

CANDIDATE ASSESSMENT REPORT SUNLAND CHANNEL

Main Report & Appendices

Prepared for:



**FLOOD CONTROL DISTRICT
OF MARICOPA COUNTY
2801 WEST DURANGO STREET
PHOENIX, ARIZONA 85009**

Contract FCD 2004C027

Prepared by



**426 NORTH 44TH STREET, SUITE 370
PHOENIX, ARIZONA 85008**

November 2006

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Executive Summary

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1 INTRODUCTION

This Executive Summary summarizes the results of the Candidate Assessment Report (CAR) describing baseline conditions, alternatives, and a recommended plan for the Sunland Channel. This analysis, with a recommended plan developed to 10 percent design plans, modifies the Sunland Channel design proposed in the Durango Regional Conveyance Channel (DRCC) CAR developed by the Flood Control District of Maricopa County dated February 2006.

The Sunland Channel project area is located approximately one-quarter mile north of and parallel to Southern Avenue in Avondale and Phoenix, Arizona. The project would extend from the DRCC to the U.S. Army Corps of Engineers Tres Rios wetlands project. The project is partially in the Avondale planning area, and partially in the Phoenix planning area, with 107th Avenue as the planning area boundary.

2 BASELINE CONDITIONS

Under current conditions, the Sunland Channel drainage area at Avondale Boulevard drains approximately 2,703 acres located generally between 75th Avenue and Avondale Boulevard and between Broadway Road and Southern Avenue. After construction of diversions associated with the Tres Rios project, expected within two years, the Sunland drainage area will be 1,472 acres.

Existing drainage in the area is conveyed overland and in irrigation canals that convey natural drainage. The delineated 100-year floodplain, occupied by existing residential development, is approximately 1,000 feet wide between the DRCC and Tres Rios. 100-year peak discharges are as listed in Table E.1.

Table E.1. Sunland 100-Year Peak Discharges for Existing Conditions.

DISCHARGE, IN CUBIC FEET PER SECOND (CFS) UPSTREAM OF FLOW CONCENTRATION POINT		
Avondale Boulevard	107TH AVE	99TH AVE
639	584	176
Tres Rios drainage area reduction assumed to be in place.		

Urban development, primarily medium-density residential, has been replacing the agricultural land use in this area. Within the Sunland Channel drainage area there is at present one recent housing development of approximately 145 acres located at the southwest corner of the intersection of Broadway Road and 99th Avenue.

3 FUTURE CONDITIONS

Under future conditions the existing agricultural uses within the drainage area would likely be replaced by residential development. At present, there are three known residential developments in the planning stage. Two are within the Avondale planning area, and one is in the Phoenix Planning Area. All would consist of residential housing. Planned facilities by Maricopa County and the U.S. Army Corps of Engineers include the DRCC, Sunland Channel and Tres Rios wetland project.

It is expected that the entire drainage area will be converted to residential development. 100-year discharges, with future development in place, are presented in Table E.2. Table E.2 shows that standard 100-year, 2-hour retention will not be sufficient to keep post-development discharges at existing levels. Future discharges are the same at Avondale Boulevard and at 107th Avenue whether or not the Sunland Channel is constructed. Post-development discharges will be substantially higher than existing conditions, resulting in an increased flood risk for existing homes in the floodplain.

Table E.2 Key Discharges for Future Conditions.

Concentration Point	100-Year Peak Discharge, in cfs	
	Future Conditions	Existing Conditions
99 th Avenue	273	176
107 th Avenue	762	584
Avondale Boulevard	1,284	639
Future conditions assumes Sunland Channel in place as described in the DRCC CAR. Future conditions discharges at Avondale Boulevard and 107 th Avenue assuming future development conditions with no Sunland Channel are the same as future conditions discharges presented in this table.		
Future conditions assumes 100-year, 2-hour retention for all new development.		

4 PLAN FORMULATION/EVALUATION OF ALTERNATIVES

Four flood control alternatives were developed and evaluated:

Alternative 1: Sunland Channel as Proposed in the DRCC CAR with Modifications. Alternative 1 would be the same as the Sunland Channel proposed in the DRCC CAR with modifications. Modifications would include: a) revised channel section for revised hydrology; b) collector channels along 107th Avenue and 99th Avenue; and, c) a detention basin alongside the channel in Phoenix. Cost: \$19,200,000.

Alternative 2: Armored Channel at Alternate Location. This alternative has the same basic features of Alternative 1 but would be located south of the Sunland Channel alignment proposed in the DRCC CAR to avoid high ground. The channel banks would be constructed of shotcrete in order to minimize right of way needs. The flow at 107th Avenue would be limited to the existing discharge by the use of a detention basin. Cost: \$17,400,000.

Alternative 3: Developer Retention. Alternative 3 would consist of 100-year, 6-hour retention for all new development in the Sunland drainage area. Alternative 3 was developed for the reason that the standard 100-year, 2-hour retention is not sufficient to keep post-development peak discharges at or below existing levels. Cost: \$10,300,000.

Alternative 4: Flood Proofing and Elevation Certificates. This alternative would provide in-place individual flood protection for existing homes in the floodplain and subject to 100-year flooding. A detention basin would be constructed in the floodplain in the Phoenix planning area to maintain post-development discharges at 107th Avenue at existing levels. Cost: \$6,100,000.

5 RECOMMENDED PLAN

The recommended plan (Figure ES.1) is derived from a combination of Alternatives 1, 2, and 3, and consists of: 1) a flood-control conveyance channel similar to the channel proposed in the DRCC CAR but reduced in capacity and extending from the DRCC to 107th Avenue; 2) linear retention basins alongside and upstream of the conveyance channel; 3) a collector channel along the east side of 107th Avenue between the main channel and Southern Avenue; 4) sufficient right of way and a landscaped character to constitute an aesthetic and recreational amenity; and, 5) 100-year, 6-hour retention for new development within the drainage area. Linear retention basins would extend from the upstream end of Sunland Avenue to Tres Rios. One row of houses along the north side of Sunland Avenue would be purchased to provide right of way for the main channel

After full development, with 100-year, 6-hour retention, the recommended plan would be a 100-year solution. If constructed under current drainage area conditions, the project would provide approximately 50-year flood protection. The cost is estimated at \$17,600,000. Table E.3 provides a summary of design dimensions.

Table E.3 Recommended Plan Design Dimensions

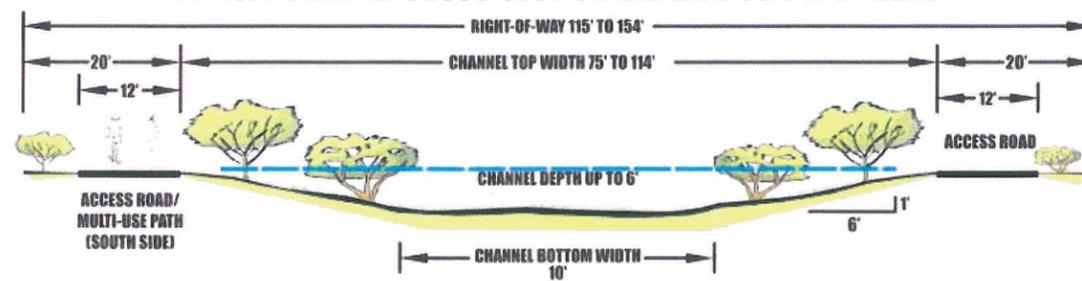
FLOW CONVEYANCE CHANNEL							
Channel Reach	Design Discharge, in cfs	Channel Bottom Width, in Feet	Channel Top Width, in Feet	Right of Way Width, in Feet	Channel Length, in Feet	Flow Depth, in Feet	Channel Depth, in Feet
DRCC to Avondale Boulevard	383	10	114	154	3,405	4.8	8.7
Adjacent to Sunland Avenue	392	10	77	117	1,157	4.2	5.6
Sunland Avenue to 107 th Ave.	419	10	75	115	4,069	4.3	5.4
COLLECTOR CHANNEL							
Channel Reach	Design Discharge, in cfs	Channel Bottom Width, in Feet	Channel Top Width, in Feet	Right of Way Width, in Feet	Channel Length, in Feet	Flow Depth, in Feet	Channel Depth, in Feet
Conveyance Channel to Southern Avenue	210	24	31	51	1,182	2.5	3.5
LINEAR RETENTION BASINS							
Reach	Retention Volume, in Acre Feet	Basin Bottom Width, in feet	Basin Top Width, in Feet	Right of Way Width, in Feet	Basin Length, in Feet	Ponding Depth, in Feet	Basin Depth, in Feet
Sunland Avenue to 107 th Ave.	16	51	99	119	3,386	3	4.0
107 th Avenue to 99 th Avenue	8.0	10	54	94	5,062	2.7	3.7
99 th Avenue to Tres Rios	2	10	54	73	1,361	2.6	3.6

SUNLAND CHANNEL PLAN VIEW

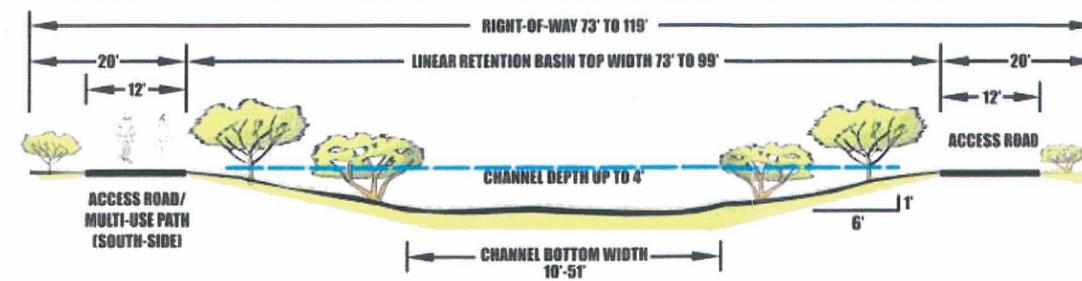
Figure ES.1



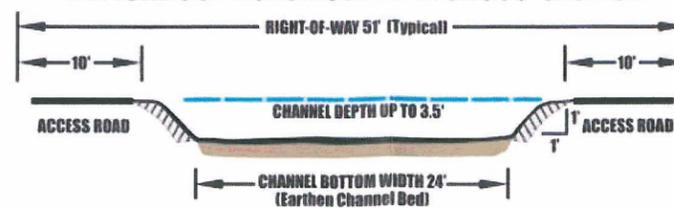
TYPICAL CHANNEL CROSS-SECTION AND LANDSCAPING THEME



TYPICAL LINEAR RETENTION BASIN CROSS-SECTION AND LANDSCAPING THEME



TYPICAL COLLECTOR CHANNEL CROSS-SECTION



CANDIDATE ASSESSMENT REPORT SUNLAND CHANNEL Main Report

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1 INTRODUCTION

This Candidate Assessment Report (CAR) describes baseline conditions, alternatives analysis, and a recommended plan for the proposed Sunland Channel in Avondale and Phoenix, Arizona. This analysis with a recommended plan developed to 10 percent design plans was done to further refine the Sunland Channel proposed in the Durango Regional Conveyance Channel (DRCC) CAR developed by the Flood Control District of Maricopa County dated February 2006 (FDCMC 2006).

1.1 PROJECT LOCATION

The proposed Sunland Channel, as described in the DRCC CAR, is located approximately one-quarter mile north of and parallel to Southern Avenue. The Sunland Channel would begin at 99th Avenue and run directly west to join the DRCC approximately one half mile west of Avondale Boulevard. Figures 1.1 and 1.2 provide location and site maps.

1.2 PROJECT OVERVIEW AND BACKGROUND

The Durango Area Drainage Master Plan (ADMP) was developed by the Flood Control District of Maricopa County (District) and is described in the report entitled "Durango Area Drainage Master Plan Recommended Design Report" (FCDMC 2002). The report describes a recommended flood control channel that would extend from 75th Avenue to the Agua Fria River along the alignment shown in Figure 1.2. The Sunland Channel, also shown in Figure 1.2, would be a tributary to the DRCC.

As a result of development-related drainage area changes since 2002, particularly along the DRCC, the DRCC master plan was updated in the DRCC CAR described above. The Sunland Channel was also revised in the DRCC CAR. As described in the DRCC CAR, the Sunland Channel would be a landscaped earthen trapezoidal channel with 6:1 side slopes. Channel bottom width would range from 30 to 51 feet. Top width would range from 101 to 134 feet. Total right-of-way, including a typical 25 feet on each side of the channel for maintenance access and aesthetic treatment and landscaping, would range from 151 to 160 feet. Channel depth would be 5.9 to 6.9 feet. Approximately 1,300 feet of the channel upstream of Avondale Boulevard would consist of a reinforced concrete box culvert below Sunland Avenue. There would be additional box culverts at 107th Avenue and at 99th Avenue. The channel would be constructed primarily on land that is under private ownership. The cost of the channel, including right-of-way, was estimated at 17.8 million dollars.

Although the Sunland Channel was included in the DRCC CAR, there was no evaluation of flood control alternatives for the Sunland Channel. At the request of the City of Avondale, the District is now revising the master plan for the Sunland Channel to include an evaluation of flood control alternatives. Basic goals to be considered in the evaluation of alternatives and development of a recommended plan include:

1. Flood control for existing properties in the floodplain.
2. A master drainage plan to guide future development.
3. Development of a regional aesthetic and recreational amenity, such as is planned with the DRCC, preferably a linear corridor extending from the DRCC to the Tres Rios project by the Corps of Engineers.
4. Maintaining the future 100-year discharge to that of existing conditions at 107th Avenue, which is the boundary between the City of Phoenix and the City of Avondale, Maricopa County Association of Governments (MAG) planning areas.

Currently there is no Sunland Channel in existence; the flows that run parallel to and north of Southern Avenue west of 91st or 95th Avenue, east of the DRCC alignment, are referred to in this report as the Sunland Channel flows.

1.3 PROJECT PURPOSE AND NEED

The Sunland Channel drainage area is historically agricultural, with low-density to medium-density residential development primarily along the north side of Sunland Avenue and in the area bounded approximately by Roeser Road, Avondale Boulevard, Sunland Avenue, and the 113th Avenue alignment. Drainage is conveyed overland, or in irrigation canals designed for irrigation, not flood control. The primary irrigation conduits in the area are the St. Johns and Voita channels.

A 100-year floodplain was delineated for the Sunland Channel flows in the Durango ADMP (FCDMC 2002). This floodplain is shown in Figure 1.3. As can be seen in this figure, the floodplain west of 99th Avenue corresponds well with the location of most of the existing development. At present, there are 166 structures within the Sunland 100-year floodplain. Most of this area is also in the existing floodplain of the Gila River, which is the subject of a flood control project by the U.S. Army Corps of Engineers (ACOE), City of Phoenix, and the District.

The Cities of Avondale and Phoenix are experiencing rapid urban growth in and around the Sunland Channel drainage area. As development occurs, drainage patterns, peaks and volumes are affected. Although new development is required to retain excess runoff created by the development, downstream peak flow rates could still be increased by development as a result of increased runoff and conveyance efficiency. Thus, there is a need for a flood control solution in the area due to the existing flood-prone homes and the impending development which has the potential to worsen the existing flooding problem. The purpose of this study is to evaluate alternative flood control solutions for the Sunland Channel, and to develop a recommended plan to address the flooding issues.

1.4 PROJECT SCOPE

This study consists of: 1) revised hydrologic modeling for existing conditions within the Sunland drainage area; 2) a topographic survey to verify topographic conditions at the location of the channel and potential alternatives; 3) revised hydrologic modeling for proposed conditions [with channel and with ultimate development]; 4) development and evaluation of Sunland Channel flood control alternatives; 5) recommended plan for a flood control solution; and, 5) development of preliminary plans with a cost estimate.

2 EXISTING CONDITIONS

2.1 DRAINAGE AREA DESCRIPTION

Under current conditions, the Sunland Channel drainage area at Avondale Boulevard drains approximately 2,703 acres located generally between 75th Avenue and Avondale Boulevard and between Broadway Road and Southern Avenue. The majority of the drainage area is within unincorporated Maricopa County although portions of the upper drainage area, particularly upstream (east) of 99th Avenue and north of Broadway Road are within the City of Phoenix. A small portion of the drainage area, downstream of 107th Avenue, is within the City of Avondale. 107th Avenue is the MAG planning area boundary for the ultimate annexation limits of the City of Phoenix and the City of Avondale. Based on the concentration point at Avondale Boulevard, approximately 75% of the drainage area is in the City

of Phoenix planning area. The rest of the drainage area is in the Avondale planning area. The Sunland Channel drainage area is flat and currently dominated by farmland and fallow areas, with the existing development as shown in Figure 1.2. Avondale Boulevard, 107th Avenue, 99th Avenue and 91st Avenue are the major paved north-south streets within the drainage area.

The 100-year floodplain as mapped in the Durango ADMP (FCDMC 2002) is shown in Figure 1.3. This floodplain is approximately 900 feet wide at the 113th Avenue alignment (approximately ¼ mile upstream of Avondale Boulevard) and remains approximately 900 to 1,200 feet wide to 99th Avenue. Between 99th Avenue and 91st Avenue, the floodplain widens to a maximum of approximately 2,100 feet. This reach, between 99th Avenue and 91st Avenue, is entirely agricultural. Based on the Durango ADMP (FCDMC 2002) hydraulic (HEC-RAS) model, the 100-year flood depth in this area averages approximately 0.7 feet, with maximum depth averaging 1.4 feet.

2.2 DEVELOPMENT

Urban development, primarily medium-density residential, has been replacing the agricultural land use in this area. Within the Sunland Channel drainage area there is one recent housing development of approximately 145 acres located at the southwest corner of the intersection of Broadway Road and 99th Avenue (Figure 1.2). This development is at a density of approximately four housing units per acre. Planned developments, with approximate boundaries, are also shown in figure 1.2. Based on the Avondale General Plan and MAG land use projections, ultimate development in the Sunland Channel drainage area is expected to be low-density residential housing (1-2 dwelling units per acre). However, based on the observed pattern of development in the area, a higher density is expected.

2.3 DRAINAGE FACILITIES

2.3.1 Existing Facilities

Existing drainage in the area is conveyed overland and in irrigation canals that also, by virtue of their location, convey natural drainage. The Buckeye Feeder Canal (BFC), St. Johns Canal, and Voita Canal (Figure 2.2) are the main flow conveyance canals in the area. The capacity of these canals is relatively small. The BFC, the largest of the three, has a capacity of approximately 900 cfs downstream of Avondale Boulevard. Voita and St. Johns Canal capacity is generally less than 100 cfs. These canals, owned and operated by the Salt River Project (SRP) are not intended to serve as flood control conveyance and could potentially be placed in underground pipes at some time in the future. The BFC intercepts the stormwater flow from the Durango drainage area to the north and it combines with the Sunland Channel flows at approximately Avondale Boulevard and Sunland Avenue. The St. Johns Canal runs along Southern Avenue and is generally at the edge of, or outside, the Sunland Channel drainage area. The Voita Canal runs roughly parallel to the proposed Sunland Channel.

2.3.2 Planned Facilities

The District and the City of Avondale plan to construct the DRCC to collect and convey flows that would otherwise be conveyed in and alongside the BFC. The DRCC location is shown in Figure 1.2. A detailed description of the proposed DRCC can be found in the Durango ADMP (FCDMC 2002), and updated in the DRCC CAR (FCDMC 2006).

The ACOE Tres Rios project proposes the construction of a wetlands restoration project located at 91st Avenue, and a levee along the north side of the Salt/Gila River that would extend from 91st Avenue to just

west of Dysart Road. Along the north side of the levee would be several detention basins intended to collect local drainage for discharge into the Gila River through the levee. Drainage channels around the wetlands restoration project would collect flow and convey it directly to the Salt River. Figure 2.2 shows the location of the proposed Tres Rios project features, and the effects of this project are discussed in Section 2.4 of this report.

2.4 HYDROLOGY

Hydrologic analysis for existing conditions was conducted by the District in a hydrologic model developed in the year 2001 (FCDMC 2002) from the Durango ADMP. The model is based on the HEC-1 flood hydrograph package by the ACOE. The HEC-1 package simulates runoff from rainfall and physical drainage area characteristics. The drainage area is divided into a series of sub-basins. Simulated runoff hydrographs from the sub-basins are routed between sub-basins and added together to simulate the runoff response to a rainfall event based on the hydrologic and hydraulic parameters used as input to the model. The 100-year 6-hour and 100-year 24-hour storms are used by the District as rainfall design events. Whichever produces the greater peak runoff at any given point is considered the design storm.

The 2001 District model was updated in the DRCC CAR, and again as part of this study. The results for the Sunland Channel are presented in Table 2.1. The appendix provides a summary of the differences between the current study, which gives a 100-year discharge of 447 cfs at 99th Avenue, and the DRCC CAR study, which gives a discharge of 1,243 cfs at 99th Avenue. The current study discharges more accurately model the study area and are used in this analysis. Discharges for the current study are fairly similar to those for the original ADMP. The highest discharge is at Avondale Boulevard. Discharges at Avondale Boulevard, 107th Avenue and 99th Avenue are 605, 539 and 495 cfs, respectively. The BFC enters the drainage area along Avondale Boulevard. Although this canal runs along the east (upstream) side of Avondale Boulevard, Table 2.1 presents two discharges at Avondale Boulevard, upstream and downstream, to distinguish the discharge that includes the BFC drainage, referred to in Table 2.1 as “downstream”, and the discharge that includes Sunland Channel drainage only, referred to in Table 2.1 as “upstream”.

Table 2.1. Sunland Channel Drainage 100-Year Discharges for Existing Conditions.

STUDY	DISCHARGE, IN CUBIC FEET PER SECOND (CFS) AT FLOW CONCENTRATION POINT				
	DRCC CONFLUENCE ^a	Avondale Boulevard (Downstream) ^b	Avondale Boulevard (Upstream)	107TH AVE	99TH AVE
Original ADMP (FCDMC 2002) ^d	ND	1,007	780 ^c	703	491
DRCC CAR	1,570	1,731	ND	1,058	1,243
Current Study	1,360	1,389	639 ^c	588	550 ^c
Current Study with Tres Rios Reduction	1,193	1,218	639 ^c	584	176

ND = No discharge computed at this location.
^a Sunland Channel flows only (no DRCC). DRCC assumed to be in place.
^b Includes BFC drainage.
^c Discharge based on the local sub-basin, not the entire upstream drainage area. See report text for detailed explanation.
^d From Appendix B of FCDMC (2002)

The modeling in this study indicated that Sunland Channel drainage discharges are largely dominated by local drainage. Figure 2.1 shows the location of the sub-basins used for hydrologic modeling in the HEC-1 model. Sub-basin CC alone, bounded by Avondale Boulevard, Broadway Road, Southern Avenue, and 107th Avenue, generates a discharge that is higher than the discharge computed for the entire drainage area at Avondale Boulevard (not including BFC flows). For this reason, the Sub-basin CC discharge is used at Avondale Boulevard. The same is true at 99th Avenue, where Sub-basin EA dominates the discharge.

The Tres Rios project, as currently designed, will remove all of the contributing watershed drainage area upstream of 91st Avenue, and most of the drainage area upstream of 99th Avenue, from the Sunland Channel drainage area by conveying it directly south to the Salt River. Figure 2.1 shows the portion of the Sunland Channel drainage area that would be affected. Total reduction in drainage area would be approximately 1,230 acres, leaving the residual 1,472-acre drainage area at Avondale Boulevard. Table 2.1 includes the results of modeling the existing-conditions drainage area under the assumption that the Tres Rios project is in place. Tres Rios would reduce the discharge at 99th Avenue to 156 cfs (approximately 68% reduction over the current study existing conditions model), but would have little or no effect at 107th and Avondale Boulevards due to the dominant effect of local drainage on Sunland discharges.

2.5 HYDRAULICS

No existing-conditions hydraulic (floodplain) analysis was performed as part of this study. However, the discharges used in the hydraulic analysis for the Durango ADMP are within 15% of the existing conditions discharges developed for this study. The ADMP floodplain analysis is therefore considered valid for use in this study. The floodplain limits are shown in Figure 1.3. Table 2.2 presents a summary of the 100-year hydraulic conditions for the reach between Avondale Boulevard and 99th Avenue. The results show that whereas the floodplain is relatively wide, averaging 948 feet, and the flow is shallow, averaging 0.7 feet in depth. Flow velocities are also low.

Table 2.2. Sunland Channel Flow Floodplain Parameters for Existing Conditions.

	Maximum Flow Depth Per HEC-RAS Cross Section, in Feet	Average Flow Depth Per HEC-RAS Cross Section, in Feet ^a	Maximum Flow Velocity Per HEC-RAS Cross Section, in Feet per Second	Average Flow Velocity Per HEC-RAS Cross Section, in Feet per Second ^b	Flow Top Width, in Feet
Minimum ^c	0.4	0.3	0.6	0.4	269
Maximum ^c	2.2	1.1	3.9	3.5	1,209
Average ^c	1.3	0.7	1.5	1.2	948

^a Computed as flow cross sectional area divided by flow top width.
^b Computed as flow discharge divided by flow cross sectional area.
^c Based on data derived from 23 HEC-RAS representing the reach from Avondale Boulevard to 99th Avenue.
 Data Source: FCDMC (2002) HEC-RAS hydraulic model for existing conditions. River Stations 0.289 to 2.08.

Based on a review of aerial photographs dated 2005, there are currently 166 structures, mostly residences, potentially subject to flooding from Sunland Channel flows between the proposed DRCC alignment and 99th Avenue. Based on Table 2.2, 100-year flood depths at these structures average 0.7 feet (8 inches), but depths could be as high as 1.3 feet (16 inches).

3 FUTURE CONDITIONS

3.1 DRAINAGE AREA

Under future conditions, the existing agricultural uses within the drainage area would likely be replaced by residential development. The Tres Rios project, when constructed, would likely reduce the drainage area by 1,230 acres, leaving a drainage area of 1,472 acres at Avondale Boulevard.

3.2 DEVELOPMENT

Figure 2.1 shows the location of expected future development based on land use designations. At present, there are three known developments in the planning stage within the Sunland drainage area. These are shown in Figure 1.2. Two are within the Avondale planning area, and one is in the Phoenix Planning Area. All would consist of residential housing.

3.3 DRAINAGE FACILITIES

The Tres Rios project is expected to construct a series of 100-year channels, located as shown in Figure 2.2, to intercept flow reaching these channels and discharge it directly into the Salt/Gila River.

The DRCC is expected to be constructed as shown in Figure 1.2. The DRCC would accommodate all drainage from the Durango drainage area that is now drained by the BFC. Although the BFC would likely remain in place after construction of the DRCC, the BFC would carry only irrigation flows and possibly a small amount of local drainage generated outside DRCC drainage area. It would no longer be a conduit for regional drainage flows.

As development occurs within the Sunland Channel drainage area, retention basins and drainage channels would be built to accommodate local drainage and to dispose of drainage generated within the development area. Some drainage would be carried in streets, which would be made more efficient conveyors of flood flow than they are currently, either within the street right-of-way or beneath the street in underground storm drains. Local drainage channels would be constructed to convey flow, probably to be ultimately discharged into the area currently occupied by the Sunland drainage floodplain.

Since the planned development west of 99th Avenue is not within the existing 100-year floodplain, new development may not need to be protected from the existing floodplain. However, County and City development standards generally require new developments to address the disposition of their runoff to ensure no adverse impact either upstream or downstream.

The potential adverse impact of increased runoff peaks and volumes from new development is generally offset by retaining flood discharges on site in retention basins. The normal retention requirement required by Maricopa County, the City of Avondale and the City of Phoenix is the volume of runoff created by a 100-year, 2-hour storm. Retention basins are generally located within the development area, are approximately 3 feet deep, and landscaped with grass.

The Maricopa County design discharge is derived from the 100-year, 6-hour rainfall, or the 100-year, 24-hour rainfall, whichever discharge is greater. Whereas the 100-year 2-hour retention requirement is intended to keep post-development discharges at or below existing discharges, an increase in post-development discharges can occur as a result of flows exceeding the retention requirement, modified flow combinations within the drainage area, and more efficient drainage conveyance facilities.

Development in the Sunland drainage area, assuming 100-year, 2-hour retention, is expected to increase flood peaks, as is described in Section 3.4 of this report. As a consequence of the potential adverse

impact of increased discharge and flow concentrations resulting from development, a future main channel, approximately in the location of the proposed Sunland Channel, or additional retention, may be required to accommodate development drainage.

3.4 HYDROLOGY

Future hydrologic conditions within the Sunland Channel drainage area will depend on a variety of factors. Primary among these is the demonstrated tendency of the drainage area to be converted from agricultural use to urban residential use. Other considerations include the presence, capacity and extent of the Sunland Channel, the amount of retention required of new development, and other factors such as new storm drains, or other drainage area modifications that could affect peak discharge rates.

For purposes of this study, basic future hydrologic conditions consist of: (1) full drainage area development; (2) 100-year, 2-hour retention for all new development; (3) the DRCC in place; (4) the Tres Rios project in place; and, (5) the Sunland Channel as described in the DRCC CAR in place between 99th Avenue and the DRCC. 100-year culverts would be installed beneath Sunland Avenue and at major access roads.

Future development in the Sunland drainage area could conform to the general plan densities (1-2 units per acre), or be at a higher density if zoning changes are approved. The one recent development in the drainage area, at the southwest corner of Broadway Road and 99th Avenue, is at approximately 4 units per acre. Other nearby development in the nearby Durango drainage area is generally at 4 units per acre or higher. For purposes of this planning level study, medium density development, based on guidelines in the Drainage Design Manual for Maricopa County (FCDMC 2003), is assumed for Sunland. Medium density lot size is 6,000 to 12,000 square feet. Assuming 25% for open space and roadways, unit density would be 2.7 to 5.5 units per acre. The existing conditions HEC-1 model was modified to reflect these conditions.

The results of the HEC-1 modeling (Table 3.1) show that, in comparison to existing conditions discharges, future development with 100-year, 2-hour retention and the Sunland Channel in place, with Tres Rios, would increase discharges along the Sunland Channel alignment. At 107th Avenue, which is the boundary between the Phoenix and Avondale planning areas, the increase is 24 percent.

Table 3.1 Key Discharges for Baseline Future Conditions

Concentration Point	Future Developed Drainage area Conditions 100-Year, 2-Hour Retention Full Sunland Channel in Place as Described in the DRCC CAR Tres Rios Assumed to be in Place			Existing Conditions Peak Discharge, in cfs
	100-Year, 24-Hour Discharge, in cfs ^a	100-Year, 6-Hour Discharge, in cfs	Design Discharge, in cfs	
	99 th Avenue	63	273	
107 th Avenue	477	762	762	584
Avondale Boulevard	1,012	1,284	1,284	639
107 th Avenue is the boundary between the Phoenix and Avondale planning areas.				

A second HEC-1 run was prepared to evaluate baseline future conditions under the assumption that the Sunland Channel is never built. This run assumed: (1) full development as depicted in Figure 2.1, and assuming that all future development will be medium density residential rather than low-density residential; (2) 100-year, 2-hour retention for all new development; (3) the DRCC in place; and, (4) the Tres Rios project in place. Routing between sub-basins was the same as in the existing conditions model and reflected the existing floodplain condition. The results were identical to those presented in Table 3.1, indicating that with full development and 100-year, 2-hour retention in place, the Sunland Channel has no effect on discharges. Discharges are governed by local sub-basins. This hydrologic model also

demonstrated that 100-year, 2-hour retention is not sufficient to maintain post-development discharges at or below existing levels. Future development is expected to increase the downstream flood risk in the Sunland drainage area.

4 PLAN FORMULATION/EVALUATION OF ALTERNATIVES

This section describes basic opportunities and constraints for development of a Sunland Channel design, describes preliminary alternatives that were developed for screening based on the opportunities and constraints, and describes each of the selected alternatives in terms of description, hydrology, conceptual design, and cost. It is assumed for purposes of this evaluation that the Tres Rios project is in place.

4.1 OPPORTUNITIES AND CONSTRAINTS

4.1.1 Constraints

Topography. A topographic survey was conducted as part of this study to verify topographic conditions at various places along the proposed channel alignment for the purpose of ensuring that the concept design be feasible. The results of this survey are presented in a survey report presented in the appendix. The survey showed that existing ground at the channel alignment, particularly between 107th Avenue and 99th Avenue, is 4 to 6 feet above the adjacent floodplain. There is intervening high ground between the east-west property line and the channel location as shown in the ADMP and the DRCC CAR. This is illustrated in Figure 4.1. Although most of the drainage area contributing to the channel between 107th Avenue and 99th Avenue is north of the channel and would therefore be intercepted by the channel, the floodplain is south of the east-west property line. Drainage of floodplain flows into the channel at this location could be problematical.

Palo Verde Effluent Line. This effluent line is within 100 feet north of Roeser Road, which is located parallel to and approximately 1,000 feet north of Sunland Avenue. Roeser Road has been considered as a possible alignment for the Sunland Channel with the objective of avoiding the need for a long box culvert in Sunland Avenue. The effluent line easement reaches the Roeser Road right-of-way, leaving little or no room for a flood-control channel. Based on information provided by developers during the course of this study, APS will not allow construction of new drainage channels across this line.

Evergreen Developer Access. The Evergreen development consists of an irregular parcel approximately 350 acres in area along the north side of the Sunland Channel alignment between the upstream end of Sunland Avenue and 107th Avenue in the Avondale Planning Area. This developer plans to widen Roeser Road for access, further limiting the possibilities of a northern alignment of the Sunland Channel in this area.

Levee along Salt/Gila River. The proposed Tres Rios levee along the Salt/Gila River restricts drainage access to the river.

Other Utilities. Other utilities, including the BFC, the Voita Canal and a buried El Paso Gas Pipeline are along the alignment of the proposed channel. These utilities would have to be crossed by the channel.

Existing Development. The presence of existing development in the floodplain limits the potential for installing a channel within the floodplain limits.

Hydrology. As is demonstrated in the hydrologic analysis summarized in Table 3.1, the Sunland Channel 100-year discharge for future conditions is governed by local sub-basins. This could have the potential for limiting the efficiency of detention-related solutions. Further, future development in the City of Phoenix planning area is expected to increase discharges at 107th Avenue to higher than existing levels.

Increased discharges would result in either increased flooding potential, or increased channel construction costs for the City of Avondale.

4.1.2 Opportunities

Tres Rios Wetland. The Tres Rios wetland project will cut off most of the drainage area upstream of 99th Avenue. The resulting reduced discharge at 99th Avenue will allow a smaller channel for the Sunland system downstream of 99th Avenue than would be the case without Tres Rios.

Concrete Channel. The Sunland Channel as presented in the ADMP and in the DRCC CAR is a landscaped earthen channel with 6:1 side slopes. Constructing a more efficient channel, for instance lined with concrete, shotcrete, or soil cement, will allow construction of a more efficient channel, with steeper side slopes, and therefore reduce right-of-way costs.

Alternate Channel Location. A smaller channel south of the east-west property line between 107th Avenue and 99th Avenue would a) avoid the topographic constraint described in Section 4.1.1; b) facilitate collection of floodplain flows by being at the same level as the floodplain; and, c) reduce channel excavation costs.

Detention. Although detention may be problematical due to the hydrologic characteristics of the drainage area, it is not necessarily ineffective. There are several vacant parcels along the channel alignment where detention basins could be constructed.

Salt/Gila River. Although the future Tres Rios levee is a constraint, the Salt/Gila River is closer to some parts of the Sunland Channel than the DRCC. Diverting flows to the Gila may avoid the need for the Sunland Avenue box culvert and the BFC crossing.

