral color, shape/size of structure, construction material, etc.

Multi-Use Opportunities

- This channel will provide the same type of multi-use opportunities as found in Jackrabbit Trail Channel.

- The multi-use path located within this channel would have the potential for a future connection/access to the Roosevelt Canal.

Loop 303 Channel

(Greenway Road to Gila River)

Landscape Aesthetics

- ***Structure Shape:*** The Loop 303 Channel is an earthen-lined meandering channel with a top width that varies from 84 feet to 190 feet and a depth that varies from 3.1 feet to 5.7 feet. The overall width of the channel (channel width plus over-bank area) varies from 144 feet to 250 feet.

- ***Over-bank Areas:*** A minimum of 30 feet is provided on both sides of the channel. This area at the top of the channel would include earth berming and plantings to provide buffering between the channel and adjacent property.

- ***Side Slopes:*** The side slopes warp and vary from 4:1 to 12:1 creating a meandering toe of slope. The side slopes would blend into the earth berming located in the over-bank areas. Where possible terracing would be incorporated into the side slopes. Plantings would be located on the side slopes.

- ***Channel Bottom:*** The channel bottom varies from 5 feet to 98 feet in width.

- ***Landscape Theme:*** There are six landscape themes for this channel. The six themes include Urban, Industrial, Neighborhood, Agricultural, Commercial, and Sonoran Desert. The Urban Theme would be applied from Greenway Road to Waddell Road; Industrial Theme from Waddell Road to Peoria Avenue; Neighborhood Theme from Peoria Avenue to Glendale Avenue; Agricultural Theme from Glendale Avenue to Camelback Road; Sonoran Desert Theme from MC85 to the Gila River; and the Commercial Theme at the intersections of I-10 and SR303L, SR303L and Van Buren Street, and SR303L and Buckeye Road. See Section 2.4.4 Typical Landscape Themes for a description of this landscape theme.

- ***Structural Components:*** Structural components located within the channel would be designed to blend with the surrounding environment. This could include the use of form liners, integral color, shape/size of structure, construction material, etc.

Multi-Use Opportunities

- This channel offers many different types of multi-use activities due to its length.

- A multi-use path would meander the entire length of the channel. This would enable the user to walk/run/bike from the northern limits of the study area to the Gila River, a length of approximately 17 miles.

- The multi-use path would also be connected to the proposed multi-use trail along Peoria Avenue. This would provide future access from the White Tank Mountains to the Agua Fria River.

- Large turf open spaces would be located within the PAD developments while smaller special use turf areas would be located within the neighborhood zones.

- Interpretive sites would be located throughout the length of the channel interpreting the current and past agricultural and industrial uses of the area.

- When the channel reaches the segment identified as native it would be treated similar to that found in the Jackrabbit - Perryville Channel.

- This channel would also be linked to the proposed basins located at Olive Avenue and Peoria Avenue thus increasing multi-use activities.

- A Flood Control maintenance road would meander along both sides of the channel. This maintenance road would also double as the multi-use path in some locations.

Reems Road Channel

(Waddell Road to Northern Avenue)

Landscape Aesthetics

- ***Structure Shape:*** The Reems Road Channel is an earthen-lined meandering channel with a top width that varies from 78 feet to 154 feet and a depth that varies from 3.1 feet to 4.8 feet. The overall width of the channel (channel width plus over-bank area) varies from 138 feet to 214 feet.

- ***Over-bank Areas:*** A minimum of 30 feet is provided on both sides of the channel. This area at the top of the channel would include earth berming and plantings to provide buffering between the channel and adjacent property.

- ***Side Slopes:*** The side slopes warp and vary from 4:1 to 12:1 creating a meandering toe of slope. The side slopes would blend into the earth berming located in the over-bank areas.

Where possible terracing would be incorporated into the side slopes. Plantings would be located on the side slopes.

- *Channel Bottom:* The channel bottom varies from 5 feet to 93 feet in width.

- *Landscape Theme:* There are three landscape themes for this channel. The three themes include Urban, Agricultural, and Commercial. The Urban Theme would be applied from Waddell Road to Peoria Avenue; Agricultural Theme from Peoria Avenue to Northern Avenue; and the Commercial Theme at the intersections of Waddell Road and Reems Road, Cactus Road and Reems Road, and Peoria Avenue and Reems Road. See Section 2.4.4 Typical Landscape Themes for a description of this landscape theme.

- *Structural Components:* Structural components located within the channel would be designed to blend with the surrounding environment. This could include the use of form liners, integral color, shape/size of structure, construction material, etc.

Multi-Use Opportunities

- The PAD segment of this channel will be treated similar to the Jackrabbit Trail Channel.

- The multi-use path would be connected to the basins located at Peoria Avenue and Northern Avenue thus increasing multi-use activities.

- The multi-use path would be connected to the proposed multi-use trail along Peoria Avenue. This would provide future access from the White Tank Mountains to the Agua Fria River. The multi-use path would also be connected with the multi-use path located along Northern Avenue channel providing access to the White Tank Mountains.

- Interpretive sites would be located throughout the agricultural segment of the channel.

- A Flood Control maintenance road would meander along both sides of the channel. This maintenance road would also double as the multi-use path in some locations.

AT&SF Railroad Channel

(Waddell Road southwest to Peoria Avenue then west one mile then south to Northern Avenue)

Landscape Aesthetics

- *Structure Shape:* The AT&SF Railroad Channel is an earthen-lined meandering channel with a top width that varies from 82 feet to 140 feet and a depth that varies from 3.3 feet to

6.8 feet. The overall width of the channel (channel width plus over-bank area) varies from 142 feet to 200 feet.

- *Over-bank Areas:* A minimum of 30 feet is provided on both sides of the channel. This area at the top of the channel would include earth berming and plantings to provide buffering between the channel and adjacent property.

- *Side Slopes:* The side slopes warp and vary from 4:1 to 12:1 creating a meandering toe of slope. The side slopes would blend into the earth berming located in the over-bank areas. Where possible terracing would be incorporated into the side slopes. Plantings would be located on the side slopes.

- *Channel Bottom:* The channel bottom varies from 5 feet to 76 feet in width.

- *Landscape Theme:* There are two landscape themes for this channel. The two themes include Industrial and Agricultural. The Industrial Theme would be applied from Waddell Road to Peoria Avenue and from Olive Avenue to Northern Avenue. The Agricultural Theme would be from Peoria Avenue to Olive Avenue. See Section 2.4.4 Typical Landscape Themes for a description of this landscape theme.

- *Structural Components:* Structural components located within the channel would be designed to blend with the surrounding environment. This could include the use of form liners, integral color, shape/size of structure, construction material, etc.

Multi-Use Opportunities

- This channel provides a multi-use path with interpretive sites that interpret the adjacent railroad facility and agricultural area. The multi-use path would also be connected to the proposed multi-use trail along Peoria Avenue. This would provide future access from the White Tank Mountains to the Agua Fria River

- A Flood Control maintenance road would meander along both sides of the channel. This maintenance road would also double as the multi-use path in some locations.

Bullard Wash Channel

(Camelback Road to existing Bullard Wash structure at Lower Buckeye Road)

For this report the Bullard Wash Channel has been split into two sections, Camelback Road to I-10 and I-10 to the existing Bullard Wash.

Landscape Aesthetics

- ***Structure Shape:*** The Bullard Wash Channel is an earthen-lined meandering channel with a top width that varies from 132 feet to 168 feet and a depth that varies from 4.1 feet to 4.9 feet from Camelback Road to I-10. The overall width of the channel (channel width plus over-bank area) from Camelback Road to I-10 varies from 192 feet to 228 feet. The channel top width, depth, and overall channel width from I-10 to the existing Bullard Wash follows the City of Goodyear typical section.

- ***Over-bank Areas:*** A minimum of 30 feet is provided on both sides of the channel. This area at the top of the channel would include earth berming and plantings to provide buffering between the channel and adjacent property.

- ***Side Slopes:*** The side slopes warp and vary from 4:1 to 12:1 creating a meandering toe of slope. The side slopes would blend into the earth berming located in the over-bank areas. Where possible terracing would be incorporated into the side slopes. Plantings would be located on the side slopes.

- ***Channel Bottom:*** The channel bottom varies from 59 feet to 87 feet in width from Camelback Road to I-10. From I-10 to the existing Bullard Wash the channel bottom follows the City of Goodyear typical section.

- ***Landscape Theme:*** There are three landscape themes for this channel. The three themes include Urban, Commercial, and Neighborhood. The Urban Theme would be applied from Camelback Road to Thomas Road, the Commercial Theme would be from Thomas Road to McDowell Road, and the Neighborhood Theme would be from McDowell Road to I-10. See Section 2.4.4 Typical Landscape Themes for a description of this landscape theme.

- ***Structural Components:*** Structural components located within the channel would be designed to blend with the surrounding environment. This could include the use of form liners, integral color, shape/size of structure, construction material, etc.

Multi-Use Opportunities

- A multi-use path would be located within the channel. This path would be one segment of a multi-use path that would extend from Camelback Road to the Gila River.

- A Flood Control maintenance road would meander along both sides of the channel. This maintenance road would also double as the multi-use path in some locations.

- Large turf areas would be located within the channel. These turf areas would provide valuable open space for users to fly kites, play Frisbee golf, to have pick-up softball and football games.

- Interpretive sites would be located within the section of the channel that goes through the golf course. These sites would interpret the game of golf.

- Interpretive sites would be located in the vicinity of Goodyear Airport. These interpretive sites would interpret the various aircraft flown in and out of Goodyear Airport, the importance of the airport, and its past history.

Northern Avenue Channel

(Beardsley Canal to Reems Road)

Landscape Aesthetics

- ***Structure Shape:*** The Northern Avenue Channel is an earthen-lined meandering channel with a top width that varies from 61 feet to 142 feet and a depth that varies from 2.7 feet to 4.3 feet. The overall width of the channel (channel width plus over-bank area) varies from 121 feet to 202 feet.

- ***Over-bank Areas:*** A minimum of 30 feet is provided on both sides of the channel. This area at the top of the channel would include earth berming and plantings to provide buffering between the channel and adjacent property.

- ***Side Slopes:*** The side slopes warp and vary from 4:1 to 12:1 creating a meandering toe of slope. The side slopes would blend into the earth berming located in the over-bank areas. Where possible terracing would be incorporated into the side slopes. Plantings would be located on the side slopes.

- ***Channel Bottom:*** The channel bottom varies from 5 feet to 77 feet in width.

- ***Landscape Theme:*** The landscape theme for this channel would follow the guidelines developed for the Neighborhood Theme. See Section 2.4.4 Typical Landscape Themes for a description of this landscape theme.

- ***Structural Components:*** Structural components located within the channel would be designed to blend with the surrounding environment. This could include the use of form liners, integral color, shape/size of structure, construction material, etc.

Multi-Use Opportunities

- This channel provides a multi-use path that would connect the various adjacent neighborhoods
- Special use turf areas would be located throughout the channel for the residents of the adjacent neighborhoods.
- The multi-use path would be connected to the basin located at Reems Road thus increasing multi-use activities for the users.
- A Flood Control maintenance road would meander along both sides of the channel. This maintenance road would also double as the multi-use path in some locations.

Camelback Channel

(Cotton Lane to Bullard Wash Channel)

Landscape Aesthetics

- ***Structure Shape:*** The Camelback Channel is an earthen-lined meandering channel with a top width that varies from 98 feet to 129 feet and a depth that varies from 5.3 feet to 6.9 feet. The overall width of the channel (channel width plus over-bank area) varies from 158 feet to 189 feet.
- ***Over-bank Areas:*** A minimum of 30 feet is provided on both sides of the channel. This area at the top of the channel would include earth berming and plantings to provide buffering between the channel and adjacent property.
- ***Side Slopes:*** The side slopes warp and vary from 4:1 to 12:1 creating a meandering toe of slope. The side slopes would blend into the earth berming located in the over-bank areas. Where possible terracing would be incorporated into the side slopes. Plantings would be located on the side slopes.
- ***Channel Bottom:*** The channel bottom varies from 5 feet to 30 feet in width.
- ***Landscape Theme:*** There are four landscape themes for this channel. The four themes include Agricultural, Industrial, Aircraft, and neighborhood. The Agricultural Theme would be applied from Cotton Lane to SR303L, the Industrial Theme (with incorporation of Aircraft Theme) would be from SR303L to just east for Sarival Road, and the Neighborhood Theme

would be from just east of Sarival Road to Bullard Wash Channel. See Section 2.4.4 Typical Landscape Themes for a description of this landscape theme.

- ***Structural Components:*** Structural components located within the channel would be designed to blend with the surrounding environment. This could include the use of form liners, integral color, shape/size of structure, construction material, etc.

Multi-Use Opportunities

- A meandering multi-use path would be located throughout the length of the channel. It would connect to the multi-use path along the Loop 303 and at Bullard Wash. This would provide the user access to the northern limits of the project area as well as the Gila River.

- Interpretive sites would be incorporated into the facility interpreting Luke Air Force Base, its aircraft, and importance to the community.

- A Flood Control maintenance road would meander along both sides of the channel. This maintenance road would also double as the multi-use path in some locations.

Buckeye Channel

(Just west of Perryville Road to Cotton Lane)

Landscape Aesthetics

- ***Structure Shape:*** The Buckeye Channel is an earthen-lined meandering channel with a top width that varies from 94 feet to 127 feet and a depth that varies from 3.1 feet to 6.4 feet. The overall width of the channel (channel width plus over-bank area) varies from 154 feet to 187 feet.

- ***Over-bank Areas:*** A minimum of 30 feet is provided on both sides of the channel. This area at the top of the channel would include earth berming and plantings to provide buffering between the channel and adjacent property.

- ***Side Slopes:*** The side slopes warp and vary from 4:1 to 12:1 creating a meandering toe of slope. The side slopes would blend into the earth berming located in the over-bank areas. Where possible terracing would be incorporated into the side slopes. Plantings would be located on the side slopes.

- ***Channel Bottom:*** The channel bottom varies from 5 feet to 66 feet in width.

- *Landscape Theme:* The landscape theme for this channel would follow the guidelines developed for the Urban Theme. See Section 2.4.4 Typical Landscape Themes for a description of this landscape theme.

- *Structural Components:* Structural components located within the channel would be designed to blend with the surrounding environment. This could include the use of form liners, integral color, shape/size of structure, construction material, etc.

Multi-Use Opportunities

- This channel will provide a multi-use path that connects to the Loop 303 multi-use path.

- Large turf areas would be located within the channel for use by the community. These turf areas would provide valuable open space for users to fly kites, play Frisbee golf, to have pick-up softball and football games.

Union Pacific Railroad Channel

(Just west of Jackrabbit Trail to Cotton Lane)

Landscape Aesthetics

- *Structure Shape:* The Union Pacific Railroad Channel is an earthen-lined meandering channel with a top width that varies from 85 feet to 125 feet and a depth that varies from 4.6 feet to 6.9 feet. The overall width of the channel (channel width plus over-bank area) varies from 145 feet to 186 feet.

- *Over-bank Areas:* A minimum of 30 feet is provided on both sides of the channel. This area at the top of the channel would include earth berming and plantings to provide buffering between the channel and adjacent property.

- *Side Slopes:* The side slopes warp and vary from 4:1 to 12:1 creating a meandering toe of slope. The side slopes would blend into the earth berming located in the over-bank areas. Where possible terracing would be incorporated into the side slopes. Plantings would be located on the side slopes.

- *Channel Bottom:* The channel bottom varies from 5 feet to 26 feet in width.

- ***Landscape Theme:*** The landscape theme for this channel would follow the guidelines developed for the Urban Theme. See Section 2.4.4 Typical Landscape Themes for a description of this landscape theme.

- ***Structural Components:*** Structural components located within the channel would be designed to blend with the surrounding environment. This could include the use of form liners, integral color, shape/size of structure, construction material, etc.

Multi-Use Opportunities

- Interpretive sites would be incorporated into the facility interpreting the railroad, its components, and importance to the area.

- A multi-use path would be connected to the Loop 303 multi-use path and the Jackrabbit – Perryville Channel multi-use path, both providing access to the Gila River.

West Valley Channel

(White Tanks FCS #3 southeast to Interstate 10 ADOT Basins)

Landscape Aesthetics

- ***Structure Shape:*** The West Valley Channel is an earthen-lined meandering channel with a top width that varies from 118 feet to 166 feet and a depth that varies from 2.5 feet to 4.7 feet. The overall width of the channel (channel width plus over-bank area) varies from 178 feet to 226 feet.

- ***Over-bank Areas:*** A minimum of 30 feet is provided on both sides of the channel. This area at the top of the channel would include earth berming and plantings to provide buffering between the channel and adjacent property.

- ***Side Slopes:*** The side slopes warp and vary from 4:1 to 12:1 creating a meandering toe of slope. The side slopes would blend into the earth berming located in the over-bank areas. Where possible terracing would be incorporated into the side slopes. Plantings would be located on the side slopes.

- ***Channel Bottom:*** The channel bottom varies from 61 feet to 105 feet in width.

- ***Landscape Theme:*** The landscape theme for this channel would follow the guidelines developed for the Sonoran Desert Theme. See Section 2.4.4 Typical Landscape Themes for a description of this landscape theme.

- ***Structural Components:*** Structural components located within the channel would be designed to blend with the surrounding environment. This could include the use of form liners, integral color, shape/size of structure, construction material, etc.

Multi-Use Opportunities

- The West Valley Channel, in conjunction with the Bullard Wash Channel and the I-10/ADOT Channel, provides a multi use path from the White Tank Mountains to the Gila River and the Agua Fria River.

- Interpretive sites would be incorporated into the facility interpreting the surrounding desert, agricultural sites, and other miscellaneous sites.

Olive Avenue/Loop 303 Basin

(Northwest corner of Olive Avenue and SR303L)

Landscape Aesthetics

- ***Structure Shape:*** The Olive Avenue/Loop 303 Basin is a 20.4-acre earthen-lined basin with a meandering top edge. The depth of the basin is 20 feet.

- ***Over-bank Areas:*** A minimum of 60 feet is provided around the top of the basin. This area at the top of the basin would include earth berming and plantings to provide buffering between the basin and adjacent property.

- ***Side Slopes:*** The side slopes of the basin would warp and vary from 4:1 to 12:1 creating a meandering toe of slope. The side slopes would blend into the earth berming located in the over-bank areas. Where possible terracing would be incorporated into the side slopes. Plantings would be located on the side slopes.

- ***Landscape Theme:*** The landscape theme for this channel would follow the guidelines developed for the Recreational Theme. See Section 2.4.4 Typical Landscape Themes for a description of this landscape theme.

- ***Structural Components:*** Structural components located within the basin would be designed to blend with the surrounding environment. This could include the use of form liners, integral color, shape/size of structure, construction material, etc.

Multi-Use Opportunities

- A soccer/softball complex could be developed for the area. In addition, other activities could be accommodated such as various court sports, and just open space for users to use as they wish.

- A multi-use path would be constructed around the perimeter of the basin. Located within the pathway could be distance markers for runners to keep track of how far they have run.

Cactus Road/Loop 303 Basin

(Northwest corner of Cactus Road and SR303L)

Landscape Aesthetics

- ***Structure Shape:*** The Cactus Road/Loop 303 Basin is a 33.2-acre earthen-lined basin with a meandering top edge. The depth of the basin is 18 feet.

- ***Over-bank Areas:*** A minimum of 60 feet is provided around the top of the basin. This area at the top of the basin would include earth berming and plantings to provide buffering between the basin and adjacent property.

- ***Side Slopes:*** The side slopes of the basin would warp and vary from 4:1 to 12:1 creating a meandering toe of slope. The side slopes would blend into the earth berming located in the over-bank areas. Where possible terracing would be incorporated into the side slopes. Plantings would be located on the side slopes.

- ***Landscape Theme:*** The landscape theme for this channel would follow the guidelines developed for the Recreational Theme. See Section 2.4.4 Typical Landscape Themes for a description of this landscape theme.

- ***Structural Components:*** Structural components located within the basin would be designed to blend with the surrounding environment. This could include the use of form liners, integral color, shape/size of structure, construction material, etc.

Multi-Use Opportunities

- This basin would be developed similar to the Olive Avenue/Loop 303 Basin.

Peoria Avenue/Reems Road Basin

(Northwest corner of Peoria Avenue and Reems Road)

Landscape Aesthetics

- ***Structure Shape:*** The Peoria Avenue/Reems Road Basin is a 26.7-acre earthen-lined basin with a meandering top edge. The depth of the basin is 18 feet.

- ***Over-bank Areas:*** A minimum of 60 feet is provided around the top of the basin. This area at the top of the basin would include earth berming and plantings to provide buffering between the basin and adjacent property.

- ***Side Slopes:*** The side slopes of the basin would warp and vary from 4:1 to 12:1 creating a meandering toe of slope. The side slopes would blend into the earth berming located in the over-bank areas. Where possible terracing would be incorporated into the side slopes. Plantings would be located on the side slopes.

- ***Landscape Theme:*** The landscape theme for this channel would follow the guidelines developed for the Recreational Theme. See Section 2.4.4 Typical Landscape Themes for a description of this landscape theme.

- ***Structural Components:*** Structural components located within the basin would be designed to blend with the surrounding environment. This could include the use of form liners, integral color, shape/size of structure, construction material, etc.

Multi-Use Opportunities

- This basin would be developed similar to the Olive Avenue/Loop 303 Basin.

Northern Avenue/Reems Road Basin

(Northwest corner of Northern Avenue and Reems Road)

Landscape Aesthetics

- ***Structure Shape:*** The Northern Avenue/Reems Road Basin is a 22.4-acre earthen-lined basin with a meandering top edge. The depth of the basin is 22 feet.

- ***Over-bank Areas:*** A minimum of 60 feet is provided around the top of the basin. This area at the top of the basin would include earth berming and plantings to provide buffering between the basin and adjacent property.

- ***Side Slopes:*** The side slopes of the basin would warp and vary from 4:1 to 12:1 creating a meandering toe of slope. The side slopes would blend into the earth berming located in the over-bank areas. Where possible terracing would be incorporated into the side slopes. Plantings would be located on the side slopes.

- ***Landscape Theme:*** This basin would incorporate two landscape themes, Recreational and Aircraft. See Section 2.4.4 Typical Landscape Themes for a description of this landscape theme.

- ***Structural Components:*** Structural components located within the basin would be designed to blend with the surrounding environment. This could include the use of form liners, integral color, shape/size of structure, construction material, etc.

Multi-Use Opportunities

- This basin would be developed similar to the Cactus Road and Loop 303 Basin.

- Earth contouring of this basin will need to respond to the adjacent Falcon Dunes Golf Course.

- A multi-use activity included as a part of this basin could include a small golf ball driving range.

Interstate 10 Basins

(North side of Interstate 10 between Dysart Road and Bullard Avenue)

Landscape Aesthetics

- ***Structure Shape:*** The interstate 10 Basins are earthen-lined, have meandering top edges, and varying depths.

- *Over-bank Areas:* A minimum of 60 feet is provided around the top of the basin. This area at the top of the basin would include earth berming and plantings to provide buffering between the basin and adjacent property.

- *Side Slopes:* The side slopes of the basin would warp and vary from 4:1 to 12:1 creating a meandering toe of slope. The side slopes would blend into the earth berming located in the over-bank areas. Where possible terracing would be incorporated into the side slopes. Plantings would be located on the side slopes.

- *Landscape Theme:* The landscape theme for this channel would follow the guidelines developed for the Recreational Theme. See Section 2.4.4 Typical Landscape Themes for a description of this landscape theme.

- *Structural Components:* Structural components located within the basin would be designed to blend with the surrounding environment. This could include the use of form liners, integral color, shape/size of structure, construction material, etc.

Multi-Use Opportunities

- A regional soccer/softball complex could be developed for the area.

- Activities such as a BMX courses, a golf course, various court sports, and just open space for users to use as they wish could be accommodated.

- A multi-use path would be constructed around the perimeter of the basin. Located within the pathway could be distance markers for runners to keep track of how far they have run.

Recommended Alternative 2

Landscape Aesthetics: This alternative has 22 different flood control facilities. These facilities consist of 13 various sized channels and 9 basins; all requiring different landscape aesthetic treatments.

These flood control facilities are located within a number of different landscape characters and therefore would receive different landscape character themes. This is based upon the *Landscape Aesthetics Assessment and Multi-Use Opportunity Assessment* report dated July 6, 2000.

Multi-Use Opportunities: There are several opportunities for multi-use within the various channel configurations and basins.

The following outlines the proposed landscape aesthetics and multi-use opportunities for each channel and basin.

Beardsley Channel
(Cactus Road to White Tanks FCS #3)

Landscape Aesthetics

- ***Structure Shape:*** The Beardsley Channel is an earthen-lined meandering channel with a top width that varies from 66 feet to 210 feet and a depth that varies from 1.8 feet to 5.5 feet. The overall width of the channel (channel width plus over-bank area) varies from 126 feet to 270 feet.

- ***Over-bank Areas:*** A minimum of 30 feet is provided on both sides of the channel. This area at the top of the channel would include earth berming and plantings to provide buffering between the channel and adjacent property.

- ***Side Slopes:*** The side slopes warp and vary from 4:1 to 12:1 creating a meandering toe of slope. The side slopes would blend into the earth berming located in the over-bank areas. Where possible terracing would be incorporated into the side slopes. Plantings would be located on the side slopes.

- ***Channel Bottom:*** The channel bottom varies from 20 feet to 143 feet in width.

- ***Landscape Theme:*** The landscape theme for this channel would follow the guidelines developed for the Sonoran Desert Theme. See Section 2.4.4 Typical Landscape Themes for a description of this landscape theme.

- ***Structural Components:*** Structural components located within the channel would be designed to blend with the surrounding environment. This could include the use of form liners, integral color, shape/size of structure, construction material, etc.

Multi-Use Opportunities

- This channel will provide the same type of multi-use opportunities as found in Alternative #1.

Table 2.10B

Recommended Alternative #2										
Channel Name	**Channel Limits***	**Side Slope**	**Overall Width of Channel****	**Bottom Width of Channel**	**[1]Top Width of Channel**	**Depth of Channel**	**Size of Basin**	**Depth of Basin**	**Landscape Theme(s)*****	**Landscape Aesthetics & Multi-Use Cost**
Beardsley Channel	Cactus Road to White Tanks FCS #3	6:1	Varies 126 ft. to 270 ft.	Varies 20 ft. to 143 ft.	Varies 66 ft. to 210 ft.	Varies 1.8 ft. to 5.5 ft.	N/A	N/A	*Sonoran Desert Theme*	Sonoran Desert Theme $4.96 M ***Total Cost $4.96 M*** *FCDMC Funding ** $3.38 M* *Additional Funding*** $1.58 M*
Jackrabbit Trail Channel	Indian School Road to McDowell Road	6:1	Varies 148 ft. to 188 ft.	Varies 34 ft. to 78 ft.	Varies 88 ft. to 128 ft.	Varies 2.1 ft. to 2.5 ft.	N/A	N/A	*Urban Theme*	Urban Theme $3.04 M ***Total Cost $3.04 M*** *FCDMC Funding ** $1.75 M* *Additional Funding*** $1.29 M*
Jackrabbit – Perryville Channel	White Tanks FCS #4 to intersection of Yuma Road and Perryville Road, south to the Gila River	6:1	Varies 140 ft. to 260 ft.	Varies 28 ft. to 134 ft.	Varies 80 ft. to 200 ft.	Varies 2.3 ft. to 6.8 ft.	N/A	N/A	*Urban Theme* north of MC85 *Sonoran Desert Theme* south of MC85 *Commercial Theme* at Broadway Road and Jackrabbit Trail intersection and MC85 and Jackrabbit Trail intersection	Urban Theme $2.21 M Sonoran Desert Theme $0.69 M Commercial Theme $2.49 M Total Cost $5.39 M *FCDMC Funding ** $3.39 M* *Additional Funding*** $2.00 M*
Loop 303 Channel	Thunderbird Road to the Gila River	6:1	Varies 134 ft. to 222 ft.	Varies 5 ft. to 87 ft.	Varies 74 ft. to 162 ft.	Varies 3.3 ft. to 6.4 ft.	N/A	N/A	*Urban Theme* from Thunderbird Road to Waddell Road *Industrial Theme* from Waddell Road to Peoria Avenue *Neighborhood Theme* from Peoria Avenue to Glendale Avenue *Agricultural Theme* from Glendale Avenue to Camelback Road *Commercial Theme* at the intersections of I-10 and SR303L, SR303L and Van Buren Street, and SR303L and Buckeye Road *Sonoran Desert Theme* from MC85 to Gila River	Urban Theme $9.10 M Industrial Theme $2.43 M Neighborhood Theme $3.78 M Agricultural Theme $2.27 M Commercial Theme $0.60 M Sonoran Desert Theme $1.09 M ***Total Cost $19.27 M*** *FCDMC Funding ** $11.56 M* *Additional Funding*** $7.71 M*
Reems Road Channel	Waddell Road to Northern Avenue	6:1	Varies 139 ft. to 206 ft.	Varies 5 ft. to 86 ft.	Varies 79 ft. to 146 ft.	Varies 3.0 ft. to 4.4 ft.	N/A	N/A	*Urban Theme* from Waddell Road to Peoria Avenue *Agricultural Theme* form Peoria Avenue to Northern Avenue *Commercial Theme* at the intersections of Waddell Road and Reems Road, Cactus Road and Reems Road, and Peoria Avenue and Reems Road	Urban Theme $2.50 M Agricultural Theme $2.18 M Commercial Theme $0.29 M ***Total Cost $4.97 M*** *FCDMC Funding ** $3.05 M* *Additional Funding*** $1.92 M*
El Mirage Channel	Greenway Road to Waddell Road then east to the AT&SF Railroad	6:1	Varies 124 ft. to 160 ft.	Varies 5 ft. to 30 ft.	Varies 64 ft. to 100 ft.	Varies 2.9 ft. to 5.9 ft.	N/A	N/A	*Urban Theme* from Greenway Road to Waddell Road then east to the AT&SF Railroad	Urban Theme $2.00 M ***Total Cost $2.00 M*** *FCDMC Funding ** $1.15 M* *Additional Funding*** $0.85 M*
AT&SF Railroad Channel	Greenway Road to one-half mile south of Peoria Avenue then west one mile then south to Northern Avenue	6:1	Varies 171 ft. to 246 ft.	Varies 16 ft. to 124 ft.	Varies 111 ft. to 186 ft.	Varies 3.0 ft. to 7.0 ft.	N/A	N/A	*Urban Theme* from Greenway Road to Waddell Road *Industrial Theme* from Waddell Road to Peoria Avenue and from Olive Avenue to Northern Avenue. *Agricultural Theme* form Peoria Avenue to Olive Avenue	Urban Theme $1.55 M Industrial Theme $2.91 M Agricultural Theme $1.36 M ***Total Cost $5.82 M*** *FCDMC Funding ** $3.56 M* *Additional Funding*** $2.26 M*

Table 2.10B

Lower El Mirage Channel	Greenway Road southeast to the Agua Fria River	6:1	Varies 138 ft. to 155 ft.	Varies 5 ft. to 26 ft.	Varies 78 ft. to 95 ft.	Varies 3.8 ft. to 4.9 ft.	N/A	N/A	*Urban Theme* from Waddell Road to Agua Fria River *Neighborhood Theme* from Greenway Road to Waddell Road	Urban Theme $1.03 M Neighborhood Theme $2.00 M ***Total Cost*** ***$3.03 M*** *FCDMC Funding *** *$1.78 M* *Additional Funding**** *$1.25 M*
Bullard Wash Channel	Camelback Road to existing Bullard Wash structure at Lower Buckeye Road	6:1 - Camelback Road to I-10 4:1 - I-10 to existing Bullard Wash	Varies 176 ft. to 246 ft. (Camelback Road to I-10) Follows City of Goodyear typical section (I-10 to existing Bullard Wash)	Varies 10 ft. to 116 ft. (Camelback Road to I-10) Follows City of Goodyear typical section (I-10 to existing Bullard Wash)	Varies 116 ft. to 186 ft. (Camelback Road to I-10) Follows City of Goodyear typical section (I-10 to existing Bullard Wash)	Varies 3.8 ft. to 7.0 ft. (Camelback Road to I-10) Follows City of Goodyear typical section (I-10 to existing Bullard Wash)	N/A	N/A	*Urban Theme* from Camelback Road to Thomas Road *Commercial Theme* from Thomas to McDowell Road *Neighborhood Theme* from McDowell to I-10	Urban Theme $3.14 M Commercial Theme $1.47 M Neighborhood Theme $1.52 M ***Total Cost*** ***$6.13 M*** *FCDMC Funding *** *$3.61 M* *Additional Funding**** *$2.52 M*
Northern Channel	Olive Avenue southeast to intersection of Citrus Road and Northern Avenue, then east to Reems Road	6:1	Varies 147 ft. to 302 ft.	Varies 5 ft. to 180 ft.	Varies 87 ft. to 242 ft.	Varies 3.0 ft. to 4.8 ft.	N/A	N/A	*Neighborhood Theme* from Olive Avenue southeast to intersection of Citrus Road and Northern Avenue, then east to Reems Road	Neighborhood Theme $6.54 M ***Total Cost*** ***$6.54 M*** *FCDMC Funding *** *$3.88 M* *Additional Funding**** *$2.66 M*
Camelback Channel	White Tanks FCS #3 southeast to the intersection of Perryville Road and Camelback Road then east to the Bullard Wash Channel	6:1	Varies 134 ft. to 277 ft.	Varies 5 ft. to 154 ft.	Varies 74 ft. to 217 ft.	Varies 3.2 ft. to 6.6 ft.	N/A	N/A	*Sonoran Desert Theme* from White Tanks FCS #3 to the intersection of Perryville Road and Camelback Road *Agricultural Theme* from Cotton Lane to SR303L *Industrial Theme (with incorporation of Aircraft Theme)* from SR303L to just east of Sarival Road *Neighborhood Theme* from just east of Sarival Road to Bullard Wash Channel	Sonoran Desert Theme $2.58 M Agricultural Theme $0.66 M Industrial Theme $1.07 M Neighborhood Theme $4.07 M ***Total Cost*** ***$8.38 M*** *FCDMC Funding *** *$5.27 M* *Additional Funding**** *$3.11 M*
Interstate 10 West Channel	Just west of Perryville Road to SR303L	6:1	Varies 173 ft. to 197 ft.	Varies 10 ft. to 83 ft.	Varies 113 ft. to 137 ft.	Varies 2.5 ft. to 7.0 ft.	N/A	N/A	*Agricultural Theme* from Perryville Road to just west of Citrus Road *Neighborhood Theme* from just west of Citrus Road to just west of Cotton Lane *Commercial Theme* at intersection of I-10 and Perryville Road and I-10 and Cotton Lane	Urban Theme $1.35 M Neighborhood Theme $1.30 M Commercial Theme $0.31 M ***Total Cost*** ***$2.96 M*** *FCDMC Funding *** *$1.74 M* *Additional Funding**** *$1.22 M*
Interstate 10 East Channel	Sarival Road to Bullard Wash	6:1	Varies 113 ft. to 125 ft.	5 ft.	Varies 53 ft. to 65 ft.	Varies 2.0 ft. to 3.0 ft.	N/A	N/A	*Neighborhood Theme* from Estrella Parkway to just west of Bullard Wash *Commercial Theme* from Sarival Avenue to Estrella Parkway and from just west of Bullard Avenue to the ADOT basins	Neighborhood Theme $0.76 M Commercial Theme $0.74 M ***Total Cost*** ***$1.50 M*** *FCDMC Funding *** *$0.91 M* *Additional Funding**** *$0.59 M*
Roosevelt Irrigation District Channel	Intersection of Cotton Lane and the Roosevelt Irrigation District Canal southwest to the intersection of Jackrabbit Trail and the Roosevelt Irrigation District Canal	6:1	Varies 133 ft. to 176 ft.	Varies 5 ft. to 10 ft.	Varies 73 ft. to 116 ft.	Varies 3.6 ft. to 6.9 ft.	N/A	N/A	*Urban Theme* from Perryville Road to Cotton Lane *Commercial Theme* from Jackrabbit Trail to Perryville Road	Urban Theme $2.19 M Commercial Theme $1.02 M ***Total Cost*** ***$3.21 M*** *FCDMC Funding *** *$1.89 M* *Additional Funding**** *$1.32 M*

Table 2.10B

Peoria Avenue and Reems Road Basin	Northwest corner of Peoria Avenue and Reems Road	4:1	N/A	N/A	N/A	N/A	25.6 acres	18 ft.	*Recreational Theme*	Recreational Theme ***Total Cost*** *FCDMC Funding* ** *Additional Funding******	<u>$1.56 M</u> ***$1.56 M*** *$1.03 M* *$0.53 M*
Northern Avenue and Reems Road Basin	Northwest corner of Northern Avenue and Reems Road	4:1	N/A	N/A	N/A	N/A	40.6 acres	23 ft.	*Recreational Theme (with incorporation of Aircraft Theme)*	Recreational Theme ***Total Cost*** *FCDMC Funding* ** *Additional Funding******	<u>$2.47 M</u> ***$2.47 M*** *$1.62 M* *$0.85 M*
SR303L and Northern Avenue Basin	Northwest corner of Northern Avenue and SR303L	4:1	N/A	N/A	N/A	N/A	55.2 acres	21 ft.	*Recreational Theme*	Recreational Theme ***Total Cost*** *FCDMC Funding* ** *Additional Funding******	<u>$3.36 M</u> ***$3.36 M*** *$2.21 M* *$1.15 M*
SR303L and Camelback Road Basin	Northwest corner of Camelback Road and SR303L	4:1	N/A	N/A	N/A	N/A	44.8 acres	23 ft.	*Recreational Theme*	Recreational Theme ***Total Cost*** *FCDMC Funding* ** *Additional Funding******	<u>$2.73 M</u> ***$2.73 M*** *$1.79 M* *$0.94 M*
SR303L and Interstate 10 Basin	Northwest corner of Interstate 10 and SR303L	4:1	N/A	N/A	N/A	N/A	52.3 acres	16 ft.	*Recreational Theme*	Recreational Theme ***Total Cost*** *FCDMC Funding* ** *Additional Funding******	<u>$3.18 M</u> ***$3.18 M*** *$2.09 M* *$1.09 M*
Bullard Wash and Interstate 10 Basin	Northwest corner of Interstate 10 and Bullard Wash	4:1	N/A	N/A	N/A	N/A	13.1 acres	14 ft.	*Recreational Theme*	Recreational Theme ***Total Cost*** *FCDMC Funding* ** *Additional Funding******	<u>$0.79 M</u> ***$0.79 M*** *$0.52 M* *$0.27 M*
Interstate 10 Basins	North side of Interstate 10 between Dysart Road and Bullard Avenue	4:1	N/A	N/A	N/A	N/A	N/A	N/A	*Recreational Theme*	Recreational Theme ***Total Cost*** *FCDMC Funding* ** *Additional Funding******	<u>$5.91 M</u> ***$5.91 M*** *$3.88 M* *$2.03 M*

(1) Includes 24 feet for 2 feet of freeboard.

* See Section 2.4.4 Typical Landscape Themes for description of themes
** Flood Control District of Maricopa County maximum dollars available ($40,000 per acre)
*** Examples of additional funding would be City funds, Grants, Private funding, IGA.

Jackrabbit Trail Channel

(Indian School Road to McDowell Road)

Landscape Aesthetics

- ***Structure Shape:*** The Jackrabbit Trail Channel is an earthen-lined meandering channel with a top width that varies from 88 feet to 128 feet and a depth that varies from 2.1 feet to 2.5 feet. The overall width of the channel (channel width plus over-bank area) varies from 148 feet to 188 feet.

- ***Over-bank Areas:*** A minimum of 30 feet is provided on both sides of the channel. This area at the top of the channel would include earth berming and plantings to provide buffering between the channel and adjacent property.

- ***Side Slopes:*** The side slopes warp and vary from 4:1 to 12:1 creating a meandering toe of slope. The side slopes would blend into the earth berming located in the over-bank areas. Where possible terracing would be incorporated into the side slopes. Plantings would be located on the side slopes.

- ***Channel Bottom:*** The channel bottom varies from 34 feet to 78 feet in width.

- ***Landscape Theme:*** The landscape theme for this channel would follow the guidelines developed for the Urban Theme. See Section 2.4.4 Typical Landscape Themes for a description of this landscape theme.

- ***Structural Components:*** Structural components located within the channel would be designed to blend with the surrounding environment. This could include the use of form liners, integral color, shape/size of structure, construction material, etc.

Multi-Use Opportunities

- This channel will provide the same type of multi-use opportunities as found in Alternative #1.

Jackrabbit-Perryville Channel

(White Tanks FCS #4 to intersection of Yuma Road and Perryville Road, south to the Gila River)

Landscape Aesthetics

- ***Structure Shape:*** The Jackrabbit-Perryville Channel is an earthen-lined meandering channel with a top width that varies from 80 feet to 200 feet and a depth that varies from 2.3 feet to 6.8 feet. The overall width of the channel (channel width plus over-bank area) varies from 140 feet to 260 feet.

- ***Over-bank Areas:*** A minimum of 30 feet is provided on both sides of the channel. This area at the top of the channel would include earth berming and plantings to provide buffering between the channel and adjacent property.

- ***Side Slopes:*** The side slopes warp and vary from 4:1 to 12:1 creating a meandering toe of slope. The side slopes would blend into the earth berming located in the over-bank areas. Where possible terracing would be incorporated into the side slopes. Plantings would be located on the side slopes.

- ***Channel Bottom:*** The channel bottom width varies from 28 feet to 134 feet in width.

- ***Landscape Theme:*** There is three landscape themes identified for this channel. The channel would have an Urban Theme north of MC85 and a Sonoran Desert Theme south of MC 85. A Commercial Theme would be applied at the intersections of MC85 and Jackrabbit Trail and Broadway Road and Jackrabbit Trail. See Section 2.4.4 Typical Landscape Themes for a description of these landscape themes.

- ***Structural Components:*** Structural components located within the channel would be designed to blend with the surrounding environment. This could include the use of form liners, integral color, shape/size of structure, construction material, etc.

Multi-Use Opportunities

- This channel will provide the same type of multi-use opportunities as found in Alternative #1.

Loop 303 Channel

(Thunderbird Road to Gila River)

Landscape Aesthetics

- ***Structure Shape:*** The Loop 303 Channel is an earthen-lined meandering channel with a top width that varies from 74 feet to 162 feet and a depth that varies from 3.3 feet to 6.4 feet.

The overall width of the channel (channel width plus over-bank area) varies from 134 feet to 222 feet.

- *Over-bank Areas:* A minimum of 30 feet is provided on both sides of the channel. This area at the top of the channel would include earth berming and plantings to provide buffering between the channel and adjacent property.
- *Side Slopes:* The side slopes warp and vary from 4:1 to 12:1 creating a meandering toe of slope. The side slopes would blend into the earth berming located in the over-bank areas. Where possible terracing would be incorporated into the side slopes. Plantings would be located on the side slopes.
- *Channel Bottom:* The channel bottom varies from 5 feet to 87 feet in width.
- *Landscape Theme:* There are six landscape themes for this channel. The six themes include Urban, Industrial, Neighborhood, Agricultural, Commercial, and Sonoran Desert. The Urban Theme would be applied from Thunderbird Road to Waddell Road; Industrial Theme from Waddell Road to Peoria Avenue; Neighborhood Theme from Peoria Avenue to Glendale Avenue; Agricultural Theme from Glendale Avenue to Camelback Road; Sonoran Desert Theme from MC85 to the Gila River; and the Commercial Theme at the intersections of I-10 and SR303L, SR303L and Van Buren Street, and SR303L and Buckeye Road. See Section 2.4.4 Typical Landscape Themes for a description of this landscape theme.
- *Structural Components:* Structural components located within the channel would be designed to blend with the surrounding environment. This could include the use of form liners, integral color, shape/size of structure, construction material, etc.

Multi-Use Opportunities

- This channel will provide the same type of multi-use opportunities as found in Alternative #1.

Reems Road Channel

(Waddell Road to Northern Avenue)

Landscape Aesthetics

- *Structure Shape:* The Reems Road Channel is an earthen-lined meandering channel with a top width that varies from 79 feet to 146 feet and a depth that varies from 3.0 feet to 4.4 feet.

The overall width of the channel (channel width plus over-bank area) varies from 139 feet to 206 feet.

- ***Over-bank Areas:*** A minimum of 30 feet is provided on both sides of the channel. This area at the top of the channel would include earth berming and plantings to provide buffering between the channel and adjacent property.

- ***Side Slopes:*** The side slopes warp and vary from 4:1 to 12:1 creating a meandering toe of slope. The side slopes would blend into the earth berming located in the over-bank areas. Where possible terracing would be incorporated into the side slopes. Plantings would be located on the side slopes.

- ***Channel Bottom:*** The channel bottom varies from 5 feet to 86 feet in width.

- ***Landscape Theme:*** There are three landscape themes for this channel. The three themes include Urban, Agricultural, and Commercial. The Urban Theme would be applied from Waddell Road to Peoria Avenue; Agricultural Theme from Peoria Avenue to Northern Avenue; and the Commercial Theme at the intersections of Waddell Road and Reems Road, Cactus Road and Reems Road, and Peoria Avenue and Reems Road. See Section 2.4.4 Typical Landscape Themes for a description of this landscape theme.

- ***Structural Components:*** Structural components located within the channel would be designed to blend with the surrounding environment. This could include the use of form liners, integral color, shape/size of structure, construction material, etc.

Multi-Use Opportunities

- This channel will provide the same type of multi-use opportunities as found in Alternative #1.

El Mirage Channel

(Greenway Road to Waddell Road then east to the AT&SF Railroad)

Landscape Aesthetics

- ***Structure Shape:*** The El Mirage Channel is an earthen-lined meandering channel with a top width that varies from 64 feet to 100 feet and a depth that varies from 2.9 feet to 5.9 feet. The overall width of the channel (channel width plus over-bank area) varies from 124 feet to 160 feet.

- *Over-bank Areas:* A minimum of 30 feet is provided on both sides of the channel. This area at the top of the channel would include earth berming and plantings to provide buffering between the channel and adjacent property.

- *Side Slopes:* The side slopes warp and vary from 4:1 to 12:1 creating a meandering toe of slope. The side slopes would blend into the earth berming located in the over-bank areas. Where possible terracing would be incorporated into the side slopes. Plantings would be located on the side slopes.

- *Channel Bottom:* The channel bottom varies from 5 feet to 30 feet in width.

- *Landscape Theme:* The landscape theme for this channel would follow the guidelines developed for the Urban Theme. See Section 2.4.4 Typical Landscape Themes for a description of this landscape theme.

- *Structural Components:* Structural components located within the channel would be designed to blend with the surrounding environment. This could include the use of form liners, integral color, shape/size of structure, construction material, etc.

Multi-Use Opportunities

- A multi-use path would meander throughout the width of the channel and connect to the multi use trail adjacent to the AT&SF Railroad.

- Large and small turf areas would be located within the channel for use by the community. These turf areas would provide valuable open space for users to fly kites, play Frisbee golf, to have pick-up softball and football games.

AT&SF Railroad Channel

(Greenway Road to one-half mile south of Peoria Avenue then west one mile then south to Northern Avenue)

Landscape Aesthetics

- *Structure Shape:* The AT&SF Railroad Channel is an earthen-lined meandering channel with a top width that varies from 111 feet to 186 feet and a depth that varies from 3.0 feet to 7.0 feet. The overall width of the channel (channel width plus over-bank area) varies from 171 feet to 246 feet.

- ***Over-bank Areas:*** A minimum of 30 feet is provided on both sides of the channel. This area at the top of the channel would include earth berming and plantings to provide buffering between the channel and adjacent property.

- ***Side Slopes:*** The side slopes warp and vary from 4:1 to 12:1 creating a meandering toe of slope. The side slopes would blend into the earth berming located in the over-bank areas. Where possible terracing would be incorporated into the side slopes. Plantings would be located on the side slopes.

- ***Channel Bottom:*** The channel bottom varies from 16 feet to 124 feet in width.

- ***Landscape Theme:*** There are three landscape themes for this channel. The three themes include Urban, Industrial and Agricultural. The Urban Theme would be applied from Greenway Road to Waddell Road; the Industrial Theme would occur from Waddell Road to Peoria Avenue and from Olive Avenue to Northern Avenue; and the Agricultural Theme would be from Peoria Avenue to Olive Avenue. See Section 2.4.4 Typical Landscape Themes for a description of this landscape theme.

- ***Structural Components:*** Structural components located within the channel would be designed to blend with the surrounding environment. This could include the use of form liners, integral color, shape/size of structure, construction material, etc.

Multi-Use Opportunities

- This channel will provide the same type of multi-use opportunities as found in Alternative #1.

Lower El Mirage Channel
(Greenway Road southeast to the Agua Fria River)

Landscape Aesthetics

- ***Structure Shape:*** The Lower El Mirage Channel is an earthen-lined meandering channel with a top width that varies from 78 feet to 95 feet and a depth that varies from 3.8 feet to 4.9 feet. The overall width of the channel (channel width plus over-bank area) varies from 138 feet to 155 feet.

- ***Over-bank Areas:*** A minimum of 30 feet is provided on both sides of the channel. This area at the top of the channel would include earth berming and plantings to provide buffering between the channel and adjacent property.

- ***Side Slopes:*** The side slopes warp and vary from 4:1 to 12:1 creating a meandering toe of slope. The side slopes would blend into the earth berming located in the over-bank areas. Where possible terracing would be incorporated into the side slopes. Plantings would be located on the side slopes.

- ***Channel Bottom:*** The channel bottom varies from 5 feet to 26 feet in width.

- ***Landscape Theme:*** The landscape theme for this channel would follow the guidelines developed for the Urban Theme. See Section 2.4.4 Typical Landscape Themes for a description of this landscape theme.

- ***Structural Components:*** Structural components located within the channel would be designed to blend with the surrounding environment. This could include the use of form liners, integral color, shape/size of structure, construction material, etc.

Multi-Use Opportunities

- A multi-use path would meander throughout the width of the channel and connect to a proposed trail along the Agua Fria River.

- Large and small turf areas would be located within the channel for use by the community. These turf areas would provide valuable open space for users to fly kites, play Frisbee golf, to have pick-up softball and football games.

Bullard Wash Channel

(Camelback Road to existing Bullard Wash structure at Lower Buckeye Road)

For this report the Bullard Wash Channel has been split into two sections, Camelback Road to I-10 and I-10 to the existing Bullard Wash.

Landscape Aesthetics

- ***Structure Shape:*** The Bullard Wash Channel is an earthen-lined meandering channel with a top width that varies from 116 feet to 186 feet and a depth that varies from 3.8 feet to 7.0 feet from Camelback Road to I-10. The overall width of the channel (channel width plus over-bank area) from Camelback Road to I-10 varies from 176 feet to 246 feet. The channel top width, depth, and overall channel width from I-10 to the existing Bullard Wash follows the City of Goodyear typical section.

- *Over-bank Areas:* A minimum of 30 feet is provided on both sides of the channel. This area at the top of the channel would include earth berming and plantings to provide buffering between the channel and adjacent property.

- *Side Slopes:* The side slopes warp and vary from 4:1 to 12:1 creating a meandering toe of slope. The side slopes would blend into the earth berming located in the over-bank areas. Where possible terracing would be incorporated into the side slopes. Plantings would be located on the side slopes.

- *Channel Bottom:* The channel bottom varies from 10 feet to 116 feet in width from Camelback Road to I-10. From I-10 to the existing Bullard Wash the channel bottom follows the City of Goodyear typical section.

- *Landscape Theme:* There are three landscape themes for this channel. The three themes include Urban, Commercial, and Neighborhood. The Urban Theme would be applied from Camelback Road to Thomas Road, the Commercial Theme would be from Thomas Road to McDowell Road, and the Neighborhood Theme would be from McDowell Road to I-10. See Section 2.4.4 Typical Landscape Themes for a description of this landscape theme.

- *Structural Components:* Structural components located within the channel would be designed to blend with the surrounding environment. This could include the use of form liners, integral color, shape/size of structure, construction material, etc.

Multi-Use Opportunities

- This channel will provide the same type of multi-use opportunities as found in Alternative #1.

Northern Avenue Channel

(Olive Avenue southeast to intersection of Citrus Road and Northern Avenue, then east to Reems Road)

Landscape Aesthetics

- *Structure Shape:* The Northern Avenue Channel is an earthen-lined meandering channel with a top width that varies from 87 feet to 242 feet and a depth that varies from 3.0 feet to 4.8 feet. The overall width of the channel (channel width plus over-bank area) varies from 147 feet to 302 feet.

- ***Over-bank Areas:*** A minimum of 30 feet is provided on both sides of the channel. This area at the top of the channel would include earth berming and plantings to provide buffering between the channel and adjacent property.

- ***Side Slopes:*** The side slopes warp and vary from 4:1 to 12:1 creating a meandering toe of slope. The side slopes would blend into the earth berming located in the over-bank areas. Where possible terracing would be incorporated into the side slopes. Plantings would be located on the side slopes.

- ***Channel Bottom:*** The channel bottom varies from 5 feet to 180 feet in width.

- ***Landscape Theme:*** The landscape theme for this channel would follow the guidelines developed for the Neighborhood Theme. See Section 2.4.4 Typical Landscape Themes for a description of this landscape theme.

- ***Structural Components:*** Structural components located within the channel would be designed to blend with the surrounding environment. This could include the use of form liners, integral color, shape/size of structure, construction material, etc.

Multi-Use Opportunities

- This channel provides a multi-use path that would connect the various neighborhoods located adjacent to the channel. This multi-use path would provide access to the White Tank Mountains and would be connected to the basins located at Loop 303 and Reems Road thus increasing multi-use activities for the users. The multi-use path would also be connected to the multi-use path adjacent to the Loop 303 providing access to the north and to the Gila River in the south.

- Open space turf areas would be located throughout the channel for the residents of the neighborhoods.

Camelback Channel

(White Tanks FCS #3 southeast to the intersection of Perryville Road and Camelback Road then east to the Bullard Wash Channel)

Landscape Aesthetics

- ***Structure Shape:*** The Camelback Channel is an earthen-lined meandering channel with a top width that varies from 74 feet to 217 feet and a depth that varies from 3.2 feet to 6.6 feet.

The overall width of the channel (channel width plus over-bank area) varies from 134 feet to 277 feet.

- *Over-bank Areas:* A minimum of 30 feet is provided on both sides of the channel. This area at the top of the channel would include earth berming and plantings to provide buffering between the channel and adjacent property.

- *Side Slopes:* The side slopes warp and vary from 4:1 to 12:1 creating a meandering toe of slope. The side slopes would blend into the earth berming located in the over-bank areas. Where possible terracing would be incorporated into the side slopes. Plantings would be located on the side slopes.

- *Channel Bottom:* The channel bottom varies from 5 feet to 154 feet in width.

- *Landscape Theme:* There are five landscape themes for this channel. The five themes include Sonoran Desert, Agricultural, Industrial, Aircraft, and neighborhood. The Sonoran Desert Theme would be applied from White Tanks FCS #3 to the intersection of Perryville Road and Camelback Road, the Agricultural Theme would occur from Cotton Lane to SR303L, the Industrial Theme (with incorporation of Aircraft Theme) would be from SR303L to just east for Sarival Road, and the Neighborhood Theme would be from just east of Sarival Road to Bullard Wash Channel. See Section 2.4.4 Typical Landscape Themes for a description of this landscape theme.

- *Structural Components:* Structural components located within the channel would be designed to blend with the surrounding environment. This could include the use of form liners, integral color, shape/size of structure, construction material, etc.

Multi-Use Opportunities

- A meandering multi-use path would be located throughout the length of the channel. It would connect to the multi-use path along the Loop 303 and at Bullard Wash. This would provide the user access to the northern limits of the project area as well as the Gila River. The multi-use path would also connect to the White Tanks #3 flood control structure providing access to the White Tank Mountains.

- Interpretive sites would also be incorporated into the facility interpreting Luke Air Force Base, its aircraft, and importance to the community.

Interstate 10 West Channel

Just west of Perryville Road to SR303L)

Landscape Aesthetics

- ***Structure Shape:*** The Interstate 10 West Channel is an earthen-lined meandering channel with a top width that varies from 113 feet to 137 feet and a depth that varies from 2.5 feet to 7.0 feet. The overall width of the channel (channel width plus over-bank area) varies from 173 feet to 197 feet.

- ***Over-bank Areas:*** A minimum of 30 feet is provided on both sides of the channel. This area at the top of the channel would include earth berming and plantings to provide buffering between the channel and adjacent property.

- ***Side Slopes:*** The side slopes warp and vary from 4:1 to 12:1 creating a meandering toe of slope. The side slopes would blend into the earth berming located in the over-bank areas. Where possible terracing would be incorporated into the side slopes. Plantings would be located on the side slopes.

- ***Channel Bottom:*** The channel bottom varies from 10 feet to 83 feet in width.

- ***Landscape Theme:*** There are three landscape themes for this channel. The three themes include Agricultural, Neighborhood, and Commercial. The Agricultural Theme would occur from Perryville Road to just west of Citrus Road, the Neighborhood Theme would be from just west of Citrus Road to just west of Cotton lane, and the Commercial Theme would be applied at the intersections of I-10 and Perryville Road and I-10 and Cotton lane. See Section 2.4.4 Typical Landscape Themes for a description of this landscape theme.

- ***Structural Components:*** Structural components located within the channel would be designed to blend with the surrounding environment. This could include the use of form liners, integral color, shape/size of structure, construction material, etc.

Multi-Use Opportunities

- This channel will provide a multi-use path that connects to the SR303L multi-use path.

- Small turf areas would be located within the channel for use by the community. These turf areas would provide valuable open space for users to enjoy.

Interstate 10 East Channel

(Sarival Road to Bullard Wash)

Landscape Aesthetics

- ***Structure Shape:*** The Interstate 10 East Channel is an earthen-lined meandering channel with a top width that varies from 53 feet to 65 feet and a depth that varies from 2.0 feet to 3.0 feet. The overall width of the channel (channel width plus over-bank area) varies from 113 feet to 125 feet.

- ***Over-bank Areas:*** A minimum of 30 feet is provided on both sides of the channel. This area at the top of the channel would include earth berming and plantings to provide buffering between the channel and adjacent property.

- ***Side Slopes:*** The side slopes warp and vary from 4:1 to 12:1 creating a meandering toe of slope. The side slopes would blend into the earth berming located in the over-bank areas. Where possible terracing would be incorporated into the side slopes. Plantings would be located on the side slopes.

- ***Channel Bottom:*** The channel bottom is 5 feet in width.

- ***Landscape Theme:*** There are two landscape themes for this channel. The two themes include Neighborhood and Commercial. The Neighborhood Theme would be from Estrella Parkway to just west of Bullard Wash. The Commercial Theme would occur from Sarival Avenue to Estrella Parkway and from just west of Bullard Wash to the ADOT basins. See Section 2.4.4 Typical Landscape Themes for a description of this landscape theme.

- ***Structural Components:*** Structural components located within the channel would be designed to blend with the surrounding environment. This could include the use of form liners, integral color, shape/size of structure, construction material, etc.

Multi-Use Opportunities

- This channel will provide a multi-use path that connects to the Bullard Wash multi-use path and the ADOT Basins.

- Small turf areas would be located within the channel for use by the community. These turf areas would provide valuable open space for users to enjoy.

Roosevelt Irrigation District Channel

(Intersection of Cotton Lane and the Roosevelt Irrigation District Canal southwest to the intersection of Jackrabbit Trail and the Roosevelt Irrigation District)

Landscape Aesthetics

- ***Structure Shape:*** The Roosevelt Irrigation District Channel is an earthen-lined meandering channel with a top width that varies from 73 feet to 116 feet and a depth that varies from 3.6 feet to 6.9 feet. The overall width of the channel (channel width plus over-bank area) varies from 133 feet to 176 feet.

- ***Over-bank Areas:*** A minimum of 30 feet is provided on both sides of the channel. This area at the top of the channel would include earth berming and plantings to provide buffering between the channel and adjacent property.

- ***Side Slopes:*** The side slopes warp and vary from 4:1 to 12:1 creating a meandering toe of slope. The side slopes would blend into the earth berming located in the over-bank areas. Where possible terracing would be incorporated into the side slopes. Plantings would be located on the side slopes.

- ***Channel Bottom:*** The channel bottom varies from 5 feet to 10 feet in width.

- ***Landscape Theme:*** There are two landscape themes for this channel. The two themes include Urban and Commercial. The Urban Theme would occur from Perryville Road to Cotton Lane. The Commercial Theme would be from Jackrabbit Trail to Perryville Road.

- ***Structural Components:*** Structural components located within the channel would be designed to blend with the surrounding environment. This could include the use of form liners, integral color, shape/size of structure, construction material, etc.

Multi-Use Opportunities

- The Roosevelt Irrigation District Channel, in conjunction with the Bullard Wash Channel and the Jackrabbit – Perryville Channel, provides a multi use path from the White Tank Mountains to the Gila River.

- Large and small turf areas would be located within the channel for use by the community. These turf areas would provide valuable open space for users of the facility.

- Interpretive sites would be located throughout the length of the channel.

Peoria Avenue/Reems Road Basin

(Northwest corner of Peoria Avenue and Reems Road)

Landscape Aesthetics

- ***Structure Shape:*** The Peoria Avenue/Reems Road Basin is a 25.6-acre earthen-lined basin with a meandering top edge. The depth of the basin is 18 feet.

- ***Over-bank Areas:*** A minimum of 60 feet is provided around the top of the basin. This area at the top of the basin would include earth berming and plantings to provide buffering between the basin and adjacent property.

- ***Side Slopes:*** The side slopes of the basin would warp and vary from 4:1 to 12:1 creating a meandering toe of slope. The side slopes would blend into the earth berming located in the over-bank areas. Where possible terracing would be incorporated into the side slopes. Plantings would be located on the side slopes.

- ***Landscape Theme:*** The landscape theme for this basin would follow the guidelines developed for the Recreational Theme. See Section 2.4.4 Typical Landscape Themes for a description of this landscape theme.

- ***Structural Components:*** Structural components located within the basin would be designed to blend with the surrounding environment. This could include the use of form liners, integral color, shape/size of structure, construction material, etc.

Multi-Use Opportunities

- This basin would be developed similar to the Olive Avenue/Loop 303 Basin described in Alternative #1.

Northern Avenue/Reems Road Basin

(Northwest corner of Northern Avenue and Reems Road)

Landscape Aesthetics

- ***Structure Shape:*** The Northern Avenue/Reems Road Basin is a 40.6-acre earthen-lined basin with a meandering top edge. The depth of the basin is 23 feet.

- ***Over-bank Areas:*** A minimum of 60 feet is provided around the top of the basin. This area at the top of the basin would include earth berming and plantings to provide buffering between the basin and adjacent property.

- ***Side Slopes:*** The side slopes of the basin would warp and vary from 4:1 to 12:1 creating a meandering toe of slope. The side slopes would blend into the earth berming located in the over-bank areas. Where possible terracing would be incorporated into the side slopes. Plantings would be located on the side slopes.

- ***Landscape Theme:*** This basin would incorporate two landscape themes, Recreational and Aircraft. See Section 2.4.4 Typical Landscape Themes for a description of this landscape theme.

- ***Structural Components:*** Structural components located within the basin would be designed to blend with the surrounding environment. This could include the use of form liners, integral color, shape/size of structure, construction material, etc.

Multi-Use Opportunities

- This basin would be developed similar to the Cactus Road and Loop 303 Basin described in Alternative #1.

- Earth contouring of this basin will need to respond to the adjacent Falcon Dunes Golf Course.

- A multi-use activity included as a part of this basin could include a small golf ball driving range.

SR303L/Northern Avenue Basin

(Northwest corner of Northern Avenue and SR303L)

Landscape Aesthetics

- ***Structure Shape:*** The SR303L/Northern Avenue Basin is a 55.2-acre earthen-lined basin with a meandering top edge. The depth of the basin is 21 feet.

- ***Over-bank Areas:*** A minimum of 60 feet is provided around the top of the basin. This area at the top of the basin would include earth berming and plantings to provide buffering between the basin and adjacent property.

- *Side Slopes:* The side slopes of the basin would warp and vary from 4:1 to 12:1 creating a meandering toe of slope. The side slopes would blend into the earth berming located in the over-bank areas. Where possible terracing would be incorporated into the side slopes. Plantings would be located on the side slopes.

- *Landscape Theme:* The landscape theme for this basin would follow the guidelines developed for the Recreational Theme. See Section 2.4.4 Typical Landscape Themes for a description of this landscape theme.

- *Structural Components:* Structural components located within the basin would be designed to blend with the surrounding environment. This could include the use of form liners, integral color, shape/size of structure, construction material, etc.

Multi-Use Opportunities

- The size of this basin lends itself to many different types of uses. A soccer/softball complex could be developed for the area. In addition, other activities could be accommodated such as various court sports, and just open space for users to use as they wish.

- A multi-use path would be constructed around the perimeter of the basin. Located within the pathway could be distance markers for runners to keep track of how far they have run.

SR303L/Camelback Road Basin

(Northwest corner of Camelback Road and SR303L)

Landscape Aesthetics

- *Structure Shape:* The SR303L/Northern Avenue Basin is a 44.8-acre earthen-lined basin with a meandering top edge. The depth of the basin is 23 feet.

- *Over-bank Areas:* A minimum of 60 feet is provided around the top of the basin. This area at the top of the basin would include earth berming and plantings to provide buffering between the basin and adjacent property.

- *Side Slopes:* The side slopes of the basin would warp and vary from 4:1 to 12:1 creating a meandering toe of slope. The side slopes would blend into the earth berming located in the over-bank areas. Where possible terracing would be incorporated into the side slopes. Plantings would be located on the side slopes.

- ***Landscape Theme:*** The landscape theme for this basin would follow the guidelines developed for the Recreational Theme. See Section 2.4.4 Typical Landscape Themes for a description of this landscape theme.

- ***Structural Components:*** Structural components located within the basin would be designed to blend with the surrounding environment. This could include the use of form liners, integral color, shape/size of structure, construction material, etc.

Multi-Use Opportunities

- This basin would be developed similar to the Loop 303/Northern Avenue Basin.

SR303L/Interstate 10 Basin

(Northwest corner of Interstate 10 and SR303L)

Landscape Aesthetics

- ***Structure Shape:*** The SR303L/Northern Avenue Basin is a 52.3-acre earthen-lined basin with a meandering top edge. The depth of the basin is 16 feet.

- ***Over-bank Areas:*** A minimum of 60 feet is provided around the top of the basin. This area at the top of the basin would include earth berming and plantings to provide buffering between the basin and adjacent property.

- ***Side Slopes:*** The side slopes of the basin would warp and vary from 4:1 to 12:1 creating a meandering toe of slope. The side slopes would blend into the earth berming located in the over-bank areas. Where possible terracing would be incorporated into the side slopes. Plantings would be located on the side slopes.

- ***Landscape Theme:*** The landscape theme for this basin would follow the guidelines developed for the Recreational Theme. See Section 2.4.4 Typical Landscape Themes for a description of this landscape theme.

- ***Structural Components:*** Structural components located within the basin would be designed to blend with the surrounding environment. This could include the use of form liners, integral color, shape/size of structure, construction material, etc.

Multi-Use Opportunities

- This basin would be developed similar to the Loop 303/Northern Avenue Basin.

