FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

GILA BEND AREA DRAINAGE MASTER PLAN

Level II Analysis Report

February, 2001

Engineering and Environmental Consultants, Inc.

Flood Control District of Maricopa County
2801 West Durango Street
Phoenix, Arizona 85009
(602) 506-1501 fax (602) 506-4601

MEMO

To: Geza Kmetty

From: Chris Perry

Date: March 5, 2001

Subject: Gila Bend Area Drainage Master Plan, Level 2 Analysis comments

1) Hacker Wash Overflow Channel:
   a) Please provide an exhibit that shows where the breakout is assumed to occur along the existing channel.
   b) Please provide a backwater analysis of the proposed solution with the next submittal.
   c) Consider a deeper, stepped-down weir section to ensure sufficient head to convey design flows to the overflow channel and to reduce backwater effects.
   d) The flow arrows on Exhibit 4.7 seem to indicate that the flow carried by the channel are primarily from the I-8 culverts. However, from the previous HEC-1 analysis, the portion diverted west along I-8 is actually greater than the flow through the culverts (the culverts only have a capacity of 1900 cfs according to exhibit 2.2). Please amend the exhibit to show both flow routes, labeled with each route's peak flow.

2) Harrington Avenue Drainage Improvements:
   Since the town area suffers most significantly from frequent local drainage problems, increase the design storm for new improvements from the 2-year to the 10-year event.

   This comment also applies to St. Louis Avenue Drainage Improvements.

3) Section 4.2.1, Page 25, "Identification of Washes to be Preserved":
   Include a sentence or brief paragraph outlining the source of the guidelines (4 rules).

4) Section 4.4, Page 31, "Sand Tank Wash Flood Control Improvements":
   In paragraph 3, the word "eliminating" in the second sentence should be changed to "reducing."

Please call me at x.64001 if you have any questions concerning these comments.

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February, 2001

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Engineering and Environmental Consultants, Inc.

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SECTION 1: INTRODUCTION

1.1 Purpose of Study

The purpose of the Gila Bend Area Drainage Master Plan (ADMP) is to 1) identify existing drainage problems and develop corrective measures and, 2) develop an overall drainage plan that will provide a tool to make sure that future growth provides adequate storm water conveyance without adversely impacting existing development.

Recently, there's been a considerable amount of land development interest in the Gila Bend area. Projects under consideration include a new 200-acre, in-town residential development, a power generating plant, and a large residential development west of the Town. In addition, the Arizona Department of Transportation is planning to widen State Route 85 (SR85) from 2-lanes into a divided, 4-lane highway. SR85 carries traffic from the Phoenix metro area, via I-10, to Gila Bend. Widening it to 4 lanes will make travel from the Phoenix area safer and faster which will likely fuel development interest in the Gila Bend area. The Gila Bend ADMP will provide a tool to properly plan for the storm water conveyance needs of the anticipated growth.

1.2 Purpose of Report

The purpose of this report, the Level II Analysis Report, is to document the alternative analysis and present a recommended drainage master plan for the Gila Bend area. This report includes the following documentation of the recommended plan: 1) documentation of the hydrologic and hydraulic analysis of the flood control improvements, 2) conceptual landscape themes for the flood control improvements, and 3) itemized cost estimates for the flood control improvements.

1.3 Study Area

The study area boundaries are shown on Exhibit 1.1. The boundaries are the Gila River on the north, Citrus Valley Road on the west, the Barry Goldwater Gunnery Range on the south, and the section line east of the Gila Bend Municipal Airport on the east. The ADMP is divided into two distinct areas: the planning area and the Town core area.

1.3.1 Planning Area

The planning area covers approximately 48 square miles and has the boundaries described above. The objective in the planning area is to define the existing flood hazards, develop solutions to the existing problems, and develop an overall drainage plan for future development that will allow future growth to occur without adversely impacting existing or future development. The ADMP for the planning area will address the major conveyance corridors throughout the study area,

including the portions of Sand Tank Wash and Scott Avenue Wash that flow through the Town Core area.

The *western planning area* (west of Gila Boulevard) is primarily undeveloped active and fallow farmlands. Paloma Ranch owns most of the developable lands to the west. They refer to the area as Citrus Valley (see Data Collection Report). It is envisioned that the flood control improvements proposed for the west area will be built with future land developments within Citrus Valley. The purpose of the ADMP for the west area is to define the floodwater conveyance requirements for the future developments and provide the Town with a tool that they can use to ensure that sufficient storm water conveyance is provided as the area develops.

The *eastern planning area* (east of Gila Boulevard) includes Bender Wash, Sand Tank Wash and Scott Avenue Wash. These washes are the primary flooding sources for the town core area. Flood control improvements on these washes would benefit existing development that is currently within the floodplain. The purpose of the ADMP for the east planning area is to assess potential flood control alternatives that would benefit existing homes and businesses in the Town core area. In addition, the ADMP will provide drainage requirements for new development.

1.3.2 Town Core Area

The Town core area covers approximately 3 square miles. Its boundaries are I-8 on the South, Gila Boulevard on the west, Indian Road on the north, and 299th Avenue (Stout Road) on the east. The objective of the ADMP in the Town core area is to identify and develop cost effective solutions for local drainage problems. These are flooding problems that are not related to flooding on Sand Tank Wash or Scott Avenue Wash, but are instead local problems caused by storm water runoff within the Town.

For purposes of this report, the town core area has been divided into four separate local watersheds. They are the *South Gila Bend, Harrington Avenue, Scott Avenue Wash, and St. Louis Avenue* watersheds. Existing flooding problems and alternative solutions are discussed separately for each of these local watersheds.

1.4 Project Scope

Review of Existing Data: Review of existing data includes previous drainage studies, documentation of flood problems, plans of existing and proposed drainage structures, land ownership data, location of existing and proposed recreational facilities, environmental data (including ecological and cultural data), and data on existing utilities.

Survey and Mapping: New mapping is included in the scope of work to supplement the existing mapping that was done as part of the Gila Bend Area

Floodplain Delineation Study. This mapping effort includes approximately 5 square miles of 2-foot contour mapping in the immediate vicinity of the Town of Gila Bend. It also includes approximately 17 square miles of 4-foot contour mapping within the planning area.

Hydrologic Analysis: The hydrologic analysis includes review of the existing HEC-1 hydrologic models for the planning area as well as development of a new hydrologic model for the town core area. The hydrologic analysis also includes modification of the existing HEC-1 models in order to assess the impact of the alternative flood control solutions.

Assessment of Environmental Data: The scope includes an inventory of environmental data to assess environmental impacts of the flood control alternatives. The environmental data includes ecological resources, cultural resources, estimated limits of 404 jurisdictional waters, and locations of hazardous waste sites.

Floodplain Delineations: The scope of work includes 18 stream miles of detailed floodplain/floodway delineations on the washes south of I-8 and15 stream miles of approximate floodplain delineations on the washes north of I-8.

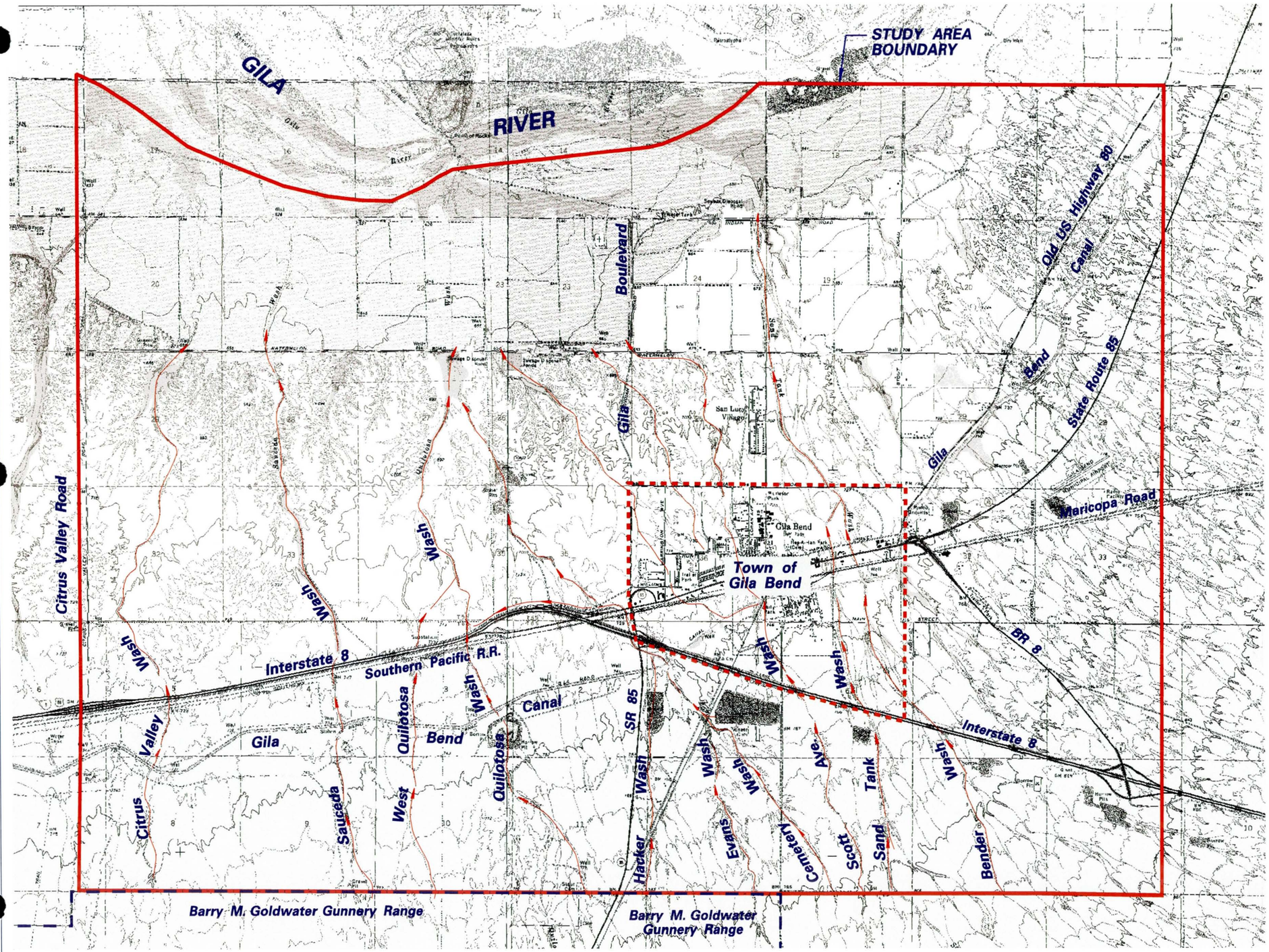
Landscape Guidelines: The work includes a landscape character analysis of the Gila Bend area as well as the development of landscape guidelines for the proposed features of the ADMP.

Identification of Drainage Problems and Development of Alternative Solutions: The alternatives analysis includes solutions to known flooding problems as well as development of plans to maintain storm water conveyance as the area develops. The analysis considers environmental impacts, right-of-way costs, incorporation of recreational facilities, impact to major utilities, construction costs, and maintenance.

Preparation of Preliminary Design Plans: The scope of work includes preparation of preliminary design plans of the preferred alternative.

Public Involvement: Three public meetings are included in the scope of work. One to inform the public about the study, another to present the alternative drainage plans and a third to present the final area drainage master plan.

Reports: A series of reports are included in the scope of work intended to document the study process. These include the Data Collection Report, the Alternatives Analysis Report, and the Recommended Design Report. In addition, a Technical Data Notebook will be prepared to document the Floodplain Delineation Study.



GILA BEND
Area Drainage Master Plan

STUDY AREA MAP
Exhibit 1.1

LEGEND

- PLANNING STUDY AREA BOUNDARY
- CORE STUDY AREA BOUNDARY
- GUNNERY RANGE BOUNDARY

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SCALE: 1" = 4,000'

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SECTION 2: EXISTING CONDITIONS/FLOODING PROBLEMS

2.1 Flood Flows

Exhibit 2.1 presents the existing condition, 100-year flood flows. These flows were developed with two previous studies and then modified with this ADMP. The two previous studies were the "Gila Bend Area Floodplain Delineation Study" and the "Gila Bend Canal Floodplain Delineation Study"; both were prepared for the Flood Control District and serve as the hydrologic base for the ADMP. The detailed floodplain delineations, done as part of this ADMP, revealed additional/revised flow diversions that were not included in the original hydrology models. The modified diversions are documented in the Gila Bend ADMP, Floodplain Delineations report. In most cases, the results of the modified diversions are reflected on Exhibit 2.1, however, in the case of Sand Tank Wash, Scott Avenue Wash, and Bender Wash, the peak flows presented on Exhibit 2.1 (downstream of I-8) are the current FEMA peak discharges. The FEMA peak flows are actually higher than the modified values. However, since the modified peak flows are based on numerous upstream split flow calculations with their inherent uncertainty, the FEMA peak discharges were left unchanged.

2.2 Drainage Facilities

Exhibit 2.2 presents the existing drainage facilities within the study area. For the most part these facilities are associated with cross drainage through I-8, the Gila Bend Canal, SR85, B-8, and the Railroad. The exception to this is the channelization that Paloma Ranch did on the washes within the agricultural areas west of the Town. The approximate size and capacity of these channels is indicated on Exhibit 2.2.

2.3 Existing Conditions

2.3.1 Western Planning Area (west of Gila Blvd.)

The West Planning Area contains both natural and man-made channels. Upstream of the Gila Bend Canal, the channels are natural, shallow, braided washes typically found in the lower Sonoran Desert environment. Downstream of the Canal, however, the land has been graded for agriculture, with several man-made channels that drain to the Gila River. These manmade channels don't have adequate capacity to convey the 100-year flood.

The Gila Bend Canal is built on an elevated embankment, throughout the West Planning Area, that intercepts and redistributes flood flows from their natural paths. Although canal overchutes and/or culverts are provided at most of the major wash crossings, they don't have adequate capacity to pass the 100-year

flood. As a result, the Canal will be overtopped in a number of locations during a 100-year flood. The overtopping could occur almost anywhere between SR85 and Citrus Valley Road, but the highest risk areas are at the intersections with major washes. The floodplain delineations study identified overtopping at Citrus Valley Wash, West Quilotosa Wash, Quilotosa Wash, and just west of SR85.