Floodproofing. Reduced discharges at 99th Avenue will reduce floodplain depths and widths along the reach between 99th and 107th. Lower water surface elevations will result in lower flood risk than anticipated. Floodproofing of existing structures may be an option that would avoid the need for a channel.

Developer Retention. As described in Section 3.4, proposed development, even with the standard retention in place, is expected to increase discharges substantially. Requiring additional retention from future developers could avoid this increase. The requirement could be extended to include 100% of the 100-year runoff volume from the 6-hour or 24-hour storm, whichever is greater, and possibly reduce floodplain discharges to a low level.

First-Flush Retention. The purpose of 100-year, 2-hour retention for new development is to ensure that new development not increase discharges on downstream property. If development is to be drained into a competent flood control channel draining into a downstream channel with adequate capacity, it is possible to waive the 100-year, 2-hour retention requirement if the flood control channel is designed for the increased peaks from the development. First-flush retention, which is a water-quality requirement and less than the 100-year, 2-hour retention volume, would still be required. There is an opportunity to design the Sunland Channel for first-flush retention only, thereby providing a retention benefit to future developers.

4.2 ALTERNATIVE SCREENING

4.2.1 Preliminary Alternatives

Eight preliminary Sunland Channel design alternatives were developed for alternative screening purposes:

Sunland Channel as Proposed with Modifications. This preliminary alternative consists of the Sunland Channel as described in the DRCC CAR and the ADMP, with modifications. Modifications would consist of channel sizing for revised hydrology, and possible collector channels between Southern Avenue and the Sunland Channel along the 107th Avenue and 99th Avenue alignments.

Armored Channel. This preliminary alternative would be the same as Preliminary Alternative 1, but a narrower, more efficient cross section, with steeper side slopes, would be used to reduce right-of-way costs. Because of steeper side slopes and higher flow velocities, this channel may need to be armored with concrete, shotcrete, soil cement, or other erosion-resistant material.

Alternate Channel Location. This preliminary alternative would be the same as #1, but located on the south side of the east-west property line depicted in Figure 4.1. This would avoid the high ground on the north side of the east-west property line between 107th Avenue and 99th Avenue.

Armored Channel at Alternate Location. This preliminary alternative would be the same as #2 but utilize an armored channel to reduce right-of-way costs. This would avoid the high ground on the north side of the east-west property line between 107th Avenue and 99th Avenue, and keep right-of-way costs to a minimum.

Drain to the Salt/Gila River. This preliminary alternative would consist of constructing north-south channels along 99th Avenue, 107th Avenue, or other north-south alignments to drain into the Salt/Gila River. Cooperation with the ACOE would be required for crossing of the proposed Tres Rios levee. Culverts may be required to get through the levee. Detention basins, similar to those already proposed by the ACOE, may be required to reduce discharges to a manageable level for traversing the levee.

Detention. This preliminary alternative would consist of one or more detention basins in or adjacent to the floodplain between Avondale Boulevard and 91st Avenue. The detention basins could be used to reduce the flood damage potential on existing development within the floodplain, or to ensure that development-related increased flood peaks be reduced to existing levels at 107th Avenue (the Avondale planning area boundary).

Developer Retention. This preliminary alternative would consist of requiring future developers within the Sunland Channel drainage area to retain all runoff for the 100-year, 6-hour storm, or the 100-year, 24-hour storm, whichever is greater. This would not only ensure no development-related increase in flood peaks, it could reduce the existing floodplain level.

Floodproofing/Elevation Certificates. This preliminary alternative would consist of remapping the floodplain for revised discharges, which may be future conditions discharges with development in place, and installing individual floodproofing for structures that would be subject to 100-year flooding. Floodproofing could take such forms as floodwalls, impermeable wall sealants, ring dikes, or elevation of finished floor levels. Lowest floor levels could be surveyed and elevation certificates obtained for structures high enough to be out of the floodplain.

No Project. This preliminary alternative consists of doing nothing and allowing development to go in using current and typical development and drainage standards.

4.2.2 Alternative Selection

Preliminary alternatives were screened in a matrix format and given scores according to the four criteria described below. The scores were summed and the four alternatives getting the highest scores were selected for further evaluation. The results of the screening evaluation are presented in Table 4.1.

Cost. Relative, screening-level cost estimates were made for the preliminary alternatives for screening purposes. Those with lower cost were ranked higher than those with higher cost.

Multi-Use/Aesthetic Characteristics. One goal of the City of Avondale is to incorporate aesthetic and recreational components into the flood control solution if possible. Most desirable would be a regional trail system, including adjacent parks, as was incorporated into the DRCC. Preliminary alternatives judged to have a high potential for multiple use and aesthetic characteristics were ranked higher than those with little or none.

Level of Protection. Whereas 100-year protection is typically the goal in flood-control projects, some preliminary alternatives might not achieve that goal for all of the homes that are now in the floodplain. Preliminary alternatives with a higher potential for flood protection were scored higher than those with lower flood protection potential.

Feasibility. Feasibility was a qualitative estimate of whether a preliminary alternative would be practicable given the constraints present.

Table 4.1 Alternative Screening Evaluation.

PRELIMINARY ALTERNATIVE NUMBER	PRELIMINARY ALTERNATIVE TITLE	SCREENING RANK	DISCUSSION
4	Smaller Channel at Alternate Location	1	Considered an effective solution at relatively low overall cost, but does not address the issue of development-related increased discharge at 107 th Avenue, resulting in higher flood protection costs for Avondale than would be the case under existing conditions. Low aesthetic potential. Possible need to purchase some existing structures.
2	Armored Channel	2	Same as Alternative #4, but would be constructed in high ground between 107 th Avenue and 99 th Avenue, making floodplain drainage to the channel in this area problematical. There would be no existing structures in this alignment.
3	Alternate Channel Location	3	Same as Alternative #4, but with higher right-of-way cost and higher aesthetic potential.
1	Sunland Channel as Proposed With Modifications	4	Same as Alternative 2 but with higher right-of-way cost and higher aesthetic potential.
6	Developer Retention	5	Considered to be possibly an effective solution without the need for new channel construction.
7	Floodproofing/ Elevation Certificates	6	Avoids the need for a channel, but may not be 100% effective and level of protection may vary with different structures. May not be an effective long-term solution due to the probable lack of agency control over improvements that would be privately owned.
5	Detention	7	Problematical as a stand-alone solution due to hydrologic characteristics of the drainage area and flow entry/exit considerations.
8	No Project	8	Avoids channel construction but does not address a flood problem that is likely to worsen as the drainage area is developed.
4	Drain to the Salt/Gila River	9	Overall channel length not significantly shorter than the proposed channel. Detention likely required. Problematical due to high ground between the floodplain and the Salt/Gila River. Requires cooperation with the ACOE for crossing of the Tres Rios Levee.

Based on the screening evaluation and consideration of the needs of the City of Avondale and the residents of the floodplain, the following alternatives, which in some cases combine features of the preliminary alternatives, were selected for further evaluation:

Alternative 1: Sunland Channel as Proposed in the DRCC CAR with Modifications. Modifications would include: a) revised channel section for revised hydrology; b) collector channels along 107th Avenue and 99th Avenue; and, c) a detention basin alongside the channel in Phoenix. The purpose of the collector channels is to convey floodplain flows into the channel. The purpose of the detention basin is to ensure that the post-development peak discharge at 107th Avenue is kept to the existing level, thereby avoiding

increased flood-control costs in Avondale. Whereas there is an opportunity for designing this and other alternative channels for first-flush retention only, this was not considered for the reason that the limitation on new drainage channels over the Palo Verde effluent line limits the potential scope of this opportunity to a relatively small area, most of which is in Phoenix. Since it is desired to maintain 100-year discharges at the Avondale planning boundary at existing levels, the first-flush opportunity was discarded.

Alternative 2: Armored Channel at Alternate Location. This channel would be located on the south side of the east/west property line depicted in Figure 4.1. The channel would be constructed of shotcrete in order to minimize right of way needs. For purposes of this evaluation, collector channels would be constructed along 107th Avenue and 99th Avenue as in Alternative 1, although a more detailed future analysis may find these channels unnecessary. The flow at 107th Avenue would be limited to the existing discharge by the use of a detention basin. The channel right of way would include consideration for inclusion of a recreational trail.

Alternative 3: Developer Retention. Alternative 3 was developed for the reason that future development, although with the standard 100-year, 2-hour retention in place, is expected to increase flood peaks and thereby worsen the existing flood risk unless a flood-control project to accommodate this increased flow is implemented, or the retention requirement for these developments is increased. Alternative 3 assumes there will be no flood-control project, and therefore relies on retention. Alternative 3 would consist of 100-year, 6-hour retention for all new development in the Sunland drainage area. This requirement is already in place nearby (Tolleson) and is considered a reasonable approach in these areas where the difference between post-development and pre-development runoff exceeds the standard retention requirement.

Alternative 4: Floodproofing and Elevation Certificates. This alternative would provide in-place individual flood protection for existing homes in the floodplain and subject to 100-year flooding. Lowest floors would be surveyed and elevation certificates provided to homeowners that may qualify for Letters of Map Amendment (LOMAs).

4.3 ALTERNATIVE 1: SUNLAND CHANNEL AS PROPOSED IN THE DRCC WITH MODIFICATIONS

4.3.1 Description

Alternative 1 is the same as the same as the recommended plan proposed in the DRCC CAR, with modifications. This alternative consists of a landscaped earthen channel with depth approximately 5.9 feet, and 6:1 side slopes, extending from the DRCC to 99th Avenue along the alignment shown in Figure 4.2. That portion of the channel beneath Sunland Avenue, a reach of approximately 1,300 feet, would be in a reinforced concrete box culvert beneath the roadway surface. There would be additional culverts at 107th Avenue and at 99th Avenue. Modifications to the DRCC CAR design include:

- Revised channel section for revised hydrology;
- A side-weir retention basin at approximately 105th Avenue; and,
- A collector channel along the upstream side of 99th Avenue between the Sunland Channel and Southern Avenue.

The retention basin is included for the purpose of maintaining the 100-year discharge at or near the existing level. Table 3.1 shows that without a basin the 100-year discharge at 107th Avenue would be increased by 30% with full development and the Sunland Channel in place. The basin would be located to the south of the channel, and at a lower elevation than the channel because of the topography in that area. The basin would not receive flow from the channel unless the discharge in the channel exceeded 356 cfs. The basin would have no positive drainage outlet to the surface. At this time, it is assumed the

basin would be drained by dry wells, although this could be problematical due to shallow groundwater in this area. A concrete spillway, approximately 73 feet by 82 feet, would convey flow from the channel to the basin. A box culvert would be constructed in the channel to limit discharge to 356 cfs and ensure that discharges in excess of that amount are diverted into the spillway and retention basin.

4.3.2 Hydrology

Design discharges for Alternative 1 are presented in Table 4.2. The Discharge at 107th Avenue is slightly lower than the existing conditions discharge. Discharges at 99th and Avondale Boulevards are increased over existing conditions.

Table 4.2 Key Discharges for Alternative 1.

Concentration Point	100-Year, 24-Hour Discharge, in cfs*	100-Year, 6-Hour Discharge, in cfs	Alternative 1 Design Discharge, in cfs	Existing Conditions Discharge, in cfs
99 th Avenue	63	273	273	176
107 th Avenue	471	566	566	584
Avondale Boulevard	1,012	1,284	1,284	639

4.3.3 Conceptual Design

Table 4.3 provides a summary of key channel design and hydraulic parameters for Alternative 1. Channel top width for the main channel ranges from 81 to 139 feet. Total right-of-way width ranges from 131 to 164 feet.

4.3.4 Cost

Tables 4.4 and 4.5 summarize the cost estimate for Alternative 1. Detailed cost estimates for this and other alternatives are provided in the appendix. The estimated cost, with contingency, is \$19,220,072. Right-of-way is the most significant single cost item, followed by reinforced concrete and landscaping. Concrete costs are significant due primarily to the Sunland Avenue culvert. Costs are highest in the Avondale Planning area since the majority of the system, including the Sunland Avenue culvert, is in this area.

Table 4.3 Selected Design Parameters for Alternative 1.

MAIN CHANNEL							
Channel reach	Design Discharge, in cfs	Channel Bottom width, in Feet	Channel Top width, in Feet	Right-of-way width, in Feet	Reach Length, in Feet	Flow depth, in Feet	Channel depth, in Feet
DRCC to Avondale Boulevard.	1,284	56	139	164	2,849	5.5	6.9
Sunland Ave. to 107 th .	925	25	96	146	3,825	4.7	5.9
107 th Ave. to 105 th Ave. Basin	584	12	83	133	1,254	4.7	5.9
105 th Ave. Basin to 99 th Ave.	517	11	79	129	3,764	4.5	5.7
COLLECTOR CHANNEL							
99 th Avenue	137	20	58	74	1,250	2.2	3.2
Collector channel design parameters are variable. These are averages.							
SUNLAND AVENUE CULVERT							
Design Discharge, in cfs	Culvert Depth, in Feet	Number of Barrels		Barrel Width, in Feet	Culvert Length, in Feet		
1,095	6	3		9.5	1,388		
105 th AVENUE BASIN							
Basin Area, in Acres	Parcel Area, in Acres (Includes area for maintenance access and park construction outside the basin)		Maximum Ponding Depth, in Feet		Basin Depth, in Feet		
3.9	5.9		3		4		

Table 4.4 Alternative 1 Cost Estimate by Cost Item

COST ITEM	COST
Right-of-Way	\$ 6,960,000
Reinforced Concrete (Culverts and Spillway)	\$ 3,401,196
Landscaping	\$ 2,931,675
Excavation	\$ 1,191,690
Maintenance Access Road	\$ 255,110
Dry Wells	\$ 45,000
Subtotal	\$ 14,784,671
Contingency 30%	\$ 4,435,401
Project Total	\$ 19,220,072
The cost of utility relocation, design and other miscellaneous items is considered to be included in the 30% contingency for this and other alternative cost estimates.	

Table 4.5 Alternative 1 Cost by Reach

AVONDALE PLANNING AREA	
CHANNEL REACH	COST
DRCC to Avondale Boulevard	\$ 2,819,362
Sunland Avenue Culvert	\$ 3,060,675
Sunland Avenue Culvert to 107th Avenue	\$ 3,086,263
Avondale Subtotal	\$ 8,966,300
Avondale Contingency 30%	\$ 2,689,890
Avondale Total	\$ 11,656,190
PHOENIX PLANNING AREA	
107th Avenue to Basin at 105th Avenue	\$ 1,047,980
Basin at 105th Avenue	\$ 1,619,495
Basin at 105th Avenue to 99th Avenue	\$ 2,681,481
99th Avenue Collector	\$ 469,415
Phoenix Subtotal	\$ 5,818,371
Phoenix Contingency 30%	\$ 1,745,511
Phoenix Total	\$ 7,563,882
Project Total	\$ 19,220,072

4.4 ALTERNATIVE 2: ARMORED CHANNEL AT ALTERNATE LOCATION.

4.4.1 Description

Alternative 2 (Figure 4.3) would be a channel located on the south side of the east/west property line depicted in Figure 4.1. The channel sides would be constructed of shotcrete with 4 inches thickness on 1:1 side slopes in order to minimize right of way needs. Channel depth would be approximately 6 feet. That portion of the channel beneath Sunland Avenue would be in a reinforced concrete box culvert beneath the roadway surface. There would be additional culverts at 107th Avenue and at 99th Avenue. Alternative 2 includes a side-weir detention basin at approximately 105th Avenue, and collector channel along the upstream side of 99th Avenue between the Sunland Channel and Southern Avenue. The collector channel would be lined with shotcrete, same as the main channel. As with Alternative 1, the detention basin is included for the purpose of maintaining the 100-year discharge at or near the existing level. Unlike Alternative 1, in which the retention basin would be drained by dry wells, the Alternative 2 basin would drain back into the main channel through a 24-inch culvert located in the side weir. A box culvert would be constructed in the channel to ensure diversion of main channel flow into the detention basin. The channel right of way would include consideration for inclusion of a recreational trail.

4.4.2 Hydrology

Discharges at major concentration points are the same for Alternative 2 as for Alternative 1.

4.4.3 Conceptual Design

Table 4.6 provides a summary of key channel design and hydraulic parameters for Alternative 2. Channel top width for the main channel would range from 28 to 64 feet. Total right-of-way width range would be from 78 to 89 feet.

Table 4.6 Selected Design Parameters for Alternative 2.

MAIN CHANNEL							
Channel Reach	Design Discharge, in cfs	Channel Bottom width, in Feet	Channel Top width, in Feet	Right-of-way width, in Feet	Reach Length, in Feet	Flow depth, in Feet	Channel depth, in Feet
DRCC to Avondale Boulevard.	1,284	50	64	89	2,849	5.5	6.9
Sunland Ave. to 107 th .	925	28	40	90	3,825	4.7	6.0
107 th Ave. to 105 th Ave. Basin	584	19	31	81	1,254	4.7	6.0
105 th Ave. Basin to 99 th Ave.	517	17	29	79	3,764	4.7	6.0
COLLECTOR CHANNEL							
99 th Avenue	137	15	22	38	1,250	2.5	3.5
Collector channel design parameters are variable. These are averages.							
SUNLAND AVENUE CULVERT							
Design Discharge, in cfs	Culvert Depth, in Feet	Number of Barrels		Barrel Width, in Feet		Culvert Length, in Feet	
1,095	6	3		9.5		1,388	
105 th AVENUE BASIN							
Basin Area, in Acres	Parcel Area, in Acres (Includes area for maintenance access and park construction outside the basin)		Maximum Ponding Depth, in Feet		Basin Depth, in Feet		
4.4	6.6		3		6		

4.4.4 Cost

Tables 4.7 and 4.8 summarize the cost estimate for Alternative 2. The estimated cost, with contingency, is \$17,375,483. Right-of-way is the most significant single cost item, followed by shotcrete and reinforced concrete.

Table 4.7 Alternative 2 Cost Estimate by Cost Item

COST ITEM	COST
Right-of-Way	\$ 4,575,000
Shotcrete	\$ 3,560,550
Reinforced Concrete (Culverts and Spillway)	\$ 3,339,648
Landscaping	\$ 820,149
Excavation	\$ 812,082
Maintenance Access Road	\$ 255,959
105th Avenue Basin Drain	\$ 2,368
Subtotal	\$ 13,365,756
Contingency 30%	\$ 4,009,727
Project Total	\$ 17,375,483
The cost of utility relocation, design and other miscellaneous items is considered to be included in the 30% contingency.	

Table 4.8 Alternative 2 Cost by Reach

AVONDALE PLANNING AREA	
CHANEL REACH	COST
DRCC to Avondale Boulevard	\$ 2,077,577
Sunland Avenue Culvert	\$ 3,060,675
Sunland Avenue Culvert to 107th Avenue	\$ 2,621,532
Avondale Subtotal	\$ 7,759,784
Avondale Contingency 30%	\$ 2,327,935
Avondale Total	\$ 10,087,719
PHOENIX PLANNING AREA	
107th Avenue to Basin at 105th Avenue	\$ 945,659
Basin at 105th Avenue	\$ 1,753,576
Basin at 105th Avenue to 99th Avenue	\$ 2,452,594
99th Avenue Collector	\$ 454,143
Phoenix Subtotal	\$ 5,605,972
Phoenix Contingency 30%	\$ 1,681,792
Phoenix Total	\$ 7,287,764
Project Total	\$ 17,375,483

4.5 ALTERNATIVE 3: DEVELOPER RETENTION.

4.5.1 Description

In Alternative 3, all future developers within the Sunland Channel drainage area upstream of Avondale Boulevard would be required to retain all runoff from the 100-year, 6-hour storm. There would be no channel construction. However, the additional retention could be placed in a linear corridor along the alignment of the Sunland Channel, as shown in Figure, 4.4, to create a recreational and aesthetic amenity. This corridor would be landscaped similar to what has been done along the original DRCC alignment in Phoenix (See FCDMC 2006).

4.5.2 Hydrology

Table 4.9 provides the hydrologic modeling results for Alternative 3. Peak discharge rates would be reduced significantly throughout the floodplain, but not eliminated due to existing areas that are already developed, but without full retention.

Table 4.9 Key Discharges for Alternative 3.

Concentration Point	100-Year, 24-Hour Discharge, in cfs*	100-Year, 6-Hour Discharge, in cfs	Alternative 3 Design Discharge, in cfs	Existing Conditions Discharge, in cfs
99th Avenue	0	1	0	176
107th Avenue	301	425	485	584
Avondale Boulevard	310	383	383	639

4.5.3 Conceptual Design

Alternative 3 would require an additional 48 acre feet of developer retention above the 100-year, 2-hour requirement, of which 20 acre feet would be by developers in the Avondale planning area, and 28 acre feet would be in the Phoenix planning area.

It is assumed that the retention depth would be 3 feet, with one foot of freeboard in the basins. Installation of this retention in linear basins along the alignment shown in Figure 4.4 would result in the following retention basin cross section dimensions in the Avondale Planning Area:

Basin Length:	3,388 feet
Basin Depth:	4 feet
Basin Bottom Width:	67 feet
Basin Top Width:	115 feet
Total Right of Way Width:	155 feet

The linear basin in the Phoenix Planning Area would have the following dimensions:

Basin Length:	6,423 feet
Basin Depth:	4 feet
Basin Bottom Width:	45 feet
Basin Top Width:	93 feet
Total Right of Way Width:	133 feet

A trapezoidal cross section is assumed. Right of way includes 20 feet on each side of the basin for maintenance and recreation access. The maintenance road on each side is 12 feet wide decomposed granite. It is assumed the basins would be drained by dry wells.

4.5.4 Cost

The estimated cost, assuming unit costs the same as those used for the Sunland Channel cost estimate, is \$10,264,029 (Tables 4.10 and 4.11).

Table 4.10 Alternative 3 Cost Estimate by Cost Item

COST ITEM	COST
Right-of-Way	\$ 4,755,000
Landscaping	\$ 2,062,131
Excavation	\$ 670,380
Maintenance Access Road	\$ 152,896
Dry Wells	\$ 255,000
Subtotal	\$ 7,895,407
Contingency 30%	\$ 2,368,622
Project Total	\$ 10,264,029

Table 4.11 Alternative 3 Cost by Planning Area

AVONDALE	
COST ITEM	COST
Avondale Subtotal	\$ 3,049,037
Avondale Contingency 30%	\$ 914,711
Avondale Total	\$ 3,963,748
PHOENIX	
Phoenix Subtotal	\$ 4,846,370
Phoenix Contingency 30%	\$ 1,453,911
Phoenix Total	\$ 6,300,281
Project Total	\$ 10,264,029

4.6 ALTERNATIVE 4: ALTERNATIVE 4: FLOODPROOFING AND ELEVATION CERTIFICATES.

4.6.1 Description

Alternative 4 would provide in-place individual flood protection for existing homes in the floodplain and subject to 100-year flooding. The floodplain would be mapped for with-development drainage area conditions. Lowest floors within the floodplain would be surveyed, and those subject to flooding would be offered floodproofing. At this time, floodproofing is assumed to take the form of floodwalls constructed adjacent to the existing structure wall. Elevation certificates would be provided for those structures with lowest floors above the 100-year flood level. These could be used to apply for Letters of Map Amendment if applicable.

Alternative 4 would include a retention basin with capacity of 10-acre feet in the position shown in Figure 4.5. As in Alternatives 1 and 2, the purpose of this basin would be to ensure that the 100-year discharge at 107th Avenue remains near the existing condition discharge.

4.6.2 Hydrology

The hydrologic modeling for Alternative 4 consists of developed drainage area conditions as in Alternatives 1 and 2, but with Sunland drainage routing for existing conditions under the assumption that there would be no Sunland Channel. The results are presented in Table 4.12.

Table 4.12 Key Discharges for Alternative 4.

Concentration Point	100-Year, 24-Hour Discharge, in cfs*	100-Year, 6-Hour Discharge, in cfs	Alternative 4 Design Discharge, in cfs	Existing Conditions Discharge, in cfs
99 th Avenue	63	273	273	176
107 th Avenue	304	539	539	584
Avondale Boulevard	1,012	1,284	1,284	639

4.6.3 Conceptual Design

The average flood depth with the above-referenced discharges will be approximately one foot. Flood walls, with sealable entryways, would be constructed adjacent to existing homes at a height averaging 2 feet above adjacent ground, to provide one foot of freeboard.

4.6.4 Cost

The cost estimate for Alternative 4 is based on an average home perimeter in this area of 265 feet measured from aerial photographs. A 2-foot floodwall is estimated to cost \$107/linear foot, for an average per-structure cost of \$28,355. There are approximately 123 floodplain homes without current elevation certificates in the Avondale planning area, and 43 such homes in the Phoenix planning area. Table 4.13 summarizes the cost estimate. Total cost of Alternative 4 would be approximately \$9,167,108. Survey and floodplain remapping cost would be approximately \$100,000 and is included in the contingency.

Table 4.13 Alternative 4 Cost by Planning Area

AVONDALE	
ITEM	COST
Avondale Subtotal	\$ 3,487,665
Avondale Contingency 30%	\$ 1,046,300
Avondale Total	\$ 4,533,965
PHOENIX	
Phoenix Subtotal	\$ 3,563,956
Phoenix Contingency 30%	\$ 1,069,187
Phoenix Total	\$ 4,633,143
Project Total	\$ 9,167,108
The Phoenix total cost, with contingency, includes \$3,048,098 for a retention basin.	

4.7 ALTERNATIVE COMPARISON

Table 4.14 is a matrix listing the costs and relative advantages and disadvantages of the four alternatives.

Table 4.14. Alternative Comparison Matrix.

Alternative	Cost	Advantages	Disadvantages
1. Sunland Channel as Proposed in the DRCC CAR with Modifications.	\$19,220,072	Similar to recommended plan from DRCC CAR. 100-year flood protection. Multiple use linear corridor Aesthetic amenity	Dry well drains may not be practical Highest cost Channel is mostly outside the floodplain, partly on high ground
2. Armored Channel at Alternate Location.	\$17,375,483	100-year flood protection. Multiple use linear corridor Channel is within or at the edge of the floodplain	High cost Aesthetic qualities minimal Some homes may have to be purchased
3. Developer Retention.	\$10,264,029	Moderate cost. Cost is borne over time, mostly or partly by developers. No disruption of existing landowners in the floodplain or need to purchase right of way.	Dry well drains may not be practical Not 100-year flood protection. Implementation may take years. Linear corridor unlikely or fragmented.
4. Floodproofing and Elevation Certificates.	\$ 6,119,010	Low cost. No need to purchase right of way.	Not 100-year flood protection. High liability (improvements would be owned and maintained privately). No linear corridor or aesthetic amenity.

Alternative 1 provides all of the desired features of a flood-control solution for the Sunland Channel, but has the highest cost. Specifically, this alternative provides a 100-year solution and an opportunity for an aesthetic linear recreational corridor that conforms to what is currently planned for the DRCC as well as Tres Rios. However, this channel is mostly outside the floodplain and on land that will not benefit from the flood-control solution. Further, the cost is the highest. The retention basin in Alternative 1 relies on dry wells to drain. Groundwater in this area is high, and drainage by dry well may be very slow, or not practical at all given the need to drain the basin in 72 hours. An alternate drainage solution, which could involve a horizontal pipe drain to the Gila River, would cost substantially more than the dry wells.

Alternative 2 solves the problem of placing the channel on land that is not in the floodplain and does not benefit from a flood-control solution, but at the cost of the need to purchase some of the homes that are currently in need of protection. Alternative 2 provides 100-year protection and an opportunity for a linear corridor, but it would have lower aesthetic quality than Alternative 1 or the current Recommended Plan from the DRCC CAR, and so would have lesser success as a regional recreational amenity.

Alternative 3 would have a significantly reduced cost, and the cost would be borne all, or in part, by developers, but would not provide a 100-year solution and the solution would be implemented slowly over time at the schedule of development. It may be possible to achieve a linear corridor by requiring that retention be placed in a linear fashion as has been done along the DRCC alignment in Phoenix, but in the end the corridor would be fragmented by being limited to newly developed land.

Alternative 4 could potentially provide 100-year protection to homes, but would still allow flooding over property and streets. Homes may still be at risk due to uncertainties in the effectiveness in floodproofing. Over time, the risk would increase as floodproofing falls into disrepair, or is disabled. The County or Cities may have liability for floodproofing failures, but little ability to ensure proper maintenance and function of the improvements. Alternative 4 would provide no linear corridor and no aesthetic amenity. Aesthetic quality of the neighborhood would probably decrease.

After review of the advantages and disadvantages of the four alternatives, consideration of the project goals described in Section 1.2 of this report, and discussions with the City of Avondale, a recommendation was made that comprises parts of Alternatives 2 and 3. Basic features of the recommended plan are: 1) a flood-control conveyance channel similar to the channel proposed in the previous CAR but reduced in capacity and extending from the DRCC to 107th Avenue only; 2) linear retention basins alongside and upstream of the conveyance channel; 3) sufficient right of way and a landscaped character to constitute an aesthetic and recreational amenity; and, 4) 100-year, 6-hour retention for new development within the drainage area.

This recommendation, presented as the recommended plan and described in detail in Section 5 of this report, achieves all of the project goals described in Section 1.2. The channel design discharge, and therefore cost, is minimized by recognizing that the retention requirement for future development is likely to be higher than the standard requirement in order to avoid worsening the flood risk. The plan installs some of this future retention to ensure a linear amenity to Tres Rios.

5 RECOMMENDED PLAN

5.1 DESCRIPTION AND COST ESTIMATE

5.1.1 Project Features

Location, alignment and typical cross sections of the recommended plan improvements are shown in Figure 5.1. Channel and retention basin dimensions are presented in Table 5.1.

Table 5.1 Recommended Plan Design Dimensions

FLOW CONVEYANCE CHANNEL							
Channel Reach	Design Discharge, in cfs	Channel Bottom Width, in Feet	Channel Top Width, in Feet	Right of Way Width, in Feet	Channel Length, in Feet	Flow Depth, in Feet	Channel Depth, in Feet
DRCC to Avondale Boulevard	383	10	114	154	3,405	4.8	8.7*
Adjacent to Sunland Avenue	392	10	77	117	1,157	4.2	5.6
Sunland Avenue to 107 th Ave.	419	10	75	115	4,069	4.3	5.4
COLLECTOR CHANNEL ***							
Channel Reach	Design Discharge, in cfs	Channel Bottom Width, in Feet	Channel Top Width, in Feet	Right of Way Width, in Feet	Channel Length, in Feet	Flow Depth, in Feet	Channel Depth, in Feet
Conveyance Channel to Southern Avenue	210	24	31	51	1,182	2.5	3.5
LINEAR RETENTION BASINS							
Reach	Retention Volume, in Acre Feet	Basin Bottom Width, in feet	Basin Top Width, in Feet	Right of Way Width, in Feet	Basin Length, in Feet	Ponding Depth, in Feet	Basin Depth, in Feet
Sunland Avenue to 107 th Ave.	16	51	99	119**	3,386	3	4.0
107 th Avenue to 99 th Avenue	8.0	10	54	94	5,062	2.7	3.7
99 th Avenue to Tres Rios	2	10	54	73	1,361	2.6	3.6
*This channel is deeper than necessary for design discharge conveyance for two reasons: 1) to meet the downstream grade of the DRCC; and, 2) to be deep enough at the upstream end to allow construction of a drop inlet and culvert to convey flow beneath the BFC.							
**This basin is adjacent to a flow conveyance channel with intervening maintenance access/linear corridor right of way. Right of way represented here represents basin top width and maintenance access on the north side only. Intervening access is represented by the right of way for the conveyance channel.							
*** Design dimensions vary. Those given here are representative.							

The recommended plan consists of:

- A landscaped earthen flow conveyance channel from the DRCC to Avondale Boulevard.
- A reinforced concrete drop inlet and box culvert to convey Sunland flows beneath the BFC. This culvert would consist of two, 7-foot (wide) by 3-foot (deep) reinforced concrete box cells.
- A landscaped earthen flow conveyance channel along the north side of Sunland Avenue to the east end of Sunland Avenue. In the previous CAR, this reach was to be an underground box culvert. The purpose of proposing a channel in this reach for this recommended plan is to ensure connectivity of the regional corridor, and to avoid the cost of constructing a long box culvert. Construction of this channel would require the purchase of 8 existing homes with lots along the north side of Sunland Avenue. Excess right of way from purchasing the lots would be sold after construction of the project.

- A landscaped earthen flow conveyance channel from the end of Sunland Avenue to 107th Avenue. This channel would be constructed to the south of the alignment proposed in the previous CAR, on land that is currently subject to flooding. This channel would curve into Evergreen property at the western end in order to continue along the north side of Sunland Avenue (see previous bullet item).
- A linear retention basin along the north side of the conveyance channel from the end of Sunland Avenue to 107th Avenue. This retention basin would be designed for the difference between 100-year, 6-hour runoff and 100-year, 2-hour runoff for the Evergreen development proposed for the north side of the flow conveyance alignment in this reach. This volume is the same (within less than one acre foot) as the volume of the entire 100-year, 6-hour retention volume for that (90-acre) portion of the Evergreen development south of the Palo Verde effluent line. This retention basin would drain into the adjacent flow conveyance channel by means of one or more small circular culverts. These culverts, likely no larger than 24-inch pipes, would be small enough to allow the basins to retain virtually all of the runoff reaching them during a storm, but large enough to drain the basins within 72 hours.
- A linear retention basin along the alignment shown in Figure 5.1 between 107th Avenue and 99th Avenue. This retention basin would be designed for the difference between 100-year, 6-hour runoff and 100-year, 2-hour runoff for an unnamed development expected along the north side of the basin alignment in this reach. This basin would drain into the flow conveyance channel downstream of 107th Avenue by means of a small circular culvert.
- A linear retention basin along the alignment shown in Figure 5.1 between 99th Avenue and the ACOE Tres Rios project. This retention basin would be designed for the difference between 100-year, 6-hour runoff and 100-year, 2-hour runoff for an unnamed development expected along the north side of the basin alignment in this reach. This basin would drain into the retention basin downstream of 99th Avenue by means of a small circular culvert.
- A collector channel along the east side of 107th Avenue between the proposed conveyance channel/retention basin alignment and Southern Avenue. This channel would have an earth bottom with sides lined with concrete. Construction of this channel would require the purchase of at least one existing home along the east side of 107th Avenue.

The conveyance channel and linear retention basins would have right-of-way sufficient to provide multi-use opportunities such as a recreation corridor and aesthetic amenity linking the Tres Rios Project with the DRCC and therefore, ultimately to the Agua Fria River. .

5.1.2 Hydrology

The hydrologic analysis for the recommended plan is based on the assumption that the drainage area is fully developed and the recommended 100-year, 6-hour retention has been implemented, as well as the project features. Tres Rios is assumed to be in place. Table 5.2 provides a summary of key discharges for the recommended plan.

Table 5.2 Key Discharges for Recommended Plan.

Concentration Point	100-Year, 24-Hour Discharge, in cfs*	100-Year, 6-Hour Discharge, in cfs	Recommended Plan Design Discharge, in cfs	Existing Conditions Discharge, in cfs
99 th Avenue	0	0	0	176
107 th Avenue	301	419	419	584
Avondale Boulevard	310	383	383	639

5.1.3 Cost

Cost estimates are provided in Tables 5.3 and 5.4. The project cost, including 30% contingency to account for design costs, utility relocation, and other uncertainties, is estimated at \$17,603,399. 72% of this cost, \$12,703,990, would be in the Avondale Planning Area, the rest would be in the Phoenix Planning Area. The cost of the conveyance structures, including channels, culverts and collector channel, is \$10,675,180. Retention basins comprise \$6,928,219. Right of Way (Table 5.4) is the main cost component, followed by landscaping. All other cost components are minor and together comprise less than 15% of the total cost.