Bullard Wash/Interstate 10 Basin

(Northwest corner of Interstate 10 and SR303L)

Landscape Aesthetics

- ***Structure Shape:*** The SR303L/Northern Avenue Basin is a 13.1-acre earthen-lined basin with a meandering top edge. The depth of the basin is 14 feet.

- ***Over-bank Areas:*** A minimum of 60 feet is provided around the top of the basin. This area at the top of the basin would include earth berming and plantings to provide buffering between the basin and adjacent property.

- ***Side Slopes:*** The side slopes of the basin would warp and vary from 4:1 to 12:1 creating a meandering toe of slope. The side slopes would blend into the earth berming located in the over-bank areas. Where possible terracing would be incorporated into the side slopes. Plantings would be located on the side slopes.

- ***Landscape Theme:*** The landscape theme for this basin would follow the guidelines developed for the Recreational Theme. See Section 2.4.4 Typical Landscape Themes for a description of this landscape theme.

- ***Structural Components:*** Structural components located within the basin would be designed to blend with the surrounding environment. This could include the use of form liners, integral color, shape/size of structure, construction material, etc.

Multi-Use Opportunities

- This basin lends itself to be developed as a community park. Facilities would include soccer/softball field, various court sports, and just open space for users to use as they wish.

- A multi-use path would be constructed around the perimeter of the basin. Located within the pathway could be distance markers for runners to keep track of how far they have run.

Interstate 10 Basins

(North side of Interstate 10 between Dysart Road and Bullard Avenue)

Landscape Aesthetics

- ***Structure Shape:*** The interstate 10 Basins are earthen-lined, have meandering top edges, and varying depths.

- ***Over-bank Areas:*** A minimum of 60 feet is provided around the top of the basin. This area at the top of the basin would include earth berming and plantings to provide buffering between the basin and adjacent property.

- ***Side Slopes:*** The side slopes of the basin would warp and vary from 4:1 to 12:1 creating a meandering toe of slope. The side slopes would blend into the earth berming located in the over-bank areas. Where possible terracing would be incorporated into the side slopes. Plantings would be located on the side slopes.

- ***Landscape Theme:*** The landscape theme for this channel would follow the guidelines developed for the Recreational Theme. See Section 2.4.4 Typical Landscape Themes for a description of this landscape theme.

- ***Structural Components:*** Structural components located within the basin would be designed to blend with the surrounding environment. This could include the use of form liners, integral color, shape/size of structure, construction material, etc.

Multi-Use Opportunities

- This basin will provide the same type of multi-use opportunities as found in Alternative #1.

Recommended Alternative 3

Landscape Aesthetics: This alternative has 21 different flood control facilities. These facilities consist of 11 various sized channels and 10 basins all requiring different landscape aesthetic treatments.

These flood control facilities are located within a number of different landscape characters and therefore would receive different landscape character themes. This is based upon the *Landscape Aesthetics Assessment and Multi-Use Opportunity Assessment* report dated July 6, 2000.

Multi-Use Opportunities: There are several opportunities for multi-use within the various channel configurations and basins.

The following outlines the proposed landscape aesthetics and multi-use opportunities for each channel and basin.

Table 2.10C

Recommended Alternative #3										
Channel Name	**Channel Limits***	**Side Slope**	**Overall Width of Channel****	**Bottom Width of Channel**	**[1]Top Width of Channel**	**Depth of Channel**	**Size of Basin**	**Depth of Basin**	**Landscape Theme(s)*****	**Landscape Aesthetics & Multi-Use Cost**
·dsley Channel	Cactus Road to White Tanks FCS #3	6:1	Varies 126 ft. to 329 ft.	Varies 20 ft. to 184 ft.	Varies 66 ft. to 269 ft.	Varies 1.8 ft. to 5.1 ft.	N/A	N/A	*Sonoran Desert Theme*	Sonoran Desert Theme $6.51 M ***Total Cost $6.51 M*** *FCDMC Funding ** $4.44 M* *Additional Funding*** $2.07 M*
Jackrabbit Trail Channel	Bethany Home Road to McDowell Road	6:1	Varies 158 ft. to 246 ft.	Varies 41 ft. to 137 ft.	Varies 98 ft. to 186 ft.	Varies 1.9 ft. to 3.1 ft.	N/A	N/A	*Urban Theme*	Urban Theme $4.29 M ***Total Cost $4.29 M*** *FCDMC Funding ** $2.47 M* *Additional Funding*** $1.82 M*
Tuthill Channel		6:1	Varies 212 ft. to 267 ft.	Varies 51 ft. to 148 ft.	Varies 152 ft. to 207 ft.	Varies 2.9 ft. to 6.4 ft.	N/A	N/A	*Urban Theme* from White Tanks FCS #4 to the Union Pacific Railroad *Commercial Theme* from Union Pacific Railroad to Irrigation Canal *Sonoran Desert Theme* Irrigation Canal to Gila River	Urban Theme $5.44 M Commercial Theme $0.85 M Sonoran Desert Theme $3.06 M ***Total Cost $9.35 M*** *FCDMC Funding ** $5.73 M* *Additional Funding*** $3.62 M*
Loop 303 Channel	Greenway Road to the Gila River	6:1	Varies 129 ft. to 228 ft.	Varies 5 ft. to 112 ft.	Varies 69 ft. to 168 ft.	Varies 2.6 ft. to 7.0 ft.	N/A	N/A	*Urban Theme* from Greenway Road to Waddell Road *Industrial Theme* from Waddell Road to Peoria Avenue *Neighborhood Theme* from Peoria Avenue to Glendale Avenue *Agricultural Theme* from Glendale Avenue to Camelback Road *Commercial Theme* at the intersections of I-10 and SR303L, SR303L and Van Buren Street, and SR303L and Buckeye Road *Sonoran Desert Theme* from MC85 to Gila River	Urban Theme $9.04 M Industrial Theme $2.42 M Neighborhood Theme $3.75 M Agricultural Theme $2.26 M Commercial Theme $0.60 M Sonoran Desert Theme $1.25 M ***Total Cost $19.32 M*** *FCDMC Funding ** $11.49 M* *Additional Funding*** $7.83 M*
Reems Road Channel	Waddell Road to Northern Avenue	6:1	Varies 196 ft. to 232 ft.	Varies 79 ft. to 111 ft.	Varies 136 ft. to 172 ft.	Varies 2.7 ft. to 3.6 ft.	N/A	N/A	*Urban Theme* from Waddell Road to Peoria Avenue *Agricultural Theme* form Peoria Avenue to Northern Avenue *Commercial Theme* at the intersections of Waddell Road and Reems Road, Cactus Road and Reems Road, and Peoria Avenue and Reems Road	Urban Theme $3.19 M Agricultural Theme $2.89 M Commercial Theme $0.28 M ***Total Cost $6.36 M*** *FCDMC Funding ** $3.86 M* *Additional Funding*** $2.50 M*
El Mirage Channel	Greenway Road to Waddell Road then east to the AT&SF Railroad	6:1	Varies 127 ft. to 185 ft.	Varies 5 ft. to 65 ft.	Varies 67 ft. to 125 ft.	Varies 2.3 ft. to 6.8 ft.	N/A	N/A	*Urban Theme* from Greenway Road to Waddell Road then east to the AT&SF Railroad	Urban Theme $2.22 M ***Total Cost $2.22 M*** *FCDMC Funding ** $1.28 M* *Additional Funding*** $0.94 M*
AT&SF Railroad Channel	One-half mile south of Peoria Avenue turns west for one mile and then south to Northern Avenue	6:1	Varies 161 ft. to 185 ft.	Varies 5 ft. to 65 ft.	Varies 101 ft. to 125 ft.	Varies 3.0 ft. to 7.0 ft.	N/A	N/A	*Agricultural Theme* form Peoria Avenue to just south of Olive Avenue *Industrial Theme* from just south of Olive Avenue to Northern Avenue	Industrial Theme $3.37 M Agricultural Theme $1.04 M ***Total Cost $4.41 M*** *FCDMC Funding ** $2.76 M* *Additional Funding*** $1.65 M*

Table 2.10C

SR303L and Interstate 10 Basin	Northwest corner of Interstate 10 and SR303L	4:1	N/A	N/A	N/A	N/A	40.9 acres	16 ft.	*Recreational Theme*	Recreational Theme ***Total Cost*** *FCDMC Funding *** *Additional Funding****	<u>$2.49 M</u> ***$2.49 M*** *$1.64 M* *$0.85 M*
SR303L and Buckeye Road Basin	Northwest corner of Buckeye Road and SR303L	4:1	N/A	N/A	N/A	N/A	26.5 acres	16 ft.	*Recreational Theme*	Recreational Theme ***Total Cost*** *FCDMC Funding *** *Additional Funding****	<u>$1.61 M</u> ***$1.61 M*** *$1.06 M* *$0.55 M*
SR303L and MC 85 Basin	Northwest corner of Southern Avenue and SR303L	4:1	N/A	N/A	N/A	N/A	11.3 acres	13 ft.	*Recreational Theme*	Recreational Theme ***Total Cost*** *FCDMC Funding *** *Additional Funding****	<u>$0.68 M</u> ***$0.68 M*** *$0.45 M* *$0.23 M*
Northern Avenue and Reems Road Basin	Northwest corner of Northern Avenue and Reems Road	4:1	N/A	N/A	N/A	N/A	57.9 acres	22 ft.	*Recreational Theme*	Recreational Theme ***Total Cost*** *FCDMC Funding *** *Additional Funding****	<u>$3.53 M</u> ***$3.53 M*** *$2.32 M* *$1.21 M*
Bullard Wash and Interstate 10 Basin	Northwest corner of Interstate 10 and Bullard Wash	4:1	N/A	N/A	N/A	N/A	13.1 acres	14 ft.	*Recreational Theme*	Recreational Theme ***Total Cost*** *FCDMC Funding *** *Additional Funding****	<u>$0.80 M</u> ***$0.80 M*** *$0.53 M* *$0.27 M*
Interstate 10 Basins	North side of Interstate 10 between Dysart Road and Bullard Wash		N/A	N/A	N/A	N/A	N/A	N/A	*Recreational Theme*	Recreational Theme ***Total Cost*** *FCDMC Funding *** *Additional Funding****	<u>$5.91 M</u> ***$5.91 M*** *$3.88 M* *$2.03 M*

(1) Includes 24 feet for 2 feet of freeboard.

* See Section 2.4.4 Typical Landscape Themes for description of themes
** Flood Control District of Maricopa County maximum dollars available ($40,000 per acre)
*** Examples of additional funding would be City funds, Grants, Private funding, IGA.

Table 2.10C

Lower El Mirage Channel	Greenway Road to the Agua Fria River	6:1	Varies 139 ft. to 165 ft.	Varies 5 ft. to 39 ft.	Varies 79 ft. to 105 ft.	Varies 3.5 ft. to 5.2 ft.	N/A	N/A	*Urban Theme* from Waddell Road to Agua Fria River *Neighborhood Theme* from Greenway Road to Waddell Road	Urban Theme $1.07 M Neighborhood Theme $2.07 M ***Total Cost*** ***$3.14 M*** *FCDMC Funding *** *$1.85 M* *Additional Funding**** *$1.29 M*
Bullard Wash	Camelback Road to existing Bullard Wash structure at Lower Buckeye Road	6:1 - Camelback Road to I-10 4:1 - I-10 to existing Bullard Wash	Varies 177 ft. to 208 ft. (Camelback Road to I-10) Follows City of Goodyear typical section (I-10 to existing Bullard Wash)	Varies 10 ft. to 54 ft. (Camelback Road to I-10) Follows City of Goodyear typical section (I-10 to existing Bullard Wash)	Varies 117 ft. to 148 ft. (Camelback Road to I-10) Follows City of Goodyear typical section (I-10 to existing Bullard Wash)	Varies 6.1 ft. to 7.0 ft. (Camelback Road to I-10) Follows City of Goodyear typical section (I-10 to existing Bullard Wash)	N/A	N/A	*Urban Theme* from Camelback Road to Thomas Road *Commercial Theme* from Thomas to McDowell Road *Neighborhood Theme* from McDowell to I-10	Urban Theme $2.87 M Commercial Theme $1.34 M Neighborhood Theme $1.39 M ***Total Cost*** ***$5.60 M*** *FCDMC Funding *** *$3.29 M* *Additional Funding**** *$2.31 M*
Northern Channel	Beardsley Canal to Reems Road	6:1	Varies 140 ft. to 271 ft.	Varies 5 ft. to 142 ft.	Varies 80 ft. to 211 ft.	Varies 2.7 ft. to 4.3 ft.	N/A	N/A	*Neighborhood Theme* from Beardsley Canal to Reems Road	Neighborhood Theme $6.66 M ***Total Cost*** ***$6.66 M*** *FCDMC Funding *** *$3.95 M* *Additional Funding**** *$2.71 M*
Camelback Channel	SR303L to Bullard Wash Channel	6:1	Varies 125 ft. to 158 ft.	Constant 5 ft.	Varies 65 ft. to 98 ft.	Varies 3.0 ft. to 5.8 ft.	N/A	N/A	*Industrial Theme (with incorporation of Aircraft Theme)* from SR303L to just east of Sarival Road *Neighborhood Theme* from just east of Sarival Road to Bullard Wash Channel	Industrial Theme $0.92 M Neighborhood Theme $0.95 M ***Total Cost*** ***$1.87 M*** *FCDMC Funding *** *$1.14 M* *Additional Funding**** *$0.73 M*
Roosevelt Irrigation District Channel	Intersection of Cotton Lane and the Roosevelt Irrigation District Canal southwest to Tuthill Road	6:1	Varies 133 ft. to 194 ft.	Varies 5 ft. to 41 ft.	Varies 73 ft. to 134 ft.	Varies 3.6 ft. to 6.5 ft.	N/A	N/A	*Urban Theme* from end of commercial theme to Tuthill Road *Commercial Theme* at intersection of Cotton Lane and Roosevelt Irrigation District Canal	Urban Theme $2.34 M Commercial Theme $1.10 M ***Total Cost*** ***$3.44 M*** *FCDMC Funding *** *$2.02 M* *Additional Funding**** *$1.42 M*
SR303L and Cactus Road Basin	Northwest corner of Cactus Road and SR303L	4:1	N/A	N/A	N/A	N/A	42.8 acres	13 ft.	*Recreational Theme*	Recreational Theme $2.61 M ***Total Cost*** ***$2.61 M*** *FCDMC Funding *** *$1.72 M* *Additional Funding**** *$0.89 M*
SR303L and Northern Avenue Basin	Northwest corner of Northern Avenue and SR303L	4:1	N/A	N/A	N/A	N/A	43.6 acres	21 ft.	*Recreational Theme*	Recreational Theme $2.65 M ***Total Cost*** ***$2.65 M*** *FCDMC Funding *** *$1.75 M* *Additional Funding**** *$0.90 M*
SR303L and Camelback Road Basin	Northwest corner of Camelback Road and SR303L	4:1	N/A	N/A	N/A	N/A	24.6 acres	22 ft.	*Recreational Theme*	Recreational Theme $1.50 M ***Total Cost*** ***$1.50 M*** *FCDMC Funding *** *$.99 M* *Additional Funding**** *$.51 M*

Beardsley Channel
(Cactus Road to White Tanks FCS #3)

Landscape Aesthetics

- ***Structure Shape:*** The Beardsley Channel is an earthen-lined meandering channel with a top width that varies from 66 feet to 269 feet and a depth that varies from 1.8 feet to 5.1 feet. The overall width of the channel (channel width plus over-bank area) varies from 126 feet to 329 feet.

- ***Over-bank Areas:*** A minimum of 30 feet is provided on both sides of the channel. This area at the top of the channel would include earth berming and plantings to provide buffering between the channel and adjacent property.

- ***Side Slopes:*** The side slopes warp and vary from 4:1 to 12:1 creating a meandering toe of slope. The side slopes would blend into the earth berming located in the over-bank areas. Where possible terracing would be incorporated into the side slopes. Plantings would be located on the side slopes.

- ***Channel Bottom:*** The channel bottom varies from 20 feet to 184 feet in width.

- ***Landscape Theme:*** The landscape theme for this channel would follow the guidelines developed for the Sonoran Desert Theme. See Section 2.4.4 Typical Landscape Themes for a description of this landscape theme.

- ***Structural Components:*** Structural components located within the channel would be designed to blend with the surrounding environment. This could include the use of form liners, integral color, shape/size of structure, construction material, etc.

Multi-Use Opportunities

- This channel will provide the same type of multi-use opportunities as found in Alternative #1.

Jackrabbit Trail Channel

(Bethany Home Road to McDowell Road)

Landscape Aesthetics

- ***Structure Shape:*** The Jackrabbit Trail Channel is an earthen-lined meandering channel with a top width that varies from 98 feet to 186 feet and a depth that varies from 1.9 feet to 3.1 feet. The overall width of the channel (channel width plus over-bank area) varies from 158 feet to 246 feet.

- ***Over-bank Areas:*** A minimum of 30 feet is provided on both sides of the channel. This area at the top of the channel would include earth berming and plantings to provide buffering between the channel and adjacent property.

- ***Side Slopes:*** The side slopes warp and vary from 4:1 to 12:1 creating a meandering toe of slope. The side slopes would blend into the earth berming located in the over-bank areas. Where possible terracing would be incorporated into the side slopes. Plantings would be located on the side slopes.

- ***Channel Bottom:*** The channel bottom varies from 41 feet to 137 feet in width.

- ***Landscape Theme:*** The landscape theme for this channel would follow the guidelines developed for the Urban Theme. See Section 2.4.4 Typical Landscape Themes for a description of this landscape theme.

- ***Structural Components:*** Structural components located within the channel would be designed to blend with the surrounding environment. This could include the use of form liners, integral color, shape/size of structure, construction material, etc.

Multi-Use Opportunities

- This channel will provide the same type of multi-use opportunities as found in Alternative #1.

Tuthill Channel

(White Tanks FCS #4 to Roosevelt Irrigation District Canal then West to Rainbow Road)

Landscape Aesthetics

- ***Structure Shape:*** The Tuthill Channel is an earthen-lined meandering channel with a top width that varies from 152 feet to 207 feet and a depth that varies from 1.9 feet to 3.1 feet. The overall width of the channel (channel width plus over-bank area) varies from 212 feet to 267 feet.

- ***Over-bank Areas:*** A minimum of 30 feet is provided on both sides of the channel. This area at the top of the channel would include earth berming and plantings to provide buffering between the channel and adjacent property.

- ***Side Slopes:*** The side slopes warp and vary from 4:1 to 12:1 creating a meandering toe of slope. The side slopes would blend into the earth berming located in the over-bank areas. Where possible terracing would be incorporated into the side slopes. Plantings would be located on the side slopes.

- ***Channel Bottom:*** The channel bottom varies from 51 feet to 148 feet in width.

- ***Landscape Theme:*** There are three landscape themes for this channel. The three themes include Urban, Commercial, and Sonoran Desert. The Urban Theme would occur from the White Tanks FCS #4 to the Union Pacific Railroad, the Commercial Theme would be from the union Pacific Railroad to the Roosevelt Irrigation District canal, and the Sonoran Desert Theme would be applied from the Roosevelt Irrigation District canal to the Gila River. See Section 2.4.4 Typical Landscape Themes for a description of this landscape theme.

- ***Structural Components:*** Structural components located within the channel would be designed to blend with the surrounding environment. This could include the use of form liners, integral color, shape/size of structure, construction material, etc.

Multi-Use Opportunities

- A multi-use path would meander the entire length of the channel. This would enable the user to walk/run/bike from the White Tanks #4 flood control structure to the Gila River.

- Large turf open spaces would be located within the PAD developments.

- Interpretive sites would be located throughout the length of the channel interpreting the current and past agricultural uses of the area and the Gila River.

Loop 303 Channel

(Greenway Road to Gila River)

Landscape Aesthetics

- ***Structure Shape:*** The Loop 303 Channel is an earthen-lined meandering channel with a top width that varies from 69 feet to 168 feet and a depth that varies from 2.6 feet to 7.0 feet. The overall width of the channel (channel width plus over-bank area) varies from 129 feet to 228 feet.

- ***Over-bank Areas:*** A minimum of 30 feet is provided on both sides of the channel. This area at the top of the channel would include earth berming and plantings to provide buffering between the channel and adjacent property.

- ***Side Slopes:*** The side slopes warp and vary from 4:1 to 12:1 creating a meandering toe of slope. The side slopes would blend into the earth berming located in the over-bank areas. Where possible terracing would be incorporated into the side slopes. Plantings would be located on the side slopes.

- ***Channel Bottom:*** The channel bottom varies from 5 feet to 112 feet in width.

- ***Landscape Theme:*** There are six landscape themes for this channel. The six themes include Urban, Industrial, Neighborhood, Agricultural, Commercial, and Sonoran Desert. The Urban Theme would be applied from Greenway Road to Waddell Road; Industrial Theme from Waddell Road to Peoria Avenue; Neighborhood Theme from Peoria Avenue to Glendale Avenue; Agricultural Theme from Glendale Avenue to Camelback Road; Sonoran Desert Theme from MC85 to the Gila River; and the Commercial Theme at the intersections of I-10 and SR303L, SR303L and Van Buren Street, and SR303L and Buckeye Road. See Section 2.4.4 Typical Landscape Themes for a description of this landscape theme.

- ***Structural Components:*** Structural components located within the channel would be designed to blend with the surrounding environment. This could include the use of form liners, integral color, shape/size of structure, construction material, etc.

Multi-Use Opportunities

- This channel will provide the same type of multi-use opportunities as found in Alternative #1.

Reems Road Channel

(Waddell Road to Northern Avenue)

Landscape Aesthetics

- ***Structure Shape:*** The Reems Road Channel is an earthen-lined meandering channel with a top width that varies from 136 feet to 172 feet and a depth that varies from 2.7 feet to 3.6 feet. The overall width of the channel (channel width plus over-bank area) varies from 196 feet to 232 feet.

- ***Over-bank Areas:*** A minimum of 30 feet is provided on both sides of the channel. This area at the top of the channel would include earth berming and plantings to provide buffering between the channel and adjacent property.

- ***Side Slopes:*** The side slopes warp and vary from 4:1 to 12:1 creating a meandering toe of slope. The side slopes would blend into the earth berming located in the over-bank areas. Where possible terracing would be incorporated into the side slopes. Plantings would be located on the side slopes.

- ***Channel Bottom:*** The channel bottom varies from 79 feet to 111 feet in width.

- ***Landscape Theme:*** There are three landscape themes for this channel. The three themes include Urban, Agricultural, and Commercial. The Urban Theme would be applied from Waddell Road to Peoria Avenue; Agricultural Theme from Peoria Avenue to Northern Avenue; and the Commercial Theme at the intersections of Waddell Road and Reems Road, Cactus Road and Reems Road, and Peoria Avenue and Reems Road. See Section 2.4.4 Typical Landscape Themes for a description of this landscape theme.

- ***Structural Components:*** Structural components located within the channel would be designed to blend with the surrounding environment. This could include the use of form liners, integral color, shape/size of structure, construction material, etc.

Multi-Use Opportunities

- This channel will provide the same type of multi-use opportunities as found in Alternative #1.

El Mirage Channel

(Greenway Road to Waddell Road then east to the AT&SF Railroad)

Landscape Aesthetics

- ***Structure Shape:*** The El Mirage Channel is an earthen-lined meandering channel with a top width that varies from 67 feet to 125 feet and a depth that varies from 2.3 feet to 6.8 feet. The overall width of the channel (channel width plus over-bank area) varies from 127 feet to 185 feet.

- ***Over-bank Areas:*** A minimum of 30 feet is provided on both sides of the channel. This area at the top of the channel would include earth berming and plantings to provide buffering between the channel and adjacent property.

- ***Side Slopes:*** The side slopes warp and vary from 4:1 to 12:1 creating a meandering toe of slope. The side slopes would blend into the earth berming located in the over-bank areas. Where possible terracing would be incorporated into the side slopes. Plantings would be located on the side slopes.

- ***Channel Bottom:*** The channel bottom varies from 5 feet to 65 feet in width.

- ***Landscape Theme:*** The landscape theme for this channel would follow the guidelines developed for the Urban Theme. See Section 2.4.4 Typical Landscape Themes for a description of this landscape theme.

- ***Structural Components:*** Structural components located within the channel would be designed to blend with the surrounding environment. This could include the use of form liners, integral color, shape/size of structure, construction material, etc.

Multi-Use Opportunities

- This channel will provide the same type of multi-use opportunities as found in Alternative #2.

AT&SF Railroad Channel
(One-half mile south of Peoria Avenue turns west for one mile and then south to Northern Avenue)

Landscape Aesthetics

- ***Structure Shape:*** The AT&SF Railroad Channel is an earthen-lined meandering channel with a top width that varies from 101 feet to 125 feet and a depth that varies from 3.0 feet to 7.0 feet. The overall width of the channel (channel width plus over-bank area) varies from 161 feet to 185 feet.

- ***Over-bank Areas:*** A minimum of 30 feet is provided on both sides of the channel. This area at the top of the channel would include earth berming and plantings to provide buffering between the channel and adjacent property.

- ***Side Slopes:*** The side slopes warp and vary from 4:1 to 12:1 creating a meandering toe of slope. The side slopes would blend into the earth berming located in the over-bank areas. Where possible terracing would be incorporated into the side slopes. Plantings would be located on the side slopes.

- ***Channel Bottom:*** The channel bottom varies from 5 feet to 65 feet in width.

- ***Landscape Theme:*** There are two landscape themes for this channel. The two themes include Industrial and Agricultural. The Industrial Theme would occur from just south of Olive Avenue to Northern Avenue. The Agricultural Theme would be from Peoria Avenue to just south of Olive Avenue. See Section 2.4.4 Typical Landscape Themes for a description of this landscape theme.

- ***Structural Components:*** Structural components located within the channel would be designed to blend with the surrounding environment. This could include the use of form liners, integral color, shape/size of structure, construction material, etc.

Multi-Use Opportunities

- This channel will provide the same type of multi-use opportunities as found in Alternative #1.

Lower El Mirage Channel
(Greenway Road to the Agua Fria River)

Landscape Aesthetics

- ***Structure Shape:*** The Lower El Mirage Channel is an earthen-lined meandering channel with a top width that varies from 79 feet to 105 feet and a depth that varies from 3.5 feet to 5.2 feet. The overall width of the channel (channel width plus over-bank area) varies from 139 feet to 165 feet.

- ***Over-bank Areas:*** A minimum of 30 feet is provided on both sides of the channel. This area at the top of the channel would include earth berming and plantings to provide buffering between the channel and adjacent property.

- *Side Slopes:* The side slopes warp and vary from 4:1 to 12:1 creating a meandering toe of slope. The side slopes would blend into the earth berming located in the over-bank areas. Where possible terracing would be incorporated into the side slopes. Plantings would be located on the side slopes.

- *Channel Bottom:* The channel bottom varies from 5 feet to 39 feet in width.

- *Landscape Theme:* There are two landscape themes for this channel. The two themes include Urban and Neighborhood. The Urban Theme would occur from Waddell Road to the Agua Fria River. The Neighborhood Theme would be from Greenway Road to Waddell Road. See Section 2.4.4 Typical Landscape Themes for a description of this landscape theme.

- *Structural Components:* Structural components located within the channel would be designed to blend with the surrounding environment. This could include the use of form liners, integral color, shape/size of structure, construction material, etc.

Multi-Use Opportunities

- This channel will provide the same type of multi-use opportunities as found in Alternative #2.

Bullard Wash Channel

(Camelback Road to existing Bullard Wash structure at Lower Buckeye Road)

For this report the Bullard Wash Channel has been split into two sections, Camelback Road to I-10 and I-10 to the existing Bullard Wash.

Landscape Aesthetics

- *Structure Shape:* The Bullard Wash Channel is an earthen-lined meandering channel with a top width that varies from 117 feet to 148 feet and a depth that varies from 6.1 feet to 7.0 feet from Camelback Road to I-10. The overall width of the channel (channel width plus over-bank area) from Camelback Road to I-10 varies from 177 feet to 208 feet. The channel top width, depth, and overall channel width from I-10 to the existing Bullard Wash follows the City of Goodyear typical section.

- ***Over-bank Areas:*** A minimum of 30 feet is provided on both sides of the channel. This area at the top of the channel would include earth berming and plantings to provide buffering between the channel and adjacent property.

- ***Side Slopes:*** The side slopes warp and vary from 4:1 to 12:1 creating a meandering toe of slope. The side slopes would blend into the earth berming located in the over-bank areas. Where possible terracing would be incorporated into the side slopes. Plantings would be located on the side slopes.

- ***Channel Bottom:*** The channel bottom varies from 10 feet to 54 feet in width from Camelback Road to I-10. From I-10 to the existing Bullard Wash the channel bottom follows the City of Goodyear typical section.

- ***Landscape Theme:*** There are three landscape themes for this channel. The three themes include Urban, Commercial, and Neighborhood. The Urban Theme would be applied from Camelback Road to Thomas Road; the Commercial Theme would be from Thomas Road to McDowell Road; and the Neighborhood Theme would be from McDowell Road to I-10. See Section 2.4.4 Typical Landscape Themes for a description of this landscape theme.

- ***Structural Components:*** Structural components located within the channel would be designed to blend with the surrounding environment. This could include the use of form liners, integral color, shape/size of structure, construction material, etc.

Multi-Use Opportunities

- This channel will provide the same type of multi-use opportunities as found in Alternative #1.

Northern Avenue Channel

(Beardsley Canal to Reems Road)

Landscape Aesthetics

- ***Structure Shape:*** The Northern Avenue Channel is an earthen-lined meandering channel with a top width that varies from 80 feet to 211 feet and a depth that varies from 2.7 feet to 4.3 feet. The overall width of the channel (channel width plus over-bank area) varies from 140 feet to 271 feet.

- ***Over-bank Areas:*** A minimum of 30 feet is provided on both sides of the channel. This area at the top of the channel would include earth berming and plantings to provide buffering between the channel and adjacent property.

- ***Side Slopes:*** The side slopes warp and vary from 4:1 to 12:1 creating a meandering toe of slope. The side slopes would blend into the earth berming located in the over-bank areas. Where possible terracing would be incorporated into the side slopes. Plantings would be located on the side slopes.

- ***Channel Bottom:*** The channel bottom varies from 5 feet to 142 feet in width.

- ***Landscape Theme:*** The landscape theme for this channel would follow the guidelines developed for the Neighborhood Theme. See Section 2.4.4 Typical Landscape Themes for a description of this landscape theme.

- ***Structural Components:*** Structural components located within the channel would be designed to blend with the surrounding environment. This could include the use of form liners, integral color, shape/size of structure, construction material, etc.

Multi-Use Opportunities

- This channel will provide the same type of multi-use opportunities as found in Alternative #1.

Camelback Channel

(SR303L to Bullard Wash)

Landscape Aesthetics

- ***Structure Shape:*** The Camelback Channel is an earthen-lined meandering channel with a top width that varies from 65 feet to 98 feet and a depth that varies from 3.0 feet to 5.8 feet. The overall width of the channel (channel width plus over-bank area) varies from 125 feet to 158 feet.

- ***Over-bank Areas:*** A minimum of 30 feet is provided on both sides of the channel. This area at the top of the channel would include earth berming and plantings to provide buffering between the channel and adjacent property.

- *Side Slopes:* The side slopes warp and vary from 4:1 to 12:1 creating a meandering toe of slope. The side slopes would blend into the earth berming located in the over-bank areas. Where possible terracing would be incorporated into the side slopes. Plantings would be located on the side slopes.

- *Channel Bottom:* The channel bottom has a constant width of 5 feet.

- *Landscape Theme:* There are three landscape themes for this channel. The three themes include Industrial, Aircraft and Neighborhood. The Industrial Theme (with incorporation of Aircraft Theme) would be from SR303L to just east for Sarival Road; the Neighborhood Theme would be from just east of Sarival Road to Bullard Wash Channel. See Section 2.4.4 Typical Landscape Themes for a description of this landscape theme.

- *Structural Components:* Structural components located within the channel would be designed to blend with the surrounding environment. This could include the use of form liners, integral color, shape/size of structure, construction material, etc.

Multi-Use Opportunities

- This channel will provide the same type of multi-use opportunities as found in Alternative #1.

Roosevelt Irrigation District Channel

(Intersection of Cotton Lane and the Roosevelt Irrigation District Canal southwest to Tuthill Road)

Landscape Aesthetics

- *Structure Shape:* The Roosevelt Irrigation District Channel is an earthen-lined meandering channel with a top width that varies from 73 feet to 134 feet and a depth that varies from 3.6 feet to 6.5 feet. The overall width of the channel (channel width plus over-bank area) varies from 133 feet to 194 feet.

- *Over-bank Areas:* A minimum of 30 feet is provided on both sides of the channel. This area at the top of the channel would include earth berming and plantings to provide buffering between the channel and adjacent property.

- *Side Slopes:* The side slopes warp and vary from 4:1 to 12:1 creating a meandering toe of slope. The side slopes would blend into the earth berming located in the over-bank areas.

Where possible terracing would be incorporated into the side slopes. Plantings would be located on the side slopes.

- ***Channel Bottom:*** The channel bottom varies from 5 feet to 41 feet in width.

- ***Landscape Theme:*** There are two landscape themes for this channel. The two themes include Urban and Commercial. The Urban Theme would occur from the end of the commercial theme to Tuthill Road. The Commercial Theme would be at the intersection of Cotton Lane and Roosevelt Irrigation District canal.

- ***Structural Components:*** Structural components located within the channel would be designed to blend with the surrounding environment. This could include the use of form liners, integral color, shape/size of structure, construction material, etc.

Multi-Use Opportunities

- This channel will provide the same type of multi-use opportunities as found in Alternative #2.

Cactus Road/Loop 303 Basin

(Northwest corner of Cactus Road and SR303L)

Landscape Aesthetics

- ***Structure Shape:*** The Cactus Road/Loop 303 Basin is a 42.8-acre earthen-lined basin with a meandering top edge. The depth of the basin is 13 feet.

- ***Over-bank Areas:*** A minimum of 60 feet is provided around the top of the basin. This area at the top of the basin would include earth berming and plantings to provide buffering between the basin and adjacent property.

- ***Side Slopes:*** The side slopes of the basin would warp and vary from 4:1 to 12:1 creating a meandering toe of slope. The side slopes would blend into the earth berming located in the over-bank areas. Where possible terracing would be incorporated into the side slopes. Plantings would be located on the side slopes.

- ***Landscape Theme:*** The landscape theme for this channel would follow the guidelines developed for the Recreational Theme. See Section 2.4.4 Typical Landscape Themes for a description of this landscape theme.

- ***Structural Components:*** Structural components located within the channel would be designed to blend with the surrounding environment. This could include the use of form liners, integral color, shape/size of structure, construction material, etc.

Multi-Use Opportunities

- This basin will provide the same type of multi-use opportunities as found in Alternative #1.

SR303L/Northern Avenue Basin

(Northwest corner of Northern Avenue and SR303L)

Landscape Aesthetics

- ***Structure Shape:*** The SR303L/Northern Avenue Basin is a 43.6-acre earthen-lined basin with a meandering top edge. The depth of the basin is 21 feet.

- ***Over-bank Areas:*** A minimum of 60 feet is provided around the top of the basin. This area at the top of the basin would include earth berming and plantings to provide buffering between the basin and adjacent property.

- ***Side Slopes:*** The side slopes of the basin would warp and vary from 4:1 to 12:1 creating a meandering toe of slope. The side slopes would blend into the earth berming located in the over-bank areas. Where possible terracing would be incorporated into the side slopes. Plantings would be located on the side slopes.

- ***Landscape Theme:*** The landscape theme for this basin would follow the guidelines developed for the Recreational Theme. See Section 2.4.4 Typical Landscape Themes for a description of this landscape theme.

- ***Structural Components:*** Structural components located within the basin would be designed to blend with the surrounding environment. This could include the use of form liners, integral color, shape/size of structure, construction material, etc.

Multi-Use Opportunities

- This basin will provide the same type of multi-use opportunities as found in Alternative #2.

SR303L/Camelback Road Basin

(Northwest corner of Camelback Road and SR303L)

Landscape Aesthetics

- ***Structure Shape:*** The SR303L/Camelback Road Basin is a 24.6-acre earthen-lined basin with a meandering top edge. The depth of the basin is 22 feet.

- ***Over-bank Areas:*** A minimum of 60 feet is provided around the top of the basin. This area at the top of the basin would include earth berming and plantings to provide buffering between the basin and adjacent property.

- ***Side Slopes:*** The side slopes of the basin would warp and vary from 4:1 to 12:1 creating a meandering toe of slope. The side slopes would blend into the earth berming located in the over-bank areas. Where possible terracing would be incorporated into the side slopes. Plantings would be located on the side slopes.

- ***Landscape Theme:*** The landscape theme for this basin would follow the guidelines developed for the Recreational Theme. See Section 2.4.4 Typical Landscape Themes for a description of this landscape theme.

- ***Structural Components:*** Structural components located within the basin would be designed to blend with the surrounding environment. This could include the use of form liners, integral color, shape/size of structure, construction material, etc.

Multi-Use Opportunities

- This basin will provide the same type of multi-use opportunities as found in Alternative #2.

SR303L/Interstate 10 Basin

(Northwest corner of Interstate 10 and SR303L)

Landscape Aesthetics

- ***Structure Shape:*** The SR303L/Interstate 10 Basin is a 40.9-acre earthen-lined basin with a meandering top edge. The depth of the basin is 16 feet.

- ***Over-bank Areas:*** A minimum of 60 feet is provided around the top of the basin. This area at the top of the basin would include earth berming and plantings to provide buffering between the basin and adjacent property.

- ***Side Slopes:*** The side slopes of the basin would warp and vary from 4:1 to 12:1 creating a meandering toe of slope. The side slopes would blend into the earth berming located in the over-bank areas. Where possible terracing would be incorporated into the side slopes. Plantings would be located on the side slopes.

- ***Landscape Theme:*** The landscape theme for this basin would follow the guidelines developed for the Recreational Theme. See Section 2.4.4 Typical Landscape Themes for a description of this landscape theme.

- ***Structural Components:*** Structural components located within the basin would be designed to blend with the surrounding environment. This could include the use of form liners, integral color, shape/size of structure, construction material, etc.

Multi-Use Opportunities

- This basin will provide the same type of multi-use opportunities as found in Alternative #2.

SR303L/Buckeye Road Basin

(Northwest corner of Buckeye Road and SR303L)

Landscape Aesthetics

- ***Structure Shape:*** The SR303L/Buckeye Road Basin is a 26.5-acre earthen-lined basin with a meandering top edge. The depth of the basin is 16 feet.

- ***Over-bank Areas:*** A minimum of 60 feet is provided around the top of the basin. This area at the top of the basin would include earth berming and plantings to provide buffering between the basin and adjacent property.

- ***Side Slopes:*** The side slopes of the basin would warp and vary from 4:1 to 12:1 creating a meandering toe of slope. The side slopes would blend into the earth berming located in the over-bank areas. Where possible terracing would be incorporated into the side slopes. Plantings would be located on the side slopes.

- ***Landscape Theme:*** The landscape theme for this basin would follow the guidelines developed for the Recreational Theme. See Section 2.4.4 Typical Landscape Themes for a description of this landscape theme.

- ***Structural Components:*** Structural components located within the basin would be designed to blend with the surrounding environment. This could include the use of form liners, integral color, shape/size of structure, construction material, etc.

Multi-Use Opportunities

- This basin will provide the same type of multi-use opportunities as found in the Loop 303 and Camelback Road basin.

SR303L/MC 85 Basin

(Northwest corner of Buckeye Road and SR303L)

Landscape Aesthetics

- ***Structure Shape:*** The SR303L/MC 85 Basin is an 11.3-acre earthen-lined basin with a meandering top edge. The depth of the basin is 13 feet.

- ***Over-bank Areas:*** A minimum of 60 feet is provided around the top of the basin. This area at the top of the basin would include earth berming and plantings to provide buffering between the basin and adjacent property.

- ***Side Slopes:*** The side slopes of the basin would warp and vary from 4:1 to 12:1 creating a meandering toe of slope. The side slopes would blend into the earth berming located in the over-bank areas. Where possible terracing would be incorporated into the side slopes. Plantings would be located on the side slopes.

- ***Landscape Theme:*** The landscape theme for this basin would follow the guidelines developed for the Recreational Theme. See Section 2.4.4 Typical Landscape Themes for a description of this landscape theme.

- ***Structural Components:*** Structural components located within the basin would be designed to blend with the surrounding environment. This could include the use of form liners, integral color, shape/size of structure, construction material, etc.

Multi-Use Opportunities

- This basin will provide the same type of multi-use opportunities as found in the Bullard Wash/Interstate 10 Basin identified in Alternative #2.

Northern Avenue/Reems Road Basin

(Northwest corner of Northern Avenue and Reems Road)

Landscape Aesthetics

- ***Structure Shape:*** The Northern Avenue/Reems Road Basin is a 57.9-acre earthen-lined basin with a meandering top edge. The depth of the basin is 22 feet.

- ***Over-bank Areas:*** A minimum of 60 feet is provided around the top of the basin. This area at the top of the basin would include earth berming and plantings to provide buffering between the basin and adjacent property.

- ***Side Slopes:*** The side slopes of the basin would warp and vary from 4:1 to 12:1 creating a meandering toe of slope. The side slopes would blend into the earth berming located in the over-bank areas. Where possible terracing would be incorporated into the side slopes. Plantings would be located on the side slopes.

- ***Landscape Theme:*** This basin would incorporate two landscape themes, Recreational and Aircraft. See Section 2.4.4 Typical Landscape Themes for a description of this landscape theme.

- ***Structural Components:*** Structural components located within the basin would be designed to blend with the surrounding environment. This could include the use of form liners, integral color, shape/size of structure, construction material, etc.

Multi-Use Opportunities

- This basin will provide the same type of multi-use opportunities as found in Alternative #1.

Bullard Wash/Interstate 10 Basin

(Northwest corner of Interstate 10 and SR303L)

Landscape Aesthetics

- ***Structure Shape:*** The SR303L/Northern Avenue Basin is a 13.1-acre earthen-lined basin with a meandering top edge. The depth of the basin is 14 feet.

- ***Over-bank Areas:*** A minimum of 60 feet is provided around the top of the basin. This area at the top of the basin would include earth berming and plantings to provide buffering between the basin and adjacent property.

- ***Side Slopes:*** The side slopes of the basin would warp and vary from 4:1 to 12:1 creating a meandering toe of slope. The side slopes would blend into the earth berming located in the over-bank areas. Where possible terracing would be incorporated into the side slopes. Plantings would be located on the side slopes.

- ***Landscape Theme:*** The landscape theme for this basin would follow the guidelines developed for the Recreational Theme. See Section 2.4.4 Typical Landscape Themes for a description of this landscape theme.

- ***Structural Components:*** Structural components located within the basin would be designed to blend with the surrounding environment. This could include the use of form liners, integral color, shape/size of structure, construction material, etc.

Multi-Use Opportunities

- This basin will provide the same type of multi-use opportunities as found in Alternative #2.

Interstate 10 Basins

(North side of Interstate 10 between Dysart Road and Bullard Wash)

Landscape Aesthetics

- ***Structure Shape:*** The interstate 10 Basins are earthen-lined, have meandering top edges, and varying depths.

- ***Over-bank Areas:*** A minimum of 60 feet is provided around the top of the basin. This area at the top of the basin would include earth berming and plantings to provide buffering between the basin and adjacent property.

- ***Side Slopes:*** The side slopes of the basin would warp and vary from 4:1 to 12:1 creating a meandering toe of slope. The side slopes would blend into the earth berming located in the over-bank areas. Where possible terracing would be incorporated into the side slopes. Plantings would be located on the side slopes.

- ***Landscape Theme:*** The landscape theme for this channel would follow the guidelines developed for the Recreational Theme. See Section 2.4.4 Typical Landscape Themes for a description of this landscape theme.

- ***Structural Components:*** Structural components located within the basin would be designed to blend with the surrounding environment. This could include the use of form liners, integral color, shape/size of structure, construction material, etc.

Multi-Use Opportunities

- These basins will provide the same type of multi-use opportunities as found in Alternative #1.

2.4.7 Proposed Plant Palette

The landscape palette for each flood control facility or section of flood control facility is based upon the identified landscape theme of the flood control facility. As stated earlier the landscape theme is based upon the landscape character of the area. The following is a proposed plant palette based upon the identified landscape theme for the flood control facility.

Urban Theme / Commercial Theme / Industrial Theme

Botanical Name	**Common Name**
Trees	
Cercidium spp.	Palo Verde
Dalbergia sissoo	Sissoo Tree
Eucalyptus spp.	Eucalyptus
Fraxinus velutina	Ash
Phoenix dactyliferia	Date palm
Pistacia chinensis	Pistache
Pinus spp.	Pine
Prosopis spp.	Mesquite
Quercus spp.	Oak
Washingtonia robusta	Mexican Fan Palm
Shrubs	
Agave spp.	Agave

Bougainvillea spp.	Bougainvillea
Buddleia marrubiifolia	Butterfly Bush
Caesalpinia pulcherrrima	Red Bird of Paradise
Cassia Spp.	Cassia
Cotoneaster spp.	Cotoneaster
Calliandra spp.	Calliandra
Dalea spp.	Dalea
Dasylirion wheeleri	Desert Spoon
Encelia farinosa	Brittlebush
Gazania rigens	Gazania
Hesperaloe parviflora	Hesperaloe
Juniperus spp.	Juniper
Justicia spp.	Justicia
Lantana spp.	Lantana
Leucophyllum spp.	Texas Ranger
Nerium oleander	Oleander
Salvia spp.	Salvia
Yucca spp.	Yucca

Neighborhood Theme

Botanical Name	**Common Name**
Trees	
Cercidium spp.	Palo Verde
Dalbergia sissoo	Sissoo Tree
Eucalyptus spp.	Eucalyptus
Fraxinus velutina	Ash
Jacaranda mimosifolia	Jacaranda
Pistacia chinensis	Pistache
Pinus spp.	Pine
Prosopis spp.	Mesquite
Rhus lancea	African Sumac
Quercus spp.	Oak
Ulmus spp.	Elm
Shrubs	
Agave spp.	Agave
Bougainvillea spp.	Bougainvillea

Buddleia marrubiifolia	Butterfly Bush
Caesalpinia pulcherrima	Red Bird of Paradise
Cassia Spp.	Cassia
Cotoneaster spp.	Cotoneaster
Calliandra spp.	Calliandra
Dalea spp.	Dalea
Dasylirion wheeleri	Desert Spoon
Dodonea viscosa	Hopseed Bush
Encelia farinosa	Brittlebush
Euonymus spp.	Euonymus
Gazania rigens	Gazania
Hesperaloe parviflora	Hesperaloe
Juniperus spp.	Juniper
Justicia spp.	Justicia
Lantana spp.	Lantana
Leucophyllum spp.	Texas Ranger
Lonicera japonica	Hall's Honeysuckle
Nerium oleander	Oleander
Photinia fraseri	Photinia
Pyracantha spp.	Pyracantha
Salvia spp.	Salvia
Yucca spp.	Yucca

Recreational Theme

Botanical Name	**Common Name**
Trees	
Cercidium spp.	Palo Verde
Dalbergia sissoo	Sissoo Tree
Eucalyptus spp.	Eucalyptus
Fraxinus velutina	Ash
Pinus spp.	Pine
Prosopis spp.	Mesquite
Shrubs	
Agave spp.	Agave
Bougainvillea spp.	Bougainvillea
Caesalpinia pulcherrima	Red Bird of Paradise

Cassia Spp.	Cassia
Cotoneaster spp.	Cotoneaster
Calliandra spp.	Calliandra
Dalea spp.	Dalea
Dasylirion wheeleri	Desert Spoon
Gazania rigens	Gazania
Hesperaloe parviflora	Hesperaloe
Juniperus spp.	Juniper
Justicia spp.	Justicia
Lantana spp.	Lantana
Leucophyllum spp.	Texas Ranger
Nerium oleander	Oleander
Salvia spp.	Salvia
Yucca spp.	Yucca

Native Theme

Botanical Name	**Common Name**
Trees	
Acacia spp.	Acacia
Cercidium spp.	Palo Verde
Celtis pallida	Desert Hackberry
Chilopsis linearis	Desert Willow
Olneya tesota	Ironwood
Prosopis spp.	Mesquite
Shrubs	
Agave spp.	Agave
Ambrosia spp.	Bursage
Atriplex spp.	Saltbush
Calliandra eriophylla	Fairy Duster
Cordia parvifolia	Littleleaf Cordia
Encelia spp.	Brittlebush
Ericameria laricifolia	Turpentine Bush
Eriogonum spp.	Buckwheat
Hymenoclea spp.	Burrobush
Hyptis emoryi	Desert-lavender
Justicia spp.	Justicia

Larrea tridentata	Creosote Bush
Lycium berlandieri	Wolfberry
Penstemon spp.	Penstemon
Hesperaloe parviflora	Hesperaloe
Juniperus spp.	Juniper
Salvia spp.	Salvia
Vauquelinia spp.	Rosewood

Grasses

Aristida purpurea	Purple Threeawn
Bouteloua spp.	Grama
Sporobolus spp.	Sand Dropseed

Cactus

Carnegia gigantea	Saguaro
Ferocactus spp.	Barrel Cactus
Fouquieria splendens	Ocotillo
Opuntia spp.	Prickly-pear
Yucca spp.	Yucca

2.5 DEVELOPMENT OF ANALYSIS CRITERIA AND WEIGHTED MATRIX REFINEMENT

As part of the Level I alternatives analysis, a comprehensive list of criteria was developed by which each proposed alternative could be measured. These criteria were developed and weighted relative to one another based on the following information as well as the general considerations discussed in the above sections.

- Opportunities and constraints identified within the watershed in the Data Collection Report
- Comments made at the committee / stakeholders meeting(s)
- Comments made at the first and second neighborhood meeting(s)
- An evaluation of the scope of work and its primary objectives

During the Level I phase of the ADMP Update project, the above list presented under the general considerations Section 2.4.1 was used as a source to draw on for creating the evaluation matrix. During an open forum / meeting held at the URS office with the project team and a member of the FCDMC staff, the matrix criteria to be used were determined and listed. Once the criterion was listed, it was given a relative importance and used to define / develop the weighted matrix presented in this section.

The individual criterion developed and brief descriptions of each are listed below. While some criteria are the same as listed under Section 2.4.1, others are a result of more detailed analysis.

Environmental Permits and Approvals – The recommended alternative will minimize environmental impacts to and around the immediate and surrounding area. For example, construction activities in existing natural washes will require 401/404 permits and could delay construction.

Utility Conflicts – The alternative that minimizes major utility conflicts will be more cost effective since relocations will be less. The recommended alternative should avoid conflicts with existing channels, retention basins, overhead utilities and major underground utilities.

Biological Conflicts – Activity in areas where endangered species, sensitive vegetation or riparian habitats may require special permits or cause costly delays to construction activities should be avoided.

Archeological Conflicts – Proposed alternative alignments and construction activity associated with an alternative should avoid identified archeological sites. These sites may contain pottery shards, ancient / historic ruins and other important historic / prehistoric artifacts. This type of conflict can cause project delays and other unbudgeted costs.

Hazardous Waste Conflicts – Construction activity associated with an alternative should avoid areas containing leaking underground storage tanks (LUST), landfills, etc. These types of conflicts can lead to mixing pollutants with storm water and can pose serious health hazards and/or result in the introduction of pollutants in the groundwater table.

Aesthetics / Landscape Character – High priority has been placed on creating an effective regional flood control solution that incorporates and maintains aesthetically pleasing landscape character. Based upon this fact, the alternatives with superior aesthetic qualities will be preferred.

Multi-Use Opportunities – This criterion goes along with the aesthetic criterion listed above. In addition to aesthetics, a high priority for multi-use facilities has been identified. Based on this, alternatives that incorporate parks and/or other multi-use facility with flood control will be preferred.

Opportunity for Partnering – If proposed components of an alternative can be built as part of other improvements already planned or being planned and designed by a different agency, there may be opportunities for sharing cost and partnering. These types of opportunities may be difficult to predict without detailed knowledge of planned city improvements; however, it must be evaluated based upon the best and most current information available.

Land Subsidence Areas – The alternative that minimizes the number of structures passing through areas experiencing significant amounts of subsidence is preferred. Subsidence areas will require designs that can continue to function even when significant subsidence occurs. These designs require different materials (flexible to resist cracking), excessive capacities (to account for lost conveyance), etc. Such designs are more expensive than their conventional counterparts.

The subsidence contours presented in the original WLB ADMS were superimposed on the three alternatives and used to evaluate the extent to which each would be affected by subsidence. See Tables 2.11A-2.11D for a summary of the alternatives related to known subsidence areas in the project area.

Engineering Feasibility and Constructability – Alternatives which minimize "out of the ordinary" construction techniques, traffic impacts, etc., will be preferable. Easily constructed alternatives will be built faster and cheaper since contractors will not be forced to use unfamiliar techniques or exotic materials to do the job.

Flood Reduction – The preferred alternative will provide the highest level of flood protection possible given all of the constraints. The alternative will handle storm water relatively efficiently and will alleviate / solve as many known flooding problems as possible.

Right-of-way Requirements – The alternative should minimize the amount of right-of-way acquisition required for proposed flood control elements. This can significantly reduce the cost of a project. This can also help keep a project from experiencing time delays caused by legal issues that may arise in trying to acquire right-of-way.

Potential for Staged Construction – Due to the nature of the project area, an alternative that proposes facilities that may be constructed in stages or phases will be preferred. This is due to the large scale and scope of the project area. The order of magnitude associated with the proposed facilities is such that funding for each facility will be difficult to raise unless the facility is constructed in phases.

Table 2.11A

Land Subsidence - Matrix Evaluation

Facility	none LF Adj.	Channel Length Adjacent to Subsidence Areas 0-2 ft LF Adj.	2-4 ft LF Adj.	4-6 ft LF Adj.	6-8 ft LF Adj.	8-10 ft LF Adj.	10-12 ft LF Adj.	12-14 ft LF Adj.	14-16 ft LF Adj.	16-18 ft LF Adj.	Approximate Total Channel Length
Beardsley Channel	10,500	8,000									18,500
Jackrabbit Trail Channel	16,500										16,500
Jackrabbit /Perryville Channel	23,500										23,500
tuthill Channel	41,000										41,000
Loop 303 Channel	29,400	4,000	4,000	19,700	12,000	12,000	3,900				85,000
Reems Channel	1,300					2,000	2,000	2,700	6,000	8,500	22,500
AT & SF Railroad Channel	1,500				2,000	2,500	5,000	5,000	8,000		24,000
Bullard Wash Channel	22,300	14,000	1,700	2,000							40,000
Northern Avenue Channel	800	2,500	2,500	2,200	6,000	1,200	1,500	1,700	2,600	1,500	22,500
Camelback Road Channel	500		3,000	5,500	3,500						12,500
I-10 Channel	12,500										12,500
Buckeye Channel	12,000										12,000
Union Pacific Railroad Channel	18,500										18,500
West Valley Regional Drain	6,500	25,000	12,500								44,000
Totals:	***196,800***	***53,500***	***23,700***	***29,400***	***23,500***	***17,700***	***12,400***	***9,400***	***16,600***	***10,000***	***393,000***
%Total LF of Channels:	***50.1%***	***13.6%***	***6.0%***	***7.5%***	***6.0%***	***4.5%***	***3.2%***	***2.4%***	***4.2%***	***2.5%***	

Table 2.11B

Land Subsidence - Matrix Evaluation

Facility	none LF Adj.	Channel Length Adjacent to Subsidence Areas 0-2 ft LF Adj.	2-4 ft LF Adj.	4-6 ft LF Adj.	6-8 ft LF Adj.	8-10 ft LF Adj.	10-12 ft LF Adj.	12-14 ft LF Adj.	14-16 ft LF Adj.	16-18 ft LF Adj.	Approximate Total Channel Length
Beardsley Channel	10,500	8,000									18,500
Jackrabbit Trail Channel	15,500										15,500
Jackrabbit /Perryville Channel	30,000										30,000
Loop 303 Channel	29,400	4,000	4,000	19,700	12,000	12,000	3,900				85,000
Reems Channel	1,300					2,000	2,000	2,700	6,000	8,500	22,500
AT & SF Railroad Channel	1,500				2,000	2,500	5,000	5,000	8,000		24,000
El Mirage Channel	0			3,800	2,700	3,250	2,700				12,450
Bullard Wash Channel	22,300	14,000	1,700	2,000							40,000
Northern Avenue Channel	2,800	2,500	2,500	2,200	6,000	1,200	1,500	1,700	2,600	1,500	24,500
Camelback Road Channel	0	800	16,500	11,200	3,500						32,000
I-10 Channel	18,800	5,200									24,000
Lower El Mirage Wash	0	3,500	14,200								17,700
RID Channel	18,000										18,000
Totals:	***150,100***	***38,000***	***38,900***	***38,900***	***26,200***	***20,950***	***15,100***	***9,400***	***16,600***	***10,000***	***364,150***
%Total LF of Channels:	***41.2%***	***10.4%***	***10.7%***	***10.7%***	***7.2%***	***5.8%***	***4.1%***	***2.6%***	***4.6%***	***2.7%***	

Table 2.11C

Land Subsidence - Matrix Evaluation

Facility	none LF Adj.	Channel Length Adjacent to Subsidence Areas 0-2 ft LF Adj.	2-4 ft LF Adj.	4-6 ft LF Adj.	6-8 ft LF Adj.	8-10 ft LF Adj.	10-12 ft LF Adj.	12-14 ft LF Adj.	14-16 ft LF Adj.	16-18 ft LF Adj.	Approximate Total Channel Length
Beardsley Channel	10,500	8,000									18,500
Jackrabbit Trail Channel	16,000	4,000									20,000
Tuthill Channel	32,000										32,000
Loop 303 Channel	29,400	4,000	4,000	19,700	12,000	12,000	3,900				85,000
Reems Channel	1,300					2,000	2,000	2,700	6,000	8,500	22,500
AT & SF Railroad Channel	1,500				2,000	2,500	5,000	5,000	8,000		24,000
El Mirage Channel	0			3,800	2,700	5,250	11,200				22,950
Bullard Wash Channel	22,300	14,000	1,700	2,000							40,000
Northern Avenue Channel	800	2,500	2,500	2,200	6,000	1,200	1,500	1,700	2,600	1,500	22,500
Camelback Road Channel	500		3,000	5,500	3,500						12,500
I-10 Channel	3,500										3,500
Lower El Mirage Wash	0	3,500	14,200								17,700
RID Channel	24,000										24,000
Totals:	***141,800***	***36,000***	***25,400***	***33,200***	***26,200***	***22,950***	***23,600***	***9,400***	***16,600***	***10,000***	***345,150***
%Total LF of Channels:	***41.1%***	***10.4%***	***7.4%***	***9.6%***	***7.6%***	***6.6%***	***6.8%***	***2.7%***	***4.8%***	***2.9%***	

T [illegible] 2.11D

Land Subsidence - Matrix Evaluation

		Channel Length Adjacent to Subsidence Areas									Approximate
Facility	**none LF Adj.**	**0-2 ft LF Adj.**	**2-4 ft LF Adj.**	**4-6 ft LF Adj.**	**6-8 ft LF Adj.**	**8-10 ft LF Adj.**	**10-12 ft LF Adj.**	**12-14 ft LF Adj.**	**14-16 ft LF Adj.**	**16-18 ft LF Adj.**	**Total Channel Length**
Loop 303 Channel	29,400	4,000	4,000	19,700	12,000	12,000	3,900				85,000
Totals:	*29,400*	*4,000*	*4,000*	*19,700*	*12,000*	*12,000*	*3,900*	*0*	*0*	*0*	*85,000*
%Total LF of Channels:	*34.6%*	*4.7%*	*4.7%*	*23.2%*	*14.1%*	*14.1%*	*4.6%*	*0.0%*	*0.0%*	*0.0%*	*100.0%*

Compatibility with Other Projects and Plans – The preferred alternative will be compatible with other projects or plans currently proposed within the project area. This will provide incentive for partnering and cost sharing as well as promote a more cohesive end result.

Removal of FEMA Flood Zones – The preferred alternative will provide the potential to remove significant amounts of area from existing FEMA Flood Zones.

Site Accessibility and Loss of Productivity – The extent to which the facilities proposed with a particular alternative may be accessed will have a direct impact on the ability of work crews to effectively do their jobs. If it is difficult to access portions of a channel that require maintenance, for example, there will be a loss in productivity resulting from a loss of time. The preferred alternative will propose channel alignments and detention pond locations that are easily accessible.

Major and Minor Transportation Routes – The preferred alternative will be the least disruptive to the existing minor and major transportation routes found within the project area. If an alternative proposes several channels that cross major transportation routes or will otherwise disrupt the flow of traffic during construction, that alternative would be less preferred than one that resulted in negligible traffic disruptions.

Sole Access – The more sole access required by particular alternative, the better from a flood control standpoint. The opposite is true from an aesthetic / multi-use perspective. The reason for this is due to the fact that sole access would seriously inhibit any multi-use capability that an alternative might have.

From the perspective of flood control alone, sole access would be desirable. Since the aesthetic and multi-use aspects of the alternatives are being evaluated separately, the sole access category has been evaluated from a flood control perspective.

Extent of Use of Existing Facilities – The recommended alternative should incorporate to the largest extent possible any existing flood control facilities already existing within the project area. This will keep costs down and result in a more efficient flood control system.

Project Cost – The preferred alternative will minimize capital costs.

Acceptability to Local Residents – The acceptability of each alternative to the local residents is being evaluated based upon comments provided by the public at the neighborhood meetings. Most of the comments to date have been from private development currently active in the project area.

Facility Maintenance – The recommended alternative should propose facilities whose maintenance requirements are minimal. This will keep long-term maintenance costs associated with the continued function of a facility down over the course of its useful life.

Implementation – The simpler it is to implement a design including the interim design, the more economically practical it will be. Also, it is important to have an alternative that provides a plan for smooth transitions from one phase to another as the watershed develops. An alternative should provide a plan for flood protection at during interim phases prior to full build-out.

Effectiveness for Existing and Proposed Development – The recommended alternative will provide an efficient outfall for adjacent development. In addition, the alternative will tie existing flood control discontinuities together so that they function as one system.

Adjacent Land Use and Zoning Regulations – The recommended alternative will not require significant rezoning for construction. The more compliant a proposed alternative is with current zoning regulations, the quicker and more cost effectively it can be implemented.

Impact on Existing Facilities – The effect of each of the three alternatives and the Baseline Alternative on the existing flood control facilities located in the project area has been evaluated to ensure that the recommended alternative will maximize the use of existing facilities without over taxing them. Any alternative that results in significant negative impacts on the existing facilities will be less preferable to one that does not.

Upon completion of the above criteria, it was decided that, at Level II, there is not enough known information to adequately evaluate each alternative to the level of detail required by every one of the above criteria. Therefore, the above criteria were combined into more general categories which were applicable. These categories are broader and can be easily weighted based on available data.

In some cases, categories that were previously combined during the Level I portion of the project have been broken out for this Level II Phase II analysis. This was done if more detailed information allowed for an adequate rating of the expanded category.

The following categories were created from the list above. Each was assigned a relative weighted value of importance in percent and placed within the weighted evaluation matrix. The proposed alternatives were given a rating from 1 to 5 (1 = Poor, 5 = Excellent) for each category described below. The matrix computed an overall score for each alternative evaluated and the top score was used in developing the final recommended alternative.

The categories used in the weighted matrix and a brief summary of each are listed below:

Permits – This category was created to include the environmental permits and approvals, biological and archeological conflict criteria. This category was assigned a weighted importance of 3% relative to all other categories.

Environment – This category was created to include the hazardous waste conflicts criteria and was assigned a relative weighted importance of 7%.

Aesthetics – This category was created to include the aesthetics opportunities associated with each alternative and the possibilities for blending facility treatments with existing and future desired land use character. This category was assigned a relative weighted importance of 8%.

Multi-Use – This category was created to include the multi-use opportunity criteria. This category was assigned a relative weighted importance of 8%.

Partnering Potential – This category was created to include the opportunity for partnering criteria. This category was assigned a relative weighted importance of 7%.

Engineering Feasibility and Constructability – This category was created to include the utility conflicts, land subsidence areas, complexity of crossings, etc. This category was assigned a relative weighted importance of 5%.

Flood Reduction – This category was created to include the flood control and effectiveness of an alternative in relation to existing land development criteria. This category was assigned a relative weighted importance of 12%.

Traffic – This category was added after the development of the criteria listed above. This category reflects possible negative impacts of an alternative on traffic patterns within the project area. This category was assigned a relative weighted importance of 2%.

Right-of-Way – This category was created to include the right-of-way criterion. The data for required right-of-way per alternative compiled for the quantity / cost estimate were used to evaluate this category. This category was assigned a relative weighted importance of 6%.

Potential for Staged Construction – This category evaluates the potential for projects identified under a given alternative to be constructed in phases. This category has been assigned a relative weighted importance of 5%.

Compatibility with Other Projects and Plans – The category was created to evaluate the extent to which the projects identified by a given alternative are compatible with the surrounding proposed and existing land development. This category has been assigned a relative weighted importance of 5%.

Removal of FEMA Flood Zones – This category was created to evaluate the extent to which proposed alternative flood control facilities may be used to eliminate or improve existing FEMA floodplains currently identified and published on the Flood Insurance Rate Maps (FIRM). This category was assigned a relative weighted importance of 5%.

Site Accessibility and Loss of Productivity – This category was included to allow for some evaluation regarding the potential loss or increase in productivity depending on the ease with which the facilities proposed with a particular alternative may be accessed. This category has been assigned a relative weighted importance of 3%.

Major and Minor Transportation Routes – This category was added to determine the relative performance of the alternatives in regard to major and minor transportation routes throughout the project area. Possible disruption to these routes during construction has been estimated for each of the alternatives. This category has been assigned a relative weighted importance of 4%.

Sole Access – This category was added to determine the relative impacts on alternatives that require more or less sole access. Sole access has been evaluated as a positive from a flood control perspective. Although more sole access may inhibit aesthetics and multi-use opportunities, which will be evaluated under the aesthetic and multi-use categories. This category has been assigned a relative weighted importance of 2%.

Extent to Which Existing Facilities Are Used – This category was created to include the extent of use of existing facilities criterion. This category was assigned a relative weighted importance of 3%.

Capital Cost – This category was created for the capital cost criterion listed above. This category was assigned a relative weighted importance of 7%.

Operation & Maintenance – This category was created to include the facility maintenance criterion. This category was assigned a relative weighted importance of 3%.

Acceptability to Local Residents – This category was added to factor the suggestions and views of the public into the matrix weighting of the alternatives. This category was assigned a relative weighted importance of 5%.

The matrix used in the above analysis is shown on Table 2.12. The results of the matrix analysis were used for selecting the recommended preferred alternative discussed in Section 4.

2.6 MATRIX EVALUATION AND RESULTS

The following section contains a brief description of each category and the process used to determine matrix scores for each.

2.6.1 Final Matrix Evaluation Categories

Permits – All alternatives are likely to require a Section 404 permit and probably a NPDES permit under the Clean Water Act. The environmental permitting efforts are unlikely to vary substantially among the alternatives, and the potential for needing to comply with NEPA appears to be low for all alternatives. Although there is only slight variation among the alternatives regarding permitting requirements, implementation of any alternative will require additional funds and time for permitting, which are likely to entail jurisdictional water delineation, biological surveys, and cultural resource surveys.