Downstream of the Canal, the wash crossings under I-8 and the Railroad also don't have enough capacity for the 100-year flood. This results in overtopping of the Railroad and the Highway at Citrus Valley Wash, Sauceda Wash, Quilotosa Wash, West Quilotosa Wash, and Hacker Wash. At Citrus Valley Wash, the Railroad has sufficient capacity, but the Highway doesn't.

Although there are flooding problems associated with the inadequate conveyance capacity at the culvert crossings on I-8, the Railroad, the Gila Bend Canal, and the channeled washes north of I-8, the natural conveyance corridors have been preserved, albeit with inadequate capacity. Therefore, future development can provide adequate floodwater conveyance simply by improving the conveyance capacity of the existing drainage corridors.

Currently there aren't any homes or other buildings in the west planning area and so the problems outlined above only impact the Canal, the Highway, the Railroad, and the agricultural areas. Therefore, it is envisioned that the west area flood control improvements will be constructed with future land development projects. The purpose of the ADMP in this area is to describe the problems, provide alternative solutions and, most importantly, provide the Town with a tool that will ensure new development is constructed with adequate floodwater conveyance.

2.3.2 Eastern Planning Area (east of Gila Blvd.)

The main drainage feature in the East Planning Area is Sand Tank Wash, which passes through the Town Core, crossing I-8, the Gila Bend Canal, the Southern Pacific Railroad tracks, and Business Route 8 (Pima Street). Sand Tank Wash has the largest watershed of all the washes in the Gila Bend area. Upstream of I-8, its 100-year peak discharge is 23,800 cfs. For the most part, the Town has done a good job of floodplain management relative to the Sand Tank Wash floodplain; with only about 25 structures located within the floodplain. The biggest problem with Sand Tank Wash is the split flows that occur upstream of I-8, diverting substantial flows towards the west and significantly increasing the peak discharges on Scott Avenue Wash, Evans Wash, and Hacker Wash. This diversion results in both drainage problems and drainage benefits for Gila Bend. The benefit is that the peak discharge on Sand Tank Wash is reduced through the Town core area. The problem is that the diversion adds a considerable amount of runoff to Scott Avenue Wash and Hacker Wash. The diversion is also a significant problem in terms of floodplain management upstream of I-8. Future development would have to be designed to maintain the diversion, otherwise the

downstream floodplain delineation on Sand Tank Wash (which was based on the reduced peak discharge), could be exceeded.

2.4 Flooding Problems – Planning Area

Exhibit 2.3 presents the known flooding problems within the planning area. The following is a summary of the problems, identified through discussions with representatives of the Town, through review of previous flood studies, and through the floodplain delineation work done with this ADMP.

Citrus Valley Wash

- Overtops of the Gila Bend Canal
- Overtops of I-8

Sauceda Wash

- Overtops the Gila Bend Canal
- Overtops the Southern Pacific railroad
- Overtops I-8
- Flow diversion to the east at I-8
- Exceeds capacity of Manmade channel downstream of I-8

West Quilotosa Wash

- Overtops the Gila Bend Canal (no drainage crossing at Canal)
- Flow diversion to the west at the Gila Bend Canal (diverts to Sauceda Wash)
- Overtops the Southern Pacific Railroad
- Overtops I-8
- Exceeds the capacity of the manmade channel downstream of I-8

Quilotosa Wash

- Overtops the Gila Bend Canal
- Overtops the Southern Pacific Railroad
- Overtops I-8
- Exceeds the capacity of the manmade channel downstream of I-8

Evans Wash

- Overtops the Tucson-Cornelia and gila bend Railroad
- Overtops Gila Bend Canal at confluence with Hacker Wash; resulting in a split flow with some flow diverting westerly over SR85 and the remainder spilling over the Canal.

Hacker Wash

- Overtops SR85 downstream of the Gila Bend Canal
- Exceeds Capacity of I-8 culvert causing large portion of flow to divert westerly along the I-8 embankment

- Overtops the Southern Pacific Railroad, Pima Street, and the I-8 Frontage Road
- Exceeds capacity of manmade channel downstream of I-8 and splits out, flowing northerly through the fallow farmland north of I-8.

Scott Avenue Wash

- Conveys substantial flow that splits out of the Sand Tank Wash floodplain
- Exceeds capacity of I-8 culvert; causing flow through the Martin Avenue underpass and a diversion of flow westerly along I-8
- Overtops Tucson-Cornelia and Gila Bend Railroad
- Overtops the Gila Bend Canal (causes diversion of a portion of the flow into Harrington Avenue watershed)
- Ponding behind the Gila Bend Canal floods a large part of the residential area (approximately 75 homes) in the South Gila Bend area
- Overtops the Southern Pacific Railroad, Pima Street, Papago Street, Hunt street, Richards Street and Indian Road
- Floods approx. 30 homes and businesses downstream of the Gila Bend Canal

Sand Tank Wash

- Floodwaters split out of the floodplain upstream of I-8, flowing westerly into Scott Avenue Wash (causes a substantial increase in peak discharge on Scott Avenue Wash)
- Exceeds capacity of the I-8 bridges, causing flow to be diverted westerly along the highway embankment (the diverted flow causes a substantial increase in peak discharge on Scott Avenue Wash and Evans Wash)
- Overtops the Gila Bend Canal
- Overtops the levee protecting the South Gila Bend area
- Overtops the Southern Pacific Railroad
- Overtops Pima Street, Indian Road, St. Louis Avenue, and Watermelon Road
- Floods approximately 15 homes and businesses

Bender Wash

- Floodwaters split out of the floodplain upstream of I-8, flowing westerly into Sand Tank Wash
- Exceeds capacity of the I-8 culverts, causing flow to be diverted westerly along the highway embankment
- Combines with Sand Tank Wash and overtops the Gila Bend Canal

2.5 Flooding Problems – Town Core Area

Exhibit 2.4 presents the known flooding problems within the Town core area. Town officials identified these problems.

Harrington Avenue Drainage Basin

- Flooding along Harrington Avenue that gets approximately 12 inches deep during larger storms.
- Ponded storm water in the alley north of Margaret Street that doesn't drain away when the storms are over.

Scott Avenue Wash Drainage Basin

- Street flooding at roadway crossings along Scott Avenue Wash.
- Flooding at Hunt Street just west of Johnny Street (at the concentration point of Subbasin number 20).
- Flooding of homes and yards along Scott Avenue Wash.

South Gila Bend Drainage Basin

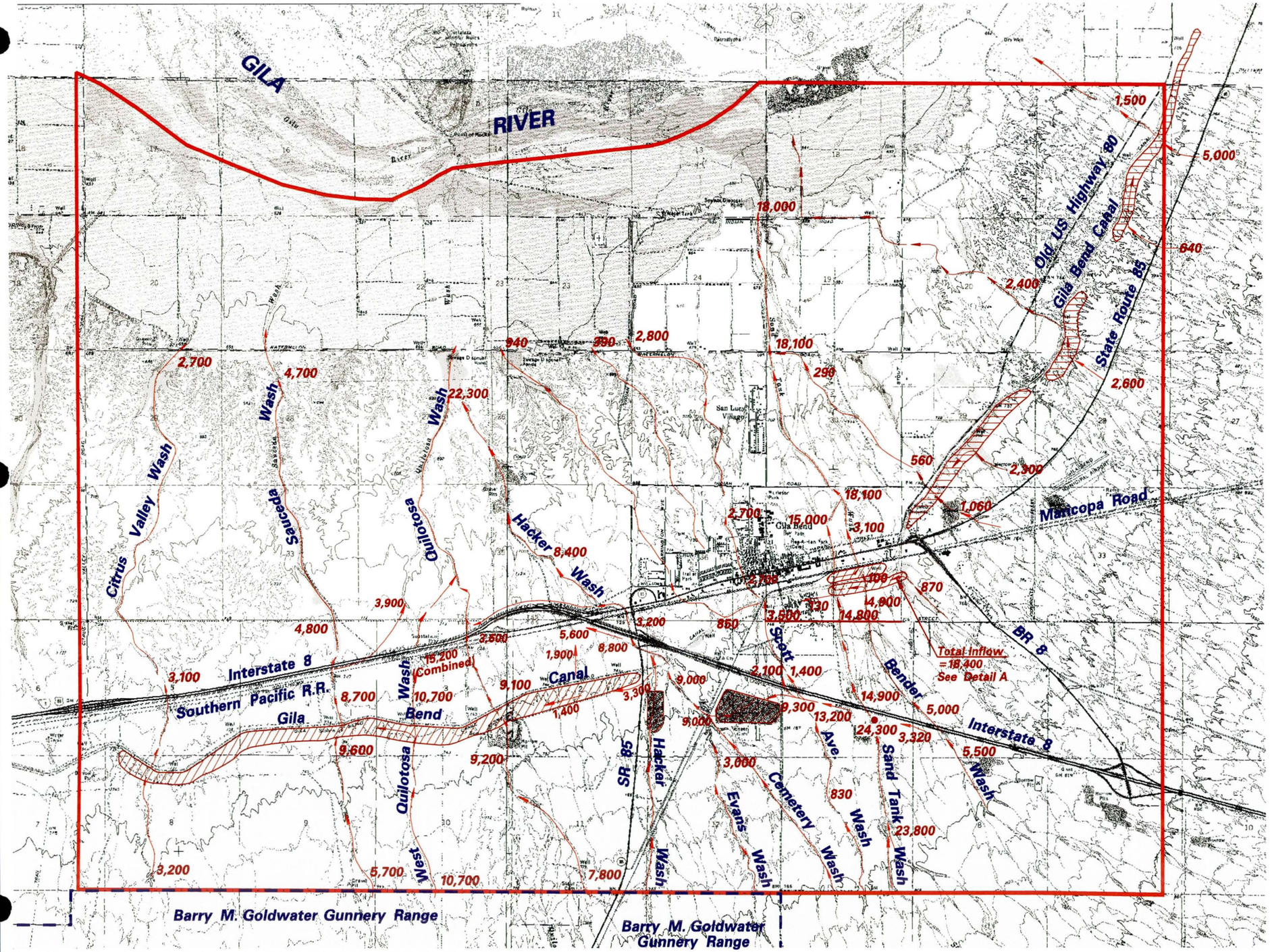
- Standing water in streets that doesn't drain away after the rain storms end.
- Flooding of homes and yards along the Gila Bend Canal that is caused by storm water buildup behind the Canal and behind the dike on Sand Tank Wash.

St. Louis Avenue Drainage Basin

- Flooding as well as standing water along St. Louis Avenue.
- Flooding over Richards Street, west of St. Louis Avenue.

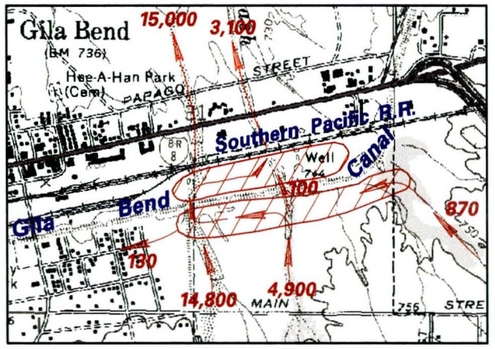
GILA BEND
Area Drainage Master Plan

EXISTING CONDITION
100–YEAR FLOOD FLOWS
Exhibit 2.1



LEGEND

2,600	100–YEAR PEAK DISCHARGE IN CFS
	FLOW PATH
	PONDING AREA
	PLANNING AREA STUDY BOUNDARY



DETAIL A

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SCALE: 1" = 4,000'

NOTE: FLOOD FLOWS DOWNSTREAM OF I-8 ON SCOTT AVENUE WASH, SAND TANK WASH AND BENDER WASH ARE BASED ON FEMA APPROVED PEAK DISCHARGES AND DO NOT REFLECT CHANGES IN DIVERSIONS UPSTREAM OF I-8 DISCOVERED WITH THIS STUDY.

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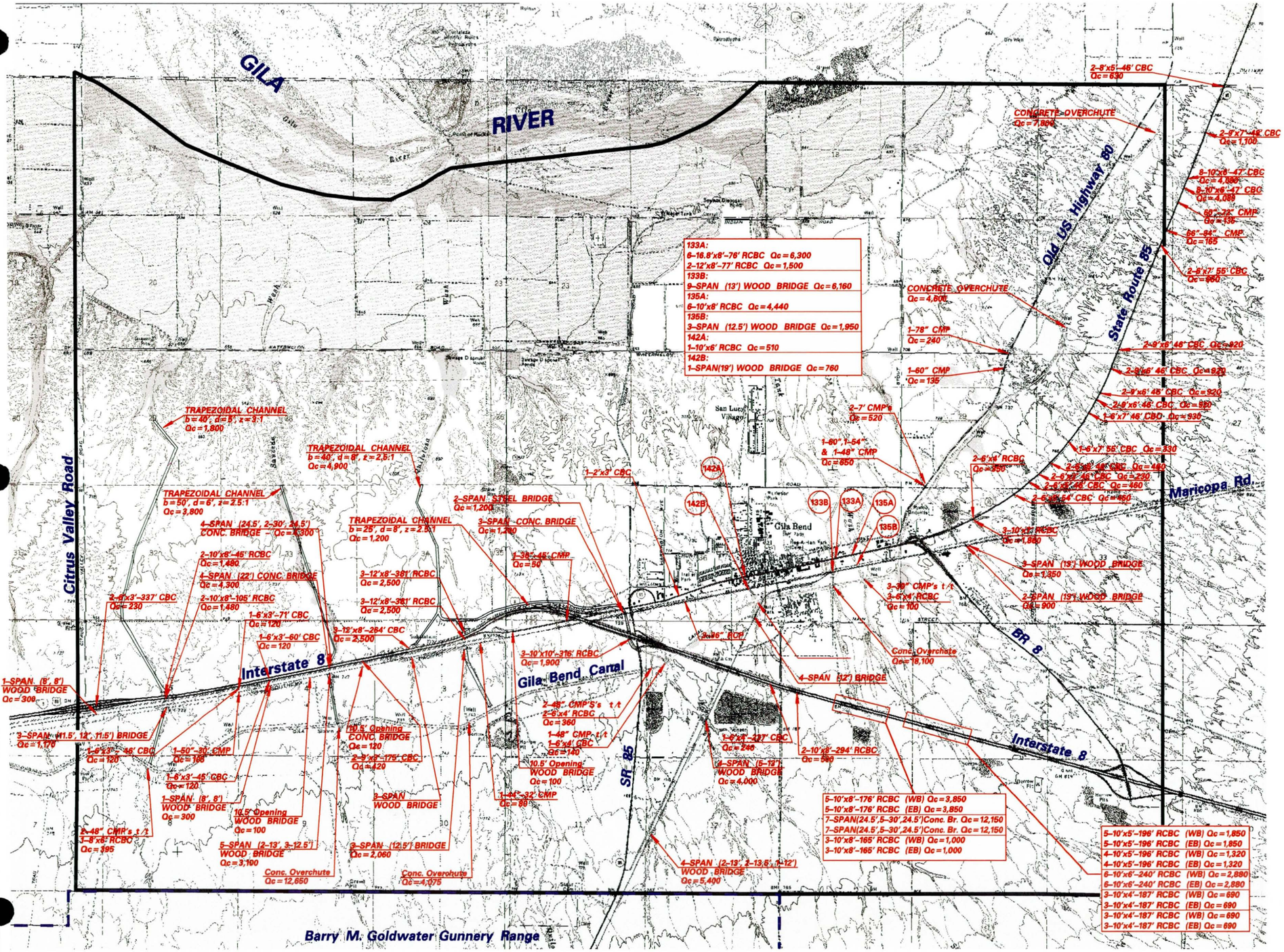