Table 5.3. Recommended Plan Estimated Cost by Reach.

REACH	COST
AVONDALE PLANNING AREA	
DRCC to Avondale Boulevard	\$ 3,055,182
Adjacent to Sunland Avenue	\$ 1,870,395
Flow Conveyance Channel Sunland Avenue to 107 th Avenue	\$ 2,540,789
Linear Retention Sunland Avenue to 107 th Avenue	\$ 2,305,934
Avondale Subtotal	\$ 9,772,300
Avondale Contingency 30%	\$ 2,931,690
Avondale Total	\$ 12,703,990
PHOENIX PLANNING AREA	
107 th Avenue Collector Channel	\$ 745,311
Linear Retention 107 th Avenue to 99 th Avenue to Tres Rios	\$ 2,483,586
Linear Retention 99 th Avenue to Tres Rios	\$ 539,879
Phoenix Subtotal	\$ 3,768,776
Phoenix Contingency 30%	\$ 1,130,633
Phoenix Total	\$ 4,899,409
AVONDALE AND PHOENIX PLANNING AREAS	
Project Total	\$17,603,399
Linear retention is based on 100-year, 6-hour storm.	

The cost does not include additional costs that would be borne by other developers within the drainage area for additional retention in excess of the 100-year, 2-year requirement. Using the same unit costs as presented in Table 5.4, and assuming linear basins with bottom width of 50 feet, a preliminary and approximate estimate of this additional cost is \$3,600,000, for a total project cost of approximately \$21,200,000.

Table 5.4. Recommended Plan Estimated Cost by Cost-Item.

Cost Item	Quantity	Unit	Unit Cost	Cost
Right of Way	46.6	Acres	\$ 150,000	\$ 8,510,000*
Landscaping	39.5	Acres	\$ 78,408	\$ 3,097,116
Excavation	183,360	Cubic Yards	\$ 6	\$ 1,100,160
Culvert Concrete	581	Cubic Yards	\$ 669	\$ 388,689
Maintenance Road	9.3	Acres	\$ 28,314	\$ 263,321
Shotcrete	18,179	Square Feet	\$ 10	\$ 181,790
Subtotal				\$ 13,541,076
Contingency 30%				\$ 4,062,323
Total				\$ 17,603,399
* This includes \$1,520,000 for net cost (after sale of excess land) for purchase of homes and lots not included in the 47.2 acres.				

5.2 DISCUSSION

There are several considerations that should be taken into account with regard to the recommended plan, including two potential design variations presented because of the reliance of the project on future retention. These are addressed in this section.

5.2.1 Tres Rios

The project hydrology relies on the presence of the future Tres Rios wetland restoration project. Based on discussions with the Corps of Engineers, the design of this project is expected to be complete in approximately one year from the date of this report, with construction to begin by the year 2008. Based on this schedule, Tres Rios could be constructed about the same time as the Sunland Channel. Should the Sunland project progress to final design as presented herein, the District should coordinate closely with the Corps of Engineers to ensure validity of design assumptions.

5.2.1 Existing Conditions Design Variation

Since the project as designed relies on a developed-conditions drainage area with retention, 100-year flood protection is achieved only after full development of the drainage area. If constructed as presented, under existing drainage area conditions, the project hydrology would be as presented in Table 5.5.

As shown in Table 5.5, the expected discharges are higher than the recommended plan design discharges. At Avondale Boulevard, the peak is higher than the existing conditions discharge. This last is due to more efficient flood routing between 107th Avenue and Avondale Boulevard with the project in place than under existing conditions. Without the anticipated development retention, the recommended plan retention has no effect on the 100-year discharge at 99th Avenue, and only moderate effect at 107th Avenue. The result will be that if constructed prior to development, the project will initially be less than a 100-year-capacity project.

Table 5.5 Key Discharges for Recommended Plan in Place with Existing Drainage Area Conditions.

Concentration Point	100-Year Discharge, in cfs, for Existing Conditions Drainage Area with Recommended Plan in Place	100-Year Design Discharge, in cfs	Existing Conditions Discharge, in cfs, with No Plan in Place
99 th Avenue	176	0	176
107 th Avenue	547	419	584
Avondale Boulevard	760	383	639

Recommended plan retention between Sunland Avenue and Tres Rios assumed to be in place. No other retention except what is already in place by limited development within the drainage area.

Table 5.6 presents the level of flood protection under existing drainage area conditions with the recommended plan in place. The approximate level of flood protection in Table 5.6 is derived in part from ratios of lesser return period discharges to 100-year discharges presented in the original ADMP (FCDMC 2002).

The table shows that the project will provide 100-year flood protection immediately after construction in the reach between the DRCC and Avondale Boulevard. At the Avondale Boulevard Culvert, which must drop below the BFC, the flood protection is approximately 50-year with standard freeboard in place, and the level of protection is about the same for the channel between Avondale Boulevard and 107th Avenue. The collector channel, not presented in the table, would have greater than 50-year capacity.

Without freeboard in place, in other words with flow at the channel rim, the flood protection is 100-year everywhere downstream of 107th Avenue except at the Avondale Boulevard culvert, which would still have about a 50-year capacity.

Table 5.6. Level of Flood Protection Under Existing Drainage Area Conditions with Recommended Plan in Place.

Reach	Maximum 100-Year Discharge, in cfs, for Existing Conditions Drainage Area With Recommended Plan in Place	Maximum Design Discharge, in cfs	Maximum Project Conveyance Capacity with Freeboard, in cfs*	Approximate Level of Flood Protection With Freeboard, in Years**	Maximum Project Conveyance Capacity without Freeboard, in cfs	Approximate Level of Flood Protection Without Freeboard, in Years
DRCC to Avondale Boulevard	760	383	903	>100	1,589	>100
Avondale Boulevard Culvert	760	392	392	52	435	57
Avondale Boulevard to 107 th Avenue	760	419	419	55	760	100
107 th Avenue to 99 th Avenue	547	Not Applicable	No Channel	Minimal	Not Applicable	Minimal***

* Measured as standard FCDMC freeboard. Standard freeboard may be less than the design freeboard.

** For with-project condition with existing-conditions drainage area.

*** Refers to reduced discharges resulting from the project. Flood protection is 100-year at 99th Avenue. At 107th Avenue a risk of flooding remains, but it is less than under the existing condition due to lower 100-year discharge.

If constructed under current drainage area conditions, the project will be approximately a 50-year flood-control-project. Capacity will increase as development occurs until 100-year capacity is achieved when all development with retention is in place. At the rate the surrounding area is being converted to residential development, particularly given that there is already one completed development within the Sunland drainage area, with at least three more being planned, it is likely 100-year capacity will be achieved in a short period of time.

100-year capacity can be achieved under existing drainage area conditions by widening the channel between Avondale Boulevard and 107th Avenue. Table 5.7 provides design dimensions that would achieve 100-year capacity in the initial stages of the project. Total right of way adjacent to Sunland Avenue would be 136 feet rather than 117 feet as presented in Table 5.1. Between Sunland Avenue and 107th Avenue, channel right of way would be 128 feet rather than 115 feet. The cost, summarized in Table 5.8, would be \$18,484,498. Since this cost is only about 5% greater than the recommended plan, consideration should be given to designing the channel for existing conditions discharges.

Table 5.7 Recommended Plan Design Dimensions for 100-Year Capacity Under Existing Drainage Area Conditions.

FLOW CONVEYANCE CHANNEL							
Channel Reach	Design Discharge, in cfs	Channel Bottom Width, in Feet	Channel Top Width, in Feet	Right of Way Width, in Feet	Channel Length, in Feet	Flow Depth, in Feet	Channel Depth, in Feet
DRCC to Avondale Boulevard	760	10	114	154	3,405	6.4	8.7*
Adjacent to Sunland Avenue	760	30	96	136	1,157	4.4	5.5
Sunland Avenue to 107 th Ave.	627	22	88	128	4,069	4.4	5.5
COLLECTOR CHANNEL***							
Channel Reach	Design Discharge, in cfs	Channel Bottom Width, in Feet	Channel Top Width, in Feet	Right of Way Width, in Feet	Channel Length, in Feet	Flow Depth, in Feet	Channel Depth, in Feet
Conveyance Channel to Southern Avenue	273	32	39	59	1,182	2.5	3.5
LINEAR RETENTION BASINS							
Reach	Retention Volume, in Acre Feet	Basin Bottom Width, in feet	Basin Top Width, in Feet	Right of Way Width, in Feet	Basin Length, in Feet	Ponding Depth, in Feet	Basin Depth, in Feet
Sunland Avenue to 107 th Ave.	16	51	99	119**	3,386	3	4.0
107 th Avenue to 99 th Avenue	8.0	10	54	94	5,062	2.7	3.7
99 th Avenue to Tres Rios	2	10	54	73	1,361	2.6	3.6
*This channel is deeper than necessary for design discharge conveyance for two reasons: 1) to meet the downstream grade of the DRCC; and, 2) to be deep enough at the upstream end to allow construction of a drop inlet and culvert to convey flow beneath the BFC.							
**This basin is adjacent to a flow conveyance channel with intervening maintenance access/linear corridor right of way. Right of way represented here represents basin top width and maintenance access on the north side only. Intervening access is represented by the right of way for the conveyance channel.							
*** Design dimensions vary. Those given here are representative.							

Table 5.8. Estimated Cost by Reach for 100-Year Capacity Channel Under Existing Drainage Area Conditions.

REACH	COST
AVONDALE PLANNING AREA	
DRCC to Avondale Boulevard	\$ 3,055,182
Adjacent to Sunland Avenue	\$ 2,109,252
Flow Conveyance Channel Sunland Avenue to 107 th Avenue	\$ 2,904,217
Linear Retention Sunland Avenue to 107 th Avenue	\$ 2,305,934
Avondale Subtotal	\$ 10,374,585
Avondale Contingency 30%	\$ 3,112,376
Avondale Total	\$ 13,486,961
PHOENIX PLANNING AREA	
107 th Avenue Collector Channel	\$ 820,794
Linear Retention 107 th Avenue to 99 th Avenue to Tres Rios	\$ 2,483,586
Linear Retention 99 th Avenue to Tres Rios	\$ 539,879
Phoenix Subtotal	\$ 3,844,259
Phoenix Contingency 30%	\$ 1,153,278
Phoenix Total	\$ 4,997,537
AVONDALE AND PHOENIX PLANNING AREAS	
Project Total	\$18,484,498

5.2.1 No Retention Basins Design Variation

The project as proposed includes two linear retention basins that would anticipate required retention for the developments to be built in the future at and adjacent to these basins. These retention basins, which would normally be required of future development for flood control, are included to reduce design discharges and to ensure a linear corridor extending to Tres Rios. These basins can be built at the time the project is constructed, as is recommended, or they can be deferred until the area develops, upon which they would be constructed by developers. Should construction of these basins be deferred, and the proposed channel be constructed with no supporting retention, the existing conditions 100-year discharge would be higher than presented in Table 5.5. This discharge would be 584 cfs at 107th Avenue (same as under the existing condition without project) and 918 cfs at Avondale Boulevard.

Under these discharge conditions, the recommended plan channel as presented in Table 5.7 would have approximately 40-year capacity. Table 5.9 briefly summarizes design considerations if the channel is to be designed for existing drainage area conditions with no retention at all. The cost is about 12% higher than the recommended plan. Additional retention (above the 100-year, 2-hour) would be needed from developers to keep discharges at these levels.

Table 5.9. Design Summary for Recommended Plan with Existing Conditions Drainage Area and No Retention.

Item	Description	
	100-Year Stand Alone Channel (No Retention)	Recommended Plan
100-Year Discharge at Avondale Boulevard	918 cfs	383 cfs
100-Year Discharge at 107 th Avenue	584 cfs	419 cfs
Approximate Right of Way Width DRCC to Avondale Boulevard	155 Feet	154 Feet
Approximate Right of Way Width Adjacent to Sunland Avenue	146 feet	117 Feet
Approximate Right of Way Sunland Avenue to 107 th Avenue	135 Feet	115 Feet
Approximate Right of Way Width for Collector Channel	62 Feet	51 Feet
Approximate Construction Cost with 30% Contingency	\$11,945,838	\$ 10,675,180

5.2.4 Effect on the DRCC

The DRCC design presented in the previous CAR was based on certain design assumptions for the Sunland Channel that may not now be valid. Modifications to the Sunland Channel design would the hydrology of the DRCC through modifications of Sunland peak discharges and discharge timing. This section presents a summary of the expected changes to the DRCC. The hydrologic and design evaluation, summarized in Tables 5.10 and 5.11, show that downstream of El Mirage Road, the Sunland project will have negligible impact on the DRCC. Discharges with the revised Sunland Channel in place are within 2% of the previous DRCC design discharges. Between El Mirage Road and the Sunland Channel, the effect is greater and would constitute a reduction of approximately 24 feet in the DRCC right of way width.

Table 5.12 compares DRCC costs for those reaches affected, as well as total DRCC cost. Under current drainage area conditions, with the Sunland recommended plan in place, the DRCC cost would reduce by approximately \$80,000. If the DRCC is designed for future development and future retention with the Sunland project in place, the DRCC cost would be reduced by approximately \$300,000. It is recommended that the DRCC design reflect the Sunland recommended plan with existing drainage area conditions. This would involve an increase in DRCC right of way width of three feet downstream of El Mirage Road, and a reduction of ten feet between El Mirage Road and the Sunland Confluence.

Table 5.10. DRCC Hydrology with Sunland Recommended Plan.

Concentration Point	DRCC Design Discharge, in cfs From Previous CAR	DRCC Design Discharge, in cfs With Sunland Recommended Plan in Place	
		Existing Drainage Area Condition	With Future Development and Developer Retention
El Mirage Road Upstream	1,645	1,455	1,183
El Mirage Road Downstream	2,654	2,688	2,704
Dysart Road	3,069	3,115	3,144

Table 5.11 Revised DRCC Design Parameters

Channel Reach	Design Discharge, in cfs	Channel Bottom Width, in Feet	Channel Top Width, in Feet	Right of Way Width, in Feet	Channel Slope, in Feet per Foot	Flow Depth, in Feet	Channel Depth, in Feet
DRCC DESIGN DIMENSIONS PRESENTED IN DRCC CAR							
Downstream of El Mirage Road	3,069	156	227	277	0.0014	4.7	5.9
El Mirage Road to Sunland Channel	1,645	69	140	190	0.0017	4.7	5.9
DRCC DESIGN DIMENSIONS REVISED FOR RECOMMENDED PLAN SUNLAND CHANNEL IN PLACE ASSUMING FULL DEVELOPMENT, FULL RETENTION IN SUNLAND DRAINAGE AREA*							
Downstream of El Mirage Road	3,144	160	231	281	0.0014	4.7	5.9
El Mirage Road to Sunland Channel	1,183	45	116	166	0.0017	4.7	5.9
DRCC DESIGN DIMENSIONS REVISED FOR RECOMMENDED PLAN SUNLAND CHANNEL IN PLACE ASSUMING EXISTING DEVELOPMENT AND EXISTING WATERSHED CONDITIONS*							
Downstream of El Mirage Road	3,115	159	230	280	0.0014	4.7	5.9
El Mirage Road to Sunland Channel	1,455	59	130	180	0.0017	4.7	5.9
* DRCC reaches upstream of the Sunland confluence are not affected.							

Table 5.12. DRCC Cost Evaluation with Sunland Recommended Plan.

Reach	DRCC Cost with 30% Contingency		
	Current DRCC Design	With Recommended Plan Sunland Channel (Future Drainage Area and Retention Conditions)	With Recommended Plan Sunland Channel (Existing Drainage Area and Retention Conditions)
Channel Downstream of Dysart	\$ 1,873,451	\$ 1,895,993	\$ 1,895,143
Channel Dysart to El Mirage	\$11,137,677	\$11,291,471	\$ 11,253,020
Channel El Mirage to Sunland Channel	\$ 3,897,605	\$ 3,419,064	\$ 3,680,892
Total DRCC	\$52,886,496	\$52,584,290	\$ 52,806,816

6 NEW DEVELOPMENT WITHOUT THE PROJECT

Probable development requirements without the Sunland Channel Project in place were assessed for one development currently proposed along the Sunland Channel alignment. This development, referred to as Evergreen, is located along the north side of the Sunland Channel alignment between the upstream end of Sunland Avenue and 107th Avenue in the Avondale Planning Area. This development is not within the Sunland floodplain, but it would have to address the issue of retention.

The normal retention requirement would be the volume of runoff generated from the 100-year, 2-hour storm. However, as demonstrated in the hydrologic analysis for this report, 100-year, 2-hour retention is not sufficient to reduce 100-year discharges to existing conditions levels, and unless some additional improvements are implemented, development with the normal retention requirement would exacerbate the existing flooding problem for the homes along Sunland Avenue.

Additional improvements could involve installing flood conveyance capacity between the development and the proposed DRCC. This may not be practical since it would involve acquiring right of way from other property owners. The most likely solution would be additional retention volume to ensure no increase in peak flow rates.

For purposes of this analysis, the total development retention requirement would be 100-year, 6-hour retention. This retention amount would ensure that post-development discharges from the development be below existing condition discharges, thereby ensuring no increase in flood risk to adjacent or downstream property. The retention volume of 16 acre feet presented for the reach between Sunland Avenue and 107th Avenue in the recommended plan is the same as the difference between 100-year, 6-hour retention and 100-year, 2-hour retention for the Evergreen development. In the absence of a Sunland project, this additional retention volume would be required of the Evergreen developer. Retention of the 100-year, 2-hour runoff volume would also be required.

The most-effective place to install this additional retention volume is in a linear basin along the southern boundary of the Evergreen development, at the location of the retention basin between Sunland Avenue and 107th Avenue shown in Figure 5.1. This location not only provides a visual and recreation amenity and buffer between the new development and the existing development to the south, it ensures the capture of flows leaving the Evergreen development such that that nuisance flows not enter the existing development.

Table 6.1 provides preliminary dimensions for this retention in the configuration described. Table 6.2 provides a cost estimate. The estimated cost of these improvements is \$3.6 million dollars.

This analysis is based on hydrologic parameters using the assumption of a medium development density according to FCDMC (2003). Medium density is approximately 2.7 to 5.5 units per acre. This analysis could be refined should the final lot density information for Evergreen not conform to these assumptions.

Table 6.1. Evergreen Development Retention Volume in the Absence of the Project.

ITEM	DIMENSION
Retention Basin Length	3, 386 Feet
Retention Volume*	18.1 Acre Feet
Retention Basin Side Slopes	6:1
Retention Basin Bottom Width	59 Feet
Retention Ponding Depth	3 Feet
Freeboard	1 Foot
Retention Basin Total Depth	4 Feet
Retention Basin Top Width	107 Feet
Maintenance Right of Way	20 Feet Each Side
Total Right of Way Width	147Feet
Total Area	9.9 Acres

* Represents the difference between 100-year, 6-hour runoff volume and 100-year, 2-hour runoff volume. 100-year, 2-hour retention is a standard requirement that would still be required. 100-year, 2-hour retention is assumed to be distributed elsewhere within the development and, as a standard requirement, is not considered in this preliminary design concept or cost estimate.

Table 6.2. Evergreen Development Retention Cost Estimate in the Absence of the Project.

ITEM	QUANTITY	UNIT	UNIT COST	COST
Excavation	42,350	Cubic Yards	\$ 6	\$ 254,100
Landscaping	9.6	Acres	\$ 78,408	\$ 752,717
Land	11.5	Acres	\$ 150,000	\$ 1,725,000
Maintenance Road*	1.9	Acres	\$ 28,314	\$ 53,797
Subtotal				\$ 2,785,614
Contingency 30%				\$ 835,684
Total Cost				\$ 3,621,298

* Assumes two 12-foot roadways of decomposed granite.

7 REFERENCES

Flood Control District of Maricopa County (FCDMC), 2002. Durango Area Drainage Master Plan Recommended Design Report FCD #99-41. October 2002

FCDMC, 2002. Durango Area Drainage Master Plan FCD #99-41. Hydrology Report, September, 2002

FCDMC, 2003. Drainage Design Manual for Maricopa County, Arizona. Hydrology. November 2003.

FCDMC, 2006. Candidate Assessment Report for the Durango Regional Conveyance Channel. February, 2006

CANDIDATE ASSESSMENT REPORT SUNLAND CHANNEL Appendix A

Report Figures

Prepared for:



**FLOOD CONTROL DISTRICT OF
MARICOPA COUNTY
2801 WEST DURANGO STREET
PHOENIX, ARIZONA 85009**

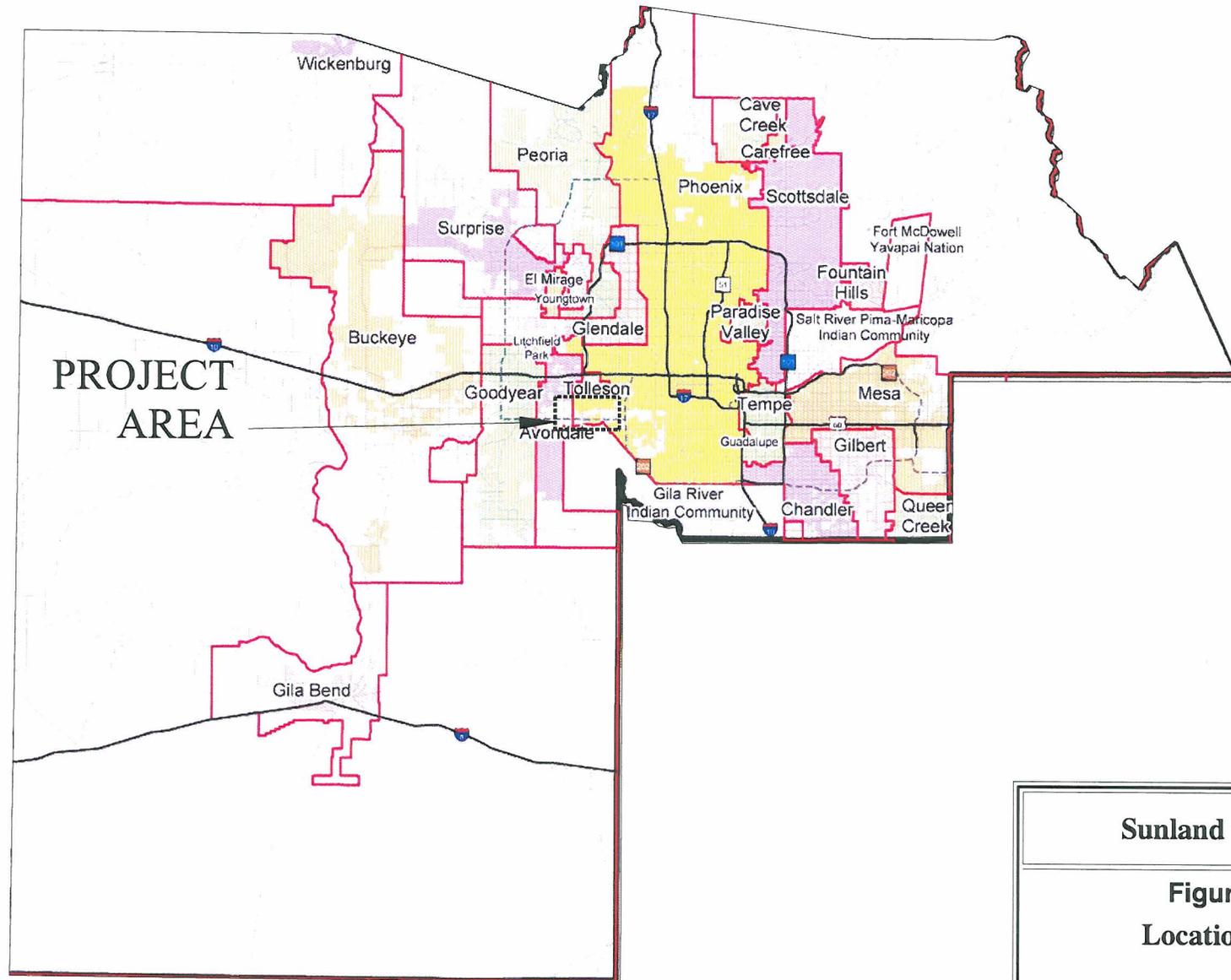
Contract FCD 2004C027

Prepared by:



**426 N. 44th Street, Suite 370
Phoenix, Arizona, 85008**

November 2006

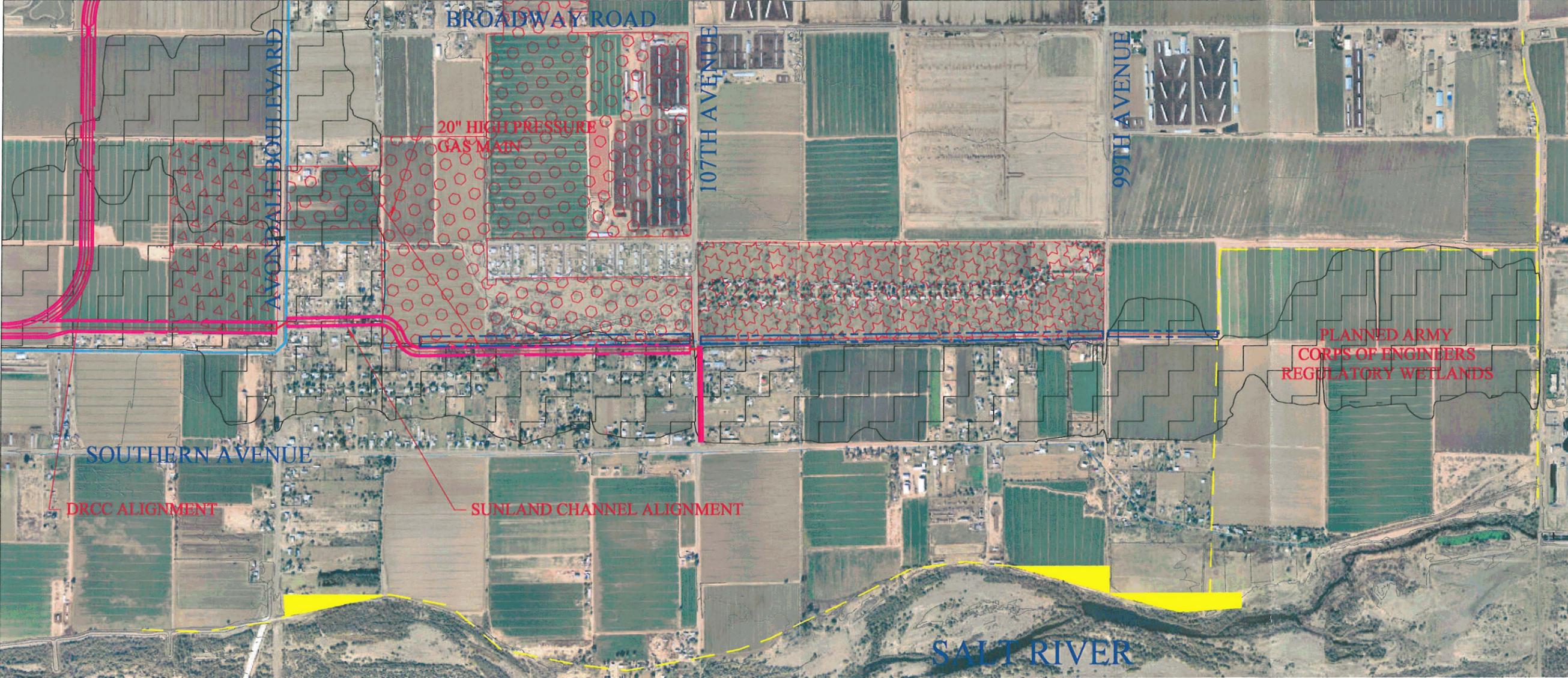


Sunland Channel

Figure 1.1
Location Map

Aspen
Consulting Engineers
A Division of Aspen Environmental Group

Candidate Assessment Report Sunland Channel DRCC/Sunland Channel Alignment



- ARMY CORPS OF ENGINEERS PROPOSED DRAINAGE
- PROPOSED SUNLAND CHANNEL ALIGNMENT
- VOITA DITCH
- BUCKEYE FEEDER CANAL
- DOS RIOS DEVELOPMENT
- EVERGREEN DEVELOPMENT
- "UNNAMED" DEVELOPMENT
- EXISTING FLOODPLAIN

SOURCE: CANDIDATE ASSESSMENT REPORT
DURANGO REGIONAL CONVEYANCE CHANNEL
PEPARED FOR THE FLOOD CONTROL DISTRICT
OF MARICOPA COUNTY

NOTES: 1. FLOODPLAIN SOURCE DIBBLE 2002.
2. AERIAL PHOTO WAS PROVIDED BY FCDMC.
THE FLIGHT DATE IS 11/2004.



FIGURE 1.2

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

FIGURE 1.2, DRCC/Sunland Channel Alignment, 11/06

Candidate Assessment Report Sunland Channel

Existing Conditions 100-Year Floodplain



 EXISTING BFC/SUNLAND 100-YEAR FLOODPLAIN
 (SALT/GILA FLOODPLAIN NOT SHOWN)
 VOITA DITCH
 BUCKEYE FEEDER CANAL

SOURCE: CANDIDATE ASSESSMENT REPORT
 DURANGO REGIONAL CONVEYANCE CHANNEL
 PREPARED FOR THE FLOOD CONTROL DISTRICT
 OF MARICOPA COUNTY

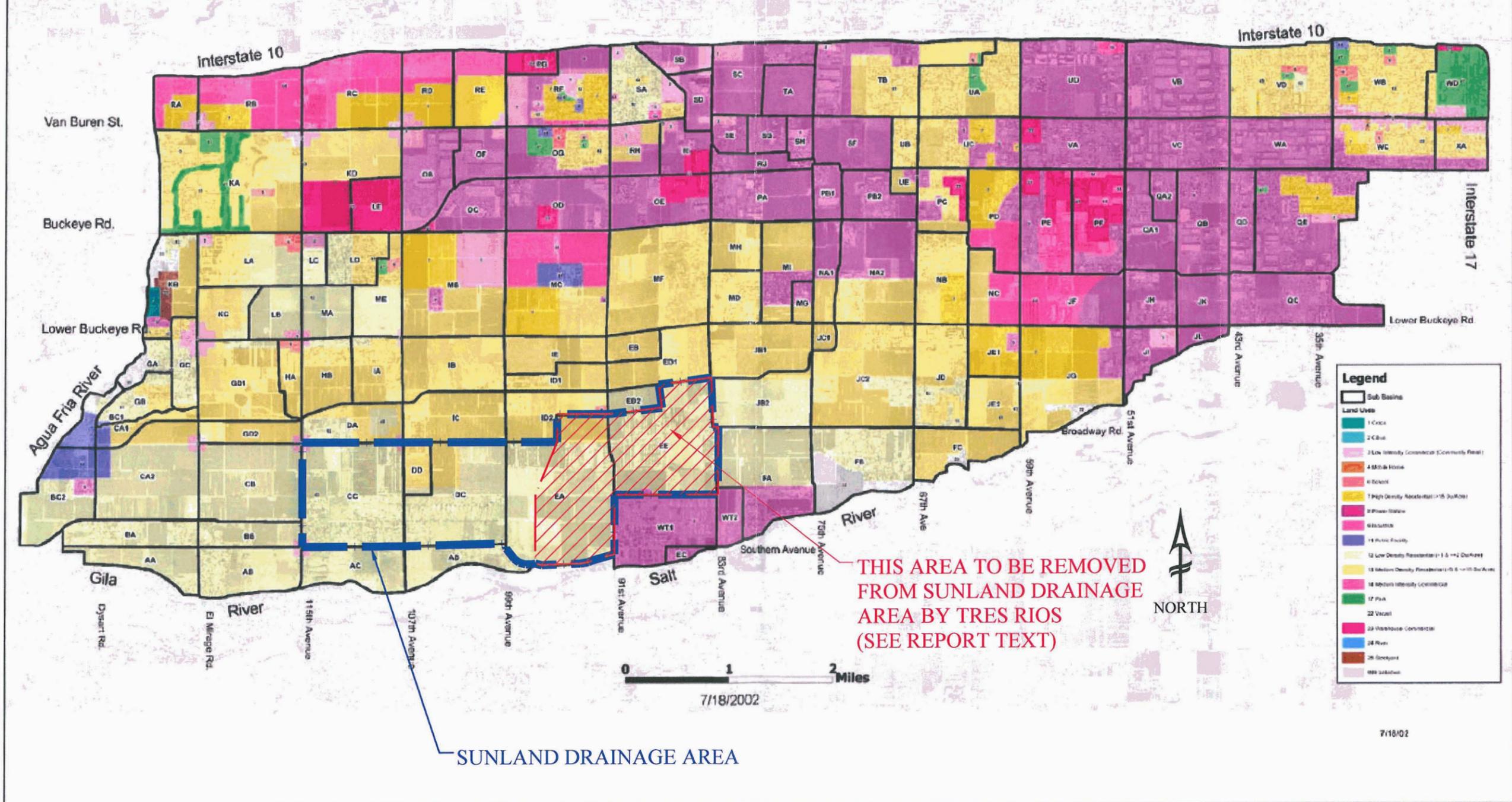
NOTES: 1. FLOODPLAIN SOURCE DIBBLE 2002.
 2. AERIAL PHOTO WAS PROVIDED BY FCDMC.
 THE FLIGHT DATE IS 11/2004.