The evaluation of this category was generally based on the 401/404 permitting process. The U.S. Army Corps of Engineers (USACOE) requires that a permit for any construction activity proposed to take place within jurisdictional waters be issued.

Generally, the greater the extent of construction proposed within jurisdictional waters, the more costly, time consuming and difficult it is to obtain the proper permit(s). With this in mind, the proposed alternative channels and basin alignments were overlaid onto the color aerial photo and an estimate was made as to how much impact each alternative might have on jurisdictional waters. For simplicity at this level of analysis, the jurisdictional waters were assumed to be the Agua Fria River and Gila River.

Channel inflow locations at each of the rivers were evaluated based on the number of outfalls and top width. The outfall pipes were evaluated based on the approximate width of the proposed pipe and headwall structure. The more extensive the disturbed jurisdictional area, the lower the matrix score would be for a particular alternative.

Environment – All alternatives are projected to result in no significant impacts on native vegetation communities, wildlife, and sensitive species of plants and animals. The potential for any alternative to adversely affect cultural resources is projected to be low. Therefore, environmental factors are considered to be unimportant in choosing among the alternatives being considered.

Landscape Aesthetics – The aesthetics opportunities for Alternatives 1 through 3 are generally the same. The landscape aesthetic treatment of the channels or basins will be the same regardless of the alternative. Therefore, the aesthetic ratings are equivalent. The Baseline Alternative

Table 2.12

Loop 303 Corridor/White Tanks Area Drainage Master Plan Update

Alternatives Evaluation Matrix

Relative Importance[2] Scoring Values[1]	3% 1-2-3-4-5	7% 1-2-3-4-5	8% 1-2-3-4-5	8% 1-2-3-4-5	7% 1-2-3-4-5	5% 1-2-3-4-5	12% 1-2-3-4-5	2% 1-2-3-4-5	6% 1-2-3-4-5	5% 1-2-3-4-5	5% 1-2-3-4-5	5% 1-2-3-4-5	3% 1-2-3-4-5	4% 1-2-3-4-5	2% 1-2-3-4-5	3% 1-2-3-4-5	7% 1-2-3-4-5	3% 1-2-3-4-5	5% 1-2-3-4-5	
Option	Permits	Environment	Aesthetics	Multi Use	Partnering Potential	Constructability	Flood Reduction	Traffic	R/W	Potential for Staged Construction	Compatibility with other Projects and Plans	Potential for Removal of Existing FEMA Flood Zone	Site Accessibility Inconvenience and Loss of Productivity	Major or Minor Transportation Routs	Sole Access	Extent to Which Existing Facilities are Used	Capital Cost	Operation & Maintenance	Acceptability to Local Residents	Alternative Weighted Average
Alternative 1	3.50	4.00	5.00	4.50	2.00	3.50	5.00	3.00	2.00	4.50	2.00	3.00	3.50	3.00	4.00	3.00	2.00	2.00	3.50	**3.1**
Alternative 2	3.50	4.00	5.00	5.00	4.00	4.00	4.00	2.50	2.50	4.00	3.50	4.50	3.00	3.00	4.50	3.00	2.50	2.50	3.50	**3.4**
Alternative 3	4.00	4.00	5.00	4.50	3.50	4.00	5.00	2.50	2.50	3.50	3.00	3.50	3.50	2.50	4.50	3.00	3.50	2.50	3.00	**3.4**
Baseline	5.00	4.00	1.00	1.00	2.50	4.00	2.00	4.50	4.50	1.00	1.50	1.00	5.00	4.00	2.00	1.00	4.50	3.50	2.50	**2.6**

1. Scoring Explanation:
   1 = Poor Value
   2 = Below Average
   3 = Average Value
   4 = Above Average
   5 = Excellent Value
2. The relative importance is a measure of how important each category is relative to all of the other categories (1 = unimportant, 5 = very important)

received a low rating due to being a straight hard-lined channel and square, steep sloped, deep detention basins.

Multi-Use – Alternative 2 received a slightly higher rating than Alternatives 1 and 3 due to having a pathway connection on Camelback Road from the WT FRS #3 to SR 303L, a connection from SR 303L to Bullard Wash along I-10, a channel adjacent to Roosevelt Irrigation District Canal, and for having basins spread out throughout the project area. Alternative 2 overall provided for better connection of pathways throughout the project area.

Partnering Potential – The evaluation of each of the alternatives for partnering potential accounted for several factors. These factors included the impact of channel alignments proposed with an alternative on proposed development, the number of proposed developments that might benefit from proposed channel alignments and the extent to which proposed alternative features coincided with future parks and open space areas in the project area.

If an alternative channel alignment was shown to bisect a proposed or existing development site, this would be an example of a negative impact. However, if the alternative proposed channels that might be used as outfall points for proposed development while limiting the amount of right-of-way required, this would be a positive impact.

The following categories were created for evaluation for each alternative including the Baseline Alternative:

- The number of times proposed channels bisect proposed or existing development.
- The number of proposed developments that could potentially use a proposed channel or basin as an outfall.
- The number of lineal feet that were coincident with future / planned parks and open space areas.

The higher the number in the first category, the lower an alternative's partnering rating. By contrast, higher numbers for the second and third categories indicated a more favorable matrix rating.

Engineering Feasibility and Constructability – Alternatives which minimize "out of the ordinary" construction techniques, traffic impacts, etc., will be preferable.

An evaluation used for the matrix scoring was completed for the alternatives. The evaluation criterion included the following:

- **Degree of curvature of a proposed alignment –** The more curved a channel, the more complicated the construction.

- **Number and complexity of crossings –** The higher the number of roads, structures, railroads, etc., that a proposed channel must cross, the more difficult the construction.

- **Number of homes or buildings in the path of the alignment –** The higher the number of structures that would be required to be purchased and torn down to make way for a proposed channel, the less feasible the alternative.

- **Number of channels leaving the project area –** The more channels that proposed alignments leaving the actual project area, the less feasible the alternative.

- **Subsidence –** The higher the number of structures that are susceptible to subsidence relative to the total number proposed for a given alternative, the less feasible the alternative.

- **Proposed channel flow direction relative to natural grade –** If an alternative proposes channels that are adverse to existing slopes, this is less feasible than an alternative that proposes channel alignments to follow existing grades.

Each alternative was evaluated under the above categories and the results were used to determine the matrix score.

***Flood Reduction* –** The amount of flood reduction from one alternative to another varied depending on where channels were placed.

The evaluation of this category was accomplished by randomly choosing approximately 40 concentration points around the project area and comparing the flow rates computed with each alternative. The more reduction present at a selected concentration point, the better the matrix score for an alternative.

The results were totaled for each concentration point and a final matrix score was determined.

***Traffic* –** The evaluation of the traffic category was simply a measure of the potential disruption of a particular alternative on traffic patterns.

The following two categories of information were collected and used to estimate the disruption potential of each alternative:

- The percentage of total proposed channel length crossing existing commercial and heavy population centers.

- The percentage of total proposed channel length crossing proposed future commercial and high-density population centers.

The second evaluation point will be more important if several proposed facilities are not constructed right away.

By overlaying the proposed alternative alignments with both the color aerial map and the proposed future land use map, the percentages associated with the categories listed above were determined and used to enter an appropriate score on the matrix for each alternative.

Right-of-Way – The amount of right-of-way required for each alternative as part of the quantities and costs portion of the alternative evaluation was used to determine a relative score for each alternative in the matrix. The higher the right-of-way required, the lower the matrix score.

Potential for Staged Construction – The potential for staged construction was evaluated on the feasibility of constructing proposed facilities in stages. This would be similar to the way in which the existing Bullard Wash improvements are being constructed. The outfall portion / reach has already been constructed from the Gila River north to approximately Lower Buckeye Road. The next stage of construction will include the reach from approximately Lower Buckeye Road north to approximately I-10.

If the facilities proposed with one alternative could be easily phased or built in stages relative to the other alternatives, it was given a higher matrix score. Some facilities could not be easily phased and provide sufficient protection. An example is the Baseline Alternative channel along Loop 303. The channel would be required to be built entirely to provide a continuous outfall for the portions of channel constructed upstream along the roadway alignment.

Compatibility with Other Projects and Plans – Each alternative was evaluated based on its potential compatibility with other projects and plans. This was estimated by accounting for the following factors:

- The total area of proposed facilities that will significantly encroach or cross-existing or proposed development.

- The percentage of facilities that are coincident with future proposed developments and future proposed parks.

Potential for Removal of Existing FEMA Floodplain – The number of lineal feet of proposed channel associated with an alternative that would directly or indirectly allow for the potential removal or containment of existing FEMA floodplains was determined. The value was estimated based on overlaying the proposed channel alignments with the existing FEMA floodplain data.

- The greater the number of lineal feet potentially removed, the higher the score entered on the matrix.

Site Accessibility, Inconvenience, and Loss of Productivity – This category was evaluated by estimating the difficulty of the adjacent terrain, existing and future land use adjacent to proposed facilities and existing access to proposed facilities. The more remote the proposed facility and the harder it is to access, the more time that will be lost by maintenance crews trying to gain access.

The matrix score for each alternative was determined by evaluating the degree of access available under the alternatives. The more accessible the alternative, the higher the matrix score.

Major and Minor Transportation Routes – In general, from a flood control perspective, the more major and minor transportation routes paralleled by proposed facilities in an alternative the better. This is due to the fact that these transportation routes usually have existing right-of-way and offer easy access to the proposed facilities. Although bridges / culverts may be needed to provide driveway access to existing businesses or residences, the benefits of potential use of existing right-of-way outweigh these drawbacks. Further, there are currently very few existing businesses or residences along proposed channel alignments.

From an aesthetics / multi-use perspective paralleling major and minor transportation routes may not be a positive aspect. This is because parks, bike trails, golf courses, equestrian paths, etc., are better served away from the noise and exhaust created from busy roadways.

This category was evaluated from a flood control perspective since the aesthetic and multi-use components of the alternatives are evaluated under their respective category headings. By estimating the percentage of proposed facilities that parallel major and minor transportation routes and comparing the results, a score for each alternative relative to the others was entered into the matrix.

Sole Access – From a flood control perspective, the more sole access required by a particular alternative, the higher the matrix score. This is due to the fact that sole access is desired to prevent accidents and to promote safety when floodwater is being stored or conveyed by a proposed facility. Sole access would also make it easier to maintain a facility and would limit vandalism.

From an aesthetic / multi-use perspective, the more sole access required by an alternative, the lower the matrix score. This is due to the fact that sole access limits the extent to which a facility may serve in a multi-use capacity.

This category was evaluated from a flood control perspective since the aesthetic and multi-use components of the alternatives are evaluated under their respective category headings. By estimating the number of facilities that might require sole access due to the location, safety and proximity to sensitive structures or development (such as LAFB) a matrix score was determined for each alternative.

Extent to Which Existing Facilities are Used – This category was evaluated by estimating the percent of facilities proposed with a given alternative that make use of the existing flood control facilities already constructed in the project area. These facilities include:

- The existing Bullard Outfall Channel
- The existing ADOT basins
- The existing WT FRS #3 and #4
- The existing WT FRS #4 inlet channel
- The existing Falcon Dunes detention basin
- The existing Dysart Drain
- The existing Camelback Channel
- The existing Colter Channel

In general, all three alternatives make the same use of these facilities. Approximately 25% of the proposed facilities in each alternative tie into one of the above existing facilities. The Baseline Alternative does not propose any use of the existing facilities.

Using the above information, matrix scores were entered for each alternative.

Capital Cost – The capital cost of each alternative was estimated by determining the quantities required for each of the proposed flood control facilities and totaling the cost.

Using the results of the quantities / cost analysis, the matrix scores were determined for each alternative.

Operation and Maintenance – This category was evaluated by looking at the number of culvert crossings, detention basins, drop structures and the overall area of proposed facilities associated with each alternative. The relative impact of each of the above items is briefly mentioned below:

- ***Culvert Crossings:*** Since culvert crossings are prone to siltation and clogging, they will require regular maintenance. Therefore, the higher the numbers of culvert crossings, the lower the matrix score.

- ***Drop Structures:*** Drop structures are associated with energy dissipation and hydraulic jumps. Such energy dissipation may cause scouring or erosion. Therefore, the more drop structures proposed the lower the matrix score.

- ***Total Facility Area:*** Since the facilities will be designed with aesthetics and multi-use as a high priority, they will likely be planted with vegetation ranging from grass and trees to desert shrubs and cactus. The more vegetation associated with an alternative, the more maintenance required to ensure the aesthetics of the landscaping. Therefore, the higher the total facility footprint area associated with a proposed alternative, the lower the matrix score.

Acceptability to Local Residents – The acceptability to the local residents of each of the proposed alternatives was estimated based on the results of the questionnaires used at the initial neighborhood meetings in March of 2000 as well as those held on August 28th and 30th.

The comments on the questionnaires from the neighborhood meetings indicated that the most common feature disliked by the public was a large channel paralleling Loop 303 and the use of too many north south collector channels. The feature most approved of was the use of channels that follow natural or historic flow paths such as west east channels north of I-10.

Each of the proposed alternatives was evaluated based on the above comments and scored accordingly.

2.6.2 Results of Matrix Evaluation

From the results of the matrix evaluation, Alternative 2 has been tentatively recommended over Alternatives 1 and 3. Alternative 3 received the next highest score, followed by Alternative 1 and finally the Baseline Alternative (do nothing). Each alternative and a summary of the matrix results is briefly discussed below. See section 4 for a detailed discussion of the recommended preferred alternative.

Alternative 1 – Alternative 1 scored the strongest in the areas of aesthetics, multi-use and the potential for staged construction while it scored the lowest in the areas of right-of-way requirements, compatibility with other projects and plans, partnering potential, capitol cost and operation and maintenance. It should be noted that the lowest score received by Alternative 1 was 2.0.

Overall, Alternative 1 had below average to poor scores in approximately 28% of the total weighted categories possible while it scored above average to very good in approximately 58% of the total weighted categories possible.

Alternative 2 – Alternative 2 scored the strongest in the areas of aesthetics, multi-use, potential for removal of existing FEMA flood zones and sole access while it scored the lowest in the areas of right-of-way requirements, traffic, capital cost and operation and maintenance. It should be noted that the lowest score received by Alternative 2 was 2.5.

Overall, Alternative 2 had below average to poor scores in approximately 18% of the total weighted categories possible while it scored above average to very good in approximately 72% of the total weighted categories possible.

Alternative 3 – Alternative 3 scored the strongest in the areas of flood reduction and sole access while it scored the lowest in the areas of right-of-way requirements, major and minor transportation routes and operation and maintenance. It should be noted that the lowest score received by Alternative 3 was 2.5.

Overall, Alternative 3 had below average to poor scores in approximately 15% of the total weighted categories possible while it scored above average to very good in approximately 73% of the total weighted categories possible.

Baseline Alternative – The Baseline Alternative scored the strongest in the areas permits, traffic, right-of-way, site accessibility and capital cost while it scored the lowest in the areas of aesthetics, multi-use, flood reduction, potential for staged construction, compatibility with other projects and plans, potential for removal of existing FEMA flood zones, sole access and the extent to which existing facilities are used. It should be noted that the lowest score received by Baseline Alternative was 1.0.

3.0 COST / QUANTITIES

3.1 QUANTITIES

A cost estimate was prepared as part of the Phase II analysis. Quantities were computed for the major components associated with each of the recommended alternatives described in Section 2. A **contingency of 30%** was set, based on the fact that only major components of each alternative have been sized at this time. Many smaller components that may be required as part of the more detailed design phase of the project are not yet known and have not been evaluated. One example of what these components may include is inlet / outlet details whose exact dimensions have not been calculated at this level of analysis.

Several simplifying assumptions were made to facilitate a quick yet informative cost comparison between the alternatives. It should be recognized that these assumptions might change as the level of detail regarding the analysis inputs increases during the Level III portion of the ADMP Update project.

The cost estimate provided in this report should not be used for actual final cost information. As described above, the level of detail for this phase of the study does not require a final dollar amount, rather an approximate order of magnitude and relative difference for an adequate comparison of the recommended alternatives and the Baseline Alternative.

3.1.1 Basic Assumptions

Several assumptions / limitations were used at this level of analysis to simplify the computation of quantities used with the cost estimate. These assumptions and limitations are listed below:

- Culverts were sized for major roadway crossings only. Culverts required at intermediate roadway crossings were not evaluated at this time.
- Detailed quantities regarding inlet / outlet aprons, filter fabric, tow-downs and other details were not considered.
- All facilities were considered to be earthen with grass linings.
- Velocities in channels were limited to a maximum of 6 f/s to minimize erosion during large runoff events.
- Land acquisition quantities were based on a single value of $40,000/acre as provided to URS by the FCDMC.

- If channel slopes did not produce velocities of more than 6 f/s, drop structures were not designed.

- Cut quantities were calculated using the average end area method and applied along proposed channel reaches and within proposed detention basins.

- Hydroseed quantities were based on the approximate required footprint for a given facility.

- Land acquisition quantities were based on the approximate required footprint for a given facility. The channel top widths were increased by 60 feet to allow for aesthetics / multi-use features. Additionally, 30 feet was added to proposed basin footprints to account for aesthetic / multi-use features. In the case of the ADOT basins, only right-of-way outside the limits of the existing right-of-way was considered a land acquisition quantity.

3.1.2 Quantities Calculations Methodology

The methodology followed when computing the quantities was fairly simple. The importance of consistency between the calculations from alternative to alternative was considered the most important aspect of the analysis. Consistency is crucial to a meaningful comparison between the proposed alternatives and the baseline. The discussion below summarizes the methodology followed when calculating the quantities used to determine a relative cost for each of the alternatives.

As an organization tool and in an effort to maintain consistency, spreadsheets were used to tabulate the quantities required for the four alternatives. The quantities estimated include, right-of-way requirements, channel excavation, hydroseed area, grouted riprap hydraulic drops, energy dissipators, excavations for detention and mixing basins, culverts for major road crossings and concrete channel lining estimates when necessary.

3.1.2.1 Proposed Channel Quantities

As discussed in Section 2.3.1, the design of the channels for each of the proposed flood conveyance systems for each alternative was based upon results of the HEC-1 study. To design the channel reaches for each alternative, flow rate values were taken from the HEC-1 output files at locations that identified elements of the flood control system and imported into Excel spreadsheet files. Reaches are organized by proposed channel alignment and are identified by their associated downstream concentration points. For a given reach between nodes, for instance, major street intersections, the reach was assumed to have a uniform channel section throughout. The following list describes the process followed:

- Each channel reach was assigned a discharge (taken from the downstream concentration point of the reach), slope, length, side slope(s), and roughness coefficient.

- From these values, the individual reaches were sized – by varying depth, slope and width – using FlowMaster by Haestead Methods.

- To size each channel, a list of criteria was established; the assumed uniform channel flow velocity was to be kept at or below 6 f/s, the trapezoidal channel side slopes were set at 6 horizontal to 1 vertical, the channel cover was assumed as grass-lined with a Manning's Roughness value set at 0.03, modified channel slopes were assigned a minimum value of 0.2 percent (0.002), and the depth of flow was generally limited to 6 feet.

- After sizing each channel reach according to the assigned criteria, the following derived channel characteristics were entered into the spreadsheet;
  - the new channel slope (if necessary)
  - channel depth
  - bottom width
  - surface top water width
  - the resulting channel flow velocity

- From the computed channel data entered into the spreadsheet, the excavation, right-of-way and hydroseed area quantities were calculated. For the excavation quantities, the depth of flow in the channel reach was rounded up to the nearest whole integer and 2 feet of freeboard depth was added to come up with an overall channel depth for the reach. This depth was then utilized with the bottom width and 6:1 side slopes to calculate an average cross sectional area and this in turn was multiplied by the reach length to obtain an estimate of channel excavation volume required for each reach.

- For the right-of-way width, the top width of the channel was calculated from the channel depth and 30 feet of landscaping easement was added to both sides of the channel, this overall width was then multiplied by the reach length to calculate the required right-of-way area.

- The hydraulic perimeter of the channel using the overall channel depth and the additional 30 feet of landscape easement on either side were added together and multiplied by the reach length to arrive at the hydroseed quantity required for each reach.

3.1.2.2 Calculation of Approach Slope and Stilling Basin Quantities

Slopes for some of the channel reaches had to be modified from the existing condition to meet the specified channel design criteria. Typically, with large flow rates on the order of 3,000 cfs to 6,000 cfs, channel slopes were flattened to lower flow velocities. However, some slopes were modified for even lower flow rates if the existing slope were steep enough to induce flow velocities greater than the allowable 6 f/s. In these instances when the channel slopes were modified from existing, hydraulic drops in the channel reach were assumed to account for the difference in hydraulic elevation from the top of the reach to the bottom. Across these drops, hydraulic jumps are assumed to occur in the channel and the following steps describe how the various characteristics of the drops and associated hydraulic jumps were derived; refer to the detailed data and calculation sheets in Appendix A.

3.1.2.3 Calculation of Culvert Quantities

After the reach excavation and drop structure quantities were calculated, culverts required beneath major street and/or feature crossings (e.g., railroad crossings and canal crossings) were estimated for the three recommended alternatives. The example spreadsheet located in Appendix A – Alternative 1, Culvert Sizing Table Example (pages 12-14 of Appendix A) demonstrates how the conveyance mechanisms were determined and their corresponding quantities calculated.

3.1.2.4 Calculation of Quantities within the Bullard Wash

Quantities that were calculated within the Bullard Wash – namely those reaches defined between Thomas Road and McDowell Road and south of I-10 to Lower Buckeye Road were based upon the City of Goodyear established typical section of the Bullard Wash multi-use corridor. The criteria utilized for the creation of this typical section can be seen in pages 25-29 of Appendix A. The excavation quantities were based solely on this assumed constant cross section multiplied by the respective reach lengths. The right-of-way and hydroseed quantities were also calculated from this typical cross section and the respective reach lengths.

3.1.2.5 Calculation of Quantities for the Baseline Alternative

The quantities calculated for the Baseline Alternative were based upon typical channel and basin sections proposed by the Estrella Corridor Study conducted by DeLeuw, Cather & Company, dated August 1998. This typical section has a 60-foot maximum bottom width, 7-foot maximum channel depth, and 2:1 side slopes and an 88-foot maximum top width. The cross sectional area of this typical section was calculated and multiplied by the respective reach lengths for the excavation quantities. The hydraulic perimeter using the 7-foot channel depth was multiplied by the respective reach lengths to obtain the necessary concrete channel lining quantities. Finally, the 88-foot top width of the channel was multiplied by the respective channel reaches to obtain the required right-of-way area quantities.

The culvert quantities established for the Baseline Alternative were based upon the typical culvert sections proposed by DeLeuw, Cather & Company. The first section was an 8-foot by 6-foot reinforced concrete box section and the second section was a 12-foot by 8-foot reinforced concrete box section. The allowable flow calculations for the specified channel slope value of 0.002 can be seen in pages 30 and 31 of Appendix A for both culverts. Concrete headwall, wingwall and apron quantities were calculated according to the ADOT Structures Section Standard Drawing reproduced on pages 19-24 of Appendix A.

3.2 UNIT COSTS

To develop the unit costs used with the quantity take-offs described above, two reference materials were utilized. The first source was the ADOT Bid Tabulations published for the fiscal year 1999. The second source of cost data was taken from the cost estimate prepared for State Route Loop 101 – Aqua Fria Freeway – Encanto Boulevard to Camelback Road dated March 19, 1999. The established unit costs and their respective references can be seen on page 32 of Appendix A. The unit cost used for right-of-way was provided to URS from the FCDMC as $40,000/acre.

3.3 AESTHETICS AND MULTI-USE UNIT COSTS

The unit costs listed below were developed based on the proposed facility treatments resulting from aesthetic / multi-use evaluations and analysis. These unit costs will apply to each of the three proposed alternatives. Since the Baseline Alternative consists of a hard-lined channel, there will not be any significant multi-use / aesthetic component.

Cost for landscape aesthetics and multi-use features are based upon a typical area for each channel and basin. Costs include plantings, irrigation, hardscape features, and labor.

- Bullard Channel North average square foot cost is $1.40.
- Bullard Channel South average square foot cost is $1.40.
- I-10 to ADOT Basins Channel average square foot cost is $1.40

- West Valley Regional Flood Control Structure average square foot cost is $1.35
- I-10 and Bullard Basin average square foot cost is $1.30

Note that the Maricopa Flood Control District maximum spending allowance on landscape aesthetics is $1.00 per square foot. Any Cost above this maximum allowance must be negotiated or paid by others.

3.4 COST ESTIMATE AND RESULTS

The results of the cost estimate show that the most expensive alternative is Alternative 1 while the least expensive is the Baseline Alternative. Alternative 2 was less than Alternative 1 but more expensive than Alternative 3. The results of the cost estimate are not surprising given the relatively large amount of right-of-way required by alternatives 1 and 2. In addition, the footprint areas of the proposed facilities are generally larger than with the other two. Also, the channel alignments proposed with alternatives 1 and 2 require more culvert crossings than either of the other two alternatives. Finally, the channel alignments and design discharges associated with alternatives 1 and 2 result in higher flow velocities and require more drop structures than the other alternatives.

The Baseline Alternative is much less expensive than the others. This is simply due to the fact that the Baseline Alternative consists of only one channel and four basins versus 14-16 channels and 6-8 basins as proposed by the other three alternatives. See Tables 3.1A-3.1D for the detailed quantity and cost estimate.

Tat 1A

Quantities and Cost Estimate

ALTERNATIVE #		ITEM DESCRIPTION	UNIT	UNIT COST	QUANTITY	COST
Alternative #1		Channel Excavation	C.Y.	$3.25	35478918	115,306,484
		Detention Basin Excavation	C.Y.	$5.00	2433099	12,165,495
		Mixing Basin Excavation	C.Y.	$5.00	29029	145,145
		Drop Structures - Grouted Rip-Rap	C.Y.	$130.00	30437	3,956,810
		ROW	ACRE	$40,000.00	1384	55,360,000
		Hydroseed & Topsoil	ACRE	$2,500.00	2012	5,030,000
	2	Barrel 75' Long, 72" DIAM. RCP Culvert	EA.	$38,745.00	2	77,490
	4	Barrel 75' Long, 72" DIAM. RCP Culvert	EA.	$45,870.00	5	229,350
	5	Barrel 75' Long, 72" DIAM. RCP Culvert	EA.	$49,432.50	6	296,595
	6	Barrel 75' Long, 72" DIAM. RCP Culvert	EA.	$52,995.00	4	211,980
	7	Barrel 75' Long, 72" DIAM. RCP Culvert	EA.	$56,557.50	8	452,460
	8	Barrel 75' Long, 72" DIAM. RCP Culvert	EA.	$60,120.00	6	360,720
	9	Barrel 75' Long, 72" DIAM. RCP Culvert	EA.	$63,682.50	8	509,460
	10	Barrel 75' Long, 72" DIAM. RCP Culvert	EA.	$67,245.00	9	605,205
	11	Barrel 75' Long, 72" DIAM. RCP Culvert	EA.	$70,807.50	8	566,460
	12	Barrel 75' Long, 72" DIAM. RCP Culvert	EA.	$74,370.00	2	148,740
	13	Barrel 150' Long, 72" DIAM. RCP Culvert	EA.	$103,807.50	2	207,615
	13	Barrel 150' Long, 72" DIAM. RCP Culvert	EA.	$77,932.50	5	389,663
	14	Barrel 75' Long, 72" DIAM. RCP Culvert	EA.	$81,495.00	2	162,990
	15	Barrel 75' Long, 72" DIAM. RCP Culvert	EA.	$85,057.50	2	170,115
	15	Barrel 300' Long, 72" DIAM. RCP Culvert	EA.	$162,682.50	1	162,683
	16	Barrel 75' Long, 72" DIAM. RCP Culvert	EA.	$88,620.00	1	88,620
	17	Barrel 75' Long, 72" DIAM. RCP Culvert	EA.	$92,182.50	1	92,183
	22	Barrel 75' Long, 72" DIAM. RCP Culvert	EA.	$109,995.00	1	109,995
	23	Barrel 75' Long, 72" DIAM. RCP Culvert	EA.	$113,557.50	4	454,230
	33	Barrel 75' Long, 72" DIAM. RCP Culvert	EA.	$149,182.50	1	149,183
	35	Barrel 75' Long, 72" DIAM. RCP Culvert	EA.	$156,307.50	1	156,308
	6	Barrel 175' Long, 60" DIAM. RCP Culvert	EA.	$294,840.00	1	294,840
	4	Barrel 215' Long, 60" DIAM. RCP Culvert	EA.	$239,625.00	1	239,625
	3	Barrel 215' Long, 60" DIAM. RCP Culvert	EA.	$180,817.50	1	180,818
	5	Barrel 7200' Long, 60" DIAM. RCP Culvert	EA.	$9,378,932.50	1	9,378,933
		Aesthetics and Mulit-Use	EA.	$97,790,000.00	1	97,790,000

Sub Total: 305,450,191
30% Contingency *91,635,057*

Total: **397,085,248**

1. Contingency includes unlisted costs and construction costs.

6/24/2003

Table 3.1 - Cost-Estimate-8-15-01.xls

Tat ' 1B

Quantities and Cost Estimate

ALTERNATIVE #		ITEM DESCRIPTION	UNIT	UNIT COST	QUANTITY	COST
Alternative #2		Channel Excavation	C.Y.	$3.25	33409474	108,580,791
		Detention Basin Excavation	C.Y.	$5.00	6261816	31,309,080
		Mixing Basin Excavation	C.Y.	$5.00	4087	20,435
		Drop Structures - Grouted Rip-Rap	C.Y.	$130.00	34307	4,459,910
		ROW	ACRE	$40,000.00	1198	47,920,000
		Hydroseed & Topsoil	ACRE	$2,500.00	1553	3,882,500
	1	Barrel 75' Long, 72" DIAM. RCP Culvert	EA.	$35,182.50	2	70,365
	2	Barrel 75' Long, 72" DIAM. RCP Culvert	EA.	$38,745.00	1	38,745
	3	Barrel 75' Long, 72" DIAM. RCP Culvert	EA.	$42,307.50	5	211,538
	3	Barrel 150' Long, 72" DIAM. RCP Culvert	EA.	$68,182.50	1	68,183
	4	Barrel 75' Long, 72" DIAM. RCP Culvert	EA.	$45,870.00	7	321,090
	4	Barrel 300' Long, 72" DIAM. RCP Culvert	EA.	$123,495.00	1	123,495
	5	Barrel 75' Long, 72" DIAM. RCP Culvert	EA.	$49,432.50	10	494,325
	5	Barrel 150' Long, 72" DIAM. RCP Culvert	EA.	$75,307.50	1	75,308
	6	Barrel 75' Long, 72" DIAM. RCP Culvert	EA.	$52,995.00	3	158,985
	7	Barrel 75' Long, 72" DIAM. RCP Culvert	EA.	$56,557.50	4	226,230
	8	Barrel 75' Long, 72" DIAM. RCP Culvert	EA.	$60,120.00	5	300,600
	10	Barrel 75' Long, 72" DIAM. RCP Culvert	EA.	$67,245.00	3	201,735
	12	Barrel 75' Long, 72" DIAM. RCP Culvert	EA.	$74,370.00	2	148,740
	13	Barrel 75' Long, 72" DIAM. RCP Culvert	EA.	$77,932.50	2	155,865
	14	Barrel 75' Long, 72" DIAM. RCP Culvert	EA.	$81,495.00	4	325,980
	15	Barrel 75' Long, 72" DIAM. RCP Culvert	EA.	$85,057.50	2	170,115
	16	Barrel 75' Long, 72" DIAM. RCP Culvert	EA.	$88,620.00	3	265,860
	17	Barrel 75' Long, 72" DIAM. RCP Culvert	EA.	$92,182.50	3	276,548
	18	Barrel 75' Long, 72" DIAM. RCP Culvert	EA.	$95,745.00	1	95,745
	19	Barrel 75' Long, 72" DIAM. RCP Culvert	EA.	$99,307.50	2	198,615
	20	Barrel 75' Long, 72" DIAM. RCP Culvert	EA.	$102,870.00	2	205,740
	25	Barrel 75' Long, 72" DIAM. RCP Culvert	EA.	$120,682.50	1	120,683
	26	Barrel 75' Long, 72" DIAM. RCP Culvert	EA.	$124,245.00	1	124,245
	1	Barrel 175' Long, 60" DIAM. RCP Culvert	EA.	$52,802.50	1	52,803
	1	Barrel 7200' Long, 60" DIAM. RCP Culvert	EA.	$1,879,302.50	1	1,879,303
		Aesthetics and Mulit-Use	EA.	$96,690,000.00	1	96,690,000

Sub Total:	299,173,553
30% Contingency	*89,752,066*
Total:	**388,925,619**

1. Contingency includes unlisted costs and construction costs.

6/24/2003

Table 3.1 - Cost-Estimate-8-15-01.xls

Tab 1C

Quantities and Cost Estimate

ALTERNATIVE #		ITEM DESCRIPTION	UNIT	UNIT COST	QUANTITY	COST
Alternative #3		Channel Excavation	C.Y.	$3.25	33,185,802	107,853,857
		Detention Basin Excavation	C.Y.	$5.00	4656119	23,280,595
		Mixing Basin Excavation	C.Y.	$5.00	7770	38,850
		Drop Structures - Grouted Rip-Rap	C.Y.	$130.00	24637	3,202,810
		ROW	ACRE	$40,000.00	1163	46,520,000
		Hydroseed & Topsoil	ACRE	$2,500.00	1455	3,637,500
	2	Barrel 75' Long, 72" DIAM. RCP Culvert	EA.	$38,745.00	4	154,980
	2	Barrel 300' Long, 72" DIAM. RCP Culvert	EA.	$116,370.00	1	116,370
	3	Barrel 75' Long, 72" DIAM. RCP Culvert	EA.	$42,307.50	8	338,460
	4	Barrel 75' Long, 72" DIAM. RCP Culvert	EA.	$45,870.00	7	321,090
	4	Barrel 150' Long, 72" DIAM. RCP Culvert	EA.	$71,745.00	1	71,745
	5	Barrel 75' Long, 72" DIAM. RCP Culvert	EA.	$49,432.50	1	49,433
	6	Barrel 75' Long, 72" DIAM. RCP Culvert	EA.	$52,995.00	2	105,990
	7	Barrel 75' Long, 72" DIAM. RCP Culvert	EA.	$56,557.50	3	169,673
	8	Barrel 75' Long, 72" DIAM. RCP Culvert	EA.	$60,120.00	8	480,960
	9	Barrel 75' Long, 72" DIAM. RCP Culvert	EA.	$63,682.50	2	127,365
	10	Barrel 75' Long, 72" DIAM. RCP Culvert	EA.	$67,245.00	5	336,225
	11	Barrel 75' Long, 72" DIAM. RCP Culvert	EA.	$70,807.50	1	70,808
	12	Barrel 75' Long, 72" DIAM. RCP Culvert	EA.	$74,370.00	1	74,370
	13	Barrel 75' Long, 72" DIAM. RCP Culvert	EA.	$77,932.50	4	311,730
	14	Barrel 75' Long, 72" DIAM. RCP Culvert	EA.	$81,495.00	2	162,990
	15	Barrel 75' Long, 72" DIAM. RCP Culvert	EA.	$85,057.50	3	255,173
	16	Barrel 75' Long, 72" DIAM. RCP Culvert	EA.	$88,620.00	1	88,620
	17	Barrel 75' Long, 72" DIAM. RCP Culvert	EA.	$92,182.50	2	184,365
	18	Barrel 75' Long, 72" DIAM. RCP Culvert	EA.	$95,745.00	1	95,745
	19	Barrel 75' Long, 72" DIAM. RCP Culvert	EA.	$99,307.50	1	99,308
	33	Barrel 75' Long, 72" DIAM. RCP Culvert	EA.	$149,182.50	2	298,365
	1	Barrel 7200' Long, 60" DIAM. RCP Culvert	EA.	$1,879,302.50	1	1,879,303
		Aesthetics and Mulit-Use	EA.	$94,930,000.00	1	94,930,000

Sub Total:	285,256,677
30% Contingency	*85,577,003*
Total:	**370,833,679**

1. Contingency includes unlisted costs and construction costs.

6/24/2003

Tab ⁴D

Quantities and Cost Estimate

ALTERNATIVE #		ITEM DESCRIPTION	UNIT	UNIT COST	QUANTITY	COST
Baseline Alternative		Channel Excavation	C.Y.	$3.25	1485413	4,827,592
		Detention Basin Excavation	C.Y.	$5.00	5262222	26,311,110
		Channel Concrete Lining	S.Y.	$21.00	261825	5,498,325
		ROW	ACRE	$40,000.00	290	11,600,000
		Hydroseed & Topsoil	ACRE	$2,500.00	135	337,500
	7	Barrel 98' Long, 8'x6' Box Culverts	EA.	$208,861.83	1	208,862
	3	Barrel 98' Long, 12'x8' Box Culverts	EA.	$179,899.10	2	359,798
	4	Barrel 98' Long, 12'x8' Box Culverts	EA.	$229,675.93	2	459,352
	5	Barrel 98' Long, 12'x8' Box Culverts	EA.	$281,050.17	2	562,100
	6	Barrel 98' Long, 12'x8' Box Culverts	EA.	$331,326.80	5	1,656,634
	7	Barrel 98' Long, 12'x8' Box Culverts	EA.	$381,603.43	4	1,526,414
		Aesthetics and Mulit-Use	EA.	$0.00	1	0

Sub Total:	*53,347,687*
30% Contingency	*16,004,306*
Total:	**69,351,993**

1. Contingency includes unlisted costs and construction costs.

6/24/2003

4.0 RECOMMENDED PREFERRED ALTERNATIVE

Upon inspection of the results of the matrix scoring for the alternatives, there is not a clear 'preferred alternative'. The results show that while some components of a particular alternative may be preferable to those of another, other components of that alternative may be less effective relative to those of another. Given this result, the 'high-scoring' components of the alternatives analyzed should be incorporated into the final recommended/preferred alternative. In regard to the Baseline Alternative, it does not meet the goals set by the ADMP Update project in general. Therefore, the Baseline Alternative received a very low score (approximately 20% lower than the next highest score) and has eliminated itself as a potential candidate for the recommended/preferred alternative.

The spread of scores for the three recommended alternatives was between 0% and 10%. This makes it difficult to select a single preferred alternative from the three. For example, if some of the relative importance factors used in weighting the scores entered into the matrix are changed among the categories, the final results can be changed slightly. By changing these factors to simulate different relative importance combinations of the categories, a sort of sensitivity analysis can be done. This is important since the relative importance of a given category can be very subjective. The analysis showed that two outcomes were consistently obtained regarding the final relative alternative scores. These two outcomes (described as A and B below), are shown below:

Outcome A: The scoring for outcome A results in the following standing of alternatives from best to worst:

- Alternative 2
- Alternative 3
- Alternative 1
- Baseline Alternative

Outcome B: The scoring for outcome B results in the following standing of alternatives from best to worst:

- Alternative 3 and Alternative 2
- Alternative 1

- Baseline Alternative

Since the Baseline Alternative is generally a minimum of 20% lower than the next highest score, it can be safely eliminated from consideration.

Alternative 1 always finished last, however, depending on the relative importance factors used it sometimes scored very close to alternatives 2 and 3. Therefore, there are some features in Alternative 1 that are positive while others are negative enough to cause it to consistently score last.

Finally, it is clear that both alternatives 2 and 3 contain positive features that should not be discarded or excluded simply by choosing one over the other. It is also difficult to select either Alternative 2 or 3 since the scoring margin is so small between the two regardless of the relative importance factors used with the analysis. See Table 2.13 for the weighted matrix and resulting scores for each alternative.

Therefore, it is recommended that the positive features of each alternative (excluding the baseline) be identified and combined into a single recommended preferred alternative.

4.1 RECOMMENDED PREFERRED ALTERNATIVE

The components finally selected for inclusion in the recommended preferred alternative were identified by evaluating several matrices. These matrices were filled in at the stakeholders meeting held on September 12, 2001, at the FCDMC.

At this meeting, the results of the analysis presented in this report and the compiled data obtained at the above-mentioned public neighborhood meeting(s) were used by stakeholders to fill out the evaluation matrices. The compiled results of the evaluation matrices were the basis for the determination of the final preferred alternative.

4.1.1 STAKEHOLDERS MATRIX EVALUATIONS

As explained above, the recommended preferred alternative is a combination of the proposed alternatives. By dividing the project area into 5 different regions the components making up each alternative were analyzed individually on a region by region basis, see Figure 4.1 for the project units. Stakeholders filled out one matrix per region and the results of the evaluation were then tabulated. Table 4.1A – 4.1C illustrates the results of the stakeholders matrix evaluations. After compiling the results, a single alternative was selected per region and combined into the recommended preferred alternative. See Figure 4.2.

Since the results of the evaluation showed the selection of Alternative 1 only in the White Tanks Region, there was no outfall for the existing White Tanks FRS #3 directly proposed as part of the resulting recommended preferred alternative. This was due to the fact that Alternative 3 selected for the Estrella Region does not propose a west to east outfall channel from White Tanks FRS #3. Similarly, Alternative 1 selected for the White Tanks Region does not propose a north to south outfall channel from the White Tanks FRS #3.

Under the direction of the FCDMC, URS extended the proposed JackRabbit Trail Channel from Indian School Road north to White Tanks FRS #3. The actual channel proposed as part of Alternative 1 extended from the existing White Tanks FRS #4 inlet channel north to Indian School Road.

4.1.2 Compiled Stakeholders Matrix Data

In an effort to determine the preferred alternative in each project unit, the scores determined by the matrices filled out by individual stakeholders at committee meeting #4 for each alternative were evaluated using to three different methods.

Method #1 – The first step to determining the preferred alternative was to record the final composite score for each alternative and the baseline alternative in each of the 5 project areas for each of the stakeholders. A single table was created for each stakeholder listing the alternative in the far left column and the project units across the top row. The final score awarded each alternative for a particular region was then entered into the table. see Table 4.1B.

A final composite table summed the scores for each alternative. The preferred alternative was the one that received the highest overall score in any given region, see Table 4.1B.

Method #2 – Using the table(s) created in Method #1, the alternative selected for each project unit was tabulated by stake holder. The stake-holders were listed in the far left column and the project units were listed across the top row. For each stakeholder, the alternative that received the highest score in a given project unit was listed under the appropriate heading.

After tabulating the data, the alternative most often selected in a particular region was listed in the bottom row of the table, see Table 4.1C.

Method #3 – Method #3 was based on awarding points for first, second, third and fourth places for each alternative in a given region for a particular stakeholder. A table listing the alternatives in the far left column versus the project units listed across the top row was used to sum up the total number of points awarded a particular alternative in a given project unit. The alternative with the most points in a given region was considered the preferred alternative, see Table 4.1D.

A final summary table was created to show the project units in the far left column and the alternative selected using each method listed across the top row. The alternative most selected for a particular project unit by the three methods was listed as the preferred alternative for that region. See Table 4.1A for the results of the above analysis.

5.0 REFERENCES

Section 1

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Section 2

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Final Drainage Report, Snyder's of Hanover, I-10 and Bullard Avenue, Goodyear Arizona, Primatech, LLC, dated January 1998

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Offsite Drainage Design Report, Dibble and Associates Consulting Engineers, dated January 1976

Landscape Aesthetics Assessment and Multi-Use Opportunities Assessment, Logan Simpson Design Inc., April 17, 2000.

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Drainage Channel Study for West Half of Estrella Freeway Loop 303 from Interstate 17, Technical Memorandum, dated August 1998, by Deleuw Cather & Company.

Section 3

ADOT Bid Tabulations published for the fiscal year 1999

Cost estimate prepared for State Route Loop 101 – Aqua Fria Freeway – Encanto Blvd. to Camelback Road dated March 19, 1999

Section 4

Arizona Department of Transportation (ADOT) Construction Cost 1997 and 1999.

ADOT B-standards, B11.12, B11.14, B05.10.

City of Phoenix monitored unit costs for the MAG pay items, 3/16/00.

Loop 303
Area Drainage Master Plan

Quantities Calculations/Methodology

Problem Statement

The object of this package is to describe and document the methodology used to prepare the estimates of quantities for the four alternatives proposed with the Loop 303 Area Drainage Master Plan.

Basic Assumptions

Several assumptions/limitations were used at this level of analysis to simplify the computation of quantities used with the cost estimate. These assumptions and limitations are listed below:

- Culverts were sized for major roadway crossings only. Culverts required at smaller roadway crossings were not evaluated at this time.
- Detailed quantities regarding inlet/outlet aprons, filter fabric, tow-downs and other details were not considered.
- All facilities were considered to be earthen with grass linings.
- Velocities in channels were limited to a maximum of 6 f/s to minimize erosion during large runoff events.
- Land acquisition quantities were based on a single value of $40,000/acre as provided to URS by the MCFCD.
- If channel slopes did not produce velocities of more than 6 f/s, drop structures were not designed.
- Cut quantities were calculated using the average end area method and applied along proposed channel reaches and within proposed detention basins.
- Hydroseed quantities were based on the approximate required footprint for a given facility.
- Land acquisition quantities were based on the approximate required footprint for a given facility. The channel top widths were increased by 60 feet to allow for aesthetics/multi-use features. Additionally, 30 feet was added to proposed basin footprints to account for

aesthetic/multi-use features. In the case of the ADOT basins, only right of way outside the limits of the existing right of way was considered a land acquisition quantity.

3.1.2 Quantities Calculations Methodology

The methodology followed when computing the quantities was fairly simple. The importance of consistency between the calculations from alternative to alternative was considered the most important aspect of the analysis. Consistency is crucial to a meaningful comparison between the proposed alternatives and the baseline. The discussion below summarizes the methodology followed when calculating the quantities used to determine a relative cost for each of the alternatives.

As an organization tool and in an effort to maintain consistency, spreadsheets were used to tabulate the quantities required for the four alternatives. The quantities estimated include, right-of-way (ROW) requirements, channel excavation, hydroseed area, grouted rip-rap hydraulic drops, energy dissipators, excavations for detention and mixing basins, culverts for major road crossings and concrete channel lining estimates when necessary.

3.1.2.1 Proposed Channel Quantities

As discussed in section 2.3.1, the design of the channels for each of the proposed flood conveyance systems for each alternative was based upon results of the HEC-1 study. To design the channel reaches for each alternative, flow rate values were taken from the HEC-1 output files at locations that identified elements of the flood control system and imported into Excel Spreadsheet files. Reaches are organized by proposed channel alignment and are identified by their associated downstream concentration points. For a given reach between nodes, for instance major street intersections, the reach was assumed to have a uniform channel section throughout. The following list describes the process followed:

- Each channel reach was assigned a discharge (taken from the downstream concentration point of the reach), slope, length, side slope(s), and roughness coefficient.
- From these values, the individual reaches were sized – by varying depth, slope and width - using FlowMaster by Haestead Methods (Haestead Methods).

- To size each channel, a list of criteria was established; the assumed uniform channel flow velocity was to be kept at or below 6 feet per second (fps), the trapezoidal channel side slopes were set at 6 horizontal to 1 vertical, the channel cover was assumed as grass-lined with a Manning's Roughness value set at 0.03, modified channel slopes were assigned a minimum value of 0.2 percent (0.002), and the depth of flow was generally limited to 6 feet.
- After sizing each channel reach according to the assigned criteria, the following derived channel characteristics were entered into the spreadsheet;
- the new channel slope (if necessary)
- channel depth
- bottom width
- surface top water width
- the resulting channel flow velocity
- From the computed channel data entered into the spreadsheet, the excavation, ROW and hydroseed area quantities were calculated. For the excavation quantities, the depth of flow in the channel reach was rounded up to the nearest whole integer and 2 feet of freeboard depth was added to come up with an overall channel depth for the reach. This depth was then utilized with the bottom width and 6:1 side slopes to calculate an average cross sectional area and this in turn was multiplied by the reach length to obtain an estimate of channel excavation volume required for each reach.
- For the ROW width, the top width of the channel was calculated from the channel depth and 30 feet of landscaping easement was added to both sides of the channel, this overall width was then multiplied by the reach length to calculate the required ROW area.
- The hydraulic perimeter of the channel using the overall channel depth and the additional 30' of landscape easement on either side were added together and multiplied by the reach length to arrive at the hydroseed quantity required for each reach.

3.1.2.2 Calculation of Approach Slope and Stilling Basin Quantities

Slopes for some of the channel reaches had to be modified from the existing condition to meet the specified channel design criteria. Typically, with large flow rates on the order of 3,000 to 6,000 cfs channel slopes were flattened to lower flow velocities. However, some slopes were modified for even lower flow rates if the existing slope were steep enough to induce flow velocities greater than the allowable 6 feet per second. In these instances when the channel slopes were modified from existing, hydraulic drops in the channel reach were assumed to account for the difference in hydraulic elevation from the top of the reach to the bottom. Across these drops, hydraulic jumps are assumed to occur in the channel and the following steps describe how the various characteristics of the drops and associated hydraulic jumps were derived, please refer to the detailed data and calculation sheets in **Appendix X.X**.

- The channel reach characteristics were imported from the channel sizing spreadsheets described in the previous section (see columns A through L in the Hydraulic Jumps Example Spreadsheet, **Appendix X.X**).
- Reach lengths were located from the HEC-1 input files and assigned to each reach (column F).
- For each reach where the original slope had been modified, the overall drop in flow-line elevation between the top to the bottom was calculated by taking the numeric difference between the existing channel slope and the proposed channel slope and multiplying by the reach length (Col N = (Col G – Col H)*Col F).
- A number of drops were assigned for each reach and the incremental height difference for each drop was calculated. This incremental height value was usually kept between 4 to 5 feet (Col P = Col N/Col O).
- In order to define the hydraulic jump characteristics that will occur across the incremental height drops, it was assumed that the channel cross section would remain constant through the jump approach slope and stilling basin area where the jump would form. The jump approach slope was assumed to be at a 10:1 slope (an average, acceptable slope assumed to allow for predicable jump formation).
- The jump characteristics were assumed to be in accordance with a Type I Basin as defined in the Engineering Monograph No 25 "Hydraulic Design of Stilling Basins and Energy Dissipators" by A.J. Peterka produced by the U.S. Dept. of Interior, Bureau of Reclamation - USBR EM 25 (see pages 9-11 of **Appendix X.X**).
- To estimate the height of the jump within the stilling basin, equation (2) was utilized from USBR EM 25 (see page 10 **of Appendix X.X**).
- To estimate the length of the jump, Figure 6 – Length of jump in terms of D_1 (Basin I) – was utilized from USBR EM 25 (see page 11 of **Appendix X.X**).
- The methodology used to calculate the jump parameters was to assume a set Froude Number (see page 10 **of Appendix X.X**) at the toe of the stilling basin approach slope. This allows for

a depth, D_1, to be calculated and subsequently a depth D_2 from USBR EM 25 equation (2). A Froude number value between 2.0 and 2.5 was usually set at the toe of the stilling basin approach slope since the associated flow velocities were typically lower than 20 feet per second, the assumed maximum flow velocity for the grouted rip-rap approach slope and stilling basin.

- The example spreadsheet titled "Example Hydraulic Jump Calculations" seen on page 8 of **Appendix X.X** demonstrates the calculation of the induced hydraulic jump height, D_2. Columns A and B display the associated reach and downstream concentration point. Column C displays the depth of flow at the toe of the stilling basin approach slope (variable D_1 in equation USBR EM 25). Columns D through H display and calculate the channel flow rate, bottom width, flow area, and flow velocity for determination of the Froude Number. Column J calculates the hydraulic jump flow depth, D_2 , from USBR EM 25 equation (2). Column K displays the normal depth of flow downstream of the jump and column L displays the numeric difference between the jump depth and the normal depth. For calculation purposes an initial trial Froude Number value of 2.0 was assumed and the corresponding jump depth was calculated. If the difference value in column L was lower that 0.25 the Froude Number in the reach was increased until a difference in flow depths of 0.25 feet was calculated. This value of 0.25 feet was assumed to be a reasonable difference in flows depths and would allow for adequate formation of a jump and corresponding dissipation of flow energy across the channel drop structure.
- Once the jump parameters were determined for each reach, the flow depth at the toe of the stilling basin approach slope and the jump depth within the stilling basin were entered into columns Q and R of the Hydraulic Jumps (quantities) spreadsheet (see pages 5-7 **of Appendix X.X**). Column S displays the associated Froude Number for reference. Columns T through Y calculate the grouted rip-rap quantities necessary for each of the reaches requiring channel drop structures. From Figure 6 in USBR EM 25 (page 11), around a Froude Number of 2 the length of the hydraulic jump with the Type I stilling basin is 10 times the depth of flow at the toe of the stilling basin approach slope. Column T utilizes this relationship to calculate the length of the required stilling basin by multiplying the flow depth in column Q (Y_1) by a factor of 10. In column U, the length of the stilling basin approach slope is calculated from the assumed slope of 10:1 and the incremental height per drop displayed in column P. Column V calculates the grouted rip-rap volume in the stilling basin using the assumed uniform reach cross section and length of hydraulic jump calculated in column T.

Column X calculates the grouted rip-rap volume for the stilling basin approach slope using the length calculated in column U and the assumed uniform reach cross section. Column X sums the grouted rip-rap volumes in the stilling basin and approach slope for each drop structure and finally, column Y sums the total volume of grouted rip-rap within the entire reach using the number of drops determined within the reach (column O).

3.1.2.3 Calculation of Culvert Quantities

After the reach excavation and drop structure quantities were calculated, culverts required beneath major street and or feature crossings (ex. railroad crossings & canal crossings) were estimated for the three recommended alternatives. The example spreadsheet located in **Appendix X.X** – "Alternative 1, Culvert Sizing Table Example" (pages 12-14 of **Appendix X.X**) demonstrates how the conveyance mechanisms were determined and their corresponding quantities calculated. The following list identifies the steps taken to calculate these quantities:

- Major street crossings that were identified for a culvert crossing storm water flow were assumed to occur roughly every mile on the section lines. There were a few road crossings and man made features that occurred outside of this criteria which have been included in the alternative quantity spreadsheets. Proposed culverts were assumed to be 75 feet long, typical for the anticipated road sections to be encountered. However, at the crossings of Loop 303 the culvert lengths were assumed to be 150 feet long (taken from proposed sections for Loop 303) and at the crossings at I-10 the culvert lengths were assumed to be 300 feet long.
- Two main mechanisms were assumed for flow conveyance and at each identified culvert/street crossing the cost of both was evaluated. The first culvert was a 72 inch diameter reinforced concrete pipe (RCP) and the second culvert was a 10'x6' reinforced concrete box structure. Each culvert was analyzed for flow conveyance characteristics within the anticipated range of slope values. The culvert calculator within Land Development Desktop, Release 2i was used to evaluate the hydraulic capacity of each culvert. The upstream allowable depth of flow was assumed to be 7 feet equivalent to 1 foot of head on both culverts. At the downstream end of the culverts, the tailwater was assumed to be at the crown of the culvert. Parametric studies were performed for both culvert types with the two culvert inlet and outlet control conditions using the appropriate FHWA HDS-5 charts. Results of these studies can be seen in pages 15 through 18 in **Appendix X.X**. For the 72" ϕ

RCP, the allowable flow rates varied from 168 cfs to 200 cfs over the range of anticipated channel slopes. This difference in flow rates was considered minimal and an average allowable flow rate value of 195 cfs (see page 15 in **Appendix X.X** for average calculations) was chosen for the 72" ϕ RCP. For the 10'x6' concrete box structure the flow rates varied from 403 cfs to 437 cfs and again these differences were considered trivial and an average allowable flow rate value of 432 cfs was calculated (see page 17 in **Appendix X.X** for calculations).

- The allowable flow rate values for the two conveyance culverts were entered into the Culvert Sizing Table and were used to calculate the number of barrels for each culvert type necessary to handle the designated reach flow rate at the major street intersection locations. These locations are seen in column C of the example Culvert Sizing spreadsheet and the corresponding flow rates are seen in column D. Columns E and F use the allowable flow rate values determined to calculate the number of barrels required for each culvert type.
- The ADOT Structures Section Standard Drawings were used to calculate the required concrete and reinforcing quantities for the multi-barrel culverts determined in columns E and F (see pages 19-24 of **Appendix X.X**). For the 72" ϕ RCP culvert, the total cost was a function of the cost of the pipe per linear foot (cost is assumed to include excavation, installation and backfill) plus the cost of construction for the inlet and outlet headwalls and the outlet concrete apron. For the 10'x6' reinforced concrete box section, the total cost was a function of the excavation, concrete section construction and backfill plus the cost of the inlet and outlet headwalls and the concrete outlet apron. Columns G and H tabulate the RCP culvert length and unit cost. The required concrete and reinforcing steel quantity costs for inlet and outlet headwalls as well as outlet aprons for both culvert types were tabulated in columns I and L. Column J tabulates the total cost for the multi barreled 72" ϕ RCP and column M tabulates the total cost for the 10'x6' box culvert. Finally, column N evaluates and tabulates the best-cost alternative between the two proposed culvert types.

3.1.2.4 *Calculation of Quantities within the Bullard Wash*

Quantities that were calculated within the Bullard Wash – namely those reaches defined between Thomas Road and McDowell Road and south of I-10 to Lower Buckeye Road were based upon the City of Goodyear established typical section of the Bullard Wash multi-use corridor. The criteria utilized for the creation of this typical section can be seen in pages 25-29 of **Appendix**

X.X. The excavation quantities were based solely upon this assumed constant cross section multiplied by the respective reach lengths. The ROW and hydroseed quantities were also calculated from this typical cross section and the respective reach lengths.

3.1.2.5 *Calculation of Quantities for the Baseline Alternative*

The quantities calculated for the baseline alternative were based upon typical channel and basin sections proposed by the Estrella Corridor Study conducted by DeLeuw Cather and Company, dated August 1998. This typical section has a 60-foot maximum bottom width, 7-foot maximum channel depth, and 2:1 side slopes and an 88-foot maximum top width. The cross sectional area of this typical section was calculated and multiplied by the respective reach lengths for the excavation quantities. The hydraulic perimeter using the 7-foot channel depth was multiplied by the respective reach lengths to obtain the necessary concrete channel lining quantities. Finally, the 88-foot top width of the channel was multiplied by the respective channel reaches to obtain the required ROW area quantities.