GILA BEND
Area Drainage Master Plan

EXISTING DRAINAGE FACILITIES
Exhibit 2.2

LEGEND & ABBREVIATIONS

———	PLANNING STUDY AREA BOUNDARY
RCBC	REINFORCED CONCRETE BOX CULVERT
Qc	APPROXIMATE CONVEYANCE CAPACITY IN cfs
CMP	CORRUGATED METAL PIPE
WB	WEST BOUND
EB	EAST BOUND
t/t	TRANSITION TO

N

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SCALE: 1" = 4,000'

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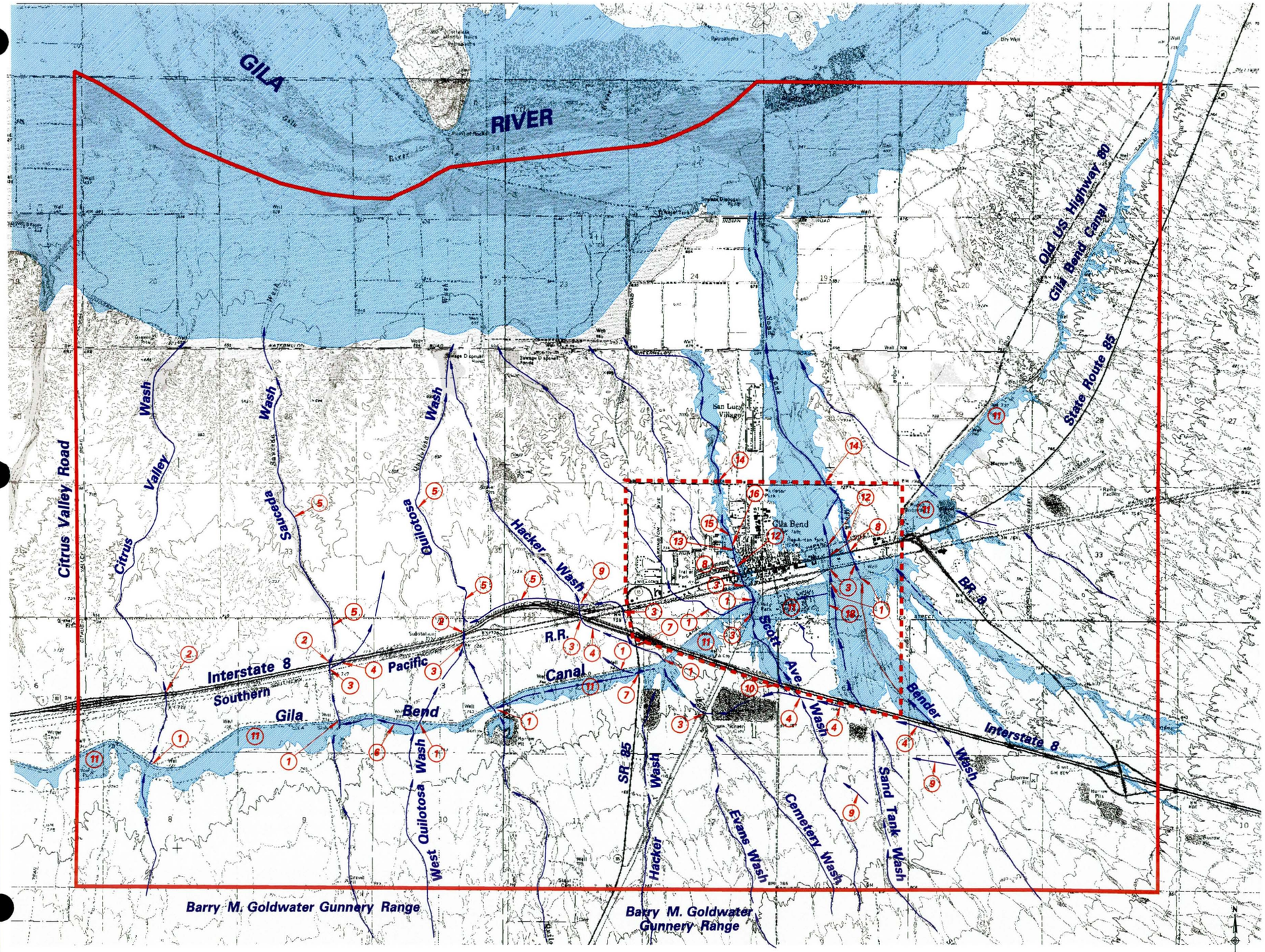

GILA BEND
Area Drainage Master Plan

EXISTING FLOODING PROBLEMS
Exhibit 2.3

LEGEND

- EXISTING DEFINED 100-YEAR FLOODPLAIN LIMITS
- MAJOR RUNOFF AND FLOW DIRECTION
- CORE STUDY AREA BOUNDARY

FLOODING PROBLEMS

1. OVERTOPPING OF GILA BEND CANAL
2. OVERTOPPING OF I-8
3. OVERTOPPING OF RAILROAD
4. FLOW DIVERSION AT I-8
5. CHANNEL CAPACITY EXCEEDED
6. FLOW DIVERSION AT THE GILA BEND CANAL
7. OVERTOPPING OF SR85
8. OVERTOPPING OF PIMA STREET
9. SPLIT FLOW
10. FLOW THROUGH MARTIN AVENUE UNDERPASS
11. PONDING BEHIND THE GILA BEND CANAL
12. OVERTOPPING OF PAPAGO STREET
13. OVERTOPPING OF HUNT STREET
14. OVERTOPPING OF INDIAN ROAD
15. OVERTOPPING OF RICHARDS STREET
16. FLOODING OF HOMES AND YARDS
17. FLOW DIVERSION
18. OVERTOPPING OF FLOOD CONTROL LEVEE

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SCALE: 1" = 4,000'

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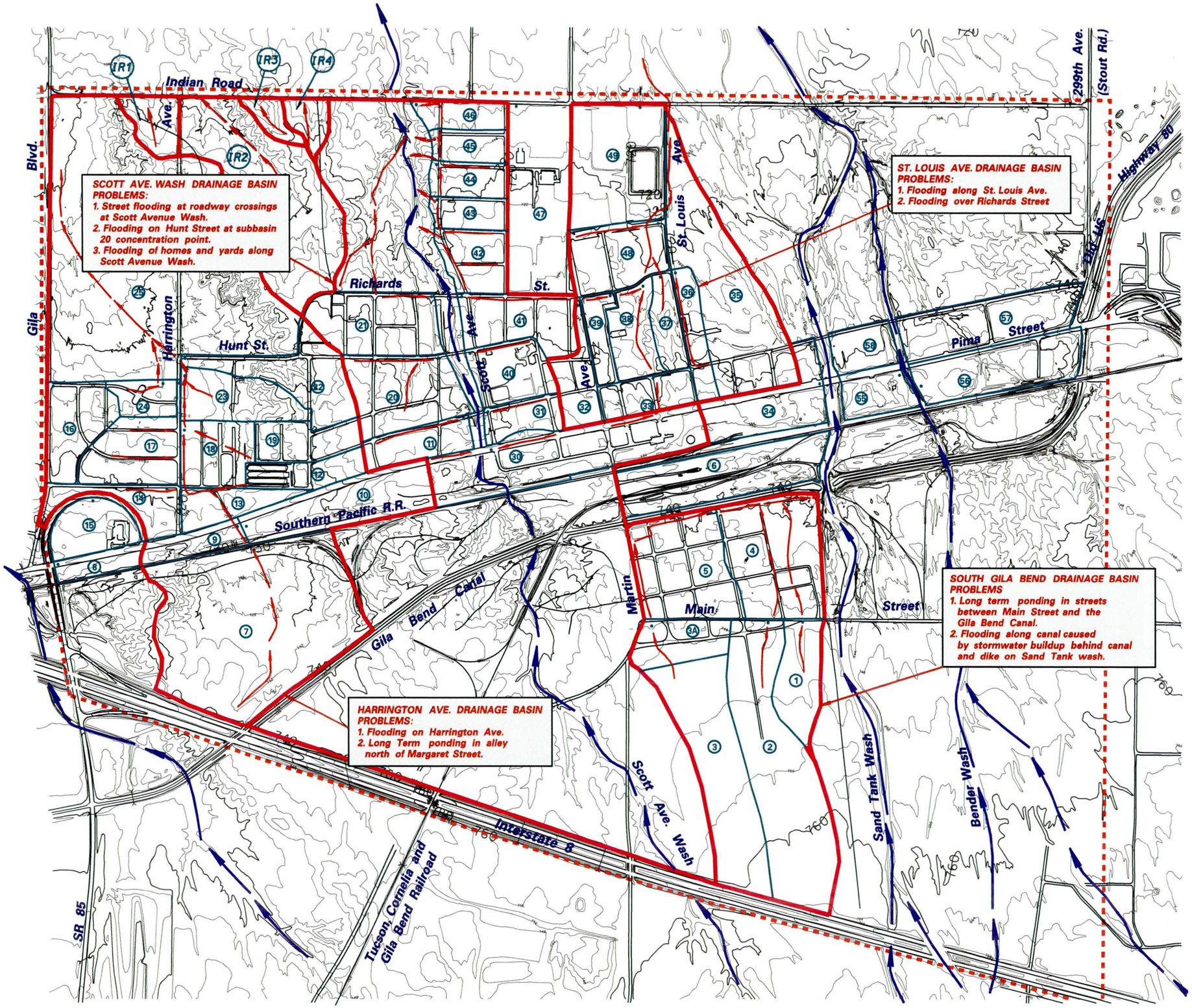

GILA BEND
Area Drainage Master Plan

TOWN CORE AREA
EXISTING FLOODING PROBLEMS
Exhibit 2.4

LEGEND

- TOWN CORE AREA BOUNDARY
- DRAINAGE BASIN BOUNDARY
- DRAINAGE SUBBASIN BOUNDARY
- (57) DRAINAGE SUBBASIN NUMBER
- MAJOR WATER COURSE
- LOCAL DRAINAGE PATH

N

0 250 500 1000 2000

SCALE: 1" = 1000'

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SECTION 3: ALTERNATIVES ANALYSIS

The Level I Analysis identified potential alternatives to the flooding problems and, through preliminary investigation, narrowed the number of alternatives to those which are most feasible. This section describes the analysis procedure, the alternatives considered, and the concepts carried forward to Level II.

3.1 Review Committee/Brainstorming

A series of two brainstorming meetings were held with the review committee during the Level I Analysis. The committee made up of representatives from the Town, the Flood Control District, and the consultant team. The initial brainstorming session (held 10/13/99) was convened to develop a list of potential alternatives. The consultant team described the flooding problems and presented a number of "seed" ideas for solving the problems. The committee discussed the options and developed a list of alternatives to be quantatively evaluated in the Level I Analysis.

The second brainstorming session (held 2/7/00) occurred after the consultant team completed the Level I Analysis. During this meeting, the committee created an evaluation matrix of the alternatives studied in Level I. This evaluation resulted in the alternatives to be carried forward to Level II.

3.2 Public Participation

A public meeting was conducted at the beginning of the Level I Analysis to introduce the study to the residents of the Town and to solicit their knowledge of the flooding problems as well as their ideas for solutions to the problems. The meeting was part of one of the Town's regularly held Council meetings on the evening of October 19, 1999. At the meeting, the project team described the purpose of the study, went over the study procedure, summarized the flooding problems that were known to the team, and gave a description of flood control concepts that were being considered. The Council members expressed a desire to reduce the floodplain boundaries on Sand Tank Wash and Scott Avenue Wash.

A second public meeting was held on May 11, 2000 at a regular Town Council meeting. At this meeting, the project team described the Level II flood control alternatives and asked the Council and the Town's residents to fill out a public comment sheet that was distributed at the meeting. Eight residents responded. Seven of the eight expressed a favorable opinion of the Sand Tank Wash flood control improvements. The eighth didn't give an opinion. They were split, however, on the question of landscape character. Two preferred natural appearance, three preferred a modified-natural appearance (with trails, etc.) and

one preferred a park-like look. With regard to the Town core drainage plan, only one respondent commented. He requested that the design team make sure that the proposed channel, along the Canal in the South Gila Bend area, is large enough to prevent flooding.

The comment sheet also asked the residents to give names to the unnamed washes. The following is what the team decided to name the washes, based on comments from the public.

Unnamed Wash No. 1	Citrus Valley Wash
Unnamed Wash No. 2	Hacker Wash
Unnamed Wash No. 3	Evans Wash
Unnamed Wash No. 4	Cemetery Wash
Unnamed Wash No. 6	West Quilotosa Wash

3.3 West Planning Area – Alternative Selection

Flooding Problems

The flooding problems in the west planning area include inadequate conveyance capacity at the culvert crossings on I-8, the Railroad, and the Gila Bend Canal, as well as insufficient capacity on the channeled washes north of I-8. The primary problem is inadequate conveyance through the Canal, which results in overtopping and washout. In general, though, the natural conveyance corridors have been preserved, albeit with inadequate capacity, with major wash corridors at intervals of about one mile. Therefore, future development can provide adequate floodwater conveyance simply by improving the conveyance capacity of the existing drainage corridors.