FIGURE 1.3

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

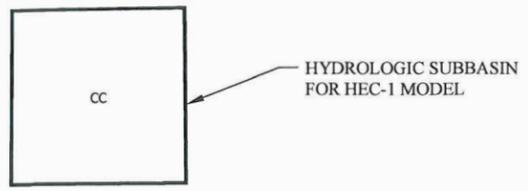
Subbasins and Future Land Use in the Durango Area Drainage Master Plan Area



- Legend**
- Sub Basins
 - Land Uses
 - 1 Creek
 - 2 Canal
 - 3 Low Intensity Commercial (Community Retail)
 - 4 Medium Density Residential
 - 5 School
 - 6 High Density Residential (>15 Dwellings)
 - 7 Office/Business
 - 8 Education
 - 9 Public Facility
 - 10 Low Density Residential (1-5 Dwellings)
 - 11 Medium Density Residential (6-10 Dwellings)
 - 12 Medium Density Residential (11-15 Dwellings)
 - 13 Medium Intensity Commercial
 - 14 Park
 - 15 Vacant
 - 16 Warehouse/Commercial
 - 17 River
 - 18 Backyard
 - 999 Unknown

THIS AREA TO BE REMOVED FROM SUNLAND DRAINAGE AREA BY TRES RIOS (SEE REPORT TEXT)

SUNLAND DRAINAGE AREA



DRCC DRAINAGE AREA AND FUTURE LANDUSE MAP

CANDIDATE ASSESSMENT REPORT
DURANGO REGIONAL CONVEYANCE CHANNEL
PREPARED FOR THE FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

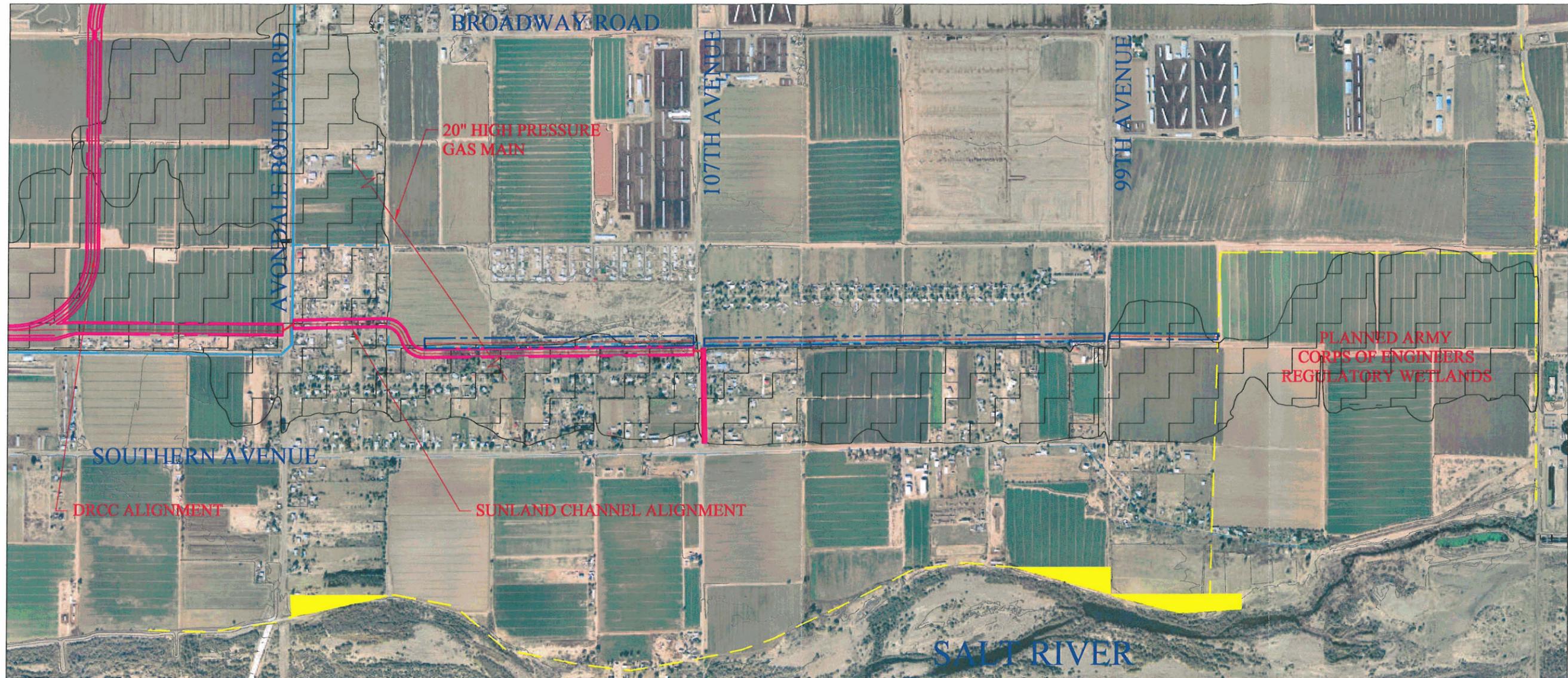
Aspen
Consulting Engineers
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FIGURE 2.1 PROJECT NO. P1005

BASE MAP SOURCE DIBBLE & ASSOCIATES (2002).

FIGURE 2.1. DRCC DRAINAGE AREA AND FUTURE LANDUSE MAP, 11/06

Candidate Assessment Report Sunland Channel Existing and Planned Facilities



- ARMY CORPS OF ENGINEERS PLANNED TRES RIOS CHANNEL
- PROPOSED SUNLAND CHANNEL ALIGNMENT
- VOITA DITCH
- BUCKEYE FEEDER CANAL
- ST. JOHN'S CANAL

SOURCE: CANDIDATE ASSESSMENT REPORT
DURANGO REGIONAL CONVEYANCE CHANNEL
PEPARED FOR THE FLOOD CONTROL DISTRICT
OF MARICOPA COUNTY

NOTES: 1. FLOODPLAIN SOURCE DIBBLE 2002.
2. AERIAL PHOTO WAS PROVIDED BY FCDMC.
THE FLIGHT DATE IS 11/2004.



FIGURE 2.2

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

FIGURE 2.2, Existing and Planned Facilities, 11/06

TYPICAL GROUND CROSS SECTION AT SUNLAND CHANNEL ALIGNMENT
BETWEEN 107TH AVENUE AND 99TH AVENUE

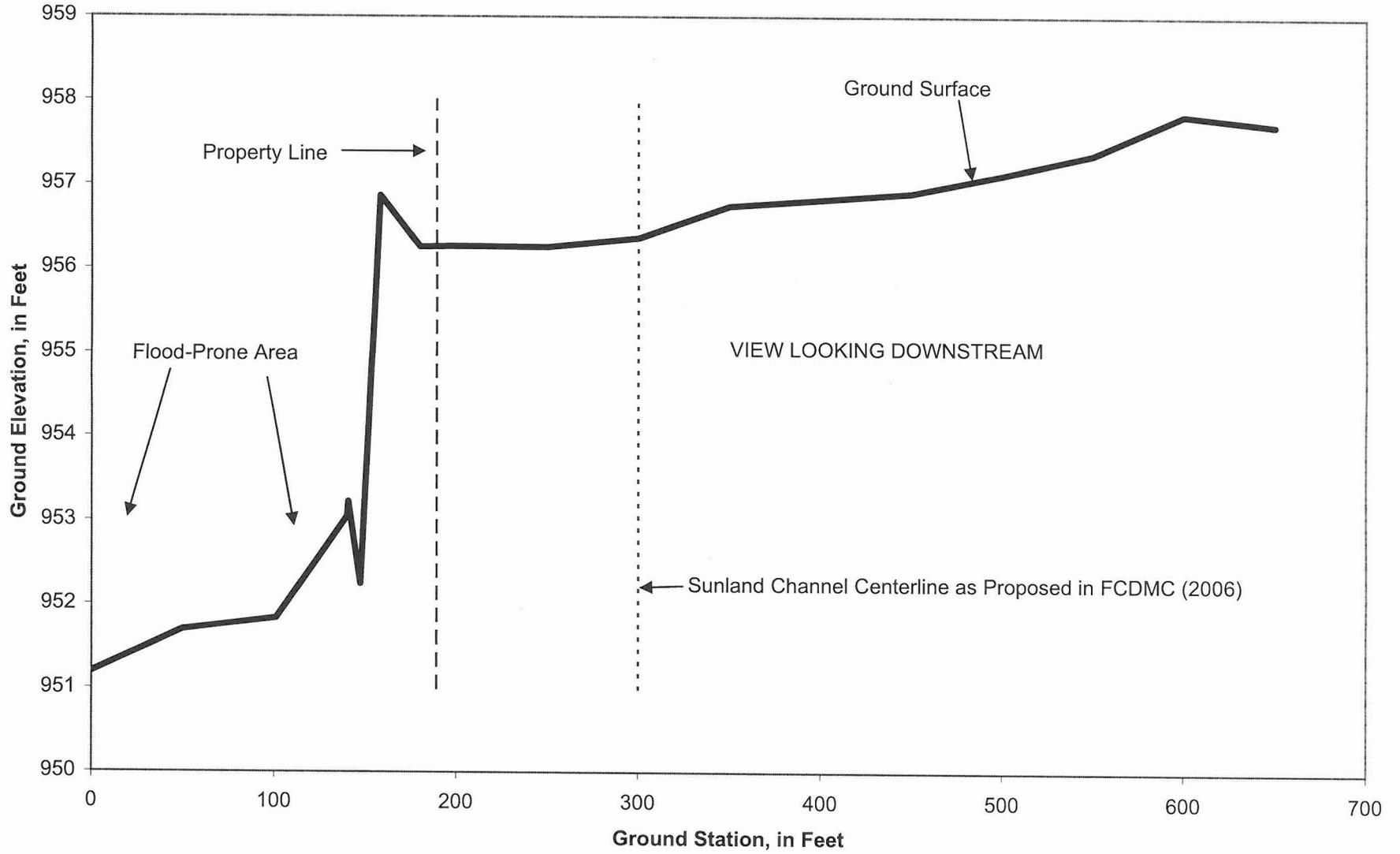


Figure 4.1

CANDIDATE ASSESSMENT REPORT SUNLAND CHANNEL Appendix D

Design Data and Cost Estimates for Alternatives

Prepared for:



**FLOOD CONTROL DISTRICT OF
MARICOPA COUNTY
2801 WEST DURANGO STREET
PHOENIX, ARIZONA 85009**

Contract FCD 2004C027

Prepared by:



426 N. 44th Street, Suite 370
Phoenix, Arizona, 85008

November 2006

DESIGN DATA AND COST ESTIMATE FOR SUNLAND CHANNEL ALTERNATIVE 1

COST BY CITY

AVONDALE COMPONENTS		COST
DRCC to 115th Avenue	\$	2,819,362
Sunland Avenue Culvert	\$	3,060,675
Sunland Avenue Culvert to 107th Avenue	\$	3,086,263
Avondale Subtotal	\$	8,966,300
Avondale Contingency 30%	\$	2,689,890
Avondale Total	\$	11,656,190

PHOENIX COMPONENTS

107th Avenue to Basin at 105th Avenue	\$	1,047,980
Basin at 105th Avenue	\$	1,619,495
Basin at 105th Avenue to 99th Avenue	\$	2,681,481
99th Avenue Collector	\$	469,415
Phoenix Subtotal	\$	5,818,371
Phoenix Contingency 30%	\$	1,745,511
Phoenix Total	\$	7,563,882

Project Total	\$	19,220,072
---------------	----	------------

Does not include modifications to the DRCC

COST BY ITEM

Right-of-Way	\$	6,960,000
Reinforced Concrete (Culverts and Spillway)	\$	3,401,196
Landscaping	\$	2,931,675
Excavation	\$	1,191,690
Maintenance Access Road	\$	255,110
Dry Wells	\$	45,000
Subtotal	\$	14,784,671
Contingency 30%	\$	4,435,401
Project Total	\$	19,220,072

DESIGN DATA AND COST ESTIMATE FOR SUNLAND CHANNEL ALTERNATIVE 1

COST ESTIMATE FOR SUNLAND CHANNEL FROM DRCC TO 115TH AVENUE

Channel Length	2849 Feet
Channel Discharge	1284 cfs
Channel Slope	0.0008 Feet/Foot
Channel Side Slopes	6 Feet/Foot
Channel Bottom Width	56 feet
Channel Roughness	0.04
Channel Flow Depth	5.5 Feet (From Master Plan)
Channel Freeboard	1.4 Feet (From FCD Standards)
Channel Total Depth	6.9 Feet
Channel excavation area	672.06 Cubic Feet
Channel Excavation Volume	70,915 Cubic Yards
Channel Wetted Perimeter	140 Feet
Channel Top Width	139 Feet
Channel Landscape Area	9.2 AC (Channel Only)
Channel Total Area	9.1 AC (Channel Only)
Maintenance ROW	25.0 Feet (Assumes 25 feet one side)
DRCC Total ROW Width	164 Feet
DRCC Total Area	10.7 AC (Includes maintenance ROW)
Culvert Total Head	5.5 Feet
Culvert Effective Head	3.1 Feet
Culvert Height	4.9 Feet
Culvert area required	151 Square Feet
Culvert width	31 Feet
Number barrels	3
Barrel width	11 Feet
Culvert Concrete Area	90 Square Feet
Culvert number	0
Culvert Length	0 Feet
Total Culvert Concrete	0 Cubic Yards

Channel depth increased by one foot to allow 6-foot culvert upstream.
 No maintenance right of way on south side.

ITEM	QUANTITY	UNIT	UNIT COST	COST
Channel Excavation Volume	70,915	CY	\$ 6	\$ 425,490
Channel Landscaping	9.7	AC	\$ 78,408	\$ 760,558
Channel Area*	10.7	AC	\$ 150,000	\$ 1,605,000
Culvert Concrete	0	CY	\$ 669	\$ -
Maintenance Road**	1.0	AC	\$ 28,314	\$ 28,314
Total Cost				\$ 2,819,362

* Includes 50-foot Right of Way outside of channel proper.

**Two roads, 16-feet wide decomposed granite.

DESIGN DATA AND COST ESTIMATE FOR SUNLAND CHANNEL ALTERNATIVE 1

COST ESTIMATE FOR SUNLAND AVENUE CULVERT

Culvert Discharge*	1095 cfs
Culvert slope	0.0022 Feet/Foot
Culvert depth	6 Feet
Number barrels	3
Barrel width	9.5 Feet
Culvert Concrete Area	89 Square Feet
Culvert number	1
Culvert Length	1388 Feet
Total Culvert Concrete	4575 Cubic Yards

*Taken as ratio of 115th and 107th discharges based on distance from 115th to culvert entrance.

Culvert design based on mannings using a slope of 0.0022.

Flow depth 4.7 feet, same as upstream channel.

Assume no right of way requirement because in Sunland Avenue.

Culvert roughness is 0.015.

ITEM	QUANTITY	UNIT	UNIT COST	COST
Culvert Concrete	4575	CY	\$ 669	\$ 3,060,675
Total Cost				\$ 3,060,675

DESIGN DATA AND COST ESTIMATE FOR SUNLAND CHANNEL ALTERNATIVE 1

COST ESTIMATE FOR SUNLAND CHANNEL FROM SUNLAND AVENUE TO 107TH AVENUE

Channel Length	3825 Feet
Channel Discharge*	925 cfs
Channel Slope	0.0022 Feet/Foot
Channel Side Slopes	6 Feet/Foot
Channel Bottom Width	25 Feet
Channel Roughness	0.04
Channel Flow Depth	4.7 Feet (From FCDMC 2006)
Channel Freeboard	1.2 Feet (From FCD Standards)
Channel Total Depth	5.9 Feet
Channel excavation area	356.36
Channel Excavation Volume	50,484 Cubic Yards
Channel Wetted Perimeter	97 Feet
Channel Top Width	96 Feet
Channel Landscape Area	8.5 AC (Channel Only)
Channel Total Area	9.7 AC (Channel Only)
Maintenance ROW	50.0 Feet (Assumes 25 feet one side)
DRCC Total ROW Width	146 Feet
DRCC Total Area	12.8 AC (Includes maintenance ROW)

*Discharge is average between 115th Avenue and 107th Avenue

ITEM	QUANTITY	UNIT	UNIT COST	COST
Channel Excavation Volume	50,484	CY	\$ 6	\$ 302,904
Channel Landscaping	10.0	AC	\$ 78,408	\$ 784,080
Channel Area*	12.8	AC	\$ 150,000	\$ 1,920,000
Maintenance Road**	2.8	AC	\$ 28,314	\$ 79,279
Total Cost				\$ 3,086,263

* Includes 50-foot Right of Way outside of channel proper.

**Two roads, 16-foot wide decomposed granite.

DESIGN DATA AND COST ESTIMATE FOR SUNLAND CHANNEL ALTERNATIVE 1

COST ESTIMATE FOR SUNLAND CHANNEL FROM 107TH AVENUE TO CULVERT AT 105TH AVENUE

Channel Length	1254 Feet
Channel Discharge	584 cfs
Channel Slope	0.0018 Feet/Foot
Channel Side Slopes	6 Feet/Foot
Channel Bottom Width	12 Feet
Channel Roughness	0.04
Channel Flow Depth	4.7 Feet (From FDCMC 2006)
Channel Freeboard	1.2 Feet (From FCD Standards)
Channel Total Depth	5.9 Feet
Channel excavation area	279.66
Channel Excavation Volume	12,989 Cubic Yards
Channel Wetted Perimeter	84 Feet
Channel Top Width	83 Feet
Channel Landscape Area	2.4 AC (Channel Only)
Channel Total Area	2.4 AC (Channel Only)
Maintenance ROW	50.0 Feet (Assumes 25 feet one side)
DRCC Total ROW Width	133 Feet
DRCC Total Area	3.8 AC (Includes maintenance ROW)

107TH AVE CULVERT DISCHARGE	584.0 cfs
Culvert Total Head	4.7 Feet
Culvert Effective Head	2.8 Feet
Culvert Height	3.9 Feet
Culvert area required	72 Square Feet
Culvert width	18 Feet
Number barrels	2
Barrel width	9 Feet
Culvert Concrete Area	54 Square Feet
Culvert number	1
Culvert Length	110 Feet
Total Culvert Concrete	220 Cubic Yards

ITEM	QUANTITY	UNIT	UNIT COST	COST
Channel Excavation Volume	12,989	CY	\$ 6	\$ 77,934
Channel Landscaping	2.9	AC	\$ 78,408	\$ 227,383
Channel Area*	3.8	AC	\$ 150,000	\$ 570,000
Culvert Concrete	220	CY	\$ 669	\$ 147,180
Maintenance Road**	0.9	AC	\$ 28,314	\$ 25,483
Total Cost				\$ 1,047,980

* Includes 50-foot Right of Way outside of channel proper.

**Two roads, 16-feet wide decomposed granite.

DESIGN DATA AND COST ESTIMATE FOR SUNLAND CHANNEL ALTERNATIVE 1

COST ESTIMATE FOR DETENTION BASIN AT 105TH AVENUE

SIDE-WEIR RETENTION BASIN
 DRAIN BY DRY WELLS
 BASIN VOLUME 10 ACRE FEET
 ASSUME 3-FOOT DEPTH
 6:1 SIDE SLOPES
 1 FOOT FREEBOARD
 BASIN AREA 3.9 ACRES
 USE 5.9 ACRES FOR LANDSCAPING AND PARK
 CONCRETE SPILLWAY 73 FEET BY 115 FEET, 6 INCHES THICK REINFORCED CONCRETE
 DRAIN BY DRY WELLS
 DIVERSION CULVERT IS 10 BY 4 AND 24 FEET LONG

EXCAVATION	22,503 CY	\$ 6.00	\$	135,018
Basin Landscaping	5.29 AC	\$ 78,408	\$	414,778
Parcel Area	5.90 AC	\$ 150,000	\$	885,000
MAINTENANCE ROAD	0.61 AC	\$ 28,314	\$	17,272
SPILLWAY	155 CY	\$ 669	\$	103,695
DRY WELL	3 EA	\$ 15,000	\$	45,000
DIVERSION CULVERT	28 CY	669	\$	18,732
TOTAL COST			\$	1,619,495

DESIGN DATA AND COST ESTIMATE FOR SUNLAND CHANNEL ALTERNATIVE 1

COST ESTIMATE FOR SUNLAND CHANNEL FROM 107TH AVENUE TO 99TH AVENUE

Channel Length	3764 Feet
Channel Discharge	517 cfs (Average of discharges between 105 basin and 99th)
Channel Slope	0.0018 Feet/Foot
Channel Side Slopes	6 Feet/Foot
Channel Bottom Width	11 Feet
Channel Roughness	0.04
Channel Flow Depth	4.5 Feet (From FDCMC 2006)
Channel Freeboard	1.2 Feet (From FCD Standards)
Channel Total Depth	5.7 Feet
Channel excavation area	257.64 Cubic Feet
Channel Excavation Volume	35,917 Cubic Yards
Channel Wetted Perimeter	80 Feet
Channel Top Width	79 Feet
Channel Landscape Area	6.9 AC (Channel Only)
Channel Total Area	6.8 AC (Channel Only)
Maintenance ROW	50.0 Feet (Assumes 25 feet one side)
DRCC Total ROW Width	129 Feet
DRCC Total Area	11.1 AC (Includes maintenance ROW)

99TH AVE CULVERT DISCH/	273.0 CFS
Culvert area required	29 Square Feet
Culvert width	7 Feet (Assumes 4-foot height)
Number barrels	1
Barrel width	7 Feet
Culvert Concrete Area	26 Square Feet
Culvert number	1
Culvert Length	110 Feet
Total Culvert Concrete, CY	106 Cubic Yards

ITEM	QUANTITY	UNIT	UNIT COST	COST
Channel Excavation Volume	35,917	CY	\$ 6	\$ 215,502
Channel Landscaping	8.3	AC	\$ 78,408	\$ 650,786
Channel Area*	11.1	AC	\$ 150,000	\$ 1,665,000
Culvert Concrete	106	CY	\$ 669	\$ 70,914
Maintenance Road**	2.8	AC	\$ 28,314	\$ 79,279
Total Cost				\$ 2,681,481

* Includes 50-foot Right of Way outside of channel proper.

**Two roads, 16-feet wide decomposed granite.

DESIGN DATA AND COST ESTIMATE FOR SUNLAND CHANNEL ALTERNATIVE 1

COST ESTIMATE FOR COLLECTOR CHANNEL ALONG 99TH AVENUE

Channel Length	1250 Feet
Channel Discharge	137 cfs (Average one half of discharge at 99th Avenue)
Channel Slope	0.0031 Feet/Foot
Channel Side Slopes	6 Feet/Foot
Channel Bottom Width	20 Feet
Channel Roughness	0.04
Channel Flow Depth	2.2 Feet (Average for depth of zero to 270 cfs)
Channel Freeboard	1.0 Feet (Minimum)
Channel Total Depth	3.2 Feet
Channel excavation area	125.44 Cubic Feet
Channel Excavation Volume, (5,807 Cubic Yards
Channel Wetted Perimeter	59 Feet
Channel Top Width	58 Feet
Channel Landscape Area, AC	1.7 AC (Channel Only)
Channel Total Area	1.7 AC (Channel Only)
Maintenance ROW, FT	16.0 Feet (Assumes 16 feet one side)
DRCC Total ROW Width	74 Feet
DRCC Total Area, AC	2.1 AC (Includes maintenance ROW)

ITEM	QUANTITY	UNIT	UNIT COST	COST
Channel Excavation Volume	5,807	CY	\$ 6	\$ 34,842
Channel Landscaping	1.2	AC	\$ 78,408	\$ 94,090
Channel Area*	2.1	AC	\$ 150,000	\$ 315,000
Maintenance Road**	0.9	AC	\$ 28,314	\$ 25,483
Total Cost				\$ 469,415

* Includes 50-foot Right of Way outside of channel proper.

**Two roads, 16-feet wide decomposed granite.

DESIGN DATA AND COST ESTIMATE FOR SUNLAND CHANNEL ALTERNATIVE 2

COST BY CITY	COST
AVONDALE COMPONENTS	
DRCC to 115th Avenue	\$ 2,077,577
Sunland Avenue Culvert	\$ 3,060,675
Sunland Avenue Culvert to 107th Avenue	\$ 2,621,532
Avondale Subtotal	\$ 7,759,784
Avondale Contingency 30%	\$ 2,327,935
Avondale Total	\$ 10,087,719
PHOENIX COMPONENTS	
107th Avenue to Basin at 105th Avenue	\$ 945,659
Basin at 105th Avenue	\$ 1,753,576
Basin at 105th Avenue to 99th Avenue	\$ 2,452,594
99th Avenue Collector	\$ 454,143
Phoenix Subtotal	\$ 5,605,972
Phoenix Contingency 30%	\$ 1,681,792
Phoenix Total	\$ 7,287,764
Project Total	\$ 17,375,483
Does not include modifications to the DRCC	

COST BY ITEM

Right-of-Way	\$ 4,575,000
Shotcrete	\$ 3,560,550
Reinforced Concrete (Culverts and Spillway)	\$ 3,339,648
Landscaping	\$ 820,149
Excavation	\$ 812,082
Maintenance Access Road	\$ 255,959
105th Avenue Basin Drain	\$ 2,368
Subtotal	\$ 13,365,756
Contingency 30%	\$ 4,009,727
Project Total	\$ 17,375,483

DESIGN DATA AND COST ESTIMATE FOR SUNLAND CHANNEL ALTERNATIVE 2

COST ESTIMATE FOR SUNLAND CHANNEL FROM DRCC TO 115TH AVENUE

Channel Length	2849 Feet
Channel Discharge	1284 cfs
Channel Slope	0.0008 Feet/Foot
Channel Side Slopes	1 Feet/Foot
Channel Bottom Width	50 Feet
Channel Roughness	0.028
Channel Flow Depth	5.5 Feet (From Master Plan)
Channel Freeboard	1.4 Feet (From FCD Standards)
Channel Total Depth	6.9 Feet
Channel excavation area	392.61 Cubic Feet
Channel Excavation Volume	41,428 Cubic Yards
Channel Wetted Perimeter	70 Feet
Channel Top Width	64 Feet
Channel Landscape Area	4.6 AC (Channel Channel Only)
Channel Total Area	4.2 AC (Channel Channel Only)
Maintenance ROW	25.0 Feet (Assumes 25 feet one side)
DRCC Total ROW Width	89 Feet
DRCC Total Area	5.8 AC (Includes maintenance ROW)
Culvert area required	120 Square Feet
Culvert width	24 Feet (Assumes height = channel depth minus 2 feet)
Number barrels	2
Barrel width	11 Feet
Culvert Concrete Area	62 Square Feet
Culvert number	0
Culvert Length	0 Feet
Total Culvert Concrete	0 Cubic Yards

Channel depth increased by one foot to allow 6-foot culvert upstream.
No maintenance right of way on south side.

ITEM	QUANTITY	UNIT	UNIT COST	COST
Channel Excavation Volume	41,428	CY	\$ 6	\$ 248,568
Landscaping	0.6	AC	\$ 78,408	\$ 47,045
Shotcrete	88,365	SF	\$ 10	\$ 883,650
Channel Area*	5.8	AC	\$ 150,000	\$ 870,000
Culvert Concrete	0	CY	\$ 669	\$ -
Maintenance Road**	1.0	AC	\$ 28,314	\$ 28,314
Total Cost				\$ 2,077,577

* Includes 50-foot Right of Way outside of channel proper.

**Two roads, 16-feet wide decomposed granite.

Shotcrete assume 3-foot key in at top plus toe down one half depth of flow each side.
Assume 4 inches thick.

DESIGN DATA AND COST ESTIMATE FOR SUNLAND CHANNEL ALTERNATIVE 2

COST ESTIMATE FOR SUNLAND AVENUE CULVERT

CULVERT DISCHARGE	1095 cfs	Taken as at 115th Avenue
Culvert slope	0.0022 Feet/Foot	
Culvert depth	6 Feet	From FCDMC 2006
Number barrels	3	From FCDMC 2006
Barrel width	9.5 Feet	From FCDMC 2006
Culvert Concrete Area	89 Square Feet	
Culvert number	1	
Culvert Length	1388 Feet	
Total Culvert Concrete, CY	4575 Cubic Yards	

Culvert design based on mannings using a slope of 0.0022.

Flow depth 4.7 feet, same as upstream channel.

Assume no right of way requirement because in Sunland Avenue.

ITEM	QUANTITY	UNIT	UNIT COST	COST
Culvert Concrete	4575	CY	\$ 669	\$ 3,060,675
Total Cost				\$ 3,060,675

DESIGN DATA AND COST ESTIMATE FOR SUNLAND CHANNEL ALTERNATIVE 2

COST ESTIMATE FOR SUNLAND CHANNEL FROM SUNLAND AVENUE TO 107TH AVENUE

Channel Length	3825 Feet
Channel Discharge*	925 cfs
Channel Slope	0.0022 Feet/Foot
Channel Side Slopes	1 Feet/Foot
Channel Bottom Width	28 Feet
Channel Roughness	0.028
Channel Flow Depth	4.7 Feet (From FCDMC 2006)
Channel Freeboard	1.3 Feet (From FCD Standards)
Channel Total Depth	6 Feet
Channel excavation area	204
Channel Excavation Volume	28,900 Cubic Yards
Channel Wetted Perimeter	45 Feet
Channel Top Width	40 Feet
Channel Landscape Area	4.0 AC (Channel Only)
Channel Total Area	4.8 AC (Channel Only)
Maintenance ROW	50.0 Feet (Assumes 25 feet one side)
DRCC Total ROW Width	90 Feet
DRCC Total Area	7.9 AC (Includes maintenance ROW)

*Discharge is average between 115th Avenue and 107th Avenue

ITEM	QUANTITY	UNIT	UNIT COST	COST
Channel Excavation Volume	28,900	CY	\$ 6	\$ 173,400
Channel Landscaping	1.6	AC	\$ 78,408	\$ 125,453
Shotcrete	105,840	SF	\$ 10	\$ 1,058,400
Channel Area*	7.9	AC	\$ 150,000	\$ 1,185,000
Maintenance Road**	2.8	AC	\$ 28,314	\$ 79,279
Total Cost				\$ 2,621,532

* Includes 50-foot Right of Way outside of channel proper.

**Two roads, 16-feet wide decomposed granite.

Shotcrete assume 3-foot key in at top plus toe down one half depth of flow each side.

DESIGN DATA AND COST ESTIMATE FOR SUNLAND CHANNEL ALTERNATIVE 2

COST ESTIMATE FOR SUNLAND CHANNEL FROM 107TH AVENUE TO BASIN AT 105TH AVENUE

Channel Length	1254 Feet
Channel Discharge	584 cfs
Channel Slope	0.0018 Feet/Foot
Channel Side Slopes	1 Feet/Foot
Channel Bottom Width	19 Feet
Channel Roughness	0.04
Channel Flow Depth	4.7 Feet (From FDCMC 2006)
Channel Freeboard	1.3 Feet (From FCD Standards)
Channel Total Depth	6 Feet
Channel excavation area	150
Channel Excavation Volume	6,967 Cubic Yards
Channel Wetted Perimeter	36 Feet
Channel Top Width	31 Feet
Channel Landscape Area	1.0 AC (Channel Channel Only)
Channel Total Area	0.9 AC (Channel Channel Only)
Maintenance ROW	50.0 Feet (Assumes 25 feet one side)
DRCC Total ROW Width	81 Feet
DRCC Total Area	2.3 AC (Includes maintenance ROW)

107TH AVE CULVERT DISCHARGE	584.0 cfs
Culvert Total Head	4.7 Feet
Culvert Effective Head	2.7 Feet
Culvert Height	4.0 Feet
Culvert area required	74 Square Feet
Culvert width	19 Feet
Number barrels	2
Barrel width	9 Feet
Culvert Concrete Area	54 Square Feet
Culvert number	1
Culvert Length	110 Feet
Total Culvert Concrete, CY	220 Cubic Yards

ITEM	QUANTITY	UNIT	UNIT COST	COST
Channel Excavation Volume	6,967	CY	\$ 6	\$ 41,802
Channel Landscaping	0.5	AC	\$ 78,408	\$ 39,204
Shotcrete	34,699	SF	\$ 10	\$ 346,990
Channel Area*	2.3	AC	\$ 150,000	\$ 345,000
Culvert Concrete	220	CY	\$ 669	\$ 147,180
Maintenance Road**	0.9	AC	\$ 28,314	\$ 25,483
Total Cost				\$ 945,659

* Includes 50-foot Right of Way outside of channel proper.

**Two roads, 16-foot wide decomposed granite.

Shotcrete assume 3-foot key in at top plus toe down one half depth of flow each side.

COST ESTIMATE FOR DETENTION BASIN AT 105TH AVENUE

SIDE-WEIR RETENTION BASIN
 DRAIN BY 24-INCH PIPE THROUGH WEIR SECTION
 BASIN VOLUME 10 ACRE FEET
 ASSUME 3-FOOT DEPTH
 6:1 SIDE SLOPES
 1 FOOT FREEBOARD
 BASIN AREA 4.4 ACRES Assumes 6 foot depth
 USE 6.6 ACRES FOR LANDSCAPING AND PARK
 CONCRETE SPILLWAY 90 FEET BY 38 FEET, 6 INCHES THICK REINFORCED CONCRETE
 DRAIN BY DRY WELLS
 DIVERSION CULVERT IS 9.5 BY 4 AND 24 FEET LONG

EXCAVATION	35,816 CY	\$ 6.00	\$	214,896
Basin Landscaping	5.96 AC	\$ 78,408	\$	467,312
Parcel Area	6.60 AC	\$ 150,000	\$	990,000
MAINTENANCE ROAD	0.64 AC	\$ 28,314	\$	18,121
SPILLWAY	63 CY	\$ 669	\$	42,147
24-Inch Pipe	16 LF	\$ 148	\$	2,368
DIVERSION CULVERT	28 CY	669	\$	18,732
TOTAL COST			\$	1,753,576

DESIGN DATA AND COST ESTIMATE FOR SUNLAND CHANNEL ALTERNATIVE 2

COST ESTIMATE FOR SUNLAND CHANNEL FROM 105TH BASIN TO 99TH AVENUE

Channel Length	3764 Feet
Channel Discharge	517 cfs (Average of discharges between 105 basin and 99th)
Channel Slope	0.0018 Feet/Foot
Channel Side Slopes	1 Feet/Foot
Channel Bottom Width	17 Feet
Channel Roughness	0.028
Channel Flow Depth	4.7 Feet (From FDCMC 2006)
Channel Freeboard	1.3 Feet (From FCD Standards)
Channel Total Depth	6 Feet
Channel excavation area	138 Cubic Feet
Channel Excavation Volume	19,238 Cubic Yards
Channel Wetted Perimeter	34 Feet
Channel Top Width	29 Feet
Channel Landscape Area	2.9 AC (Channel Channel Only)
Channel Total Area	2.5 AC (Channel Channel Only)
Maintenance ROW	50.0 Feet (Assumes 25 feet one side)
DRCC Total ROW Width	79 Feet
DRCC Total Area	6.8 AC (Includes maintenance ROW)

99TH AVE CULVERT DISCHARGE	273.0 CFS
Culvert area required	28 Square Feet
Culvert width	7 Feet (Assumes 4-foot height)
Number barrels	1
Barrel width	7 Feet
Culvert Concrete Area	26 Square Feet
Culvert number	1
Culvert Length	110 Feet
Total Culvert Concrete, CY	106 Cubic Yards

ITEM	QUANTITY	UNIT	UNIT COST	COST
Channel Excavation Volume	19,238	CY	\$ 6	\$ 115,428
Channel Landscaping	1.6	AC	\$ 78,408	\$ 125,453
Shotcrete	104,152	SF	\$ 10	\$ 1,041,520
Channel Area*	6.8	AC	\$ 150,000	\$ 1,020,000
Culvert Concrete	106	CY	\$ 669	\$ 70,914
Maintenance Road**	2.8	AC	\$ 28,314	\$ 79,279
Total Cost				\$ 2,452,594

* Includes 50-foot Right of Way outside of channel proper.

**Two roads, 16-feet wide decomposed granite.

Shotcrete assume 3-foot key in at top plus toe down one half depth of flow each side.

DESIGN DATA AND COST ESTIMATE FOR SUNLAND CHANNEL ALTERNATIVE 2

COST ESTIMATE FOR COLLECTOR CHANNEL ALONG 99TH AVENUE

Channel Length	1250 Feet
Channel Discharge	137 cfs (Average one half of discharge at 99th Avenue)
Channel Slope	0.0031 Feet/Foot
Channel Side Slopes	1 Feet/Foot
Channel Bottom Width	15 Feet
Channel Roughness	0.028
Channel Flow Depth	2.5 Feet (Average for depth of zero to 270 cfs)
Channel Freeboard	1.0 Feet (Minimum)
Channel Total Depth	3.5 Feet
Channel excavation area	64.75 Cubic Feet
Channel Excavation Volume, (2,998 Cubic Yards
Channel Wetted Perimeter	25 Feet
Channel Top Width	22 Feet
Channel Landscape Area, AC	0.7 AC (Channel Channel Only)
Channel Total Area	0.6 AC (Channel Channel Only)
Maintenance ROW, FT	16.0 Feet (Assumes 16 feet one side)
DRCC Total ROW Width	38 Feet
DRCC Total Area, AC	1.1 AC (Includes maintenance ROW)

ITEM	QUANTITY	UNIT	UNIT COST	COST
Channel Excavation Volume	2,998	CY	\$ 6	\$ 17,988
Shotcrete	22,999	SF	\$ 10	\$ 229,990
Channel Landscaping	0.2	AC	\$ 78,408	\$ 15,682
Channel Area*	1.1	AC	\$ 150,000	\$ 165,000
Maintenance Road**	0.9	AC	\$ 28,314	\$ 25,483
Total Cost				\$ 454,143

* Includes 50-foot Right of Way outside of channel proper.