The culvert quantities established for the Baseline Alternative were based upon the typical culvert sections proposed by DeLeuw Cather and Company. The first section was an 8'x6' reinforced concrete box section and the second section was a 12'x8' reinforced concrete box section. Similar to the culvert quantity calculations for the first three alternatives, the capacity of the proposed culvert sections were calculated with the Culvert Calculator in Land Development Desktop Release 2I assuming a foot head on the inlet and complete submergence of the outlet. The allowable flow calculations for the specified channel slope value of 0.002 can be seen in pages 30 and 31 of **Appendix X.X** for both culverts. Concrete headwall, wingwall and apron quantities were calculated according to the ADOT Structures Section Standard Drawing reproduced on pages 19-24 of **Appendix X.X.**

Alternative 1
Hydraulic Jumps Example Spreadsheet

	A	B	C	D	E	F	G	H	I	J	K	L	N	O	P	Q	R	S	T	U	V	W	X	Y
1	Proposed Channel	D/S Concentration Point	Routing Section	Discharge [cfs]	Mannings n	Reach Length (ft)	Original Channel Slope [ft/ft]	Revised Channel Slope [ft/ft]	Depth [ft]	Bottom Width [ft]	Surface Water Top Width [ft]	Velocity [ft/s]	Drop Across Channel from Exist. Slope (ft)	# Drops	ΔH per Drop	Y	Y	Froude #	Length of Jump Stilling Basin Type I	Length of Drop Assume 10H:1V	Stilling Basin Grouted Rip Rap Volume (yd^3)	Drop Grouted Rip Rap Volume (yd^3)	Grouted Rip Rap Volume per Drop & Basin (yd^3)	Grouted Rip Rap Volume Reach Total (yd^3)
2	Beardsley Channel	BC1	RBCUS	313	0.03	3500	0.0083	0.0083	1.84	20	42.03	5.5												
3																								
4		BC2	RBC1	2829	0.03	3550	0.0076	0.0040	2.95	142	177.42	5.99	12.9	3	4.3	1.4	3.3	2.0	14	43	111	323	435	1305
5																								
6		BC3	RBC2	6435	0.03	6550	0.0075	0.0020	5.1	180	241.26	5.98	36.0	8	4.5	1.8	5.4	2.4	19	45	195	463	658	5261
7																								
8		BC4	RBC3	6455	0.03	3750	0.0083	0.0020	5.1	181	242.19	5.98	23.7	6	4.0	1.8	5.3	2.4	19	40	196	408	604	3623
9																								
10		BC5	RBC4	6653	0.03	2050	0.0113	0.0020	5.08	188	249.01	5.99	19.1	4	4.8	1.8	5.3	2.4	19	48	201	505	706	2825
11	Jackrabbit Trail	JR1		923																				
12																								
13		JR2	RJR1	1417	0.03	5280	0.0063	0.0063	2.09	101	126.05	5.98												
14																								
15		JR3	RJR2	1719	0.03	4500	0.0089	0.0050	2.55	97	127.64	5.99	17.5	4	4.4	1.3	3.1	2.0	13	44	82	256	338	1350
16	Jackrabbit-Perryville	JP1	RJPUS	948	0.03	2800	0.0061	0.0061	1.91	79	101.92	5.49												
17																								
18		JP2	RJP1	1181	0.03	5280	0.0068	0.0068	2.01	86	110.08	6												
19																								
20		JP3	RJP2	1168	0.03	2800	0.0068	0.0068	2.01	85	109.08	6												
21																								
22		JP4	RJP3	1282	0.03	2450	0.0029	0.0029	4.66	22	77.97	5.5												
23																								
24		JP5	RJP4	1755	0.03	2640	0.0023	0.0023	5.88	19	89.54	5.5												
25																								
26		JP6	RJP5	1952	0.03	2640	0.0015	0.0020	6.97	10	93.64	5.4												
27																								
28		JP7	RJP6	1961	0.03	5280	0.0013	0.0020	6.98	10	93.8	5.41												
29																								
30	Tuthill Channel	TC1	RTCUS	1474	0.03	5280	0.0068	0.0030	3.88	46	92.5	5.49	20.2	4	5.0	1.7	4.1	2.0	18	50	87	222	310	1238
31																								
32		TC2	RTC1	1497	0.03	3550	0.0020	0.0020	6.61	5	84.37	5.07												
33																								
34		TC3	RTC2	2065	0.03	5450	0.0007	0.0020	6.94	13	96.33	5.48												
35	Loop 303																							
36		LP1	R121A	1278	0.03	5280	0.0028	0.0028	5.3	12	75.65	5.5												
37																								
38		LP2	RLP1	2387	0.03	5280	0.0023	0.0023	4.56	68	122.67	5.5												
39																								
40		LP3	RLP2	1822	0.03	5280	0.0042	0.0040	3.19	76	114.33	5.99	0.9	1	0.9	1.5	3.6	2.0	16	9	88	49	137	137
41																								
42		LP4	RLP3	2089	0.03	5280	0.0034	0.0030	4.43	52	105.17	6	2.2	1	2.2	2.0	4.7	2.0	21	22	107	110	216	216
43																								
44		LP5	RLP4	848	0.03	5280	0.0047	0.0047	3.95	12	59.45	6												
45																								
46		LP6	RLP5	1119	0.03	5280	0.0034	0.0034	5.3	5	68.56	5.74												
47																								
48		LP7	RLP6	1264	0.03	5280	0.0045	0.0045	3.11	49	86.36	6												
49																								
50		LP8	RLP7	1879	0.03	5280	0.0037	0.0037	3.48	69	110.79	6												
51																								
52		LP9	RLP8	1096	0.03	5280	0.0027	0.0027	5.5	5	71.01	5.24												
53																								
54		LP10	RLP9	1142	0.03	4875	0.0045	0.0045	3.25	39	78.06	6												
55																								
56		LP11	RLP10	1270	0.03	6200	0.0044	0.0044	3.2	47	85.4	6												
57																								
58		LP12	RLP11	2815	0.03	1125	0.0043	0.0030	3.98	94	141.73	6	1.4	1	1.4	1.8	4.2	2.0	18	14	119	88	207	207
59																								
60		LP13	RLP12	2738	0.03	3950	0.0040	0.0030	4	90	138.02	6	4.0	2	2.0	1.8	4.2	2.0	18	20	117	122	239	478
61																								
62		LP14	RLP13	4217	0.03	5280	0.0044	0.0020	5.74	88	156.91	6	12.4	3	4.1	2.2	6.0	2.3	22	41	151	285	436	1307
63																								
64		LP15	RLP14	4450	0.03	5280	0.0038	0.0020	5.63	98	165.56	6	9.4	3	3.1	2.2	5.8	2.3	22	31	159	228	387	1160
65																								

Alternative 1
Hydraulic Jumps Example Spreadsheet

	A	B	C	D	E	F	G	H	I	J	K	L	N	O	P	Q	R	S	T	U	V	W	X	Y
1	Proposed Channel	D/S Concentration Point	Routing Section	Discharge [cfs]	Mannings n	Reach Length (ft)	Original Channel Slope [ft/ft]	Revised Channel Slope [ft/ft]	Depth [ft]	Bottom Width [ft]	Surface Water Top Width [ft]	Velocity [ft/s]	Drop Across Channel from Exist Slope (ft)	# Drops	ΔH per Drop	Y_1	Y_2	Froude #	Length of Jump Stilling Basin Type I	Length of Drop Assume 10H:1V	Stilling Basin Grouted Rip Rap Volume (yd^3)	Drop Grouted Rip Rap Volume (yd^3)	Grouted Rip Rap Volume per Drop & Basin (yd^3)	Grouted Rip Rap Volume Reach Total (yd^3)
66		LP16	RLP15	4402	0.03	3750	0.0043	0.0020	5.65	96	163.8	6	8.5	3	2.8	2.2	5.9	2.3	22	28	158	203	360	1081
67																								
68		LP17	RLP16	4361	0.03	7500	0.0013	0.0020	5.65	95	162.78	6												
69	Reems Channel	RM1		1115	0.03		0.0038																	
70																								
71		RM2	2RRM1	1091	0.03	2640	0.0034	0.0034	3.78	30	75.31	5.49												
72																								
73		RM3	RRM2	1561	0.03	5280	0.0063	0.0040	3.34	58	98.08	5.99	12.4	3	4.1	1.6	3.8	2.0	16	41	78	200	278	834
74																								
75		RM4	RRM3	2066	0.03	5280	0.0042	0.0040	3.09	93	130.12	5.99	0.9	1	0.9	1.5	3.5	2.0	15	9	92	54	146	146
76																								
77		RM5	RRM4	642	0.03	5280	0.0040	0.0040	4.09	5	54.1	5.31												
78																								
79		RM6	RRM5	879	0.03	5280	0.0034	0.0034	4.81	5	62.66	5.41												
80	AT & SF Railroad Channel																							
81		RR1	2D152	623	0.03	6500	0.0027	0.0027	4.38	5	57.55	4.55												
82																								
83		RR2	RRR1	748	0.03	5280	0.0036	0.0036	4.45	5	58.39	5.3												
84																								
85		RR3	RRR2	1624	0.03	7875	-0.0008	0.0020	6.83	5	86.97	5.17												
86																								
87		RR4	RRR3	1879	0.03	2250	0.0031	0.0031	4.44	44	97.29	5.99												
88																								
89		RR5	RRR4	1913	0.03	5280	0.0038	0.0038	3.33	76	115.97	5.98												
90	Bullard Wash	BD1N	RBDUS	1856	0.03		0.0027	0.0027	4.05	59	107.65	5.49												
91																								
92		1I241	RBD1N	2911	0.03	3550	0.0039	0.0025	4.93	69	128.12	5.99	5.1	2	2.6	2.1	5.2	2.1	21	26	129	146	276	551
93																								
94		BD3N	RBD2N	3268	0.03	5800	0.0046	0.0025	4.72	87	143.67	6	12.4	3	4.1	2.0	5.0	2.1	20	41	128	263	390	1170
95																								
96		BD4N	RBD3N	3249	0.03		0.0021																	
97																								
98		BD1S	RBD4N	3645	0.03	5280	0.0028	0.0028	6.19	61	135.29	6												
99																								
100		BD2S	RBD1S	3674	0.03	950	0.0020	0.0020	6.18	62	136.13	6												
101																								
102		BD3S	RBD2S	3709	0.03	3750	0.0032	0.0032	3.53	154	196.32	6	No Jump Quantities to be Calculated											
103																								
104		BD4S	RBD3S	3391	0.03	5280	0.0028	0.0028	4.1	113	162.25	6												
105																								
106		BD5S	RBD4S	3405	0.03	2640	0.0023	0.0023	5.2	78	140.35	6												
107																								
108		BLRD2	RBD5S	4987	0.03	2640	0.0038	0.0038	5.44	120	185.3	6												
109	Northern Channel	NR1	RNRUS	256	0.03		0.0049	0.0049	2.68	5	37.11	4.54												
110																								
111		NR2	RNR1	1269	0.03	6200	0.0056	0.0040	3.7	35	79.42	5.99	10.2	3	3.4	1.8	4.3	2.0	19	34	85	136	221	662
112																								
113		NR3	RNR2	2201	0.03	5280	0.0064	0.0030	4.29	60	111.46	5.99	18.2	4	4.5	1.9	4.6	2.0	20	45	108	244	352	1406
114																								
115		NR4	RNR3	2341	0.03	2640	0.0045	0.0030	4.19	68	118.32	5.99	4.1	2	2.0	1.9	4.5	2.0	19	20	108	116	223	447
116																								
117		NR5	RNR4	1747	0.03	2640	0.0042	0.0042	3.06	77	113.68	5.99												
118																								
119		NR6	RNR5	1890	0.03	5280	0.0038	0.0038	3.35	74	114.23	5.99												
120	Camelback Channel																							
121		CM1	1R237	1348	0.03	2640	0.0034	0.0034	5.34	10	74.1	6												
122																								
123		CM2	RCM1	1652	0.03		0.0020	0.0020																
124																								
125		CM3	RCM2	1683	0.03	2640	0.0020	0.0020	6.93	5	88.14	5.22												
126																								
127		CM4	RCM3	2319	0.03	3375	0.0020	0.0020	6.13	30	104.58	5.54												
128	I-10 Channel	10-1		1275	0.03		0.0035																	

Alternative 1
Hydraulic Jumps Example Spreadsheet

	A	B	C	D	E	F	G	H	I	J	K	L	N	O	P	Q	R	S	T	U	V	W	X	Y
1	Proposed Channel	D/S Concentration Point	Routing Section	Discharge [cfs]	Mannings n	Reach Length (ft)	Original Channel Slope [ft/ft]	Revised Channel Slope [ft/ft]	Depth [ft]	Bottom Width [ft]	Surface Water Top Width [ft]	Velocity [ft/s]	Drop Across Channel from Exist. Slope (ft)	# Drops	ΔH per Drop	Y_1	Y_2	Froude #	Length of Jump Stilling Basin Type I	Length of Drop - Assume 10H:1V	Stilling Basin Grouted Rip Rap Volume (yd^3)	Drop Grouted Rip Rap Volume (yd^3)	Grouted Rip Rap Volume per Drop & Basin (yd^3)	Grouted Rip Rap Volume Reach Total (yd^3)
129																								
130		10-2	R10-1	1452	0.03	1700	0.0053	0.0053	2.48	83	112.72	5.99												
131																								
132		10-3	R10-2	1463	0.03	1500	0.0047	0.0047	2.81	70	103.73	5.99												
133																								
134		10-4	R10-3	1618	0.03	1125	0.0036	0.0036	3.81	48	93.73	5.99												
135																								
136		10-5	R10-4	1927	0.03	2640	0.0036	0.0036	3.56	69	111.71	5.99												
137																								
138		10-6	R10-5	1923	0.03	375	0.0027	0.0027	6.1	16	89.18	6												
139																								
140		10-7	R10-6	1933	0.03	750	0.0020	0.0020	6.94	10	93.31	5.39												
141																								
142		10-8	R10-7	1929	0.03	550	0.0020	0.0020	6.94	10	93.24	5.39												
143																								
144		10-9	R10-8	1926	0.03	1700	0.0020	0.0020	6.93	10	93.22	5.39												
145																								
146		10-10	R10-9	1920	0.03		0.0023	0.0023																
147	Buckeye Channel																							
148		BE1	RD307	901	0.03	2640	0.0015	**0.0020**	5.4	5	69.81	4.46												
149																								
150		BE2	RBE1	1415	0.03	4500	0.0033	0.0033	5.42	11	76.01	6												
151																								
152		BE3	RBE2	1397	0.03	2450	0.0020	0.0020	6.43	5	82.22	4.98												
153																								
154		BE4	RBE3	1554	0.03	3000	0.0043	0.0043	3.07	66	102.84	6												
155	Union Pacific Railraod Channel	UP1	RUPUS	620	0.03		0.0016	**0.0020**	4.64	5	60.74	4.06												
156																								
157		UP2	RUP1	767	0.03	1125	0.0027	0.0027	4.76	5	62.17	4.79												
158																								
159		UP3	RUP2	809	0.03	3750	0.0000	**0.0020**	5.17	5	67.06	4.34												
160																								
161		UP4	RUP3	1677	0.03	4125	0.0015	**0.0020**	6.92	5	88.02	5.21												
162																								
163		UP5	RUP4	2201	0.03	2450	0.0016	**0.0020**	6.29	26	101.43	5.5												
164																								
165		UP6	RUP5	2433	0.03	2640	0.0030	0.0030	4.12	74	123.43	5.98												
166																								
167		UP7	RUP6	2413	0.03	2450	0.0024	0.0024	6.07	30	102.79	5.99												
168	West Valley Channel	WVR1	RWVRUS	1268	0.03	7200	0.0093	**0.0050**	2.73	61	93.77	6	31.2	7	4.5	1.4	3.3	2.0	14	45	69	201	271	1894
169																								
170		WVR2	RWVR1	1666	0.03	6500	0.0067	**0.0050**	2.54	95	125.43	5.96	10.8	3	3.6	1.3	3.0	2.0	13	36	81	208	289	868
171																								
172		WVR3	RWVR2	1931	0.03	6000	0.0073	**0.0040**	3.16	83	120.88	6	20.0	5	4.0	1.5	3.6	2.0	15	40	87	231	318	1589
173																								
174		WVR4	RWVR3	2243	0.03	5280	0.0042	**0.0040**	3.04	105	141.5	5.98	0.9	1	0.9	1.5	3.4	2.0	15	9	99	58	157	157
175																								
176		WVR5	RWVR4	2428	0.03	2640	0.0038	**0.0030**	4.09	75	124.06	5.97	2.1	1	2.1	1.8	4.3	2.0	19	21	113	123	236	236
177																								
178		WVR6	RWVR5	2493	0.03	6750	0.0027	0.0027	4.65	62	117.81	5.96												
179																								
180		WVR7	RWVR6	2524	0.03	2640	0.0030	0.0030	4.03	81	129.32	5.96												
181																								
182		WVR8	RWVR7	2565	0.03	3000	0.0040	**0.0030**	3.99	84	131.9	5.95	3.0	1	3.0	1.8	4.2	2.0	18	30	113	174	287	287
183																								
184	ADOT	DIADOT	RADOT	199	0.03		0.0024	0.0024		5	38.57	3.27												
185																							Σ =	30437

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Example Hydraulic [illegible] Calculations - Alt 1

	A	B	C	D	E	F	G	H	I	J	K	L
1	Reach	Concentration	y	Q	B	A	V	RHS	Froude #	D_2	D_n	ΔD
2		Point	(ft)	(cfs)	(ft)	(ft^2)	(ft/s)			(ft)	(ft)	(ft)
3												
4												
5	2D152	RR1	2.12	623	5	37.6	16.58	2.007	2.01	5.05	4.38	0.67
6	RBC1	BC2	1.40	2829	142	210.6	13.44	2.001	2.01	3.32	2.95	0.37
7	RBC2	BC3	1.83	6435	180	349.5	18.41	2.399	2.40	5.36	5.10	0.26
8	RBC3	BC4	1.83	6455	181	351.3	18.37	2.394	2.40	5.35	5.10	**0.25**
9	RBC4	BC5	1.82	6653	188	362.0	18.38	2.401	2.41	5.34	5.08	0.26
10	RJR2	JR3	1.27	1719	97	132.9	12.94	2.023	2.03	3.05	2.55	0.50
11	RLP2	LP3	1.52	1822	76	129.4	14.08	2.013	2.02	3.63	3.19	0.44
12	RLP3	LP4	2.04	2089	52	131.0	15.94	1.967	1.97	4.75	4.43	0.32
13	RLP5	LP6	2.76	1119	5	59.5	18.80	1.995	2.00	6.53	5.30	1.23
14	RLP11	LP12	1.78	2815	94	186.3	15.11	1.996	2.00	4.21	3.98	**0.23**
15	RLP12	LP13	1.79	2738	90	180.3	15.18	2.000	2.00	4.25	4.00	**0.25**
16	RLP13	LP14	2.20	4217	88	222.6	18.94	2.250	2.26	5.99	5.74	**0.25**
17	RLP14	LP15	2.15	4450	98	238.4	18.66	2.243	2.25	5.83	5.63	**0.20**
18	RLP15	LP16	2.16	4402	96	235.4	18.70	2.243	2.25	5.86	5.65	**0.21**
19	RRM2	RM3	1.60	1561	58	108.2	14.43	2.011	2.02	3.82	3.34	0.48
20	RRM3	RM4	1.47	2066	93	149.7	13.80	2.006	2.01	3.50	3.09	0.41
21	RBD1N	1I241	2.10	2911	69	171.4	16.99	2.066	2.07	5.17	4.93	**0.24**
22	RBD2N	BD3N	1.97	3268	87	194.7	16.79	2.108	2.11	4.97	4.72	**0.25**
23	RBD4N	BD1S	2.45	3645	61	185.5	19.65	2.213	2.22	6.54	6.19	0.35
24	RBD5S	BLRD2	2.02	4987	120	266.9	18.69	2.317	2.32	5.69	5.44	**0.25**
25	RNR1	NR2	1.81	1269	35	83.0	15.29	2.003	2.01	4.30	3.70	0.60
26	RNR2	NR3	1.94	2201	60	139.0	15.84	2.004	2.01	4.61	4.29	0.32
27	RNR3	NR4	1.89	2341	68	150.0	15.61	2.001	2.01	4.49	4.19	0.30
28	RTCUS	TC1	1.74	1474	46	98.2	15.01	2.005	2.01	4.14	3.88	0.26
29	RWVR1	WVR2	1.27	1666	95	130.3	12.78	1.999	2.00	3.01	2.54	0.47
30	RWVR2	WVR3	1.50	1931	83	138.0	13.99	2.013	2.02	3.59	3.16	0.43
31	RWVR3	WVR4	1.45	2243	105	164.9	13.61	1.991	2.00	3.42	3.04	0.38
32	RWVR4	WVR5	1.84	2428	75	158.3	15.34	1.992	2.00	4.35	4.09	0.26
33	RWVR7	WVR8	1.79	2565	84	169.6	15.13	1.992	2.00	4.23	3.99	**0.24**
34	RWVRUS	WVR1	1.37	1268	61	94.8	13.37	2.013	2.02	3.28	2.73	0.55
35												
36												

9

A WATER RESOURCES TECHNICAL PUBLICATION

Engineering Monograph No. 25

Hydraulic Design of Stilling Basins and Energy Dissipators

By A. J. PETERKA

Denver, Colorado

United States Department of the Interior

BUREAU OF RECLAMATION

for the larger flumes. Out-of-scale frictional resistance on the floor and side walls produced a short jump. As testing advanced and this deficiency became better understood, some allowance was made for this effect in the observations.

Experimental Results

Definitions of the symbols used in connection with the hydraulic jump on a horizontal floor are shown in Figure 4. The procedure followed in each test of this series was to establish a flow and then gradually increase the tail water depth until the front of the jump moved upstream to Section 1, indicated in Figure 4. The tail water depth was then measured, the length of the jump recorded, and the depth of flow entering the jump, D_1, was obtained by averaging a generous number of point gage measurements taken immediately upstream from Section 1. The results of the measurements and succeeding computations are tabulated in Table 1. The measured quantities are tabulated as follows: total discharge (Col. 3); tail water depth (Col. 6); length of jump (Col. 11), and depth of flow entering jump (Col. 8).

Column 1 indicates the test flumes in which the experiments were performed, and Column 4 shows the width of each flume. All computations are based on discharge per foot width of flume; unit discharges (q) are shown in Column 5.

The velocity entering the jump V_1, Column 7, was computed by dividing q (Col. 5) by D_1 (Col. 8).

The Froude Number

The Froude number, Column 10, Table 1, is:

$$F_1 = \frac{V_1}{\sqrt{gD_1}} \tag{1}$$

where F_1 is a dimensionless parameter, V_1 and D_1 are velocity and depth of flow, respectively, entering the jump, and g is the acceleration of gravity. The law of similitude states that where gravitational forces predominate, as they do in open channel phenomena, the Froude number should have the same value in model and prototype. Therefore, a model jump in a test flume

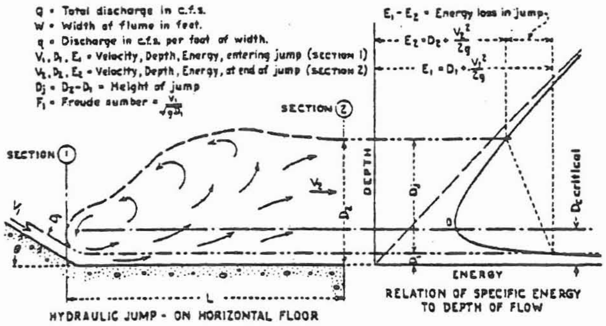


FIGURE 4.—*Definition of symbols (Basin I).*

will have the identical characteristics of a prototype jump in a stilling basin, if the Froude numbers of the incoming flows are the same. Although energy conversions in a hydraulic jump bear some relation to the Reynolds number, gravity forces predominate, and the Froude number becomes most useful in plotting stilling basin characteristics. Bakhmeteff and Matzke (*1*) demonstrated this application in 1936 when they related stilling basin characteristics to the square of the Froude number, $\frac{V^2}{gD_1}$, which they termed the kinetic flow factor.

The Froude number, equation (1), is used throughout this monograph. As the acceleration of gravity is a constant, the term g could be omitted. However, its inclusion makes the expression dimensionless, and the form shown as equation (1) is preferred.

Applicability of Hydraulic Jump Formula

The theory of the hydraulic jump in horizontal channels has been treated thoroughly by others (see "Bibliography"), and will not be repeated here. The expression for the hydraulic jump, based on pressure-momentum may be written (*15*):

$$D_2 = -\frac{D_1}{2} + \sqrt{\frac{D_1^2}{4} + \frac{2V_1^2 D_1}{g}}$$

or (2)

$$D_2 = -\frac{D_1}{2} + \sqrt{\frac{D_1^2}{4} + \frac{2V_1^2 D_1^2}{gD_1}}$$

where D_1 and D_2 are the depths before and after the jump, Figure 4. These depths are often called conjugate or sequent depths.

opening. The extreme case involved a discharge of 0.14 c.f.s. and a value of D_1 of 0.032 foot, for $F_1=8.9$, which is much smaller than any discharge or value of D_1 used in the present experiments. Thus, it is reasoned that as the gate opening decreased, in the 6-inch-wide flume, frictional resistance in the channel downstream increased out of proportion to that which would have occurred in a larger flume or a prototype structure. Thus, the jump formed in a shorter length than it should. In laboratory language, this is known as "scale effect," and is construed to mean that prototype action is not faithfully reproduced. It is quite certain that this was the case for the major portion of curve 1. In fact, Bahkmeteff and Matzke were somewhat dubious concerning the small-scale experiments.

To confirm the above conclusion, it was found that results from Flume F, which was 1 foot wide, became erratic when the value of D_1 approached 0.10. Figures 6 and 7 show three points obtained with a value of D_1 of approximately 0.085. The three points are given the symbol ⊠ and fall short of the recommended curve.

The two remaining curves, labeled "3" and "4," on Figure 7, portray the same trend as the recommended curve. The criterion used by each experimenter for judging the length of the jump is undoubtedly responsible for the displacement. The curve labeled "3" was obtained at the Technical University of Berlin on a flume ½ meter wide by 10 meters long. The curve labeled "4" was determined from experiments performed at

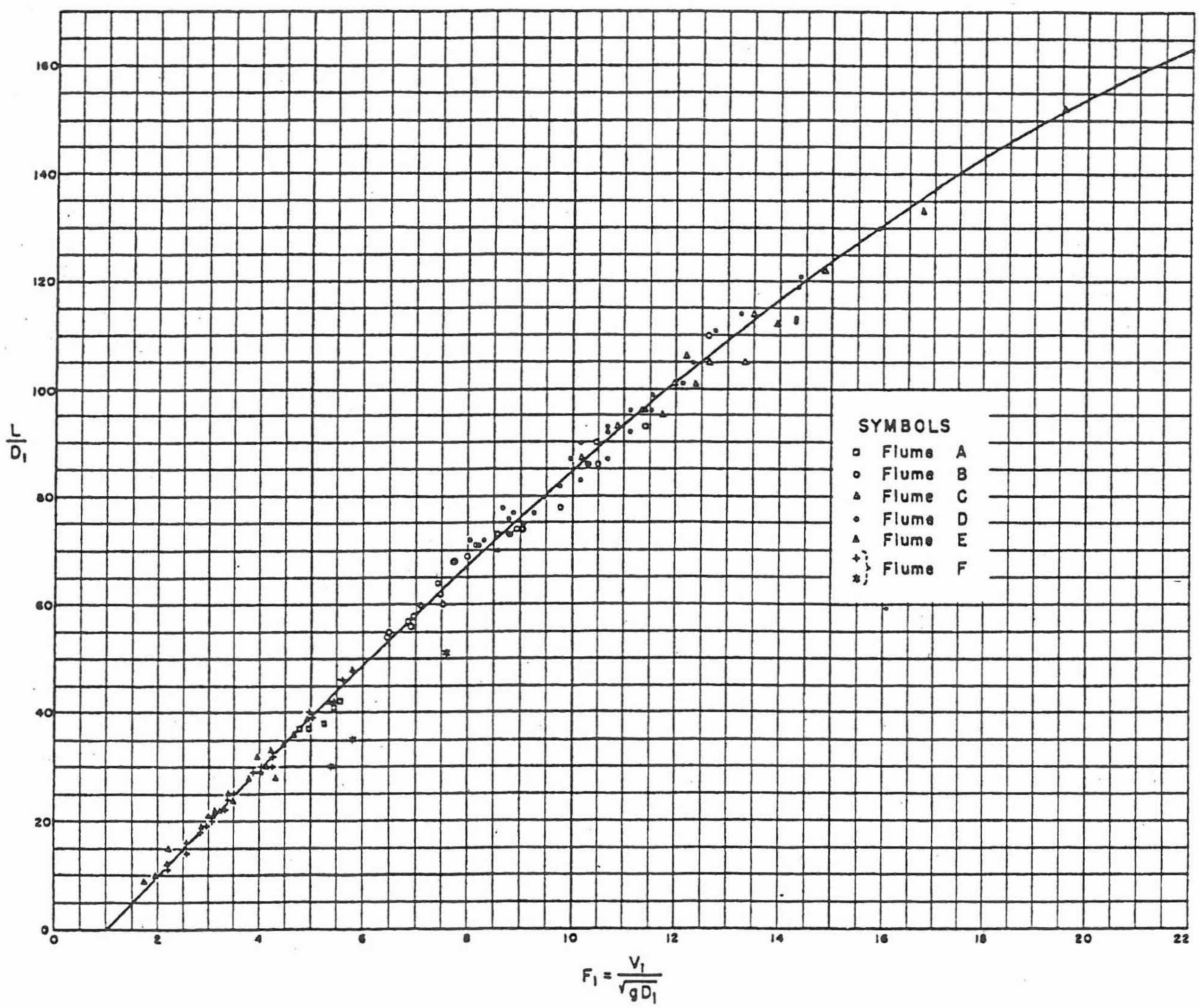


FIGURE 6.—*Length of jump in terms of D_1 (Basin I).*

Alternative 1
Culvert Sizing Table Example

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
3	Proposed Channel	Concentration Point	Location	Revised Discharge (cfs)	No. of 72" Φ RCP Barrels	No. of 10'x6' Box Culvert Barrels	Culvert Length (ft)	Cost for RCP per Foot of Length	Cost Inlet Outlet Headwalls and Apron for RCP	Total Cost of RCP	Cost for Box per Foot of Length	Cost Inlet Outlet Headwalls and Apron for Box	Total Cost of Box	Best Cost
4	Beardsley Channel	BC1	Peoria Ave.	313	2	1	75	$345.00	$12,870.00	$38,745.00	$434.79	$9,600.00	$42,209.44	$38,745.00
5														
6		BC2	Olive Ave.	2829	15	7	75	$345.00	$59,182.50	$85,057.50	$2,549.05	$23,379.00	$214,557.61	$85,057.50
7														
8		BC3	Northern Ave.	6435	33	15	75	$345.00	$123,307.50	$149,182.50	$5,354.19	$41,751.00	$443,315.17	$149,182.50
9														
10		BC5	Glendale Ave.	6653	35	16	75	$345.00	$130,432.50	$156,307.50	$5,704.83	$44,047.50	$471,909.86	$156,307.50
11														
12	Jackrabbit Trail	JR1	Indian School Rd.	923	5	3	75	$345.00	$23,557.50	$49,432.50	$1,149.73	$14,193.00	$100,422.58	$49,432.50
13														
14		JR2	Thomas Rd.	1417	8	4	75	$345.00	$34,245.00	$60,120.00	$1,490.72	$16,489.50	$128,293.53	$60,120.00
15														
16	Jackrabbit-Perryville	JP1	Buckeye Rd.	948	5	3	75	$345.00	$23,557.50	$49,432.50	$1,149.73	$14,193.00	$100,422.58	$49,432.50
17														
18		JP2	Broadway Rd.	1181	7	3	75	$345.00	$30,682.50	$56,557.50	$1,149.73	$14,193.00	$100,422.58	$56,557.50
19														
20		JP4	Southern Ave.	1282	7	3	75	$345.00	$30,682.50	$56,557.50	$1,149.73	$14,193.00	$100,422.58	$56,557.50
21														
22		JP6	Baseline Ave.	1952	11	5	75	$345.00	$44,932.50	$70,807.50	$1,847.76	$18,786.00	$157,368.22	$70,807.50
23														
24		JP7	Tuthill Rd.	1961	11	5	75	$345.00	$44,932.50	$70,807.50	$1,847.76	$18,786.00	$157,368.22	$70,807.50
25														
26	Tuthill Channel	TC1	Yuma Rd.	1474	8	4	75	$345.00	$34,245.00	$60,120.00	$1,490.72	$16,489.50	$128,293.53	$60,120.00
27														
28		TC2	Airport Rd.	1497	8	4	75	$345.00	$34,245.00	$60,120.00	$1,490.72	$16,489.50	$128,293.53	$60,120.00
29														
30		TC3	Dean Rd.	2065	11	5	75	$345.00	$44,932.50	$70,807.50	$1,847.76	$18,786.00	$157,368.22	$70,807.50
31														
32		TC3	Buckeye Rd.	2065	11	5	75	$345.00	$44,932.50	$70,807.50	$1,847.76	$18,786.00	$157,368.22	$70,807.50
33														
34		TC3	Lower Buckeye Rd.	2065	11	5	75	$345.00	$44,932.50	$70,807.50	$1,847.76	$18,786.00	$157,368.22	$70,807.50
35														
36		TC3	Broadway Rd.	2065	11	5	75	$345.00	$44,932.50	$70,807.50	$1,847.76	$18,786.00	$157,368.22	$70,807.50
37														
38		TC3	Southern Ave.	2065	11	5	75	$345.00	$44,932.50	$70,807.50	$1,847.76	$18,786.00	$157,368.22	$70,807.50
39														
40		TC3	MC 85/Baseline	2065	11	5	75	$345.00	$44,932.50	$70,807.50	$1,847.76	$18,786.00	$157,368.22	$70,807.50
41														
42	Loop 303	LP1	Waddell Rd.	1278	7	3	75	$345.00	$30,682.50	$56,557.50	$1,149.73	$14,193.00	$100,422.58	$56,557.50
43														
44		LP3	Cactus Rd.	1822	10	5	75	$345.00	$41,370.00	$67,245.00	$1,847.76	$18,786.00	$157,368.22	$67,245.00
45														
46		LP3	Peoria Ave.	1822	10	5	75	$345.00	$41,370.00	$67,245.00	$1,847.76	$18,786.00	$157,368.22	$67,245.00
47														
48		LP5	Olive Ave.	848	5	2	75	$345.00	$23,557.50	$49,432.50	$798.04	$11,896.50	$71,749.14	$49,432.50
49														
50		LP5	Northern Ave.	848	5	2	75	$345.00	$23,557.50	$49,432.50	$798.04	$11,896.50	$71,749.14	$49,432.50
51														
52		LP6	Glendale Ave.	1119	6	3	75	$345.00	$27,120.00	$52,995.00	$1,149.73	$14,193.00	$100,422.58	$52,995.00
53														
54		LP7	Bethany Home Rd.	1264	7	3	75	$345.00	$30,682.50	$56,557.50	$1,149.73	$14,193.00	$100,422.58	$56,557.50
55														
56		LP8	Camelback Rd.	1879	10	5	75	$345.00	$41,370.00	$67,245.00	$1,847.76	$18,786.00	$157,368.22	$67,245.00
57														
58		LP9	Indian School Rd.	1096	6	3	75	$345.00	$27,120.00	$52,995.00	$1,149.73	$14,193.00	$100,422.58	$52,995.00
59														
60		LP10	Thomas Rd.	1142	6	3	75	$345.00	$27,120.00	$52,995.00	$1,149.73	$14,193.00	$100,422.58	$52,995.00

Alternative 1
Culvert Sizing Table Example

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
3	Proposed Channel	Concentration Point	Location	Revised Discharge [cfs]	No. of 72" Φ RCP Barrels	No. of 10'x6' Box Culvert Barrels	Culvert Length (ft)	Cost for RCP per Foot of Length	Cost Inlet Outlet Headwalls and Apron for RCP	Total Cost of RCP	Cost for Box per Foot of Length	Cost Inlet Outlet Headwalls and Apron for Box	Total Cost of Box	Best Cost
61														
62		LP11	McDowell Rd.	1270	7	3	75	$345.00	$30,682.50	$56,557.50	$1,149.73	$14,193.00	$100,422.58	$56,557.50
63														
64		LP12	I-10	2815	15	7	300	$345.00	$59,182.50	$162,682.50	$2,549.05	$23,379.00	$788,093.44	$162,682.50
65														
66		LP13	Van Buren St.	2738	15	7	75	$345.00	$59,182.50	$85,057.50	$2,549.05	$23,379.00	$214,557.61	$85,057.50
67														
68		LP14	Yuma Rd.	4217	22	10	75	$345.00	$84,120.00	$109,995.00	$3,600.98	$30,263.50	$300,341.69	$109,995.00
69														
70		LP15	Buckeye Rd.	4450	23	11	75	$345.00	$87,682.50	$113,557.50	$3,951.62	$32,565.00	$328,936.39	$113,557.50
71														
72		LP16	Broadway Rd.	4402	23	11	75	$345.00	$87,682.50	$113,557.50	$3,951.62	$32,565.00	$328,936.39	$113,557.50
73														
74		LP17	State Route 85	4361	23	11	75	$345.00	$87,682.50	$113,557.50	$3,951.62	$32,565.00	$328,936.39	$113,557.50
75														
76		LP17	Southern Ave.	4361	23	11	75	$345.00	$87,682.50	$113,557.50	$3,951.62	$32,565.00	$328,936.39	$113,557.50
77														
78	Reems Channel	RM2	Waddell Rd.	1091	6	3	75	$345.00	$27,120.00	$52,995.00	$1,149.73	$14,193.00	$100,422.58	$52,995.00
79														
80		RM3	Cactus Rd.	1561	9	4	75	$345.00	$37,807.50	$63,682.50	$1,490.72	$16,489.50	$128,293.53	$63,682.50
81														
82		RM5	Peoria Ave.	642	4	2	75	$345.00	$19,995.00	$45,870.00	$798.04	$11,896.50	$71,749.14	$45,870.00
83														
84		RM5	Olive Ave.	642	4	2	75	$345.00	$19,995.00	$45,870.00	$798.04	$11,896.50	$71,749.14	$45,870.00
85														
86	AT & SF Railroad Channel	RR1	Cactus Rd.	623	4	2	75	$345.00	$19,995.00	$45,870.00	$798.04	$11,896.50	$71,749.14	$45,870.00
87														
88		RR2	Peoria Ave.	748	4	2	75	$345.00	$19,995.00	$45,870.00	$798.04	$11,896.50	$71,749.14	$45,870.00
89														
90		RR3	Litchfield Rd.	1624	9	4	75	$345.00	$37,807.50	$63,682.50	$1,490.72	$16,489.50	$128,293.53	$63,682.50
91														
92		RR4	Olive Ave.	1879	10	5	75	$345.00	$41,370.00	$67,245.00	$1,847.76	$18,786.00	$157,368.22	$67,245.00
93														
94	Bullard Wash	BD1N	Bethany Home Rd.	1856	10	5	75	$345.00	$41,370.00	$67,245.00	$1,847.76	$18,786.00	$157,368.22	$67,245.00
95														
96		BD2N	Camelback Rd.	3007	16	7	75	$345.00	$62,745.00	$88,620.00	$2,549.05	$23,379.00	$214,557.61	$88,620.00
97														
98		BD3N	Indian School Rd.	3268	17	8	75	$345.00	$66,307.50	$92,182.50	$2,899.69	$25,675.50	$243,152.31	$92,182.50
99														
100	Northern Channel	NR1	Perryville Rd.	256	2	1	75	$345.00	$12,870.00	$38,745.00	$434.79	$9,600.00	$42,209.44	$38,745.00
101														
102		NR2	Citrus Rd.	1269	7	3	75	$345.00	$30,682.50	$56,557.50	$1,149.73	$14,193.00	$100,422.58	$56,557.50
103														
104		NR3	Cotton Ln.	2201	12	6	75	$345.00	$48,495.00	$74,370.00	$2,198.41	$21,082.50	$185,962.92	$74,370.00
105														
106		NR4	Loop 303	2341	13	6	150	$345.00	$52,057.50	$103,807.50	$2,198.41	$21,082.50	$350,843.33	$103,807.50
107														
108		NR4	167th Ave.	2341	13	6	75	$345.00	$52,057.50	$77,932.50	$2,198.41	$21,082.50	$185,962.92	$77,932.50
109														
110		NR5	Sarival Ave.	1747	9	5	75	$345.00	$37,807.50	$63,682.50	$1,847.76	$18,786.00	$157,368.22	$63,682.50
111														
112		NR6	Reems Rd.	1890	10	5	75	$345.00	$41,370.00	$67,245.00	$1,847.76	$18,786.00	$157,368.22	$67,245.00
113														
114	Camelback Channel	CM1	Sarival Ave.	1348	7	4	75	$345.00	$30,682.50	$56,557.50	$1,490.72	$16,489.50	$128,293.53	$56,557.50
115														
116		CM2	159th Ave.	1652	9	4	75	$345.00	$37,807.50	$63,682.50	$1,490.72	$16,489.50	$128,293.53	$63,682.50

P:\Calculations Evaluations\Hydrology\URS Models\Existing Condition\Alternatives\With JD\Alternative 1\Quantities 3\Culvert Qtys Alt1 Example.xls

Alternative 1
Culvert Sizing Table Example

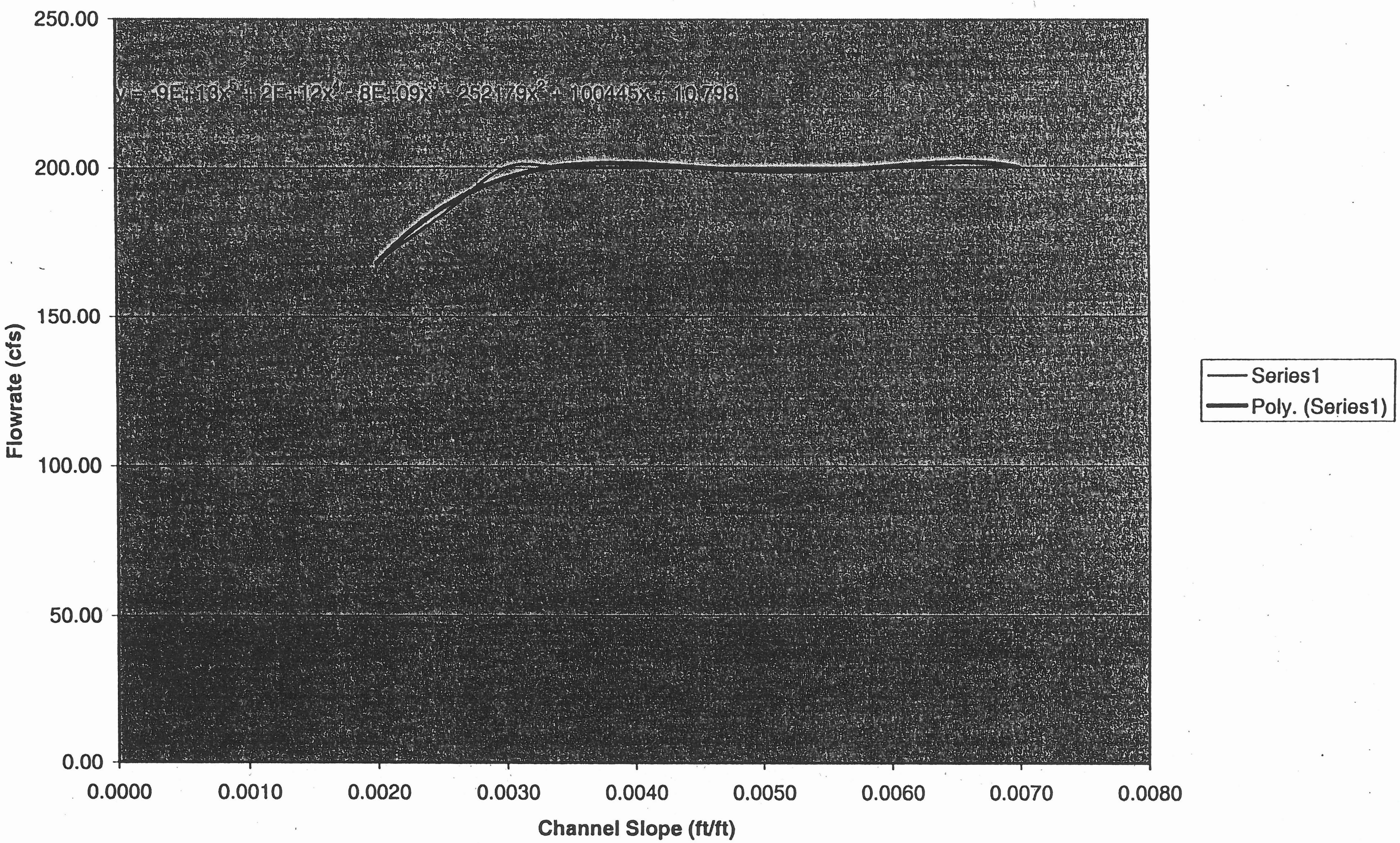
	A	B	C	D	E	F	G	H	I	J	K	L	M	N
3	Proposed Channel	Concentration Point	Location	Revised Discharge (cfs)	No. of 72"Φ RCP Barrels	No. of 10'x6' Box Culvert Barrels	Culvert Length (ft)	Cost for RCP per Foot of Length	Cost Inlet Outlet Headwalls and Apron for RCP	Total Cost of RCP	Cost for Box per Foot of Length	Cost Inlet Outlet Headwalls and Apron for Box	Total Cost of Box	Best Cost
117														
118		CM3	Reems Rd.	1683	9	4	75	$345.00	$37,807.50	$63,682.50	$1,490.72	$16,489.50	$128,293.53	$63,682.50
119														
120	I-10 Channel	10-2	Perryville Rd.	1452	8	4	75	$345.00	$34,245.00	$60,120.00	$1,490.72	$16,489.50	$128,293.53	$60,120.00
121														
122		10-5	Citrus Rd.	1927	10	5	75	$345.00	$41,370.00	$67,245.00	$1,847.76	$18,786.00	$157,368.22	$67,245.00
123														
124	Buckeye Channel	BE1	Perryville Rd.	901	5	3	75	$345.00	$23,557.50	$49,432.50	$1,149.73	$14,193.00	$100,422.58	$49,432.50
125														
126		BE2	Citrus Rd.	1415	8	4	75	$345.00	$34,245.00	$60,120.00	$1,490.72	$16,489.50	$128,293.53	$60,120.00
127														
128		BE3	175th Ave.	1397	8	4	75	$345.00	$34,245.00	$60,120.00	$1,490.72	$16,489.50	$128,293.53	$60,120.00
129														
130	Union Pacific Railraod Channel	UP2	Jackrabbit Trail	767	4	2	75	$345.00	$19,995.00	$45,870.00	$798.04	$11,896.50	$71,749.14	$45,870.00
131														
132		UP3	Perryville Rd.	809	5	2	75	$345.00	$23,557.50	$49,432.50	$798.04	$11,896.50	$71,749.14	$49,432.50
133														
134		UP4	183rd Ave.	1677	9	4	75	$345.00	$37,807.50	$63,682.50	$1,490.72	$16,489.50	$128,293.53	$63,682.50
135														
136		UP5	Citrus Rd.	2201	12	6	75	$345.00	$48,495.00	$74,370.00	$2,198.41	$21,082.50	$185,962.92	$74,370.00
137														
138		UP6	175th Ave.	2433	13	6	75	$345.00	$52,057.50	$77,932.50	$2,198.41	$21,082.50	$185,962.92	$77,932.50
139														
140	West Valley Channel	WVR1	Bethany Home Rd.	1268	7	3	75	$345.00	$30,682.50	$56,557.50	$1,149.73	$14,193.00	$100,422.58	$56,557.50
141														
142		WVR2	Perryville Rd.	1666	9	4	75	$345.00	$37,807.50	$63,682.50	$1,490.72	$16,489.50	$128,293.53	$63,682.50
143														
144		WVR2	Camelback Rd.	1666	9	4	75	$345.00	$37,807.50	$63,682.50	$1,490.72	$16,489.50	$128,293.53	$63,682.50
145														
146		WVR3	Citrus Rd.	1931	10	5	75	$345.00	$41,370.00	$67,245.00	$1,847.76	$18,786.00	$157,368.22	$67,245.00
147														
148		WVR3	Indian School Rd.	1931	10	5	75	$345.00	$41,370.00	$67,245.00	$1,847.76	$18,786.00	$157,368.22	$67,245.00
149														
150		WVR5	Cotton Ln.	2428	13	6	75	$345.00	$52,057.50	$77,932.50	$2,198.41	$21,082.50	$185,962.92	$77,932.50
151														
152		WVR5	Loop 303	2428	13	6	150	$345.00	$52,057.50	$103,807.50	$2,198.41	$21,082.50	$350,843.33	$103,807.50
153														
154		WVR6	Thomas Rd.	2493	13	6	75	$345.00	$52,057.50	$77,932.50	$2,198.41	$21,082.50	$185,962.92	$77,932.50
155														
156		WVR7	Sarival Ave.	2524	13	6	75	$345.00	$52,057.50	$77,932.50	$2,198.41	$21,082.50	$185,962.92	$77,932.50
157														
158		WVR8	Reems Rd.	2565	14	6	75	$345.00	$55,620.00	$81,495.00	$2,198.41	$21,082.50	$185,962.92	$81,495.00
159														
160		WVR8	McDowell Rd.	2565	14	6	75	$345.00	$55,620.00	$81,495.00	$2,198.41	$21,082.50	$185,962.92	$81,495.00
161														
162	ADOT	DIADOT	RADOT	199										
163														
164													Σ =	$5,602,042.50

Allowable Flowrate Versus Slope of Channel Bed for a 72" Diam. RCP

Slope of Channel Bed	Allowable Flowrate
0.0020	168.57
0.0025	183.70
0.0030	200.01
0.0035	200.08
0.0040	200.08
0.0045	200.08
0.0050	200.08
0.0060	200.08
0.0070	200.08
Σ =	1752.76
Average Q =	194.75

Therefore use a flowrate of 195 cfs for (1) 72" Diam Culvert

Channel Slope vs Flowrate for 72" Diam RCP



16

Allowable Flowrate Versus Slope of Channel Bed for a 10'x6' Box Culvert

Channel Slope	Flowrate
0.002	403.49
0.003	437.23
0.004	437.23
0.005	437.23
0.006	437.23
0.007	437.23
$\Sigma =$	2589.64
Average Q =	431.61

Therefore use an allowable flowrate of 432 cfs for the 10'x6' box culvert

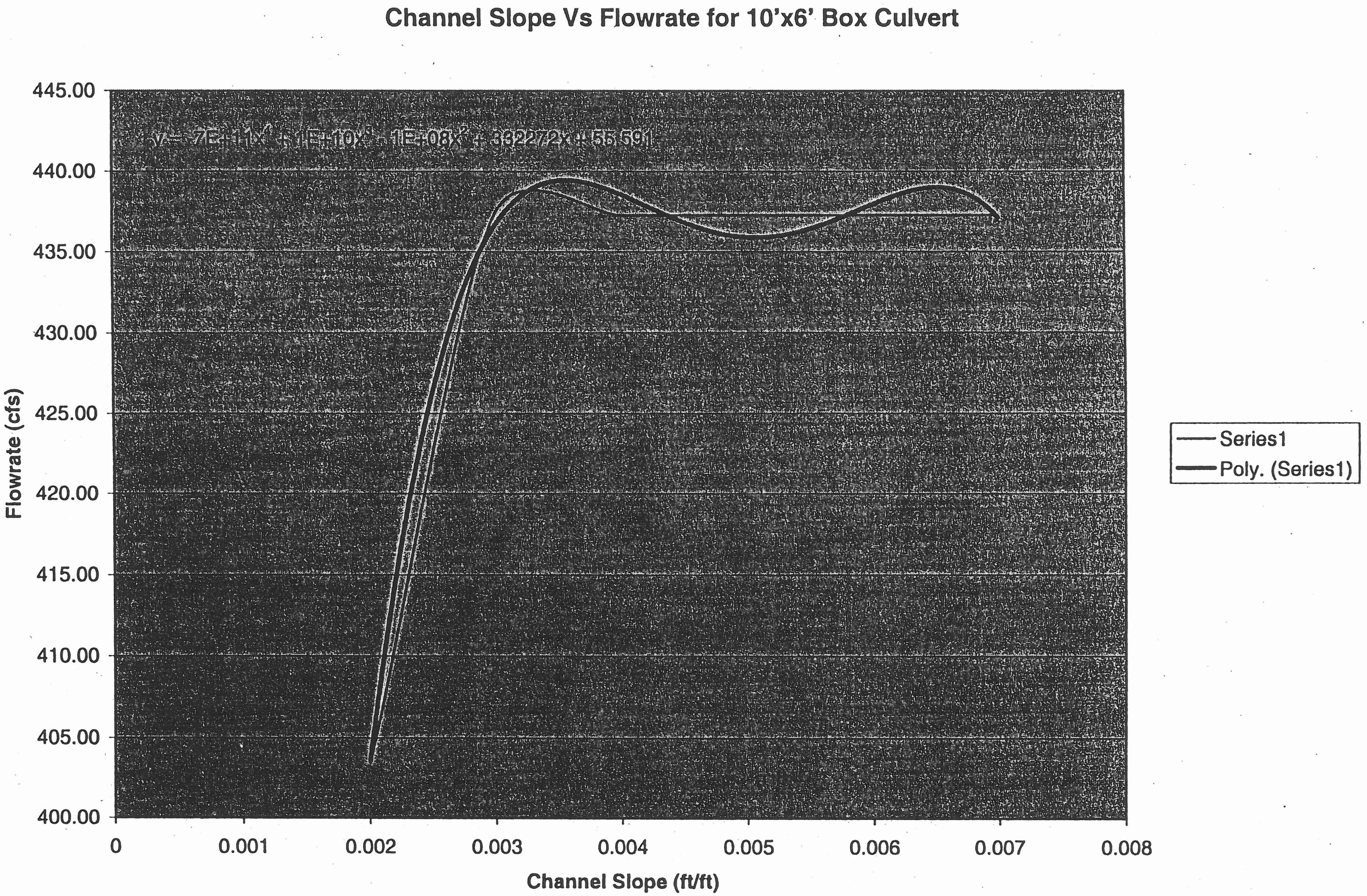

Channel Slope Vs Flowrate for 10'x6' Box Culvert
y = -7E+11x4 + 1E+10x3 - 1E+08x2 + 332272x + 55.591
445.00
440.00
435.00
430.00
425.00
420.00
415.00
410.00
405.00
400.00
Flowrate (cfs)
0
0.001
0.002
0.003
0.004
0.005
0.006
0.007
0.008
Channel Slope (ft/ft)
Series1
Poly. (Series1)

TABLE NO. I — 0'-10' FILL				aa		cc	ee			gg	hh			
Span "S"	Height "H"	Slab "T"	Walls "W"	Spacing	Length	Number +	Bar Size	Spacing	Length	Number +	Bar Size	Spacing	Length	F
6'	3'	9½"	9"	12"	4'-2	20	5	6"	7'-2	14	4	9"	5'-2	2'-6
	4'	9½"	9"	12"	5'-2	24	5	6"	7'-2	16	4	8"	5'-11	2'-9
	5'	9½"	9"	12"	6'-2	24	5	6"	7'-2	16	4	6"	6'-5	2'-9
	6'	9½"	9"	12"	7'-2	28	6	8"	7'-2	18	4	6"	7'-2	3'-0
	7'	9½"	9"	12"	8'-2	32	6	8"	7'-2	18	4	6"	7'-8	3'-0
8'	3'	10"	11"	12"	4'-3	20	6	9"	9'-6	18	4	6"	6'-2	3'-5
	4'	10"	11"	12"	5'-3	24	6	8"	9'-6	20	4	6"	6'-8	3'-5
	5'	10"	11"	12"	6'-3	24	6	8"	9'-6	20	4	6"	7'-1	3'-4
	6'	10"	11"	12"	7'-3	28	6	8"	9'-6	20	4	6"	7'-7	3'-4
	7'	10"	11"	12"	8'-3	32	6	6"	9'-6	22	4	6"	8'-0	3'-3
	8'	10"	11"	12"	9'-3	32	6	6"	9'-6	22	4	6"	8'-5	3'-2
10'	3'	10"	13"	12"	4'-3	20	6	8"	11'-10	22	5	6"	7'-4	4'-5
	4'	10"	13"	12"	5'-3	24	6	8"	11'-10	22	5	6"	7'-10	4'-5
	5'	10"	13"	12"	6'-3	24	6	7"	11'-10	24	5	7"	8'-3	4'-4
	6'	10"	13"	12"	7'-3	28	6	7"	11'-10	24	5	7"	8'-9	4'-4
	7'	10"	13"	12"	8'-3	32	6	7"	11'-10	26	5	7"	9'-2	4'-3
	8'	10"	13"	12"	9'-3	32	6	7"	11'-10	26	5	7"	9'-8	4'-3
	9'	10"	13"	12"	10'-3	36	6	6"	11'-10	28	5	8"	10'-1	4'-2
	10'	10½"	13"	12"	11'-4	40	6	6"	11'-10	28	5	8"	10'-7	4'-2
12'	8'	11½"	15"	9"	9'-6	32	7	6"	14'-2	38	6	6"	10'-4	4'-8
	9'	11½"	15"	8"	10'-6	36	8	8"	14'-2	38	6	6"	10'-10	4'-8
	10'	11½"	15"	6"	11'-6	40	7	6"	14'-2	40	6	6"	11'-4	4'-8
	11'	12"	15"	8"	12'-7	40	8	8"	14'-2	42	6	6"	11'-6	4'-4
	12'	12"	15"	6"	13'-7	44	8	6"	14'-2	46	6	6"	12'-2	4'-6

TABLE NO. II — 10'-15' FILL				aa		cc	ee			gg	hh			
Span "S"	Height "H"	Slab "T"	Walls "W"	Spacing	Length	Number +	Bar Size	Spacing	Length	Number +	Bar Size	Spacing	Length	F
6'	3'	8"	9"	12"	3'-11	20	5	8"	7'-2	14	4	6"	5'-1	2'-6
	4'	8"	9"	12"	4'-11	24	5	8"	7'-2	14	4	6"	5'-7	2'-6
	5'	8"	9"	12"	5'-11	24	5	6"	7'-2	14	4	6"	6'-1	2'-6
	6'	8"	9"	12"	6'-11	28	6	9"	7'-2	14	4	6"	6'-7	2'-6
	7'	8"	9"	12"	7'-11	32	6	9"	7'-2	14	4	6"	7'-1	2'-6
8'	3'	9"	11"	9"	4'-1	20	5	6"	9'-6	18	5	6"	5'-8	2'-10
	4'	9"	11"	9"	5'-1	24	5	6"	9'-6	18	5	6"	6'-2	2'-10
	5'	9½"	11"	9"	6'-2	24	6	6"	9'-6	18	5	6"	6'-8	2'-10
	6'	9½"	11"	9"	7'-2	28	6	6"	9'-6	18	5	6"	7'-1	2'-9
	7'	9½"	11"	12"	8'-2	32	6	6"	9'-6	18	5	6"	7'-7	2'-9
	8'	9½"	11"	12"	9'-2	32	6	6"	9'-6	18	5	6"	8'-1	2'-9
10'	3'	10½"	13"	8"	4'-4	20	6	6"	11'-10	22	6	6"	6'-9	3'-8
	4'	10½"	13"	8"	5'-4	24	6	6"	11'-10	22	6	6"	7'-2	3'-7
	5'	10½"	13"	9"	6'-4	24	6	6"	11'-10	22	6	6"	7'-7	3'-6
	6'	11"	13"	8"	7'-5	28	7	8"	11'-10	22	6	8"	8'-1	3'-6
	7'	11"	13"	8"	8'-5	32	7	8"	11'-10	22	6	8"	8'-6	3'-5
	8'	11"	13"	10"	9'-5	32	7	7"	11'-10	22	6	7"	9'-0	3'-5
	9'	11½"	13"	11"	10'-6	36	7	7"	11'-10	22	6	7"	9'-6	3'-4
	10'	11½"	13"	11"	11'-6	40	7	6"	11'-10	22	6	9"	10'-0	3'-4
12'	8'	13"	15"	10"	9'-9	32	8	7"	14'-2	26	6	7"	9'-5	3'-8
	9'	13"	15"	10"	10'-9	36	8	7"	14'-2	26	6	7"	9'-11	3'-8
	10'	13"	15"	10"	11'-9	40	8	7"	14'-2	26	6	7"	10'-5	3'-8
	11'	13"	15"	10"	12'-9	40	9	7"	14'-2	26	6	7"	11'-0	3'-9
	12'	13½"	15"	7"	13'-10	44	8	7"	14'-2	26	6	7"	11'-7	3'-9

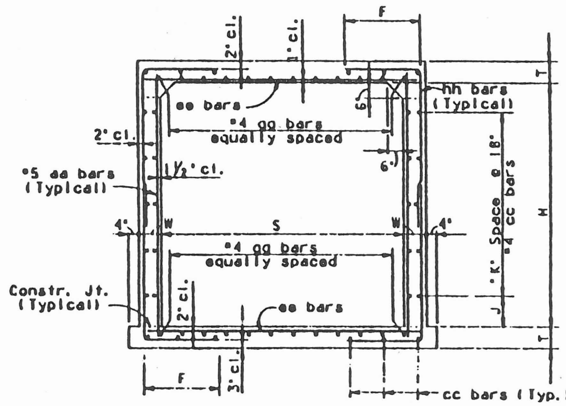
TABLE NO. III — 15'-20' FILL				aa		cc	ee			gg	hh			
Span "S"	Height "H"	Slab "T"	Walls "W"	Spacing	Length	Number +	Bar Size	Spacing	Length	Number +	Bar Size	Spacing	Length	F
6'	3'	9"	9"	12"	4'-1	20	5	6"	7'-2	14	4	6"	5'-2	2'-6
	4'	9"	9"	12"	5'-1	24	5	6"	7'-2	14	4	6"	5'-8	2'-6
	5'	9"	9"	12"	6'-1	24	6	8"	7'-2	14	4	6"	6'-2	2'-6
	6'	9"	9"	12"	7'-1	28	6	6"	7'-2	14	4	6"	6'-8	2'-6
	7'	9"	9"	12"	8'-1	32	6	6"	7'-2	14	4	6"	7'-2	2'-6
8'	3'	10½"	11"	7"	4'-4	20	6	7"	9'-6	18	5	7"	5'-7	2'-8
	4'	10½"	11"	10"	5'-4	24	6	6"	9'-6	18	5	6"	6'-1	2'-8
	5'	10½"	11"	9"	6'-4	24	6	6"	9'-6	18	5	6"	6'-7	2'-8
	6'	11"	11"	11"	7'-5	28	7	7"	9'-6	18	5	7"	7'-2	2'-8
	7'	11"	11"	11"	8'-5	32	7	8"	9'-6	18	5	8"	7'-8	2'-8
	8'	11"	11"	12"	9'-5	32	7	6"	9'-6	18	5	8"	8'-2	2'-8
10'	3'	12½"	13"	6"	4'-8	20	6	6"	11'-10	22	6	6"	6'-7	3'-4
	4'	12½"	13"	7"	5'-8	24	7	7"	11'-10	22	6	7"	7'-1	3'-4
	5'	12½"	13"	7"	6'-8	24	7	7"	11'-10	22	6	7"	7'-7	3'-4
	6'	12½"	13"	7"	7'-8	28	7	7"	11'-10	22	6	7"	8'-1	3'-4
	7'	12½"	13"	9"	8'-8	32	7	6"	11'-10	22	5	6"	8'-3	3'-2
	8'	13"	13"	9"	9'-9	32	7	6"	11'-10	22	5	6"	8'-10	3'-2
	9'	13"	13"	10"	10'-9	36	8	6"	11'-10	22	5	6"	9'-4	3'-2
	10'	13"	13"	11"	11'-9	40	8	6"	11'-10	22	5	6"	9'-10	3'-2
12'	8'	15"	15"	10"	10'-1	32	8	7"	14'-2	26	6	7"	9'-6	3'-7
	9'	15"	15"	10"	11'-1	36	9	7"	14'-2	26	6	7"	10'-0	3'-7
	10'	15½"	15"	10"	12'-2	40	8	6"	14'-2	26	6	8"	10'-7	3'-7
	11'	15½"	15"	10"	13'-2	40	8	6"	14'-2	26	6	6"	11'-2	3'-8
	12'	15½"	15"	6"	14'-2	44	8	6"	14'-2	26	6	6"	11'-9	3'-9

TABLE NO. IV — 20'-25' FILL				aa		cc	ee			gg	hh			
Span "S"	Height "H"	Slab "T"	Walls "W"	Spacing	Length	Number +	Bar Size	Spacing	Length	Number +	Bar Size	Spacing	Length	F
6'	3'	10"	9"	12"	4'-3	20	6	8"	7'-2	14	4	6"	5'-3	2'-6
	4'	10"	9"	12"	5'-3	24	6	6"	7'-2	14	4	6"	5'-9	2'-6
	5'	10"	9"	12"	6'-3	24	6	6"	7'-2	14	4	6"	6'-3	2'-6
	6'	10"	9"	12"	7'-3	28	7	9"	7'-2	14	4	6"	6'-9	2'-6
	7'	10"	9"	12"	8'-3	32	7	9"	7'-2	14	4	6"	7'-3	2'-6
8'	3'	12"	11"	11"	4'-7	20	7	7"	9'-6	18	5	7"	5'-9	2'-8
	4'	12"	11"	12"	5'-7	24	7	8"	9'-6	18	5	6"	6'-1	2'-8
	5'	12"	11"	12"	6'-7	24	7	6"	9'-6	18	5	8"	6'-7	2'-8
	6'	12"	11"	12"	7'-7	28	7	7"	9'-6	18	5	7"	6'-1	2'-8
	7'	12"	11"	12"	8'-7	32	7	6"	9'-6	18	5	9"	6'-7	2'-8
	8'	12½"	11"	12"	9'-8	32	7	6"	9'-6	18	4	6"	6'-1	2'-8
10'	3'	14"	13"	6"	4'-11	20	8	9"	11'-10	22	6	6"	6'-6	3'-2
	4'	14"	13"	6"	5'-11	24	8	8"	11'-10	22	6	8"	7'-0	3'-2
	5'	14"	13"	7"	6'-11	24	8	7"	11'-10	22	6	7"	7'-6	3'-2
	6'	14½"	13"	7"	8'-0	28	8	7"	11'-10	22	6	7"	8'-1	3'-2
	7'	14½"	13"	8"	9'-0	32	9	8"	11'-10	22	5	6"	8'-5	3'-2
	8'	14½"	13"	8"	10'-0	32	9	8"	11'-10	22	5	6"	8'-11	3'-2
	9'	14½"	13"	9"	11'-0	36	9	9"	11'-10	22	5	6"	9'-5	3'-2
	10'	15"	13"	8"	12'-0	40	9	8"	11'-10	22	5	6"	9'-11	3'-2
12'	8'	17"	15"	10"	10'-5	32	8	6"	14'-2	26	5	6"	9'-6	3'-6
	9'	17½"	15"	9"	11'-6	36	9	6"	14'-2	26	6	9"	10'-3	3'-7
	10'	17½"	15"	10"	12'-6	40	10	9"	14'-2	26	5	6"	10'-7	3'-7
	11'	17½"	15"	7"	13'-6	40	9	7"	14'-2	26	6	7"	11'-5	3'-8
	12'	17½"	15"	7"	14'-6	44	10	7"	14'-2	26	6	7"	12'-0	3'-9

+Total number of bars in the cross-section.

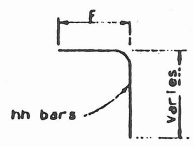
TABLE NO. V — 25'-30' FILL				aa		cc	ee			gg	hh			
Span "S"	Height "H"	Slab "T"	Walls "W"	Spacing	Length	Number +	Bar size	Spacing	Length	Number +	Bar Size	Spacing	Length	F
6'	3'	10½"	9"	12"	4'-4	20	6	6"	7'-2	14	4	6"	5'-3	2'-6
	4'	11"	9"	12"	5'-5	24	6	6"	7'-2	14	4	6"	5'-10	2'-6
	5'	11"	9"	12"	6'-5	24	6	6"	7'-2	14	4	6"	6'-4	2'-6
	6'	11"	9"	12"	7'-5	28	7	8"	7'-2	14	4	6"	6'-10	2'-6
	7'	11"	9"	12"	8'-5	32	7	8"	7'-2	14	4	6"	7'-4	2'-6
8'	3'	13"	11"	7"	4'-9	20	7	7"	9'-6	18	5	7"	5'-10	2'-8
	4'	13"	11"	10"	5'-9	24	7	6"	9'-6	18	5	6"	6'-4	2'-8
	5'	13½"	11"	10"	6'-10	24	8	8"	9'-6	18	5	8"	6'-10	2'-8
	6'	13½"	11"	11"	7'-10	28	8	8"	9'-6	18	5	8"	7'-4	2'-8
	7'	13½"	11"	11"	8'-10	32	8	6"	9'-6	18	4	6"	7'-10	2'-8
	8'	13½"	11"	12"	9'-10	32	8	8"	9'-6	18	4	6"	8'-4	2'-8
10'	3'	16"	13"	6"	5'-3	20	7	6"	11'-10	22	6	8"	7'-0	3'-5
	4'	16"	13"	7"	6'-3	24	8	7"	11'-10	22	6	7"	7'-6	3'-5
	5'	16"	13"	8"	7'-3	24	8	8"	11'-10	22	6	8"	8'-0	3'-4
	6'	16"	13"	8"	8'-3	28	8	8"	11'-10	22	6	8"	8'-4	3'-4
	7'	16"	13"	8"	9'-3	32	8	8"	11'-10	22	5	6"	8'-8	3'-3
	8'	16"	13"	9"	10'-3	32	8	6"	11'-10	22	5	6"	9'-2	3'-3
	9'	16"	13"	9"	11'-3	36	8	6"	11'-10	22	5	6"	9'-7	3'-2
	10'	16½"	13"	12"	12'-4	40	8	6"	11'-10	22	5	6"	10'-1	3'-2
12'	8'	19½"	15"	8"	10'-10	32	10	8"	14'-2	26	5	6"	9'-8	3'-6
	9'	19½"	15"	10"	11'-10	36	10	7"	14'-2	26	5	7"	10'-2	3'-6
	10'	19½"	15"	10"	12'-10	40	9	6"	14'-2	26	5	6"	10'-8	3'-7
	11'	19½"	15"	8"	13'-10	40	10	8"	14'-2	26	6	8"	11'-6	3'-8
	12'	20"	15"	10"	14'-11	44	9	6"	14'-2	26	6	6"	12'-0	3'-9

QUANTITIES PER LINEAR FOOT OF BARREL		Table I		Table II		Table III		Table IV		Table V	
Span "S"	Height "H"	Concrete C.Y.	Reinf. Steel Lbs.	Concrete C.Y.	Reinf. Steel Lbs.	Concrete C.Y.	Reinf. Steel Lbs.	Concrete C.Y.	Reinf. Steel Lbs.	Concrete C.Y.	Reinf. Steel Lbs.
6'	3'	0.635	90.0	0.563	95.7	0.611	104.2	0.659	107.7	0.684	118.6
	4'	0.691	104.4	0.618	104.7	0.667	113.2	0.715	127.4	0.763	128.4
	5'	0.746	123.0	0.674	118.4	0.722	121.8	0.771	133.6	0.819	134.7
	6'	0.802	137.8	0.729	126.1	0.778	141.5	0.826	138.6	0.874	144.5
	7'	0.858	146.7	0.785	135.1	0.833	150.4	0.882	147.5	0.930	153.4
8'	3'	0.841	123.8	0.778	123.7	0.872	129.7	0.966	143.5	1.029	150.7
	4'	0.908	138.8	0.846	133.3	0.940	149.2	1.034	150.1	1.097	173.0
	5'	0.976	144.3	0.945	157.9	1.008	157.7	1.102	160.7	1.196	164.0
	6'	1.044	153.3	1.013	166.8	1.107	165.4	1.170	163.8	1.264	170.5
	7'	1.112	177.1	1.081	170.8	1.175	158.8	1.238	171.2	1.332	220.3
	8'	1.180	182.7	1.149	177.0	1.243	181.8	1.337	198.7	1.400	199.5
10'	3'	1.022	151.4	1.060	193.8	1.215	197.7	1.330	210.9	1.485	209.8
	4'	1.102	160.4	1.140	204.6	1.295	206.9	1.410	213.3	1.565	238.6
	5'	1.182	165.0	1.221	210.6	1.375	215.6	1.491	241.0	1.645	220.3
	6'	1.262	173.4	1.340	202.0	1.455	227.0	1.610	253.6	1.725	229.1
	7'	1.343	182.5	1.420	211.6	1.535	225.8	1.690	255.2	1.806	232.1
	8'	1.423	188.1	1.500	235.3	1.654	233.6	1.770	262.5	1.886	267.4
	9'	1.503	190.3	1.619	243.4	1.735	269.9	1.850	255.2	1.966	276.4
	10'	1.622	206.4	1.699	244.4	1.815	276.6	1.969	282.4	2.085	277.7
12'	8'	1.803	313.2	1.940	289.8	2.123	291.5	2.307	295.4	2.535	336.2
	9'	1.896	325.9	2.033	300.2	2.216	337.3	2.445	348.2	2.628	352.8
	10'	1.988	353.4	2.126	310.5	2.354	321.2	2.538	326.2	2.721	357.9
	11'	2.127	345.8	2.218	354.4	2.447	362.5	2.630	375.1	2.813	373.9
	12'	2.219	414.3	2.356	345.2	2.540	398.4	2.723	431.2	2.952	421.0



Height "H"	"J" Dia.	"K" Spaces
3'	9"	1
4'	3"	2
5'	12"	2
6'	9"	3
7'	3"	4
8'	12"	[illegible]
9'	9"	5
10'	3"	[illegible]
11'	12"	6
12'	9"	7

TYPICAL SECTION



BENDS

NOTE: See B-01.10 for General Notes and Miscellaneous Details.