Currently there aren't any homes or other buildings in the west planning area and so the problems outlined above only impact the Canal, the Highway, the Railroad, and the agricultural areas. Therefore, it is envisioned that the west area flood control improvements will be constructed with future land development projects. The purpose of the ADMP in this area is to describe the problems, provide alternative solutions and, most importantly, provide the Town with a tool that will ensure new development is constructed with adequate floodwater conveyance.

Level I Alternatives

The Level I drainage improvement concepts included: alternative 1) improving conveyance through the drainage structures and channels, alternative 2) storing upstream runoff to reduce flood flows down to the capacity of existing drainage structures, and alternative 3) intercepting the flood flows, that overtop I-8, on the downstream side of the Freeway. Refer to the Level I report for detailed descriptions, cost estimates, and exhibits for each alternative.

Selected Alternative

The concept flood control plan that was selected for further study is a variation of alternative 3. It includes a collector channel on the downstream side of I-8 as well as improvements to the existing manmade channels. The variation is in the treatment of Hacker Wash. In alternative 3, the Hacker Wash diversion channel, that follows the I-8 on-ramp over to Quilotosa Wash, is widened to contain the 100-year flood. In the selected plan, the existing diversion channel is left unchanged and the 100-year breakout flow is conveyed in a "developer built" overflow channel through Section 35; following the existing drainage pattern.

Alternative 3 (modified as described above) was chosen because it is the most practical solution for the planned Citrus Valley development that lies downstream of I-8. It is the lease expensive and doesn't require cross drainage improvements to the Gila Bend Canal, the Southern Pacific Railroad, or I-8. Table 3.1 is the evaluation matrix developed during the Level II brainstorming meeting.

Table 3.1
West Planning Area Evaluation Matrix

Alternative No.	Description	Advantages	Disadvantages	Retain [yes/no]
1	Increased Conveyance	Enhances existing channel conditions, lower maintenance, contains & controls 100-year flood.	High cost, impractical in terms of ADOT or R/R agreement, increases downstream flows, increases liability, impact to Waters of the U.S.	NO
2	Detention Basins	Controls flooding, no downstream impact, works with existing landuse, no overtopping of I-8 or R/R, some recreational potential	Very high cost, lose future land development Opportunity with large basin areas.	NO
3	Interceptor Channels north of I-8	No ADOT or R/R improvements, lowest cost, contains flows downstream of I-8, no increased flows downstream of I-8, channels along I-8 Create buffer to development.	Impact to Water of the U.S., changes some existing flow paths, adds flow to Quliotosa Wash, overtopping of Canal, I-8 and R/R remains.	NO
4	Same as #3 but with Preserving overflow Drainage pattern on Hacker Wash	Same as No. 3 and preserves riparian habitat in existing I-8 diversion channel (Hacker Wash),maintains existing overland flow path for breakout flows on Hacker Wash.	Changes some existing flow paths, adds flow to Quliotosa Wash, overtopping of Canal, I-8, and R/R.	YES

3.4 East Planning Area – Alternative Selection

Flooding Problems
The primary flooding source in the east planning area is Sand Tank Wash and its commingling flow pattern with Bender Wash and Scott Avenue Wash. Upstream of I-8, floodwaters tend to spill westerly from Bender Wash to Sand Tank Wash and likewise from Sand Tank Wash to Scott Avenue Wash. At I-8, the highway embankment adds further complexity by diverting large quantities of flow to the west. This diversion more than doubles the peak discharge in Hacker Wash, which eventually combines with Quilotosa Wash.

The most significant flood hazard caused by Sand Tank Wash, however, is the diverted flow into Scott Avenue Wash, which flows through a more densely developed area within the Town. Development has, for the most part, stayed out of the Sand Tank Wash floodplain and, therefore, the potential flood losses along Sand Tank are relatively low. The diverted flow into Scott Avenue Wash, however, has considerable impact, flooding over 100 homes and businesses.

Level I Alternatives
The Level I flood control alternatives for Sand Tank Wash included alternative 1) increase conveyance on Sand Tank Wash, alternative 2) large detention basin at I-8, alternative 3) smaller detention basin at I-8 (for diverted flow only), alternative 4) flood control dam upstream of I-8 (taller version) and alternative 5) flood control dam upstream of I-8 (lower version). Refer to the Level I report for detailed descriptions, cost estimates, and exhibits for each alternative.

Selected Alternatives
The concept flood control plans that were selected for further study included alternative 3 and alternative 5. Alternative 3 is an "offline" detention basin, on the upstream side of I-8, that stores the diverted flow and eliminates flood flows into Scott Avenue Wash. Although this alternative solves the problem of flooding along Scott Avenue Wash and eliminates the diverted flow to Hacker Wash, it doesn't do anything to reduce flooding on Sand Tank Wash. Alternative 5, on the other hand, eliminates the diversion and substantially reduces flood flows on Sand Tank Wash. The alternative 5 flood control dam was designed to reduce the outflow down to the capacity of the railroad and highway cross drain structures. Therefore, alternative 5 not only eliminates flooding on Scott Avenue, it also reduces flooding on Sand Tank Wash and eliminates overtopping of the downstream railroad and highway structures.

Alternative 3 was chosen because it was the least expensive solution to flooding along Scott Avenue Wash. With its 200-acre basin, it also offers a wide range of multi-use options. Alternative 5 was chosen because it has a minimal impact on the environment and it substantially reduces the Sand Tank Wash floodplain. Table 3.2 presents the evaluation matrix developed during the Level II brainstorming session.

Table 3.2
East Planning Area Evaluation Matrix

Alternative No.	Description	Advantages	Disadvantages	Retain [yes/no]
1	Increased Conveyance	No Diversion at I-8, Linear Park through town, Eliminate overtopping of BR-8 and R/R, Reduce Harrington Ave. Flooding, Eliminate South Gila Bend Floodplain and reduce flow over SR-85 at Gila Bend Canal	Increase downstream flow, substantial 404 impact, Increased Liability, High Cost, includes major structural improvements, may have environmental permit problems and would require ADOT and R/R improvements	NO
2	Detention Basins	Reduce flow on Sand Tank Wash, provide Multi-Use areas, uses existing borrow pit, reduces flow to Harrington Avenue, reduces flow to Scott Avenue Wash, provides gravel/borrow sources, reduces flow over SR-85 at Gila Bend Canal, and removes South Gila Bend from the floodplain.	Environmental impact, reduces developable land south of I-8, high cost, fill area disturbance, 404 impact	NO
3	Detention Basin to control I-8 Diversion	Lowest cost, cuts off diversion to Scott Ave & flooding to Harrington, remove South Gila Bend from floodplain, improved "proportionate" recreation area, gravel/borrow source, minimal 404 impact	Overtopping of R/R and BR-8 remains, Sand Tank Wash floodplain unchanged, fill area disturbance.	YES
4 & 5	Upstream Detention Structure	Least intrusive to environment, minimal 404 impact, medium cost, some recreation opportunities, transportation alignment opportunities, reduces Sand Tank Wash floodplain, removes South Gila Bend from Floodplain	ADWR jurisdiction, licensing and ownership, maintenance, liability, safety, public perception, unknown cost to purchase flow paths for PMF spillways.	YES
6	Upper watershed multiple dams or stock ponds	Distributed risk, low visual impact, wildlife stock tanks, low 404 impact, low risk structures	Multi-construction sites, no multi-use, questionable technical feasibility, requires access roads for maintenance and construction, majority of property lies on Gunnery Range	NO

3.5 Town Core Alternative Selection

3.5.1 South Gila Bend Watershed

Flooding Problems
The South Gila Bend area lies between the Gila Bend Canal and Interstate 8 (I-8). Sand Tank Wash lies to the east separated from the residential area by a man-made levee. Scott Avenue Wash runs along the west side of the watershed. Runoff flows across Main Street, into the developed part of the watershed, and collects along the elevated embankment of the Gila Bend Canal. It concentrates behind the levee on Sand Tank Wash, along the upstream side of the Canal, and discharges through a 36" pipe that outlets into the Sand Tank Wash. The concentration of runoff at the Sand Tank Wash levee results in ponded water that floods homes and yards that lie along the Canal. In addition, the streets don't drain well, which results in ponded storm water that stands long after the storms have passed.

Level I Alternatives
There were 5 alternative drainage concepts developed for the South Gila Bend area. They included a combination of detention basins, upstream diversions using both storm drains and open channels, and street improvements to convey runoff within the streets. Concepts were developed for both the 2-year and 10-year flood. Refer to the Level I report for detailed descriptions, cost estimates and exhibits of each alternative.

Selected Alternative
The selected Alternative is a variation on Alternative No. 1 which is a 10-year design concept. It was chosen because it helps prevent the flooding of homes adjacent to the Gila Bend Canal, it is relatively inexpensive and it is consistent with the Town's plans for roadway improvements. The plan includes an extension of the roadside channel on Main Street; from Barnes Street to St. Louis Avenue. It also includes a new collector channel along the Gila Bend Canal, beginning at Capitol Street, that will convey runoff to a new detention basin located at the intersection of the Canal and Sand Tank Wash Levee. To solve the storm water ponding problems, the streets will be repaved in the South Gila Bend area based upon Town's Circulation Plan and design standards for streets.

3.5.2 Harrington Avenue Watershed

Flooding Problems
Harrington Avenue collects much of the runoff from the west side of the Town core area. Its boundaries are the Gila Bend Canal on the south, Gila Boulevard on the west, and the ridgeline for Scott Avenue Wash on the east. Local storm water runoff originates on the undeveloped land that lies upstream of the Southern Pacific Railroad. It ponds up behind the Railroad and discharges through a culvert under the Railroad, under Pima Street, and out to Harrington

Avenue. Between Pima Street and Hunt Street, Harrington Avenue accumulates a fairly large amount of storm water runoff, which causes frequent street flooding. Additionally, a low spot in the alley between Margaret Street and Robert E. Lee Lane causes local flooding problems

Level I Alternatives
There were 5 alternative drainage concepts developed for the Harrington Avenue watershed. They included the use of detention/retention basins, storm drains, street improvements, and new channels. Concepts were presented for both the 2-year and the 10-year design storms. Refer to the Level I report for detailed descriptions, cost estimates and exhibits of each alternative.

Selected Alternative
Alternative 2, with its 2-year storm drain, was selected for further study. It was chosen because it provides a reasonable level of flood protection, can be easily phased, and has lower cost. The plan includes a 100-year retention basin upstream of the Southern Pacific Railroad and a new 2-year storm drain in Harrington Avenue. It also includes new roadway improvements, new culvert crossings, and installation of a valley gutter to prevent further flooding problems in the alley south of Robert E. Lee Lane.

3.5.3 Scott Avenue Wash Watershed

Flooding Problems
The local drainage issues in this watershed are mostly associated with the street crossings of Scott Avenue Wash. With the exception of Pima Street, the local streets are dip sections through the wash. Therefore, every time the wash flows, the streets become flooded and are sometimes impassable. In addition to the street crossings, homes and yards along the wash experience flooding. Another problem is the concentration of runoff that occurs at Hunt Street, between Johnny Street and Weidner Street. Storm water accumulates on the south side of Hunt Street and spills through yards over to Scott Avenue Wash.

The 100-year flood on Scott Avenue Wash is very large, relative to the channel capacity, and represents one of the primary flooding problems in the Gila Bend area. The existing 100-year flood on Scott Avenue Wash is over 3000 cfs, due largely to a diversion from Sand Tank Wash into Scott Avenue Wash upstream of I-8. The existing culvert crossings are woefully inadequate for this flow, as is the channel capacity. For example, the culvert under the Gila Bend Canal is only a 3'x6' box culvert with capacity of about 290 cfs which is far less than the 100-year flood of 3000 cfs. Therefore, the Scott Avenue Wash drainage alternatives are based on the assumption that the 100-year flood will be stored or diverted upstream of I-8 in order to alleviate the problems associated with the 100-year floodplain. Only a small low flow, of about 30 cfs, was assumed to drain through I-8 for purposes of developing improvement concepts for the local drainage problems. Refer to Section 3.4.

Level I Alternatives
There were 2 alternatives developed for the Scott Avenue Wash watershed. Both alternatives included new culverts at the street crossings. One of them also included a new detention basin at the low point along Hunt Street as well as a new upstream detention basin. Refer to the Level I report for detailed descriptions, cost estimates and exhibits of each alternative.

Selected Alternative
The concept alternative selected for this watershed was a variation of Alternative No. 1. It was chosen because it eliminates the ponding problems on Hunt Street and provides passable roadway crossings over Scott Avenue Wash. The variation from Alternative 1 was to omit the new upstream detention basin and, instead, simply preserve the detention area that already exists upstream of the Gila Bend Canal. The alternative includes constructing new road crossings at Papago Street, Hunt Street, Richards Street and Indian Road using culverts to convey the 10-year discharge under the roadway. It also includes a new detention basin south of Hunt Street, between Johnny and Wiedner Streets, with a drain pipe that outfalls in Scott Avenue Wash just north of Hunt Street.

3.5.4 St. Louis Avenue Watershed

Flooding Problems
St. Louis Avenue collects much of the runoff from the east side of the Town core area. Its boundaries are the Southern Pacific Railroad on the south, Sand Tank Wash on the east, and the ridgeline for Scott Avenue Wash on the west. Runoff accumulates in roadside ditches along St. Louis Avenue as well as in a drainage swale that runs between St. Louis and Martin Avenue. The swale flows across Richards Street and combines with the St. Louis Avenue roadside ditches further downstream. The runoff flowing across Richards Street is an undesirable situation. In addition, the existing roadside ditches on St. Louis Avenue don't drain well, don't have culverts at the crossing streets, and experience a considerable amount of standing water after the floods have passed.

Level I Alternatives
There were 3 drainage alternatives developed for the St. Louis Avenue watershed. They included the use of storm drains, street improvements, detention basins, and new roadside channels. Refer to the Level I report for detailed descriptions, cost estimates and exhibits of each alternative.