**Two roads, 16-feet wide decomposed granite.

Shotcrete assume 3-foot key in at top plus toe down one half depth of flow each side.

DESIGN DATA AND COST ESTIMATE FOR SUNLAND CHANNEL ALTERNATIVE 3

COST BY CITY		COST
Avondale Cost	\$	3,049,037
Avondale Contingency 30%	\$	914,711
Avondale Total	\$	3,963,748
Phoenix Cost	\$	4,846,370
Phoenix Contingency 30%	\$	1,453,911
Phoenix Total	\$	6,300,281
Project Total	\$	10,264,029

COST BY ITEM

Right-of-Way	\$	4,755,000
Landscaping	\$	2,062,131
Excavation	\$	670,380
Maintenance Access Road	\$	152,896
Dry Wells	\$	255,000
Subtotal	\$	7,895,407
Contingency 30%	\$	2,368,622
Project Total	\$	10,264,029

DESIGN DATA AND COST ESTIMATE FOR SUNLAND CHANNEL ALTERNATIVE 3

COST ESTIMATE FOR LINEAR RETENTION FROM SUNLAND AVENUE TO 107TH AVENUE

Retention Length	3388 Feet
Retention Volume	20.00 Acre Feet
Retention Side Slopes	6 Feet/Foot
Retention Bottom Width	67 Feet
Retention Ponding Depth	3 Feet
Retention Freeboard	1.0 Feet
Retention Total Depth	4 Feet
Retention excavation area	364 Square Feet
Retention Excavation Volume	45,913 Cubic Yards
Retention Wetted Perimeter	116 Feet
Retention Top Width	115 Feet
Retention Total Area	8.9 AC
Maintenance ROW	40.0 Feet (Assumes 20 feet each side)
Total ROW Width	155 Feet
Total Area	12.1 AC (Includes maintenance ROW)

ITEM	QUANTITY	UNIT	UNIT COST	COST
Retention Excavation Volume	45,913	CY	\$ 6	\$ 275,478
Landscaping	10.2	AC	\$ 78,408	\$ 799,762
Right of Way*	12.1	AC	\$ 150,000	\$ 1,815,000
Maintenance Road**	1.9	AC	\$ 28,314	\$ 53,797
Dry Wells	7.0	EA	\$ 15,000	\$ 105,000
Total Cost				\$ 3,049,037

* Includes 40-foot Right of Way for maintenance.

**Two roads, 12-foot wide decomposed granite.

Dry wells are sufficient to drain the basins in 72 hours at 0.5 cfs.

DESIGN DATA AND COST ESTIMATE FOR SUNLAND CHANNEL ALTERNATIVE 3

COST ESTIMATE FOR LINEAR RETENTION FROM SUNLAND AVENUE TO 107TH AVENUE

Retention Length	6423 Feet
Retention Volume	28.00 Acre Feet
Retention Side Slopes	6 Feet/Foot
Retention Bottom Width	45 Feet
Retention Ponding Depth	3 Feet
Retention Freeboard	1.0 Feet
Retention Total Depth	4 Feet
Retention excavation area	276 Square Feet
Retention Excavation Volume	65,817 Cubic Yards
Retention Wetted Perimeter	94 Feet
Retention Top Width	93 Feet
Retention Total Area	13.7 AC
Maintenance ROW	40.0 Feet (Assumes 20 feet each side)
Total ROW Width	133 Feet
Total Area	19.6 AC (Includes maintenance ROW)

ITEM	QUANTITY	UNIT	UNIT COST	COST
Retention Excavation Volume	65,817	CY	\$ 6	\$ 394,902
Landscaping	16.1	AC	\$ 78,408	\$ 1,262,369
Right of Way*	19.6	AC	\$ 150,000	\$ 2,940,000
Maintenance Road**	3.5	AC	\$ 28,314	\$ 99,099
Dry Wells	10.0	EA	\$ 15,000	\$ 150,000
Total Cost				\$ 4,846,370

* Includes 40-foot Right of Way for maintenance.

**Two roads, 12-foot wide decomposed granite.

dry wells are sufficient to drain the basins in 72 hours at 0.5 cfs.

DESIGN DATA AND COST ESTIMATE FOR SUNLAND CHANNEL ALTERNATIVE 4

FLOOD PROOFING

COST BY CITY

Phoenix	\$	1,219,265
105 BASIN	\$	2,344,691
Phoenix Subtotal	\$	3,563,956
Phoenix Contingency	\$	1,069,187
Phoenix Total	\$	4,633,143
Avondale	\$	3,487,665
Avondale Contingency	\$	1,046,300
Avondale Total	\$	4,533,965
Project Total	\$	9,167,108

DESIGN DATA AND COST ESTIMATE FOR SUNLAND CHANNEL ALTERNATIVE 4

FLOOD PROOFING

HOUSES	AVGERAGE PERIMETER (FT)	COST (\$/LF)	TOTAL
PHOENIX 43	265	\$ 107	\$ 1,219,265
AVONDALE 123	265	\$ 107	\$ 3,487,665
Total Cost			\$ 4,706,930

COST ESTIMATE FOR DETENTION BASIN AT 105TH AVENUE

SIDE-WEIR RETENTION BASIN

DRAIN BY DRY WELLS

BASIN VOLUME 10 ACRE FEET

ASSUME 3-FOOT DEPTH

6:1 SIDE SLOPES

1 FOOT FREEBOARD

BASIN AREA 3.9 ACRES

USE 5.9 ACRES FOR LANDSCAPING AND PARK

CONCRETE SPILLWAY 57 FEET BY 1200 FEET, 6 INCHES THICK REINFORCED CONCRETE

DRAIN BY DRY WELLS

EXCAVATION	22,503 CY	\$ 6.00	\$	135,018
Basin Landscaping	5.29 AC	\$ 78,408	\$	414,778
Parcel Area	5.90 AC	\$ 150,000	\$	885,000
MAINTENANCE ROAD	0.61 AC	\$ 28,314	\$	17,272
SPILLWAY	1,267 CY	\$ 669	\$	847,623
DRY WELL	3 EA	\$ 15,000	\$	45,000
TOTAL COST			\$	2,344,691

CANDIDATE ASSESSMENT REPORT SUNLAND CHANNEL Appendix B

Comparison to Previous DRCC CAR Hydrology

Prepared for:



**FLOOD CONTROL DISTRICT OF
MARICOPA COUNTY
2801 WEST DURANGO STREET
PHOENIX, ARIZONA 85009**

Contract FCD 2004C027

Prepared by:



**426 N. 44th Street, Suite 370
Phoenix, Arizona, 85008**

November 2006

**SUNLAND CHANNEL CANDIDATE ASSESSMENT REPORT
SUMMARY OF MODIFICATIONS TO SUNLAND HEC-1 MODELS
CURRENT REVISED MODELS COMPARED TO DRCC CAR MODELS
ASPEN CONSULTING ENGINEERS
October 24, 2006**

EXISTING CONDITIONS MODELS

Basic modifications to the existing conditions HEC-1 model, from the DRCC CAR model to the current revised model, are as follows:

- Land use and watershed parameters were reevaluated and modified as necessary for all subbasins based on an independent assessment by Aspen. Subbasin DC has a new medium-density development in it. This development, with 100-year, 2-hour retention, was included in the model. Most of the existing low-density development in Subbasins CC and DC appears on the ground as almost agricultural in watershed characteristics. The weighted watershed roughness value reflected this condition. Specifically, the Kn input was as follows:

DRCC CAR Existing Conditions Model: Subbasin CC Kn =0.084, Subbasin DC Kn =0.095.
Revised Existing Conditions Model: Subbasin CC Kn =0.091, Subbasin DC Kn =0.080.

- Routings from Subbasin EE to DRCC were modified based on Aspen assessment of 2-foot topography. Previous (DRCC CAR) routings were based on a street section with adjacent agriculture and the routing cross sections were not specific to the routed reaches. Revised routing cross sections are specific to and representative of each routed reach. 2-foot topography shows that flow will go overland in a wide flat swale mostly north of Southern Avenue, not down streets.
- Flows from Subbasin DD were assumed to flow down 107th Avenue to combine with upstream flows at 107th Avenue, rather than crossing west across Subbasin CC to combine at 115th Avenue.
- Subbasin EE basin area was corrected. The DRCC CAR HEC-1 had an incorrect value for the area of this subbasin.
- Flow combinations at 115th Avenue were modified to identify Sunland Avenue flows at 115th Avenue prior to combining them with Buckeye Feeder Canal flows at the same location. The DRCC CAR model combined all at once, making it impossible to determine how much flow came from Sunland at that concentration point. This had no effect on discharges, but provided additional information that could be used to compare with the future conditions models.
- Tres Rios was assumed to be in place in a separate existing-conditions model. This resulted in the elimination of Subbasin EE, and reduction in area of Subbasin EA.

Tables 1 and 2 below list specific modifications made to the existing conditions model.

**TABLE 1
COMPARISON OF DRCC CAR HEC-1 MODEL FOR EXISTING CONDITIONS WITH ASPEN CURRENT REVISED HEC-1 MODEL FOR EXISTING CONDITIONS
CHANGES MADE TO SUNLAND DRAINAGE AREA ONLY**

ITEM	DRCC CAR MODEL	CURRENT REVISED MODEL	COMMENTS
Subbasin EE	Basin Area =1.465 Square Miles	Basin Area =0.958 Square Miles	0.958 is correct.
Subbasin EE	LG Record: LG 0.35 0.25 5.00 0.34 19	LG Record: LG 0.50 0.25 4.90 0.44 0	Revised based on Aspen assessment of land use. This subbasin is agricultural.
Subbasin EE	S Graph: L= 1.6 Lca=1.0 S=16.0 Kn=.076 LAG=78.2	S Graph: L=1.8 Lca=1.1 S= 20.7 Kn=.076 LAG= 79.8	Revised based on Aspen assessment of land use. This subbasin is agricultural.
All routings: Subbasin EE to DRCC Confluence	Based on street section with adjacent agriculture. Cross section not specific to routed reach.	Based on 2-foot topography. Cross section specific to and representative of routed reach. No street sections.	Topography shows flow will not go down streets but overland in a wide flat swale mostly north of Southern Avenue.
Subbasin EA	LG Record: LG 0.50 0.25 5.30 0.34 0	LG Record: LG 0.50 0.25 5.30 0.37 0	Revised based on Aspen assessment of land use. This subbasin is agricultural.
Subbasin EA	S Graph: L=1.5 Lca=.8 S= 21.3 Kn=.098 LAG= 86.9	S Graph: L=1.5 Lca=.8 S=21.3 Kn= .098 LAG= 84.6	Revised based on Aspen assessment of land use. This subbasin is agricultural.
Subbasin DC	LG Record: LG 0.48 0.25 6.00 0.27 1	LG Record: LG 0.40 0.24 6.00 0.26 10.5	Revised based on Aspen assessment of land use. This subbasin is partly agricultural and partly developed. New development in this subbasin.
Subbasin DC	S Graph: L= 1.4 Lca=.4 S= 22.1 Kn=.095 LAG=63.7	S Graph: L= 1.6 Lca= .8 S= 22.1 Kn=.08 LAG= 70.3	Revised based on Aspen assessment of land use. This subbasin is partly agricultural and partly developed. New development in this subbasin.
Subbasin DC	No development retention.	Added 20.7 acre feet retention for existing (new) development	New development in this subbasin.
Subbasin DD	LG Record: LG 0.50 0.25 4.65 0.43 0	LG Record: LG 0.50 0.25 4.7 0.50 0	Revised based on Aspen assessment of land use. This subbasin is considered agricultural.
Subbasin DD	S Graph: L= .5 Lca= .3 S= 28.3 Kn=.100 LAG= 36.4	S Graph: L= .5 Lca=.3 S= 23.9 Kn=.100 LAG= 38.3	Revised based on Aspen assessment of land use. This subbasin is considered agricultural.
Subbasin DD Routed Flows	Routed across Subbasin CC to combine with Subbasin CC flows at 115 th Avenue.	Routed down 107 th Avenue to combine with Subbasin DC flows at 107 th Avenue.	Revised based on Aspen interpretation of 2-foot topography.
Subbasin CC	LG Record: LG 0.38 0.24 6.20 0.21 6	LG Record: LG 0.46 0.24 6.20 0.21 6	Revised based on Aspen assessment of land use. This subbasin is partly agricultural and partly developed.
Subbasin CC	S Graph: L= 1.4 Lca= .7 S= 22.8 Kn=.084 LAG=56.3	S Graph: L=1.4 Lca= .7 S= 22.8 Kn=.091 LAG= 71.8	Revised based on Aspen assessment of land use. This subbasin is partly agricultural and partly developed.
Sunland Flow Combination at 115 th Avenue	Subbasin CC flows first combined with flows from Buckeye Feeder Canal (HC 2), then combined with routed flows from Subbasin DD and from Subbasins EE, EA, and DC (HC 3)	Subbasin CC flows first combined with routed flows from Subbasins EE, EA, DC, and DD (HC 2), then with Buckeye Feeder Canal flows (HC 2)	This has no effect on discharges but gives an estimate of Sunland flows at 115 th Avenue prior to combining with Buckeye Feeder Canal flows. The purpose for this modification is for comparison purposes with future condition models which have the DRCC in place.
Subbasin DA	LG Record: LG 0.39 0.17 6.80 0.18 6	LG Record: LG 0.43 0.17 6.9 0.17 1.8	Revised based on Aspen assessment of land use.
Subbasin DA	S Graph: L= 1.0 Lca= .6 S=17.6 Kn=.076 LAG=51.6	S Graph: L= 1.0 Lca=.6 S=17.6 Kn=.076 LAG= 52.3	Revised based on Aspen assessment of land use.
Subbasin CB	S Graph: L= 1.2 Lca= .5 S=11.1 Kn=.097 LAG= 71.6	S Graph: L=1.2 Lca=.6 S= 10.9 Kn=.097 LAG= 71.6	Revised based on Aspen assessment of land use.

ITEM	DRCC CAR MODEL	CURRENT REVISED MODEL WITH TRES RIOS	COMMENTS
Subbasin EE and Return Divert from Upstream	Modeled as in place and part of the Sunland drainage area.	Not in the model.	All of Subbasin EE will be directed to the Gila River by Tres Rios.
Subbasin EA	Basin Area =1.321 square miles	Basin Area =0.357 square miles	Most of Subbasin EA will be directed to the Gila River by Tres Rios.
Subbasins DC, DD, CC, CB, and DA with routings	Same as described in Table 1	Same as described in Table 1	Same as described in Table 1

FUTURE CONDITIONS MODELS

For purposes of this discussion, future conditions consists of 1) full watershed development with 100-year, 2-hour retention for all new development; 2) Sunland Channel in place as described in the DRCC CAR; and, 3) Tres Rios in place. Basic modifications to the future conditions model, from the DRCC CAR model to the current revised model, are as follows:

- Land use and watershed parameters were reevaluated and modified as necessary for all subbasins based on an independent assessment by Aspen. This included weighting watershed basin (roughness) values and impervious areas based on existing versus anticipated development. Anticipated development was assumed to be medium-density development in the revised model, as opposed to low-density development in the DRCC CAR model. Retention values were adjusted accordingly. As with the existing-conditions model, most of the existing low-density development in Subbasins CC and DC appears on the ground as almost agricultural in watershed characteristics. The weighted watershed roughness value reflected this condition. Specifically, the Kn input was as follows:

DRCC CAR Proposed Conditions Model: Subbasin CC Kn =0.050, Subbasin DC Kn =0.050.

Revised Existing Conditions Model: Subbasin CC Kn =0.059, Subbasin DC Kn =0.055.

The future conditions models assumed a valley S-graph rather than an agricultural S-graph as was assumed for the existing conditions models (this was done in the DRCC CAR as well as revised models).

- Flows from Subbasin DD were assumed to flow down 107th Avenue to combine with upstream flows at 107th Avenue, rather than crossing west across Subbasin CC to combine at 115th Avenue.
- Tres Rios was assumed to be in place in the revised model. This resulted in the elimination of Subbasin EE, and reduction in area of Subbasin EA.
- 100-year, 2-hour retention was assumed for all new development in the revised model. The DRCC CAR future conditions model assumed first flush retention for development adjacent to the channel, and 100-year, 2-hour retention for all other development.

Table 4 shows the results of the analysis. The results show that proposed development will increase discharges at 107th Avenue and at 115th Avenue, by approximately 30% to 100%, even though 100-year, 24-hour retention is incorporated.

TABLE 3
COMPARISON OF DRCC CAR HEC-1 MODEL FOR FUTURE DEVELOPED CONDITIONS WITH ASPEN CURRENT REVISED HEC-1 MODEL
FOR FUTURE DEVELOPED CONDITIONS
CHANGES MADE TO SUNLAND DRAINAGE AREA ONLY
BASELINE FUTURE CONDITIONS MODEL: ASSUMES TRES RIOS IS IN PLACE AND SUNLAND CHANNEL IN PLACE AS DESCRIBED IN
THE DRCC CAR

ITEM	DRCC CAR MODEL	CURRENT REVISED MODEL	COMMENTS
Subbasin EE and Return Divert from Upstream	Modeled as in place and part of the Sunland drainage area.	Not in the model.	All of Subbasin EE will be directed to the Gila River by Tres Rios.
Subbasin EA	Basin Area =1.321 square miles	Basin Area =0.357 square miles.	Most of Subbasin EA will be directed to the Gila River by Tres Rios. Development retention volume reduced proportionally.
Subbasin EA	LG Record: LG 0.29 0.25 5.30 0.34 16	LG Record: LG 0.25 0.25 5.30 0.29 30	DRCC CAR model assumed low-density residential development. The current revised model assumes medium density development.
Subbasin DC	LG Record: LG 0.29 0.25 6.00 0.27 16	LG Record: LG 0.28 0.24 6.00 0.22 25	Revised based on Aspen assessment of land use. This subbasin will be partly developed by medium-density development. The remainder is existing light-density development that appears to be almost agricultural in watershed characteristics.
Subbasin DC	S Graph: L= 1.4 Lca=.4 S= 22.1 Kn=.05 LAG= 33.5	S Graph: L= 1.6 Lca=.8 S= 22.1 Kn=.055 LAG= 48.3	Revised based on Aspen assessment of watershed characteristics and land use. This subbasin will be partly developed by medium-density development. The remainder is existing light-density development that appears to be almost agricultural in watershed characteristics.
Subbasin DC	Development retention 25.9 acre feet.	Development retention 54.2 acre feet.	DRCC CAR model assumed first flush retention adjacent to the channel. The revised model assumes 100-year, 2-hour retention in all new development.
Subbasin DD	LG Record: LG 0.25 0.25 4.65 0.43 30	LG Record: LG 0.25 0.25 4.70 0.40 30	Revised based on Aspen assessment of watershed characteristics and land use.
Subbasin DD Routed Flows	Routed across Subbasin CC to combine with Subbasin CC flows at 115 th Avenue.	Routed down 107 th Avenue to combine with Subbasin DC flows at 107 th Avenue.	Revised based on Aspen interpretation of 2-foot topography.
Subbasin CC	LG Record: LG 0.30 0.24 6.20 0.21 15	LG Record: LG 0.27 0.25 6.00 0.20 24	Revised based on Aspen assessment of watershed characteristics and land use. This subbasin will be partly developed by medium-density development. The remainder is existing light-density development, some of which appears to be almost agricultural in watershed characteristics.
Subbasin CC	S Graph: L= 1.4 Lca=.7 S= 22.8 Kn=.05 LAG= 38.6	S Graph: L= 1.4 Lca=.7 S= 22.8 Kn=.059 LAG= 46.5	Revised based on Aspen assessment of watershed characteristics and land use. This subbasin will be partly developed by medium-density development. The remainder is existing light-density development, some of which appears to be almost agricultural in watershed characteristics.
Subbasin CC	Development retention 34.2 acre feet.	Development retention 50.7 acre feet.	DRCC CAR model assumed first flush retention adjacent to the channel. The revised model assumes 100-year, 2-hour retention in all new development.

TABLE 4. SUNLAND CHANNEL DISCHARGE SUMMARY

HEC-1 MODEL	DISCHARGE, IN CUBIC FEET PER SECOND (CFS) AT FLOW CONCENTRATION POINT				
	DRCC CONFLUENCE	115TH AVE (Downstream) ^a	115TH AVE (Upstream) ^b	107TH AVE	99TH AVE
EXISTING DRAINAGE AREA CONDITIONS					
DRCC CAR (FCDMC, 2006)	1,570	1,731	ND	1,058	1,243
Current Study (Revised from FCDMC, 2006)	1,360	1,389	639	588	550
Current Study with Tres Rios Reduction	1,193	1,218	639	584	176
FUTURE DRAINAGE AREA CONDITIONS					
DRCC CAR	1,677	1,207	1,207	919	478
Current Study (Revised from DRCC CAR)	1,275	1,284	1,284	762	273
ND = No discharge computed at this location. ^a Includes BFC Flows. ^b Does not include BFC Flows.					

**CANDIDATE ASSESSMENT REPORT
SUNLAND CHANNEL
Appendix C**

**Sunland Channel Candidate Assessment
Report
(On Computer Disk)**

Prepared for:



**FLOOD CONTROL DISTRICT OF
MARICOPA COUNTY
2801 WEST DURANGO STREET
PHOENIX, ARIZONA 85009**

Contract FCD 2004C027

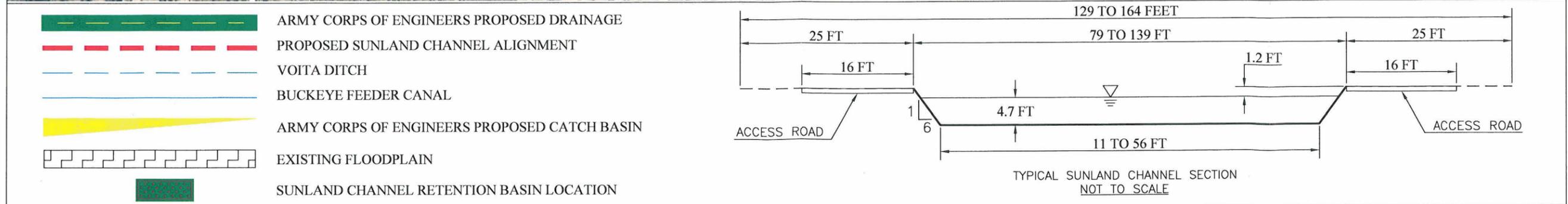
Prepared by:



**426 N. 44th Street, Suite 370
Phoenix, Arizona, 85008**

November 2006

SUNLAND CHANNEL FLOOD CONTROL ALTERNATIVE 1 - CHANNEL AS PROPOSED IN DRCC CAR WITH MODIFICATIONS



-  ARMY CORPS OF ENGINEERS PROPOSED DRAINAGE
-  PROPOSED SUNLAND CHANNEL ALIGNMENT
-  VOITA DITCH
-  BUCKEYE FEEDER CANAL
-  ARMY CORPS OF ENGINEERS PROPOSED CATCH BASIN
-  EXISTING FLOODPLAIN
-  SUNLAND CHANNEL RETENTION BASIN LOCATION

PREPARED BY JCS
Aspen
Consulting Engineers

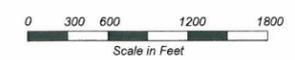
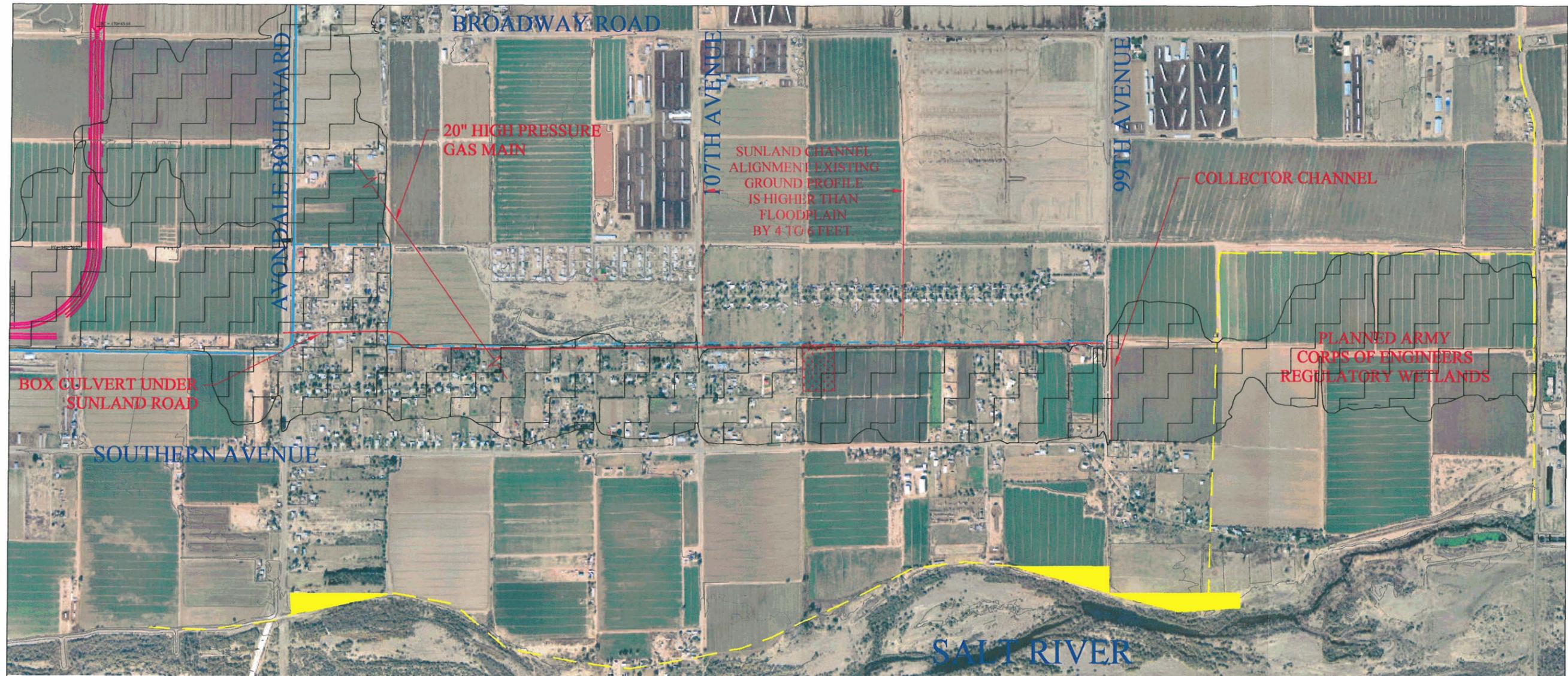


FIGURE 4.2

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

FIGURE 4.2, ALTERNATIVE 1 - CHANNEL AS PROPOSED IN DRCC CAR WITH MODIFICATIONS, 11/06

SUNLAND CHANNEL FLOOD CONTROL ALTERNATIVE 2 - SMALLER LINED CHANNEL SOUTH OF EAST/WEST PROPERTY LINE



- ARMY CORPS OF ENGINEERS PROPOSED DRAINAGE
- SMALLER LINED CHANNEL ALIGNMENT
- VOITA DITCH
- BUCKEYE FEEDER CANAL
- ARMY CORPS OF ENGINEERS PROPOSED CATCH BASIN
- EXISTING FLOODPLAIN
- SUNLAND CHANNEL RETENTION BASIN LOCATION

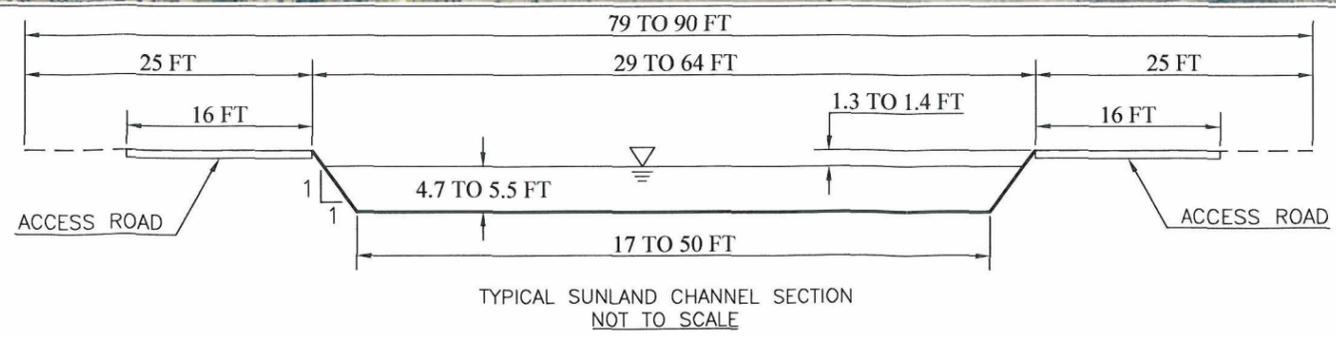
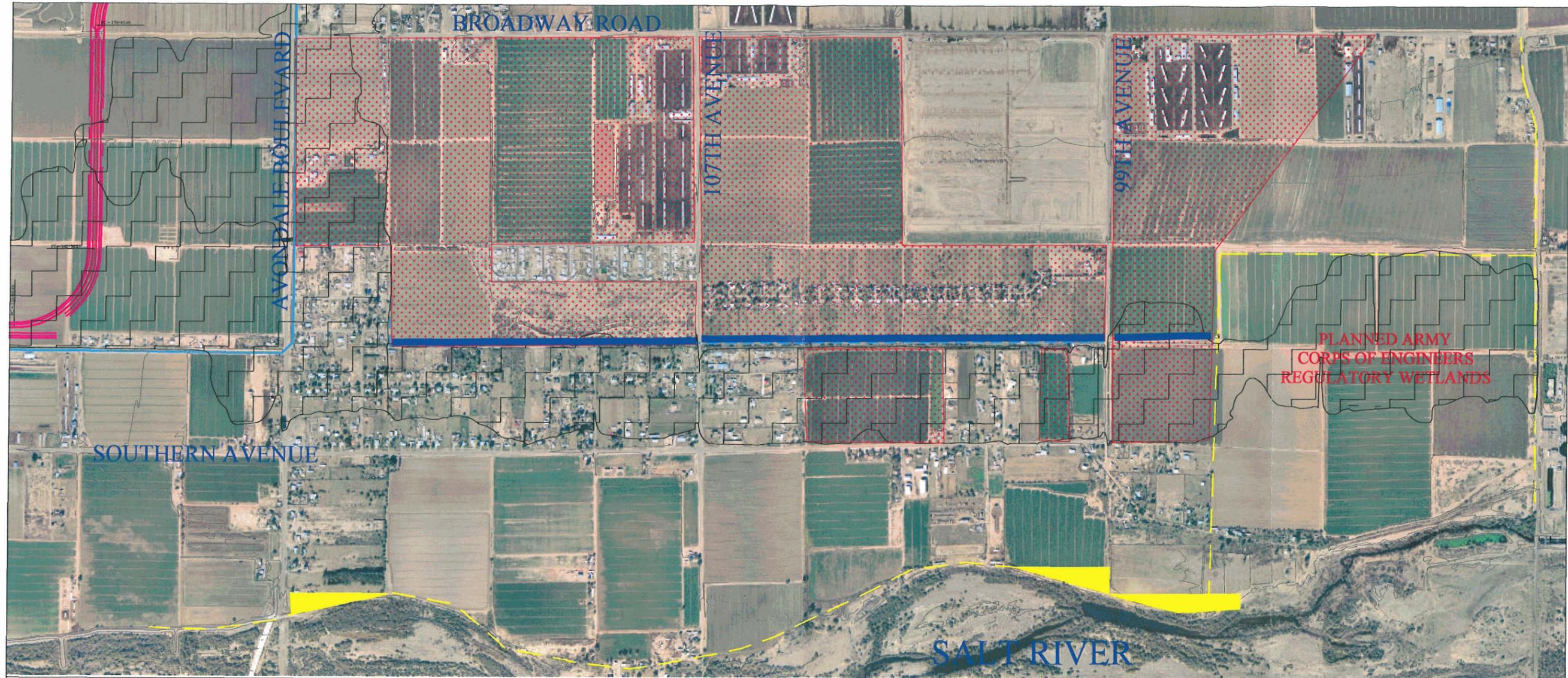


FIGURE 4.3

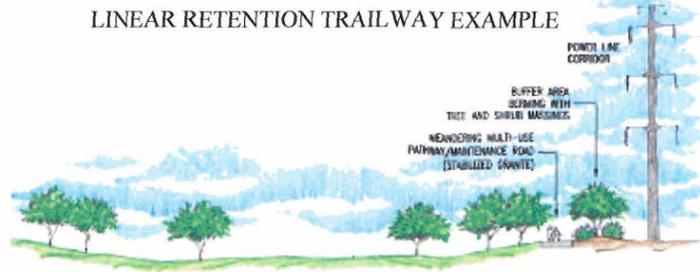
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

FIGURE 4.3, ALTERNATIVE 2 - SMALLER LINED CHANNEL SOUTH OF EAST/WEST PROPERTY LINE, 11/06

SUNLAND CHANNEL FLOOD CONTROL ALTERNATIVE 3 - DEVELOPERS RETAIN 100-YR 6-HR RAINFALL



-  ARMY CORPS OF ENGINEERS PROPOSED DRAINAGE
-  VOITA DITCH
-  BUCKEYE FEEDER CANAL
-  ARMY CORPS OF ENGINEERS PROPOSED CATCH BASIN
-  EXISTING FLOODPLAIN
-  DEVELOPERS WHO WILL RETAIN THE 100-YR 24-HR RAINFALL
-  LINEAR RETENTION TRAIL WAY