DESIGN APPROVED	ARIZONA DEPARTMENT OF TRANSPORTATION HIGHWAYS DIVISION STANDARD DRAWINGS	REVISION
J. D. Owens		
APPROVED FOR DISTRIBUTION	SINGLE BARREL BOX CULVERT	STANDARD NO.
T. A. Bryant, Jr.		B-02.10

BOX

DOUBLE BARREL

Span "S"	Height "H"	Table I Concrete C.Y.	Table I Reinf. Steel Lbs.	Table II Concrete C.Y.	Table II Reinf. Steel Lbs.	Table III Concrete C.Y.	Table III Reinf. Steel Lbs.	Table IV Concrete C.Y.	Table IV Reinf. Steel Lbs.	Table V Concrete C.Y.	Table V Reinf. Steel Lbs.
6'	3	1.172	172.1	1.039	167.5	1.172	177.7	1.305	190.0	1.437	187.7
	4	1.246	183.0	1.113	179.2	1.246	189.0	1.379	202.3	1.511	199.0
	5	1.320	191.6	1.187	187.0	1.320	197.8	1.453	210.7	1.585	206.3
	6	1.394	203.3	1.261	198.7	1.394	209.0	1.527	223.0	1.659	225.1
	7	1.468	224.5	1.335	210.5	1.468	221.8	1.601	235.4	1.734	237.5
8'	3	1.475	261.6	1.590	236.4	1.762	253.5	1.991	256.6	2.221	242.2
	4	1.558	274.9	1.673	248.5	1.845	265.8	2.075	268.9	2.304	253.5
	5	1.642	284.3	1.756	256.5	1.928	274.1	2.158	277.3	2.387	280.5
	6	1.725	297.6	1.840	268.5	2.012	286.5	2.241	289.6	2.471	292.8
	7	1.808	301.3	1.923	280.5	2.095	298.9	2.325	302.0	2.554	305.2
	8	1.892	337.1	2.006	304.5	2.178	307.2	2.408	310.3	2.637	313.5
10'	3	1.965	296.9	2.250	303.7	2.606	325.7	2.891	329.2	3.176	354.0
	4	2.067	310.0	2.352	333.8	2.708	337.8	2.993	341.2	3.278	367.1
	5	2.168	318.4	2.453	323.2	2.810	345.8	3.095	349.3	3.380	375.4
	6	2.270	330.7	2.555	353.9	2.912	357.8	3.197	361.3	3.481	387.8
	7	2.372	355.9	2.657	365.9	3.013	369.9	3.298	373.3	3.583	400.2
	8	2.474	364.9	2.759	373.9	3.115	377.9	3.400	381.3	3.685	408.5
	9	2.576	394.3	2.861	385.9	3.217	389.9	3.502	393.4	3.787	420.8
	10	2.678	410.1	2.963	398.0	3.319	401.9	3.604	405.4	3.889	434.4
12'	8	3.282	456.2	3.708	458.6	4.219	465.8	4.644	495.8	5.070	505.6
	9	3.403	453.7	3.828	471.6	4.339	477.5	4.765	509.1	5.190	519.0
	10	3.523	466.4	3.949	484.6	4.459	523.2	4.885	522.4	5.311	532.3
	11	3.643	523.5	4.069	491.1	4.580	532.5	5.005	536.9	5.431	541.6
	12	3.764	537.7	4.189	538.3	4.700	545.8	5.126	542.1	5.551	584.6

TRIPLE BARREL

Span "S"	Height "H"	Table I Concrete C.Y.	Table I Reinf. Steel Lbs.	Table II Concrete C.Y.	Table II Reinf. Steel Lbs.	Table III Concrete C.Y.	Table III Reinf. Steel Lbs.	Table IV Concrete C.Y.	Table IV Reinf. Steel Lbs.	Table V Concrete C.Y.	Table V Reinf. Steel Lbs.
6'	3	1.687	237.6	1.493	231.1	1.687	244.7	1.882	261.0	2.076	262.9
	4	1.786	252.8	1.592	246.3	1.786	260.2	1.980	276.8	2.175	277.6
	5	1.885	262.6	1.690	256.1	1.885	270.3	2.079	287.2	2.274	287.0
	6	1.984	277.8	1.789	271.3	1.984	285.7	2.178	303.0	2.372	305.0
	7	2.082	305.2	1.888	286.5	2.082	301.2	2.277	318.8	2.471	321.5
8'	3	2.135	350.1	2.303	330.0	2.557	356.4	2.894	360.3	3.231	344.1
	4	2.246	374.9	2.415	340.2	2.668	372.2	3.005	376.1	3.343	358.8
	5	2.357	386.3	2.526	358.4	2.779	382.6	3.116	386.5	3.454	391.2
	6	2.468	403.0	2.637	373.8	2.890	398.4	3.227	402.3	3.565	407.0
	7	2.579	415.4	2.748	389.3	3.001	414.2	3.338	418.0	3.676	422.8
	8	2.690	453.3	2.859	420.9	3.112	424.6	3.450	428.5	3.787	433.2
10'	3	2.851	430.6	3.271	433.3	3.795	464.5	4.215	469.1	4.635	503.4
	4	2.987	446.4	3.406	472.5	3.931	479.9	4.351	484.5	4.771	519.2
	5	3.122	459.1	3.542	458.3	4.067	490.0	4.487	494.7	4.906	529.7
	6	3.258	474.9	3.678	500.0	4.203	505.5	4.622	510.1	5.042	545.4
	7	3.394	504.9	3.814	515.5	4.338	520.9	4.758	525.6	5.178	561.2
	8	3.530	516.0	3.950	525.6	4.474	531.1	4.894	535.7	5.314	571.6
	9	3.666	556.8	4.085	541.0	4.610	546.5	5.030	551.1	5.450	587.4
	10	3.801	574.5	4.221	556.5	4.746	562.0	5.166	566.6	5.585	604.3
12'	8	4.703	646.9	5.330	643.6	6.083	662.3	6.711	695.8	7.338	705.2
	9	4.863	649.1	5.491	660.0	6.244	677.5	6.871	711.7	7.499	722.0
	10	5.024	665.2	5.651	676.4	6.404	726.5	7.032	728.4	7.659	738.7
	11	5.184	733.7	5.812	695.0	6.565	737.9	7.192	745.0	7.820	750.2
	12	5.345	752.3	5.972	745.4	6.725	754.7	7.353	764.1	7.980	806.9

FOUR BARREL

Span "S"	Height "H"	Table I Concrete C.Y.	Table I Reinf. Steel Lbs.	Table II Concrete C.Y.	Table II Reinf. Steel Lbs.	Table III Concrete C.Y.	Table III Reinf. Steel Lbs.	Table IV Concrete C.Y.	Table IV Reinf. Steel Lbs.	Table V Concrete C.Y.	Table V Reinf. Steel Lbs.
6'	3	2.203	305.2	1.947	295.8	2.203	313.9	2.459	334.3	2.715	340.3
	4	2.326	323.8	2.070	314.4	2.326	332.8	2.582	353.5	2.838	358.4
	5	2.450	335.7	2.193	326.3	2.450	345.0	2.706	366.0	2.962	369.9
	6	2.573	354.3	2.317	344.9	2.573	363.9	2.829	385.2	3.085	388.5
	7	2.697	388.1	2.440	363.5	2.697	382.8	2.953	404.4	3.209	407.7
8'	3	2.794	465.8	3.017	431.4	3.351	461.5	3.797	466.4	4.242	447.4
	4	2.933	486.0	3.156	450.3	3.490	480.7	3.936	485.6	4.381	465.6
	5	3.072	499.5	3.295	462.9	3.629	493.2	4.075	498.1	4.520	504.1
	6	3.211	518.8	3.434	481.3	3.768	512.4	4.213	517.3	4.659	523.3
	7	3.350	541.0	3.573	500.2	3.907	531.6	4.352	536.5	4.798	542.5
	8	3.489	581.0	3.712	539.7	4.046	544.2	4.491	549.1	4.937	555.0
10'	3	3.737	542.2	4.291	564.9	4.985	605.5	5.539	611.2	6.094	655.6
	4	3.907	561.5	4.461	615.2	5.154	624.3	5.709	630.1	6.263	674.8
	5	4.076	578.5	4.631	595.5	5.324	636.5	5.879	642.3	6.433	687.3
	6	4.246	597.7	4.801	648.2	5.494	655.4	6.048	661.2	6.603	706.5
	7	4.416	632.1	4.970	667.1	5.664	674.3	6.218	680.0	6.773	725.7
	8	4.586	645.2	5.140	679.3	5.833	686.5	6.388	692.2	6.942	738.2
	9	4.755	698.3	5.310	698.2	6.003	705.4	6.558	711.1	7.112	757.4
	10	4.925	717.3	5.480	717.1	6.173	724.9	6.727	730.0	7.282	777.0
12'	8	6.123	819.9	6.953	831.8	7.948	860.9	8.778	895.4	9.601	907.0
	9	6.324	826.6	7.153	851.6	8.149	879.5	8.978	915.6	9.808	927.2
	10	6.524	846.1	7.354	871.4	8.349	931.2	9.179	935.8	10.008	947.3
	11	6.725	926.2	7.555	901.1	8.550	944.7	9.379	954.4	10.209	960.8
	12	6.926	947.3	7.755	954.2	8.751	964.9	9.580	988.5	10.409	1032.1

FIVE BARREL

Span "S"	Height "H"	Table I Concrete C.Y.	Table I Reinf. Steel Lbs.	Table II Concrete C.Y.	Table II Reinf. Steel Lbs.	Table III Concrete C.Y.	Table III Reinf. Steel Lbs.	Table IV Concrete C.Y.	Table IV Reinf. Steel Lbs.	Table V Concrete C.Y.	Table V Reinf. Steel Lbs.
6'	3	2.718	369.1	2.400	364.3	2.718	386.4	3.036	411.2	3.354	421.8
	4	2.866	391.1	2.548	386.3	2.866	408.7	3.184	433.9	3.502	443.4
	5	3.014	405.1	2.697	400.3	3.014	423.0	3.332	440.5	3.650	457.0
	6	3.163	427.1	2.845	422.3	3.163	445.3	3.480	471.1	3.798	475.1
	7	3.311	467.6	2.993	444.3	3.311	467.6	3.629	493.7	3.947	497.7
8'	3	3.454	567.4	3.731	535.9	4.146	573.2	4.700	578.9	5.253	557.7
	4	3.621	591.0	3.898	550.1	4.313	595.9	4.866	601.5	5.420	579.3
	5	3.788	606.6	4.064	572.4	4.479	610.5	5.033	616.1	5.586	623.2
	6	3.954	630.2	4.231	594.7	4.646	633.1	5.200	638.8	5.753	645.8
	7	4.121	661.4	4.398	617.0	4.813	655.7	5.366	661.4	5.920	668.4
	8	4.288	702.8	4.564	664.8	4.979	670.3	5.533	676.0	6.086	683.0
10'	3	4.623	685.6	5.140	705.8	6.174	756.5	6.863	763.1	7.552	820.4
	4	4.827	708.3	5.516	760.0	6.378	778.8	7.067	785.4	7.756	843.0
	5	5.030	730.0	5.720	741.9	6.581	793.0	7.271	799.6	7.960	857.6
	6	5.234	752.6	5.923	806.5	6.785	815.3	7.474	821.9	8.164	880.2
	7	5.438	792.7	6.127	828.8	6.989	837.6	7.678	844.2	8.367	902.8
	8	5.641	808.0	6.331	843.1	7.192	851.9	7.882	858.5	8.571	917.4
	9	5.845	872.4	6.534	865.4	7.396	874.2	8.085	880.8	8.775	940.1
	10	6.049	894.1	6.738	887.7	7.600	896.5	8.289	903.1	8.978	963.9
12'	8	7.544	1025.0	8.575	1031.1	9.815	1072.9	10.844	1109.2	11.876	1122.1
	9	7.784	1037.5	8.816	1054.4	10.053	1095.0	11.085	1132.8	12.116	1145.7
	10	8.025	1060.4	9.057	1077.6	10.294	1150.9	11.326	1156.4	12.357	1169.3
	11	8.266	1151.9	9.297	1120.8	10.535	1166.5	11.566	1177.1	12.598	1184.9
	12	8.507	1176.3	9.538	1178.5	10.776	1190.1	11.807	1227.3	12.838	1269.7

SIX BARREL

Span "S"	Height "H"	Table I Concrete C.Y.	Table I Reinf. Steel Lbs.	Table II Concrete C.Y.	Table II Reinf. Steel Lbs.	Table III Concrete C.Y.	Table III Reinf. Steel Lbs.	Table IV Concrete C.Y.	Table IV Reinf. Steel Lbs.	Table V Concrete C.Y.	Table V Reinf. Steel Lbs.
6'	3	3.234	431.8	2.854	415.4	3.234	439.6	3.613	467.0	3.993	481.4
	4	3.406	457.2	3.027	440.9	3.406	465.3	3.786	493.0	4.166	506.4
	5	3.579	473.3	3.200	457.0	3.579	481.7	3.959	509.7	4.338	522.1
	6	3.752	498.8	3.372	482.4	3.752	507.4	4.132	535.7	4.511	541.3
	7	3.925	545.3	3.545	507.9	3.925	533.1	4.305	561.8	4.684	567.3
8'	3	4.114	679.4	4.445	609.6	4.941	650.2	5.602	656.3	6.264	634.1
	4	4.308	706.4	4.639	635.3	5.135	676.2	5.797	682.4	6.458	659.1
	5	4.503	724.0	4.834	651.7	5.330	692.9	5.991	699.1	6.653	709.0
	6	4.697	751.1	5.028	677.4	5.524	718.9	6.186	725.1	6.847	735.1
	7	4.892	790.1	5.222	703.1	5.719	745.0	6.380	751.2	7.042	761.1
	8	5.086	834.3	5.417	756.6	5.913	761.7	6.575	767.8	7.236	777.8
10'	3	5.509	816.5	6.333	801.8	7.363	857.8	8.187	864.3	9.011	926.5
	4	5.747	842.6	6.571	873.6	7.601	883.5	8.425	890.0	9.249	952.6
	5	5.984	868.7	6.808	843.3	7.838	899.9	8.663	906.4	9.487	969.3
	6	6.222	894.7	7.046	916.3	8.076	925.6	8.900	932.1	9.724	995.3
	7	6.460	939.5	7.284	942.1	8.314	951.3	9.138	957.8	9.962	1021.3
	8	6.697	956.9	7.521	950.4	8.551	967.7	9.376	974.2	10.200	1038.0
	9	6.935	1032.7	7.759	984.1	8.789	993.4	9.613	999.9	10.437	1064.1
	10	7.173	1056.3	7.997	1009.9	9.027	1019.8	9.851	1025.6	10.675	1091.3
12'	8	8.964	1208.2	10.198	1172.8	11.677	1220.8	12.911	1257.4	14.144	1270.0
	9	9.245	1225.6	10.478	1199.5	11.958	1246.3	13.192	1284.4	14.425	1297.1
	10	9.526	1252.0	10.759	1226.2	12.239	1305.6	13.472	1311.4	14.706	1324.1
	11	9.807	1354.6	11.040	1277.5	12.520	1323.3	13.753	1334.3	14.987	1341.0
	12	10.088	1382.5	11.321	1339.2	12.801	1350.3	14.034	1395.4	15.267	1440.3

NOTE:
Quantities shown in tables are per lin. foot of culvert length.

FROM	TO	Δ CONC	Δ REBAR
1 bbl	2	1.008	157.30
2 bbl	3	~~.988~~ .988	144.20
3 bbl	4	.988	122.80
4 bbl	5	.988	154.90
5 bbl	6	.988	142.10
6 bbl	7		
		.988	144.30

DESIGN APPROVED

APPROVED FOR DISTRIBUTION

ARIZONA
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
STANDARD DRAWINGS

CULVERT QUANTITIES

REVISION

STANDARD NO. B-02.70

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Box

INLET WINGS

Span	Hgt.	0° Skew Conc. C.Y. 1 Bbl.	0° Skew Conc. C.Y. Δc	0° Skew Steel lbs. 1 Bbl.	0° Skew Steel lbs. Δs	5° Skew Conc. C.Y. 1 Bbl.	5° Skew Conc. C.Y. Δc	5° Skew Steel lbs. 1 Bbl.	5° Skew Steel lbs. Δs	10° Skew Conc. C.Y. 1 Bbl.	10° Skew Conc. C.Y. Δc	10° Skew Steel lbs. 1 Bbl.	10° Skew Steel lbs. Δs	15° Skew Conc. C.Y. 1 Bbl.	15° Skew Conc. C.Y. Δc	15° Skew Steel lbs. 1 Bbl.	15° Skew Steel lbs. Δs
6'	3'	4.80	.86	342	80	4.84	.87	351	80	4.92	.88	357	81	5.11	.89	378	83
	4'	6.38	.86	455	80	6.68	.87	475	80	6.77	.88	477	81	7.11	.89	512	83
	5'	8.44	.86	593	80	8.64	.87	613	80	8.88	.88	620	81	9.41	.89	668	83
	6'	10.92	.86	762	80	11.11	.87	774	80	11.47	.88	792	81	11.89	.89	814	83
	7'	13.81	.86	1048	80	14.00	.87	1070	80	14.39	.88	1088	81	14.96	.89	1060	83
8'	3'	5.09	1.13	388	105	5.14	1.14	399	106	5.22	1.15	405	107	5.42	1.17	435	109
	4'	6.60	1.13	480	105	6.90	1.14	500	106	7.08	1.15	503	107	7.42	1.17	542	109
	5'	8.74	1.13	618	105	8.94	1.14	638	106	9.19	1.15	646	107	9.73	1.17	698	109
	6'	11.22	1.13	824	105	11.41	1.14	835	106	11.78	1.15	858	107	12.21	1.17	889	109
	7'	14.11	1.13	1073	105	14.31	1.14	1095	106	14.71	1.15	1114	107	15.28	1.17	1093	109
	8'	20.89	1.13	1168	105	21.54	1.14	1231	106	22.01	1.15	1258	107	23.01	1.17	1332	109
10'	3'	5.40	1.40	432	130	5.45	1.41	443	131	5.54	1.43	450	132	5.74	1.45	474	135
	4'	6.99	1.40	526	130	7.29	1.41	547	131	7.40	1.43	550	132	7.74	1.45	585	135
	5'	9.05	1.40	667	130	9.26	1.41	688	131	9.51	1.43	696	132	10.06	1.45	743	135
	6'	11.53	1.40	876	130	11.73	1.41	887	131	12.10	1.43	912	132	12.55	1.45	937	135
	7'	14.43	1.40	1128	130	14.63	1.41	1151	131	15.04	1.43	1171	132	15.62	1.45	1139	135
	8'	21.23	1.40	1225	130	21.88	1.41	1290	131	22.36	1.43	1318	132	23.37	1.45	1387	135
	9'	25.65	1.40	1580	130	26.36	1.41	1655	131	26.92	1.43	1687	132	27.91	1.45	1756	135
	10'	30.59	1.40	1858	130	31.03	1.41	1892	131	31.90	1.43	1948	132	33.29	1.45	2040	135
12'	8'	21.60	1.69	1254	156	22.26	1.69	1321	157	22.75	1.71	1349	159	23.77	1.74	1413	162
	9'	26.06	1.69	1611	156	26.74	1.69	1687	157	27.31	1.71	1710	159	28.31	1.74	1790	162
	10'	30.96	1.69	1889	156	31.41	1.69	1923	157	32.30	1.71	1980	159	33.70	1.74	2065	162
	11'	36.81	1.69	2573	156	37.27	1.69	2625	157	38.25	1.71	2677	159	39.97	1.74	2777	162
	12'	43.37	1.69	3310	156	43.91	1.69	3374	157	45.07	1.71	3406	159	46.79	1.74	3503	162

Span	Hgt.	20° Skew Conc. C.Y. 1 Bbl.	20° Skew Conc. C.Y. Δc	20° Skew Steel lbs. 1 Bbl.	20° Skew Steel lbs. Δs	25° Skew Conc. C.Y. 1 Bbl.	25° Skew Conc. C.Y. Δc	25° Skew Steel lbs. 1 Bbl.	25° Skew Steel lbs. Δs	30° Skew Conc. C.Y. 1 Bbl.	30° Skew Conc. C.Y. Δc	30° Skew Steel lbs. 1 Bbl.	30° Skew Steel lbs. Δs
6'	3'	5.40	.92	400	85	5.73	.95	420	88	5.82	1.00	436	93
	4'	7.46	.92	527	85	7.84	.95	560	88	8.06	1.00	590	93
	5'	9.92	.92	706	85	10.47	.95	744	88	10.59	1.00	756	93
	6'	12.76	.92	874	85	13.35	.95	915	88	13.51	1.00	931	93
	7'	15.79	.92	1121	85	16.62	.95	1181	88	16.81	1.00	1213	93
8'	3'	5.72	1.21	460	112	6.06	1.25	482	116	6.17	1.31	492	121
	4'	7.79	1.21	560	112	8.10	1.25	590	116	8.41	1.31	616	121
	5'	10.24	1.21	739	112	10.81	1.25	778	116	10.95	1.31	784	121
	6'	13.09	1.21	954	112	13.69	1.25	998	116	13.86	1.31	1008	121
	7'	16.12	1.21	1155	112	16.97	1.25	1206	116	17.18	1.31	1236	121
	8'	24.55	1.21	1404	112	25.70	1.25	1498	116	25.97	1.31	1539	121
10'	3'	6.05	1.49	501	139	6.41	1.55	527	144	6.53	1.62	543	150
	4'	8.12	1.49	604	139	8.53	1.55	638	144	8.78	1.62	666	150
	5'	10.58	1.49	786	139	11.17	1.55	830	144	11.32	1.62	842	150
	6'	13.44	1.49	1005	139	14.06	1.55	1054	144	14.24	1.62	1069	150
	7'	16.47	1.49	1209	139	17.33	1.55	1265	144	17.56	1.62	1301	150
	8'	24.93	1.49	1462	139	26.09	1.55	1561	144	26.30	1.62	1607	150
	9'	29.75	1.49	1849	139	31.21	1.55	1905	144	31.57	1.62	1965	150
	10'	34.99	1.49	2151	139	36.88	1.55	2292	144	37.43	1.62	2366	150
12'	8'	25.35	1.79	1502	196	26.54	1.86	1599	204	26.84	1.95	1645	213
	9'	30.18	1.79	1889	196	31.66	1.86	1944	204	32.04	1.95	2003	213
	10'	35.43	1.79	2192	196	37.34	1.86	2331	204	37.91	1.95	2389	213
	11'	42.14	1.79	2894	196	44.33	1.86	3038	204	44.50	1.95	3096	213
	12'	49.68	1.79	3777	196	51.55	1.86	3917	204	52.28	1.95	3987	213

Span	Hgt.	35° Skew Conc. C.Y. 1 Bbl.	35° Skew Conc. C.Y. Δc	35° Skew Steel lbs. 1 Bbl.	35° Skew Steel lbs. Δs	40° Skew Conc. C.Y. 1 Bbl.	40° Skew Conc. C.Y. Δc	40° Skew Steel lbs. 1 Bbl.	40° Skew Steel lbs. Δs	45° Skew Conc. C.Y. 1 Bbl.	45° Skew Conc. C.Y. Δc	45° Skew Steel lbs. 1 Bbl.	45° Skew Steel lbs. Δs
6'	3'	5.82	1.05	431	98	6.07	1.13	440	105	6.44	1.22	472	113
	4'	8.06	1.05	580	98	8.34	1.13	595	105	8.77	1.22	635	113
	5'	10.74	1.05	766	98	10.93	1.13	783	105	11.44	1.22	808	113
	6'	13.69	1.05	949	98	14.06	1.13	964	105	14.79	1.22	1014	113
	7'	16.86	1.05	1217	98	17.52	1.13	1257	105	18.49	1.22	1318	113
8'	3'	6.18	1.38	495	128	6.46	1.48	506	137	6.87	1.60	541	149
	4'	8.43	1.38	616	128	8.73	1.48	632	137	9.20	1.60	674	149
	5'	11.12	1.38	802	128	11.33	1.48	814	137	11.87	1.60	847	149
	6'	14.07	1.38	1034	128	14.47	1.48	1051	137	15.22	1.60	1104	149
	7'	17.24	1.38	1253	128	17.93	1.48	1295	137	18.93	1.60	1358	149
	8'	26.47	1.38	1551	128	27.09	1.48	1618	137	28.50	1.60	1699	149
10'	3'	6.56	1.71	569	188	6.86	1.83	591	201	7.30	1.99	627	217
	4'	8.82	1.71	694	188	9.14	1.83	721	201	9.64	1.99	765	217
	5'	11.51	1.71	884	188	11.74	1.83	907	201	12.32	1.99	939	217
	6'	14.46	1.71	1129	188	14.88	1.83	1148	201	15.61	1.99	1202	217
	7'	17.64	1.71	1343	188	18.35	1.83	1395	201	19.38	1.99	1459	217
	8'	26.89	1.71	1644	188	27.54	1.83	1717	201	28.98	1.99	1804	217
	9'	32.18	1.71	2007	188	33.02	1.83	2074	201	34.98	1.99	2212	217
	10'	37.94	1.71	2442	188	39.43	1.83	2553	201	41.33	1.99	2670	217
12'	8'	27.37	2.06	1656	265	28.04	2.20	1712	334	29.53	2.38	1816	361
	9'	32.67	2.06	2019	265	33.53	2.20	2082	334	35.53	2.38	2210	361
	10'	38.44	2.06	2456	265	39.95	2.20	2562	334	41.89	2.38	2682	361
	11'	45.38	2.06	3194	265	47.09	2.20	3336	334	49.43	2.38	3542	361
	12'	53.38	2.06	4072	265	55.28	2.20	4181	334	58.56	2.38	4472	361

OUTLET WINGS

Span	Hgt.	0° Skew Conc. C.Y. 1 Bbl.	0° Skew Conc. C.Y. Δc	0° Skew Steel lbs. 1 Bbl.	0° Skew Steel lbs. Δs	5° Skew Conc. C.Y. 1 Bbl.	5° Skew Conc. C.Y. Δc	5° Skew Steel lbs. 1 Bbl.	5° Skew Steel lbs. Δs	10° Skew Conc. C.Y. 1 Bbl.	10° Skew Conc. C.Y. Δc	10° Skew Steel lbs. 1 Bbl.	10° Skew Steel lbs. Δs	15° Skew Conc. C.Y. 1 Bbl.	15° Skew Conc. C.Y. Δc	15° Skew Steel lbs. 1 Bbl.	15° Skew Steel lbs. Δs
6'	3'	8.58	1.55	639	135	8.74	1.56	657	135	8.75	1.58	658	137	8.96	1.61	667	140
	4'	11.40	1.55	837	135	11.58	1.56	843	135	11.60	1.58	845	137	11.65	1.61	853	140
	5'	14.49	1.55	1043	135	14.71	1.56	1062	135	14.74	1.58	1060	137	14.78	1.61	1062	140
	6'	17.97	1.55	1241	135	17.99	1.56	1235	135	18.26	1.58	1278	137	18.51	1.61	1281	140
	7'	21.70	1.55	1493	135	21.82	1.56	1512	135	22.09	1.58	1584	137	22.38	1.61	1611	140
8'	3'	9.12	2.02	706	177	9.29	2.03	725	178	9.31	2.05	726	180	9.53	2.09	751	184
	4'	11.96	2.02	877	177	12.14	2.03	883	178	12.17	2.05	885	180	12.23	2.09	908	184
	5'	15.06	2.02	1083	177	15.28	2.03	1102	178	15.31	2.05	1100	180	15.36	2.09	1117	184
	6'	18.55	2.02	1316	177	18.57	2.03	1310	178	18.84	2.05	1360	180	19.11	2.09	1385	184
	7'	22.28	2.02	1534	177	22.41	2.03	1553	178	22.68	2.05	1625	180	22.99	2.09	1670	184
	8'	30.92	2.02	1924	177	31.11	2.03	1901	178	31.48	2.05	1930	180	31.62	2.09	1958	184
10'	3'	9.69	2.51	775	220	9.86	2.52	794	221	9.89	2.55	794	223	10.12	2.59	805	228
	4'	12.54	2.51	949	220	12.72	2.52	956	221	12.76	2.55	958	223	12.83	2.59	967	228
	5'	15.65	2.51	1160	220	15.87	2.52	1179	221	15.91	2.55	1177	223	15.97	2.59	1181	228
	6'	19.14	2.51	1396	220	19.17	2.52	1389	221	19.44	2.55	1434	223	19.72	2.59	1452	228
	7'	22.88	2.51	1617	220	23.01	2.52	1636	221	23.29	2.55	1710	223	23.61	2.59	1738	228
	8'	31.56	2.51	2011	220	31.75	2.52	1988	221	32.13	2.55	2018	223	32.27	2.59	2032	228
	9'	37.10	2.51	2325	220	37.38	2.52	2357	221	37.48	2.55	2342	223	38.21	2.59	2395	228
	10'	43.26	2.51	2781	220	43.54	2.52	2767	221	43.61	2.55	2801	223	44.42	2.59	2844	228
12'	8'	32.22	.98	2038	264	32.41	2.99	2025	265	32.79	3.02	2056	268	32.95	3.08	2073	274
	9'	37.85	.98	2373	264	38.05	2.99	2405	265	38.15	3.02	2390	268	38.90	3.08	2446	274
	10'	43.94	2.98	2829	264	44.21	2.99	2815	265	44.29	3.02	2850	268	45.12	3.08	2896	274
	11'	50.88	2.98	3330	264	51.13	2.99	3362	265	51.25	3.02	3360	268	52.34	3.08	3422	274
	12'	58.80	2.98	4507	264	58.86	2.99	4482	265	59.56	3.02	4558	268	60.40	3.08	4593	274

Span	Hgt.	20° Skew Conc. C.Y. 1 Bbl.	20° Skew Conc. C.Y. Δc	20° Skew Steel lbs. 1 Bbl.	20° Skew Steel lbs. Δs	25° Skew Conc. C.Y. 1 Bbl.	25° Skew Conc. C.Y. Δc	25° Skew Steel lbs. 1 Bbl.	25° Skew Steel lbs. Δs	30° Skew Conc. C.Y. 1 Bbl.	30° Skew Conc. C.Y. Δc	30° Skew Steel lbs. 1 Bbl.	30° Skew Steel lbs. Δs
6'	3'	9.17	1.65	685	143	9.16	1.71	679	149	9.29	1.79	703	156
	4'	11.97	1.65	867	143	11.89	1.71	862	149	12.21	1.79	905	156
	5'	15.34	1.65	1098	143	15.28	1.71	1099	149	15.43	1.79	1120	156
	6'	18.92	1.65	1314	143	18.85	1.71	1317	149	19.04	1.79	1342	156
	7'	23.06	1.65	1656	143	22.81	1.71	1631	149	23.03	1.79	1672	156
8'	3'	9.76	2.15	770	189	9.76	2.23	764	196	9.91	2.34	776	204
	4'	12.56	2.15	919	189	12.50	2.23	915	196	12.85	2.34	947	204
	5'	15.94	2.15	1154	189	15.90	2.23	1155	196	16.08	2.34	1164	204
	6'	19.53	2.15	1419	189	19.48	2.23	1423	196	19.69	2.34	1435	204
	7'	23.68	2.15	1712	189	23.44	2.23	1679	196	23.69	2.34	1711	204
	8'	32.45	2.15	1996	189	32.50	2.23	2019	196	32.81	2.34	2062	204
10'	3'	10.37	2.67	825	235	10.40	2.77	824	243	10.57	2.89	849	254
	4'	13.73	2.67	980	235	13.14	2.77	978	243	13.51	2.89	1021	254
	5'	16.57	2.67	1218	235	16.54	2.77	1223	243	16.75	2.89	1244	254
	6'	20.16	2.67	1488	235	20.13	2.77	1495	243	20.36	2.89	1520	254
	7'	24.32	2.67	1784	235	24.10	2.77	1754	243	24.38	2.89	1799	254
	8'	33.13	2.67	2072	235	33.19	2.77	2097	243	33.53	2.89	2154	254
	9'	39.20	2.67	2454	235	38.96	2.77	2490	243	39.37	2.89	2559	254
	10'	45.49	2.67	2910	235	45.27	2.77	2924	243	45.87	2.89	3008	254
12'	8'	33.82	3.17	2126	311	33.90	3.29	2159	323	34.26	3.44	2207	337
	9'	39.90	3.17	2505	311	39.68	3.29	2552	323	40.11	3.44	2614	337
	10'	46.20	3.17	2975	311	46.00	3.29	2987	323	46.62	3.44	3048	337
	11'	53.70	3.17	3536	311	53.70	3.29	3747	323	53.85	3.44	3803	337
	12'	61.49	3.17	4699	311	61.50	3.29	4669	323	62.28	3.44	4742	337

Span	Hgt.	35° Skew Conc. C.Y. 1 Bbl.	35° Skew Conc. C.Y. Δc	35° Skew Steel lbs. 1 Bbl.	35° Skew Steel lbs. Δs	40° Skew Conc. C.Y. 1 Bbl.	40° Skew Conc. C.Y. Δc	40° Skew Steel lbs. 1 Bbl.	40° Skew Steel lbs. Δs	45° Skew Conc. C.Y. 1 Bbl.	45° Skew Conc. C.Y. Δc	45° Skew Steel lbs. 1 Bbl.	45° Skew Steel lbs. Δs
6'	3'	9.25	1.90	695	165	9.62	2.03	711	177	10.19	2.20	763	191
	4'	12.19	1.90	892	165	12.58	2.03	714	177	13.21	2.20	874	191
	5'	15.62	1.90	1131	165	15.86	2.03	1150	177	16.57	2.20	1195	191
	6'	19.26	1.90	1362	165	19.75	2.03	1584	177	20.67	2.20	1453	191
	7'	23.05	1.90	1673	165	23.90	2.03	1725	177	25.06	2.20	1805	191
8'	3'	9.91	2.47	783	216	10.32	2.64	801	231	10.95	2.86	857	251
	4'	12.85	2.47	952	216	13.29	2.64	975	231	13.98	2.86	1038	251
	5'	16.30	2.47	1190	216	16.58	2.64	1205	231	17.34	2.86	1259	251
	6'	19.94	2.47	1470	216	20.48	2.64	1496	231	21.45	2.86	1569	251
	7'	23.74	2.47	1733	216	24.64	2.64	1787	231	25.85	2.86	1870	251
	8'	33.35	2.47	2084	216	34.09	2.64	2158	231	35.76	2.86	2264	251
10'	3'	10.60	3.06	874	298	11.05	3.27	911	318	11.74	3.54	961	344
	4'	13.55	3.06	1047	298	14.03	3.27	1089	318	14.77	3.54	1147	344
	5'	17.00	3.06	1289	298	17.32	3.27	1323	318	18.15	3.54	1369	344
	6'	20.65	3.06	1573	298	21.23	3.27	1617	318	22.27	3.54	1684	344
	7'	24.46	3.06	1839	298	25.40	3.27	1912	318	26.67	3.54	1989	344
	8'	34.10	3.06	2193	298	34.89	3.27	2281	318	36.62	3.54	2387	344
	9'	40.04	3.06	2604	298	41.01	3.27	2687	318	43.32	3.54	2848	344
	10'	46.44	3.06	3087	298	48.13	3.27	3218	318	50.32	3.54	3354	344
12'	8'	34.87	3.64	2230	397	35.70	3.89	2294	475	37.49	4.21	2424	513
	9'	40.81	3.64	2641	397	41.83	3.89	2712	475	44.21	4.21	2871	513
	10'	47.22	3.64	3125	397	48.96	3.89	3245	475	51.21	4.21	3392	513
	11'	54.81	3.64	3911	397	56.73	3.89	4067	475	59.38	4.21	4300	513
	12'	63.44	3.64	4037	397	65.55	3.89	4960	475	69.28	4.21	5287	513

NOTES :

All quantities are for headwalls of barrels shown in Table No. 1 (0-10' Fill).
Quantities are shown for single barrel culvert only.
Multi-barrel culvert headwall quantities are obtained by adding, for each additional barrel, Δs and Δc to the inlet and outlet quantities.

NOTATIONS :

Δc = Inlet or outlet concrete quantity per additional barrel.

Δs = Inlet or outlet steel quantity per additional barrel.

DESIGN APPROVED

APPROVED FOR DISTRIBUTION

ARIZONA
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
STANDARD DRAWINGS

HEADWALL QUANTITIES
4:1 SLOPE

REVISION 7-88

STANDARD NO. B-05.20

2

BOX

DIMENSIONS

Span	Hgt.	0° Skew A	0° Skew B	0° Skew C	5° Skew A	5° Skew B	5° Skew C	5° Skew D	5° Skew E
6'	3'	9'-10⅜	4'-8¼	3'-7½	10'-0⅜	4'-8½	2'-0¼	4'-8¼	10'-1¼
	4'	12'-3⅛	4'-8¼	4'-5½	12'-5⅞	4'-8½	3'-4¼	5'-9½	12'-5
	5'	14'-7¼	4'-8¼	5'-3½	14'-10⅞	4'-8½	3'-11⅜	6'-10½	14'-8½
	6'	16'-11½	4'-8¼	6'-2½	16'-9½	4'-8½	4'-6	7'-10½	16'-11⅜
	7'	19'-3⅜	4'-8¼	7'-0⅜	19'-2½	4'-8½	5'-1½	8'-11½	19'-2½
8'	3'	9'-10⅜	6'-10½	3'-7½	10'-0⅜	6'-10½	2'-0¼	4'-8¼	10'-1¼
	4'	12'-3⅛	6'-10½	4'-5½	12'-5⅞	6'-10½	3'-4¼	5'-9½	12'-5
	5'	14'-7¼	6'-10½	5'-3½	14'-10⅞	6'-10½	3'-11⅜	6'-10½	14'-8½
	6'	16'-11½	6'-10½	6'-2½	16'-9½	6'-10½	4'-6	7'-10½	16'-11⅜
	7'	19'-3⅜	6'-10½	7'-0⅜	19'-2½	6'-10½	5'-1½	8'-11½	19'-2½
	8'	21'-9⅜	5'-9½	7'-11⅜	21'-9½	5'-9½	5'-10	10'-1⅜	21'-8½
10'	3'	9'-10⅜	9'-0¼	3'-1½	10'-0⅜	9'-0⅜	2'-0¼	4'-8¼	10'-1¼
	4'	12'-3⅛	9'-0¼	4'-5½	12'-5⅞	9'-0⅜	3'-4¼	5'-9½	12'-5
	5'	14'-7¼	9'-0¼	5'-3½	14'-10⅞	9'-0⅜	3'-11⅜	6'-10½	14'-8½
	6'	16'-11½	9'-0¼	6'-2½	16'-9½	9'-0⅜	4'-6	7'-10½	16'-11⅜
	7'	19'-3⅜	9'-0¼	7'-0⅜	19'-2½	9'-0⅜	5'-1½	8'-11½	19'-2½
	8'	21'-9⅜	7'-11⅞	7'-11⅜	21'-9½	7'-11⅞	5'-10	10'-1⅜	21'-8½
	9'	24'-2½	7'-9⅜	8'-9¼	24'-2½	7'-9⅜	6'-5⅜	11'-2⅜	23'-11⅜
	10'	26'-7	7'-7¼	9'-8½	26'-7½	7'-7½	7'-1⅜	12'-3½	26'-3½
12'	8'	21'-9⅜	10'-3½	7'-11⅜	21'-9½	10'-3⅜	5'-10	10'-1⅜	21'-8½
	9'	24'-2½	10'-1	8'-9¼	24'-2½	10'-1⅜	6'-5⅜	11'-2⅜	23'-11⅜
	10'	26'-7	9'-11½	9'-8½	26'-7½	9'-11⅜	7'-1⅜	12'-3½	26'-3½
	11'	28'-11½	9'-9½	10'-6½	29'-0⅜	9'-9½	7'-9½	13'-4	28'-1½
	12'	31'-4	9'-7	11'-4⅜	31'-6½	9'-7⅜	8'-5⅜	14'-4⅜	30'-10½

Span	Hgt.	10° Skew A	10° Skew B	10° Skew C	10° Skew D	10° Skew E	15° Skew A	15° Skew B	15° Skew C	15° Skew D	15° Skew E
6'	3'	10'-1¼	4'-9¼	1'-9⅜	5'-0¼	9'-10¼	10'-1½	4'-10½	10⅜"	6'-11	9'-10½
	4'	12'-6⅜	4'-9¼	2'-2⅜	6'-11½	12'-0½	12'-1	4'-10½	1'-0⅜	8'-4½	11'-11
	5'	14'-6½	4'-9¼	2'-6½	8'-5¼	14'-7¼	14'-6⅜	4'-10½	1'-3½	9'-9⅜	13'-11⅜
	6'	17'-0	4'-9¼	3'-0	9'-8½	16'-9½	17'-0½	4'-10½	1'-5⅜	11'-6	16'-5½
	7'	19'-5⅜	4'-9¼	3'-5½	10'-11½	18'-11½	19'-6⅜	4'-10½	1'-8½	12'-11½	18'-5⅜
8'	3'	10'-1¼	6'-11½	1'-9⅜	5'-0¼	9'-10¼	10'-1½	7'-1⅜	10⅜"	6'-11	9'-10½
	4'	12'-6⅜	6'-11½	2'-2⅜	6'-11½	12'-0½	12'-1	7'-1⅜	1'-0⅜	8'-4½	11'-11
	5'	14'-6⅜	6'-11½	2'-6½	8'-5¼	14'-7¼	14'-6⅜	7'-1⅜	1'-3½	9'-9⅜	13'-11⅜
	6'	17'-0	6'-11½	3'-0	9'-8½	16'-9½	17'-0½	7'-1⅜	1'-5⅜	11'-6	16'-5½
	7'	19'-5⅜	6'-11½	3'-5½	10'-11½	18'-11½	19'-6⅜	7'-1⅜	1'-8½	12'-11½	18'-5⅜
	8'	22'-0½	5'-10½	3'-10⅜	12'-3⅜	21'-4½	21'-7⅜	5'-11¼	1'-10⅜	14'-6⅜	20'-9⅜
10'	3'	10'-1¼	9'-1⅜	1'-9⅜	5'-0¼	9'-10¼	10'-1½	9'-4	10⅜"	6'-11	9'-10½
	4'	12'-6⅜	9'-1⅜	2'-2⅜	6'-11½	12'-0½	12'-1	9'-4	1'-0⅜	8'-4½	11'-11
	5'	14'-6⅜	9'-1⅜	2'-6½	8'-5¼	14'-7¼	14'-6⅜	9'-4	1'-3½	9'-9⅜	13'-11⅜
	6'	17'-0	9'-1⅜	3'-0	9'-8½	16'-9½	17'-0½	9'-4	1'-5⅜	11'-6	16'-5½
	7'	19'-5⅜	9'-1⅜	3'-5½	10'-11½	18'-11½	19'-6⅜	9'-4	1'-8½	12'-11½	18'-5⅜
	8'	22'-0½	8'-0⅜	3'-10⅜	12'-3⅜	21'-4½	21'-7⅜	8'-2⅜	1'-10⅜	14'-6⅜	20'-9⅜
	9'	24'-0	7'-10½	4'-2¼	13'-7¼	23'-6¼	24'-1⅜	8'-0⅜	2'-1½	16'-3⅜	23'-3¼
	10'	26'-5½	7'-8½	4'-8	14'-10½	25'-9½	26'-7	7'-10½	2'-3⅜	17'-9½	25'-4⅜
12'	8'	22'-0½	10'-5½	3'-10⅜	12'-3⅜	21'-4½	21'-7⅜	10'-7⅜	1'-10⅜	14'-6⅜	20'-9⅜
	9'	24'-0	10'-3⅜	4'-2¼	13'-7¼	23'-6¼	24'-1⅜	10'-5⅜	2'-1½	16'-3⅜	23'-3¼
	10'	26'-5½	10'-1	4'-0	14'-10½	25'-9½	26'-7	10'-3½	2'-3⅜	17'-9½	25'-4⅜
	11'	28'-11⅜	9'-10½	5'-1½	16'-1½	27'-11⅜	29'-1	10'-0½	2'-6½	19'-3½	27'-6
	12'	31'-5½	9'-8⅜	5'-6½	17'-8½	30'-7⅜	31'-1	9'-10½	2'-8⅜	21'-0½	30'-0½

Span	Hgt.	20° Skew A	20° Skew B	20° Skew C	20° Skew D	25° Skew A	25° Skew B	25° Skew C	25° Skew D	30° Skew A	30° Skew B	30° Skew C	30° Skew D
6'	3'	10'-0	4'-11¼	0'-2⅜	9'-9⅜	9'-0	5'-2⅜	9'-6½	9'-6½	8'-6	5'-6⅜	10'-11⅜	9'-2¼
	4'	12'-0	4'-11¼	9'-9⅜	11'-8½	11'-0	5'-2⅜	11'-3½	11'-3½	10'-6	5'-6⅜	13'-2⅜	11'-1⅜
	5'	14'-6	4'-11¼	11'-8⅜	13'-11⅜	13'-6	5'-2⅜	13'-5½	13'-5⅜	12'-6	5'-6⅜	15'-6½	13'-0½
	6'	17'-0	4'-11¼	13'-4½	15'-10⅜	15'-6	5'-2⅜	15'-6⅜	15'-6⅜	14'-6	5'-6⅜	17'-10½	14'-11⅜
	7'	19'-6	4'-11¼	15'-3½	18'-2⅜	17'-6	5'-2⅜	17'-8½	17'-8½	16'-6	5'-6⅜	20'-1⅜	16'-10½
8'	3'	10'-0	7'-3⅜	0'-2⅜	9'-9⅜	9'-0	7'-7⅜	9'-6½	9'-6½	8'-6	8'-0⅜	10'-11⅜	9'-2½
	4'	12'-0	7'-3⅜	9'-9⅜	11'-8½	11'-0	7'-7⅜	11'-3½	11'-3½	10'-6	8'-0⅜	13'-2⅜	11'-1⅜
	5'	14'-6	7'-3⅜	11'-8⅜	13'-11⅜	13'-6	7'-7⅜	13'-5½	13'-5⅜	12'-6	8'-0⅜	15'-6½	13'-0½
	6'	17'-0	7'-3⅜	13'-4½	15'-10⅜	15'-6	7'-7⅜	15'-6⅜	15'-6⅜	14'-6	8'-0⅜	17'-10½	14'-11⅜
	7'	19'-6	7'-3⅜	15'-3½	18'-2⅜	17'-6	7'-7⅜	17'-8½	17'-8½	16'-6	8'-0⅜	20'-1⅜	16'-10½
	8'	21'-6	6'-1½	17'-1½	20'-5½	20'-0	6'-4⅜	19'-9⅜	19'-9⅜	18'-6	6'-9	22'-10½	19'-2½
10'	3'	10'-0	9'-7	0'-2⅜	9'-9⅜	9'-0	10'-0	9'-6½	9'-6½	8'-6	10'-6⅜	10'-11⅜	9'-2½
	4'	12'-0	9'-7	9'-9⅜	11'-8½	11'-0	10'-0	11'-3½	11'-3½	10'-6	10'-6⅜	13'-2⅜	11'-1⅜
	5'	14'-6	9'-7	11'-8⅜	13'-11⅜	13'-6	10'-0	13'-5½	13'-5⅜	12'-6	10'-6⅜	15'-6½	13'-0½
	6'	17'-0	9'-7	13'-4½	15'-10⅜	15'-6	10'-0	15'-6⅜	15'-6⅜	14'-6	10'-6⅜	17'-10½	14'-11⅜
	7'	19'-6	9'-7	15'-3½	18'-2⅜	17'-6	10'-0	17'-8½	17'-8½	16'-6	10'-6⅜	20'-1⅜	16'-10½
	8'	21'-6	8'-5½	17'-1½	20'-5½	20'-0	8'-9⅜	19'-9⅜	19'-9⅜	18'-6	9'-3	22'-10½	19'-2½
	9'	24'-0	8'-2⅜	19'-1½	22'-9½	22'-0	8'-7½	21'-11½	21'-11½	20'-6	9'-0½	25'-3¼	21'-2⅜
	10'	26'-6	8'-0⅜	20'-9½	24'-9½	24'-0	8'-4½	24'-1⅜	24'-1⅜	22'-6	8'-9⅜	27'-7½	23'-2⅜
12'	8'	21'-6	10'-11	17'-1½	20'-5½	20'-0	11'-4⅜	19'-9⅜	19'-9⅜	18'-6	11'-11⅜	22'-10½	19'-2½
	9'	24'-0	10'-8½	19'-1½	22'-9½	22'-0	11'-2	21'-11½	21'-11⅜	20'-6	11'-8⅜	25'-3½	21'-2⅜
	10'	26'-6	10'-6⅜	20'-9½	24'-9½	24'-0	10'-11⅜	24'-1⅜	24'-1⅜	22'-6	11'-6½	27'-7½	23'-2⅜
	11'	29'-0	10'-4½	20'-9	27'-1½	26'-6	10'-9½	26'-4½	26'-4½	24'-6	11'-3½	30'-0½	25'-2½
	12'	31'-0	10'-1½	24'-4½	29'-0⅜	28'-6	10'-6½	28'-2	28'-2	26'-6	11'-1½	32'-4⅜	27'-2½

Span	Hgt.	35° Skew A	35° Skew B	35° Skew C	35° Skew D	40° Skew A	40° Skew B	40° Skew C	40° Skew D	45° Skew A	45° Skew B	45° Skew C	45° Skew D
6'	3'	7'-6	5'-10⅜	12'-4⅜	8'-8¼	7'-0	6'-4½	14'-4½	8'-3⅜	7'-0	6'-11½	16'-6½	7'-8⅜
	4'	9'-6	5'-10⅜	14'-10⅜	10'-4⅜	9'-0	6'-4½	16'-11⅜	9'-9⅜	8'-6	6'-11½	19'-8½	9'-2½
	5'	11'-6	5'-10⅜	17'-8½	12'-5	10'-6	6'-4½	20'-0	11'-6⅜	10'-0	6'-11½	22'-10½	10'-1⅜
	6'	13'-6	5'-10⅜	20'-2½	14'-1⅜	12'-6	6'-4½	23'-0⅜	13'-3⅜	12'-0	6'-11½	26'-0½	12'-1⅜
	7'	15'-0	5'-10⅜	22'-7½	15'-10½	14'-0	6'-4½	26'-0½	15'-0⅜	13'-6	6'-11½	29'-2⅜	13'-1⅜
8'	3'	7'-6	8'-6⅜	12'-4⅜	8'-8¼	7'-0	9'-2⅜	14'-4½	8'-3⅜	7'-0	9'-11⅜	16'-6½	7'-8⅜
	4'	9'-6	8'-6⅜	14'-10⅜	10'-4⅜	9'-0	9'-2⅜	16'-11⅜	9'-9⅜	8'-6	9'-11⅜	19'-8½	9'-2½
	5'	11'-6	8'-6⅜	17'-8½	12'-5	10'-6	9'-2⅜	20'-0	11'-6⅜	10'-0	9'-11⅜	22'-10½	10'-1⅜
	6'	13'-6	8'-6⅜	20'-2½	14'-1⅜	12'-6	9'-2⅜	23'-0⅜	13'-3⅜	12'-0	9'-11⅜	26'-0½	12'-1⅜
	7'	15'-0	8'-6⅜	22'-7½	15'-10½	14'-0	9'-2⅜	26'-0½	15'-0⅜	13'-6	9'-11⅜	29'-2⅜	13'-1⅜
	8'	17'-0	7'-2½	26'-1½	18'-3½	16'-0	7'-8⅜	29'-5	16'-11½	15'-0	8'-3⅜	33'-9½	15'-9½
10'	3'	7'-6	11'-2⅜	12'-4⅜	8'-8¼	7'-0	12'-0⅜	14'-4½	8'-3⅜	7'-0	13'-0½	16'-6½	7'-8⅜
	4'	9'-6	11'-2⅜	14'-10⅜	10'-4⅜	9'-0	12'-0⅜	16'-11⅜	9'-9⅜	8'-6	13'-0½	19'-8½	9'-2½
	5'	11'-6	11'-2⅜	17'-8½	12'-5	10'-6	12'-0⅜	20'-0	11'-6⅜	10'-0	13'-0½	22'-10½	10'-1⅜
	6'	13'-6	11'-2⅜	20'-2½	14'-1⅜	12'-6	12'-0⅜	23'-0⅜	13'-3⅜	12'-0	13'-0½	26'-0½	12'-1⅜
	7'	15'-0	11'-2⅜	22'-7½	15'-10½	14'-0	12'-0⅜	26'-0½	15'-0⅜	13'-6	13'-0½	29'-2⅜	13'-1⅜
	8'	17'-0	9'-9⅜	26'-1½	18'-3½	16'-0	10'-6⅜	29'-5	16'-11½	15'-0	11'-4½	33'-9½	15'-9½
	9'	19'-0	9'-7½	28'-7½	20'-0½	17'-6	10'-3⅜	32'-6⅜	18'-9⅜	17'-0	11'-1½	37'-1½	17'-3½
	10'	20'-6	9'-4⅜	31'-1⅜	22'-1⅜	19'-6	10'-0⅜	35'-8½	20'-7½	18'-6	10'-9½	40'-5½	18'-10½
12'	8'	17'-0	12'-8⅜	26'-1½	18'-3½	16'-0	13'-6⅜	29'-5	16'-11½	15'-0	14'-8⅜	33'-9½	15'-9½
	9'	19'-0	12'-5⅜	28'-7½	20'-0½	17'-6	13'-3⅜	32'-6⅜	18'-9⅜	17'-0	14'-4½	37'-1½	17'-3½
	10'	20'-6	12'-2⅜	31'-7⅜	22'-1⅜	19'-6	13'-0⅜	35'-8½	20'-7½	18'-6	14'-1⅜	40'-5½	18'-10⅜
	11'	22'-6	11'-11⅜	34'-2	23'-11½	21'-0	12'-9⅜	38'-10⅜	22'-5⅜	20'-0	13'-10	43'-9⅜	20'-5½
	12'	24'-6	11'-9½	36'-8½	25'-0⅜	23'-0	12'-6⅜	41'-7½	24'-0½	22'-0	13'-6⅜	47'-1	22'-2½

QUANTITIES

Span	Hgt.	0° Skew Conc. C.Y. 1Bbl.	0° Δc	0° Steel lbs. 1Bbl.	0° Δs	5° Skew Conc. C.Y. 1Bbl.	5° Δc	5° Steel lbs. 1Bbl.	5° Δs	10° Skew Conc. C.Y. 1Bbl.	10° Δc	10° Steel lbs. 1Bbl.	10° Δs	15° Skew Conc. C.Y. 1Bbl.	15° Δc	15° Steel lbs. 1Bbl.	15° Δs	20° Skew Conc. C.Y. 1Bbl.	20° Δc	20° Steel lbs. 1Bbl.	20° Δs
6'	3'	0.41	1.46	46	122	0.42	1.49	48	124	0.42	1.49	48	124	0.45	1.52	52	126	0.50	1.55	57	128
	4'	0.56	1.75	69	143	0.57	1.78	72	145	0.58	1.78	71	146	0.62	1.78	75	146	0.67	1.81	79	148
	5'	0.72	2.04	98	165	0.75	2.07	101	167	0.77	2.07	103	167	0.78	2.07	102	167	0.97	2.12	112	172
	6'	0.97	2.33	132	186	0.98	2.33	133	186	1.02	2.36	137	188	1.07	2.38	141	191	1.12	2.41	144	193
	7'	1.28	2.62	172	208	1.29	2.62	173	208	1.34	2.65	176	210	1.39	2.67	179	212	1.50	2.73	188	217
8'	3'	0.93	1.98	85	158	0.95	2.02	88	161	0.96	2.03	88	161	1.00	2.07	93	164	1.06	2.11	98	167
	4'	1.18	2.36	115	186	1.20	2.40	119	189	1.21	2.42	118	189	1.25	2.40	121	190	1.31	2.44	127	193
	5'	1.44	2.75	151	214	1.47	2.78	155	217	1.50	2.78	157	217	1.51	2.78	156	218	1.62	2.86	167	224
	6'	1.78	3.13	192	243	1.79	3.12	193	243	1.84	3.16	198	246	1.90	3.20	202	249	1.96	3.24	206	252
	7'	2.19	3.51	239	271	2.19	3.51	239	271	2.25	3.54	244	274	2.31	3.58	247	277	2.44	3.65	258	283
	8'	2.77	3.91	250	301	2.78	3.91	251	301	2.85	3.95	255	304	2.88	3.95	256	304	3.04	4.02	266	310
10'	3'	1.52	2.54	128	197	1.55	2.59	132	200	1.56	2.60	133	201	1.61	2.65	138	205	1.68	2.70	145	206
	4'	1.87	3.02	166	232	1.90	3.07	171	236	1.91	3.07	170	236	1.95	3.07	174	236	2.02	3.12	180	240
	5'	2.23	3.49	210	267	2.27	3.54	214	271	2.30	3.54	216	271	2.31	3.54	216	271	2.44	3.64	228	279
	6'	2.67	3.97	258	303	2.68	3.97	259	303	2.74	4.01	265	306	2.81	4.06	270	310	2.89	4.11	275	314
	7'	3.18	4.44	313	338	3.19	4.44	313	338	3.25	4.49	319	341	3.33	4.54	323	345	3.48	4.63	335	352
	8'	3.87	4.95	332	376	3.88	4.95	333	376	3.95	5.00	338	379	3.99	4.99	338	379	4.16	5.08	351	386
	9'	4.48	5.43	387	411	4.49	5.43	388	411	4.51	5.43	388	411	4.68	5.52	400	418	4.87	5.60	412	425
	10'	5.15	5.91	447	447	5.16	5.91	447	447	5.18	5.91	446	447	5.36	6.00	458	454	5.55	6.08	468	461
12'	8'	5.01	6.04	414	450	5.02	6.03	415	450	5.10	6.09	420	454	5.14	6.09	421	454	5.33	6.20	435	463
	9'	5.72	6.61	477	493	5.73	6.61	477	493	5.75	6.61	477	493	5.94	6.72	492	501	6.15	6.82	505	509
	10'	6.49	7.19	544	536	6.50	7.19	544	536	6.52	7.18	543	536	6.72	7.29	557	544	6.93	7.40	569	552
	11'	7.33	7.76	616	579	7.33	7.76	615	578	7.35	7.76	614	578	7.56	7.87	626	587	7.89	8.02	640	598
	12'	8.22	8.34	692	621	8.23	8.34	691	621	8.35	8.39	699	625	8.49	8.43	707	628	8.72	8.54	717	636

Span	Hgt.	25° Skew Conc. C.Y. 1Bbl.	25° Δc	25° Steel lbs. 1Bbl.	25° Δs	30° Skew Conc. C.Y. 1Bbl.	30° Δc	30° Steel lbs. 1Bbl.	30° Δs	35° Skew Conc. C.Y. 1Bbl.	35° Δc	35° Steel lbs. 1Bbl.	35° Δs	40° Skew Conc. C.Y. 1Bbl.	40° Δc	40° Steel lbs. 1Bbl.	40° Δs	45° skew Conc. C.Y. 1Bbl.	45° Δc	45° Steel lbs. 1Bbl.	45° Δs
6'	3'	0.88	1.52	86	128	1.23	1.53	113	129	1.59	1.51	140	128	1.97	1.54	173	132	2.36	1.62	206	139
	4'	1.11	1.78	112	147	1.59	1.81	150	150	2.00	1.79	181	149	2.45	1.82	217	152	2.96	1.88	260	158
	5'	1.41	2.10	150	170	1.97	2.09	194	171	2.51	2.09	236	171	3.01	2.08	275	172	3.59	2.14	320	177
	6'	1.79	2.38	195	191	2.44	2.37	244	191	3.05	2.37	290	192	3.70	2.39	341	194	4.40	2.44	390	200
	7'	2.25	2.66	245	212	2.99	2.65	300	212	3.65	2.61	349	210	4.47	2.65	412	214	5.30	2.70	463	219
8'	3'	1.43	2.07	126	166	1.79	2.09	154	167	2.14	2.06	180	166	2.54	2.11	215	171	2.96	2.22	251	180
	4'	1.75	2.41	159	191	2.24	2.46	198	195	2.65	2.43	228	193	3.11	2.48	266	198	3.65	2.56	311	205
	5'	2.15	2.83	205	221	2.71	2.83	249	222	3.25	2.83	291	223	3.76	2.82	330	224	4.36	2.90	377	230
	6'	2.62	3.19	256	249	3.27	3.19	305	249	3.89	3.19	351	250	4.55	3.22	403	253	5.27	3.30	454	260
	7'	3.17	3.56	314	276	3.92	3.56	368	277	4.56	3.51	416	274	5.41	3.56	481	279	6.26	3.64	534	285
	8'	3.91	3.97	331	307	4.81	3.96	402	307	5.66	3.95	467	306	6.50	3.98	528	310	7.54	4.06	603	316
10'	3'	2.05	2.66	172	206	2.42	2.69	201	209	2.76	2.65	227	207	3.18	2.72	262	212	3.64	2.86	301	224
	4'	2.46	3.08	212	238	2.96	3.14	252	243	3.36	3.11	282	241	3.85	3.18	321	247	4.41	3.29	368	255
	5'	2.96	3.60	266	276	3.53	3.60	310	277	4.08	3.61	352	278	4.59	3.61	392	279	5.21	3.71	441	287
	6'	3.53	4.06	324	310	4.19	4.06	374	311	4.81	4.07	420	312	5.48	4.11	473	315	6.23	4.21	525	324
	7'	4.19	4.52	389	344	4.93	4.52	444	345	5.57	4.46	491	341	6.43	4.54	557	347	7.31	4.64	612	356
	8'	5.02	5.03	415	383	5.93	5.02	486	382	6.77	5.01	551	382	7.63	5.06	613	386	8.69	5.16	690	394
	9'	5.79	5.50	482	417	6.80	5.49	560	417	7.74	5.48	630	417	8.73	5.49	704	418	10.04	5.67	789	432
	10'	6.62	5.97	554	452	7.75	5.96	639	452	8.81	5.92	723	449	10.05	6.00	806	456	11.34	6.10	889	465
12'	8'	6.19	6.14	499	458	7.10	6.14	570	458	7.94	6.13	635	457	8.82	6.19	698	462	9.91	6.33	776	472
	9'	7.05	6.70	573	500	8.07	6.70	651	499	9.01	6.69	721	499	10.01	6.72	795	501	11.37	6.94	884	518
	10'	7.99	7.26	653	541	9.11	7.25	737	541	10.17	7.22	821	538	11.44	7.32	905	546	12.76	7.46	991	557
	11'	9.07	7.89	741	588	10.23	7.81	829	582	11.44	7.78	919	580	12.78	7.85	1016	585	14.23	7.98	1103	595
	12'	10.02	8.40	818	626	11.45	8.37	927	624	12.77	8.34	1023	622	14.26	8.41	1124	627	16.08	8.16	1245	643

NOTATIONS:

Δc = Apron concrete quantity per additional barrel.

Δs = Apron steel quantity per additional barrel.

DESIGN APPROVED

J. D. Dock

APPROVED FOR DISTRIBUTION

T. A. Bryant, II.

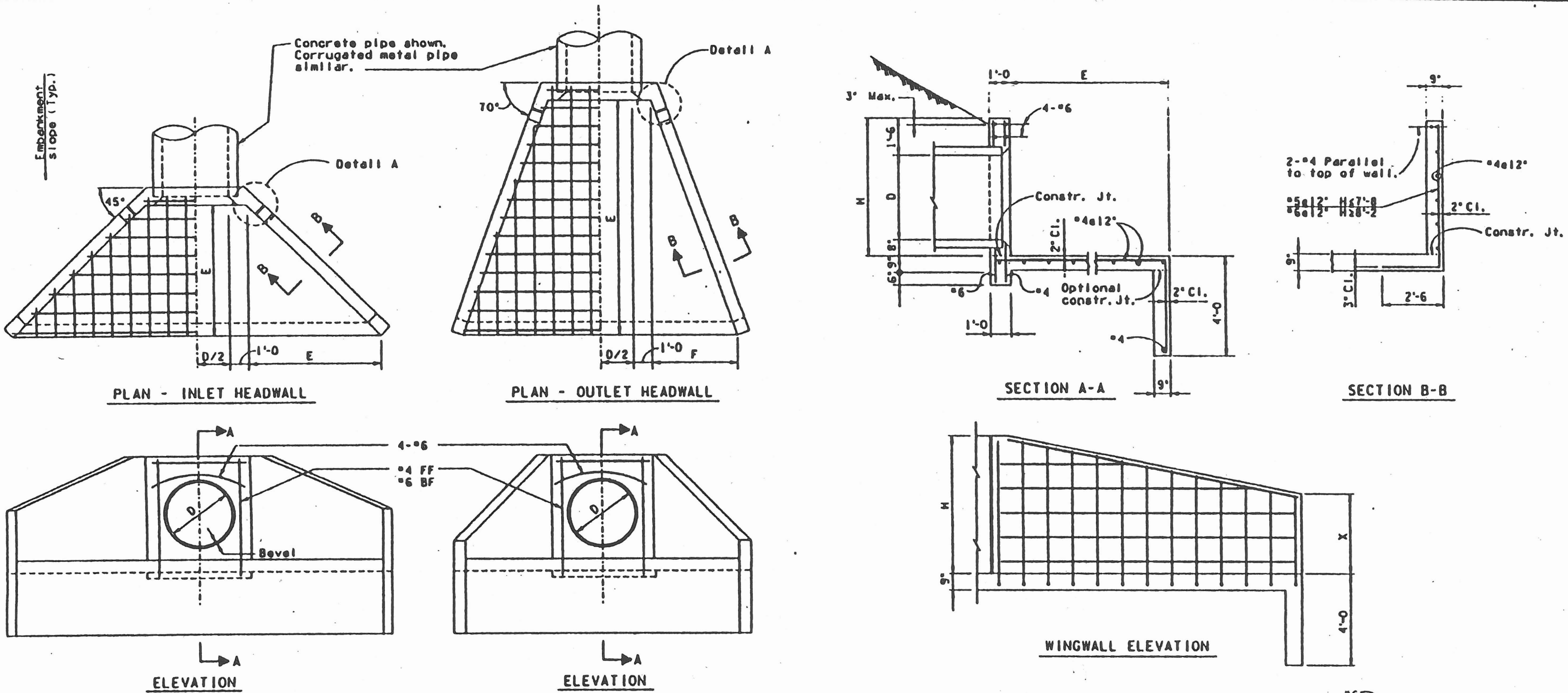
ARIZONA
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
STANDARD DRAWINGS

OUTLET APRON
DIMENSIONS & QUANTITIES
4 : 1 SLOPE

REVISION 7-88

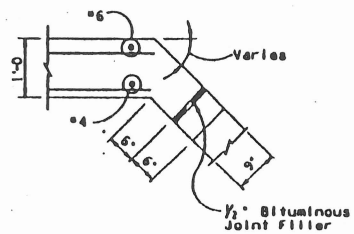
STANDARD NO. B-06.30

22



D	H	INLET END 2:1 Slope Dimensions E	X	Conc. C.Y.	Reinf. LBS.	4:1 Slope Dimensions E	X	Conc. C.Y.	Reinf. LBS.	6:1 Slope Dimensions E	X	Conc. C.Y.	Reinf. LBS.
48"	6'-2	5'-4	3'-0	6.6	395	7'-8	4'-0	9.4	570	9'-0	4'-6	11.2	680
54"	6'-8	5'-10	3'-3	7.6	445	8'-4	4'-4	10.8	630	9'-8	4'-10	12.9	745
60"	7'-2	6'-4	3'-6	8.6	490	9'-0	4'-8	12.2	725	10'-4	5'-3	14.3	835
66"	7'-8	6'-10	3'-9	9.7	555	9'-8	5'-0	13.8	810	11'-0	5'-7	16.0	940
72"	8'-2	7'-4	4'-0	10.8	700	10'-4	5'-4	15.5	1010	11'-8	6'-0	17.8	1195
78"	8'-8	7'-10	4'-3	12.1	795	11'-0	5'-8	17.2	1140	12'-4	6'-5	19.7	1305
84"	9'-2	8'-4	4'-6	13.3	875	11'-8	6'-0	19.0	1250	13'-0	6'-10	21.7	1435

D	OUTLET END 2:1 Slope Dimensions E	F	X	Conc. C.Y.	Reinf. LBS.	4:1 Slope Dimensions E	F	X	Conc. C.Y.	Reinf. LBS.	6:1 Slope Dimensions E	F	X	Conc. C.Y.	Reinf. LBS.
48"	8'-8	3'-2	1'-4	7.0	430	13'-8	5'-0	2'-6	10.8	665	16'-0	5'-10	3'-4	13.0	790
54"	9'-4	3'-5	1'-6	7.9	475	14'-8	5'-4	2'-9	12.3	750	17'-4	6'-4	3'-7	15.0	925
60"	10'-0	3'-8	1'-8	8.9	510	15'-8	5'-8	3'-0	13.9	830	18'-8	6'-10	3'-10	17.1	1020
66"	10'-8	3'-11	1'-10	10.0	570	16'-8	6'-1	3'-3	15.6	915	20'-0	7'-3	4'-2	19.3	1160
72"	11'-4	4'-2	2'-0	11.1	720	17'-8	6'-5	3'-6	17.4	1155	21'-4	7'-9	4'-5	21.7	1475
78"	12'-0	4'-4	2'-2	12.2	780	18'-8	6'-10	3'-9	19.7	1315	22'-8	8'-3	4'-9	24.3	1655
84"	12'-8	4'-7	2'-4	13.5	865	19'-8	7'-2	4'-0	21.3	1430	24'-0	8'-9	5'-0	27.0	1795



DETAIL A

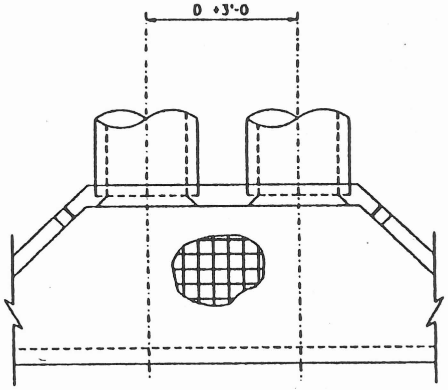
NOTE:
For General Notes and Chamfer Detail see B-11.10.
All concrete shall be Class "B", f'c = 2500 psi.
Bevel is required only on Inlet Headwalls.
Bell end of concrete pipe may replace bevel.
For CMP use anchor bolts @ 18" as shown on B-11.10.