Selected Alternative
The selected alternative is a variation of Alternative 1. It includes a new storm drain in St. Louis Avenue with laterals in both Richards and Stout Streets. The storm drain is designed for the 2-year flood, instead of the 10-year design presented with Alternative 1. The 2-year flood was chosen because the flooding problems are associated street flooding and standing water. House flooding is

not an issue. Therefore, the 2-year design was more cost effective. The roadside ditch on the east side of St. Louis Avenue was also downsized from a 10-year to a 2-year design.

SECTION 4: AREA DRAINAGE MASTER PLAN

4.1 Summary of Area Drainage Master Plan (refer to Exhibit 4.1)

The drainage master plan, for the Gila Bend area, consists of three main components. The first is a set of floodwater management tools that the Town can employ to make sure that future development occurs without adversely impacting drainage conditions. The second component consists of a number of flood control improvements that will be required, prior to development, in areas that have significant existing flood hazards. The land developers will construct these improvements. The third component consists of publicly funded, flood control improvements on Sand Tank Wash. The purpose of these improvements is to protect existing homes and businesses that are subject to flooding from Sand Tank Wash.

One of the primary purposes for the ADMP is to provide the Town with floodwater management tools so that future development can occur without adversely impacting existing drainage conditions. Fortunately, the planning area is mostly undeveloped and, for the most part, the natural drainage corridors remain. Therefore, sufficient floodwater conveyance capacity can be achieved, in most areas, by requiring future development to maintain the existing desert wash corridors and to construct onsite storm water retention. Another key component of the floodwater management for Gila Bend is to discourage development in high flood hazard areas. These areas include the Gila River floodplain and the area downstream of the Gila Bend Canal on the west end of the planning area. The primary floodwater management elements of the ADMP include: 1) preserving the existing desert washes, 2) providing storm water retention with new development, 3) preserving floodwater storage capacity behind the Gila bend Canal, and 4) discouraging development in areas of high flood hazards.

Much of the land north of I-8, on the west side of Town, is subject to substantial flood risk if certain flood control improvements aren't done. These flood risk include unconfined weir flow over I-8, undersized manmade channels downstream of I-8, and an unconfined split flow on Hacker Wash, just downstream of I-8. The proposed flood control improvements include 1) an interceptor channel on the north side of I-8 between Sauceda and Quilotosa Wash, 2) improvement of existing manmade channels on Citrus Valley Wash, Sauceda Wash, West Quilotosa Wash, and Quilotosa Wash and 3) construction of an overflow channel for Hacker Wash. exhibit 4.7 DS/I8

The most prominent feature of the ADMP is the Sand Tank Wash flood control improvements which consists of publicly funded, flood control improvements to protect existing homes and businesses that are subject to flooding from Sand Tank Wash. The improvements are phased and include phase 1) reconstruction of the Sand Tank Wash levee (located upstream of the Gila Bend Canal) and construction of a new canal overchute on Bender Wash, phase 2) a floodwater exhibit 4.8

exhibit 4.9

retention basin upstream of I-8, and phase 3) an upstream floodwater detention facility. exhibit 4.11

4.2 Floodwater Management Elements of the ADMP

The Gila Bend area is mostly undeveloped. Therefore, the most important aspect of the ADMP is to provide the Town with floodwater management tools so that future development can occur without adversely impacting existing drainage conditions. The following sections describe the floodwater management elements of the ADMP.

4.2.1 Floodplain Management/Preservation of Natural Washes

This is the most important aspect of the management plan. Since the Gila Bend Area is largely undeveloped, preserving the natural desert washes and their floodwater conveyance capacity will ensure that adequate drainage is provided as the area develops. This is particularly true in the Gila Bend area because there are numerous existing washes that can serve to provide the necessary drainage corridors to convey floodwater through the future developments.

Preserving the natural wash not only retains its floodwater carrying capacity, it also preserves the riparian vegetation adjacent to the washes and the wildlife habitat that it provides. In public meetings, the Town's residents have expressed a desire to preserve the natural washes. In addition, preserving the washes avoids having to obtain a 404 permit from the Corps of Engineers.

Identification of Washes to be Preserved

One of the more difficult determinations to make regarding the preservation of natural washes is deciding which washes must be preserved. Clearly, the major washes that are well defined should be preserved. These are identified as green lines on Exhibit 4.1. But other, smaller washes, should also be preserved if they convey significant flow and if they are well defined in terms of having a sandy bottom and adjacent riparian habitat. The determination of which of the smaller washes need to preserved is the more difficult decision to make. The following rules are proposed to make that determination.

FCD guidelines?

1. If the wash appears as a green line on Exhibit 4.1, it must be preserved.
2. If the wash originates upstream of the property to be developed and has a sandy bottom width of 5 feet, or greater, it must be preserved.
3. If the wash originates upstream of the property to be developed, is incised with banks of 2 feet or greater, and has a sandy bottom width of 3 feet or more, it must be preserved.
4. If the wash originates upstream of the property to be developed and conveys a 100-year peak discharge of 100 cfs, or more, it must be preserved.

It should be made clear that these rules do not relieve the developer from obtaining a 404 permit from the US Army Corps of Engineers (USACE). Washes

that don't meet these rules still may be considered jurisdictional waters by the USACE. For example, a significant wash could originate on the property that is jurisdictional by the USACE but doesn't meet these rules. The developer is still required to obtain a 404 permit for any impact to the wash. In every case, the developer shall obtain a delineation of jurisdictional washes from the USACE.

Limits of Wash Preservation (refer to Exhibit 4.2)
The other determination to make is the width to be preserved. Clearly the defined sandy bottom and adjacent wash banks should be preserved, but overbank setbacks are also required to convey large flood flows, provide for the potential lateral migration of the wash banks, and maintain wildlife corridors. The following rules are proposed to define the limits of wash preservation.

The overbank setbacks for wash preservation shall be the greater of the following:

1. Floodway boundary as determined using FEMA criteria of no more than a one foot rise in water surface elevation.
2. Lateral migration of wash banks as determined by Guideline 1 of the "Watercourse System Sediment Balance, State Standard Attachment 5-96, Arizona Department of Water Resources, September 1996."
3. A minimum overbank setback, measured from the top of bank, of 25 feet.

4.2.2 Provide Storm Water Detention/Retention with New Development

It's important to provide storm water retention with new development, otherwise the cumulative effects of increased runoff due to the impervious surfaces, introduced with new development, will increase the flood risks to downstream property owners. In addition, the detention/retention basins provide a means of filtering out pollutants that are collected by urban runoff. The following criteria are proposed for the design of detention/retention basins.

1. Retention/detention basin volume shall be designed to retain the runoff from the 100-year, 2-hour storm in accordance with the Drainage Design Manual for Maricopa County.
2. Retention/detention basins shall incorporate drainage outlet facilities to empty the basin in 36 hours.
3. If basins are designed to have a water depth of one foot, or less, it can be assumed that the basin will drain in 36 hours; provided the basin is designed with a pervious bottom.
4. Drainage outlets shall be set above the bottom of the basin to provide a low water pool for the "first flush". The volume of the low water pool shall be designed to retain 0.25 inches of runoff (rainfall excess) from the entire site that the basin is servicing. The maximum depth of the low water pool shall be one foot.
5. Maximum side slopes for the basins shall be 4H:1V.

6. Maximum water depth in the basins shall be 4 feet in the center and 3 feet around the edges.
7. Detention/retention basins shall not be located within the washes.

4.2.3 Discourage Development in High Flood Hazard Areas

There are two high hazard flood areas within the ADMP planning area that should remain undeveloped. These are in addition to the floodway areas on existing washes that, of course, should also remain undeveloped.

Area between the Gila Bend Canal and I-8

The area between I-8 and the Gila Bend Canal, on the west side of the planning area, is a high flood hazard area due to the fact that the Canal is susceptible to overtopping during the 100-year flood. The Canal is built on an earthen embankment with insufficient cross drainage capacity for the 100-year flood. The result is the potential for overtopping in numerous locations. Once the Canal is overtopped, the area downstream is subject too severe flooding. Furthermore, there is considerable uncertainty associated with the location of the overtopping, which makes the area a very high flood risk and one that is difficult to protect from flooding without substantial improvement to the Canal cross drainage facilities. Therefore, without the Canal improvements, this area should remain undeveloped.

Gila River Floodplain

The Gila River is subject to backwater from Painted Rock Dam, located about 20 miles downstream of the Town. The Corps of Engineers purchased flood easements that cover the impoundment up to the elevation of the spillway (elevation 661). The flood of 1993, however, overtopped the spillway which caused inundation outside the flood easement; flooding the Town's sewage lagoons. The elevation of that flood was approximately 670. The spillway is actually designed to pass 620,000 cfs at an elevation of 699. Although the 1993 flood was a rare event, far exceeding the 100-year flood, it is advised that the Town discourage development, and maintain as open space/agriculture land, those lands below the 1993 flood elevation of 670.

is a dam-break analysis needed?

4.2.4 Preserve Floodwater Storage behind the Gila Bend Canal

Even though the Gila Bend Canal is susceptible to overtopping in numerous locations, it still provides a significant amount of storage. This storage was included in the hydrologic model and therefore, it should be preserved. Otherwise downstream peak discharges will increase if development behind the Canal is allowed to displace the storage volume.

4.3 Developer Built Elements of the ADMP (West Planning Area)

The west side of the planning area is largely composed of the planned Citrus Valley land development project. This area is subject to flood hazards associated with inadequate conveyance capacity and overtopping of the Gila Bend Canal, the Southern Pacific Railroad, and I-8. In addition, the manmade channels through the agricultural area, north of I-8, don't have sufficient capacity to convey the 100-year flood. A number of alternatives for solving these flooding problems were investigated with the Level I analysis. The alternative selected for further study, Alternative 3 West, includes an interceptor channel on the downstream side of I-8 along with improvement of the manmade channels from I-8 to the Gila River.

These flood control improvements are required to protect future development from flooding. There aren't any existing homes or businesses in the area. Therefore, the land developers will be responsible to construct these flood control improvements before the areas downstream of I-8 can be developed.

4.3.1 I-8 Interceptor Channel

The I-8 interceptor channel is located on the downstream side of I-8, between Sauceda Wash and Quilotosa Wash. The purpose of the channel is to contain flood flows on Sauceda Wash that overtop the Railroad and I-8.

The 100-year flood overtops I-8 at a number of other locations, including Citrus Valley Wash, West Quilotosa Wash and Quilotosa Wash. At these locations, however, the overtopping is contained in sag vertical curves in the I-8 profile. The sag curve at Quilotosa Wash is quite long and contains the combined overtopping flow from Quilotosa Wash and West Quilotosa Wash. The highway overtopping in these locations doesn't present a particular flood problem for the downstream property because the flow is confined to the sag. As the downstream area develops, channels can be built with wide throats to intercept the flow over the highway.

In the case of Sauceda Wash, however, the overtopping flow is not confined in a sag vertical curve. Instead, there is a continuous roadway grade downhill, to the east, toward Quilotosa Wash. Flood flows that exceed the capacity of the Sauceda Wash bridges, at the Railroad and I-8, are diverted easterly along the railroad and highway embankments. The 100-year diverted flow is 3900 cfs, which overtops the highway and the railroad. In order to contain the flow, the I-8 interceptor channel is proposed along the downstream side of the highway embankment, sloped with the highway from Sauceda Wash to Quilotosa Wash. Since there is considerable uncertainty in the exact location of the overtopping, the channel is designed to convey the entire diverted flow of 3900 cfs. See Exhibit 4.1 for the extents of the interceptor channel and Exhibit 4.3 for a typical cross section of the channel.

4.3.2 Improve Existing Manmade Channels

The existing washes north of I-8 consist of manmade channels, amid graded agricultural land, that don't have adequate capacity for the 100-year flood flows. These washes include Citrus Valley Wash, Sauceda Wash, West Quilotosa Wash, Quilotosa Wash, and Hacker Wash; although Hacker Wash is a special situation that is discussed separately in Section 4.3.3. Before the area can develop, these channels will have to be improved to convey the entire 100-year flow with freeboard as required by the Flood Control District of Maricopa County.

The Town desires these channels to be multi-use to both convey floodwater and to provide open space for recreation and/or wildlife habitat. Based upon input from the Town, three concepts have been generated for the character of these constructed channels. They include a constructed natural channel, a modified natural channel, and a park like channel. The type that's constructed will vary upon the character of the proposed development, but in all three the improved conveyances are wide, earthen channels designed with non-erosive flow velocities. Concrete, or other types of "hard lined" channels are not acceptable. The flow velocity should be kept at 5 feet per second, or less, which will result in relatively wide, shallow channels that will provide ample open space. The following is a description of the three different types of improved channels. Appendices E, F, and G contain hydraulic calculations and typical cross sections for the modified natural type channel on Citrus Valley Wash, Sauceda Wash, and Quilotosa Wash.

Constructed Natural Channel (see Exhibit 4.4):
The natural cross sections consist of a benched, or single-tiered, configuration that is intended to replicate the geometry of the existing channels upstream of the Gila Bend Canal (GBC). The advantage of this configuration is that it is, by definition, natural in appearance. Relatively little landscaping effort would be necessary to create an aesthetically pleasing, natural appearing wash.

Modified Natural Channel (see Exhibit 4.5):
The modified natural cross section consists of a two-tiered configuration to allow construction of trails, parking lots, or recreation features on the bench or tier areas. The low-flow channel is designed to carry the 2-year discharge; the first tier is designed to carry flows in excess of the 2-year flow up to the 10-year flow. The second tier carries flow in excess of the 10-year flow up to the 100-year flow. This configuration has the advantage of being flexible in terms of placing recreational facilities on the higher or lower tier depending on the frequency of flooding that would be acceptable. The disadvantage of this option is that it is less natural in appearance and greater landscaping effort would be necessary to soften the "constructed channel" look.

Park Like Channel (see Exhibit 4.6):
The park like channel configuration consists of a single tier with a sand bed, low-flow channel designed to carry the 2-year peak discharge. The upper tier area could be landscaped with various plantings, bicycle trails, or other recreation features. This configuration has the advantages of being "natural" or park-line in appearance. The disadvantage is that the upper tier is subject to more frequent flooding then the upper tier shown in Exhibit 4.5. Floods greater than the 2-year event will flood the upper level in the single tier concept.