PREPARED BY JCS
Aspen
Consulting Engineers



0 300 600 1200 1800
Scale in Feet

FIGURE 4.4

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

SUNLAND CHANNEL FLOOD CONTROL ALTERNATIVE 4 - FLOOD PROOFING / ELEVATION CERTIFICATES



EXISTING FLOODPLAIN



VOITA DITCH



BUCKEYE FEEDER CANAL



HOUSE NEEDS ELEVATION CERTIFICATE OR FLOOD-PROOFING



EXISTING ELEVATION CERTIFICATE LOCATION, NUMBER AND LOT BOUNDARY

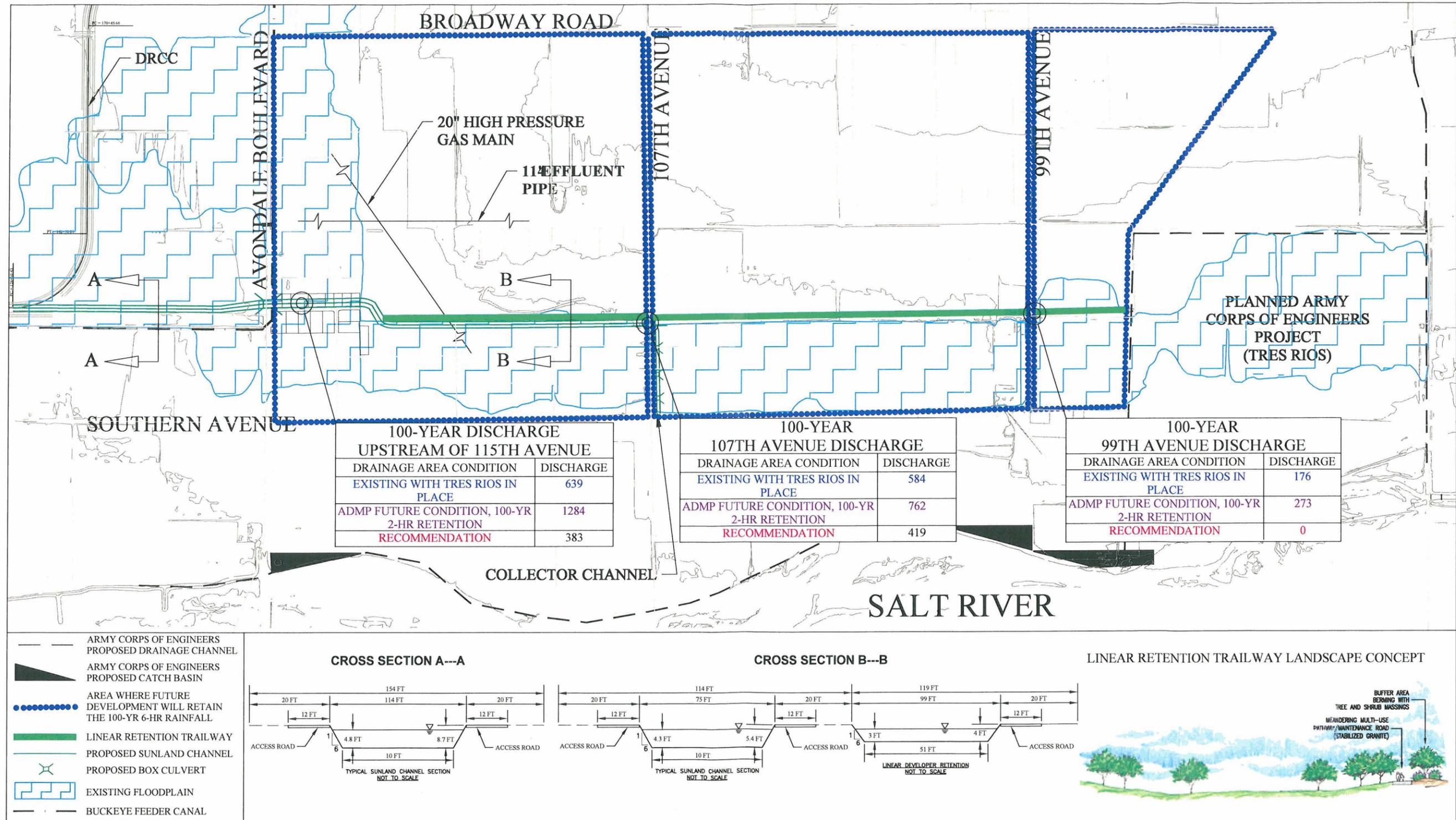


CITY OF PHOENIX PEAK REDUCING RETENTION BASIN
LOCATION



SUNLAND AREA DRAINAGE RECOMMENDED PLAN

100-YR 6-HR RETENTION FOR FUTURE DEVELOPMENT



PREPARED BY JCS
Aspen
Consulting Engineers



FIGURE 5.1 FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

FIGURE 5.1, SUNLAND AREA DRAINAGE RECOMMENDED PLAN, 11/06

CANDIDATE ASSESSMENT REPORT SUNLAND CHANNEL Appendix E

Recommended Conceptual Plan and Profile Sheets

Prepared for:



**FLOOD CONTROL DISTRICT OF
MARICOPA COUNTY
2801 WEST DURANGO STREET
PHOENIX, ARIZONA 85009**

Contract FCD 2004C027

Prepared by:



**426 N. 44th Street, Suite 370
Phoenix, Arizona, 85008**

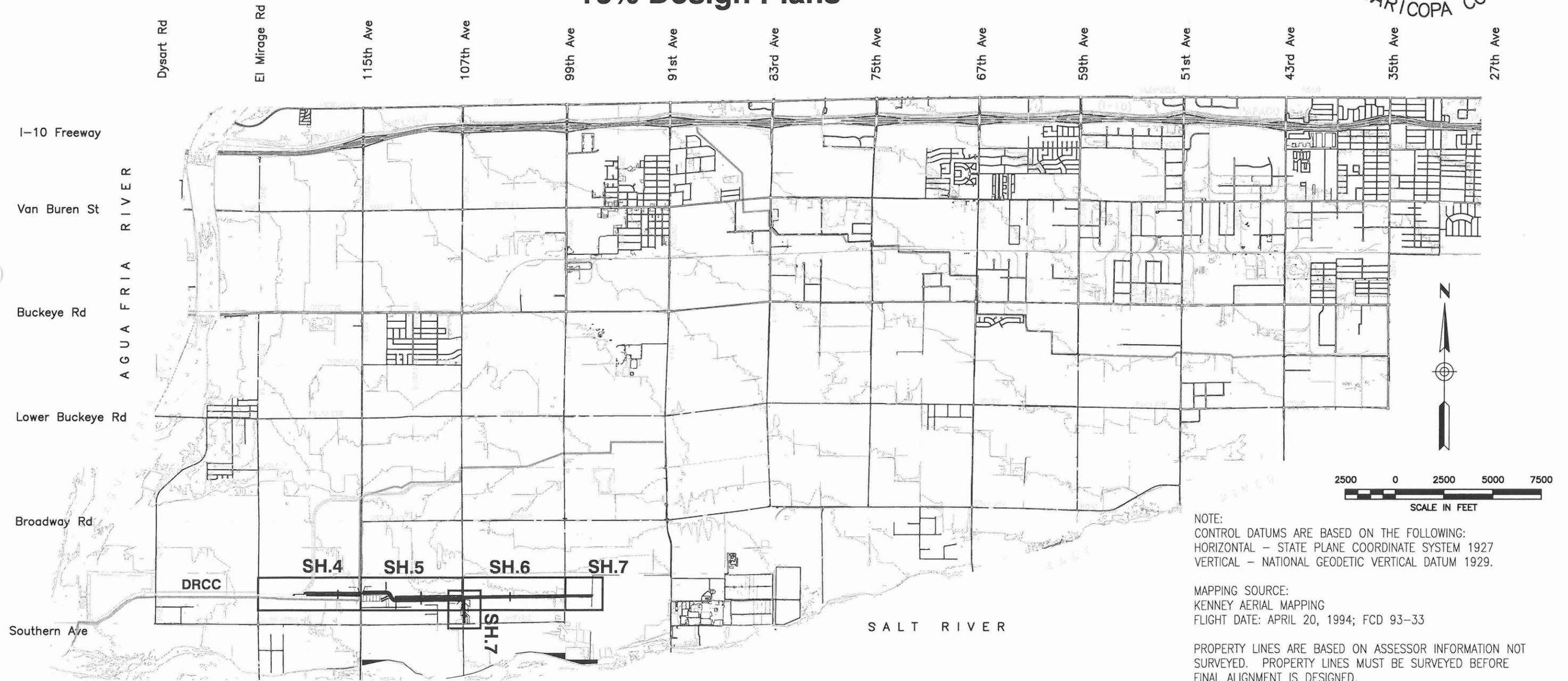
November 2006

Sunland Channel

Candidate Assessment Report

FCD #2004C027

10% Design Plans

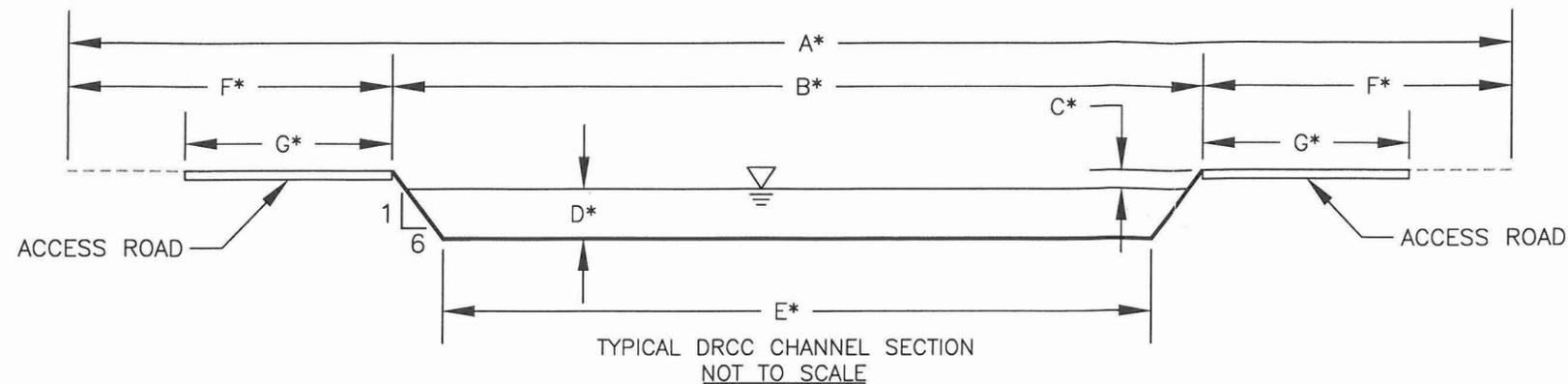


NOTE:
 CONTROL DATUMS ARE BASED ON THE FOLLOWING:
 HORIZONTAL - STATE PLANE COORDINATE SYSTEM 1927
 VERTICAL - NATIONAL GEODETIC VERTICAL DATUM 1929.

MAPPING SOURCE:
 KENNEY AERIAL MAPPING
 FLIGHT DATE: APRIL 20, 1994; FCD 93-33

PROPERTY LINES ARE BASED ON ASSESSOR INFORMATION NOT SURVEYED. PROPERTY LINES MUST BE SURVEYED BEFORE FINAL ALIGNMENT IS DESIGNED.

Aspen Consulting Engineers A Division of Aspen Environmental Group	DRN. JCS DATE: 10/06	SHEETS
	DES. JCS DATE: 10/06	
	CKD. POL DATE: 10/06	NO. <u>1</u> OF <u>7</u>



LEGEND

- NEW RIGHT-OF-WAY LINE
- NEW CHANNEL
- NEW RIGHT-OF-WAY LINE
- NEW DETENTION BASIN RIGHT-OF-WAY LINE
- NEW CULVERT
- RIGHT-OF-WAY LINE
- PROPERTY LINE
- 8 PARCEL NUMBER
- EXISTING ROAD
- 1410 EXIST. INDEX CONTOUR
- EXIST. INTERMEDIATE CONTOUR
- EXISTING STRUCTURE
- 304 ENVIRONMENTAL SITE

SUNLAND CHANNEL DIMENSIONS (SEE NOTES)

CHANNEL REACH	DESIGN DISCHARGE, IN CFS	CHANNEL SLOPE, IN FEET PER FOOT	*DIMENSION NOTE						
			A	B	C	D	E	F	G
			RIGHT OF WAY WIDTH, IN FEET	CHANNEL TOP WIDTH, IN FEET	FREEBOARD, IN FEET	FLOW DEPTH, IN FEET	CHANNEL BOTTOM WIDTH, IN FEET	MAINTENANCE ROW, IN FEET	ACCESS ROAD, IN FEET
DRCC TO 115TH AVE. (SHEET 4)	383	0.0008	154	114	3.9	4.8	10	20	12
115TH AVE. TO THE EAST END OF SUNLAND AVE. (SHEET 5)	392	0.0016	117	77	1.4	4.2	10	20	12
SUNLAND AVE. TO 107TH AVE. (SHEET 5)	419	0.0016	115	75	1.1	4.3	10	20	12
107TH AVE INTERCEPTOR (SHEET 7)	210	0.0012	51	31	1.0	2.5	24	10	10

SUNLAND LINEAR RETENTION DIMENSIONS (SEE NOTES)

LINEAR RETENTION LOCATION	RETENTION VOLUME, IN ACRE FEET	RETENTION LENGTH	*DIMENSION NOTE						
			A	B	C	D	E	F	G
			RIGHT OF WAY WIDTH, IN FEET	TOP WIDTH, IN FEET	FREEBOARD, IN FEET	DEPTH, IN FEET	BOTTOM WIDTH, IN FEET	MAINTENANCE ROW, IN FEET	ACCESS ROAD, IN FEET
SUNLAND AVE. TO 107TH AVE. (SHEET 5)	18.10	3386	119	99	1	3	51	20**	12**
107TH AVE. TO 99TH AVE. (SHEET 6)	8.0	5062	94	54	1	3	10	20	12
99TH AVE. TO TRES RIOS (SHEET 7)	2.0	1361	73	53	1	2.6	10	20**	12**

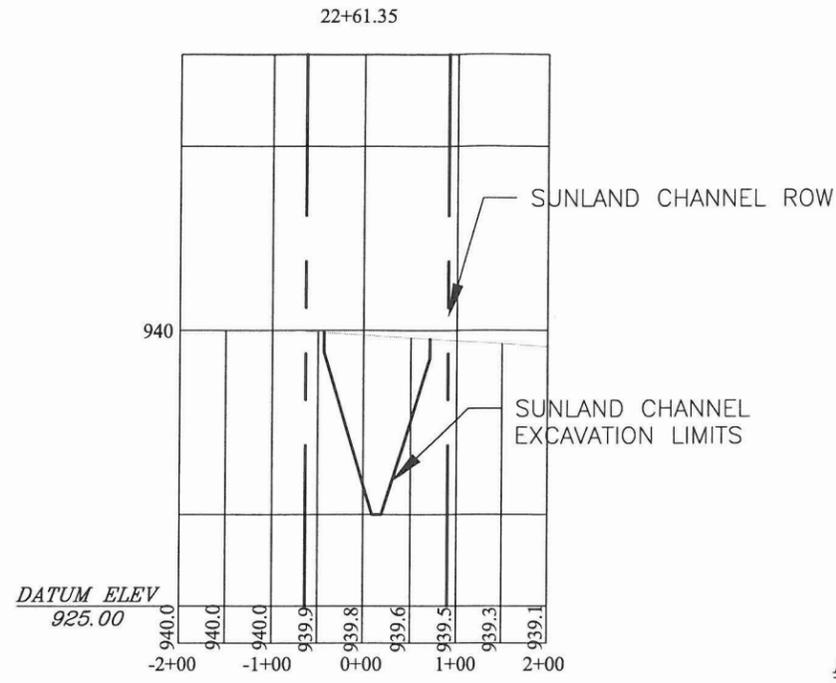
** MAINTENANCE ROW OR ACCESS ROAD ON ONE SIDE ONLY.

SUNLAND CHANNEL REINFORCED CONCRETE BOX CULVERT DIMENSIONS

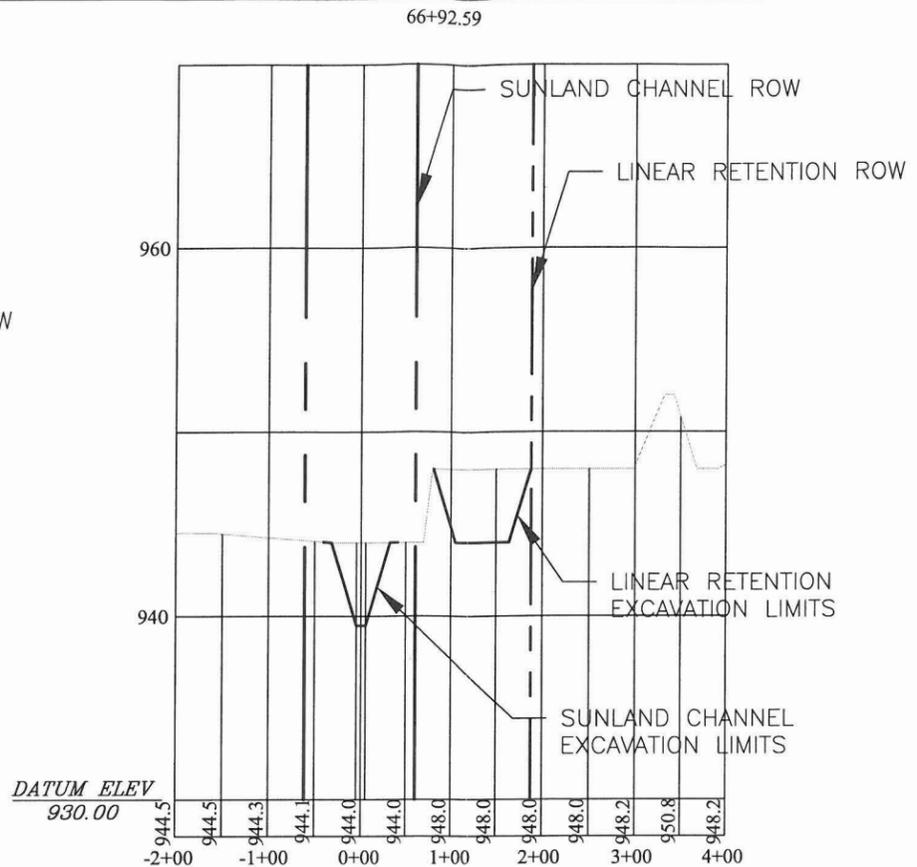
CULVERT ROADWAY CROSSING	DESIGN DISCHARGE, IN CFS	HEADWATER, IN FEET	CULVERT HEIGHT, IN FEET	CULVERT WIDTH, IN FEET	NUMBER OF BARRELS	LENGTH, IN FEET
115TH AVE. (SHEETS 4 AND 5)	392	7.6	3	7	2	153
107TH AVE. (SHEET 7)	210	3.5	2	7	2	98
STA: 90+39.34 (SHEET 7)	210	3.5	2	7	2	24
STA: 92+11.30 (SHEET 7)	210	3.5	2	7	2	24
STA: 95+00.67 (SHEET 7)	210	3.5	2	7	2	24
STA: 98+62.50 (SHEET 7)	210	3.5	2	7	2	24

NOTE:
 1. ENTIRE RIGHT OF WAY MINUS ACCESS ROADS TO BE LANDSCAPED. ACCESS ROADS 4" ABC. RIGHT OF WAY IS MINIMUM REQUIRED FOR DRAINAGE PURPOSES. ADDITIONAL RIGHT OF WAY MAY BE REQUIRED FOR RECREATION AESTHETIC PURPOSES.

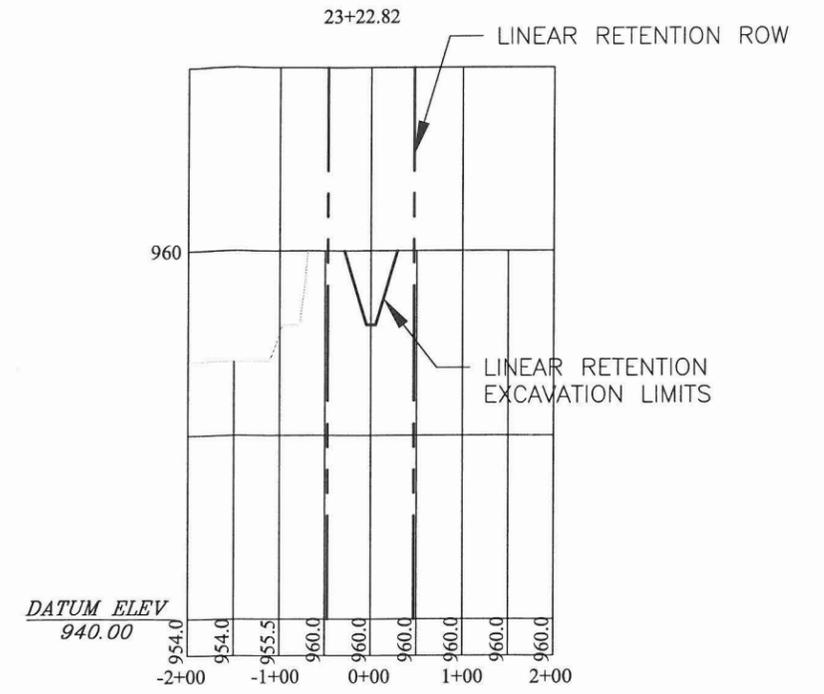
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	PROJECT DESCRIPTION		
	SUNLAND CHANNEL CANDIDATE ASSESSMENT REPORT		
Aspen Consulting Engineers A Division of Aspen Environmental Group	DRN. JCS DATE: 10/06	SCALE:	SHEETS
	DES. JCS DATE: 10/06		
	CKD. POL DATE: 10/06		NO. 2 OF 7



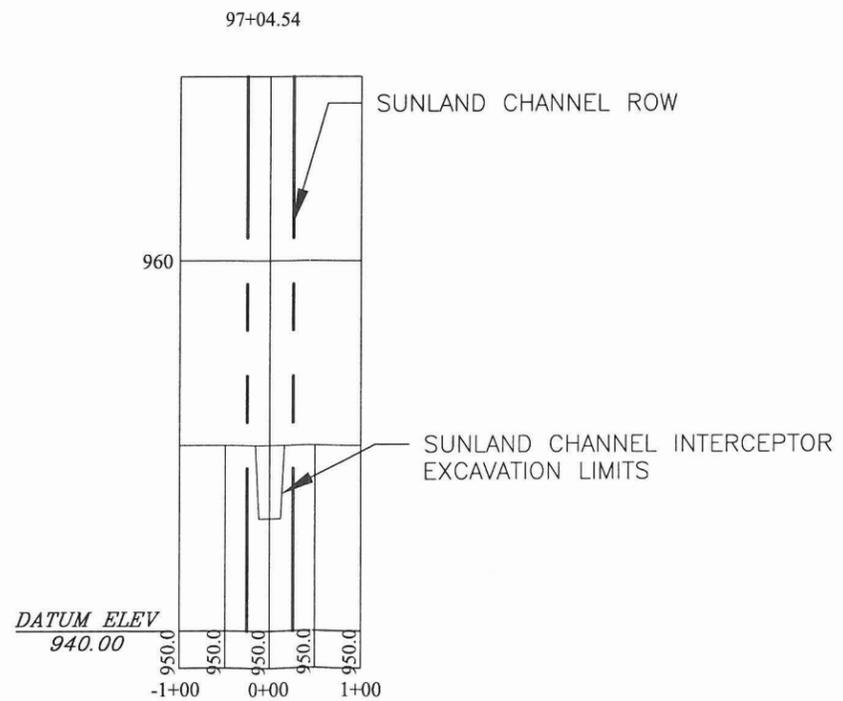
CROSS SECTION A-A
(SHEET 4)



CROSS SECTION B-B
(SHEET 5)

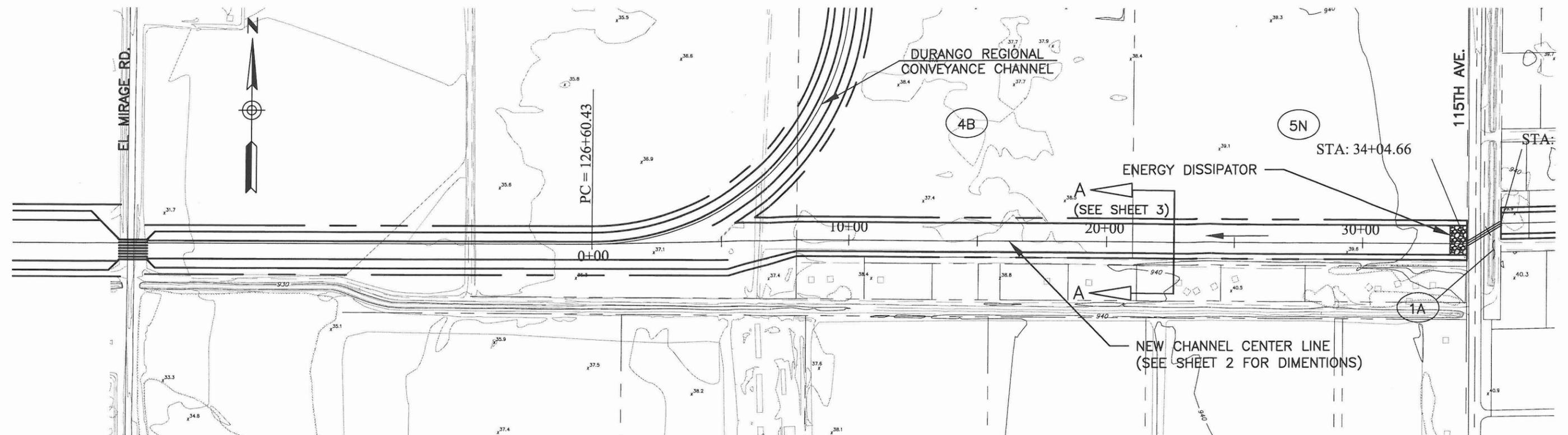


CROSS SECTION C-C
(SHEET 6)



CROSS SECTION D-D
(SHEET 7)

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	PROJECT DESCRIPTION		
	SUNLAND CHANNEL CANDIDATE ASSESSMENT REPORT		
Aspen Consulting Engineers A Division of Aspen Environmental Group	DRN. JCS DATE: 10/06	SCALE: 1"=200' HORIZONTAL	SHEETS
	DES. JCS DATE: 10/06	1"=10' VERTICAL	NO. 3 OF 7
	CKD. POL DATE: 10/06		

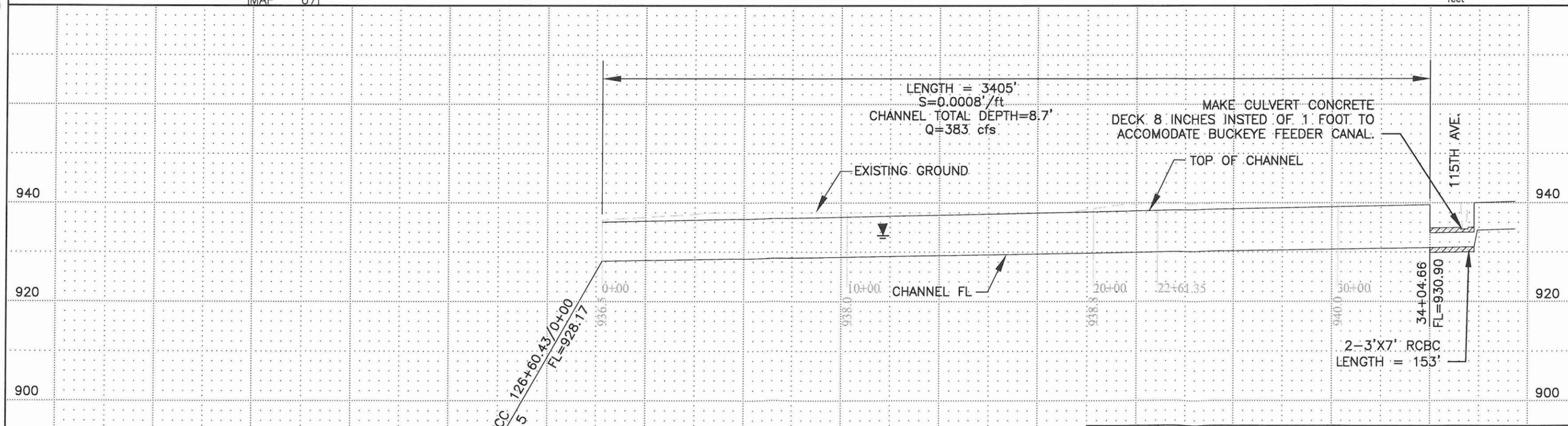
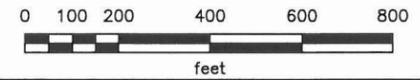


BOOK 500
MAP 67

CAUTION: Overhead High Voltage
Electric Lines. Contact APS
602-371-6965

CAUTION: Overhead High Voltage
Electric Lines. Contact SRP
602-236-5527

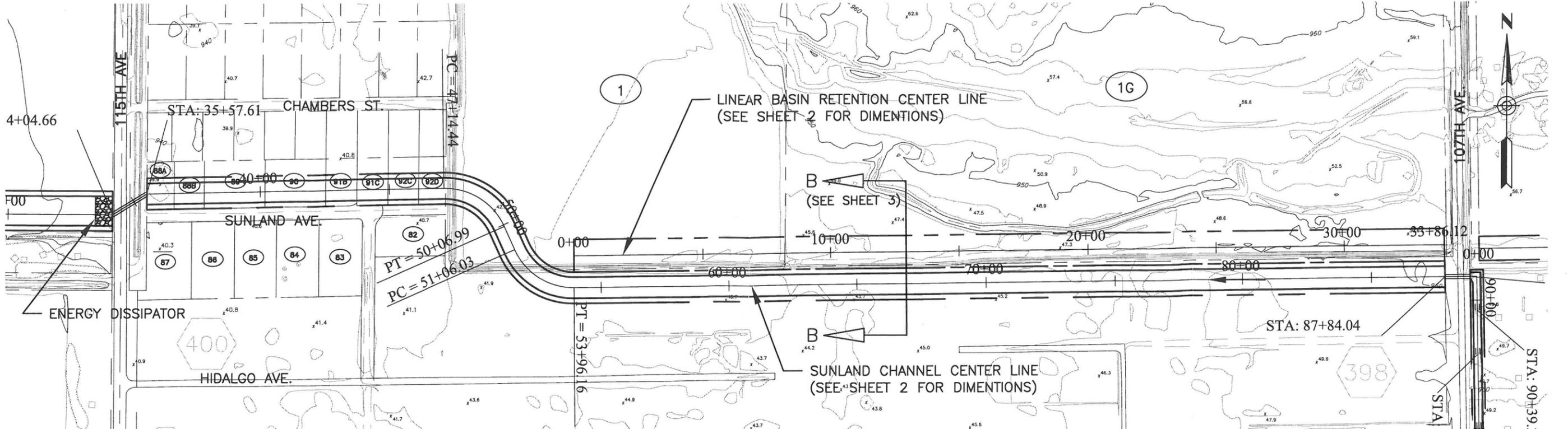
CAUTION: Buried Natural Gas Line
Contact El Paso Natural Gas Co.
915-496-5562



SUNLAND CHANNEL

	COUNTY PROJECT NO.	2004C027	SUNLAND CHANNEL CANDIDATE ASSESSMENT REPORT	
	PROJECT DESCRIPTION			
	DRN. JCS DATE:	10/06	SCALE:	SHEETS
DES. JCS DATE:	10/06	1"=400'	HORIZONTAL	NO. 4 OF 7
CKD. POL DATE:	10/06	1"=20'	VERTICAL	

Aspen Consulting Engineers
A Division of Aspen Environmental Group

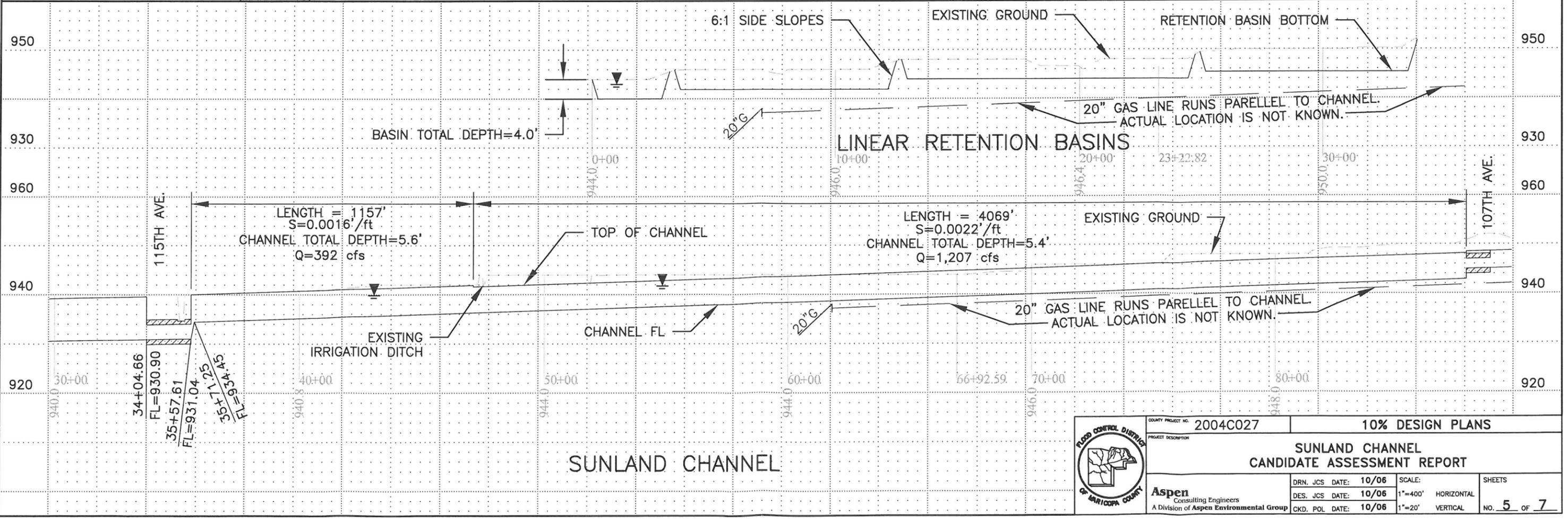
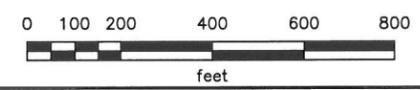