DESIGN APPROVED
APPROVED FOR DISTRIBUTION

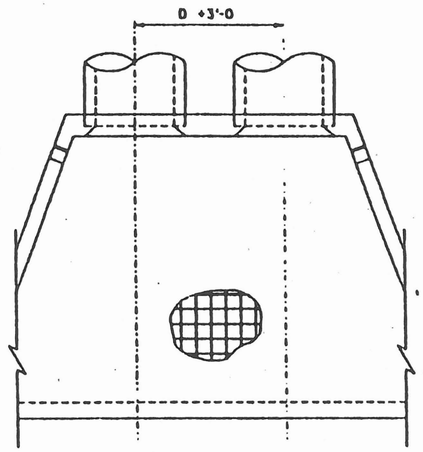
ARIZONA
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
STANDARD DRAWINGS

INLET AND OUTLET HEADWALLS
RIGHT ANGLE PIPE CULVERTS
48" - 84" PIPES

REVISION
STANDARD NO.
B-11.12



PLAN - INLET HEADWALL



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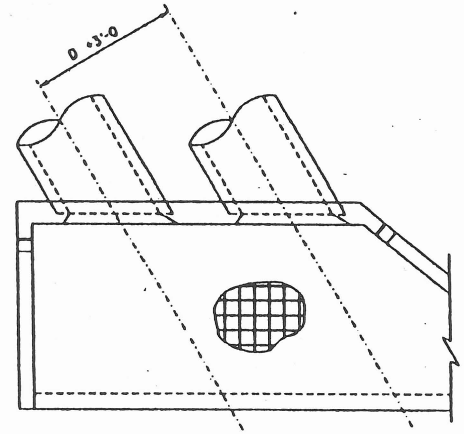
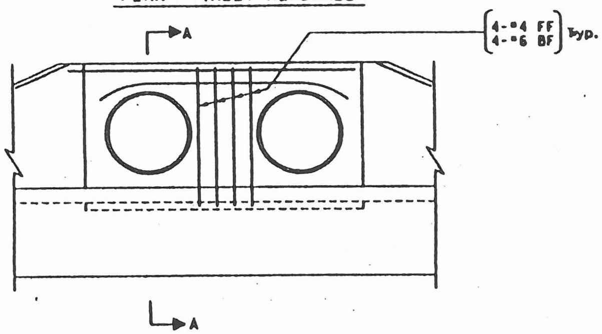
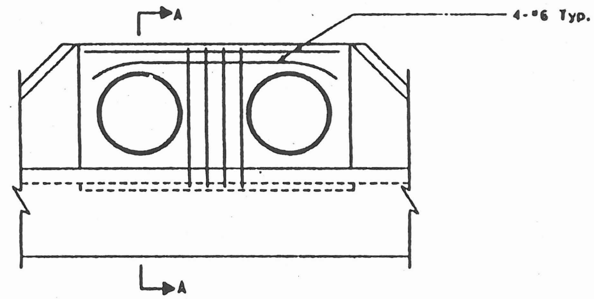


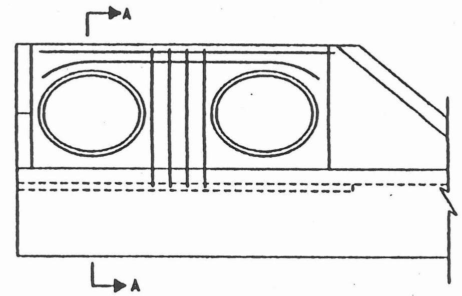
PLAN - SKEW PIPE



ELEVATION



ELEVATION



ELEVATION

CONCRETE QUANTITIES PER ADDITIONAL PIPE (C.Y.)

D	Rt. ∢ Inlet			Rt. ∢ Outlet			15°			30°			45°		
	2:1	4:1	6:1	2:1	4:1	6:1	2:1	4:1	6:1	2:1	4:1	6:1	2:1	4:1	6:1
48"	3.1	3.5	3.8	3.7	4.7	5.2	3.8	5.0	5.8	4.0	4.9	5.4	4.7	5.9	6.2
54"	3.5	4.1	4.4	4.2	5.3	5.9	4.3	5.7	6.6	4.4	5.5	6.1	5.3	6.6	7.1
60"	3.9	4.5	4.8	4.7	6.0	6.7	4.8	6.4	7.6	5.0	6.2	6.9	6.0	7.3	7.9
66"	4.3	5.0	5.3	5.2	6.6	7.4	5.3	7.1	8.2	5.6	6.9	7.8	6.6	8.1	8.9
72"	4.8	5.5	5.9	5.8	7.4	8.3	6.0	8.0	9.2	6.2	7.7	8.4	7.3	8.9	9.7
78"	5.2	6.0	6.4	6.3	8.1	9.1	6.6	8.8	10.2	6.8	8.5	9.6	8.1	9.8	10.8
84"	5.7	6.6	7.0	6.9	8.8	10.0	7.2	9.7	11.2	7.5	9.4	10.6	8.8	10.6	11.8

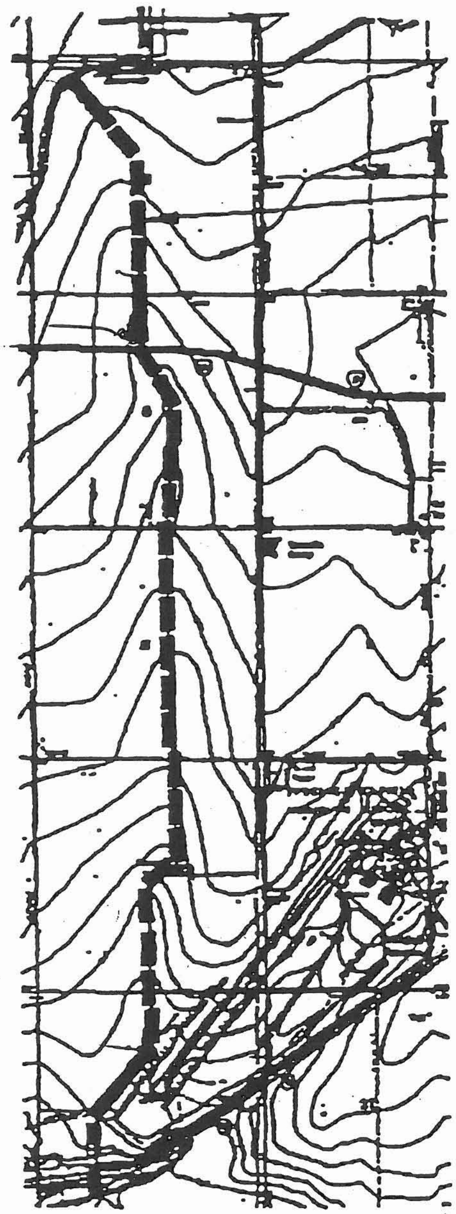
REINF. BAR QUANTITIES PER ADDITIONAL PIPE (LBS.)

D	Rt. ∢ Inlet			Rt. ∢ Outlet			15°			30°			45°		
	2:1	4:1	6:1	2:1	4:1	6:1	2:1	4:1	6:1	2:1	4:1	6:1	2:1	4:1	6:1
48"	180	205	215	210	260	280	210	270	305	220	260	285	240	290	310
54"	200	220	230	230	280	305	240	305	350	245	295	325	270	325	350
60"	220	250	260	260	315	345	260	330	385	265	325	355	300	365	395
66"	235	265	275	275	340	375	280	365	420	285	350	385	330	405	440
72"	255	295	305	305	380	420	310	405	465	320	390	430	355	425	470
78"	275	[illegible]	325	320	405	450	335	420	505	345	415	450	395	470	520
84"	300	340	355	355	450	500	370	490	560	370	460	520	425	515	570

NOTES:

For Section A-A and Details not shown see B-11.12 and B-11.13. Multipipe culvert headwall quantities are obtained by multiplying quantity shown in tables by the number of additional pipes and adding to single pipe headwall quantities.

DESIGN APPROVED	ARIZONA DEPARTMENT OF TRANSPORTATION HIGHWAYS DIVISION STANDARD DRAWINGS	REVISION
APPROVED FOR DISTRIBUTION	MULTIPIPE HEADWALLS 48"-84" PIPES	STANDARD NO. B-11.14



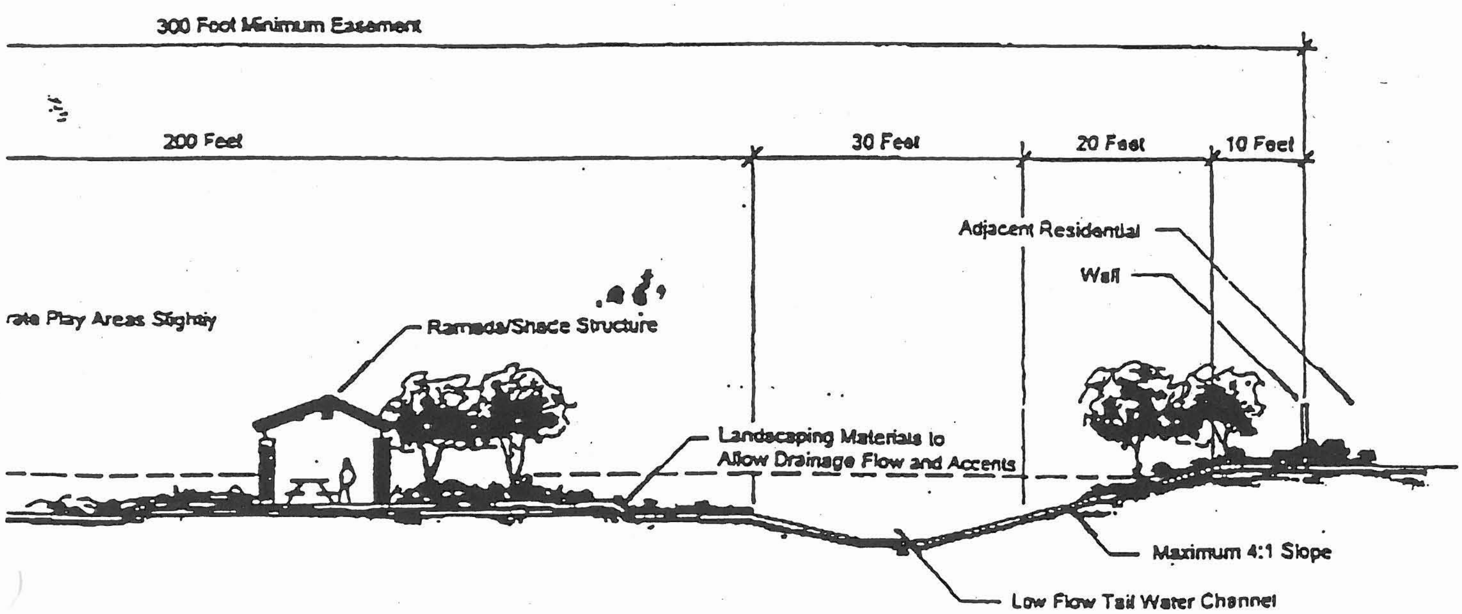
Bullard Wash

Goodyear Arizona

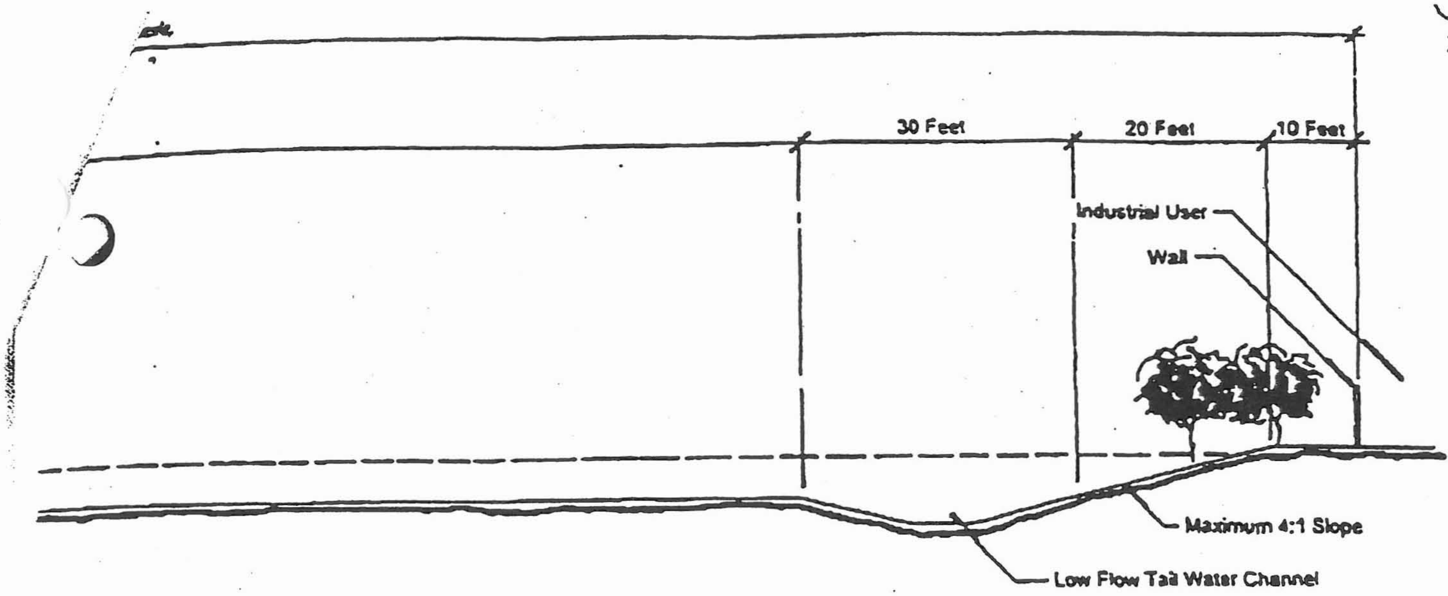
Bullard Wash extends from northwestern Metropolitan Phoenix south through different jurisdictions, ending at the Gila River in Goodyear, Arizona. This literature, as depicted on the illustration to the right, is concerned with the wash from the Thomas Road south to the Gila River, approximately xx mile south of Buckeye Road.

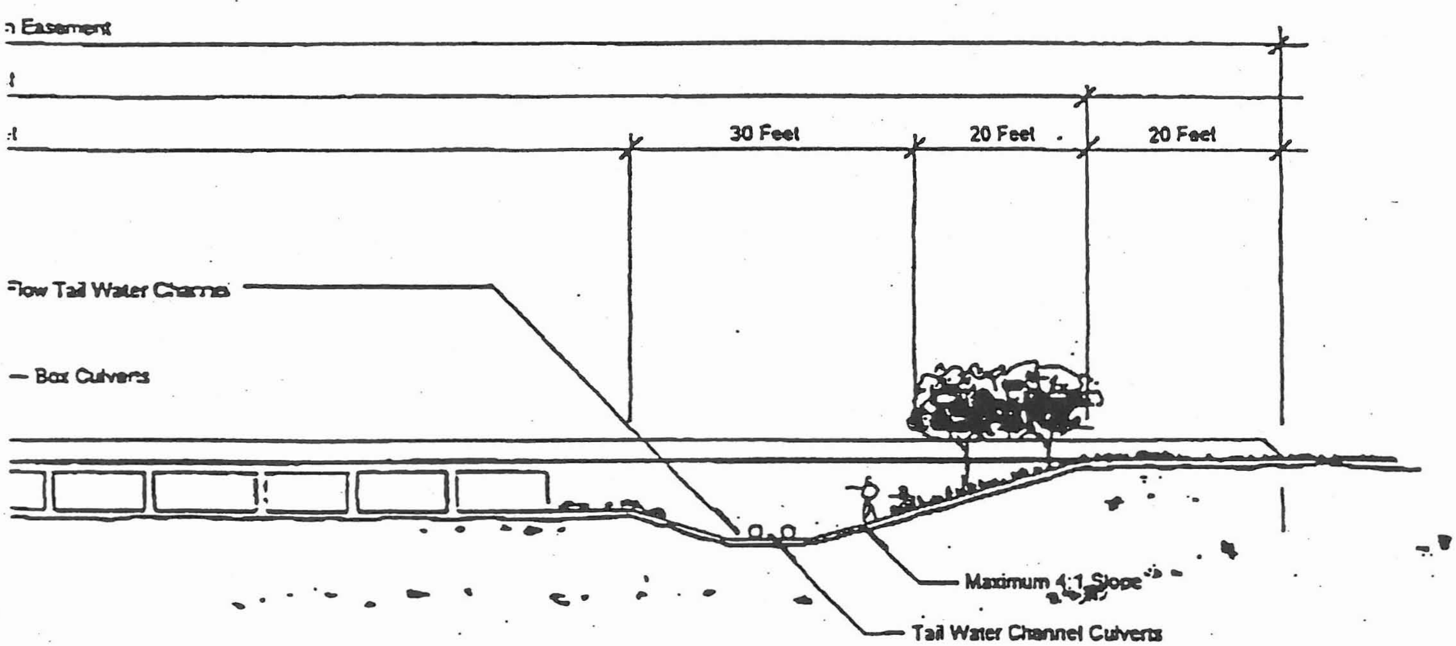
The purpose of this literature is to generally define the alignment of the wash, and the parameters for design requirements by the City of Goodyear Planning and Zoning Department and the Engineering Department.

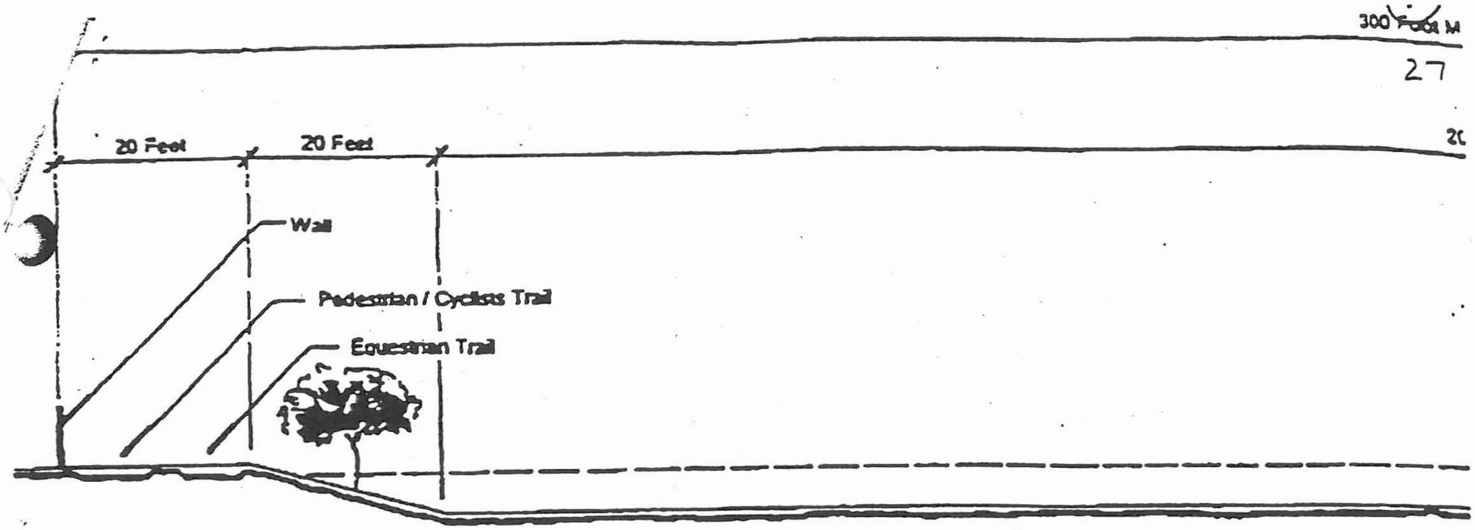
The City of Goodyear has planned for the Bullard Wash to both a storm water conveyance channel and an aesthetic open space and trail corridor through the City. Playing fields, trails for exercise and relaxation will be proposed by designers of developers controling property that fronts the proposed alignment. Designs should be a collaborative effort between developers, planners, landscape architects, engineers, architects and City staff to establish an amenity to adjacent developments and to the City of Goodyear.



26

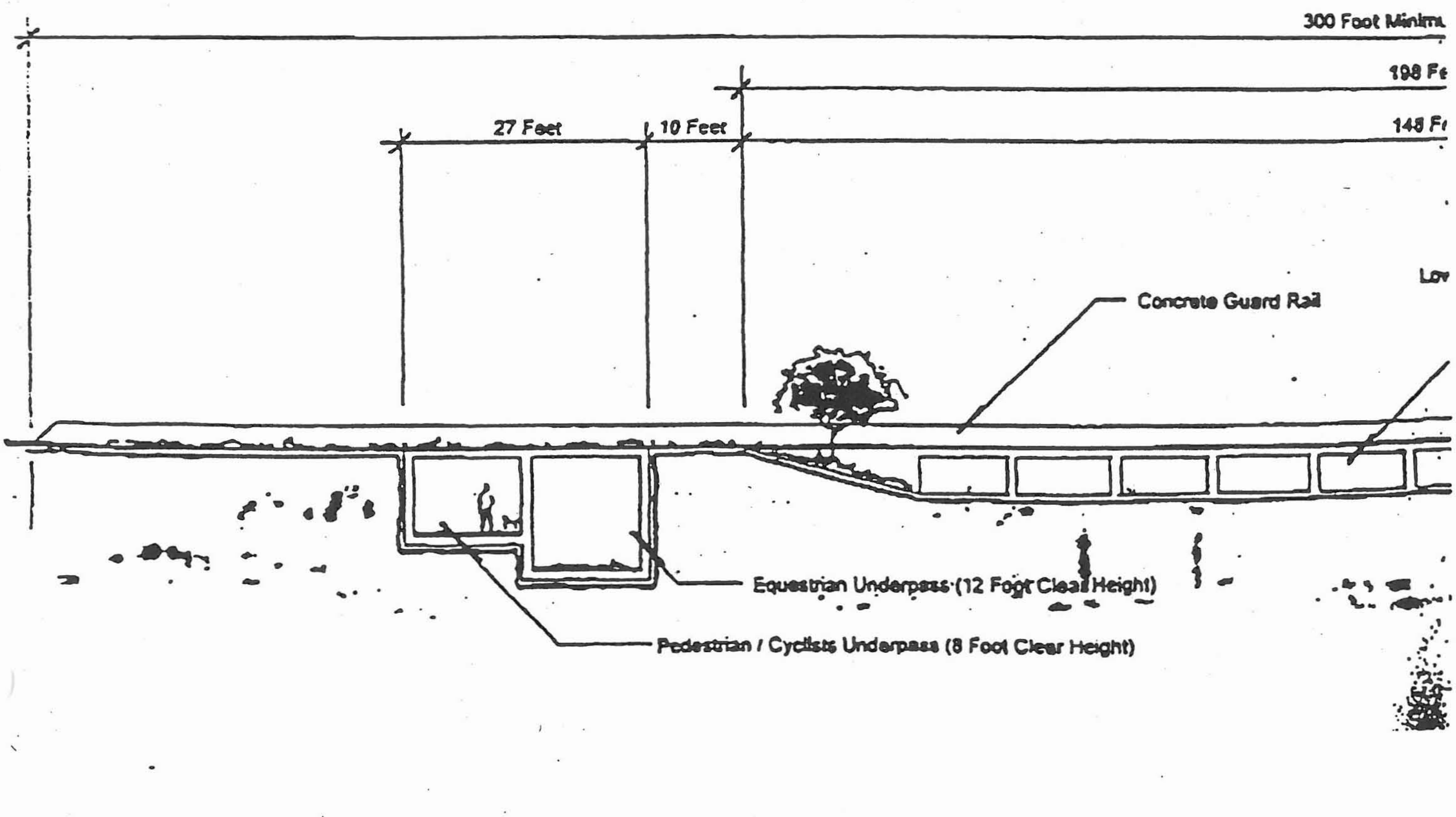

30 Feet
20 Feet
10 Feet
Industrial User
Wall
Maximum 4:1 Slope
Low Flow Tail Water Channel

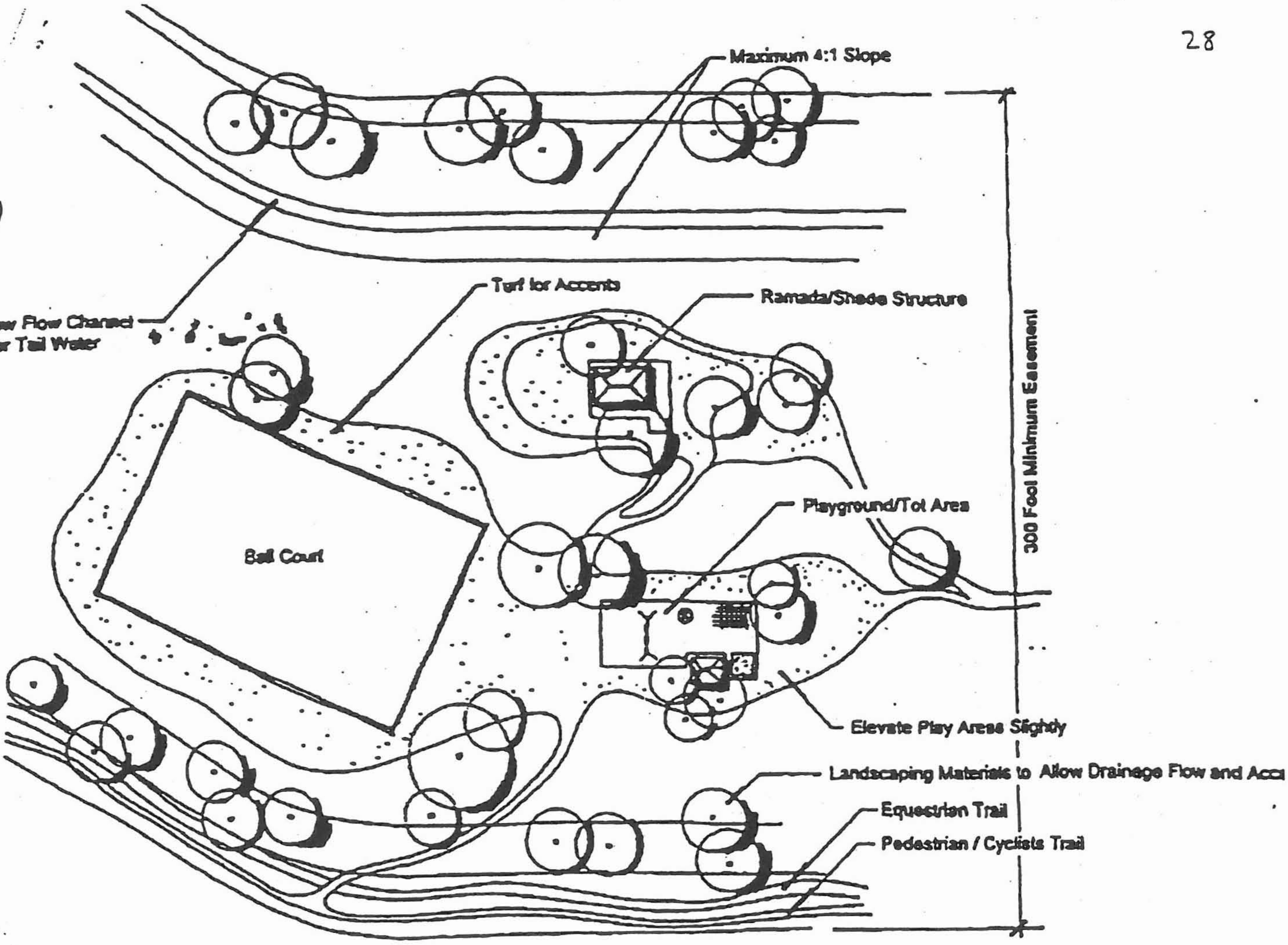

Easement
30 Feet
20 Feet
20 Feet
Flow Tail Water Channel
Box Culverts
Maximum 4:1 Slope
Tail Water Channel Culverts

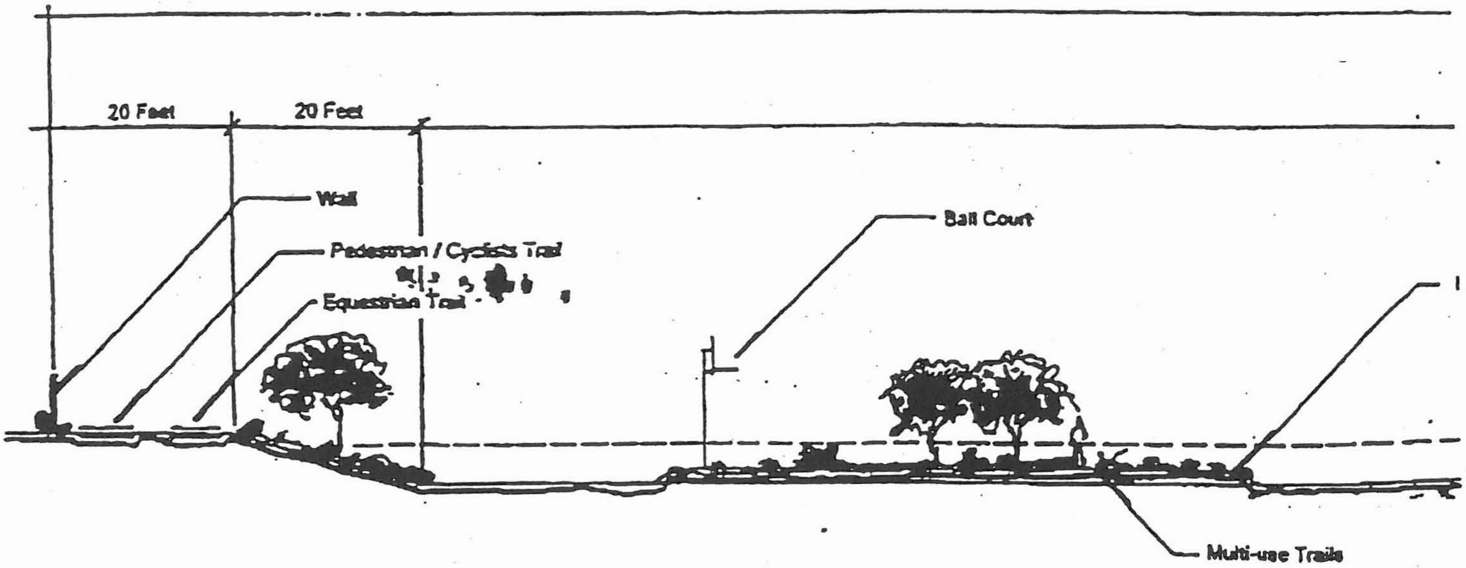


For the purpose of engineering, Bullard Wash has flows 32,000 CFS at a 100 year two-hour storm. The City of Goodyear's proposed required section will be 300 feet. In that section the required flows will be safely conveyed as well as many aesthetic "trail" features. Trails will allow for multipurpose users from pedestrians, to cycles to equestrians.

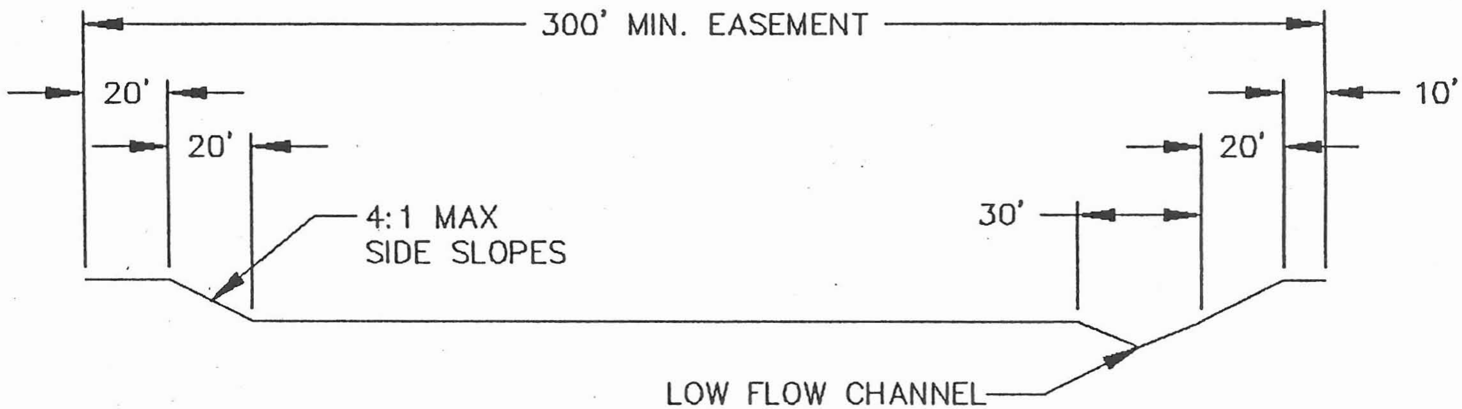
Pedestrians/cyclists are to be separated from equestrians both on the trails and at grade separated crossings at major arterials as depicted on the map to the right. Surface treatments will be hard surfaced for the pedestrians and soft surface for the equestrians.




Maximum 4:1 Slope
Low Flow Channel for Tail Water
Turf for Accents
Ramada/Shade Structure
300 Foot Minimum Easement
Ball Court
Playground/Tot Area
Elevate Play Areas Slightly
Landscaping Materials to Allow Drainage Flow and Acc
Equestrian Trail
Pedestrian / Cyclists Trail


20 Feet
20 Feet
Wall
Pedestrian / Cyclists Trail
Equestrian Trail
Ball Court
Multi-use Trails

TOTAL P.05



CITY OF GOODYEAR TYPICAL SECTION

STATION:	0	20	40	240	255	270	290	300
ELEV:	8.0	8.0	3.0	3.0	0.0	3.0	8.0	8.0

8x6-culvert.txt

Culvert Calculator

Entered Data:

```
     Shape ............................ Rectangular
     Number of Barrels ................ 1
     Solving for ...................... Headwater
     Chart Number ..................... 8
     Scale Number ..................... 1
     Chart Description ................ BOX CULVERT WITH FLARED WINGWALLS; NO INLET TOP EDGE BEVEL
     Scale Decsription ................ WINGWALLS FLARED 30 TO 75 DEGREES
     Overtopping ...................... Off
     Flowrate ......................... 262.0000 cfs
     Manning's n ...................... 0.0200
     Roadway Elevation ................ 20.0000 ft
     Inlet Elevation .................. 0.1960 ft
     Outlet Elevation ................. 0.0000 ft
     Height ........................... 6.0000 ft
     Width ............................ 8.0000 ft
     Length ........................... 98.0000 ft
     Entrance Loss .................... 0.0000
     Tailwater ........................ 6.0000 ft
```

Computed Results:

```
     Headwater ........................ 7.0006 ft Inlet Control
     Slope ............................ 0.0020 ft/ft
     Velocity ......................... 5.4583 fps
```

Messages:

```
     Inlet head > Outlet head.
     Computing Inlet Control headwater.
     Solving Inlet Equation 26.
     Solving Inlet Equation 28.
     Headwater: 7.0006 ft
```

DIS-CHARGE Flow cfs	HEAD-WATER ELEV. ft	INLET CONTROL DEPTH ft	OUTLET CONTROL DEPTH ft	FLOW TYPE	NORMAL DEPTH ft	CRITICAL DEPTH ft	OUTLET VEL. fps	OUTLET DEPTH ft	TAILWATER VEL. fps	TAILWATER DEPTH ft
260.00	6.99	6.79	6.51	NA	6.00	6.00	5.42	6.00	0.00	6.00
261.00	7.00	6.80	6.52	NA	6.00	6.00	5.44	6.00	0.00	6.00
262.00	7.00	6.80	6.52	NA	6.00	6.00	5.46	6.00	0.00	6.00
263.00	7.01	6.81	6.53	NA	6.00	6.00	5.48	6.00	0.00	6.00
264.00	7.01	6.81	6.53	NA	6.00	6.00	5.50	6.00	0.00	6.00
265.00	7.02	6.82	6.54	NA	6.00	6.00	5.52	6.00	0.00	6.00
266.00	7.02	6.82	6.55	NA	6.00	6.00	5.54	6.00	0.00	6.00
267.00	7.03	6.83	6.55	NA	6.00	6.00	5.56	6.00	0.00	6.00
268.00	7.03	6.83	6.56	NA	6.00	6.00	5.58	6.00	0.00	6.00
269.00	7.03	6.84	6.56	NA	6.00	6.00	5.60	6.00	0.00	6.00
270.00	7.04	6.84	6.57	NA	6.00	6.00	5.63	6.00	0.00	6.00

12x8-culvert.txt

Culvert Calculator

Entered Data:

```
     Shape ........................... Rectangular
     Number of Barrels ............... 1
     Solving for ..................... Headwater
     Chart Number .................... 8
     Scale Number .................... 1
     Chart Description ............... BOX CULVERT WITH FLARED WINGWALLS; NO INLET TOP EDGE BEVEL
     Scale Decsription ............... WINGWALLS FLARED 30 TO 75 DEGREES
     Overtopping ..................... Off
     Flowrate ........................ 573.0000 cfs
     Manning's n ..................... 0.0200
     Roadway Elevation ............... 20.0000 ft
     Inlet Elevation ................. 0.1960 ft
     Outlet Elevation ................ 0.0000 ft
     Height .......................... 8.0000 ft
     Width ........................... 12.0000 ft
     Length .......................... 98.0000 ft
     Entrance Loss ................... 0.0000
     Tailwater ....................... 8.0000 ft
```

Computed Results:

```
     Headwater ....................... 9.1806 ft Inlet Control
     Slope ........................... 0.0020 ft/ft
     Velocity ........................ 5.9688 fps
```

Messages:

```
     Inlet head > Outlet head.
     Computing Inlet Control headwater.
     Solving Inlet Equation 26.
     Solving Inlet Equation 28.
     Headwater: 9.1806 ft
```

DIS-CHARGE Flow cfs	HEAD-WATER ELEV. ft	INLET CONTROL DEPTH ft	OUTLET CONTROL DEPTH ft	FLOW TYPE	NORMAL DEPTH ft	CRITICAL DEPTH ft	OUTLET VEL. fps	OUTLET DEPTH ft	TAILWATER VEL. fps	TAILWATER DEPTH ft
570.00	8.74	6.61	8.55	NA	6.64	8.00	5.94	8.00	0.00	8.00
571.00	8.74	6.62	8.55	NA	6.65	8.00	5.95	8.00	0.00	8.00
572.00	8.75	6.63	8.55	NA	6.66	8.00	5.96	8.00	0.00	8.00
573.00	9.18	8.98	8.55	NA	8.00	8.00	5.97	8.00	0.00	8.00
574.00	9.18	8.99	8.56	NA	8.00	8.00	5.98	8.00	0.00	8.00
575.00	9.19	8.99	8.56	NA	8.00	8.00	5.99	8.00	0.00	8.00
576.00	9.19	8.99	8.56	NA	8.00	8.00	6.00	8.00	0.00	8.00
577.00	9.19	9.00	8.56	NA	8.00	8.00	6.01	8.00	0.00	8.00
578.00	9.19	9.00	8.57	NA	8.00	8.00	6.02	8.00	0.00	8.00
579.00	9.20	9.00	8.57	NA	8.00	8.00	6.03	8.00	0.00	8.00
580.00	9.20	9.00	8.57	NA	8.00	8.00	6.04	8.00	0.00	8.00

ITEM DESCRIPTION	UNIT	UNIT COST	SOURCE
Channel Excavation	C.Y.	$3.25	ADOT Bid Tabulations - 1999 (pg 25) Adjusted for inflation
Detention Basin Excavation	C.Y.	$5.00	ADOT Bid Tabulations - 1999 (pgs 24-25) Adjusted for inflation
Mixing Basin Excavation	C.Y.	$5.00	ADOT Bid Tabulations - 1999 (pgs 24-25) Adjusted for inflation
Grouted Rip-Rap	C.Y.	$130.00	ADOT Bid Tabulations - 1999 (pg 309) Adjusted for inflation
Hydroseed & Topsoil	ACRE	$2,500.00	ADOT Bid Tabulations - 1999 (pgs 250-251) Adjusted for inflation
Concrete Channel Lining	S.Y.	$19.50	Cost estimates for State Route SR101L, Agua Fria Freeway, Dated March 1999, adjusted for inflation
Backfill	C.Y.	$19.00	Cost estimates for State Route SR101L, Agua Fria Freeway, Dated March 1999, adjusted for inflation
Cast-In-Place Concrete	C.Y.	$250.00	Cost estimates for State Route SR101L, Agua Fria Freeway, Dated March 1999, adjusted for inflation
Reinforcing Steel	LB	$0.54	ADOT Bid Tabulations - 1999 (pg 105) Adjusted for inflation
72" Φ Class V RCP	L.F.	$350.00	ADOT Bid Tabulations - 1999 (pg 74) Adjusted for inflation
60" Φ Class V RCP	L.F.	$280.00	ADOT Bid Tabulations - 1999 (pg 73) Adjusted for inflation

Alte[illegible] 1
Channel Sizi[illegible] Table

Proposed Channel	Concentration Point	Routing Section	Revised Discharge (cfs)	Comments	Mannings n	Original Channel Slope (ft/ft)	Channel Slope (ft/ft)	Depth (ft)	Bottom Width (ft)	Surface Water Top Width (ft)	Velocity (ft/s)
Beardsley Channel	BC1		313	Use to size US reach	0.03	0.0083	0.0083	1.84	20	42.03	5.5
		RBC1									
	BC2		**2829**	Use to size RBC1	0.03	0.0076	**0.0040**	2.95	142	177.42	**5.99**
		RBC2									
	BC3		**6435**	Use to size RBC2	0.03	0.0075	**0.0020**	5.1	180	241.26	**5.98**
		RBC3									
	BC4		**6455**	Use to size RBC3	0.03	0.0083	**0.0020**	5.1	181	242.19	**5.98**
		RBC4									
	BC5		**6653**	Use to size RBC4	0.03	0.0113	**0.0020**	5.08	188	249.01	**5.99**
Jackrabbit Trail	JR1		923	not used for sizing	0.03						
		RJR1		not used for sizing							
	JR2		**1417**	Size RJR1	0.03	0.0063	0.0063	2.09	101	126.05	**5.98**
		RJR2									
	JR3		**1719**	Size RJR2	0.03	0.0089	**0.0050**	2.55	97	127.64	**5.99**
Jackrabbit-Perryville	JP1		948	Size US reach	0.03	0.0061	0.0061	1.91	79	101.92	5.49
		RJP1									
	JP2		**1181**	Size RJP1	0.03	0.0068	0.0068	2.01	86	110.08	**6**
		RJP2									
	JP3		**1168**	Use to size RJP2	0.03	0.0068	0.0068	2.01	85	109.08	**6**
		RJP3									
	JP4		**1282**	Use to size RJP3	0.03	0.0029	0.0029	4.66	22	77.97	5.5
		RJP4									
	JP5		**1755**	Use to size RJP4	0.03	0.0023	0.0023	5.88	19	89.54	5.5
		RJP5									
	JP6		**1952**	Use to size RJP5	0.03	0.0015	**0.0020**	6.97	10	93.64	5.4
		RJP6									
	JP7		**1961**	Use to size RJP6 and	0.03	0.0013	**0.0020**	6.98	10	93.8	5.41
		RJP7									
Tuthill Channel	TC1		1474	Size US reach	0.03	0.0068	**0.0030**	3.88	46	92.5	5.49
		RTC1									
	TC2		**1497**	Size RTC1	0.03	0.0020	0.0020	6.61	5	84.37	5.07
		RTC2									
	TC3		**2065**	Size RTC2 and DS se	0.03	0.0007	**0.0020**	6.94	13	96.33	5.48
Loop 303		R121A									
	LP1		1278	Use to size R121A	0.03	0.0028	0.0028	5.3	12	75.65	5.5
		RLP1									
	LP2		**2387**	Size RLP1	0.03	0.0023	0.0023	4.56	68	122.67	5.5
		RLP2									
	LP3		1822	Size RLP2	0.03	0.0042	**0.0040**	3.19	76	114.33	**5.99**
		RLP3									
	LP4		**2089**	Size RLP3	0.03	0.0034	**0.0030**	4.43	52	105.17	**6**
		RLP4									
	LP5		**848**	Size RLP4	0.03	0.0047	0.0047	3.95	12	59.45	**6**
		RLP5									
	LP6		**1119**	Size RLP5	0.03	0.0034	**0.0034**	5.3	5	68.56	**5.74**
		RLP6									

1) FLOWS FROM L3PA1E4B.OH1

P:\Calculations Evaluations\Hydrology\URS Models\Existing Condition\Alternatives\With JD\Alternative 1\Excel-3rd-iter\New Reaches alt1 3l.xls

Proposed Channel	Concentration Point	Routing Section	Revised Discharge	Comments	Mannings n	Original Channel Slope	Channel Slope	Depth	Bottom Width	Surface Water Top Width	Velocity
	LP7		1264	Size RLP6	0.03	0.0045	0.0045	3.11	49	86.36	6
		RLP7									
	LP8		1879	Size RLP7	0.03	0.0037	0.0037	3.48	69	110.79	6
		RLP8									
	LP9		1096	Size RLP8	0.03	0.0027	0.0027	5.5	5	71.01	5.24
		RLP9									
	LP10		1142	Size RLP9	0.03	0.0045	0.0045	3.25	39	78.06	6
		RLP10									
	LP11		1270	Size RLP10	0.03	0.0044	0.0044	3.2	47	85.4	6
		RLP11									
	LP12		2815	Size RLP11	0.03	0.0043	0.0030	3.98	94	141.73	6
		RLP12									
	LP13		2738	Size RLP12	0.03	0.0040	0.0030	4	90	138.02	6
		RLP13									
	LP14		4217	Size RLP13	0.03	0.0044	0.0020	5.74	88	156.91	6
		RLP14									
	LP15		4450	Size RLP14	0.03	0.0038	0.0020	5.63	98	165.56	6
		RLP15									
	LP16		4402	Size RLP15	0.03	0.0043	0.0020	5.65	96	163.8	6
		RLP16									
	LP17		4361	Size RLP16	0.03	0.0013	0.0020	5.65	95	162.78	6
Reems Channel	RM1		1115	No sizing	0.03	0.0038					
		RRM1									
		2RRM1									
	RM2		1091	Size 2RRM1	0.03	0.0034	0.0034	3.78	30	75.31	5.49
		RRM2									
	RM3		1561	Size RRM2	0.03	0.0063	0.0040	3.34	58	98.08	5.99
		RRM3									
	RM4		2066	Size RRM3	0.03	0.0042	0.0040	3.09	93	130.12	5.99
		RRM4									
	RM5		642	Size RRM4	0.03	0.0040	0.0040	4.09	5	54.1	5.31
		RRM5									
	RM6		879	Size RRM5	0.03	0.0034	0.0034	4.81	5	62.66	5.41
AT & SF Railroad Channel		2D152									
	RR1		623	Size 2D152	0.03	0.0027	0.0027	4.38	5	57.55	4.55
		RRR1									
	RR2		748	Size RRR1	0.03	0.0036	0.0036	4.45	5	58.39	5.3
		RRR2									
	RR3		1624	Size R168	0.03	-0.0008	0.0020	6.83	5	86.97	5.17
		RRR3									
	RR4		1879	Size RRR3	0.03	0.0031	0.0031	4.44	44	97.29	5.99
		RRR4									
	RR5		1913	Size RRR4	0.03	0.0038	0.0038	3.33	76	115.97	5.98
Bullard Wash	BD1N		1856	Size US reach - not m	0.03	0.0027	0.0027	4.05	59	107.65	5.49
		RBD1N									
	1I241		2911	Size RBD1N	0.03	0.0039	0.0025	4.93	69	128.12	5.99

Alte[illegible] 1
Channel Siz[illegible]g Table

Proposed Channel	Concentration Point	Routing Section	Revised Discharge	Comments	Mannings n	Original Channel Slope	Channel Slope	Depth	Bottom Width	Surface Water Top Width	Velocity
	BD2N		**3007**	fyi	0.03	0.0039					
		RBD2N									
	BD3N		**3268**	Size RBD2N	0.03	0.0046	**0.0025**	4.72	87	143.67	**6**
		RBD3N		already designed - Palm Valley GC							
	BD4N		**3249**	already designed - Pal	0.03	0.0021					
		RBD4N									
	BD1S		**3645**	Size RBD4N	0.03	0.0028	0.0028	Used City of Goodyear Typical Section - See Note			5.18
		RBD1S									
	BD2S		**3674**	Size RBD1S	0.03	0.0020	0.0020				4.68
		RBD2S									
	BD3S		**1864**	Size RBD2S	0.03	0.0032	0.0032				4.18
		RBD3S									
	BD4S		**1866**	Size RBD3S	0.03	0.0028	0.0028				4.01
		RBD4S									
	BD5S		**1880**	Size RBD4S	0.03	0.0023	0.0023				3.79
		RBD5S									
	BLRD2		**3149**	Size RBD5S	0.03	0.0038	0.0038				5.39
Northern Channel	NR1		256	Use to size US reach -	0.03	0.0049	0.0049	2.68	5	37.11	4.54
		RNR1									
	NR2		**1269**	Size RNR1	0.03	0.0056	**0.0040**	3.7	35	79.42	**5.99**
		RNR2									
	NR3		**2201**	Size RNR2	0.03	0.0064	**0.0030**	4.29	60	111.46	**5.99**
		RNR3									
	NR4		**2341**	Size RNR3	0.03	0.0045	**0.0030**	4.19	68	118.32	**5.99**
		RNR4									
	NR5		**1747**	Size RNR4	0.03	0.0042	0.0042	3.06	77	113.68	**5.99**
		RNR5									
	NR6		**1890**	Size RNR5	0.03	0.0038	0.0038	3.35	74	114.23	**5.99**
Camelback Channel		1R237									
	CM1		**1348**	Size 1R237	0.03	0.0034	0.0034	5.34	10	74.1	**6**
		RMC1									
	CM2		**1652**	Size RCM1	0.03	0.0020	0.0020	6.88	5	87.53	5.19
		RCM2									
	CM3		**1683**	Size RCM2	0.03	0.0020	0.0020	6.93	5	88.14	5.22
		RCM3									
	CM4		**2319**	Size RCM3	0.03	0.0020	0.0020	6.13	30	104.58	5.54
I-10 Channel	10-1		1275	fyi	0.03	0.0035					
		R10-1									
	10-2		1452	Size R10-1	0.03	0.0053	0.0053	2.48	83	112.72	**5.99**
		R10-2									
	10-3		**1463**	Size R10-2	0.03	0.0047	0.0047	2.81	70	103.73	**5.99**
		R10-3									
	10-4		**1618**	Size R10-3	0.03	0.0036	0.0036	3.81	48	93.73	**5.99**
		R10-4									
	10-5		**1927**	Size R10-4	0.03	0.0036	0.0036	3.56	69	111.71	**5.99**
		R10-5									
	10-6		**1923**	Size R10-5	0.03	0.0027	0.0027	6.1	16	89.18	**6**

1) FLOWS FROM L3PA1E4B.OH1

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Alte[illegible] 1
Channel S[illegible] Table

Proposed Channel	Concentration Point	Routing Section	Revised Discharge	Comments	Manning's n	Original Channel Slope	Channel Slope	Depth	Bottom Width	Surface Water Top Width	Velocity
		R10-6									
	10-7		1933	Size R10-6	0.03	0.0020	0.0020	6.94	10	93.31	5.39
		R10-7									
	10-8		1929	Size R10-7	0.03	0.0020	0.0020	6.94	10	93.24	5.39
		R10-8									
	10-9		1926	Size R10-8	0.03	0.0020	0.0020	6.93	10	93.22	5.39
		R10-9									
	10-10		1920	Size R10-9	0.03	0.0023	0.0023	6.95	7	90.36	5.68
Buckeye Channel		RD307									
	BE1		901	Size RD307	0.03	0.0015	0.0020	5.4	5	69.81	4.46
		RBE1									
	BE2		1415	Size RBE1	0.03	0.0033	0.0033	5.42	11	76.01	6
		RBE2									
	BE3		1397	Size RBE2	0.03	0.0020	0.0020	6.43	5	82.22	4.98
		RBE3									
	BE4		1554	Size RBE3	0.03	0.0043	0.0043	3.07	66	102.84	6
Union Pacific Railraod Channel	UP1		620	Size US reach - not m	0.03	0.0016	0.0020	4.64	5	60.74	4.06
		RUP1									
	UP2		767	Size RUP1	0.03	0.0027	0.0027	4.76	5	62.17	4.79
		RUP2									
	UP3		809	Size RUP2	0.03	0.0000	0.0020	5.17	5	67.06	4.34
		RUP3									
	UP4		1677	Size RUP3	0.03	0.0015	0.0020	6.92	5	88.02	5.21
		RUP4									
	UP5		2201	Size RUP4	0.03	0.0016	0.0020	6.29	26	101.43	5.5
		RUP5									

1) FLOWS FROM L3PA1E4B.OH1

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Channel Siz[illegible] Table

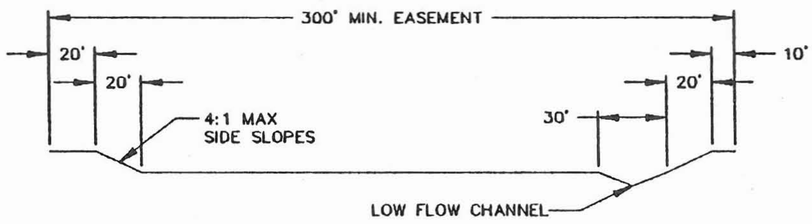
Proposed Channel	Concentration Point	Routing Section	Revised Discharge	Comments	Mannings n	Original Channel Slope	Channel Slope	Depth	Bottom Width	Surface Water Top Width	Velocity
	UP6		**2433**	Size RUP5	0.03	0.0030	0.0030	4.12	74	123.43	**5.98**
		RUP6									
	UP7		**2413**	Size RUP6	0.03	0.0024	0.0024	6.07	30	102.79	**5.99**
West Valley Channel	WVR1		1268	Size US reach - not m	0.03	0.0093	**0.0050**	2.73	61	93.77	**6**
		RWVR1									
	WVR2		**1666**	Size RWVR1	0.03	0.0067	**0.0050**	2.54	95	125.43	**5.96**
		RWVR2									
	WVR3		**1931**	Size RWVR2	0.03	0.0073	**0.0040**	3.16	83	120.88	**6**
		RWVR3									
	WVR4		**2243**	Size RWVR3	0.03	0.0042	**0.0040**	3.04	105	141.5	**5.98**
		RWVR4									
	WVR5		**2428**	Size RWVR4	0.03	0.0038	**0.0030**	4.09	75	124.06	**5.97**
		RWVR5									
	WVR6		**2493**	Size RWVR5	0.03	0.0027	**0.0027**	4.65	62	117.81	**5.96**
		RWVR6									
	WVR7		**2524**	Size RWVR6	0.03	0.0030	0.0030	4.03	81	129.32	**5.96**
		RWVR7									
	WVR8		**2565**	Size RWVR7 & RWVR	0.03	0.0040	**0.0030**	3.99	84	131.9	**5.95**
		RWVR8									

1) FLOWS FROM L3PA1E4B.OH1

Alte 1
Channel Sizing Table

Proposed Channel	Concentration Point	Routing Section	Revised Discharge	Comments	Mannings n	Original Channel Slope	Channel Slope	Depth	Bottom Width	Surface Water Top Width	Velocity
ADOT											
	DIADOT	RADOT	199	Size RADOT	0.03	0.0024	0.0024	2.8	5	38.57	3.27

Note:



CITY OF GOODYEAR TYPICAL SECTION

STATION:	0	20	40	240	255	270	290	300
ELEV:	8.0	8.0	3.0	3.0	0.0	3.0	8.0	8.0

1) FLOWS FROM L3PA1E4B.OH1

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Alte[illegible] 2
Channel Sizing Table

Proposed Channel	Concentration Point	Routing Section	Discharge w/ Basins [cfs]	Comments	Mannings n	Original Channel Slope [ft/ft]	Channel Slope [ft/ft]	Depth [ft]	Bottom Width [ft]	Surface Water Top Width [ft]	Velocity [ft/s]
Loop 303	LP1		1282	Qd for 1st reach	0.03	0.0028	0.0028	5.45	10	75.38	5.51
		RLP1									
	LP2		2440	Size RLP1	0.03	0.0024	0.0024	6.44	25	102.29	5.95
		RLP2									
	LP3		3601	Size RLP2	0.03	0.0042	0.0020	6.23	59	133.76	6
		RLP3									
	LP4		3860	Size RLP3	0.03	0.0034	0.0020	5.87	75	145.45	5.97
		RLP4									
	LP5		3708	Size RLP4	0.03	0.0047	0.0020	6.13	64	137.57	6
		RLP5									
	LP6		485	Size RLP5	0.03	0.0034	0.0034	3.77	5	50.25	4.66
		RLP6									
	LP7		841	Size RLP6	0.03	0.0045	0.0045	4.46	5	58.51	5.94
		RLP7									
	LP8		908	Size RLP7	0.03	0.0037	0.0037	4.79	5	62.43	5.63
		RLP8									
	LP9		614	Size RLP8	0.03	0.0027	0.0027	4.35	5	57.24	4.53
		RLP9									
	LP10		672	Size RLP9	0.03	0.0045	0.0045	4.07	5	53.83	5.61
		R3D278									
	LP11		1158	Size R3D278	0.03	0.0044	0.0044	3.33	38	78	5.99
		RLP11									
	LP12		2681	Size RLP11	0.03	0.0043	0.0030	4.02	87	135.26	6
		RLP12									
	LP13		654	Size R279 (RLP12)	0.03	0.0040	0.0040	4.12	5	54.47	5.34
		RLP13									
	LP14		654	Size RLP13	0.03	0.0044	0.0044	4.04	5	53.52	5.53
		RLP14									
	LP15		969	Size RLP14	0.03	0.0038	0.0038	4.89	5	63.65	5.78
		RLP15									
	LP16		935	Size RLP15	0.03	0.0025	0.0025	5.24	5	67.9	4.89
		RLP16									
	LP17		1413	Size RLP16	0.03	0.0040	0.0040	3.51	46	88.12	6
Beardsley	BC1		313	Use for 1st reach	0.03	0.0083	0.0083	1.84	20	42.03	5.5
		RBC1									
	BC2		2838	Size RBC1	0.03	0.0076	0.0040	2.95	143	178.36	5.99
		RBC2									
	BC3		4823	Size RBC2	0.03	0.0075	0.0020	5.48	114	179.73	6

1) FLOWS FROM L3PA2E3C

Alte[illegible] 2
Channel Sizing Table

Proposed Channel	Concentration Point	Routing Section	Discharge w/ Basins [cfs]	Comments	Mannings n	Original Channel Slope [ft/ft]	Channel Slope [ft/ft]	Depth [ft]	Bottom Width [ft]	Surface Water Top Width [ft]	Velocity [ft/s]
		RBC3									
	BC4		**4906**	Size RBC3	0.03	0.0083	**0.0020**	5.46	117	182.52	**6**
		RBC4									
	BC5		**4994**	Size RBC4	0.03	0.0113	**0.0030**	5.42	121	186.09	**6**
Jackrabbit	JRS1		734	Use for 1st reach	0.03	0.0062	0.0062	2.5	34	64.01	**5.99**
		RJRS1									
	JRS2		**863**	Size RJRS1	0.03	0.0068	0.0068	2.12	55	80.49	**6**
		RJRS2									
	JRS3		**1182**	Size RJRS2	0.03	0.0063	0.0063	2.16	78	103.97	**6**
		RJRS3		Already designed							
	JRS4		**1519**	Already designed	0.03	0.0089					
		RJRS4		Already designed							
Jackrabbit / Perryville	JP1		525	1st reach design Q	0.03	0.0060	0.0060	2.29	28	55.49	5.49
		RJP1									
	JP2		**2360**	Size RJP1	0.03	0.0067	**0.0035**	3.49	92	133.82	**6**
		RJP2									
	JP3		**2637**	Size RJP2	0.03	0.0053	**0.0030**	4.03	85	133.36	**5.99**
		RJP3									
	JP4		**3037**	Size RJP3	0.03	0.0059	**0.0030**	3.89	107	153.65	**5.99**
		RJP4									
	JP5		**3046**	Size RJP4	0.03	0.0052	**0.0030**	3.89	107	153.73	**6**
		RJP5									
	JP6		**3239**	Size RJP5	0.03	0.0033	0.0033	3.49	134	175.83	**6**
		RJP6									
	JP7		**3254**	Size RJP6 & RJP7	0.03	0.0020	0.0020	6.75	40	120.97	**5.99**
		RJP7									
Reems Channel	RM1		1115	Already designed	0.03						
		2R122A		Already designed							
	RM2		1062	Already designed	0.03						
		RRM2									
	RM3		**1455**	Design RRM2	0.03	0.0063	**0.0040**	3.44	50	91.26	**5.99**
		RRM3									
	RM4		**1875**	Design RRM3	0.03	0.0042	0.0042	3.01	86	122.08	**5.99**
		RRM4									
	RM5		**657**	Design RRM4	0.03	0.0040	0.0040	4.13	5	54.56	5.34
		R179									
	RM6		**725**	Design R179	0.03	0.0034	0.0034	4.44	5	58.33	5.15
El Mirage Channel	EM1		939	Use to size US reach	0.03	0.0049	0.0049	3.19	30	68.24	**6**

1) FLOWS FROM L3PA2E3C

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Altei 2
Channel Sizing Table

Proposed Channel	Concentration Point	Routing Section	Discharge w/Basins [cfs]	Comments	Mannings n	Original Channel Slope [ft/ft]	Channel Slope [ft/ft]	Depth [ft]	Bottom Width [ft]	Surface Water Top Width [ft]	Velocity [ft/s]
		R137									
	EM2		1081	Use to size R137	0.03	0.0020	0.0020	5.81	5	74.71	4.67
	138		278	Use to size ch bed 138 & 138A	0.03	0.0038	0.0038	2.92	5	40.08	4.22
		R138									
	EM3		1081	Use to size R138	0.03	0.0020	0.0020	5.81	5	74.71	4.67
		REM3									
	EM4		1142	Size REM3	0.03	0.0020	0.0020	5.94	5	76.26	4.73
Railroad Channel	RR1		1379	Size US reach	0.03	0.0045	0.0045	3.02	58	94.24	6
		RRR1									
	RR2		1505	Size RRR1	0.03	0.0036	0.0036	3.99	39	86.85	6
		RRR2									
	RR3		2254	Size RRR2	0.03	0.0020	0.0020	6.98	16	99.72	5.58
		RRR3									
	RR4		2639	Size RRR3	0.03	0.0020	0.0020	6.95	24	107.45	5.77
		RRR4									
	RR5		2674	Size R181	0.03	0.0038	0.0038	3.12	124	161.49	6
		RRR5									
Lower El Mirage	LE1		657	Use to size US reach	0.03	0.0038	0.0038	4.17	5	55.08	5.24
		RLE1									
	LE2		708	Size RLE1	0.03	0.0050	0.0050	4.07	5	53.82	5.92
		RLE2									
	LE3		983	Size RLE2	0.03	0.0038	0.0038	4.92	5	63.99	5.8
		RLE3									
	LE4		1019	Size RLE3	0.03	0.0042	0.0042	4.15	16	65.83	6
		RLE4									
	LE5		1098	Size RLE4	0.03	0.0042	0.0042	3.77	26	71.23	5.99
Bullard Wash	BD1N		1856	Size US reach	0.03	0.0020	0.0020	6.83	10	91.92	5.34
		RBD1N									
	BD2N		2865	Size RBD1N	0.03	0.0020	0.0020	6.98	28	111.75	5.87
		RBD2N									
	BD3N		3202	Size RBD2N	0.03	0.0046	0.0030	3.84	116	162.11	5.99
		RBD3N									
	BD4N		3174	RBD3N should be done per Palm Valley	0.03	0.0021	0.0021	6.26	47	122.09	6

1) FLOWS FROM L3PA2E3C

Alte. 2
Channel Sizing Table

Proposed Channel	Concentration Point	Routing Section	Discharge w/ Basins [cfs]	Comments	Mannings n	Original Channel Slope [ft/ft]	Channel Slope [ft/ft]	Depth [ft]	Bottom Width [ft]	Surface Water Top Width [ft]	Velocity [ft/s]
		RBD4N									
	BD1S		3526	Size RBD4N	0.03	0.0028	0.0028	Used City of Goodyear Typical Section - See Note			5.12
		RBD1S									
	BD2S		3560	Size RBD1S	0.03	0.0020	0.0020				4.62
		RBD2S									
	BD3S		2660	Size RBD2S	0.03	0.0032	0.0032				4.79
		RBD3S									
	BD4S		2881	Size RBD3S	0.03	0.0028	0.0028				4.74
		RBD4S									
	BD5S		2922	Size RBD4S	0.03	0.0023	0.0023				4.48
		RBD5S									
	BLRD2		3414	Size RBD5S	0.03	0.0038	0.0030				5.42
	BLRD3		3456	Can't be > 3,200 cfs, already designed	0.03						
Northern Channel	NR1		2167	Use to size US reach	0.03	0.0076	0.0040	3.06	100	136.72	5.98
		RNR1									
	NR2		2640	Size RNR1	0.03	0.0076	0.0040	2.98	130	165.73	6
		RNR2									
	NR3		3588	Size RNR2	0.03	0.0064	0.0035	3.24	165	203.98	6
		RNR3									
	NR4		3789	Size RNR3	0.03	0.0045	0.0035	3.19	180	218.28	5.96
		RNR4									
	NR5		975	Size RNR4	0.03	0.0042	0.0042	4.58	8	62.99	5.99
		RNR5									
	NR6		923	Size RNR5	0.03	0.0038	0.0038	4.79	5	62.5	5.71
Camelback Channel	CM1		3062	Size US reach	0.03	0.0064	0.0030	3.21	154	192.57	5.5
		RCM1									
	CM2		3356	Size RCM1	0.03	0.0038	0.0020	6.61	45	124.28	6
		RCM2									
	CM3		3502	Size RCM2	0.03	0.0030	0.0030	3.78	132	177.34	5.99
		RCM3									
	CM4		3844	Size RCM3	0.03	0.0044	0.0020	5.99	71	142.92	6
		RCM4									
	CM5		4213	Size RCM4	0.03	0.0034	0.0030	5.77	87	156.23	6