4.3.3 Hacker Wash Overflow Channel — include an analysis of this as "storage" structure

The Hacker Wash flood problem is a special problem associated with the inadequate conveyance capacity of the manmade channel north of I-8. At the I-8/SR 85 traffic interchange, there's an existing manmade channel that runs parallel to the I-8 frontage road. This channel was constructed to divert flow from Hacker Wash, where it passes under the frontage road, to Quilotosa Wash. The channel is constructed with very little longitudinal slope, and as such, has little hydraulic capacity and has become overgrown with trees and shrubs, further reducing its capacity to convey flood flows. Its capacity is estimated at only about 450 cfs. The 100-year inflow coming under, and spilling over, the I-8 frontage road is 8400 cfs. The special problem associated with this flood hazard is that the floodwater, that exceeds the 450 cfs capacity of the diversion channel, will spill overland in a northwesterly direction across Section 35. Therefore, before development can occur in this area, provision will have to be made to accept this overflow.

Exhibit 4.7 presents the proposed solution. The original, historic path for flows in Hacker Wash was through section 35. The land in section 35 was graded for agriculture a number of years ago, and the wash was obliterated. The proposed improvements are to restore this conveyance through Section 35. They include widening the existing diversion channel, where flow crosses over the I-8 frontage road, using a bench or tier several feet above the existing channel flowline. In this way, the existing channel bottom and vegetative growth would not be disturbed, but the hydraulic capacity of the channel would be increased sufficiently to carry the wash 100-year flow of 8400 cfs. This widening is proposed for a length of 2800 feet, downstream from the Pima Street bridge crossing. Near the downstream end of the widening, a 330-foot-long notch is proposed in north bank of the channel to allow flow in excess of 450 cfs to spill into the adjacent land in section 35. The current proposed development in section 35 includes a golf course, which would be designed to accommodate these flood flows.

In order to help divert the flow in excess of the downstream channel capacity (450 cfs), a 2-barrel 10' x 6' concrete box culvert is proposed in the diversion channel at the downstream end of the spillway notch. The capacity of the box culvert is 450 cfs. Although the box culvert structure is needed primarily for

hydraulic reasons, it could also be used as an access road, across the channel, into the property.

4.4 Sand Tank Wash Flood Control Improvements

As explained in Section 3.4, two alternative flood control plans, on Sand Tank Wash, were carried forward to solve flooding problems in the east planning area. They included an offline detention basin on Sand Tank Wash, just upstream of I-8 (alternative 3 east); and an upstream online detention facility, also on Sand Tank Wash. These two alternatives aren't directly comparable because they provide varying levels of flood protection. That is, the offline detention basin only provides flood protection for the properties that are subject to the breakout flows from Sand Tank Wash; it doesn't do anything to reduce flooding on Sand Tank Wash itself. The upstream detention facility, on the other hand, both prevents the breakout flow and substantially reduces the peak discharge on Sand Tank Wash. This difference in the level of protection was reflected in the Level I cost estimates. The inline facility, with the higher level of protection, costs about 3 times as much; $15 million for the offline basin compared with $45 million for the upstream, inline facility.

For reasons that they don't directly compete and because they can be integrated to save costs, the two alternative plans were redesigned and incorporated into a three phase approach to flood control improvements on Sand Tank Wash. The first phase includes downstream improvements to the Sand Tank Wash levee and a new overchute on the Gila Bend Canal. The second phase is the offline detention basin at I-8 and the third phase is the upstream detention facility.

Phasing the alternatives provided a number of benefits. First, the offline basin (phase 2) provides considerable benefit on it's own, eliminating much of the floodplain area within the Town, at much smaller cost. Second, the spoil from the excavation of the offline basin (phase 2) can be used to construct the upstream impoundment structure (phase 3). Third, the retention volume, provided with the offline basin (phase 2), allows the upstream detention structure (phase 3) to be substantially downsized, which saves costs.

In addition to phasing the alternatives, several other cost saving modifications were incorporated. The most notable of these modifications includes eliminating the outlet works from the offline basin and positioning the emergency spillways, on the upstream detention structure, at the major wash locations. Eliminating the outlet works on the offline detention basin cut the cost of dual 84-inch outlet pipes and allowed the basins to be much deeper. The disadvantage is that storm water will stand in the basin for long periods of time if a flood occurs. However, since only large floods will discharge into the basin, the standing water will only be an occasional problem. Positioning the emergency spillways at the major washes, on the upstream detention facility, eliminated the need to acquire downstream flood easements. In the original alternative, the emergency

spillways were at the two ends of the detention embankment, forcing flows larger then the 100-year flood out of their natural drainage pattern. Positioning them at the major washes preserves the natural drainage pattern for large floods, in excess of the 100-year flood, which eliminates the need for flowage easements.

4.4.1 Phase 1: Reconstruct Levee and New Canal Overchute

Elements of Phase 1: (Refer to Exhibit 4.8)

- Bender Wash Canal Overchute – Replace the existing 3 – 30" culverts with a 40-foot wide concrete overchute.

- Reconstruct Sand Tank Wash Levee – Improve existing Sand Tank Wash to meet FEMA standards.

Summary of Project Costs (For itemized cost estimate, see Appendix C)

Levee Reconstruction	=	$ 341,000
Bender Wash Overchute Construction	=	62,000
Land Acquisition (Levee)	=	4,000
Engineering Costs	=	50,000
Construction Administration Costs	=	60,000
Contingency (@ 20%)	=	104,000
Total	=	$621,000

Description of Phase 1

Levee design: The existing Sand Tank Wash levee, upstream of the Gila Bend Canal, wasn't constructed to FEMA standards and, according to the Gila Bend Floodplain Delineation Study, it is overtopped during the 100-year flood. Consequently, reconstructing the levee to meet FEMA standards is an essential element of the Sand Tank Wash flood control improvements.

The reconstruction involves raising the height of the existing levee approximately 4 feet in order to meet FEMA freeboard requirements. The work will include excavation and reconstruction of the existing levee embankment, soil cement bank protection on the wash side of the levee, and widening of the Canal overchute to provide space to carry the levee through the Canal embankment. Widening of the overchute will require extending the existing Canal siphon which is a 96 inch concrete pipe.

Bender Wash Canal Overchute Design: Under existing conditions, Bender Wash has a 100-year peak discharge of 4,900 cfs that reaches the Gila Bend Canal. The 3-30" culverts under the Canal, however, only have a conveyance capacity of about 100 cfs. The remaining 4,800 cfs is diverted to the Sand Tank Wash overchute; approximately 1200 feet to the west. But then, downstream of the Canal, approximately 3,100 cfs is forced back over to the Bender Wash channel and through the Bender Wash bridges under the Railroad and the Highway. The movement of floodwaters, between Bender Wash and Sand Tank Wash,

presents an erosion hazard to the Canal embankment, overtaxes the Sand Tank Wash overchute, and causes a floodplain management problem associated with the lateral movement of floodwaters. Therefore, the proposed project includes a new Canal overchute at Bender Wash which will eliminate the discontinuity in flow path.

The overchute will be designed to pass approximately 3100 cfs which matches the existing condition peak discharge downstream of the Gila Bend Canal. The work will include a new Canal siphon. This will require excavation of the existing Canal, installation of a new 96" pipe to siphon the Canal water, installation of new concrete headwalls on either end of the pipe, and reconstruction of the Canal at each end of the new Canal siphon.

4.4.2 Phase 2: I-8 Floodwater Retention Basin

Elements of Phase 2: (Refer to Exhibit 4.9)

- Floodwater Retention Basin (East Basin) – 1300 acre-foot retention basin between Sand Tank Wash and Martin Avenue.

- Floodwater Retention Basin (West Basin) – Enlarge existing borrow pit, west of Martin Avenue, to contain 1100 acre-feet.

- Inflow Spillway – New side-weir spillway into Retention Basin adjacent to Sand Tank Wash.

- Overflow Spillway – New overflow spillway, over Martin Avenue, connecting the east basin with the west basin.

- Scott Avenue Wash Diversion Channel – New channel along upstream side of the east basin to divert Scott Avenue Wash flood flows into Sand Tank Wash.

- Scott Avenue Wash Return Channel – New low flow channel to return low flows back into Scott Avenue Wash, downstream of I-8.

Summary of Project Costs (For itemized cost estimate, see Appendix C)

Retention Basin Construction	=	$5,400,000
Inflow Spillway	=	144,000
Overflow Spillway	=	144,000
Scott Avenue Wash Diversion/Return	=	53,000
Re-vegetation	=	2,160,000
Land Acquisition	=	432,000
Flood Easement Acquisition	=	622,000
Engineering Costs	=	632,000
Construction Administration	=	1,185,000
Contingency	=	2,155,000
Total (Phase 2)	=	$12,927,000

Description of Phase 2
Phase 2 is a 2400 acre-foot, offline floodwater basin located on the upstream side of I-8. Its purpose is to contain the diverted flow from Sand Tank Wash. It will effectively cut all flood flows into Scott Avenue Wash which drastically reduces the 100-year floodplain boundaries within the Town Core Area (see Exhibit 4.10).

Hydrologic Design (Refer to Appendix J for hydrologic calculations)
The new floodwater retention basin is sized to store the volume of the 100-year, diverted hydrograph at the upstream side of I-8. The total storage volume is approximately 2400 acre-feet; 1300 acre-feet in the east basin and 1100 acre-feet in the west basin. The diverted flow will enter the east basin in a side-weir, spillway whose invert is set at approximately the 10-year water surface elevation on Sand Tank Wash. Floodwater will only enter the retention basin during floods on Sand Tank Wash that exceed 9000 cfs. The west basin stays dry until the east basin fills up and spills over Martin Avenue. This makes the west basin most desirable for multi-use functions because only rare events, significantly greater than the 10-year flood, will inundate the west basin.

The list below summarizes the physical and hydrologic features of the floodwater basin. Figure 4.1 presents the reduction in the Sand Tank Wash, 100-year flood hydrograph as a result of the phase 2 floodwater basin. The area between the two hydrographs represents the volume stored in the offline retention basin.

Design Flood:	100-year, 24-hour
Basin Volume (total):	2400 ac-ft
West Basin Volume:	1100 ac-ft
East Basin Volume:	1300 ac-ft
Sand Tank Wash 100-year Peak Discharge:	24,300 cfs
Sand Tank Wash Flowby at Spillway Crest Elevation:	9,000 cfs
100-year Peak Inflow to Basin:	9,000 cfs
Reduced 100-year Peak Discharge on Sand Tank Wash (through I-8):	15,200 ft
Sand Tank Wash Flowline Elevation:	760 ft
Spillway Crest Elevation:	768.5 ft
100-year Water Surface Elevation:	771 ft

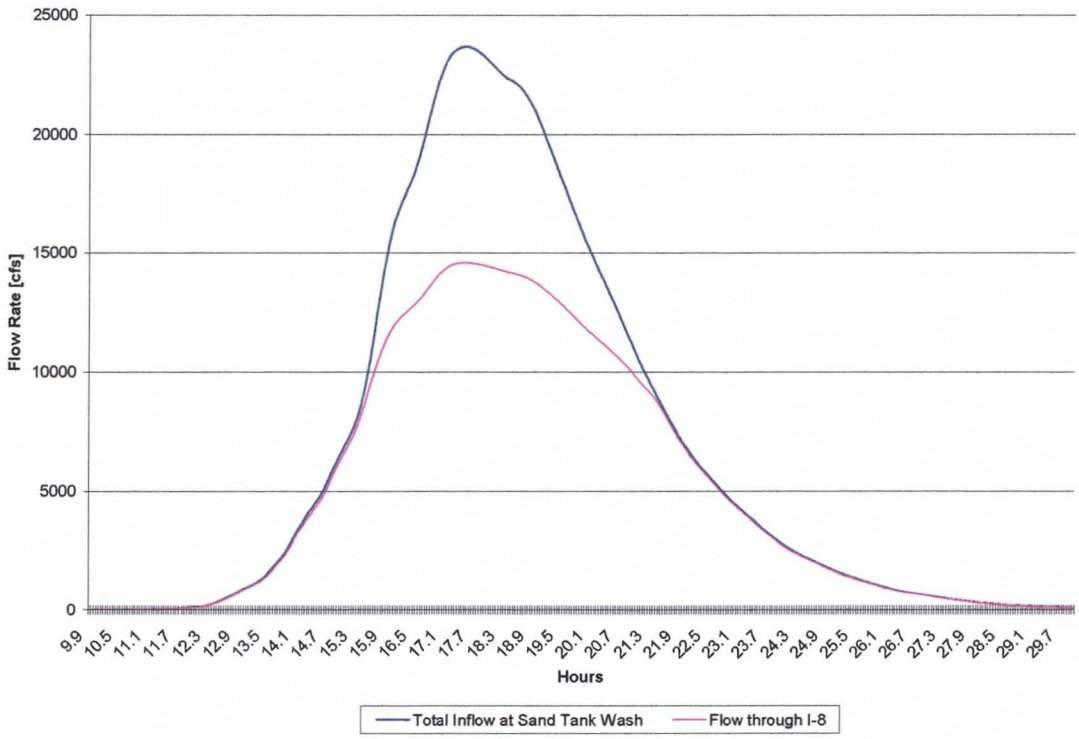


Figure 4.1 – Reduction in Sand Tank Wash Flood Hydrograph by Phase 2 Floodwater Basin

Floodplain Reduction (refer to Exhibit 4.10)
The South Gila Bend area is subject to flooding from the diverted flow on Sand Tank Wash as well as from the flows that continue in the main wash, under the highway. In fact, the entire area between the Canal and Main Street is within the 100-year floodplain. Upstream of I-8, floodwaters from Sand Tank Wash are diverted into Scott Avenue Wash; exceeding the conveyance capacity of the Scott Avenue Wash culvert under the Gila Bend Canal. The result is a 100-year floodplain that is above the top of the Gila Bend Canal. This floodplain covers a large part of the south Gila Bend area. Phase 2 will essentially eliminate the floodplain behind the Canal and will drastically reduce the floodplain on Scott Avenue Wash. Over 100 homes, businesses and historic buildings will be removed from the floodplain as a result of this project.