BOOK 101
MAP 43

CAUTION: Overhead High Voltage
Electric Lines. Contact APS
602-371-6965

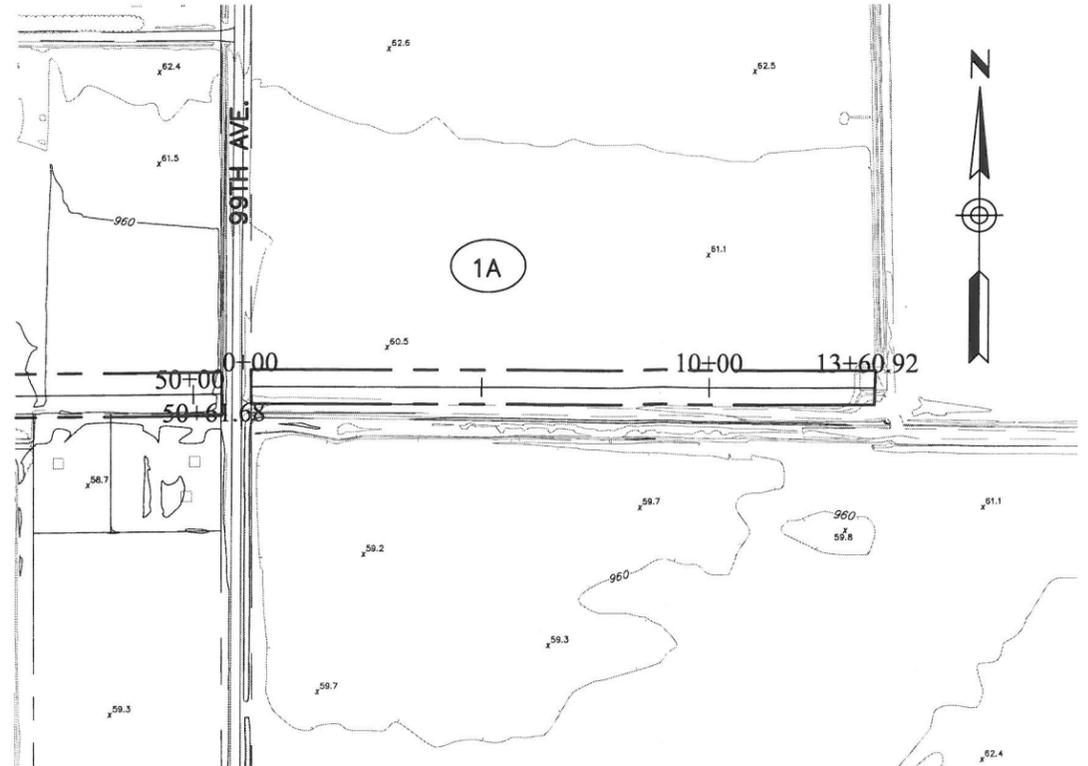
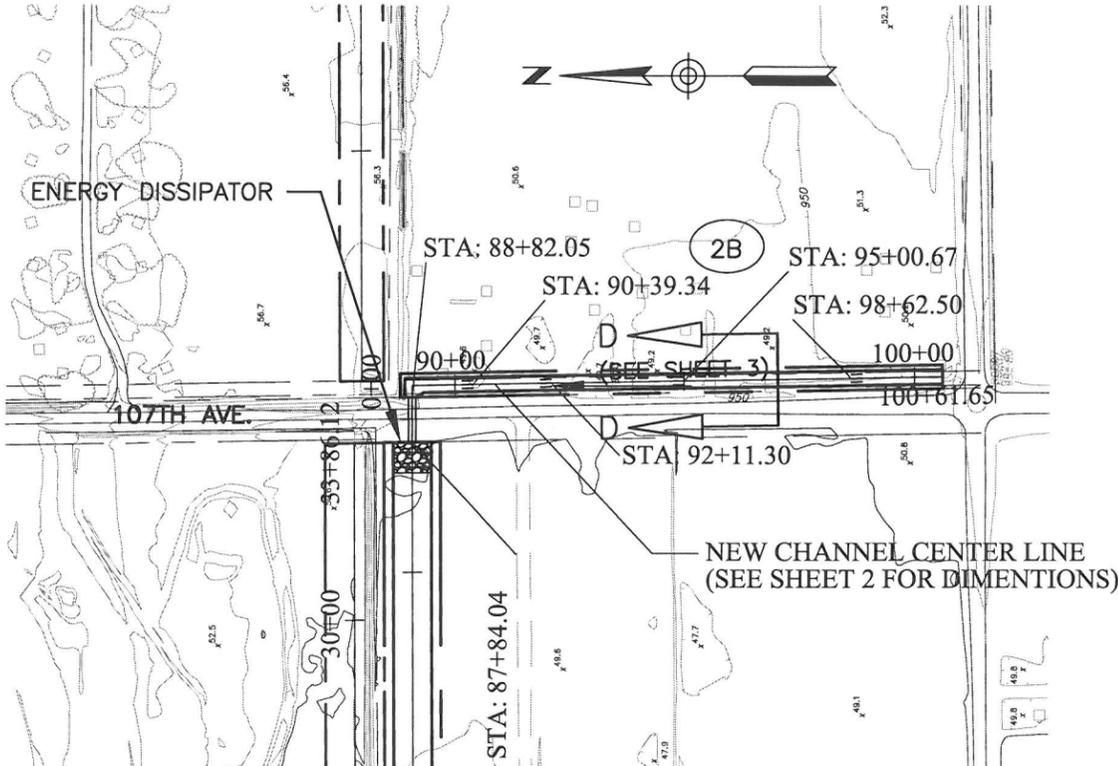
CAUTION: Overhead High Voltage
Electric Lines. Contact SRP
602-236-5527

CAUTION: Buried Natural Gas Line
Contact El Paso Natural Gas Co.
915-496-5562



	COUNTY PROJECT NO. 2004C027	10% DESIGN PLANS	
	PROJECT DESCRIPTION SUNLAND CHANNEL CANDIDATE ASSESSMENT REPORT		
	DRN. JCS DATE: 10/06 DES. JCS DATE: 10/06 CKD. POL DATE: 10/06	SCALE: 1"=400' HORIZONTAL 1"=20' VERTICAL	SHEETS NO. 5 OF 7

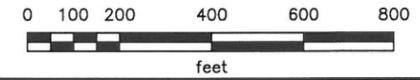
Aspen
Consulting Engineers
A Division of Aspen Environmental Group



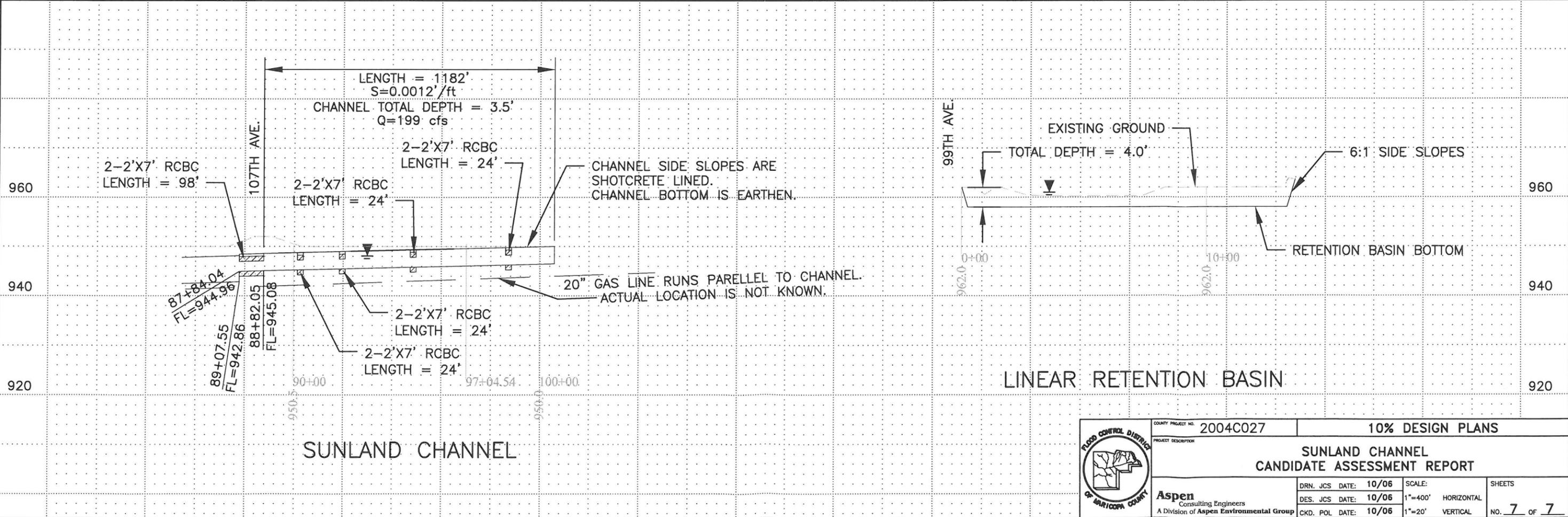
CAUTION: Overhead High Voltage
Electric Lines. Contact APS
602-371-6965

CAUTION: Overhead High Voltage
Electric Lines. Contact SRP
602-236-5527

CAUTION: Buried Natural Gas Line
Contact El Paso Natural Gas Co.
915-496-5562



BOOK 101
MAP 40



	COUNTY PROJECT NO. 2004C027	10% DESIGN PLANS	
	PROJECT DESCRIPTION		
	SUNLAND CHANNEL CANDIDATE ASSESSMENT REPORT		
Aspen Consulting Engineers A Division of Aspen Environmental Group	DRN. JCS DATE: 10/06	SCALE: 1"=400'	SHEETS
	DES. JCS DATE: 10/06	1"=20'	HORIZONTAL
	CKD. POL DATE: 10/06		VERTICAL
			NO. 7 OF 7

CANDIDATE ASSESSMENT REPORT SUNLAND CHANNEL Appendix F

Design Data and Cost Estimate for Recommended Plan

Prepared for:



**FLOOD CONTROL DISTRICT OF
MARICOPA COUNTY
2801 WEST DURANGO STREET
PHOENIX, ARIZONA 85009**

Contract FCD 2004C027

Prepared by:



**426 N. 44th Street, Suite 370
Phoenix, Arizona, 85008**

November 2006

DESIGN DATA AND COST ESTIMATE FOR SUNLAND CHANNEL RECOMMENDED PLAN

COST ESTIMATE BY CITY INCLUDING LINEAR CORRIDOR RETENTION	
AVONDALE COMPONENTS	COST
DRCC to 115th Avenue	\$ 3,055,182
Sunland Avenue	\$ 1,870,395
Sunland Avenue to 107th Avenue	\$ 2,540,789
Linear Retention	\$ 2,305,934
Avondale Subtotal	\$ 9,772,300
Avondale Contingency 30%	\$ 2,931,690
Avondale Total	\$ 12,703,990

PHOENIX COMPONENTS	
107th Avenue Interceptor	\$ 745,311
Linear Retention 107th to 99th	\$ 2,483,586
Linear Retention 99th to TR	\$ 539,879
Phoenix Subtotal	\$ 3,768,776
Phoenix Contingency 30%	\$ 1,130,633
Phoenix Total	\$ 4,899,409

Project Total \$ 17,603,399

* Does not include modifications to the DRCC.

COST ESTIMATE BY CITY INCLUDING DEVELOPER RETENTION OUTSIDE OF LINEAR CORRIDOR	
AVONDALE COMPONENTS	COST
DRCC to 115th Avenue	\$ 3,055,182
Sunland Avenue	\$ 1,870,395
Sunland Avenue to 107th Avenue	\$ 2,540,789
Linear Retention	\$ 2,305,934
Developer Retention	\$ 541,109
Avondale Subtotal	\$ 10,313,409
Avondale Contingency 30%	\$ 3,094,023
Avondale Total	\$ 13,407,432

PHOENIX COMPONENTS	
107th Avenue Interceptor	\$ 745,311
Linear Retention	\$ 3,023,465
Developer Retention	\$ 2,242,450
Phoenix Subtotal	\$ 6,011,226
Phoenix Contingency 30%	\$ 1,803,368
Phoenix Total	\$ 7,814,594

Project Total \$ 21,222,026

Developer Retention Outside of Linear Corridor \$ 3,618,627

DESIGN DATA AND COST ESTIMATE FOR SUNLAND CHANNEL RECOMMENDED PLAN

COST ESTIMATE BY FUNCTION

CHANNEL COMPONENTS	COST	
DRCC to 115th Avenue	\$	3,055,182
Sunland Avenue	\$	1,870,395
Sunland Avenue to 107th Avenue	\$	2,540,789
107th Avenue Interceptor	\$	745,311
Subtotal	\$	8,211,677
Contingency 30%	\$	2,463,503
Total Cost Channel Components	\$	10,675,180

RETENTION COMPONENTS

Linear Retention Sunland Avenue to 107th	\$	2,305,934
Linear Retention 107th to 99th	\$	2,483,586
Linear Retention 99th to TR	\$	539,879
Subtotal	\$	5,329,399
Contingency 30%	\$	1,598,820
Total Cost Retention Components	\$	6,928,219

Total Cost \$ 17,603,399

COST ESTIMATE BY ITEM

Right of Way	\$	8,510,000	63%
Landscaping	\$	3,097,116	23%
Excavation	\$	1,100,160	8%
Culvert Concrete	\$	388,689	3%
Maintenance Road	\$	263,321	2%
Shotcrete	\$	181,790	1%
Subtotal	\$	13,541,076	
Contingency 30%	\$	4,062,323	
Total	\$	17,603,399	

DESIGN DATA AND COST ESTIMATE FOR SUNLAND CHANNEL RECOMMENDED PLAN

COST ESTIMATE FOR SUNLAND CHANNEL FROM DRCC TO 115TH AVENUE

Channel Length	3405 Feet	
Channel Discharge	383 cfs	
Channel Slope	0.0008 Feet/Foot	
Channel Side Slopes	6 Feet/Foot	
Channel Bottom Width	10 Feet	
Channel Roughness	0.04	
Channel Flow Depth	4.8 Feet (Revised, master plan depth of 5.5 Feet)	
Channel Freeboard*	3.9 Feet	
Channel Total Depth*	8.7 Feet	
Channel excavation area	541.14 Square Feet	
Channel Excavation Volume	68,244 Cubic Yards	
Channel Wetted Perimeter	116 Feet	
Channel Top Width	114 Feet	
Channel Landscape Area	9.1 AC	channel only
Channel Total Area	8.9 AC	channel only
Maintenance ROW	40.0 Feet (Assumes 20 feet each side)	
Total ROW Width	154 Feet	
Total Area	12.0 AC (Includes maintenance ROW)	
Culvert area required	31 Square Feet	
Culvert width	10 Feet	
Number barrels	0	
Barrel width	0 Feet	
Culvert Concrete Area	6 Square Feet	
Culvert number	0	
Culvert Length	0 Feet	
Total Culvert Concrete	0 Cubic Yards	

* 8.7 Feet of total depth is required to meet the culvert under 115th Ave. and BFC

ITEM	QUANTITY	UNIT	UNIT COST	COST
Channel Excavation Volume	68,244	CY	\$ 6	\$ 409,464
Landscaping (Excludes Road)	10.1	AC	\$ 78,408	\$ 791,921
Right of Way*	12.0	AC	\$ 150,000	\$ 1,800,000
Culvert Concrete	0	CY	\$ 669	\$ -
Maintenance Road**	1.9	AC	\$ 28,314	\$ 53,797
Total Cost				\$ 3,055,182

* Includes 40-foot Right of Way outside of channel proper.

**One road each side, 12-foot wide decomposed granite.

DESIGN DATA AND COST ESTIMATE FOR SUNLAND CHANNEL RECOMMENDED PLAN

COST ESTIMATE FOR SUNLAND CHANNEL FROM 115TH AVENUE TO THE END OF SUNLAND AVENUE

Channel Length	1157 Feet	
Channel Discharge	392 cfs (Estimated by ratio to end of Sunland Avenue)	
Channel Slope	0.0016 Feet/Foot	
Channel Side Slopes	6 Feet/Foot	
Channel Bottom Width	10 Feet	
Channel Roughness	0.04	
Channel Flow Depth	4.2 Feet (Revised, master plan depth of 4.7 Feet)	
Channel Freeboard	1.4 Feet	
Channel Total Depth	5.6 Feet (Designed for 760cfs at the brim)	
Channel excavation area	244.16 Cubic Feet	
Channel Excavation Volume	10,463 Cubic Yards	
Channel Wetted Perimeter	78 Feet	
Channel Top Width	77 Feet	
Channel Landscape Area	2.1 AC	Channel Only
Channel Total Area	2.0 AC	Channel Only
Maintenance ROW	40.0 Feet (Assumes 20 feet each side)	
Total ROW Width	117 Feet	
Total Area	3.1 AC (Includes maintenance ROW)	
Culvert head*	7.6 Feet	
Culvert area required**	33 Square Feet	
Culvert width	11 Feet (Assumes Culvert Height = 3 Feet)	
Number barrels	2	
Barrel width***	7 Feet	
Culvert Concrete Area	46 Square Feet	
Culvert number	1 Culvert at 115th Ave.	
Culvert Length	153 Feet	
Total Culvert Concrete	261 Cubic Yards	

* Drop Inlet 3.4 feet below channel invert. Add to depth for total head.

** Drop Inlet Water Surface to Invert Height = 7.6 Feet.)

*** Slightly wider than needed for inlet control due to outlet conditions.

ITEM	QUANTITY	UNIT	UNIT COST	COST
Channel Excavation Volume	10,463	CY	\$ 6	\$ 62,778
Landscaping	2.5	AC	\$ 78,408	\$ 196,020
Property Buyout Lots at \$200K	6.0	EA	\$ 200,000	\$ 1,200,000
Property Buyout Lots at \$260K	2.0	EA	\$ 260,000	\$ 520,000
Remaining Lot Sellback	2.0	AC	\$ 150,000	\$ (300,000)
Culvert Concrete	261	CY	\$ 669	\$ 174,609
Maintenance Road*	0.6	AC	\$ 28,314	\$ 16,988
Total Cost				\$ 1,870,395

* One road each side, 12-foot wide decomposed granite.

NORTH ALIGNMENT ASSUMED FOR SUNLAND

Total buy-out lots area North	5.06 ACRES
Total buy-out lots area South	0 ACRES

DESIGN DATA AND COST ESTIMATE FOR SUNLAND CHANNEL RECOMMENDED PLAN

COST ESTIMATE FOR SUNLAND CHANNEL FROM SUNLAND AVENUE TO 107TH AVENUE

Channel Length	4069 Feet
Channel Discharge	419 cfs (Average)
Channel Slope	0.0016 Feet/Foot
Channel Side Slopes	6 Feet/Foot
Channel Bottom Width	10 Feet
Channel Roughness	0.04
Channel Flow Depth	4.3 Feet (Revised, master plan depth of 4.7 Feet)
Channel Freeboard	1.1 Feet
Channel Total Depth	5.4 Feet
Channel excavation area	228.96 Square Feet
Channel Excavation Volume	34,505 Cubic Yards
Channel Wetted Perimeter	76 Feet
Channel Top Width	75 Feet
Channel Landscape Area	7.1 AC (Channel Only)
Channel Total Area	7.0 AC (Channel Only)
Maintenance ROW	40.0 Feet (Assumes 20 feet each side)
Total ROW Width	115 Feet
Total Area	10.7 AC (Includes maintenance ROW)
Culvert area required	47 Square Feet
Culvert width	14 Feet
Number barrels	0
Barrel width	0 Feet
Culvert Concrete Area	0 Square Feet
Culvert number	0
Culvert Length	0 Feet
Total Culvert Concrete	0 Cubic Yards

ITEM	QUANTITY	UNIT	UNIT COST	COST
Channel Excavation Volume	34,505	CY	\$ 6	\$ 207,030
Landscaping	8.5	AC	\$ 78,408	\$ 666,468
Right of Way*	10.7	AC	\$ 150,000	\$ 1,605,000
Culvert Concrete	0	CY	\$ 669	\$ -
Maintenance Road**	2.2	AC	\$ 28,314	\$ 62,291
Total Cost				\$ 2,540,789

* Includes 40-foot Right of Way outside of channel proper.

** One road each side, 12-foot wide decomposed granite.

DESIGN DATA AND COST ESTIMATE FOR SUNLAND CHANNEL RECOMMENDED PLAN

COST ESTIMATE FOR SUNLAND CHANNEL INTERCEPTOR ALONG 107TH AVENUE FROM SOUTHERN AVENUE TO SUNLAND CHANNEL

Channel Length	1182 Feet
Channel Discharge*	210 cfs
Channel Slope**	0.0012 Feet/Foot
Channel Side Slopes	1 Feet/Foot
Channel Bottom Width	24 Feet
Channel Roughness	0.028
Channel Flow Depth	2.5 Feet (Maximum from slope available)
Channel Freeboard	1.0 Feet (From FCD Standards)
Channel Total Depth	3.5 Feet
Channel excavation area	96.25 Square Feet
Channel Excavation Volume	4,214 Cubic Yards
Channel Wetted Perimeter	34 Feet
Channel Top Width	31 Feet
Channel Landscape Area	0.9 AC (Channel Only)
Channel Total Area	0.8 AC (Channel Only)
Maintenance ROW	20.0 Feet (Assume 10 feet on each side)
Total ROW Width	51 Feet
Total Area	1.4 AC (Includes maintenance ROW)
Culvert area required	28 Square Feet
Culvert width	14 Feet (Assumes Height = Total Depth Minus 1.5 Feet)
Number barrels	2
Barrel width	7 Feet
Culvert Concrete Area	44.5 Square Feet
Culvert number	1
Culvert Length***	194 Feet
Total Culvert Concrete	320 Cubic Yards

* Assume half total discharge for average collector width.

** Assume 1.5-foot drop over length of channel.

*** Assume 4 local culverts 24-feet long each, and one 98-foot culvert at 107th.

ITEM	QUANTITY	UNIT	UNIT COST	COST
Channel Excavation Volume	4,214	CY	\$ 6	\$ 25,284
Shotcrete*	18,179	SF	\$ 10	\$ 181,790
Right of Way**	1.4	AC	\$ 150,000	\$ 210,000
Culvert Concrete	320	CY	\$ 669	\$ 214,080
Maintenance Road**	0.5	AC	\$ 28,314	\$ 14,157
Purchase one house	1.0	LS	\$ 100,000	\$ 100,000
Total Cost				\$ 745,311

* Shotcrete assume 3-foot key in at top plus toe down one half depth of flow each side.

Assume 4 inches thick. The channel length of shotcrete is reduced by the length of four 24-foot culverts.

** Includes 20-foot Right of Way outside of channel proper.

*** One road each side, 10-feet wide decomposed granite.

DESIGN DATA AND COST ESTIMATE FOR SUNLAND CHANNEL RECOMMENDED PLAN

COST ESTIMATE FOR LINEAR RETENTION FROM SUNLAND AVENUE TO 107TH AVENUE

Retention Length	3386 Feet
Retention Volume	16.00 Acre Feet
Retention Side Slopes	6 Feet/Foot
Retention Bottom Width	51 Feet
Retention Ponding Depth	3 Feet
Retention Freeboard	1.0 Feet
Retention Total Depth	4 Feet
Retention excavation area	300 Square Feet
Retention Excavation Volume	37,804 Cubic Yards
Retention Wetted Perimeter	100 Feet
Retention Top Width	99 Feet
Retention Total Area	7.7 AC
Maintenance ROW	20.0 Feet
Total ROW Width	119 Feet
Total Area	9.3 AC (Includes maintenance ROW)

ITEM	QUANTITY	UNIT	UNIT COST	COST
Retention Excavation Volume	37,804	CY	\$ 6	\$ 226,824
Landscaping	8.4	AC	\$ 78,408	\$ 658,627
Right of Way*	9.3	AC	\$ 150,000	\$ 1,395,000
Maintenance Road**	0.9	AC	\$ 28,314	\$ 25,483
Total Cost				\$ 2,305,934

* Includes 20-foot Right of Way on one side.

** One road, 12-feet wide decomposed granite.

DESIGN DATA AND COST ESTIMATE FOR SUNLAND CHANNEL RECOMMENDED PLAN

COST ESTIMATE FOR LINEAR RETENTION FROM 107TH AVENUE TO 99TH AVENUE

Retention Length	5062 Feet
Retention Volume	8 Acre Feet
Retention Side Slopes	6 Feet/Foot
Retention Bottom Width	10 Feet
Retention Ponding Depth	2.7 Feet
Retention Freeboard	1.0 Feet
Retention Total Depth	3.7 Feet
Retention excavation area	119.14 Square Feet
Retention Excavation Volume	22,367 Cubic Yards
Retention Wetted Perimeter	55 Feet
Retention Top Width	54 Feet
Retention Total Area	6.3 AC
Maintenance ROW	40.0 Feet
Total ROW Width	94 Feet
Total Area	10.9 AC (Includes maintenance ROW)

ITEM	QUANTITY	UNIT	UNIT COST	COST
Retention Excavation Volume	22,367	CY	\$ 6	\$ 134,202
Landscaping	8.1	AC	\$ 78,408	\$ 635,105
Right of Way*	10.9	AC	\$ 150,000	\$ 1,635,000
Maintenance Road**	2.8	AC	\$ 28,314	\$ 79,279
Total Cost				\$ 2,483,586

* Includes 40-foot Right of Way for maintenance. 20-feet on each side.

** One road each side, 12-feet wide decomposed granite.

DESIGN DATA AND COST ESTIMATE FOR SUNLAND CHANNEL RECOMMENDED PLAN

COST ESTIMATE FOR LINEAR RETENTION FROM 99TH AVENUE TO TRES RIOS

Retention Length	1361 Feet
Retention Volume	2 Acre Feet
Retention Side Slopes	6 Feet/Foot
Retention Bottom Width	10 Feet
Retention Ponding Depth	2.6 Feet
Retention Freeboard	1.0 Feet
Retention Total Depth	3.6 Feet
Retention excavation area	113.76 Square Feet
Retention Excavation Volume	5,763 Cubic Yards
Retention Wetted Perimeter	54 Feet
Retention Top Width	53 Feet
Retention Total Area	1.7 AC
Maintenance ROW	20.0 Feet
Total ROW Width	73 Feet
Total Area	2.3 AC (Includes maintenance ROW)

ITEM	QUANTITY	UNIT	UNIT COST	COST
Retention Excavation Volume	5,763	CY	\$ 6	\$ 34,578
Landscaping	1.9	AC	\$ 78,408	\$ 148,975
Right of Way*	2.3	AC	\$ 150,000	\$ 345,000
Maintenance Road**	0.4	AC	\$ 28,314	\$ 11,326
Total Cost				\$ 539,879

* Includes 20-foot Right of Way for maintenance. 20-feet on one side.

** One road, 12-feet wide decomposed granite.

CANDIDATE ASSESSMENT REPORT SUNLAND CHANNEL Appendix G

Revised DRCC Plans and Cost Estimate

Prepared for:



**FLOOD CONTROL DISTRICT OF
MARICOPA COUNTY
2801 WEST DURANGO STREET
PHOENIX, ARIZONA 85009**

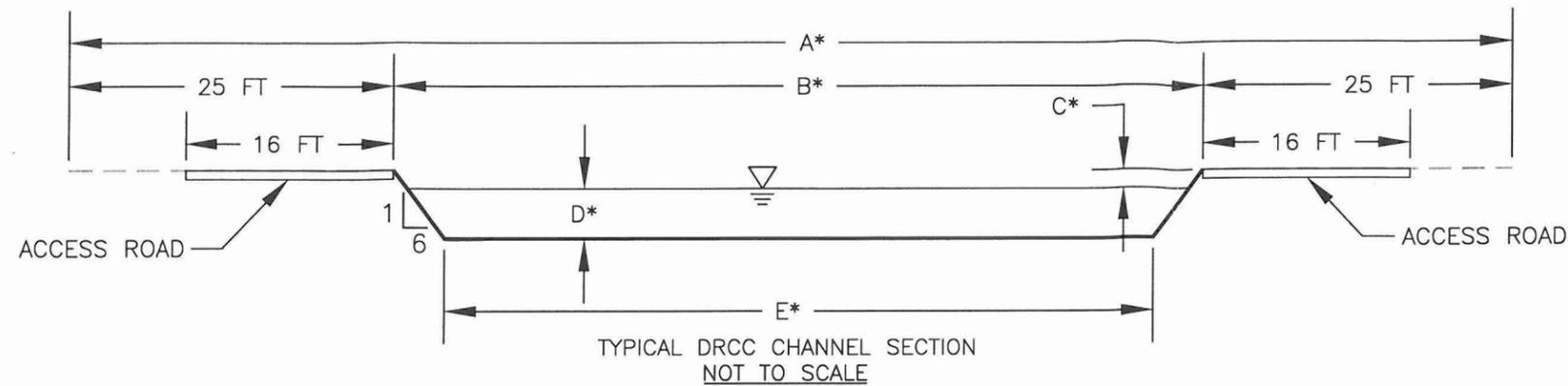
Contract FCD 2004C027

Prepared by:

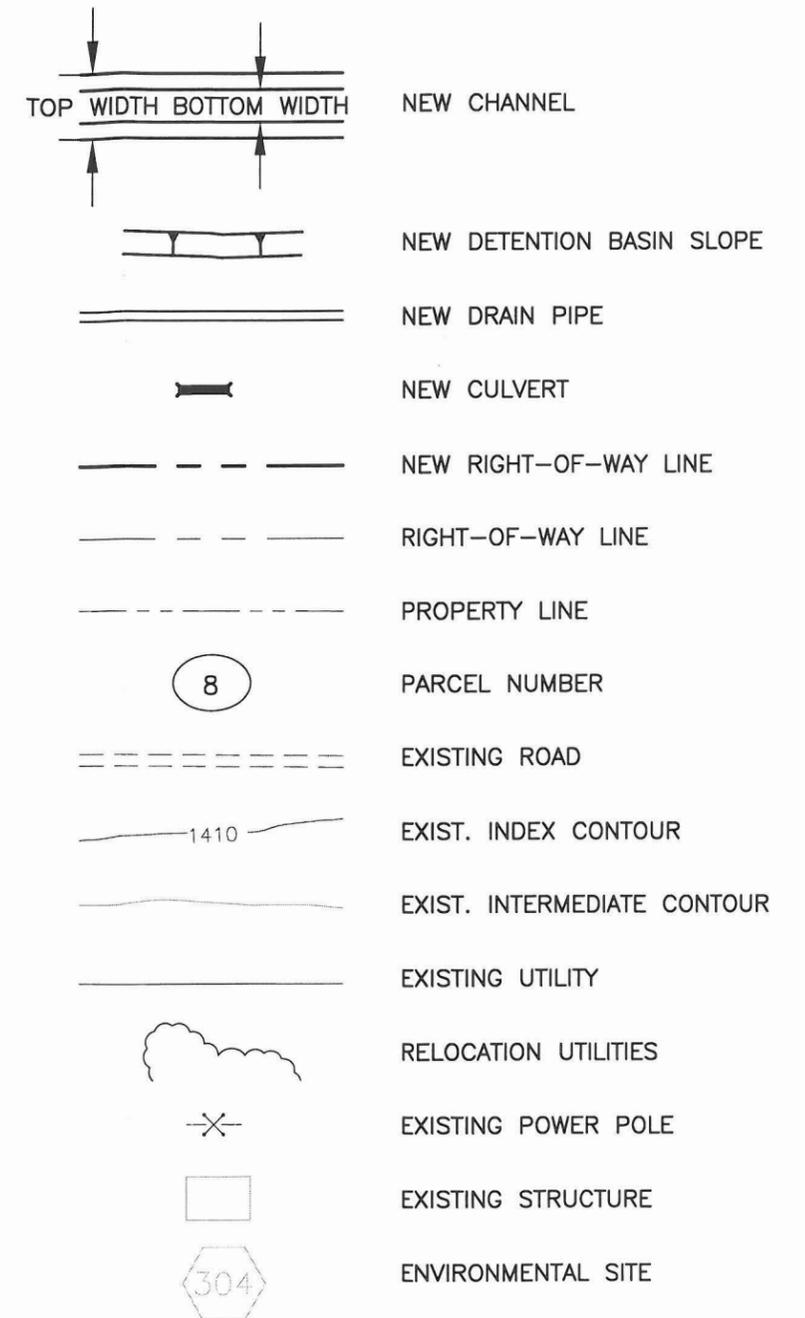


**426 N. 44th Street, Suite 370
Phoenix, Arizona, 85008**

November 2006



LEGEND



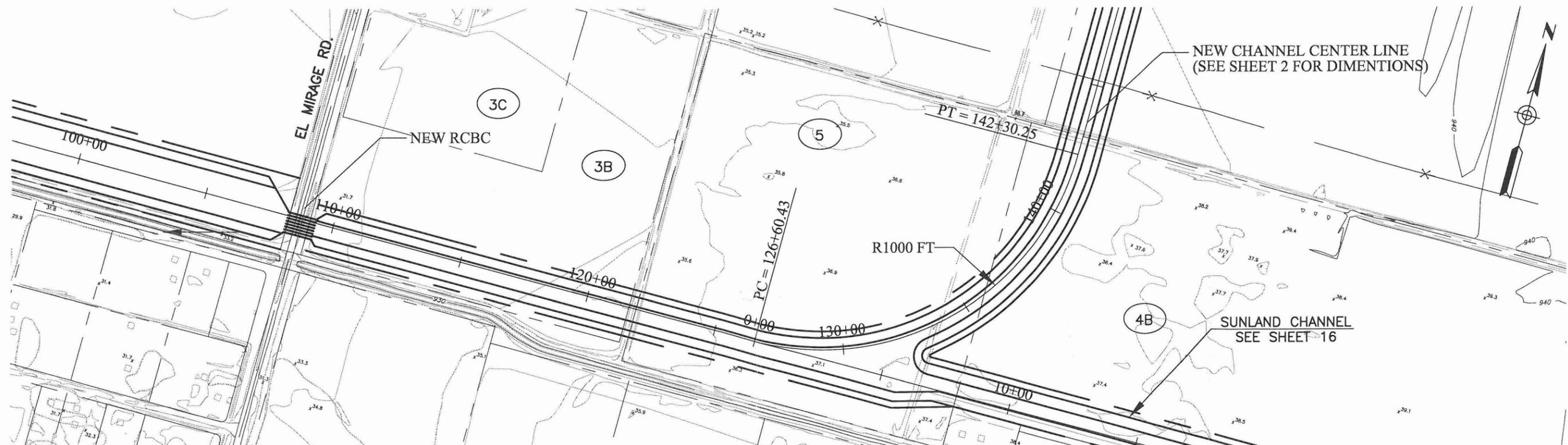
DRCC CHANNEL DIMENSIONS (SEE NOTES)							
CHANNEL REACH	DESIGN DISCHARGE, IN CFS	CHANNEL SLOPE, IN FEET PER FOOT	*DIMENSION NOTE				
			A	B	C	D	E
			RIGHT OF WAY WIDTH, IN FEET	CHANNEL TOP WIDTH, IN FEET	FREEBOARD, IN FEET	FLOW DEPTH, IN FEET	CHANNEL BOTTOM WIDTH, IN FEET
DOWNSTREAM OF DYASRT ROAD (SHEETS 4 AND 14)	3,115	0.0014	280	230	1.2	4.7	159
DYSART ROAD TO EL MIRAGE ROAD (SHEET 5)	3,115	0.0014	280	230	1.2	4.7	159
EL MIRAGE ROAD TO SUNLAND CHANNEL (SHEET 6)	1,455	0.0017	180	130	1.2	4.7	59
SUNLAND CHANNEL TO 115TH AVENUE (SHEETS 6 TO 8)	1,205	0.0017	167	117	1.2	4.7	46
115TH AVENUE TO 107TH AVENUE (SHEET 9)	1,318	0.0017	171	121	1.2	4.8	49

DRCC REINFORCED CONCRETE BOX CULVERT DIMENSIONS						
CULVERT ROADWAY CROSSING	DESIGN DISCHARGE, IN CFS	HEADWATER, IN FEET	CULVERT HEIGHT, IN FEET	CULVERT WIDTH, IN FEET	NUMBER OF BARRELS	LENGTH, IN FEET
DYSART ROAD (SHEET 5)	3,069	5.9	4	9	9	110
EL MIRAGE ROAD (SHEET 6)	2,654	5.9	4	10	7	110
BROADWAY ROAD (SHEET 8)	1,205	5.9	4	8	4	110
AVONDALE BOULEVARD (SHEET 8)	1,318	6	4	7	5	211
107TH AVENUE (SHEET 10)	775	7	4	9	2	110
95TH AVENUE (SHEET 11)	388	7	4	9	1	110
91ST AVENUE (SHEET 12)	862	7	4	10	2	110
83RD AVENUE (SHEET 13)	345	7	4	8	1	110

NOTE:

- ENTIRE RIGHT OF WAY MINUS ACCESS ROADS TO BE LANDSCAPED. ACCESS ROADS 4" ABC. RIGHT OF WAY IS MINIMUM REQUIRED FOR DRAINAGE PURPOSES. ADDITIONAL RIGHT OF WAY MAY BE REQUIRED FOR RECREATION AESTHETIC PURPOSES.