1) FLOWS FROM L3PA2E3C

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Alte[illegible] 2
Channel Sizing Table

Proposed Channel	Concentration Point	Routing Section	Discharge w/Basins [cfs]	Comments	Mannings n	Original Channel Slope [ft/ft]	Channel Slope [ft/ft]	Depth [ft]	Bottom Width [ft]	Surface Water Top Width [ft]	Velocity [ft/s]
		RCM5									
	CM6		485	Size RCM5	0.03	0.0034	0.0034	3.77	5	50.25	4.66
		RCM6									
	CM7		845	Size RCM6	0.03	0.0020	0.0020	5.26	5	68.16	4.39
		RCM7									
	CM8		850	Size RCM7	0.03	0.0020	0.0020	5.28	5	68.31	4.4
		RCM8									
	CM9		1417	Size RCM8	0.03	0.0020	0.0020	6.47	5	82.65	5
I-10 West Channel		R10W1									
	10W2		1455	Size R10W1	0.03	0.0053	0.0053	2.48	83	112.75	6
		R10W2									
	10W3		1467	Size R10W2	0.03	0.0047	0.0047	2.82	70	103.79	6
		R10W3									
	10W4		1612	Size R10W3	0.03	0.0036	0.0036	3.84	47	93.05	6
		R10W4									
	10W5		1909	Size R10W4	0.03	0.0036	0.0036	3.59	67	110.08	6
		R10W5									
	10W6		1912	Size R10W5	0.03	0.0027	0.0027	6.22	14	88.58	6
		R10W6									
	10W7		1917	Size R10W6	0.03	0.0020	0.0020	6.95	10	93.02	5.38
		R10W7									
	10W8		1912	Size R10W7	0.03	0.0020	0.0020	6.91	10	92.93	5.38
		R10W8									
	10W9		1916	Size R10W8	0.03	0.0020	0.0020	6.92	10	93	5.38
		R10W9									
	1I279		1915	Size R10W9	0.03	0.0023	0.0023	4.62	10	90.61	5.67
I-10 East Channel	I10E1		79	Size US reach	0.03	0.0020	0.0020	1.96	5	28.47	2.41
		RI10E1									
	I10E2		137	Size R10E1	0.03	0.0020	0.0020	2.48	5	34.78	2.78
		RI10E2									
	I10E3		178	Size R10E2	0.03	0.0022	0.0022	2.77	5	28.28	2.97
		RI10E3									
	1I287		327	Size R10E3	0.03	0.0049	0.0049	2.97	5	40.6	4.83
Roosevelt Irrigation District Channel	RI1		338	Size US reach	0.03	0.0020	0.0020	3.62	5	48.49	3.49
		RRI1									
	RI2		456	Size RRI1	0.03	0.0020	0.0020	4.1	5	54.19	3.76

1) FLOWS FROM L3PA2E3C

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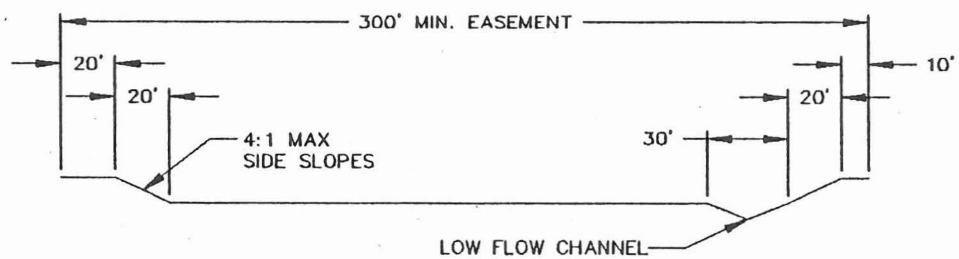
Alter 2
Channel Sizing Table

Proposed Channel	Concentration Point	Routing Section	Discharge w/Basins [cfs]	Comments	Mannings n	Original Channel Slope [ft/ft]	Channel Slope [ft/ft]	Depth [ft]	Bottom Width [ft]	Surface Water Top Width [ft]	Velocity [ft/s]
		RRI2									
	RI3		1256	Size RRI2	0.03	0.0020	0.0020	6.17	5	79.02	4.85
		RRI3									
	RI4		1230	Size RRI3	0.03	0.0020	0.0020	6.12	5	78.4	4.82
		RRI4									
	RI5		1873	Size RRI4	0.03	0.002	0.0020	6.85	10	92.23	5.35
		RRI5									
	RI6		1835	Size RRI5	0.03	0.0020	0.0020	6.79	10	91.53	5.32

Note:



CITY OF GOODYEAR TYPICAL SECTION

STATION: 0 20 40 240 255 270 290 300
ELEV: 8.0 8.0 3.0 3.0 0.0 3.0 8.0 8.0

1) FLOWS FROM L3PA2E3C

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Alte e 3
Channel Sizing Table

Proposed Channel	Concentration Point	Routing Section	Revised Discharge [cfs]	Comments	Orig. Channel Slope [ft/ft]	Channel Slope [ft/ft]	Depth [ft]	Bottom Width [ft]	Surface Water Top Width [ft]	Velocity [ft/s]
Beardsley	BC1		313	Size US reach	0.0083	0.0083	1.84	20	42.03	5.5
		RBC1								
	BC2		**2837**	Size RBC1	0.0076	**0.0050**	2.41	182	210.91	**6**
		RBC2								
	BC3		**6383**	Size RBC2	0.0075	**0.0020**	5.14	176	237.71	**6**
		RBC3								
	BC4		**6382**	Size RBC3	0.0083	**0.0020**	5.14	176	237.7	**6**
		RBC4								
	BC5		**6583**	Size RBC4	0.0113	**0.0020**	5.11	184	245.34	**6**
Jackrabbit	JR1		953	Size US reach	0.005333	0.0053	2.76	41	74.16	**5.99**
		RJR1								
	JR2		**1459**	Size RJR1	0.006167	0.0062	2.14	101	126.64	**6**
		RJR2								
	JR3		**1560**	Size RJR2	0.0068	0.0068	1.93	123	146.21	**5.99**
		RJR3								
	JR4		**1840**	Size RJR3	0.00625	0.0063	2.06	137	161.66	**6**
		RJR4								
	JR5		**2045**	Size RJR4	0.008889	**0.0040**	3.11	91	128.33	**6**
Tuthill Channel		RTCUS								
	TC1		**2471**	Size RTCUS	0.006667	**0.0040**	3.01	119	155.08	**6**
		RTC1								
	TC2		**2469**	Size RTC1	0.006667	**0.0040**	3.01	119	155.07	**5.99**
		RTC2								
	TC3		**2586**	Size RTC2	0.006667	**0.0040**	2.99	126	161.91	**6**
		RTC3								
	TC4		**2718**	Size RTC3	0.006667	**0.0040**	2.97	135	170.59	**6**
		RTC4								
	TC5		**2879**	Size RTC4	0.006667	**0.0040**	2.95	145	180.38	**6**
		RTC5								
	TC6		**2920**	Size RTC5	0.005333	**0.0040**	2.94	148	183.27	**6**
		RTC6								
	TC7		**3214**	Size RTC6	0.002667	0.0027	4.38	96	148.59	**6**
		RTC7								
	TC8		**3450**	Size RTC7 & RTC8	0.002	0.0020	6.42	51	128.1	**6**
		RTC8								
Loop 303		RLPUS								
	LP1		**1290**	Size RLPUS	0.002841	0.0028	4.93	18	77.15	5.5
		RLP1								

1) Flows From: L3PA3E2B

Alte[illegible] 3
Channel Sizing Table

Proposed Channel	Concentration Point	Routing Section	Revised Discharge [cfs]	Comments	Orig. Channel Slope [ft/ft]	Channel Slope [ft/ft]	Depth [ft]	Bottom Width [ft]	Surface Water Top Width [ft]	Velocity [ft/s]
	LP2		2447	Size RLP1	0.002273	0.0023	6.97	17	100.59	5.98
		RLP2								
	LP3		1828	Size RLP2	0.004167	0.0042	3.04	82	118.53	5.99
		RLP3								
	LP4		2097	Size RLP3	0.003409	0.0034	3.71	72	116.55	5.99
		RLP4								
	LP5		2017	Size RLP4	0.004735	0.0047	2.63	112	143.58	6
		RLP5								
	LP6		457	Size RLP5	0.003409	0.0034	3.68	5	49.12	4.59
		RLP6								
	LP7		690	Size RLP6	0.004451	0.0045	3.26	19	58.11	5.49
		RLP7								
	LP8		1375	Size RLP7	0.003693	0.0037	4.06	32	80.77	6
		RLP8								
	LP9		560	Size RLP8	0.002652	0.0027	4.21	5	55.5	4.4
		RLP9								
	LP10		608	Size RLP9	0.004545	0.0045	3.90	5	51.77	5.49
		RLP10								
	LP11		839	Size RLP10	0.004356	0.0044	2.95	34	69.4	5.5
		RLP11								
	LP12		1359	Size RLP11	0.004261	0.0043	3.26	50	89.09	6
		RLP12								
	LP13		384	Size RLP12	0.004025	0.0040	3.31	5	44.67	4.68
		RLP13								
	LP14		546	Size RLP13	0.004356	0.0044	3.76	5	50.14	5.26
		RLP14								
	LP15		673	Size RLP14	0.003788	0.0038	4.22	5	55.61	5.27
		RLP15								
	LP16		729	Size RLP15	0.002462	0.0025	4.76	5	62.06	4.57
		RLP16								
	LP17		415	Size RLP16	0.003977	0.0040	3.42	5	46.07	4.75
Reems Channel		R115		Already designed						
	RM1		402	Already designed						
		1R122A & 2R122A		Already designed						
	RM2		1062	Already designed						
		RRM2								
	RM3		1440	Design RRM2	0.006345	0.0040	2.74	79	111.89	5.5
		RRM3								

1) Flows From: L3PA3E2B

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Alte e 3
Channel Sizing Table

Proposed Channel	Concentration Point	Routing Section	Revised Discharge [cfs]	Comments	Orig. Channel Slope [ft/ft]	Channel Slope [ft/ft]	Depth [ft]	Bottom Width [ft]	Surface Water Top Width [ft]	Velocity [ft/s]
	RM4		**1913**	Design RRM3	0.004167	0.0042	3.03	87	123.36	**6**
		RRM4								
	RM5		**2360**	Design RRM4	0.003977	0.0040	3.05	111	147.54	**6**
		RRM5								
	RM6		**2365**	Design RRM5	0.003409	0.0034	3.60	88	131.15	**6**
El Mirage Channel		REMN								
	EM1N		**1019**	Size REMN	0.004924	0.0049	2.35	65	93.17	5.49
		REM1N								
	EM2N		**1251**	Size REM1N	0.003788	0.0038	4.17	25	75.07	**5.99**
	1l138	R1L138	250	Size 1/2 section between 138 & 138A - not modeled	0.002	0.0020	3.20	5	43.38	3.23
		REM2N								
	RR1		**1314**	Size REM2N	0.002308	0.0023	6.10	5	78.24	5.17
		RRR1								
	RR2		**1472**	Size RRR1	0.0045	0.0045	2.96	65	100.56	**6**
		RRR2								
	RR3		**1700**	Size RRR2	0.003598	0.0036	3.72	54	98.64	**5.99**
		RRR3								
	RR4		**1702**	Size RRR3	0.002	0.0020	6.96	5	88.51	5.23
		RRR4								
	RR5		**1329**	Size RRR4	0.002	0.0020	6.31	5	80.7	4.92
		RRR5								
	RR6		**1459**	Size RRR5	0.0031	0.0031	6.00	5	77	**5.93**
		RRR6								
	RR7		**1505**	Size RRR6	0.0038	0.0038	3.65	47	90.76	**5.99**
	EM1S		**1578**		0.006					
		REM1S								
	EM2S		**1546**	Size REM1S	0.00303	0.0030	6.17	5	79.02	**5.97**
		REM2S								
	EM3S		**1841**	Size REM2S	0.002	0.0020	6.80	10	91.64	5.32
Lower El Mirage		RLE								
	LE1		**657**	Size RLE	0.0038	0.0038	4.17	5	55.08	5.24
		RLE1								
	LE2		**792**	Size RLE1	0.005	0.0050	3.60	15	58.24	**6**
		RLE2								
	LE3		**1125**	Size RLE2	0.003788	0.0038	5.19	5	67.32	**5.99**
		RLE3								

1) Flows From: L3PA3E2B

Altε e 3
Channel Sizing Table

Proposed Channel	Concentration Point	Routing Section	Revised Discharge [cfs]	Comments	Orig. Channel Slope [ft/ft]	Channel Slope [ft/ft]	Depth [ft]	Bottom Width [ft]	Surface Water Top Width [ft]	Velocity [ft/s]
	LE4		**1157**	Size RLE3	0.004167	0.0042	3.70	30	74.34	**6**
		RLE4								
	LE5		**1250**	Size RLE4	0.004167	0.0042	3.48	39	80.8	**5.99**
Bullard Channel		RBLRD								
	BD1N		**1911**	Size RBLRD	0.002	0.0020	6.91	10	92.91	5.38
		RBD1N								
	BD2N		**3110**	Size RBD1N	0.002	0.0020	6.97	33	116.58	**5.97**
		RBD2N								
	BD3N		**3351**	Size RBD2N	0.00463	**0.0020**	6.60	45	124.22	**6**
		RBD3N								
	BD4N		**3336**	RBD3N should be done per Palm Valley	0.002083		6.13	54	127.5	**6**

1) Flows From: L3PA3E2B

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Alte. [illegible] 3
Channel Sizing Table

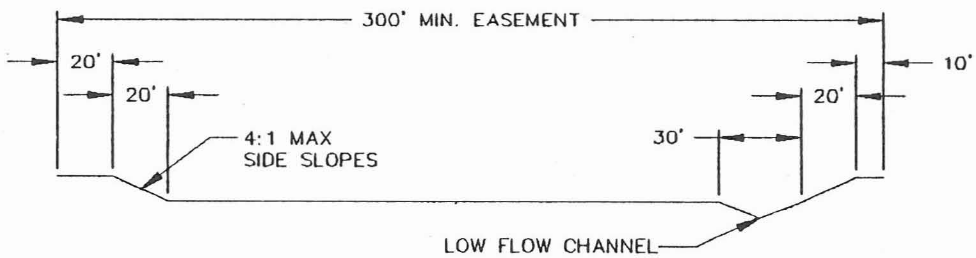
Proposed Channel	Concentration Point	Routing Section	Revised Discharge [cfs]	Comments	Orig. Channel Slope [ft/ft]	Channel Slope [ft/ft]	Depth [ft]	Bottom Width [ft]	Surface Water Top Width [ft]	Velocity [ft/s]
		RBD4N								
	BD1S		**3711**	Size RBD4N	0.002841	**0.0020**	Used City of Goodyear Typical Section - See Note			
		RBD1S								
	BD2S		**3744**	Size RBD1S	0.002	0.0020				
		RBD2S								
	BD3S		**2394**	Size RBD2S	0.0032	0.0032				
		RBD3S								
	BD4S		**2596**	Size RBD3S	0.002841	0.0028				
		RBD4S								
	BD5S		**2678**	Size RBD4S	0.002333	0.0023				
		RBD5S								
	BD6S		**2678**		0.003772					
	BLRD2		**3179**	Size RBD5S	0.003772	0.0038				
Northern Channel	NR1		1552	Use to size US reach	0.0049	0.0049	2.67	81	112.98	**6**
		RNR1								
	NR2		**2526**	Size RNR1	0.0056	0.0056	2.99	123	158.89	**5.99**
		RNR2								
	NR3		**3496**	Size RNR2	0.0064	**0.0030**	3.77	132	177.92	**5.99**
		RNR3								
	NR4		**3691**	Size RNR3	0.0045	**0.0030**	3.74	142	186.93	**5.99**
		RNR4								
	NR5		**702**	Size RNR4	0.0042	0.0042	3.85	10	56.24	5.5
		RNR5								
	NR6		**705**	Size RNR5	0.0038	0.0038	4.30	5	56.55	5.33
Camelback Channel		RCM								
	CM1		282	Size RCM	0.0034	0.0034	3.01	5	41.12	4.06
		RCM1								
	CM2		**574**	Size RCM1	0.0020	0.0020	4.50	5	59.77	3.98
		RCM2								
	CM3		**728**	Size RCM2	0.0020	0.0020	4.96	5	64.48	4.23
		RCM3								
	CM4		**1063**	Size RCM3	0.0020	0.0020	5.77	5	74.25	4.65
Roosevelt Irrigation District Channel	RI1		338	Size US reach	0.002	0.0020	3.62	5	48.49	3.49

1) Flows From: L3PA3E2B

Alte. 3
Channel Sizing Table

Proposed Channel	Concentration Point	Routing Section	Revised Discharge [cfs]	Comments	Orig. Channel Slope [ft/ft]	Channel Slope [ft/ft]	Depth [ft]	Bottom Width [ft]	Surface Water Top Width [ft]	Velocity [ft/s]
		RRI1								
	RI2		**467**	Size RRI1	0.002	0.0020	4.14	5	54.67	3.78
		RRI2								
	RI3		**1435**	Size RRI2	0.002	0.0020	6.50	5	83.05	5.01
		RRI3								
	RI4		**1416**	Size RRI3	0.002	0.0020	6.47	5	82.63	5
		RRI4								
	RI5		**2170**	Size RRI4	0.002	0.0020	6.48	22	99.76	5.5
		RRI5								
	RI6		**2390**	Size RRI5	0.002	0.0020	5.75	41	110.03	5.5

Note:



CITY OF GOODYEAR TYPICAL SECTION

STATION: 0 20 40 240 255 270 290 300
ELEV: 8.0 8.0 3.0 3.0 0.0 3.0 8.0 8.0

1) Flows From: L3PA3E2B

Alternative 1
Utility Conflicts

Channel Alignment	Crossroad/Location	Crossing Utilities: Sewer d = ( ) in	Water d = ( ) in	Gas d = ( ) in	OH Electric	Irrigation	Cable	Rail Road	Irr. Canal	Parallel Utilities: OH Electric	Irrigation
Beardsley	No Utilities Conflicts Found										
Jackrabbit Trail	Osborn Rd.				OHE						
	Thomas Rd.		Φ 8"								
	Encanto Blvd.		Φ 6"								
Jackrabbit-Perryville	800' N. of Hilton Ave.										Surface Irr. Ditch (SID)
	700' S. of Lower Buckeye Rd.				OHE						↓ L = 12100'
	Broadway Rd.				OHE						
	2800' S. of Broadway Rd.							RR - Union Pacific			
	1200' N of Southern Ave.								Buckeye I.C.		SID
	Southern Ave.				OHE						
Tuthill Channel	N. of Yuma Rd.				OHE						
	S. of Yuma Rd.				OHE					OHE ↓ L = 500'	
	500' S. of Yuma Rd.					SID				OHE	
Tuthill Channel Alt. A - Rainbow Rd.	700' S. of Lower Buckeye Rd.								Roosevelt I.C.		
	Broadway Rd.				OHE					OHE ↓ L = 7400'	
	2200' S. of Southern Ave.								Buckeye I.C.	OHE	SID ↓ L = 8900'
	Beloat Rd.										SID
Tuthill Channel Alt. B - Watson Rd.	1500' S. of Lower Buckeye Rd.								Roosevelt I.C.	E OHE, W OHE ↓ L = 13400'	
	Broadway Rd.				OHE						
	3900' S. of Southern Ave.								Buckeye I.C.	OHE OHE	SID ↓ L = 7200'
	Beloat Rd.										SID
Loop 303	Greenway Rd.				OHE						
	Waddell Rd.				OHE						

Alternative 1
Utility Conflicts

Channel Alignment	Crossroad/Location	Crossing Utilities: Sewer d = (?) in	Water d = (?) in	Gas d = (?) in	OH Electric	Irrigation	Cable	Rail Road	Irr. Canal	Parallel Utilities: OH Electric	Irrigation	
	Cactus Rd.				OHE							
	Peoria Ave.				OHE					OHE		
										L = 5200'		
	Olive Rd.							RR - AT & SF		OHE		
	Osborn Rd.				OHE							
	McDowell Rd.	Φ 24"										
	1100' S. of I-10								Roosevelt I.C.		SID	
												L = 2900'
	Van Buren St.										SID	
	N. of Yuma Rd.		Φ 24"		OHE							
	S. of Yuma Rd.				OHE							
	Lower Buckeye Rd.		Φ 24"									
	700' S. of Lower Buckeye Rd.				OHE							
	1600' S. of Lower Buckeye Rd.		Φ 16"									
	Broadway Rd.		Φ 12"									
	600' S. of Broadway Rd.							RR - Union Pacific				
	2100' S. of Broadway Rd.								Buckeye I.C.			
Reems Channel	Olive Ave.							RR - AT & SF				
AT & SF Railroad Channel	N. of Olive Ave.				OHE			RR - AT & SF				
	S. of Olive Ave.				OHE							
	Northern Ave.				OHE	SID						
Bullard Wash	Osborn Ave.				OHE							
	Thomas Rd.								Roosevelt I.C.			
	McDowell Rd.	Φ 12" FM										
	Van Buren St.	Φ 21"	Φ 24"									

Alternative 1
Utility Conflicts

Channel Alignment	Crossroad/Location	Crossing Utilities: Sewer d = ( ) in	Water d = ( ) in	Gas d = ( ) in	OH Electric	Irrigation	Cable	Rail Road	Irr. Canal	Parallel Utilities: OH Electric	Irrigation
	Yuma Rd.		Φ 16"	3" STL SWG			UGC				SID
				4" PE SWG							L = 2600'
	2600' S. of Yuma Rd.										SID
	Lower Buckeye Pkwy.	Φ 12"	Φ 16"			SID					SID
											L = 2400'
	Lower Buckeye Rd.										SID
Northern Channel	No Utility Conflicts Found										
Camelback Channel	No Utility Conflicts Found										
I-10 West Channel	Perryville Rd.		Φ 8"								
	183rd Ave.		Φ 6"								
	Citrus Rd.		Φ 6"								
Buckeye Channel	Jackrabbit Trail					SID				OHE	
	2600' W. of Perryville Rd.					SID					
	Perryville Rd.				OHE	SID					
	2500' W. of Citrus Rd.					SID				L = 16000'	
	300' W. of Citrus Rd.					SID					
	3500' W. of Cotton Lane					SID					
	Cotton Lane									OHE	
Union Pacific Railroad Channel	W. of Tuthill Rd.				OHE						
	E. of Tuthill Rd.				OHE						
	Jackrabbit Trail					SID					
	2600' W. of Perryville Rd.					SID					SID
											L = 1400'
	1200' W. of Perryville Rd.										SID
	W. of Perryville Rd.				OHE	SID					
	E. of Perryville Rd.				OHE						

Alternative 1
Utility Conflicts

Channel Alignment	Crossroad/Location	Crossing Utilities								Parallel Utilities		
		Sewer d = ( ) in	Water d = ( ) in	Gas d = ( ) in	OH Electric	Irrigation	Cable	Rail Road	Irr. Canal	OH Electric	Irrigation	
	2400' W. of Citrus Rd.					SID						
	Citrus Rd					SID						
	175th Ave.					SID						
	1100' W. of Cotton Lane		Φ 12"									
West Valley Channel	Osborn Rd.				OHE							
	800' W. of Reems Rd.								Roosevelt I.C.			
	Reems Rd.					SID						
	McDowell Rd.	Φ 12" FM										
	Bullard Ave.		Φ 16"				OHC-COX					
Key :												
OHE - Overhead Electric												
SID - Surface Irrigation Ditch												
I.C. - Irrigation Canal												
FM - Sewer Force Main												
UGC - Underground Cable												
OHC - Overhead Cable												

Alternative 2
Utility Conflicts

Channel Alignment	Crossroad/Location	Crossing Utilities: Sewer d = ( ) in	Water d = ( ) in	Gas d = ( ) in	OH Electric	Irrigation	Cable	Rail Road	Irr. Canal	Parallel Utilities: OH Electric	Irrigation
Loop 303	Cactus Rd.				OHE						
	Peoria Ave.				OHE					OHE	
										↓ L = 5200'	
	Olive Rd.							RR - AT & SF		OHE	
	Osborn Rd.				OHE						
	McDowell Rd.	Φ 24"									
	1100' S. of I-10								Roosevelt I.C.		SID
											↓ L = 2900'
	Van Buren St.										SID
	N. of Yuma Rd.		Φ 24"		OHE						
	S. of Yuma Rd.				OHE						
	Lower Buckeye Rd.		Φ 24"								
	700' S. of Lower Buckeye Rd.				OHE						
	1600' S. of Lower Buckeye Rd.		Φ 16"								
	Broadway Rd.		Φ 12"								
	600' S. of Broadway Rd.							RR - Union Pacific			
	2100' S. of Broadway Rd.								Buckeye I.C.		
Beardsley	No Utilities Conflicts Found										
Jackrabbit Trail	Osborn Rd.				OHE						
	Thomas Rd.		Φ 8"								
	Encanto Blvd.		Φ 6"								
Jackrabbit-Perryville	1600' N. of Yuma Rd.								Roosevelt I.C.		
	1200' N. of Yuma Rd.					SID					
	N. of Yuma Rd.				OHE						
	S. of Yuma Rd.				OHE						
	2300' W. of Perryville Rd.					SID					

Alternative 2
Utility Conflicts

Channel Alignment	Crossroad/Location	Crossing Utilities: Sewer d = (*) in	Water d = (*) in	Gas d = (*) in	OH Electric	Irrigation	Cable	Rail Road	Irr. Canal	Parallel Utilities: OH Electric	Irrigation
	2400' N. of Lower Buckeye Rd.									OHE	SID
											L = 2400'
	Lower Buckeye Rd.										SID
	700' S. of Lower Buckeye Rd.				OHE					L = 17000'	
	2100' S. of Broadway Rd.							RR - Union Pacific			
	3300' S. of Broadway Rd.								Buckeye I.C.		
	1200' N. of Baseline Rd.									OHE	
Reems Channel	Olive Ave.							RR - AT & SF			
AT & SF Railroad Channel	N. of Olive Ave.				OHE			RR - AT & SF			
	S. of Olive Ave.				OHE						
	Northern Ave.				OHE	SID					
Bullard Wash	Osborn Ave.				OHE						
	Thomas Rd.								Roosevelt I.C.		
	McDowell Rd.	Φ 12" FM									
	Van Buren St.	Φ 21"	Φ 24"								
	Yuma Rd.		Φ 16"	3" STL SWG 4" PE SWG			UGC				SID
											L = 2600'
	2600' S. of Yuma Rd.										SID
	Lower Buckeye Pkwy.	Φ 12"	Φ 16"			SID					SID
											L = 2400'
	Lower Buckeye Rd.										SID
Northern Channel	No Utility Conflicts Found										
Camelback Channel	No Utility Conflicts Found										
I-10 West Channel	Perryville Rd.		Φ 8"								
	183rd Ave.		Φ 6"								
	Citrus Rd.		Φ 6"								

Alternative 2
Utility Conflicts

Channel Alignment	Crossroad/Location	Crossing Utilities								Parallel Utilities		
		Sewer d = ( ) in	Water d = ( ) in	Gas d = ( ) in	OH Electric	Irrigation	Cable	Rail Road	Irr. Canal	OH Electric	Irrigation	
I-10 East Channel	1100' E. of Sarival Ave.					SID						
	1600' W. of Reems Pkwy.					SID						
	Reems Pkwy.					SID						
(ADOT CHANNEL)	Bullard Ave.		Φ 16"			SID	OHC					
Roosevelt Irrigation District Channel	Citrus Rd.		Φ 6"									
	183rd Ave.		Φ 6"									
Key :												
OHE - Overhead Electric												
SID - Surface Irrigation Ditch												
I.C. - Irrigation Canal												
FM - Sewer Force Main												
UGC - Underground Cable												
OHC - Overhead Cable												

Alternative 3
Utility Conflicts

Channel Alignment	Crossroad/Location	Crossing Utilities: Sewer d = (-) in	Water d = (-) in	Gas d = (-) in	OH Electric	Irrigation	Cable	Rail Road	Irr. Canal	Parallel Utilities: OH Electric	Irrigation
Beardsley	No Utilities Conflicts Found										
Jackrabbit Trail	Camelback Rd.		Φ 8"								
	Osborn Rd.				OHE						
	Thomas Rd.		Φ 8"								
	Encanto Blvd.		Φ 6"								
Tuthill Channel	N. of Yuma Rd.				OHE						
										E. of Tuthill	
	S. of Yuma Rd.				OHE					OHE	
	500' S. of Yuma Rd.					SID					
	900' S. of Yuma Rd.								Roosevelt I.C.		SID
	700' S. of Lower Buckeye Rd.				OHE					L = 20900'	L = 9700'
	Broadway Rd.				OHE						SID
	1600' N. of Southern Ave.							RR - Union Pacific			
	500' N. of Southern Ave.								Buckeye I.C.		
	Baseline Rd.									OHE	
Loop 303	Greenway Rd.				OHE						
	Waddell Rd.				OHE						
	Cactus Rd.				OHE						
	Peoria Ave.				OHE					OHE	
										L = 5200'	
	Olive Rd.							RR - AT & SF		OHE	
	Osborn Rd.				OHE						
	McDowell Rd.	Φ 24"									
	1100' S. of I-10								Roosevelt I.C.		SID
											L = 2900'
	Van Buren St.										SID
	N. of Yuma Rd.		Φ 24"		OHE						

Alternative 3
Utility Conflicts

Channel Alignment	Crossroad/Location	Crossing Utilities: Sewer d = ( ) in	Water d = ( ) in	Gas d = ( ) in	OH Electric	Irrigation	Cable	Rail Road	Irr. Canal	Parallel Utilities: OH Electric	Irrigation	
	S. of Yuma Rd.				OHE							
	Lower Buckeye Rd.		Φ 24"									
	700' S. of Lower Buckeye Rd.				OHE							
	1600' S. of Lower Buckeye Rd.		Φ 16"									
	Broadway Rd.		Φ 12"									
	600' S. of Broadway Rd.							RR - Union Pacific				
	2100' S. of Broadway Rd.								Buckeye I.C.			
Reems Channel	Olive Ave.							RR - AT & SF				
AT & SF Railroad Channel	N. of Olive Ave.				OHE			RR - AT & SF				
	S. of Olive Ave.				OHE							
	Northern Ave.				OHE	SID						
Bullard Wash	Osborn Ave.				OHE							
	Thomas Rd.								Roosevelt I.C.			
	McDowell Rd.	Φ 12" FM										
	Van Buren St.	Φ 21"	Φ 24"									
	Yuma Rd.		Φ 16"	3" STL SWG			UGC				SID	
				4" PE SWG								L = 2600'
	2600' S. of Yuma Rd.										SID	
	Lower Buckeye Pkwy.	Φ 12"	Φ 16"			SID					SID	
												L = 2400'
	Lower Buckeye Rd.										SID	
Northern Channel	No Utility Conflicts Found											
Camelback Channel	No Utility Conflicts Found											
Roosevelt Irrigation District Canal	Citrus Rd.		Φ 6"									
	183rd Ave.		Φ 6"									

Alternative 3
Utility Conflicts

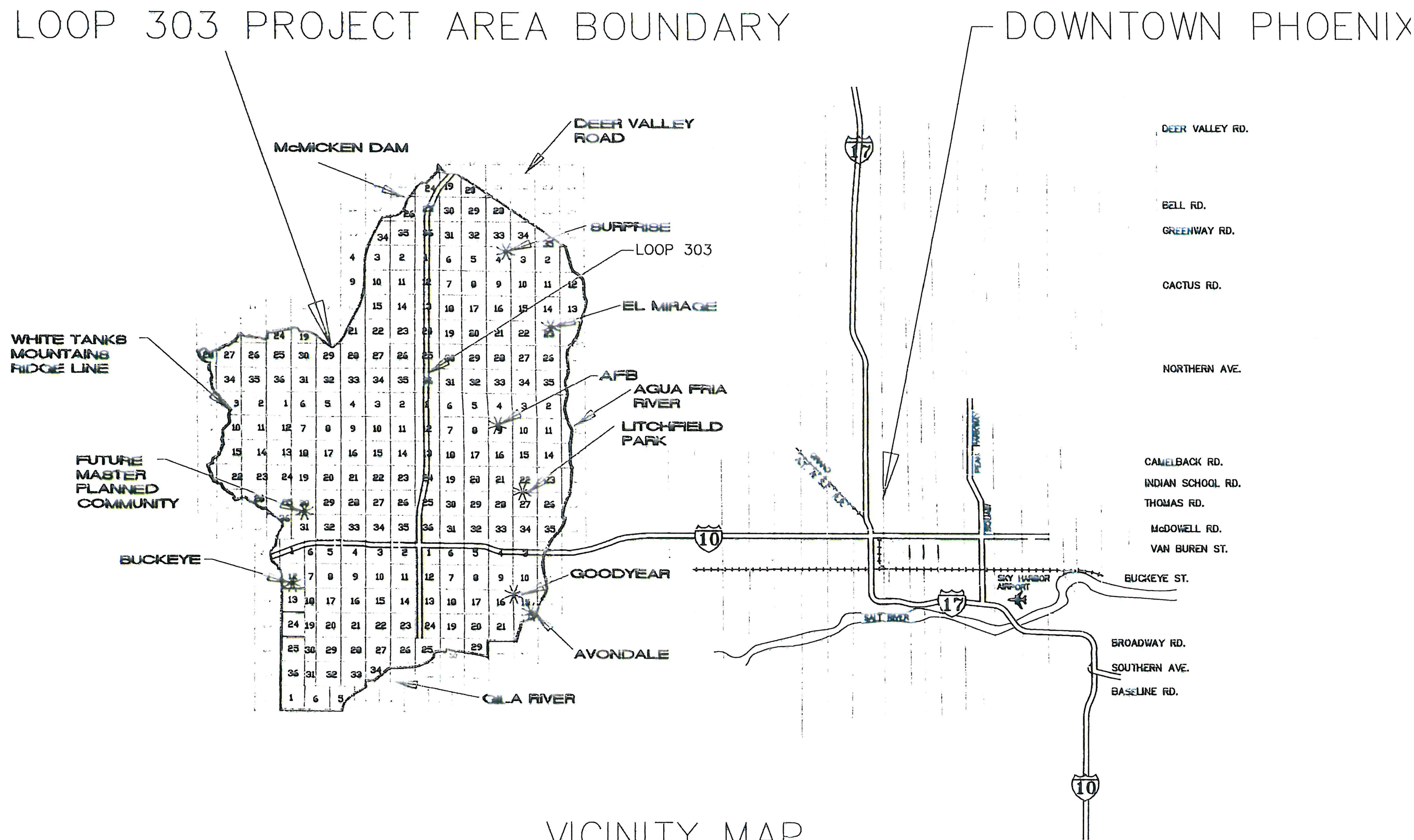
Channel Alignment	Crossroad/Location	Crossing Utilities: Sewer d = ( ) in	Water d = ( ) in	Gas d = ( ) in	OH Electric	Irrigation	Cable	Rail Road	Irr. Canal	Parallel Utilities: OH Electric	Irrigation	
	N. of Yuma Rd.				OHE							
	S. of Yuma Rd.				OHE							
Key :												
OHE - Overhead Electric												
SID - Surface Irrigation Ditch												
I.C. - Irrigation Canal												
FM - Sewer Force Main												
UGC - Underground Cable												
OHC - Overhead Cable												

Baseline Alternative
Utility Conflicts

		Crossing Utilities								Parallel Utilities	
Channel Alignment	Crossroad/Location	Sewer d = (±) in	Water d = (±) in	Gas d = (±) in	OH Electric	Irrigation	Cable	Rail Road	Irr. Canal	OH Electric	Irrigation
Loop 303	Greenway Rd.				OHE						
	Waddell Rd.				OHE						
	Cactus Rd.				OHE						
	Peoria Ave.				OHE					OHE	
										↓ L = 5200'	
	Olive Rd.							RR - AT & SF		OHE	
	Osborn Rd.				OHE						
	McDowell Rd.	Φ 24"									
	1100' S. of I-10								Roosevelt I.C.		SID
											↓ L = 2900'
	Van Buren St.										SID
	N. of Yuma Rd.		Φ 24"		OHE						
	S. of Yuma Rd.				OHE						
	Lower Buckeye Rd.		Φ 24"								
	700' S. of Lower Buckeye Rd.				OHE						
	1600' S. of Lower Buckeye Rd.		Φ 16"								
	Broadway Rd.		Φ 12"								
	600' S. of Broadway Rd.							RR - Union Pacific			
	2100' S. of Broadway Rd.								Buckeye I.C.		

Key :

OHE - Overhead Electric
SID - Surface Irrigation Ditch
I.C. - Irrigation Canal
FM - Sewer Force Main
UGC - Underground Cable
OHC - Overhead Cable

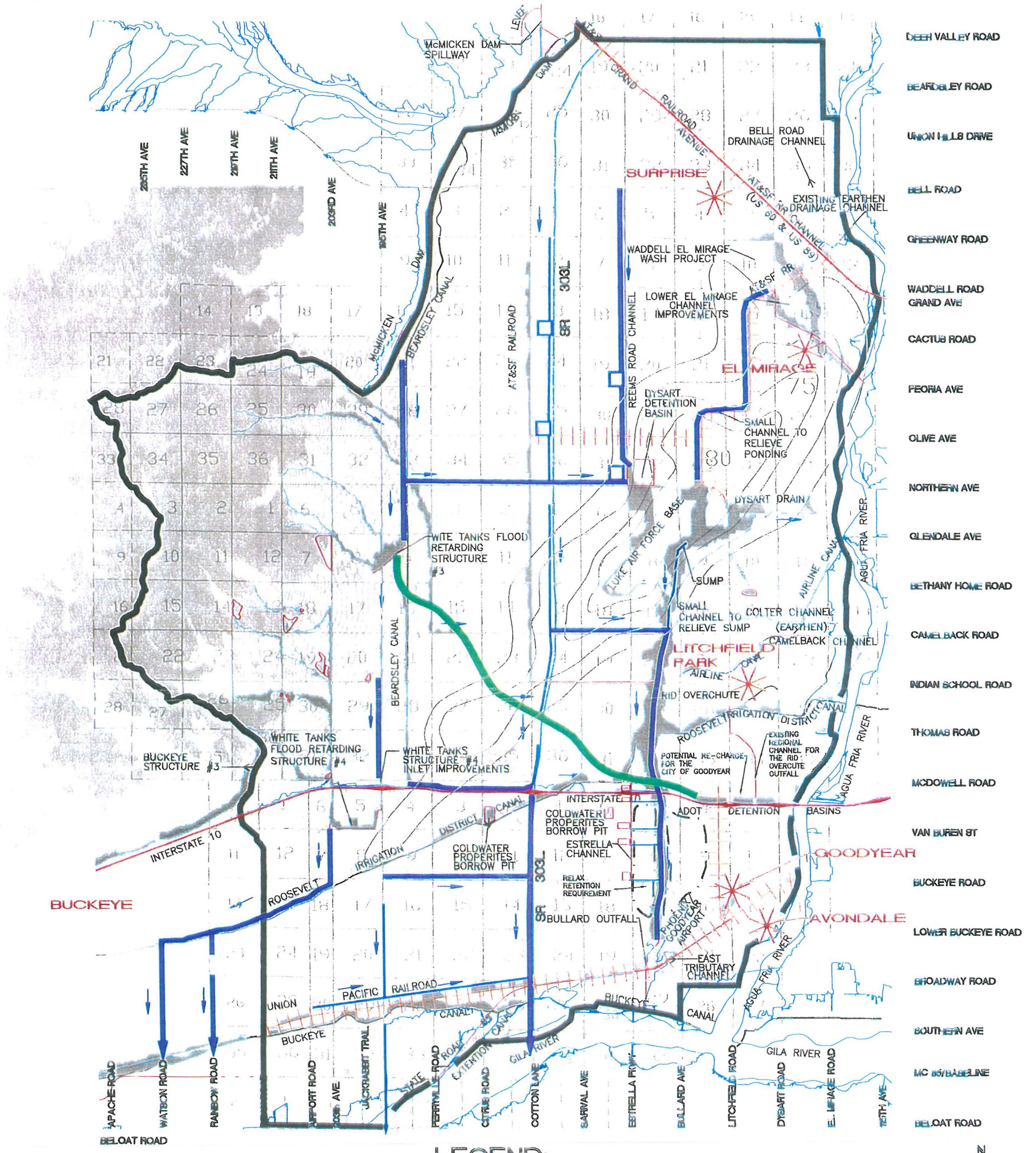


VICINITY MAP
N.T.S.

Flood Control District of Maricopa County

URS

FIGURE 1.1



LEGEND:

- = PROPOSED LARGE REGIONAL OUTFALL CHANNEL
- = PROPOSED MEDIUM TO LARGE LOCAL COLLECTOR CHANNEL
- = PROPOSED SMALL COLLECTOR CHANNEL
- = DIRECTION OF FLOW
- = PROPOSED LARGE, MEDIUM OR SMALL BASIN/PARK
- = PROJECT AREA BOUNDARY
- = PROPOSED LOOP 303 PARKWAY ALIGNMENT
- = EXISTING RAIL ROAD
- = EXISTING STRUCTURE OR FACILITY
- = FLOODPLAIN IDENTIFIED BY THE ORIGINAL WHITE TANKS ADMP, 1992

N

MARICOPA COUNTY
N.T.S.

RECOMMENDED ALTERNATIVE #1

August 2001

Loop 303 Corridor/White Tanks ADMP Update

FIGURE 2.1

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Flood Control District of Maricopa County

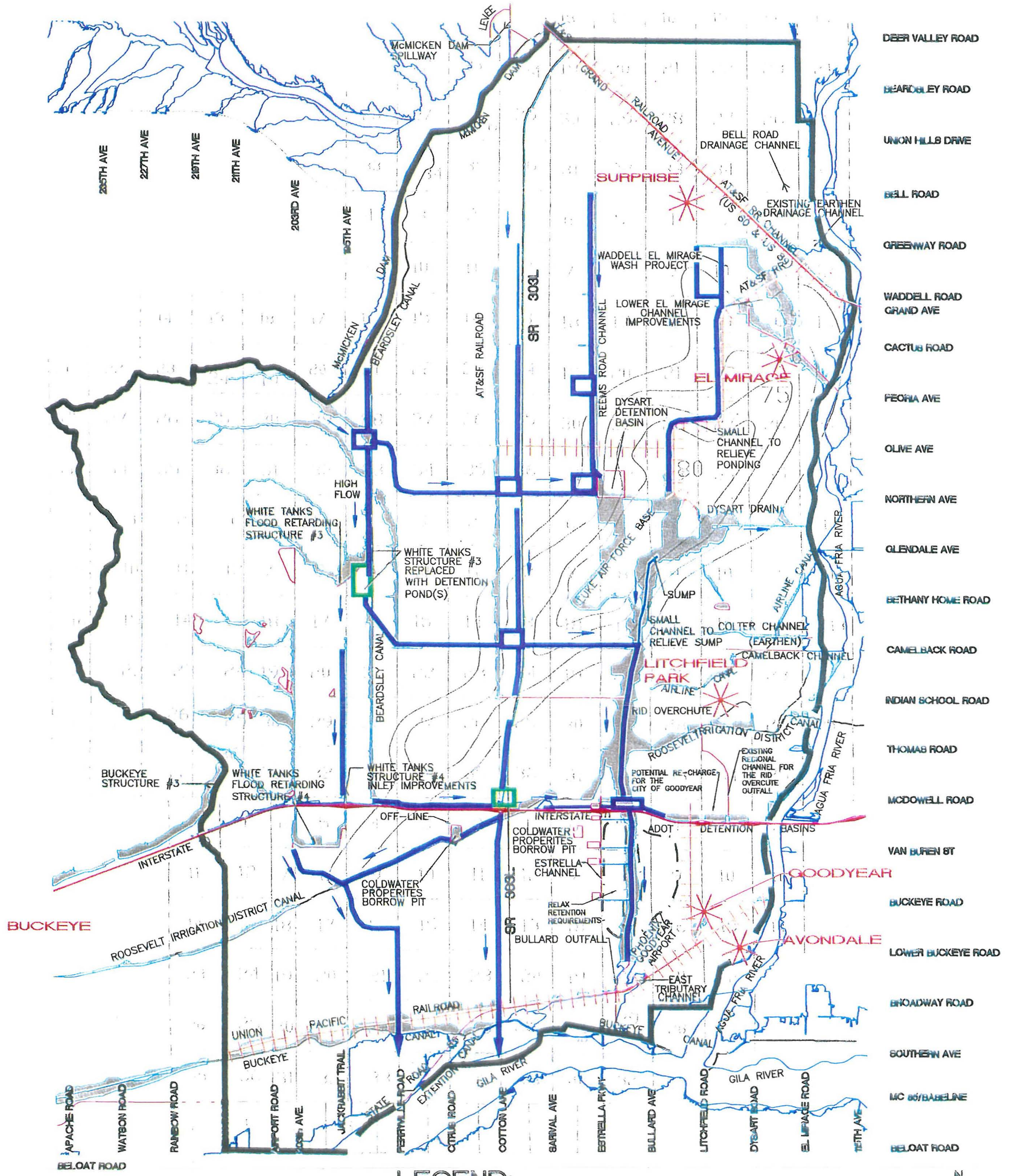
Key Features:

Large regional, multi-use drainage channel linking the White Tanks Mountains with the ADOT basins and Agua Fria River.

Small roadside channel along the west side of the Loop 303. North of I-10, this channel might convey local roadway drainage and may be used as a post storm drain outlet for adjacent developments' retention basins. South of I-10 the channel may be larger and used as regional drain outlet for local development.

Several multi-use channel corridors providing links throughout the project area with some regional basin/parks.

Overall emphasis on one very large regional outlet/collector channel with several smaller, feeder-type drains.



LEGEND:

- = PROPOSED LARGE REGIONAL OUTFALL CHANNEL
- = PROPOSED MEDIUM TO LARGE LOCAL COLLECTOR CHANNEL
- = PROPOSED SMALL COLLECTOR CHANNEL
- = DIRECTION OF FLOW
- = PROPOSED LARGE, MEDIUM OR SMALL BASIN/PARK
- = PROJECT AREA BOUNDARY
- = PROPOSED LOOP 303 PARKWAY ALIGNMENT
- = EXISTING RAIL ROAD
- = EXISTING STRUCTURE OR FACILITY
- = FLOODPLAIN IDENTIFIED BY THE ORIGINAL WHITE TANKS ADMP, 1992

N

MARICOPA COUNTY
N.T.S.

RECOMMENDED ALTERNATIVE #2

August 2001

Loop 303 Corridor/White Tanks ADMP Update

FIGURE 2.2

URS

Flood Control District of Maricopa County

Key Features:

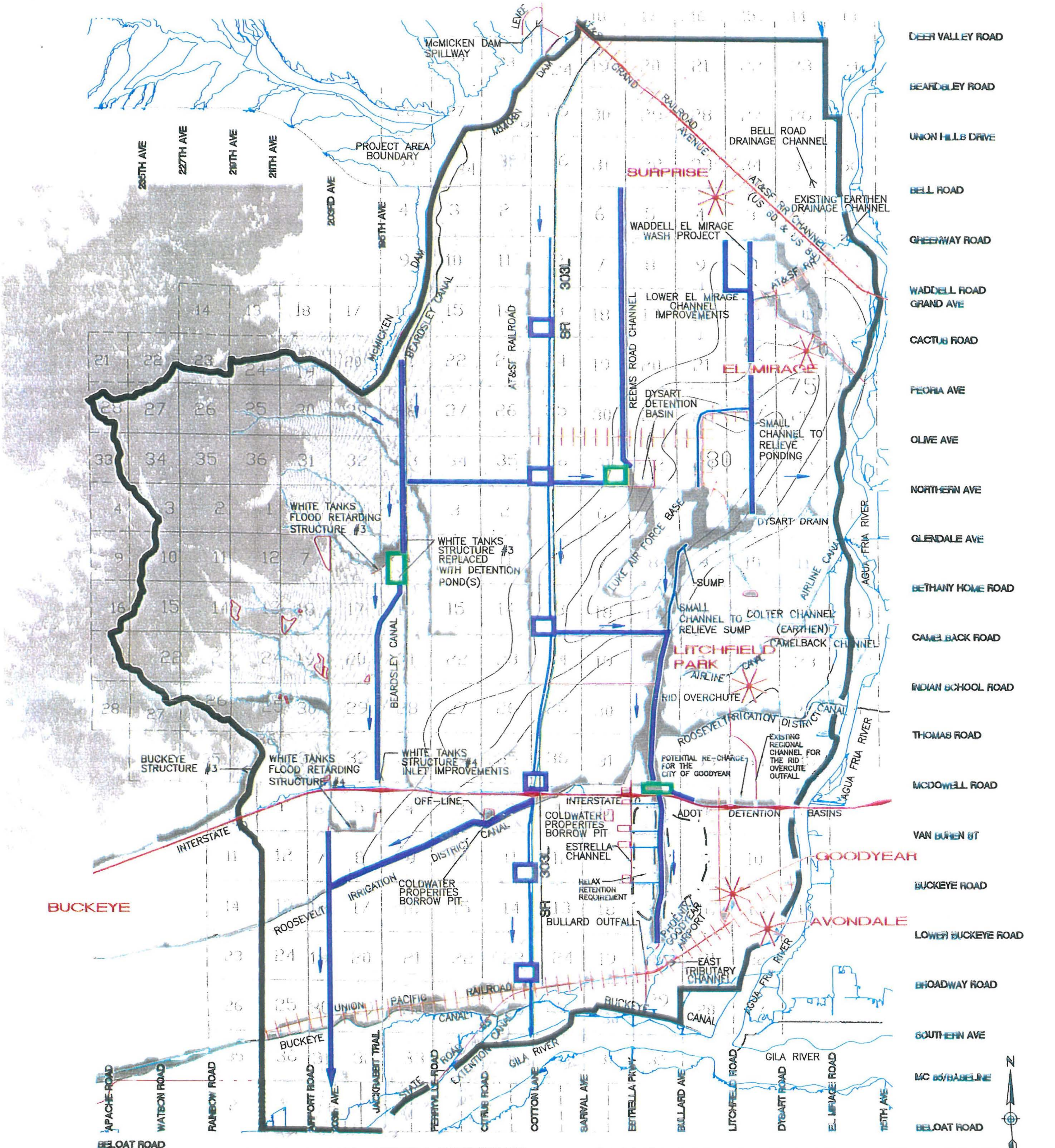
Several regional drainage channels constructed on a 2 to 3 mile grid to provide a positive outfall for development throughout the project area.

Several multi-use corridor links along proposed channels connected by regional basin/parks.

Proposed facilities will convey large amount of runoff South to the Gila/Salt rivers.

Use some west to east channels to tie into existing facilities that outfall to the Agua Fria River.

Overall emphasis on larger channels with fewer basin/parks.



LEGEND:

- = PROPOSED LARGE REGIONAL OUTFALL CHANNEL
- = PROPOSED MEDIUM TO LARGE LOCAL COLLECTOR CHANNEL
- = PROPOSED SMALL COLLECTOR CHANNEL
- = DIRECTION OF FLOW
- = PROPOSED LARGE, MEDIUM OR SMALL BASIN/PARK
- = PROJECT AREA BOUNDARY
- = PROPOSED LOOP 303 PARKWAY ALIGNMENT
- = EXISTING RAIL ROAD
- = EXISTING STRUCTURE OR FACILITY
- = FLOODPLAIN IDENTIFIED BY THE ORIGINAL WHITE TANKS ADMP, 1992

RECOMMENDED ALTERNATIVE #3

August 2001

Loop 303 Corridor/White Tanks ADMP Update

FIGURE 2.3

Flood Control District of Maricopa County

URS

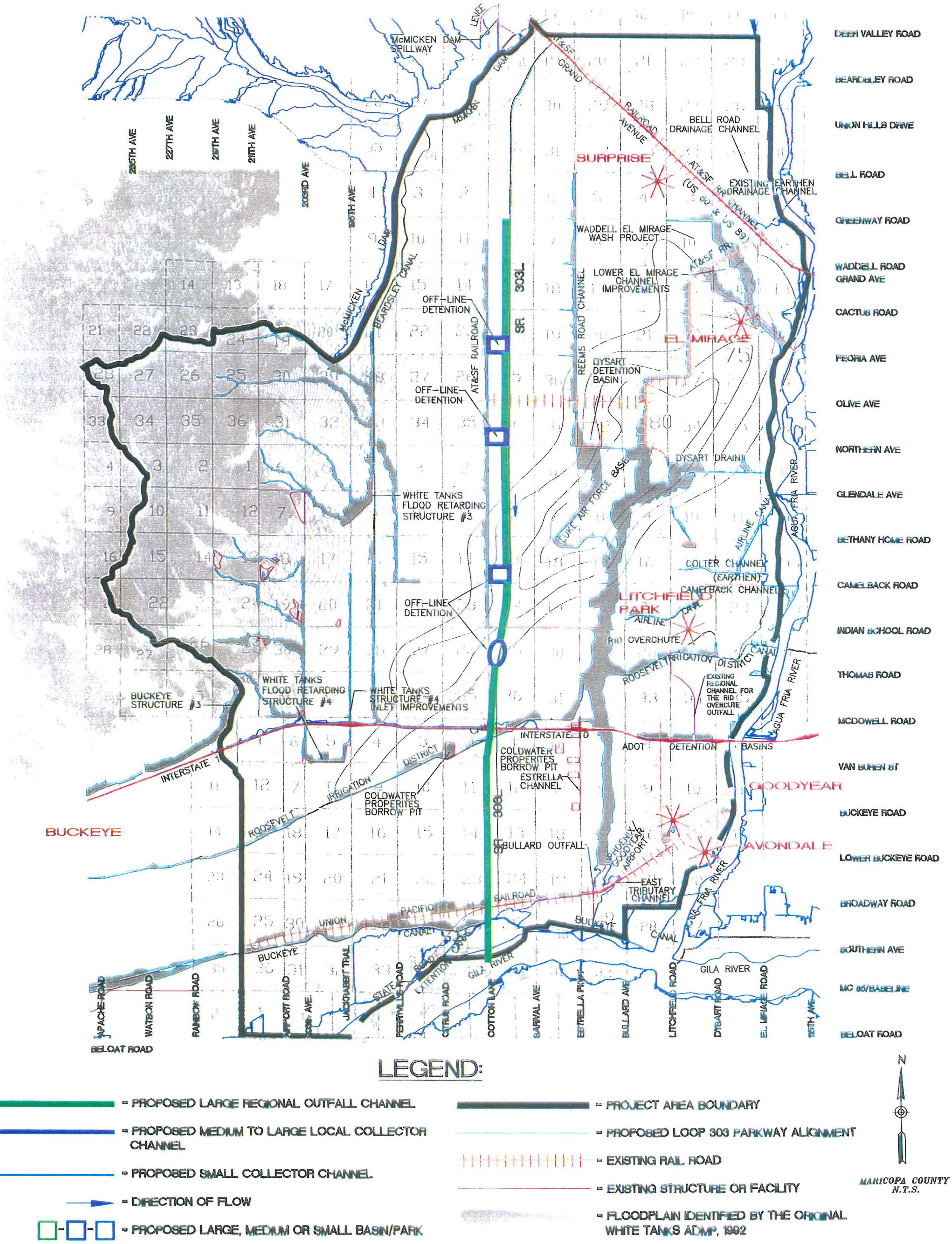
Key Features:

Some north to south regional drainage channels with large diverts east to the Bullard Wash and Agua Fria River using basin/parks.

Small roadside channel along Loop 303 with several basin/parks and flow diversions east to the Agua Fria River.

Several multi-use corridor links along proposed channels connected by regional basin/parks.

Overall emphasis on smaller channels with more basin/parks.



BASELINE ALTERNATIVE

August 2001

Loop 303 Corridor/White Tanks ADMP Update

FIGURE 2.4

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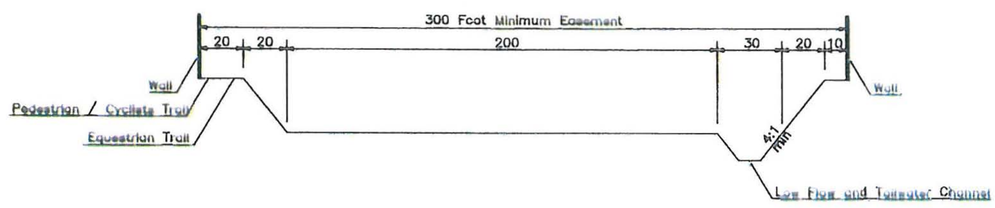
Flood Control District of Maricopa County

Key Features

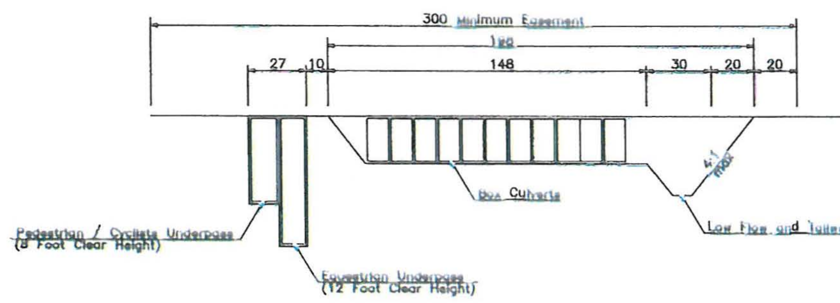
Large regional, multi-use drain adjacent to the Loop 303 with large regional basin/parks. This alternative represents the baseline alternative against which all other alternatives will be compared.

This baseline alternative is presented in the "Estrella Corridor Study, MC 85 to Interstate 17 Drainage Technical Memorandum", by DeLeuw Cather and Company, dated August 17 [illegible].

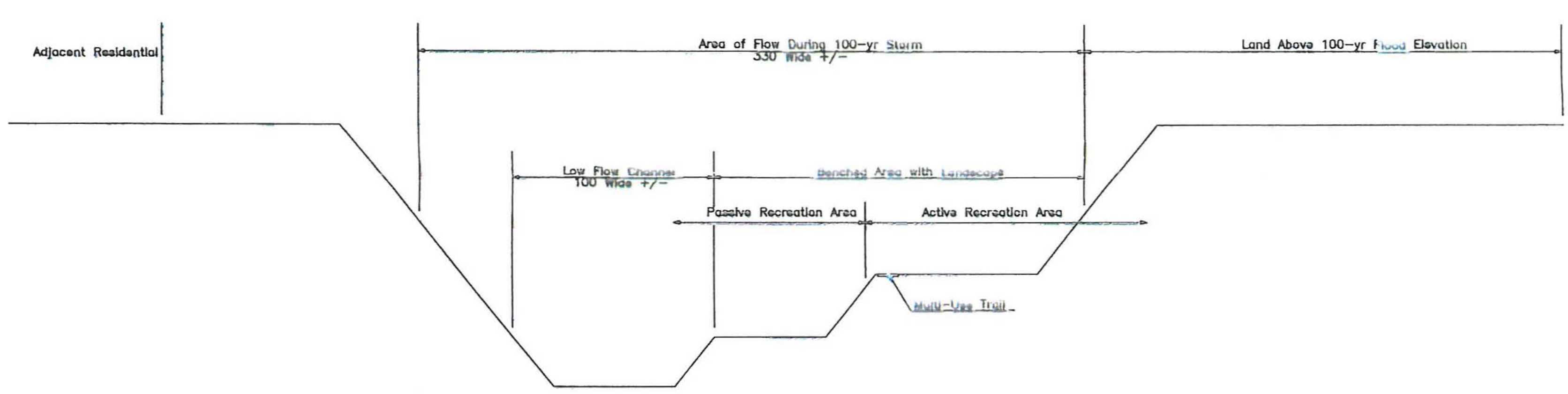
CITY OF GOODYEAR



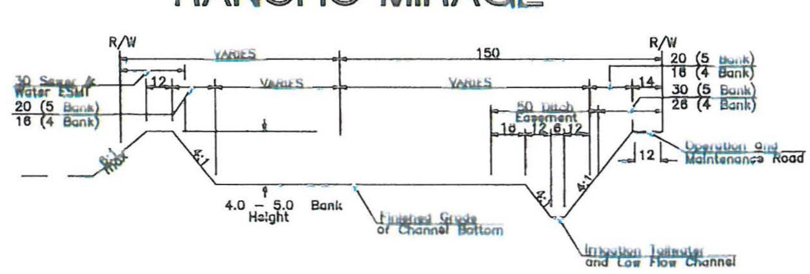
CITY OF GOODYEAR (AT UNDERPASS)



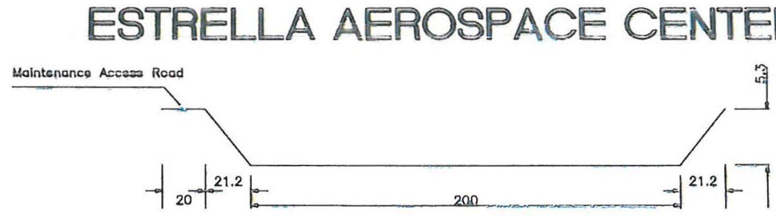
GOODYEAR PRC



RANCHO MIRAGE



ESTRELLA AEROSPACE CENTER



TYPICAL CROSS SECTIONS - BULLARD WASH

August 2001

Loop 303 Corridor/White Tanks ADMP Update

FIGURE 2.5

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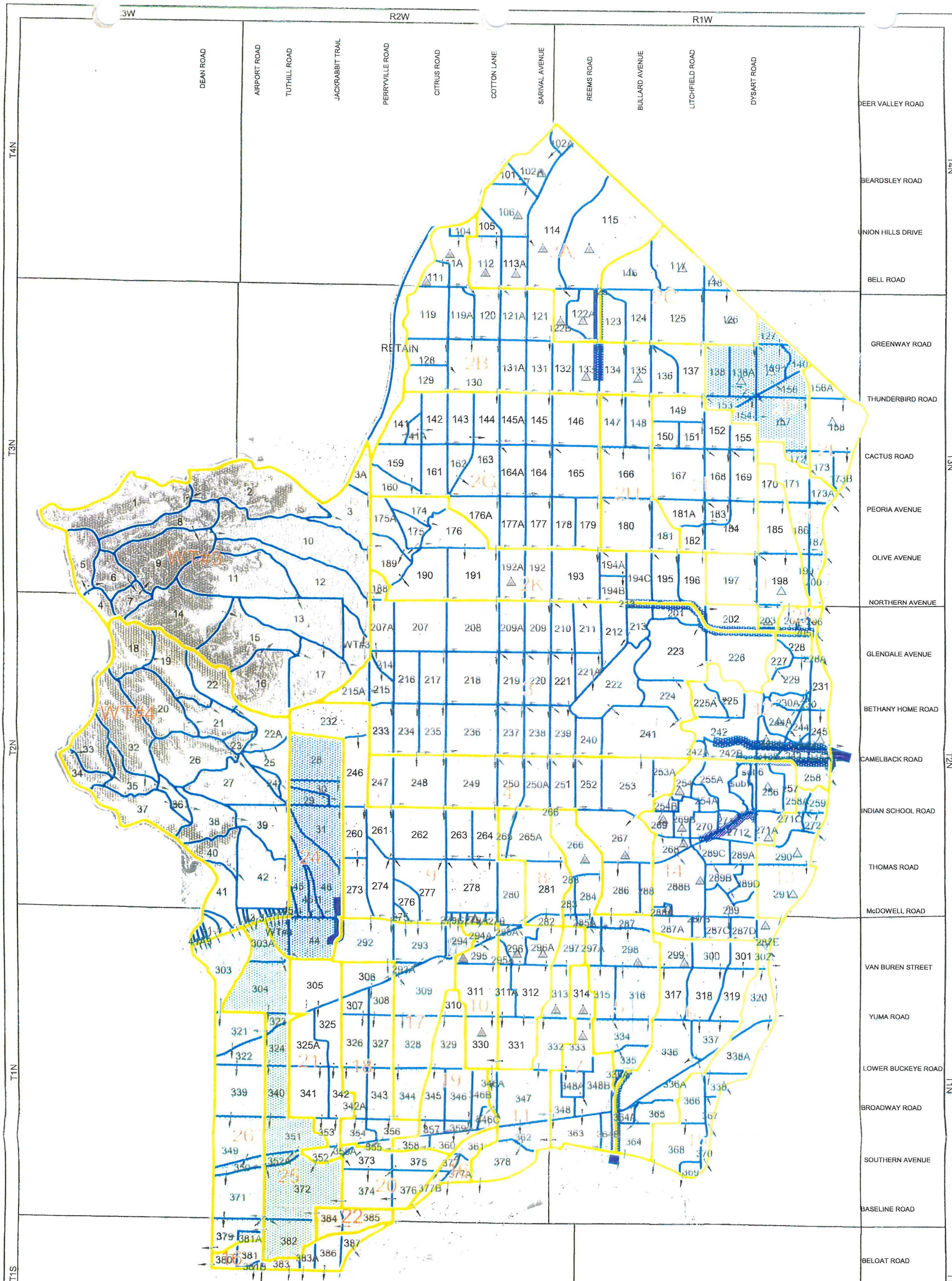

Legend

- Drainage Area Boundary
- Super Basins Boundary
- 2C Super Basins Label
- Flow Path
- Retention
- 111 Sub-basin Identification No.
- Off-line Detention Basin
- Existing Flood Control Facility

1 0 1 2

Scale in Miles

Working Draft 08/22/01

SUB BASIN MAP
Loop 303 Corridor/White Tanks Area Drainage Master Plan Update Existing Condition

Figure 2.6

URS

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URS

Memorandum

Date: March 27, 2002

To: Greg Jones, Flood Control District of Maricopa County (FCDMC)

From: Elliot Silverston
Rob Scrivo

Subject: **ADOT Basin Watershed Area**

URS has completed a review and analysis of the existing ADOT Basins and contributing watershed area located on the north side of I-10 between Bullard Avenue and Dysart Road. This Memorandum is an update to our earlier Memorandum submitted to FCDMC on October 29, 2001. This revised evaluation contains six additional scenarios related to runoff from the watershed to the existing ADOT Basins. These additional conditions were analyzed using the HEC-1 model as requested by the FCDMC at the October 31, 2001 meeting.

The six additional analyses and results are described under Tasks 3 and 4 below.

Purpose
The purpose of the analysis was to determine the volume of discharge resulting from the 100-year, 24-hour storm event intercepted by the existing ADOT Basins. In addition, the relative percentages of runoff contributing from area stakeholders upstream are summarized for comparison purposes. This information will be useful to the FCDMC in determining a quantifiable benefit in terms of flood control offered to the above entities through the use of the existing ADOT Basins as detention for the post-developed storm water volume generated within each jurisdictional boundary upstream. The stakeholders identified with the ADOT basin watershed area are listed below:

- The City of Goodyear
- The City of Litchfield Park
- The City of Avondale
- Maricopa County
- Estrella Community College
- Palm Valley Master Planned Development

Analysis
The analysis consisted of four major tasks. These tasks included a field trip, preparation of work maps, modification of the draft existing condition hydrology model prepared for the Loop 303 ADMP Update, modification of the Level III preliminary draft preferred alternative model and the preparation of various HEC-1 models for other conditions of interest.