Requirement for Flood Easements
The cost estimate for the Phase 2 improvements includes $622,000 for flood easements. This cost is for the right to flood the existing Sand Tank Wash floodplain area between the Gila River and I-8. As explained in Section 2.1, it has been determined with this ADMP that the 100-year peak discharge on Sand Tank Wash, downstream of I-8, is actually lower than the existing FEMA peak flow. This is due to additional upstream diversions on Sand Tank Wash that were discovered with the floodplain delineation study portion of this ADMP. The Phase 2 basin was designed based on FEMA flows. Therefore, installation of the basin will actually increase the existing condition peak discharges on Sand Tank Wash.

For comparison purposes, the FEMA peak discharge at the Gila Bend Canal is 18,400 cfs, whereas the existing condition 100-year peak discharge is 12,600 cfs. Installation of the Phase 2 basin will increase the peak discharge to 16,700 cfs.

It should be pointed out that Phase 3 would eliminate the need for the flood easements. In Phase 3 the 100-year peak discharge is reduced down to about 8,000 cfs.

Environmental Impact
Except for Scott Avenue Wash, the I-8 floodwater basin has little impact on vegetation and wildlife habitat in the Gila Bend area. It's situated between Sand Tank Wash and Cemetery Wash, in an area that is sparsely vegetated. The offline floodwater retention basin was chosen as the preferred alternative over other alternatives, which included channeling Sand Tank Wash. One of the reasons it was chosen was to minimize the impact on the existing wash and its riparian habitat. The offline basin concept has only minor impact on the vegetation along Sand Tank Wash and has virtually no impact on Cemetery Wash. There's also little impact, if any, to the natural sediment balance on Sand Tank Wash because floods up to approximately the 10-year event will stay in the existing channel. The plan preserves the existing wash and its riparian habitat to the maximum extent practicable.

Scott Avenue Wash, on the other hand, will be diverted to Sand Tank Wash. In comparison to Sand Tank Wash, Scott Avenue Wash is relatively small with a watershed of 2.45 square miles. There really isn't any practical alternative to diverting Scott Avenue Wash because it runs through the middle of the proposed east basin. However, a return flow channel is planned that will allow storm water runoff to discharge into the downstream portion of Scott Avenue Wash, which will maintain water supply to the vegetation along the wash; thereby preserving its riparian habitat.

Multi-Use Opportunities
The proposed floodwater basin offers a wonderful opportunity to the Town in terms of multi-use functions. Although there are no current plans or funding for recreational activities, the possibilities are numerous. Exhibit 4.9 shows how ball fields and golf courses could be incorporated into the facility. However, these activities only represent a small sample of the potential uses. Other uses could include a trail node for the Sand Tank Wash trail, off-road racing tracks (the existing west basin is currently used for off road racing), a community lake, or a desert museum type of interpretive center.

The proposed plan includes contouring of the site in a natural manner that will enhance its visual quality. The spoil areas for the excavated material are planned to be contoured and located adjacent to the Highway to help screen the basin from the negative visual and noise impacts created by I-8.

4.4.3 Phase 3: Upstream Detention Facility

Elements of Phase 3

- Upstream Detention Facility – 5,700 acre-foot floodwater detention facility located about 2.5 miles upstream of I-8.

- Modifications to I-8 Retention Basin Inflow Spillway – reconstruct I-8 retention basin inflow spillway to accept inflow at a lower elevation on Sand Tank Wash.

Summary of Project Costs (For itemized cost estimate, see Appendix C)

Excavation/Fill	=	$4,927,000
Sand Filter and Toe Drains	=	2,384,000
Spillways	=	1,469,000
Box Culverts	=	1,313,000
Pipe Culverts	=	52,000
Re-vegetation	=	1,000,000
Land Acquisition	=	3,056,000
Engineering	=	902,000
Construction Administration	=	1,672,000
Contingency	=	3,355,000
Total (Phase 3)	=	$20,130,000

Description of Phase 3

Phase 3 is a 5,700 acre-foot floodwater detention facility located on Sand Tank Wash; about 2.5 miles upstream of I-8. The structure is about 2.6 miles long and about 24 feet high. It has relatively large, uncontrolled outlet culverts at all of the wash crossings as well as emergency spillways at the 5 main wash crossings. In conjunction with the Phase 2 offline retention basin, it reduces the peak discharge on Sand Tank Wash from 24,300 cfs down to 6,100 cfs.

Hydrologic Design (Refer to Appendix L for the hydrologic calculations)
Phase 3 is an upstream dam across Sand Tank and Bender Washes. The goal of the dam is to reduce flows in Sand Tank and Bender Washes sufficiently so that the capacities of the Pima Street bridge structures over the washes are not exceeded. The capacity of those structures was estimated at 7,900 cfs using the rating curves and the HEC-2 model in the *Gila Bend Floodplain Delineation Study,* March 1992. The offline basins south of I-8 adjacent to Sand Tank Wash would collect the same volume of overflow from Sand Tank Wash as in the Phase 2 condition. To accomplish this, the levee and spillway into the basin would be lowered as discussed below.

The proposed dam is an earthen structure, approximately 24 feet in height. The side slopes would average 6:1, but could be varied and improved with landscaping to increase aesthetic appeal and reduce the "engineered" look. The

dam would actually serve as a flood retarding structure that would detain floodwater. The dam would have 13 outlet structures ranging from 10' x 6' concrete box culverts, an 8' x 6' concrete box culvert, and two 36" reinforced concrete pipes. The peak stage for the 100-year event is 15.6 feet deep.

The culvert outlet structures are proposed at the major channels that comprise Sand Tank and Bender Washes. The sizes of the outlet structures were proportioned based on the magnitude of the existing condition flows in each of those channels, so that the relative amount of flooding in each wash downstream of the dam would be unchanged from the existing condition.

The outlet structures also allow small flows in the major individual channels of Sand Tank and Bender Washes to pass through nearly unimpeded. Even larger flows, such as the 10-year or 25-year frequency flows, will pass through the dam with short-duration ponding upstream of the dam. In the 100-year or larger event, ponding depths would be 16 feet or higher.

In addition to the outlets, several ½ probable maximum flood (PMF) spillways are proposed. These spillways would allow flood flows in excess of the 100-year event, up to the ½ PMF event, to pass over the dam without causing structural damage.

The selection of the ½ PMF event is based on Arizona Department of Water Resources requirements for dams, as published in "*Draft Guidelines for Design of Emergency Spillways*", rev. 4/98. It is estimated that a dam of this size ranks as a "medium" sized dam with a "high" downstream hazard potential.

The ½ PMF spillways are located along the major channels that comprise Sand Tank and Bender Washes. As with the culvert outlet structures, the spillway lengths were proportioned so that the percentage of flow in each individual channel would be unchanged relative to the existing condition.

These spillways would be constructed of soil-cement, and as such would have a more natural color than concrete. The lengths of the spillways (along the dam) would vary according to the amount of discharge each is designed for, but the spillway elevation for each would be 16.6 feet above the upstream toe of the dam. The spillway elevation was set one foot above the peak 100-year flood stage, so that downstream properties would be protected from the 100-year flood event. The ½ PMF flow depth over each spillway is 3.4 feet, and allowing four feet of freeboard per ADWR requirements, the height from each spillway crest to the top of the dam would be 7.4 feet. As with the dam itself, the side slopes and general appearance of the ½ PMF spillways could be modified to soften their visual impact, while not interfering with their hydraulic function.

The list below summarizes the physical, hydrologic, and hydraulic features of the dam.

Height at center of dam:	24 feet
Length of downstream face:	13,800 feet
Length of wings:	3,700 feet
Average side slopes:	6:1
Top width:	20 feet
Peak 100-year storage volume:	5,690 acre-feet
Peak 100-year inflow:	25,900 cfs
Peak 100-year outflow (total):	11,900 cfs
Peak 100-year outflow (Bender Wash):	2,600 cfs
Peak 100-year outflow (Sand Tank Wash):	9,300 cfs
Peak 100-year flow at Pima Street before dam:	18,100 cfs
Peak 100-year flow at Pima Street after dam:	7,900
Peak 100-year flood stage behind dam:	15.6 feet
Outlet structures:	11 – 10' x 6' CBC's 1 – 8' x 6' CBC 2 – 36" RCP's
½ PMF peak inflow:	53,000 cfs
½ PMF peak outflow:	31,800 cfs
½ PMF peak storage volume:	9,650 acre-feet
½ PMF spillway elevations:	16.6 feet above base of dam
Number of ½ PMF spillways:	5
Cumulative length of ½ PMF spillways:	1000 feet
Cubic yards of excavation required:	103,000 cubic yards
Cubic yards of fill material:	2.9 million cubic yards
Land area required for dam:	130 acres
Land area of impoundment:	1400 acres

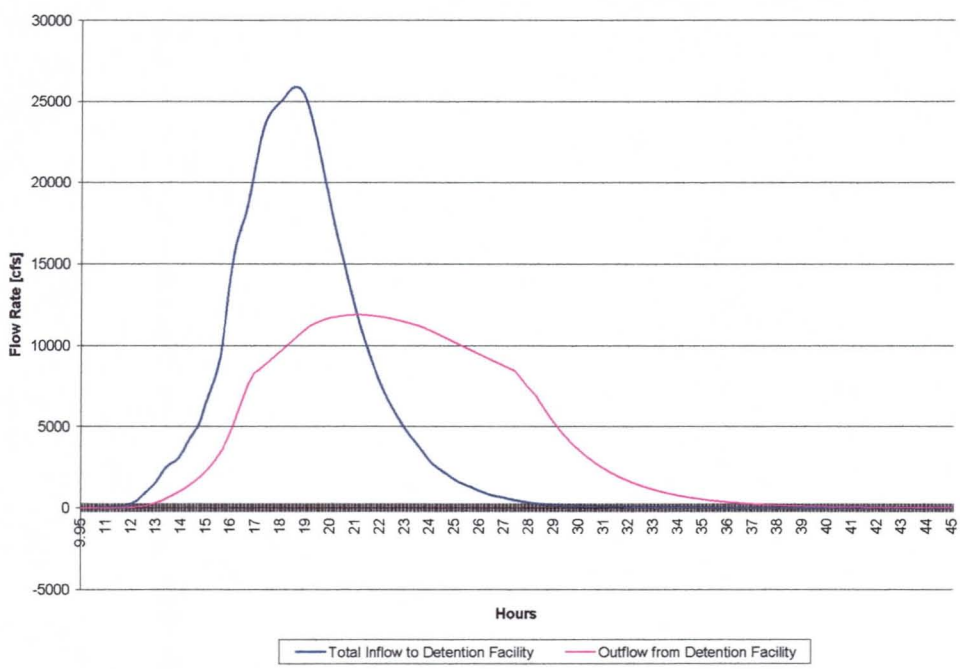


Figure 4.2 – Inflow/Outflow Hydrographs for Phase 3 Detention Facility

Modification to Phase 2 Retention Basin (Refer to Appendix K)
In Phase 3, the side wier spillway at the I-8 basin would have to be reconstructed to accept inflow at a lower water surface elevation. The spillway crest would be lowered 2.75 feet to an elevation of 765.75 and the length would be shortened from 900 feet down to 600 feet. This would allow the retention basin to accept its design volume of 2600 ac-ft. See Figure 4.3 for the 100-year design hydrographs for the modified reduction basin at I-8.

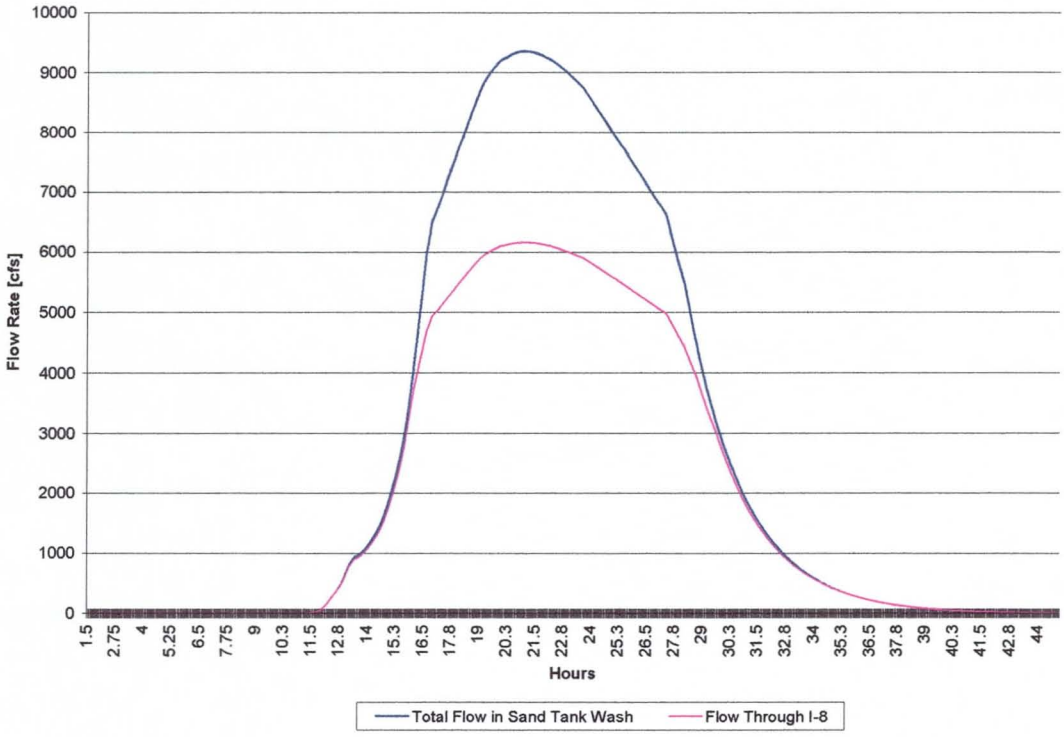


Figure 4.3 – Reduction in Sand Tank Wash Flood Hydrograph by Modified Phase 2 Basin

Floodplain Reduction (See Exhibit 4.12)
At Pima Street, the existing condition, 100-year peak discharge is 18,200 cfs. The Phase 3 flood control improvements result in a much lower peak discharge of only 7,900 cfs at Pima Street. Most of the structures that are currently in flood hazard areas will be removed from the floodplain. Pima Street and the Railroad will no longer be overtopped and the wide, shallow overbank area between Sand Tank Wash and St. Louis Avenue will be removed from the floodplain.