	COUNTY PROJECT NO. 2004C027	10% DESIGN PLANS	
	PROJECT DESCRIPTION DURANGO REGIONAL CONVEYANCE CHANNEL CANDIDATE ASSESSMENT REPORT		
	Aspen Consulting Engineers A Division of Aspen Environmental Group	DRN. JCS DATE: 02/14/06 DES. JCS DATE: 02/14/06 CKD. POL DATE: 02/14/06	SCALE:
			NO. 2 OF 17

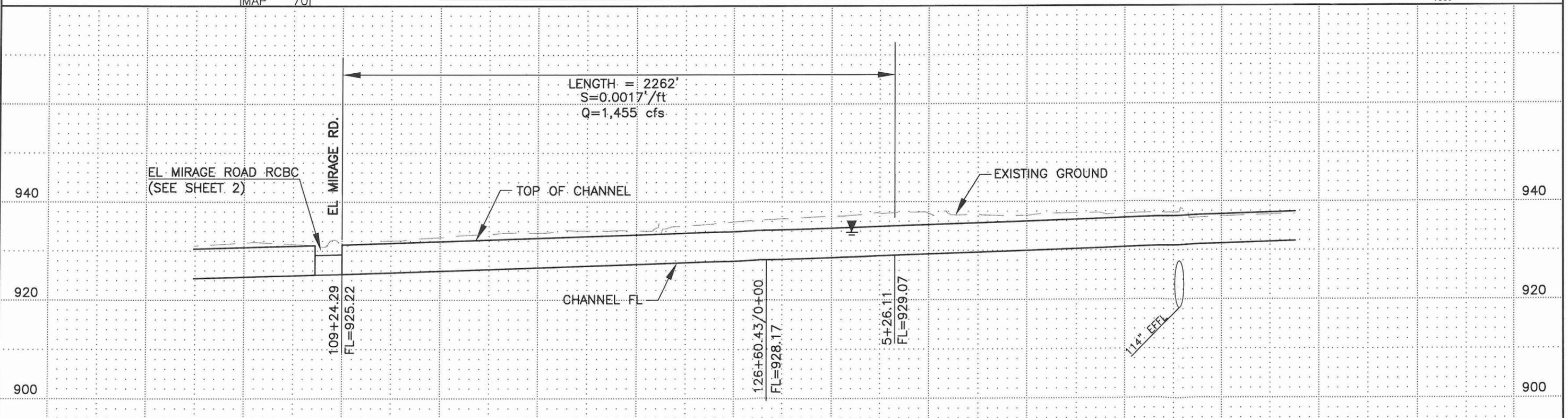
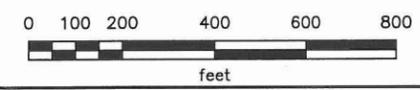


BOOK 500
MAP 70

CAUTION: Overhead High Voltage
Electric Lines. Contact APS
602-371-6965

CAUTION: Overhead High Voltage
Electric Lines. Contact SRP
602-236-5527

CAUTION: Buried Natural Gas Line
Contact El Paso Natural Gas Co.
915-496-5562



DURANGO REGIONAL CONVEYANCE CHANNEL

	COUNTY PROJECT NO.	2004C027	10% DESIGN PLANS	
	PROJECT DESCRIPTION	DURANGO REGIONAL CONVEYANCE CHANNEL CANDIDATE ASSESSMENT REPORT		
	DRN. JCS DATE: 02/14/06	SCALE:	SHEETS	
Aspen Consulting Engineers A Division of Aspen Environmental Group	DES. JCS DATE: 02/14/06	1"=400'	HORIZONTAL	NO. 6 OF 17
CKD. POL DATE: 02/14/06	1"=20'	VERTICAL		

REVISED DRCC DESIGN DATA AND COST ESTIMATE

THIS SPREADSHEET PROVIDES THE DETAILED COST ESTIMATE FOR THE DRCC ASSUMING:

REVISED SUNLAND CHANNEL IN PLACE AS DESCRIBED IN THE SUNLAND CAR
DATED 11/16/2006.
FUTURE DRAINAGE AREA CONDITIONS WITH 100-YEAR, 6-HOUR RETENTION FOR
ALL NEW DEVELOPMENT.

REVISED DRCC DESIGN DATA AND COST ESTIMATE

THIS COST ESTIMATE ASSUMES FULL SUNLAND CHANNEL, FULL DEVELOPMENT AND FULL RETENTIC COST ESTIMATE

11/16/2006

COST SUMMARY

DRCC	COST
Basin #1	\$ 5,187,292
Channel Downstream of Dysart	\$ 1,458,456
Channel Dysart to El Mirage	\$ 8,685,747
Channel El Mirage to Sunland Channel	\$ 2,630,049
Channel Sunland Channel to 115th Avenue	\$ 6,667,743
Channel 115th to 107th	\$ 6,623,036
Avondale Subtotal	\$ 31,252,323
Avondale Contingency 30%	\$ 9,375,697
Avondale Total	\$ 40,628,020
95th Avenue Basin	\$ 7,563,049
Phoenix Culverts	\$ 436,857
Phoenix Channels	\$ 1,197,225
Phoenix Subtotal	\$ 9,197,131
Phoenix Contingency 30%	\$ 2,759,139
Phoenix Total	\$ 11,956,270
DRCC Total	\$ 52,584,290

	DRCC COST IN AVONDALE	DRCC COST IN PHOENIX	DRCC TOTAL COST
WITH CONTINGENCY	\$ 40,628,020	\$ 11,956,270	\$ 52,584,290
WITHOUT CONTINGENCY	\$ 31,252,323	\$ 9,197,131	\$ 40,449,454

DRCC

ITEM	QUANTITY	UNIT	UNIT COST	COST
Channel Excavation	523,896	CY	\$ 6	\$ 3,143,376
Channel Landscaping	80.8	AC	\$ 78,408	\$ 6,335,366
Channel Area*	97.1	AC	\$ 150,000	\$ 14,565,000
Culvert Concrete	2,903	CY	\$ 669	\$ 1,942,107
Maintenance Road**	16.3	AC	\$ 28,314	\$ 461,518
BFC Replacement	5,506	LF	148	814,888
Basin #1				\$ 5,187,292
99 Basin				\$ 7,563,049
Phoenix Culverts				\$ 436,857
Subtotal				\$ 40,449,453
Contingency 30%				\$ 12,134,836
Total				\$ 52,584,289

REVISED DRCC DESIGN DATA AND COST ESTIMATE

COST ESTIMATE FOR BASIN #1 DOWNSTREAM OF DYSART

Basin Landscaping	24 AC	\$ 78,408	\$ 1,881,792
Parcel Area	137 AC	\$ 10,000	\$ 1,370,000
Drain Pipe	4230 LF	\$ 148.00	\$ 626,040
Manholes	9 EA	4500	\$ 40,500
Headwall	1 EA	\$ 1,100	\$ 1,100
Inflow Spillway	253,572 SF	\$ 5	\$ 1,267,860
TOTAL COST			\$ 5,187,292

REVISED DRCC DESIGN DATA AND COST ESTIMATE

DRCC CHANNEL DOWNSTREAM OF DYSART

Channel Length	500 Feet
Channel Discharge	3144 cfs
Channel Slope	0.0014 Feet/Foot
Channel Side Slopes	6 Feet/Foot
Channel Bottom Width	160 Feet
Channel Roughness	0.04
Channel Flow Depth	4.7 Feet
Channel Freeboard	1.2 Feet
Channel Total Depth	5.9 Feet
Channel excavation area	1152.86 Square Feet
Channel Excavation Volume	21,349 Cubic Yards
Channel Wetted Perimeter	232 Feet
Channel Top Width	231 Feet
Channel Landscape Area	2.7 Acres
Channel Total Area	2.7 Acres
Maintenance ROW	50.0 Feet (25 feet both sides)
DRCC Total ROW Width	281 Feet
DRCC Total Area	3.2 Acres (Includes maintenance right of way)
Culvert area required	331 Square Feet
Culvert width	83 Feet (4-foot height)
Number of Culvert Barrels	9
Barrel width	9.3 Feet
Culvert Concrete Area	227.4 Square Feet
Culvert number	1
Culvert Length	110 Feet
Total Culvert Concrete	926 Cubic Yards

COST ESTIMATE

ITEM	QUANTITY	UNIT	UNIT COST	COST
Channel Excavation	21,349	CY	\$ 6	\$ 128,094
Channel Landscaping	2.8	AC	\$ 78,408	\$ 219,542
Channel Area*	3.2	AC	\$ 150,000	\$ 480,000
Culvert Concrete	926	CY	\$ 669	\$ 619,494
Maintenance Road**	0.4	AC	\$ 28,314	\$ 11,326
Total Cost				\$ 1,458,456

* Includes 50-foot Right of Way outside of channel proper.

**Two roads, 16-foot wide decomposed granite.

REVISED DRCC DESIGN DATA AND COST ESTIMATE

DRCC FROM DYSART TO EL MIRAGE

Channel Length	5136 Feet
Channel Discharge	3144 cfs
Channel Slope	0.0014 Feet/Foot
Channel Side Slopes	6 Feet/Foot
Channel Bottom Width	160 Feet
Channel Roughness	0.04
Channel Flow Depth	4.7 Feet
Channel Freeboard	1.2 Feet
Channel Total Depth	5.9 Feet
Channel excavation area	1152.86 Square Feet
Channel Excavation Volum	219,300 Cubic Yards
Channel Wetted Perimeter	232 Feet
Channel Top Width	231 Feet
Channel Landscape Area	27.4 Acres
Channel Total Area	27.2 Acres
Maintenance ROW	50.0 Feet (25 feet both sides)
DRCC Total ROW Width	281 Feet
DRCC Total Area	33.1 Acres (Includes maintenance right of way)
Culvert area required	331 Square Feet
Culvert width	83 Feet (4-foot height)
Number of Culvert Barrels	9
Barrel width	9.3 Feet
Culvert Concrete Area	227.4 Square Feet
Culvert number	0
Culvert Length	110 Feet
Total Culvert Concrete	0 Cubic Yards

COST ESTIMATE

ITEM	QUANTITY	UNIT	UNIT COST	COST
Channel Excavation	219,300	CY	\$ 6	\$ 1,315,800
Channel Landscaping	29.3	AC	\$ 78,408	\$ 2,297,354
Channel Area*	33.1	AC	\$ 150,000	\$ 4,965,000
Culvert Concrete	0	CY	\$ 669	\$ -
Maintenance Road**	3.8	AC	\$ 28,314	\$ 107,593
Total Cost				\$ 8,685,747

* Includes 50-foot Right of Way outside of channel proper.

**Two roads, 16-foot wide decomposed granite.

REVISED DRCC DESIGN DATA AND COST ESTIMATE

DRCC FROM EL MIRAGE TO SUNLAND CHANNEL CONFLUENCE

Channel Length	2262 Feet
Channel Discharge	1183 cfs
Channel Slope	0.0017 Feet/Foot
Channel Side Slopes	6 Feet/Foot
Channel Bottom Width	45 Feet
Channel Roughness	0.04
Channel Flow Depth	4.7 Feet
Channel Freeboard	1.2 Feet
Channel Total Depth	5.9 Feet
Channel excavation area	474.36 Square Feet
Channel Excavation Volum	39,741 Cubic Yards
Channel Wetted Perimeter	117 Feet
Channel Top Width	116 Feet
Channel Landscape Area	6.1 Acres
Channel Total Area	6.0 Acres
Maintenance ROW	50.0 Feet (25 feet both sides)
DRCC Total ROW Width	166 Feet
DRCC Total Area	8.6 Acres (Includes maintenance right of way)
Culvert Discharge	2704.0
Culvert area required	284 Square Feet
Culvert width	71 Feet (4-foot height)
Number of Culvert Barrels	7
Barrel width	10 Feet
Culvert Concrete Area	188 Square Feet
Culvert number	1
Culvert Length	110 Feet
Total Culvert Concrete, CY	765.9 Cubic Yards

COST ESTIMATE

ITEM	QUANTITY	UNIT	UNIT COST	COST
Channel Excavation Volum	39,741	CY	\$ 6	\$ 238,446
Channel Landscaping	6.9	AC	\$ 78,408	\$ 541,015
Channel Area*	8.6	AC	\$ 150,000	\$ 1,290,000
Culvert Concrete	766	CY	\$ 669	\$ 512,454
Maintenance Road**	1.7	AC	\$ 28,314	\$ 48,134
Total Cost				\$ 2,630,049

* Includes 50-foot Right of Way outside of channel proper.

**Two roads, 16-feet wide decomposed granite.

REVISED DRCC DESIGN DATA AND COST ESTIMATE

DRCC FROM EL SUNLAND CHANNEL CONFLUENCE TO AVONDALE BOULEVARD

Channel Length	6778 Feet
Channel Discharge	1205 cfs
Channel Slope	0.0017 Feet/Foot
Channel Side Slopes	6 Feet/Foot
Channel Bottom Width	46 feet
Channel Roughness	0.04
Channel Flow Depth	4.7 Feet (From Master Plan)
Channel Freeboard	1.2 Feet (From FCD Standards)
Channel Total Depth	5.9 Feet
Channel excavation area	480.26
Channel Excavation Volum	120,563 Cubic Yards
Channel Wetted Perimeter	118 Feet
Channel Top Width	117 Feet
Channel Landscape Area, ,	18.4 AC
Channel Total Area	18.2 AC
Maintenance ROW, FT	50.0 feet assumes 25 feet both sides
DRCC Total ROW Width	167 Feet
DRCC Total Area, AC	26.0 Includes maintenance ROW
Culvert area required	127 Square Feet
Culvert width	32 Feet (Assumes 4-foot height)
Number barrels	4
Barrel width	8 Feet
Culvert Concrete Area	94 Square Feet
Culvert number	1
Culvert Length	110 Feet
Total Culvert Concrete, CY	383 Cubic Yards

ITEM	QUANTITY	UNIT	UNIT COST	COST
Channel Excavation Volum	120,563	CY	\$ 6	\$ 723,378
Channel Landscaping	21.0	AC	\$ 78,408	\$ 1,646,568
Channel Area*	26.0	AC	\$ 150,000	\$ 3,900,000
Culvert Concrete	383	CY	\$ 669	\$ 256,227
Maintenance Road**	5.0	AC	\$ 28,314	\$ 141,570
Total Cost				\$ 6,667,743

* Includes 50-foot Right of Way outside of channel proper.

**Two roads, 16-feet wide decomposed granite.

REVISED DRCC DESIGN DATA AND COST ESTIMATE

DRCC FROM AVONDALE BOULEVARD TO 107TH AVENUE

Channel Length	5403 Feet	
Channel Discharge	1318 cfs	
Channel Slope	0.0017 Feet/Foot	
Channel Side Slopes	6 Feet/Foot	
Channel Bottom Width	49 feet	calculated
Channel Roughness	0.04	
Channel Flow Depth	4.8 Feet (From Master Plan)	
Channel Freeboard	1.2 Feet (From FCD Standards)	
Channel Total Depth	6 Feet	
Channel excavation area	510	
Channel Excavation Volum	102,057	Cubic Yards
Channel Wetted Perimeter	122 Feet	
Channel Top Width	121 Feet	
Channel Landscape Area, ,	15.1 AC	Channel Only
Channel Total Area	15.0 AC	Channel Only
Maintenance ROW, FT	50.0 feet	assumes 25 feet both sides
DRCC Total ROW Width	171 Feet	
DRCC Total Area, AC	21.2	Includes maintenance ROW
Culvert area required	137	Square Feet
Culvert width	34 Feet	(Assumes 4-foot height)
Number barrels	5	
Barrel width	7 Feet	
Culvert Concrete Area	106	Square Feet
Culvert number	1	
Culvert Length	211 Feet	
Total Culvert Concrete, CY	828	Cubic Yards

ITEM	QUANTITY	UNIT	UNIT COST	COST
Channel Excavation Volum	102,057	CY	\$ 6	\$ 612,342
Channel Landscaping	17.2	AC	\$ 78,408	\$ 1,348,618
Channel Area*	21.2	AC	\$ 150,000	\$ 3,180,000
Culvert Concrete	828	CY	\$ 669	\$ 553,932
Maintenance Road**	4.0	AC	\$ 28,314	\$ 113,256
Replace BFC w/ 48" RCP	5506	LF	\$ 148	\$ 814,888
Total Cost				\$ 6,623,036

* Includes 50-foot Right of Way outside of channel proper.

**Two roads, 16-foot wide decomposed granite.

REVISED DRCC DESIGN DATA AND COST ESTIMATE

PHOENIX CHANNEL UPSTREAM OF 107TH AND 91ST
 ASSUME SAME CHANNEL AS ALREADY IN PLACE DOWNSTREAM OF 99TH
 CHANNEL LENGTH ASSUMED (1300FT UPSTREAM OF 107TH, 600FT UPSTREAM OF 91ST)

Channel Length	1900 Feet
Channel Side Slopes	3.2 Feet/Foot
Channel Bottom Width	20 Feet
Channel Total Depth	7 Feet
Channel excavation area	296.8 Square Feet
Channel Excavation Volum	20,886 Cubic Yards
Channel Wetted Perimeter	67 Feet
Channel Top Width	65 Feet
Channel Landscape Area	2.9 Acres
Channel Total Area	2.8 Acres
Maintenance ROW	50.0 Feet (25 feet both sides)
DRCC Total ROW Width	115 Feet
DRCC Total Area	5.0 Acres (Includes maintenance right of way)

COST ESTIMATE

ITEM	QUANTITY	UNIT	UNIT COST	COST
Channel Excavation	20,886	CY	\$ 6	\$ 125,316
Channel Landscaping	3.6	AC	\$ 78,408	\$ 282,269
Channel Area*	5.0	AC	\$ 150,000	\$ 750,000
Maintenance Road**	1.4	AC	\$ 28,314	\$ 39,640
Total Cost				\$ 1,197,225

* Includes 50-foot Right of Way outside of channel proper.

**Two roads, 16-feet wide decomposed granite.

REVISED DRCC DESIGN DATA AND COST ESTIMATE

COST ESTIMATE FOR 95th Avenue Basin

EXCAVATION	161,446 CY	\$ 6.00	\$ 968,676
Basin Landscaping	27.7 AC	\$ 78,408	\$ 2,171,902
Parcel Area	29.2 AC	\$ 150,000	\$ 4,380,000
MAINTENANCE ROAD	1.5 AC	\$ 28,314	\$ 42,471

TOTAL COST \$ 7,563,049

REVISED DRCC DESIGN DATA AND COST ESTIMATE

PHOENIX CULVERTS

CULVERT DEPTH 4 FEET

Q Cap

83RD AVENUE

Number barrels	1	
Barrel width	8 Feet	345
Culvert Concrete Area	28 Square Feet	
Culvert number	1	
Culvert Length	110 Feet	
Total Culvert Concrete, CY	114 Cubic Yards	

91ST AVENUE

Number barrels	2	
Barrel width	10 Feet	862
Culvert Concrete Area	58 Square Feet	
Culvert number	1	
Culvert Length	110 Feet	
Total Culvert Concrete, CY	236 Cubic Yards	

107TH AVENUE

Number barrels	2	
Barrel width	9 Feet	775
Culvert Concrete Area	54 Square Feet	
Culvert number	1	
Culvert Length	110 Feet	
Total Culvert Concrete, CY	220 Cubic Yards	

RETENTION BASIN

Number barrels	1	
Barrel width	9 Feet	388
Culvert Concrete Area	30 Square Feet	
Culvert number	1	
Culvert Length	75 Feet	
Total Culvert Concrete, CY	83 Cubic Yards	

		COST/CY	TOTAL COST
TOTAL CULVERT CONCR	653 CY	\$ 669	\$ 436,857

REVISED DRCC DESIGN DATA AND COST ESTIMATE

THIS SPREADSHEET PROVIDES THE DETAILED COST ESTIMATE FOR THE DRCC ASSUMING:

REVISED SUNLAND CHANNEL IN PLACE AS DESCRIBED IN THE SUNLAND CAR
DATED 11/16/2006.
EXISTING DRAINAGE AREA CONDITIONS

REVISED DRCC DESIGN DATA AND COST ESTIMATE

THIS COST ESTIMATE ASSUMES FULL SUNLAND CHANNEL, RECOMMENDATION RETENTION, AND EXISTING DEVELOPMENT.

11/16/2006

COST SUMMARY

DRCC	COST
Basin #1	\$ 5,187,292
Channel Downstream of Dysart	\$ 1,457,802
Channel Dysart to El Mirage	\$ 8,656,169
Channel El Mirage to Sunland Channel	\$ 2,831,455
Channel Sunland Channel to 115th Avenue	\$ 6,667,743
Channel 115th to 107th	\$ 6,623,036
Avondale Subtotal	\$ 31,423,497
Avondale Contingency 30%	\$ 9,427,049
Avondale Total	\$ 40,850,546
95th Avenue Basin	\$ 7,563,049
Phoenix Culverts	\$ 436,857
Phoenix Channels	\$ 1,197,225
Phoenix Subtotal	\$ 9,197,131
Phoenix Contingency 30%	\$ 2,759,139
Phoenix Total	\$ 11,956,270
DRCC Total	\$ 52,806,816

	DRCC COST IN AVONDALE	DRCC COST IN PHOENIX	DRCC TOTAL COST
WITH CONTINGENCY	\$ 40,850,546	\$ 11,956,270	\$ 52,806,816
WITHOUT CONTINGENCY	\$ 31,423,497	\$ 9,197,131	\$ 40,620,628

DRCC

ITEM	QUANTITY	UNIT	UNIT COST	COST
Channel Excavation	529,584	CY	\$ 6	\$ 3,177,504
Channel Landscaping	81.4	AC	\$ 78,408	\$ 6,382,411
Channel Area*	97.7	AC	\$ 150,000	\$ 14,655,000
Culvert Concrete	2,903	CY	\$ 669	\$ 1,942,107
Maintenance Road**	16.3	AC	\$ 28,314	\$ 461,518
BFC Replacement	5,506	LF	148	814,888
Basin #1				\$ 5,187,292
99 Basin				\$ 7,563,049
Phoenix Culverts				\$ 436,857
Subtotal				\$ 40,620,626
Contingency 30%				\$ 12,186,188
Total				\$ 52,806,814

REVISED DRCC DESIGN DATA AND COST ESTIMATE

COST ESTIMATE FOR BASIN #1 DOWNSTREAM OF DYSART

Basin Landscaping	24 AC	\$ 78,408	\$ 1,881,792
Parcel Area	137 AC	\$ 10,000	\$ 1,370,000
Drain Pipe	4230 LF	\$ 148.00	\$ 626,040
Manholes	9 EA	4500	\$ 40,500
Headwall	1 EA	\$ 1,100	\$ 1,100
Inflow Spillway	253,572 SF	\$ 5	\$ 1,267,860
TOTAL COST			\$ 5,187,292

REVISED DRCC DESIGN DATA AND COST ESTIMATE

DRCC CHANNEL DOWNSTREAM OF DYSART

Channel Length	500 Feet
Channel Discharge	3115 cfs
Channel Slope	0.0014 Feet/Foot
Channel Side Slopes	6 Feet/Foot
Channel Bottom Width	159 Feet
Channel Roughness	0.04
Channel Flow Depth	4.7 Feet
Channel Freeboard	1.2 Feet
Channel Total Depth	5.9 Feet
Channel excavation area	1146.96 Square Feet
Channel Excavation Volume	21,240 Cubic Yards
Channel Wetted Perimeter	231 Feet
Channel Top Width	230 Feet
Channel Landscape Area	2.7 Acres
Channel Total Area	2.6 Acres
Maintenance ROW	50.0 Feet (25 feet both sides)
DRCC Total ROW Width	280 Feet
DRCC Total Area	3.2 Acres (Includes maintenance right of way)
Culvert area required	328 Square Feet
Culvert width	82 Feet (4-foot height)
Number of Culvert Barrels	9
Barrel width	9.3 Feet
Culvert Concrete Area	227.4 Square Feet
Culvert number	1
Culvert Length	110 Feet
Total Culvert Concrete	926 Cubic Yards

COST ESTIMATE

ITEM	QUANTITY	UNIT	UNIT COST	COST
Channel Excavation	21,240	CY	\$ 6	\$ 127,440
Channel Landscaping	2.8	AC	\$ 78,408	\$ 219,542
Channel Area*	3.2	AC	\$ 150,000	\$ 480,000
Culvert Concrete	926	CY	\$ 669	\$ 619,494
Maintenance Road**	0.4	AC	\$ 28,314	\$ 11,326
Total Cost				\$ 1,457,802

* Includes 50-foot Right of Way outside of channel proper.

**Two roads, 16-foot wide decomposed granite.

REVISED DRCC DESIGN DATA AND COST ESTIMATE

DRCC FROM DYSART TO EL MIRAGE

Channel Length	5136 Feet
Channel Discharge	3115 cfs
Channel Slope	0.0014 Feet/Foot
Channel Side Slopes	6 Feet/Foot
Channel Bottom Width	159 Feet
Channel Roughness	0.04
Channel Flow Depth	4.7 Feet
Channel Freeboard	1.2 Feet
Channel Total Depth	5.9 Feet
Channel excavation area	1146.96 Square Feet
Channel Excavation Volum	218,177 Cubic Yards
Channel Wetted Perimeter	231 Feet
Channel Top Width	230 Feet
Channel Landscape Area	27.2 Acres
Channel Total Area	27.1 Acres
Maintenance ROW	50.0 Feet (25 feet both sides)
DRCC Total ROW Width	280 Feet
DRCC Total Area	33.0 Acres (Includes maintenance right of way)
Culvert area required	328 Square Feet
Culvert width	82 Feet (4-foot height)
Number of Culvert Barrels	9
Barrel width	9.3 Feet
Culvert Concrete Area	227.4 Square Feet
Culvert number	0
Culvert Length	110 Feet
Total Culvert Concrete	0 Cubic Yards

COST ESTIMATE

ITEM	QUANTITY	UNIT	UNIT COST	COST
Channel Excavation	218,177	CY	\$ 6	\$ 1,309,062
Channel Landscaping	29.2	AC	\$ 78,408	\$ 2,289,514
Channel Area*	33.0	AC	\$ 150,000	\$ 4,950,000
Culvert Concrete	0	CY	\$ 669	\$ -
Maintenance Road**	3.8	AC	\$ 28,314	\$ 107,593
Total Cost				\$ 8,656,169

* Includes 50-foot Right of Way outside of channel proper.

**Two roads, 16-foot wide decomposed granite.

REVISED DRCC DESIGN DATA AND COST ESTIMATE

DRCC FROM EL MIRAGE TO SUNLAND CHANNEL CONFLUENCE

Channel Length	2262 Feet
Channel Discharge	1455 cfs
Channel Slope	0.0017 Feet/Foot
Channel Side Slopes	6 Feet/Foot
Channel Bottom Width	59 Feet
Channel Roughness	0.04
Channel Flow Depth	4.7 Feet
Channel Freeboard	1.2 Feet
Channel Total Depth	5.9 Feet
Channel excavation area	556.96 Square Feet
Channel Excavation Volum	46,661 Cubic Yards
Channel Wetted Perimeter	131 Feet
Channel Top Width	130 Feet
Channel Landscape Area	6.8 Acres
Channel Total Area	6.8 Acres
Maintenance ROW	50.0 Feet (25 feet both sides)
DRCC Total ROW Width	180 Feet
DRCC Total Area	9.3 Acres (Includes maintenance right of way)
Culvert Discharge	2688.0
Culvert area required	283 Square Feet
Culvert width	71 Feet (4-foot height)
Number of Culvert Barrels	7
Barrel width	10 Feet
Culvert Concrete Area	188 Square Feet
Culvert number	1
Culvert Length	110 Feet
Total Culvert Concrete, CY	765.9 Cubic Yards

COST ESTIMATE

ITEM	QUANTITY	UNIT	UNIT COST	COST
Channel Excavation Volum	46,661	CY	\$ 6	\$ 279,966
Channel Landscaping	7.6	AC	\$ 78,408	\$ 595,901
Channel Area*	9.3	AC	\$ 150,000	\$ 1,395,000
Culvert Concrete	766	CY	\$ 669	\$ 512,454
Maintenance Road**	1.7	AC	\$ 28,314	\$ 48,134
Total Cost				\$ 2,831,455

* Includes 50-foot Right of Way outside of channel proper.

**Two roads, 16-feet wide decomposed granite.

REVISED DRCC DESIGN DATA AND COST ESTIMATE

DRCC FROM EL SUNLAND CHANNEL CONFLUENCE TO AVONDALE BOULEVARD

Channel Length	6778 Feet
Channel Discharge	1205 cfs
Channel Slope	0.0017 Feet/Foot
Channel Side Slopes	6 Feet/Foot
Channel Bottom Width	46 feet
Channel Roughness	0.04
Channel Flow Depth	4.7 Feet (From Master Plan)
Channel Freeboard	1.2 Feet (From FCD Standards)
Channel Total Depth	5.9 Feet
Channel excavation area	480.26
Channel Excavation Volum	120,563 Cubic Yards
Channel Wetted Perimeter	118 Feet
Channel Top Width	117 Feet
Channel Landscape Area, ,	18.4 AC
Channel Total Area	18.2 AC
Maintenance ROW, FT	50.0 feet assumes 25 feet both sides
DRCC Total ROW Width	167 Feet
DRCC Total Area, AC	26.0 Includes maintenance ROW
Culvert area required	127 Square Feet
Culvert width	32 Feet (Assumes 4-foot height)
Number barrels	4
Barrel width	8 Feet
Culvert Concrete Area	94 Square Feet
Culvert number	1
Culvert Length	110 Feet
Total Culvert Concrete, CY	383 Cubic Yards

ITEM	QUANTITY	UNIT	UNIT COST	COST
Channel Excavation Volum	120,563	CY	\$ 6	\$ 723,378
Channel Landscaping	21.0	AC	\$ 78,408	\$ 1,646,568
Channel Area*	26.0	AC	\$ 150,000	\$ 3,900,000
Culvert Concrete	383	CY	\$ 669	\$ 256,227
Maintenance Road**	5.0	AC	\$ 28,314	\$ 141,570
Total Cost				\$ 6,667,743

* Includes 50-foot Right of Way outside of channel proper.

**Two roads, 16-feet wide decomposed granite.

REVISED DRCC DESIGN DATA AND COST ESTIMATE

DRCC FROM AVONDALE BOULEVARD TO 107TH AVENUE

Channel Length	5403 Feet	
Channel Discharge	1318 cfs	
Channel Slope	0.0017 Feet/Foot	
Channel Side Slopes	6 Feet/Foot	
Channel Bottom Width	49 feet	calculated
Channel Roughness	0.04	
Channel Flow Depth	4.8 Feet (From Master Plan)	
Channel Freeboard	1.2 Feet (From FCD Standards)	
Channel Total Depth	6 Feet	
Channel excavation area	510	
Channel Excavation Volum	102,057	Cubic Yards
Channel Wetted Perimeter	122 Feet	
Channel Top Width	121 Feet	
Channel Landscape Area, ,	15.1 AC	Channel Only
Channel Total Area	15.0 AC	Channel Only
Maintenance ROW, FT	50.0 feet	assumes 25 feet both sides
DRCC Total ROW Width	171 Feet	
DRCC Total Area, AC	21.2	Includes maintenance ROW
Culvert area required	137	Square Feet
Culvert width	34 Feet	(Assumes 4-foot height)
Number barrels	5	
Barrel width	7 Feet	
Culvert Concrete Area	106	Square Feet
Culvert number	1	
Culvert Length	211 Feet	
Total Culvert Concrete, CY	828	Cubic Yards

ITEM	QUANTITY	UNIT	UNIT COST	COST
Channel Excavation Volum	102,057	CY	\$ 6	\$ 612,342
Channel Landscaping	17.2	AC	\$ 78,408	\$ 1,348,618
Channel Area*	21.2	AC	\$ 150,000	\$ 3,180,000
Culvert Concrete	828	CY	\$ 669	\$ 553,932
Maintenance Road**	4.0	AC	\$ 28,314	\$ 113,256
Replace BFC w/ 48" RCP	5506	LF	\$ 148	\$ 814,888
Total Cost				\$ 6,623,036

* Includes 50-foot Right of Way outside of channel proper.

**Two roads, 16-feet wide decomposed granite.

REVISED DRCC DESIGN DATA AND COST ESTIMATE

PHOENIX CHANNEL UPSTREAM OF 107TH AND 91ST
 ASSUME SAME CHANNEL AS ALREADY IN PLACE DOWNSTREAM OF 99TH
 CHANNEL LENGTH ASSUMED (1300FT UPSTREAM OF 107TH, 600FT UPSTREAM OF 91ST)

Channel Length	1900 Feet
Channel Side Slopes	3.2 Feet/Foot
Channel Bottom Width	20 Feet
Channel Total Depth	7 Feet
Channel excavation area	296.8 Square Feet
Channel Excavation Volum	20,886 Cubic Yards
Channel Wetted Perimeter	67 Feet
Channel Top Width	65 Feet
Channel Landscape Area	2.9 Acres
Channel Total Area	2.8 Acres
Maintenance ROW	50.0 Feet (25 feet both sides)
DRCC Total ROW Width	115 Feet
DRCC Total Area	5.0 Acres (Includes maintenance right of way)

COST ESTIMATE

ITEM	QUANTITY	UNIT	UNIT COST	COST
Channel Excavation	20,886	CY	\$ 6	\$ 125,316
Channel Landscaping	3.6	AC	\$ 78,408	\$ 282,269
Channel Area*	5.0	AC	\$ 150,000	\$ 750,000
Maintenance Road**	1.4	AC	\$ 28,314	\$ 39,640
Total Cost				\$ 1,197,225

* Includes 50-foot Right of Way outside of channel proper.

**Two roads, 16-foot wide decomposed granite.

REVISED DRCC DESIGN DATA AND COST ESTIMATE

COST ESTIMATE FOR 95th Avenue Basin

EXCAVATION	161,446 CY	\$ 6.00	\$ 968,676
Basin Landscaping	27.7 AC	\$ 78,408	\$ 2,171,902
Parcel Area	29.2 AC	\$ 150,000	\$ 4,380,000
MAINTENANCE ROAD	1.5 AC	\$ 28,314	\$ 42,471

TOTAL COST \$ 7,563,049

REVISED DRCC DESIGN DATA AND COST ESTIMATE

PHOENIX CULVERTS

CULVERT DEPTH 4 FEET

Q Cap

83RD AVENUE

Number barrels	1	
Barrel width	8 Feet	345
Culvert Concrete Area	28 Square Feet	
Culvert number	1	
Culvert Length	110 Feet	
Total Culvert Concrete, CY	114 Cubic Yards	

91ST AVENUE

Number barrels	2	
Barrel width	10 Feet	862
Culvert Concrete Area	58 Square Feet	
Culvert number	1	
Culvert Length	110 Feet	
Total Culvert Concrete, CY	236 Cubic Yards	

107TH AVENUE

Number barrels	2	
Barrel width	9 Feet	775
Culvert Concrete Area	54 Square Feet	
Culvert number	1	
Culvert Length	110 Feet	
Total Culvert Concrete, CY	220 Cubic Yards	

RETENTION BASIN

Number barrels	1	
Barrel width	9 Feet	388
Culvert Concrete Area	30 Square Feet	
Culvert number	1	
Culvert Length	75 Feet	
Total Culvert Concrete, CY	83 Cubic Yards	

		COST/CY	TOTAL COST
TOTAL CULVERT CONCR	653 CY	\$ 669	\$ 436,857