Task 1
The first task consisted of a comprehensive field review to assess the extent to which development has occurred since the submittal of the Draft Existing Condition Hydrology model as well as to

verify modeled retention areas within the watershed. The watershed was video taped and several pictures were taken to document the findings of the field visit. The information was summarized in tables and put into the project file.

Information from the field visit was used to summarize the most recent changes in the watershed and incorporate those into a revised version of the Draft Existing Condition Hydrology model. This information is presented in Table 1.1a.

Only two modeled retention basins from the Draft Existing Condition Hydrology model were not field verified. The first is modeled in sub basin 288A and was not yet constructed. This basin is described in some detail in the "Drainage Report for Palm Valley Phase II Mass grading", dated December 23, 1998 by the WLB Group. This basin was removed from the draft existing condition model. The second basin is located within sub area 254. This area is gated and no access is permitted to the public. This development appeared fully built-out however, and the retention was assumed to be in place.

In some cases, on-lot retention in recently developed strip malls and other commercial properties was noted, however, this amount of volume was considered inconsequential compared with the total contributing watershed area and was not included in the model.

Task 2

The next task was to prepare a work-map from which the contributing areas and the percent contribution of each city/jurisdictions and the Palm Valley Master Planned Community boundary were estimated. The map is shown on Figure 1.1. The map shows stakeholder boundaries and sub basins. Using this map, the relative percentage of contributing watershed area associated with the stakeholders was determined and quantified.

Task 3

The next step in the analysis was to develop the following 10 hydrologic models:

- Undeveloped Model -This model was created by simply modifying the percent impervious (RTIMP) variable in the draft existing condition model to reflect an undeveloped condition. In addition, all existing retention/detention diverts were disabled.
- Existing Model – This model was a result of modifications made to the draft existing condition model based upon the data in Table 1.1a resulting from the field visit described in Task 1.
- Fully Developed No Retention – This model was created using the data provided URS from the FCDMC GIS Data base during the Level II portion of the Loop 303 ADMP Update project. This information consists of a tabulation of all sub basins within the ADMP Update project area and the associated full build-out or completely developed RTIMP variable. In this model, there were no diverts for retention of detention.
- Fully Developed with Retention – This model was created by adding retention diversions to the fully developed no retention model. The magnitude of these diverts was determined by running the 100-year, 6-hour storm for sub basins located within the City of Goodyear and the 100-year, 2-hour storm for all remaining sub basins. Sub Basins whose boundaries cross multiple jurisdictions were evaluated by computing a composite retention volume based upon the percentage of area found each jurisdiction. See Table 1.1b. All computed retention

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volumes were multiplied by an 80% efficiency factor (as requested by FCDMC) to account for lost volume due to inadequate construction, siltation, etc...

- No ADMP, Future Retention Requirements met – This model was created by modifying the existing condition hydrology model for future conditions with onsite retention in currently undeveloped sub basins within the ADOT Basins contributing watershed.
- No ADMP, Future Retention Based on Pre-Post Analysis - This model was created by modifying the existing condition hydrology model for future conditions. Onsite retention in currently undeveloped sub basins within the ADOT Basins contributing watershed is provided. In lieu of normal on-site retention requirements, enough retention is provided so that post developed peak discharge is attenuated to be less than or equal to the existing peak discharge.
- The ADMP is in place and Future Retention Requirements are met – This model was created by modifying the Level III preliminary draft preferred condition hydrology model for future conditions within the ADOT Basins watershed. Onsite retention in currently undeveloped sub basins within the ADOT Basins contributing watershed is modeled for the ultimate build-out scenario.
- The ADMP is in place and Future Retention Based on Pre-Post Analysis is provided - This model was created by modifying the Level III preliminary draft preferred condition hydrology model for future conditions within the ADOT Basins watershed. Onsite retention in currently undeveloped sub basins within the ADOT Basins contributing watershed is provided. In lieu of normal on-site retention requirements however, only the amount of retention required for a pre-post peak attenuation is modeled.
- The ADMP is in place and there is no future retention modeled for the ultimate build out of the ADOT Basin watershed.
- There is no ADMP in place and there is no future retention modeled for the ultimate build out of the ADOT Basin watershed.

Task 4

This task involved the preparation of summary tables showing the results of the ten hydrologic models described above. Table 1.2a shows a break down of all four ADOT Basins labeled A – D from west to east and the amount of volume flowing to each. Both the total volume as well as the percentage of volume from the individual cities/jurisdictions and Palm Valley is shown. Table 1.2b shows a break down of all four ADOT Basins labeled A – D from west to east and the approximate stage corresponding with the condition modeled within the contributing watershed.

Table(s) 1.3 – 1.7 show the ADOT Basins as a composite and then individually for all ten hydrologic models analyzed as well as analysis results from other studies/reports. The information contained on these tables includes peak inflow/outflow data, peak stage/storage data and maximum ponding and storage information.

Figure 1.2 illustrates total expected inflow volume based on the results of the modeled conditions described above relative to the existing volume provided by the ADOT Basins. Important relationships between the inflow volumes have been highlighted. These relationships show comparisons of interest between various modeled watershed conditions. Table 1.8 contains a tabulated summary of the key comparisons shown on Figure 1.2.

Results

It is important to note that the volume of inflow indicated on Table 1.2a is lower than the peak storage information shown on Table(s) 1.3 – 1.7. This is a result of the way in which the HEC-1 model is routing flow from the western most basin ('A') to the eastern most basin ('D'). Since the basins are connected by pipes/culverts and the flow moves from one to the next in the model, peak storage volume data given by the HEC-1 output summary at Basin D for example would include both runoff directly flowing into basin D and also, runoff routed from Basin C to the west. For this reason, the total inflow volumes shown on Table 1.2a were obtained by simply summing the volume generated on individual sub basins contributing to the total inflow upstream.

In addition, it should be noted that the total inflow volume would typically be higher than the peak storage volume since it represents the entire volume under the inflow hydrograph for the entire storm duration rather than only that volume present in the basin corresponding to the hydrograph peak discharge. This is always true for a basin with only a single inflow point.

The results of the analysis showed that for any given storm event the majority of runoff contributing to the volume at the ADOT Basins comes from the City of Goodyear followed by Litchfield Park and then Avondale. The Palm Valley development contributes approximately 60% of the total volume conveyed downstream to the ADOT Basins (Note: Palm Valley is located in several jurisdictions – Figure 1.1). By comparison, the City of Goodyear contributes approximately 46% of the total inflow volume versus approximately 37% and 14% for the cities of Litchfield Park and Avondale respectively.

The results of the above analysis have been charted and are presented on figure 1.2. From a review of the analysis results and figure 1.2, it is clear that under existing conditions, the outer ADOT Basins 'A' (far west) and 'D' (far east) have far more volume than that which is directly flowing in from the adjacent watershed. However, the results also indicate that the existing inner ADOT Basins 'B' and 'C' accept the highest rates of inflow and may not have adequate volume under certain conditions modeled. This indicates that the excess inflow volume to the inner basins would require transfer to the outer basins whose geometry provide more volume than that which directly flows in from the adjacent land. This would be a direct function of the adequacy or in-adequacy of the existing connection pipes/culverts.

Taken as a composite facility, the existing ADOT Basins appear to have adequate capacity to store the runoff generated by the offsite drainage area as well as diverted discharges from the Bullard Wash, however, the FCDMC minimum freeboard requirement may not be met.

Table 1.8 summarizes key comparisons made between the 10 modeled inflow conditions illustrated on Figure 1.2. According to these comparisons, the difference between the existing condition inflow volume and the undeveloped inflow volume (165 ac-ft) represents the current benefit to upstream development. This apparent benefit is due to the lack of existing onsite retention provided by the majority of existing upstream development. Typically, development must reserve land for the construction of onsite retention basins to attenuate post-developed peak discharges resulting from the 100-year storm event. In this case, most of the upstream development has not constructed onsite retention basins but has instead directed storm water runoff downstream to the existing ADOT Basins.

If planned future development on currently undeveloped sub basins upstream of the existing ADOT Basins is allowed to directly discharge post developed storm water downstream without providing onsite retention, the total benefit would be equal to the land that would be required to store approximately 415 ac-ft. Based on Table 1.2a, the approximate relative benefits to each of the stakeholders in the watershed in terms of volume are as follows:

- The City of Goodyear – 192 ac-ft
- The City of Litchfield Park – 156 ac-ft
- The City of Avondale – 59 ac-ft
- Maricopa County – 5 ac-ft
- Estrella Community College – 3 ac-ft
- Palm Valley Master Planned Community – 264 ac-ft

In reviewing the results in Figure 1.2 and Table 1.2a, key comparisons can be made to the use of retention in the existing contributing watershed to the ADOT Basins. The impacts of the ADMP in diverting runoff to the ADOT Basins can also be evaluated. These scenarios are used for comparison purposes.

1. Assuming there is no ADMP in place, the impact of waiving retention criteria in the contributing watershed to date is approximately 165 ac-ft, which is approximately 25% of the present contributing runoff volume to the basins. Based on Table 1.2a, the approximate relative benefits to each of the stakeholders in the watershed in terms of volume are as follows:
   - The City of Goodyear – 76 ac-ft
   - The City of Litchfield Park – 62 ac-ft
   - The City of Avondale – 23 ac-ft
   - Maricopa County – 2 ac-ft
   - Estrella Community College – 2 ac-ft
   - Palm Valley Master Planned Community – 105 ac-ft
2. If the ADMP is not implemented and development occurred as planned in the ADOT Basins watershed, the increased volume of runoff to the ADOT Basins by waiving retention entirely is approximately 139 ac-ft. Based on Table 1.2a, the approximate relative benefits to each of the stakeholders in the watershed in terms of volume are as follows:
   - The City of Goodyear – 64 ac-ft
   - The City of Litchfield Park – 52 ac-ft
   - The City of Avondale – 20 ac-ft
   - Maricopa County – 2 ac-ft
   - Estrella Community College – 1 ac-ft
   - Palm Valley Master Planned Community – 89 ac-ft
3. If the ADMP is implemented and development occurs as planned in the entire watershed (existing hydrology), the increase in runoff volume to the ADOT Basins is again 139 ac-ft. However, the ADMP project diverts an additional runoff volume of approximately 156 ac-ft to the ADOT Basins. Again, based on Table 1.2a, the approximate relative benefits to each of the stakeholders in the watershed in terms of volume are as follows:
   - The City of Goodyear – 64 ac-ft

- The City of Litchfield Park – 50 ac-ft
- The City of Avondale – 20 ac-ft
- Maricopa County – 156 ac-ft
- Estrella Community College – 1 ac-ft
- Palm Valley Master Planned Community – 898 ac-ft

Note that when the ADMP is in place the FCDMC now contributes 55% of the total increase in inflow at the ADOT Basins while area stakeholders combined contribute 45% of the total increase in runoff volume. The 45% would then be split between the stakeholders according to the percentages shown on Table 1.2a.
The data provided herein can be used to determine the impacts of each stakeholder including FCDMC on the ADOT Basins. The proportional benefit to each stakeholder may be used to facilitate partnering in the future improvement(s) to the basins.

cc:

Attachment

Hydrologic Modeling Parameters

Sub Area	Modeled Parameters: Retention Triangle (Y/N)	Development: [18]RTIMP (WLB)	Development: RTIMP (Draft Exist) (URS)	[5]Ultimate RTIMP (FCDMC-GIS)	[1]Modeled As Dev or (FD,UD,PD)	Color Aerial Visible Development (FD,UD,PD)	[6]Estimated Percentage of Development in Draft Exist. Condition Model	Field Check Development As a % of Full Build-out (approx. %)	Field Verified Existing Condition of Sub Basin (FD,UD,PD)	Revised Existing Cond. RTIMP	[7]Field Check Verified Retention (Y/N)	[8]Future Retention Proposed in Sub-Area (Y/N)	Palm Valley Phase
288A	Y	0%	0%	80.0%	UD	UD	0%	0%	UD	0.0%	[13]N	Y	II
287A	N	0%	16%	61.0%	PD	PD	26%	26%	PD	16%	N/A	N/A	N/A
254	Y	0%	8%	9.9%	PD	PD	81%	92%	PD	9.1%	[10]Y	N	NS
254B	N	0%	0%	20.7%	UD	UD	0%	0%	UD	0.0%	N/A	[14]N	NS
269	Y	0%	30%	37.9%	PD	PD	79%	100%	FD	37.9%	[15]Y	[14]N	NS
269B	Y	0%	15%	46.0%	PD	PD	33%	74%	PD	34.0%	[15]Y	[14]N	NS
268	Y	0%	30%	37.4%	PD	PD	80%	100%	FD	37.4%	[12]Y	[14]N	NS
[2]288B	Y	0%	14%	32.4%	PD	PD	43%	43%	PD	13.9%	Y	[14]N	II
287B	N	0%	54%	55.7%	PD	PD	97%	100%	FD	55.7%	[9]N/A	N/A	N/A
2711	N	0%	20%	20.0%	FD	FD	100%	100%	FD	20.0%	N/A	[20]N	NS
254A	N	20%	20%	48.1%	FD	FD	Used URS RTIMP	100%	FD	20.0%	N/A	[20]N	N/A
257	N	0%	0%	21.7%	UD	UD	0%	0%	UD	0.0%	N/A	Unknown	N/A
256	Y	0%	3%	22.1%	PD	PD	14%	27%	PD	6.0%	Y	[21]Y	N/A
SUB6	N	12%	20%	11.0%	FD	FD	Used URS RTIMP	100%	FD	20.0%	N/A	[20]N	N/A
SUB7	N	12%	3%	5.8%	FD	FD	Used URS RTIMP	100%	FD	3.0%	N/A	[20]N	N/A
271A	Y	0%	13%	71.1%	PD	PD	18%	65%	PD	46.2%	Y	[14]N	NS
255A	N	12%	12%	9.5%	FD	FD	Used URS RTIMP	100%	FD	12.0%	N/A	[20]N	N/A
2712	N	0%	2%	59.8%	PD	PD	3%	3%	PD	2%	N/A	[14]N	I
270	N	18%	30%	35.4%	PD	PD	85%	100%	FD	35.4%	N/A	[20]N	N/A
289C	N	0%	1%	13.6%	PD	PD	7%	7%	PD	1.0%	N/A	[14]N	I
289A	N	0%	27%	27.0%	FD	[19]PD	100%	100%	FD	27.0%	N/A	[14]N	I
[3]289B	N	0%	15%	25.7%	FD	FD	Used URS RTIMP	90%	PD	15.0%	N/A	[14]N	I
[illegible]D	N	0%	26%	26.0%	FD	FD	100%	100%	FD	26.0%	N/A	[14]N	I
289	N	0%	27%	30.4%	PD	PD	89%	96%	PD	29.2%	[9]N/A	[14]N	I
287C	N	0%	48%	53.0%	PD	PD	91%	91%	PD	48%	N/A	N/A	N/A
287D	N	0%	0%	56.7%	UD	UD	0%	0%	UD	0.0%	N/A	N/A	N/A

FD = Fully Developed
PD = Partly Developed
UD = Un-Developed

1. If the percent impervious is 0%, then undeveloped.
2. Represents off-line retention as described in "Drainage Report for Palm Valley Phase 2 Mass Grading", dated 12/23/1998.
3. EEC/URS modeled as a lower RTIMP at full build-out than later calculated by the FCDMC GIS data base for preparation of Future Condition Hydrology model. Did not change to the higher value since the ~~value~~ used in the Existing Condition model had already been approved by the FCDMC.
4. RTIMP fully developed was less than the full build-out RTIMP used in the Existing Condition model, therefore, the RTIMP from the Existing Condition model was used for consistency.
5. Data source from the FCDMC GIS Data Base. Based on the percentage of the total sub basin area that will be developed in the ultimate built-out condition.
6. This is the percentage of the sub area that was built out at the time the Draft Existing Condition Hydrology model was prepared.
7. N = field trip could not verify the modled retention, Y = field trip verified modeled retention.
8. As described by applicable drainage report, this would be new or additional retention, beyond what currently exists.
9. Some on-lot retention observed, not included in model.
10. Could not access portion of sub area 254 due to gate, assume no change from draft and that retention exists.
11. "100%" indicates this area is completely built-out according to future land-use plan. Note that this does not necessarily mean the entire sub area is covered with development for the 100% or "full build-out" condition.
12. This retention was verified and documented on page 12 by the "Palm Valley Concept Drainage Plan for the Roosevelt Canal Watershed", dated 12/17/96.
13. Retention as described on pages 9 and 12 of the "Drainage Report for Palm Valley Phase 2 Mass Grading", dated 12/23/1998 - not yet constructed however, modeled in the Draft Existing Condtion Hydrology Model. This divert will be turned off for the existing condition in this analysis since it was not yet constructed.
14. Per the "Developed Conditions Watershed Boundary Map" (11"x17") map, in the "Master Drainage Study for Palm Valley", dated March 8 1998, excess runoff from this area will drain directly to the ADOT basins.
15. Retention provided per the "Palm Valley Master Drainage Study", by the WLB Group, dated 1/8/98 - see sub basins '**S34**', '**S34A**' and '**S12**'.
[illegible]r the "Developed Conditions Watershed Boundary Map" (11"x17") map, in the "Master Drainage Study for Palm Valley", dated March 8 1998, this area generally drains to the RID Overchute.
[illegible]S" indicates that there was no phase specified for this sub basin in any documentation available to URS.
18. Some differences due to sub basin boundary changes in the ADMP Update.
19. Although area appears partly developed on aerial, it may be fully developed according to future land use.
20. Sub basin is fully developed without retention.
21. Retention construction noted during field trip.

Table 1.1b

Onsite Retention Requirements for ADOT Basin Watershed Sub Basins

Retention Requirement Sub Basin	ADOT Basin Study % Area Within Jurisdiction 100-yr, 2-hr Avondale	100-yr, 6-hr Goodyear	100-yr, 2-hr Litchfield Park	100-yr, 2-hr Maricopa County	100-yr, 2-hr Estrella CC	100-yr, 2-hr Volume (ac-ft)	100-yr, 6-hr Volume (ac-ft)	[1]Modeled Design Storm	Required Onsite Retention (ac-ft)	Volume of Diverted Flow Currently Used to Model Existing Onsite Retention (ac-ft)	Required to Provide Future Retention?	% Future Development to be Retained	(80% Eff.) (ac-ft)	Part 1A&2A RET. DIV. in HEC-1 as % of Future Developed Area (ac-ft)	Part 1B&2B RET. DIV. in HEC-2 as % of Future (ac-ft)
[5,8]254			100%			11.8	21.8	100-yr, 2-hr	11.8	29.6	N	0.0%	9.4	**29.6**	4.80
[5]256			95%	5%		36.9	50.8	100-yr, 2-hr	36.9	5.0	Y	73.0%	29.5	**26.5**	20.50
[5]257			100%			31.9	42.5	100-yr, 2-hr	31.9	0.0	Y	100.0%	25.5	**25.5**	18.40
268		100%				19.2	27.4	100-yr, 6-hr	27.4	N/A	N/A	N/A	21.9	N/A	N/A
269		100%				18.1	25.9	100-yr, 6-hr	25.9	N/A	N/A	N/A	20.7	N/A	N/A
270			90%	10%		23.5	33.4	100-yr, 2-hr	23.5	N/A	N/A	N/A	18.8	N/A	N/A
[6]289		100%				20.7	29.6	100-yr, 6-hr	29.6	0.0	N	0.0%	23.7	0.0	N/A
2711			100%			6.8	10.7	100-yr, 2-hr	6.8	N/A	N/A	N/A	5.4	N/A	N/A
[5]2712	90%	6%		4%		45.2	59.4	*Composite*	46.1	0.0	Y	89.0%	36.9	**32.8**	36.65
254A			100%			11.3	23.8	100-yr, 2-hr	11.3	N/A	N/A	N/A	9.0	N/A	N/A
[6]254B			100%			8.1	12.7	100-yr, 2-hr	8.1	0.0	N	0.0%	6.5	0.0	N/A
255A			100%			38.1	59.3	100-yr, 2-hr	38.1	N/A	N/A	N/A	30.5	N/A	N/A
[5]269B		55%	37%	7%		21.5	30.3	*Composite*	26.4	12.4	Y	24.0%	21.1	**17.5**	16.60
[5]271A	100%					27.2	34.5	100-yr, 2-hr	27.2	11.1	Y	33.5%	21.7	**18.4**	20.00
[5]287A		100%				35.3	45.9	ADOT Basin	45.9	0.0	Y	74.0%	36.7	**N/A**	N/A
287B		100%				9.4	12.6	ADOT Basin	12.6	N/A	N/A	N/A	10.1	N/A	N/A
[6]287C		100%				24.6	31.7	ADOT Basin	31.7	0.0	N	0.0%	25.3	0.0	N/A
[5]287D		100%				26.1	33.0	ADOT Basin	33.0	0.0	Y	100.0%	26.4	**N/A**	N/A
[5]288A		100%				8.9	11.0	100-yr, 6-hr	11.0	0.0	Y	100.0%	8.8	**8.8**	6.50
[5,7]288B		100%				68.3	99.8	100-yr, 6-hr	99.8	[7]N/A	Y	26.0%	79.8	**20.8**	47.10
289A	67%				33%	13.8	20.9	100-yr, 2-hr	13.8	N/A	N/A	N/A	11.0	N/A	N/A
[6]289B		100%				21.4	31.4	100-yr, 6-hr	31.4	0.0	N	0.0%	25.1	0.0	N/A
[5]289C	87%	14%				16.6	27.1	*Composite*	18.1	0.0	Y	76.5%	14.5	**11.1**	10.80
289D		100%				17.2	26.1	100-yr, 6-hr	26.1	N/A	N/A	N/A	20.9	N/A	N/A
SUB6			100%			8.2	11.8	100-yr, 2-hr	8.2	N/A	N/A	N/A	6.6	N/A	N/A
SUB7			100%			14.4	23.1	100-yr, 2-hr	14.4	N/A	N/A	N/A	11.5	N/A	N/A

1. N/A indicates that the sub area exists as 100% developed with no retention, therefore, no future retention divert is waranted. However, for the purposes of this study retention will be used to evaluate the "benefit" to a development of not having to provide on-site retention.
2. Data taken frome the Loop 303 ADMP Update workbook, "sub basin data.xls". Since the scope for this study allows for more accurate determination of jurisdictional boudaries as well as percentages of sub basins within different jurisdictions, the data from this study supercedes that from the ADMP Update. The ADMP data was included for information only.
3. Differences in percentages of a sub basin found in multiple jurisdictions between the ADMP Update and this study are a result of more detailed scope and data used to produce this information.
4. The ADMP Update used the following criteria to model future onsite retention: If 75% or more of a sub basin was within the city of Goodyear, the 100-year, 6-hour storm event was used, otherwise the 100-year, 2-hour storm event was used (results in higher downstream runoff and hence is more conservative). Per the higher level of detail required by this study, the retention will be weighted by the percentages of the sub basin found within and outside of the City of Goodyear.
5. Sub basin is going to develop in the future and will be required to provide the required on-site retention.
6. Sub basin is going to develop in the future but is part of existing phases of the Palm Valley development and will not provide future retention.
7. Off-line retention exists in the golf course portion of this sub basin. It is modeled by HEC-1. The proposed future retention will be based on on the balance of area currently un-developed and will be shown in the HEC-1 model as a divert.
8. Total divert in existing condition is 29.6 ac-ft. This includes approximately 4.8 ac-ft for existing development and 24.8 ac-ft for ponding behind the airline canal.

Contributing Jurisdictions/Development to ADOT Basin Inflow

Total ADOT Basin Contributing Watershed Area: 7.39 sm

Basin ID	Total Contributing Area (sm)	Modeled Condition	Goodyear % Total	Goodyear Peak Discharge (cfs)	Goodyear Volume (ac-ft)	Litchfield Park % Total	Litchfield Park Peak Discharge (cfs)	Litchfield Park Volume (ac-ft)	Avondale % Total	Avondale Peak Discharge (cfs)	Avondale Volume (ac-ft)	Maricopa County % Total	Maricopa County Peak Discharge (cfs)	Maricopa County Volume (ac-ft)	Estrella Community College % Total	Estrella Community College Peak Discharge (cfs)	Estrella Community College Volume (ac-ft)	Palm Valley % Total	Palm Valley Peak Discharge (cfs)	Palm Valley Volume (ac-ft)	[3]Total Inflow Volume (ac-ft)	Actual Available Storage (ac-ft)
A	0.41	Completely Undeveloped	100.0%	277	26	0.0%	0	0	0.0%	0	0	0.0%	0	0	0.0%	0	0	66.6%	184	17	26	265.2
		Existing Conditions	100.0%	295	34	0.0%	0	0	0.0%	0	0	0.0%	0	0	0.0%	0	0	66.6%	196	23	34	
		Fully Developed - No Onsite Retention	100.0%	361	64	0.0%	0	0	0.0%	0	0	0.0%	0	0	0.0%	0	0	66.6%	240	42	64	
		Fully Developed - Onsite Retention All Sub Basins	100.0%	297	55	0.0%	0	0	0.0%	0	0	0.0%	0	0	0.0%	0	0	66.6%	198	37	55	
		Part 1A:No diverts from ADMP, Future Onsite Retention Provided	100.0%	297	55	0.0%	0	0	0.0%	0	0	0.0%	0	0	0.0%	0	0	66.6%	198	37	55	
		Part 1B:No diverts from ADMP, Post developed Q's </equal to existing	100.0%	297	57	0.0%	0	0	0.0%	0	0	0.0%	0	0	0.0%	0	0	66.6%	198	38	57	
		Part 2A:Diverts from ADMP, Future Onsite Retention Provided	100.0%	723	211	0.0%	0	0	0.0%	0	0	0.0%	0	0	0.0%	0	0	66.6%	481	140	211	
		Part 2B: Diverts from ADMP, Post developed Q's </equal to existing	100.0%	733	213	0.0%	0	0	0.0%	0	0	0.0%	0	0	0.0%	0	0	66.6%	488	142	213	
		Part 3A: No ADMP, Dev. W/O Future Retention	100.0%	361	64	0.0%	0	0	0.0%	0	0	0.0%	0	0	0.0%	0	0	66.6%	240	42	64	
		Part 3B: W/ADMP, Dev. W/O Future Retention	100.0%	733	220	0.0%	0	0	0.0%	0	0	0.0%	0	0	0.0%	0	0	66.6%	488	146	220	
B	2.18	Completely Undeveloped	75.7%	890	93	23.5%	276	29	0.0%	0	0	0.8%	9	1	0.0%	0	0	96.0%	1128	118	123	109.0
		Existing Conditions	75.7%	520	143	23.5%	162	44	0.0%	0	0	0.8%	6	2	0.0%	0	0	96.0%	659	181	188	
		Fully Developed - No Onsite Retention	75.7%	1007	174	23.5%	313	54	0.0%	0	0	0.8%	11	2	0.0%	0	0	96.0%	1276	220	229	
		Fully Developed - Onsite Retention All Sub Basins	75.7%	280	58	23.5%	87	18	0.0%	0	0	0.8%	3	1	0.0%	0	0	96.0%	355	73	77	
		Part 1A:No diverts from ADMP, Future Onsite Retention Provided	75.7%	532	141	23.5%	165	44	0.0%	0	0	0.8%	6	1	0.0%	0	0	96.0%	675	179	186	
		Part 1B:No diverts from ADMP, Post developed Q's </equal to existing	75.7%	436	122	23.5%	135	38	0.0%	0	0	0.8%	5	1	0.0%	0	0	96.0%	553	154	161	
		Part 2A:Diverts from ADMP, Future Onsite Retention Provided	75.7%	532	141	23.5%	165	44	0.0%	0	0	0.8%	6	1	0.0%	0	0	96.0%	675	179	186	
		Part 2B: Diverts from ADMP, Post developed Q's </equal to existing	75.7%	436	122	23.5%	135	38	0.0%	0	0	0.8%	5	1	0.0%	0	0	96.0%	553	154	161	
		Part 3A: No ADMP, Dev. W/O Future Retention	75.7%	535	158	23.5%	166	49	0.0%	0	0	0.8%	6	2	0.0%	0	0	96.0%	678	200	208	
		Part 3B: W/ADMP, Dev. W/O Future Retention	75.7%	535	158	23.5%	166	49	0.0%	0	0	0.8%	6	2	0.0%	0	0	96.0%	678	200	208	
C	4.57	Completely Undeveloped	24.7%	331	76	49.4%	662	152	22.8%	305	70	1.6%	21	5	1.6%	22	5	47.1%	630	145	308	324.5
		Existing Conditions	24.7%	350	99	49.4%	699	197	22.8%	322	91	1.6%	22	6	1.6%	23	6	47.1%	666	188	400	
		Fully Developed - No Onsite Retention	24.7%	436	121	49.4%	872	242	22.8%	402	111	1.6%	28	8	1.6%	28	8	47.1%	831	230	489	
		Fully Developed - Onsite Retention All Sub Basins	24.7%	132	49	49.4%	265	98	22.8%	122	45	1.6%	8	3	1.6%	9	3	47.1%	252	93	199	
		Part 1A:No diverts from ADMP, Future Onsite Retention Provided	24.7%	322	93	49.4%	644	185	22.8%	297	85	1.6%	21	6	1.6%	21	6	47.1%	614	176	375	
		Part 1B:No diverts from ADMP, Post developed Q's </equal to existing	24.7%	314	95	49.4%	627	189	22.8%	289	87	1.6%	20	6	1.6%	20	6	47.1%	597	180	383	
		Part 2A:Diverts from ADMP, Future Onsite Retention Provided	24.7%	322	93	49.4%	644	185	22.8%	297	85	1.6%	21	6	1.6%	21	6	47.1%	614	176	375	
		Part 2B: Diverts from ADMP, Post developed Q's </equal to existing	24.7%	314	95	49.4%	627	189	22.8%	289	87	1.6%	20	6	1.6%	20	6	47.1%	597	180	383	
		Part 3A: No ADMP, Dev. W/O Future Retention	24.7%	379	117	49.4%	758	234	22.8%	349	108	1.6%	24	7	1.6%	25	8	47.1%	723	223	473	
		Part 3B: W/ADMP, Dev. W/O Future Retention	24.7%	379	117	49.4%	758	234	22.8%	349	108	1.6%	24	7	1.6%	25	8	47.1%	723	223	473	
[illegible]	0.23	Completely Undeveloped	100.0%	460	19	0.0%	0	0	0.0%	0	0	0.0%	0	0	0.0%	0	0	51.7%	238	10	19	334.7
		Existing Conditions	100.0%	460	19	0.0%	0	0	0.0%	0	0	0.0%	0	0	0.0%	0	0	51.7%	238	10	19	
		Fully Developed - No Onsite Retention	100.0%	482	35	0.0%	0	0	0.0%	0	0	0.0%	0	0	0.0%	0	0	51.7%	249	18	35	
		Fully Developed - Onsite Retention All Sub Basins	100.0%	284	35	0.0%	0	0	0.0%	0	0	0.0%	0	0	0.0%	0	0	51.7%	147	18	35	
		Part 1A:No diverts from ADMP, Future Onsite Retention Provided	100.0%	472	35	0.0%	0	0	0.0%	0	0	0.0%	0	0	0.0%	0	0	51.7%	244	18	35	
		Part 1B:No diverts from ADMP, Post developed Q's </equal to existing	100.0%	472	35	0.0%	0	0	0.0%	0	0	0.0%	0	0	0.0%	0	0	51.7%	244	18	35	
		Part 2A:Diverts from ADMP, Future Onsite Retention Provided	100.0%	472	35	0.0%	0	0	0.0%	0	0	0.0%	0	0	0.0%	0	0	51.7%	244	18	35	
		Part 2B: Diverts from ADMP, Post developed Q's </equal to existing	100.0%	472	35	0.0%	0	0	0.0%	0	0	0.0%	0	0	0.0%	0	0	51.7%	244	18	35	
		Part 3A: No ADMP, Dev. W/O Future Retention	100.0%	477	35	0.0%	0	0	0.0%	0	0	0.0%	0	0	0.0%	0	0	51.7%	247	18	35	
		Part 3B: W/ADMP, Dev. W/O Future Retention	100.0%	477	35	0.0%	0	0	0.0%	0	0	0.0%	0	0	0.0%	0	0	51.7%	247	18	35	

Modeled Condition	Composite [1]Total Inflow Volume (ac-ft)	[3]Goodyear (ac-ft)	[3]Litchfield Park (ac-ft)	[3]Avondale (ac-ft)	[3]Maricopa County (ac-ft)	[3]Estrella College (ac-ft)	[3]Palm Valley (ac-ft)
Percentage of Contributing Area at ADOT Basins		46.3%	37.5%	14.1%	1.2%	1.0%	63.7%
Completely Undeveloped	476	220	178	67	6	5	303
Existing Conditions	641	297	240	90	8	6	408
Fully Developed - No Onsite Retention	818	378	307	115	10	8	521
Fully Developed - Onsite Retention All Sub Basins	365	169	137	51	4	4	233
Part 1A:No diverts from ADMP, Future Onsite Retention Provided	651	301	244	92	8	7	415
Part 1B:No diverts from ADMP, Post developed Q's </equal to existing	636	294	239	90	8	6	405
Part 2A:Diverts from ADMP, Future Onsite Retention Provided	807	374	303	114	10	8	514
Part 2B: Diverts from ADMP, Post developed Q's </equal to existing	792	367	297	112	10	8	505
Part 3A: No ADMP, Dev. W/O Future Retention	780	361	292	110	9	8	497
Part 3B: W/ADMP, Dev. W/O Future Retention	936	433	351	132	11	9	597

1. Note: The 'Total Volume' reported here is indicative of the sum of the volumes generated on the individual sub basins upstream that contribute directly to the ADOT Basins. Peak storage values on Table 1.3 were obtained by summing the peak storage value reported at each ADOT Basin (A-D) in the HEC-1 output file. Since the basins are interconnected and modeled routing the discharges from one to the next (A-D), these volumes in effect double-count storm water. For example, the peak storage in Basin D would have portions of the volume that originally discharged into the upstream bains A - C as well as volume from the adjacent/upstream sub basin areas.
2. Note: The sum of the volumes will be higher than the total if Palm Valley is included. This is because portions of Palm Valley lie within multiple cities. If it is excluded, the summation will equal the total volume.
3. Note: Portion of the total volume that drains to the ADOT Basins from respective city, jurisdiction or development. This value is based on the percentage of total contributing area shown above.

Tab. .b

Ponding Elevation Summary

Basin ID	Total Contributing Area (sm)	Modeled Condition	[2]Max. Ponding Elevation (ft)	[4]Ponding Elevation at Peak Inflow (ft)
A	**0.41** (Ex. Vol: 265.2 ac-ft)	*Completely Undeveloped*	986	978.7
		Existing Conditions	986	978.9
		Fully Developed - No Onsite Retention	986	979.6
		Fully Developed - Onsite Retention All Sub Basins	986	979.3
		Part 1A:No diverts from ADMP, Future Onsite Retention Provided	986	979.3
		Part 1B:No diverts from ADMP, Post developed Q's </equal to existing	986	979.4
		Part 2A:Diverts from ADMP, Future Onsite Retention Provided	986	983.3
		Part 2B: Diverts from ADMP, Post developed Q's </equal to existing	986	983.3
		Part 3A: No ADMP, Dev. W/O Future Retention	986	979.6
		Part 3B: W/ADMP, Dev. W/O Future Retention	986	983.5
B	**2.18** (Ex. Vol: 109.0 ac-ft)	*Completely Undeveloped*	986	982.9
		Existing Conditions	986	982.0
		Fully Developed - No Onsite Retention	986	985.1
		Fully Developed - Onsite Retention All Sub Basins	986	980.5
		Part 1A:No diverts from ADMP, Future Onsite Retention Provided	986	981.9
		Part 1B:No diverts from ADMP, Post developed Q's </equal to existing	986	981.7
		Part 2A:Diverts from ADMP, Future Onsite Retention Provided	986	981.9
		Part 2B: Diverts from ADMP, Post developed Q's </equal to existing	986	981.7
		Part 3A: No ADMP, Dev. W/O Future Retention	986	982.4
		Part 3B: W/ADMP, Dev. W/O Future Retention	986	982.4
C	**4.57** (Ex. Vol: 324.5 ac-ft)	*Completely Undeveloped*	986	982.7
		Existing Conditions	986	983.9
		Fully Developed - No Onsite Retention	986	987.3
		Fully Developed - Onsite Retention All Sub Basins	986	978.6
		Part 1A:No diverts from ADMP, Future Onsite Retention Provided	986	982.9
		Part 1B:No diverts from ADMP, Post developed Q's </equal to existing	986	982.8
		Part 2A:Diverts from ADMP, Future Onsite Retention Provided	986	982.9
		Part 2B: Diverts from ADMP, Post developed Q's </equal to existing	986	982.9
		Part 3A: No ADMP, Dev. W/O Future Retention	986	986.0
		Part 3B: W/ADMP, Dev. W/O Future Retention	986	985.7
D	**0.23** (Ex. Vol: 334.7 ac-ft)	*Completely Undeveloped*	986	984.9
		Existing Conditions	986	987.6
		Fully Developed - No Onsite Retention	986	992.9
		Fully Developed - Onsite Retention All Sub Basins	986	981.0
		Part 1A:No diverts from ADMP, Future Onsite Retention Provided	986	987.5
		Part 1B:No diverts from ADMP, Post developed Q's </equal to existing	986	987.7
		Part 2A:Diverts from ADMP, Future Onsite Retention Provided	986	988.1
		Part 2B: Diverts from ADMP, Post developed Q's </equal to existing	986	988.2
		Part 3A: No ADMP, Dev. W/O Future Retention	986	990.9
		Part 3B: W/ADMP, Dev. W/O Future Retention	986	991.5

(Ex. Vol: 1033.3 ac-ft)

COMPOSITE BASIN Modeled Condition	Max. Ponding Elevation (ft)	[1]Ponding Elevation at Peak Inflow (ft)
Completely Undeveloped	986	982.4
Existing Conditions	986	983.6
Fully Developed - No Onsite Retention	986	986.9
Fully Developed - Onsite Retention All Sub Basins	986	979.8
Part 1A:No diverts from ADMP, Future Onsite Retention Provided	986	983.4
Part 1B:No diverts from ADMP, Post developed Q's </equal to existing	986	983.4
Part 2A:Diverts from ADMP, Future Onsite Retention Provided	986	984.6
Part 2B: Diverts from ADMP, Post developed Q's </equal to existing	986	984.6
Part 3A: No ADMP, Dev. W/O Future Retention	986	985.6
Part 3B: W/ADMP, Dev. W/O Future Retention	986	986.6

1. Represents a weighted average using the peak elevations shown above within individual basins and weighting them according to total volume provided. This is only an approximation and is not the result of an actual model.
2. WSEL's exceding 986' may no longer be contained within the basins and may begin to pond on upstream adjacent land.
3. At the time of peak inflow discharge, this is the HEC-1 maximum ponding WSEL. This indicates breakout if it exceeds the maximum WSEL of 986'.

Tab'e 1.3

Cc)
ADOT Basin
Capacity

Design Storm (Yr-Duration)	Q_{in} Peak (cfs)	Q_{out} Peak (cfs)	Peak[1,10] Stage (ft)	Max.[2] Ponding Elevation (ft)	Peak Storage (ac-ft)	Max. Storage (ac-ft)	Modeled Condition	Data Source (Design Report)
100-24	3252	73	978.7 - 984.9	986	605.6	1033.3	Completely Undeveloped	ADOT Basin Analysis, URS, 10/01
100-24	2857	80	978.9 - 987.7	986	726.2	1033.3	[11]Existing Condition	ADOT Basin Analysis, URS, 10/01
100-24	3938	92	979.6 - 992.9	986	1074.1	1033.3	Completely Developed with NO Onsite Retention on All Sub Basins	ADOT Basin Analysis, URS, 10/01
100-24	1487	63	978.6 - 981.0	986	353.8	1033.3	Completely Developed with Onsite Retention on All Sub Basins	ADOT Basin Analysis, URS, 10/01
100-24	2776	79	979.3 - 987.5	986	696.9	1033.3	Part 1A:No diverts from ADMP, Future Onsite Retention Provided	ADOT Basin Analysis, URS, 2/02
100-24	2614	79	979.4 - 987.7	986	699.9	1033.3	Part 1B:No diverts from ADMP, Post developed Q's </equal to existing	ADOT Basin Analysis, URS, 2/02
100-24	3202	81	981.9 - 988.1	986	846.5	1033.3	Part 2A:Diverts from ADMP, Future Onsite Retention Provided	ADOT Basin Analysis, URS, 2/02
100-24	3050	81	981.7 - 988.2	986	847.8	1033.3	Part 2B:Diverts from ADMP, Post developed Q's </equal to existing	ADOT Basin Analysis, URS, 2/02
100-25	3080	87	979.6 - 990.9	986	913.2	1033.3	Part 3A: No ADMP, Dev. W/O Future Retention	ADOT Basin Analysis, URS, 2/03
100-26	3452	88	982.4 - 991.5	986	1062.2	1033.3	Part 3B: W/ADMP, Dev. W/O Future Retention	ADOT Basin Analysis, URS, 2/04
50-24	965[3]	58[4]	982.1	983.4	810[5]	1020	Existing Condition	Offsite Drainage Design Report, I-IG-10-2(37)C, Ehrenberg-Phoenix, Highway, Bullard-Dysart Road, Dibble and Associates, January, 1976.
100-24	1,861	67	979.3 - 982.8	Varies[8,9]	514.2	1541.6	Existing Condition	White Tanks/Agua Fria Area Drainage Master Study, Part A: Flood Study Technical Data Notebook, By: The WLB Group, Inc., October 1992
100-24	2,100[6]/3,600[7]	62[6]/67[7]	981[6]/982.5[7]	988	510[6]/650[7]	1350.0	Existing/Developed	Palm Valley Phase I, Golf Course LOMR, RID Canal Overchute to ADOT Detention Basins, by The WLB Group, 2/298.
100-24	4,303	99	979.7	984	416.0	725.0	Existing Condition	I-10/Litchfield Road Basins, Final Hydrology Study, by Parsons Brinckerhoff, 7/23/99.
100-24	2,797	77	978.8 - 986.8	986	700.6	1125.7	Existing Condition	URS Draft Existing Condition Hydrology, 6/29/01.

1. May not include freeboard.
2. Overflow elevation. Freeboard is equal to peak stage minus max. ponding elevation.
3. Sum of discharges 1-3 from Hydrologic Design Data Sheets, SCS Method, 50-year, 24-hour event.
4. From stage-storage-discharge curve for Alternate 3, 48" pipe.
5 From stage-storage-discharge curve for Alternate 3, 48" pipe.
6. Existing discharge.
7. Post development discharge.
8. See Flood Study Technical Data Notebook for the White Tanks/Agua Fria ADMS, Appendix I, Vol. 10 of 15 by WLB, dated 5/28/92.
9. Max. ponding elevations are: Basin A = 988.8'; Basin B = 987.3'; Basin C = 988.6'; Basin D = 990.5'.
10. WLB and URS values represent the range from lowest to highest WSEL computed within the 4 basins - these models look at each basin individually.
11. Note:The Peak Storage for the "ADOT Basin Analysis" Existing Condition is larger than that shown for the Draft Existing Hydrology. This is due to increased RTIMP variables verified by recent field trips.

T[illegible] 1.4

Capa[illegible]ow
to
ADOT Basin 'A'

Design Storm (Yr-Duration)	Q_{in} Peak (cfs)	Q_{out} Peak (cfs)	Peak[1] Stage (ft)	Max.[2] Ponding Elevation (ft)	Peak Storage (ac-ft)	Max. Storage (ac-ft)	Modeled Condition	Data Source (Design Report)
100-24	277	23	978.7	986	23.9	265.17	Completely Undeveloped	ADOT Basin Analysis, URS, 10/01
100-24	295	28	978.9	986	27.9	265.17	[9]Existing Condition	ADOT Basin Analysis, URS, 10/01
100-24	361	46	979.6	986	44.9	265.17	Completely Developed with NO Onsite Retention on All Sub Basins	ADOT Basin Analysis, URS, 10/01
100-24	297	38	979.3	986	37.9	265.17	Completely Developed with Onsite Retention on All Sub Basins	ADOT Basin Analysis, URS, 10/01
100-24	297	36	979.3	986	37.9	265.17	Part 1A:No diverts from ADMP, Future Onsite Retention Provided	ADOT Basin Analysis, URS, 2/02
100-24	297	38	979.4	986	39.9	265.17	Part 1B:No diverts from ADMP, Post developed Q's </equal to existing	ADOT Basin Analysis, URS, 2/02
100-24	723	55	983.3	986	167.0	265.17	Part 2A:Diverts from ADMP, Future Onsite Retention Provided	ADOT Basin Analysis, URS, 2/02
100-24	733	55	983.3	986	169.0	265.17	Part 2B:Diverts from ADMP, Post developed Q's </equal to existing	ADOT Basin Analysis, URS, 2/02
100-25	0	44	979.6	986	44.9	265.17	Part 3A: No ADMP, Dev. W/O Future Retention	ADOT Basin Analysis, URS, 2/03
100-26	0	55	983.5	986	174.1	265.17	Part 3B: W/ADMP, Dev. W/O Future Retention	ADOT Basin Analysis, URS, 2/04
50-24	n/a	n/a	n/a	n/a	n/a	n/a	Existing Condition	Offsite Drainage Design Report, I-IG-10-2(37)C, Ehrenberg-Phoenix, Highway, Bullard-Dysart Road, Dibble and Associates, January, 1976.
100-24	618	55	981.18	988.8	106.5	423.01	Existing Condition	WLB[8]
100-24	n/a	n/a	n/a	n/a	n/a	n/a	Existing/Developed	PV
100-24	n/a	n/a	n/a	n/a	n/a	n/a	Existing Condition	PB
100-24	245	23	978.75	986	25.9	265.17	Existing Condition	URS Draft Existing Condition Hydrology, 6/29/01.

1. Does not include freeboard.
2. Overflow elevation. Freeboard is equal to peak stage minus max. ponding elevation.
3. Sum of discharges 1-3 from Hydrologic Design Data Sheets, SCS Method, 50-year, 24-hour event.
4. From stage-storage-discharge curve for Alternate 3, 48" pipe.
5 From stage-storage-discharge curve for Alternate 3, 48" pipe.
6. Existing discharge.
7. Post development discharge.
8. See Flood Study Technical Data Notebook for the White Tanks/Agua Fria ADMS, Appendix I, Vol. 10 of 15 by WLB, dated 5/28/92.
9. Note:The Peak Storage for the "ADOT Basin Analysis" Existing Condition is larger than that shown for the Draft Existing Hydrology. This is due to increased RTIMP variables verified by recent field trips.

T[illegible] 1.5

Capa[illegible]ow
to
ADOT Basin 'B'

Design Storm (Yr-Duration)	Q_{in} Peak (cfs)	Q_{out} Peak (cfs)	Peak[1] Stage (ft)	Max.[2] Ponding Elevation (ft)	Peak Storage (ac-ft)	Max. Storage (ac-ft)	Modeled Condition	Data Source (Design Report)
100-24	1176	357	982.9	986.0	68.86	108.98	Completely Undeveloped	ADOT Basin Analysis, URS, 10/01
100-24	687	270	982.0	986.0	57	108.98	[9]Existing Condition	ADOT Basin Analysis, URS, 10/01
100-24	1330	581	985.1	986.0	97.58	108.98	Completely Developed with NO Onsite Retention on All Sub Basins	ADOT Basin Analysis, URS, 10/01
100-24	370	114	980.5	986.0	39.58	108.98	Completely Developed with Onsite Retention on All Sub Basins	ADOT Basin Analysis, URS, 10/01
100-24	703	247	981.9	986.0	55.7	108.98	Part 1A:No diverts from ADMP, Future Onsite Retention Provided	ADOT Basin Analysis, URS, 2/02
100-24	576	231	981.7	986.0	53.7	108.98	Part 1B:No diverts from ADMP, Post developed Q's </equal to existing	ADOT Basin Analysis, URS, 2/02
100-24	703	247	981.9	986.0	55.7	108.98	Part 2A:Diverts from ADMP, Future Onsite Retention Provided	ADOT Basin Analysis, URS, 2/02
100-24	576	231	981.7	986.0	53.7	108.98	Part 2B:Diverts from ADMP, Post developed Q's </equal to existing	ADOT Basin Analysis, URS, 2/02
100-25	576	301	982.4	986.0	62	108.98	Part 3A: No ADMP, Dev. W/O Future Retention	ADOT Basin Analysis, URS, 2/03
100-26	576	301	982.4	986.0	62	108.98	Part 3B: W/ADMP, Dev. W/O Future Retention	ADOT Basin Analysis, URS, 2/04
50-24	n/a	n/a	n/a	n/a	n/a	n/a	Existing Condition	Offsite Drainage Design Report, I-IG-10-2(37)C, Ehrenberg-Phoenix, Highway, Bullard Dysart Road, Dibble and Associates, January, 1976.
100-24	212	65	980.06	987.3	39	132.52	Existing Condition	WLB[8]
100-24	n/a	n/a	n/a	n/a	n/a	n/a	Existing/Developed	PV
100-24	n/a	n/a	n/a	n/a	n/a	n/a	Existing Condition	PB
100-24	692	252	981.9	986	56	108.98	Existing Condition	URS Draft Existing Condition Hydrology, 6/29/01.

1. Does not include freeboard.
2. Overflow elevation. Freeboard is equal to peak stage minus max. ponding elevation.
3. Sum of discharges 1-3 from Hydrologic Design Data Sheets, SCS Method, 50-year, 24-hour event.
4. From stage-storage-discharge curve for Alternate 3, 48" pipe.
5 From stage-storage-discharge curve for Alternate 3, 48" pipe.
6. Existing discharge.
7. Post development discharge.
8. See Flood Study Technical Data Notebook for the White Tanks/Agua Fria ADMS, Appendix I, Vol. 10 of 15 by WLB, dated 5/28/92.
9. Note:The Peak Storage for the "ADOT Basin Analysis" Existing Condition is larger than that shown for the Draft Existing Hydrology. This is due to increased RTIMP variables verified by recent field trips.

T‹ 1.6

Capac... ...low
to
ADOT Basin 'C'

Design Storm (Yr-Duration)	Q_{in} Peak (cfs)	Q_{out} Peak (cfs)	Peak[1] Stage (ft)	Max.[2] Ponding Elevation (ft)	Peak Storage (ac-ft)	Max. Storage (ac-ft)	Modeled Condition	Data Source (Design Report)
100-24	1339	460	982.7	986	211.7	324.54	Completely Undeveloped	ADOT Basin Analysis, URS, 10/01
100-24	1415	460	983.9	986	254.9	324.54	[9]Existing Condition	ADOT Basin Analysis, URS, 10/01
100-24	1765	460	987.3	986	373.6	324.54	Completely Developed with NO Onsite Retention on All Sub Basins	ADOT Basin Analysis, URS, 10/01
100-24	536	297	978.6	986	87.5	324.54	Completely Developed with Onsite Retention on All Sub Basins	ADOT Basin Analysis, URS, 10/01
100-24	1304	460	982.9	986	219.7	324.54	Part 1A:No diverts from ADMP, Future Onsite Retention Provided	ADOT Basin Analysis, URS, 2/02
100-24	1269	460	982.8	986	218.2	324.54	Part 1B:No diverts from ADMP, Post developed Q's </equal to existing	ADOT Basin Analysis, URS, 2/02
100-24	1304	460	982.9	986	220.4	324.54	Part 2A:Diverts from ADMP, Future Onsite Retention Provided	ADOT Basin Analysis, URS, 2/02
100-24	1269	460	982.9	986	218.2	324.54	Part 2B:Diverts from ADMP, Post developed Q's </equal to existing	ADOT Basin Analysis, URS, 2/02
100-25	1269	460	986.0	986	313.7	324.54	Part 3A: No ADMP, Dev. W/O Future Retention	ADOT Basin Analysis, URS, 2/03
100-26	1269	460	985.7	986	314.7	324.54	Part 3B: W/ADMP, Dev. W/O Future Retention	ADOT Basin Analysis, URS, 2/04
50-24	n/a	n/a	n/a	n/a	n/a	n/a	Existing Condition	Offsite Drainage Design Report, I-IG-10-2(37)C, Ehrenberg-Phoenix, Highway, Bullard-Dysart Road, Dibble and Associates, January, 1976.
100-24	649	376	979.28	988.6	122.6	453.25	Existing Condition	WLB[8]
100-24	n/a	n/a	n/a	n/a	n/a	n/a	Existing/Developed	PV
100-24	n/a	n/a	n/a	n/a	n/a	n/a	Existing Condition	PB
100-24	1400	460	983.43	986	237.7	324.54	Existing Condition	URS Draft Existing Condition Hydrology, 6/29/01.

1. Does not include freeboard.
2. Overflow elevation. Freeboard is equal to peak stage minus max. ponding elevation.
3. Sum of discharges 1-3 from Hydrologic Design Data Sheets, SCS Method, 50-year, 24-hour event.
4. From stage-storage-discharge curve for Alternate 3, 48" pipe.
5 From stage-storage-discharge curve for Alternate 3, 48" pipe.
6. Existing discharge.
7. Post development discharge.
8. See Flood Study Technical Data Notebook for the White Tanks/Agua Fria ADMS, Appendix I, Vol. 10 of 15 by WLB, dated 5/28/92.
9. Note:The Peak Storage for the "ADOT Basin Analysis" Existing Condition is larger than that shown for the Draft Existing Hydrology. This is due to increased RTIMP variables verified by recent field trips.

T 1.7

Capac...ow to ADOT Basin 'D'

Design Storm (Yr-Duration)	Q_{in} Peak (cfs)	Q_{out} Peak (cfs)	Peak[1] Stage (ft)	Max.[2] Ponding Elevation (ft)	Peak Storage (ac-ft)	Max. Storage (ac-ft)	Modeled Condition	Data Source (Design Report)
100-24	460	73	984.9	986	301.2	334.65	Completely Undeveloped	ADOT Basin Analysis, URS, 10/01
100-24	460	80	987.6	986	386.4	334.65	[9]Existing Condition	ADOT Basin Analysis, URS, 10/01
100-24	482	92	992.9	986	558.1	334.65	Completely Developed with NO Onsite Retention on All Sub Basins	ADOT Basin Analysis, URS, 10/01
100-24	284	63	981.0	986	188.8	334.65	Completely Developed with Onsite Retention on All Sub Basins	ADOT Basin Analysis, URS, 10/01
100-24	472	79	987.5	986	383.6	334.65	Part 1A:No diverts from ADMP, Future Onsite Retention Provided	ADOT Basin Analysis, URS, 2/02
100-24	472	79	987.7	986	388.1	334.65	Part 1B:No diverts from ADMP, Post developed Q's </equal to existing	ADOT Basin Analysis, URS, 2/02
100-24	472	81	988.1	986	403.4	334.65	Part 2A:Diverts from ADMP, Future Onsite Retention Provided	ADOT Basin Analysis, URS, 2/02
100-24	472	81	988.2	986	406.9	334.65	Part 2B:Diverts from ADMP, Post developed Q's </equal to existing	ADOT Basin Analysis, URS, 2/02
not include fre	472	87	990.9	986	492.6	334.65	Part 3A: No ADMP, Dev. W/O Future Retention	ADOT Basin Analysis, URS, 2/03
equal to peak	472	88	991.5	986	511.4	334.65	Part 3B: W/ADMP, Dev. W/O Future Retention	ADOT Basin Analysis, URS, 2/04
50-24	n/a	n/a	n/a	n/a	n/a	n/a	Existing Condition	Offsite Drainage Design Report, I-IG-10-2(37)C, Ehrenberg-Phoenix, Highway, Bullard-Dysart Road, Dibble and Associates, January, 1976.
100-24	382	67	982.8	990.5	246.1	532.82	Existing Condition	WLB[8]
100-24	n/a	n/a	n/a	n/a	n/a	n/a	Existing/Developed	PV
100-24	n/a	n/a	n/a	n/a	n/a	n/a	Existing Condition	PB
100-24	460	77	986.8	986	381	334.65	Existing Condition	URS Draft Existing Condition Hydrology, 6/29/01.

1. Does not include freeboard.
2. Overflow elevation. Freeboard is equal to peak stage minus max. ponding elevation.
3. Sum of discharges 1-3 from Hydrologic Design Data Sheets, SCS Method, 50-year, 24-hour event.
4. From stage-storage-discharge curve for Alternate 3, 48" pipe.
5 From stage-storage-discharge curve for Alternate 3, 48" pipe.
6. Existing discharge.
7. Post development discharge.
8. See Flood Study Technical Data Notebook for the White Tanks/Agua Fria ADMS, Appendix I, Vol. 10 of 15 by WLB, dated 5/28/92.
9. Note:The Peak Storage for the "ADOT Basin Analysis" Existing Condition is larger than that shown for the Draft Existing Hydrology. This is due to increased RTIMP variables verified by recent field trips.

Tab[illegible].8

Modeled Condition Comparison	Total Inflow Volume (ac-ft)	Δ (delta) (ac-ft)	Comments
Part 1A:No diverts from ADMP, Future Onsite Retention Provided	651	*156*	Increased inflow volume at ADOT Basins due to the ADMP
Part 2A:Diverts from ADMP, Future Onsite Retention Provided	807		
Part 3A: No ADMP, Dev. W/O Future Retention	780	*156*	Diversion to ADOT Basin with ADMP
Part 3B: W/ADMP, Dev. W/O Future Retention	936		
Fully Developed - Onsite Retention All Sub Basins	365	*276*	Decreased volume due to enforcement of retention requirements to date
Existing Conditions	641		
Completely Undeveloped	476	*165*	Benefit to date to development - volume increase from adjacent properties and sub basins to ADOT Basins
Existing Conditions	641		
Part 3A: No ADMP, Dev. W/O Future Retention	780	*139*	Increase in volume associated with the future condition assuming no future retention and no ADMP
Existing Conditions	641		
Part 3A: No ADMP, Dev. W/O Future Retention	780	*415*	Approximate total increase in volume due to non-enforcement of retention requirements at ultimate build-out
Fully Developed - Onsite Retention All Sub Basins	365		
Part 3B: W/ADMP, Dev. W/O Future Retention	936	*295*	Total additional ADMP volume from today
Existing Conditions	641		
Part 3B: W/ADMP, Dev. W/O Future Retention	936	*94*	Minimum excess volume of ADOT Basin - ADMP diversion to basins, no on-site retention in watershed for future development
Existing Volume Provided	1030		

1. Maximum ponding elevation before overtopping is 986'.

Composite ADOT Basin Total Inflow Volume

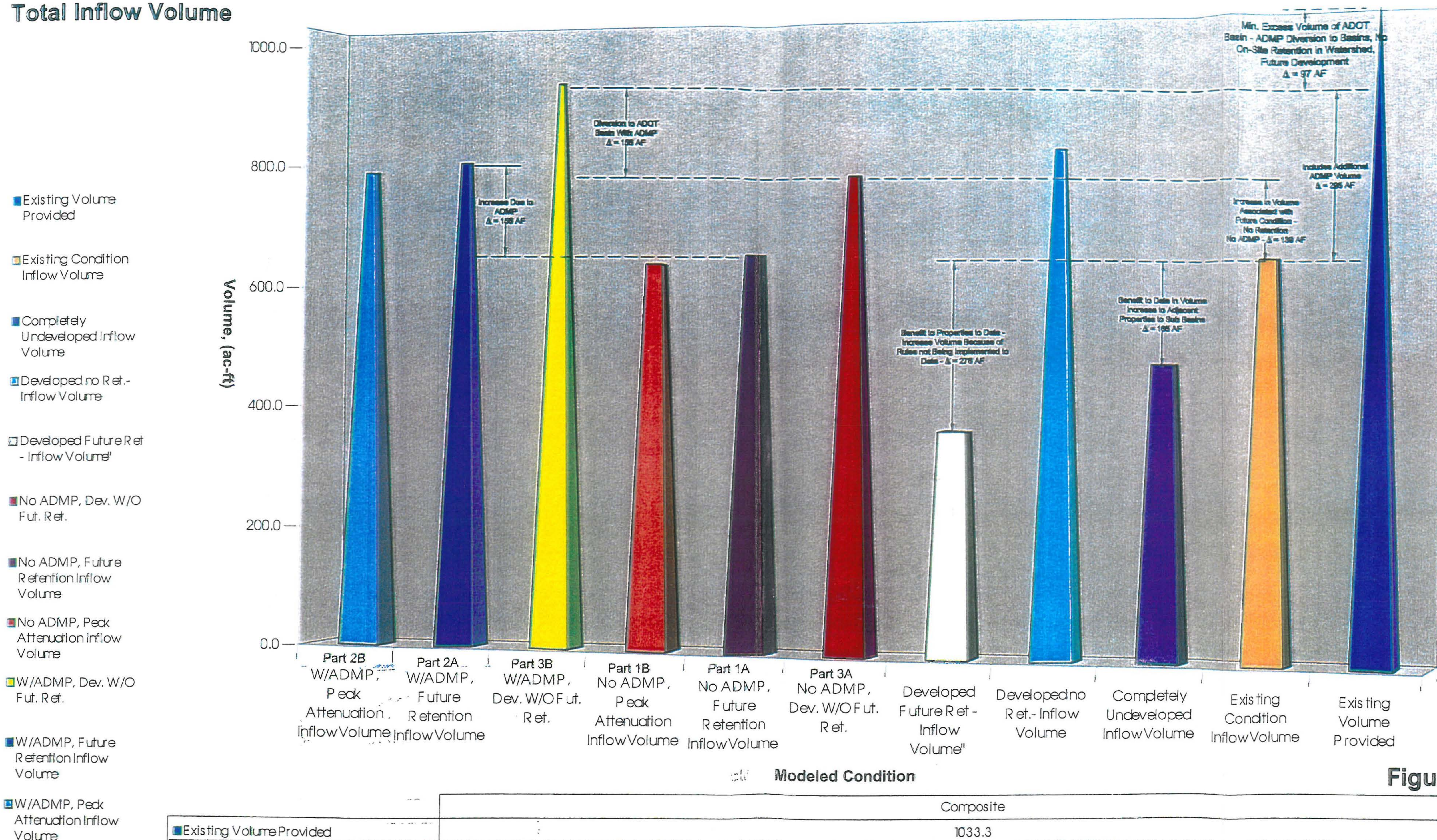
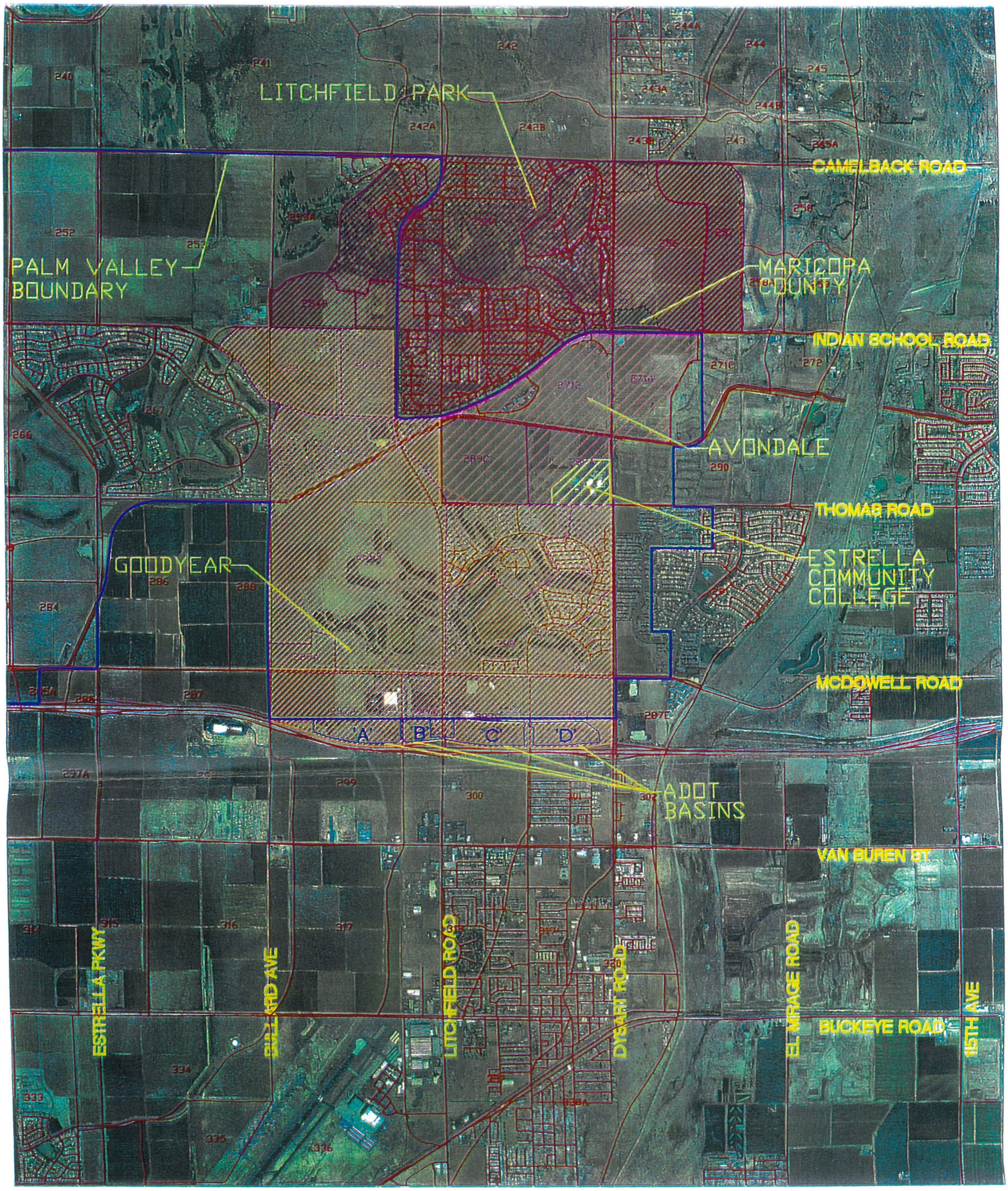


Figure 1.2

	Composite
Existing Volume Provided	1033.3
Existing Condition Inflow Volume	641
Completely Undeveloped Inflow Volume	476
Developed no Ret.- Inflow Volume	818
Developed Future Ret - Inflow Volume"	365
No ADMP, Dev. W/O Fut. Ret.	780
No ADMP, Future Retention Inflow Volume	651
No ADMP, Peak Attenuation Inflow Volume	636
W/ADMP, Dev. W/O Fut. Ret.	936
W/ADMP, Future Retention Inflow Volume	807
W/ADMP, Peak Attenuation Inflow Volume	792



LEGEND:

- = AVONDALE
- = GOODYEAR
- = LITCHFIELD PARK
- = MARICOPA COUNTY
- = ESTRELLA COMMUNITY COLLEGE
- = PALM VALLEY

N

MARICOPA COUNTY
N.T.S.

CONTRIBUTING WATERSHED TO ADOT BASINS

ADOT Basins/Contributing Watershed Analysis

February 2002

FIGURE 1.1

Flood Control District of Maricopa County

URS