Borrow Source
The borrow required to build the embankment for the detention facility will come from the spoil at the I-8 retention basin. The spoil from the retention basin is

about 3.6 million cubic yards. This is more than enough to construct the detention facility, which is about 2.8 million cubic yards.

Environmental Impact
The Phase 3 detention facility provides significant flood reduction with minimal environmental impact. As described above, the borrow for the dam will come from the I-8 retention basin spoil. Therefore, the area disturbed will be limited to the footprint of the dam. The upstream and downstream washes will not be disturbed and, since the pass through culverts are large enough to convey bank full, or nearly bank full, flood flows, there will be little impact to their riparian habitats.

4.5 Buyout Alternative to Phases 1 and 2

The primary purpose of the Sand Tank Wash Flood Control Improvements (phase 1 and 2) is to protect the 100 plus homes and businesses that lie within the floodplain behind the Gila Bend Canal and along Scott Avenue Wash. Although this was, by far, the least expensive flood control alternative, it still cost over $13 million. As an alternative to the flood control improvements, the cost to purchase the flood prone properties was estimated to be $7 million. This cost includes purchase of the properties, demolition, and relocation costs for the owners.

It should be pointed out that this buyout option cannot be directly compared to the Sand Tank Wash Flood Control Improvements (phase 1 and 2). That is because the flood control improvements provide many more benefits than just protecting houses and businesses. These benefits include: 1) eliminating flow diversion into Hacken Wash (which reduces flooding over the Canal, the Railroad, and the highway), 2) eliminating flood flow on Scott Avenue Wash (which eliminates overtopping of the Canal, the Railroad, and the highway, and 3) eliminating flow diversion over the Gila Bend Canal and into Harrington Avenue (which substantially reduces the 100-year flood on Harrington Avenue).

It should also be pointed out that the Town Core drainage plans for the Scott Avenue Wash watershed are based on the assumption that the Sand Tank Wash flood control improvements are in place.

Buyout Computation0
Refer to Figure 4.4 for the properties used to compute the buyout costs. Also refer to Appendix B for property value data.

- Area 1 (South Gila Bend Residential Area)

Purchase Costs (75 residences @ $25,000)	=	$ 1,875,000
Relocation Costs (75 @ $10,000)	=	750,000
Demolition Costs (75 @ $5,000)	=	375,000

Title Reports/Fees (75 @ $2,000)	=	150,000
Total	=	$3,150,000

- Area 2 (Scott Avenue Wash Commercial Area)

Purchase Costs (5 Businesses)	=	$ 810,000
Relocation Costs (5 @ $25,000)	=	125,000
Demolition Costs (5 @ $10,000)	=	50,000
Title Reports/Fees (5 @ $2,000)	=	10,000
Total	=	$ 995,000

- Area 3 (Scott Avenue Wash Residential Area)

Purchase Costs (26 residences @ $95,000)	=	$2,470,000
Relocation Costs (26 @ $10,000)	=	260,000
Demolition Costs (26 @ $5,000)	=	130,000
Title Reports/Fees (26 @ $2,000)	=	52,000
Total	=	$2,912,000

GRAND TOTAL = $7,057,000

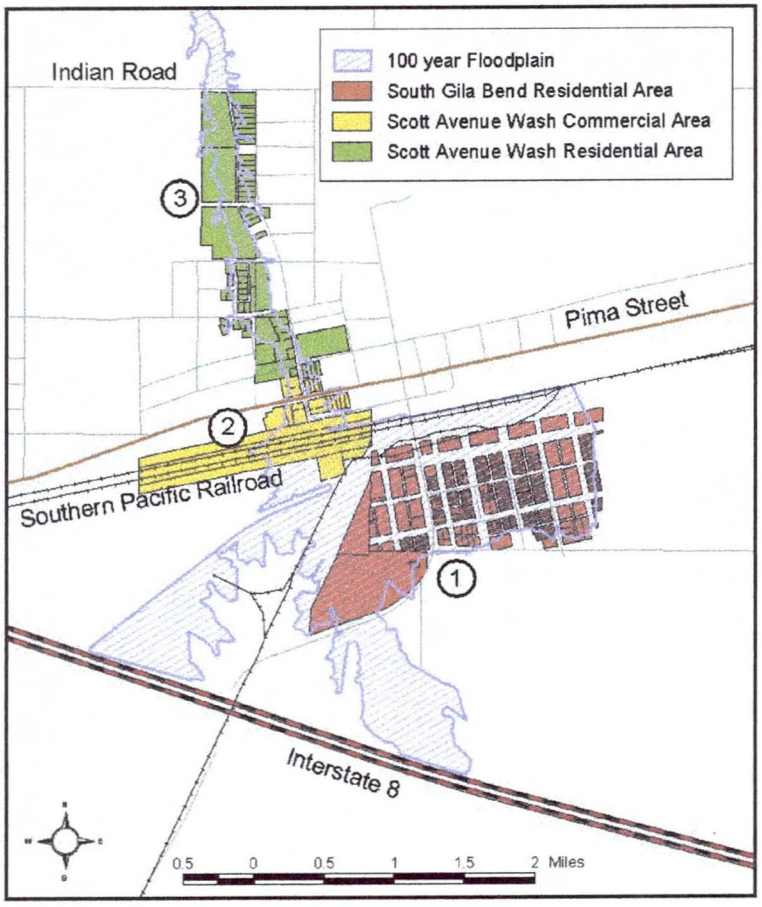
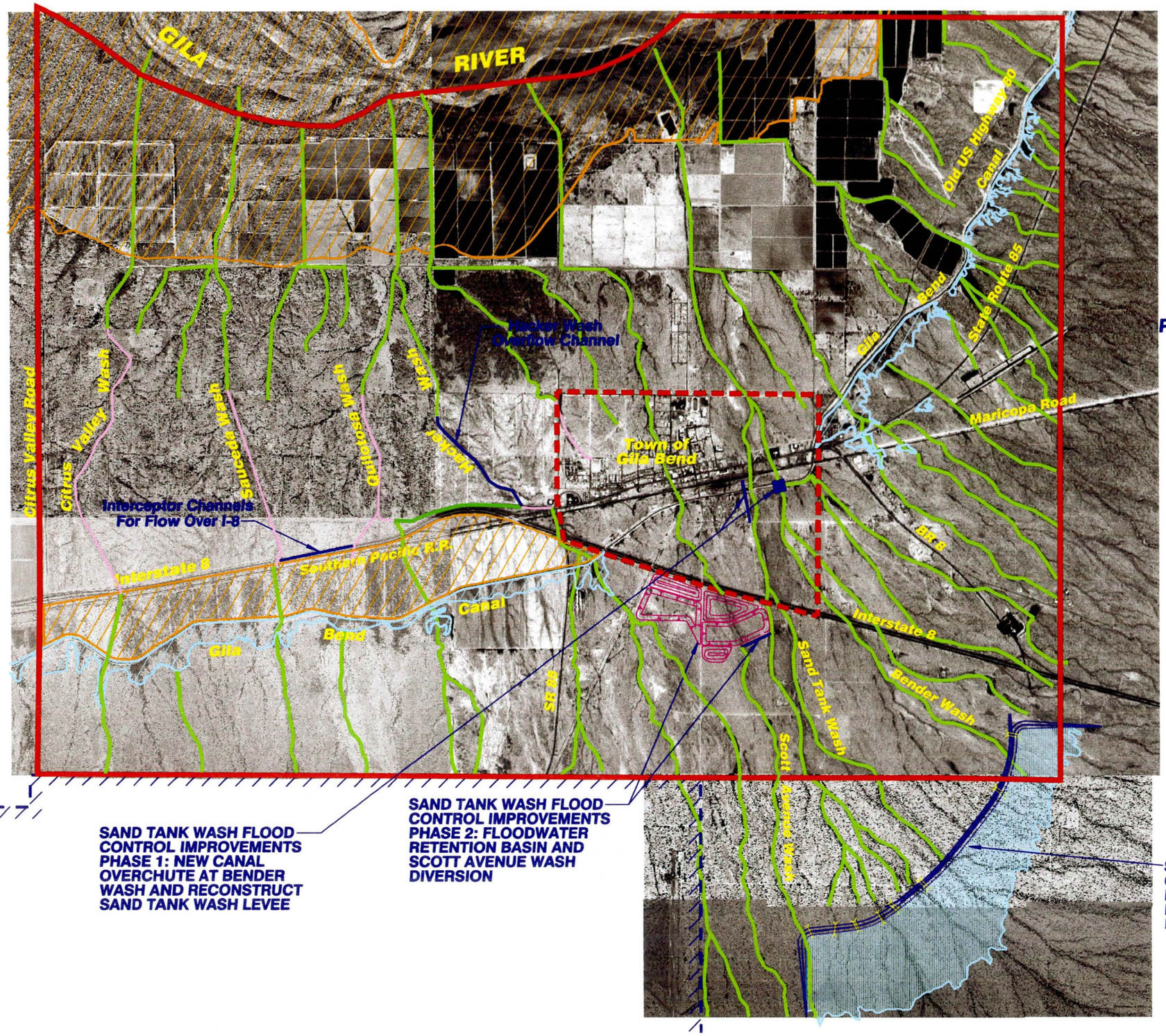


Figure 4.4 – Properties Used to Compute the Buyout Costs



GILA BEND
Area Drainage Master Plan

PRELIMINARY AREA MASTER DRAINAGE PLAN
EXHIBIT 4.1

LEGEND

- PLANNING STUDY AREA BOUNDARY
- CORE STUDY AREA BOUNDARY
- GUNNERY RANGE BOUNDARY
- HIGH FLOOD HAZARD AREA
- FLOODWATER STORAGE BEHIND GILA BEND CANAL TO BE PRESERVED
- NATURAL WASHES / CHANNELS TO BE PRESERVED
- EXISTING CHANNELS TO BE IMPROVED
- NEW CHANNELS / LEVEES

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0 250 500 4000 8000

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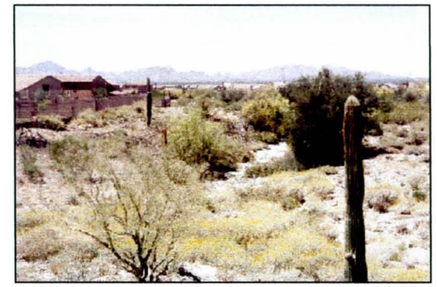
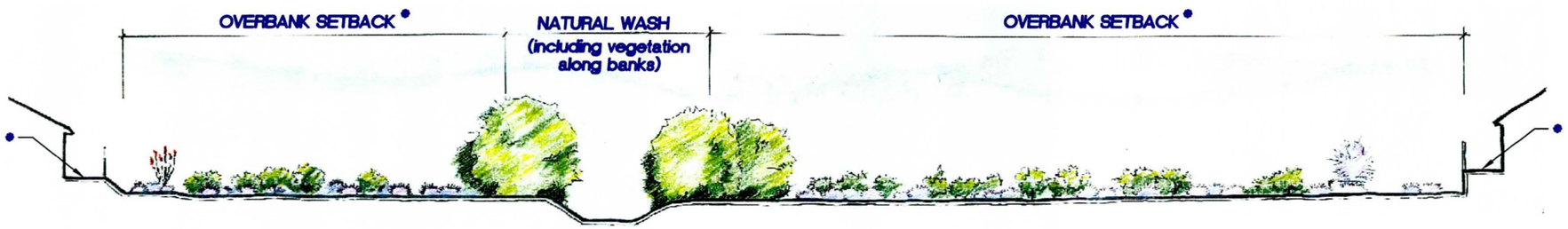


GILA BEND
Area Drainage Master Plan

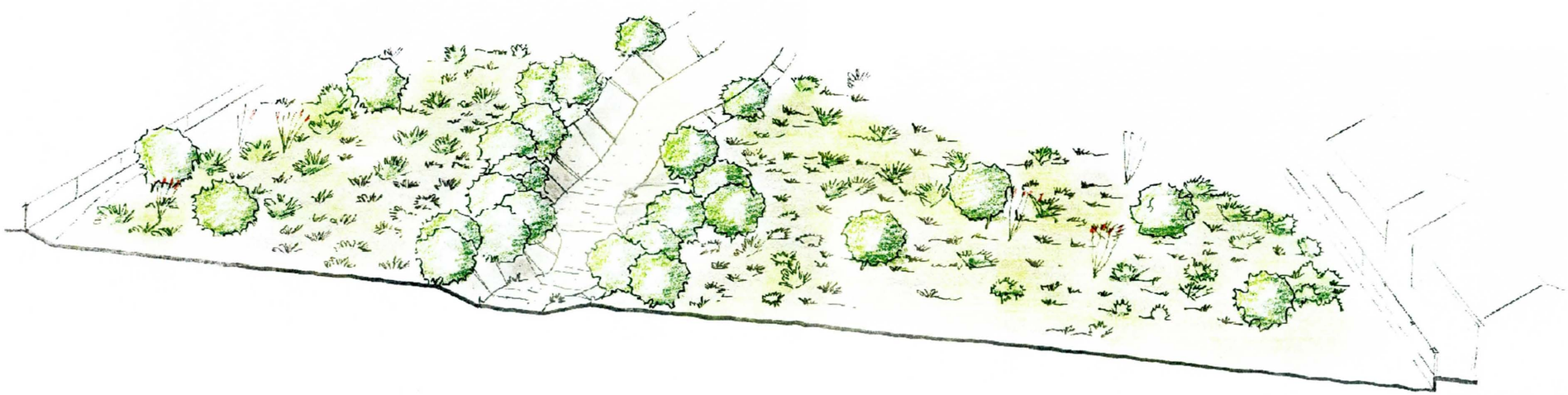
PRESERVATION OF NATURAL WASH
(PROVIDES FLOODWATER CONVEYANCE & PRESERVES HABITAT)

EXHIBIT 4.2



* Elevation of adjacent lots to be at least 1 foot above floodwater elevation.

* Setback to be the greater of:
1) Prediction of wash lateral migration, 2) Floodway width, 3) A minimum setback width of 25 feet.



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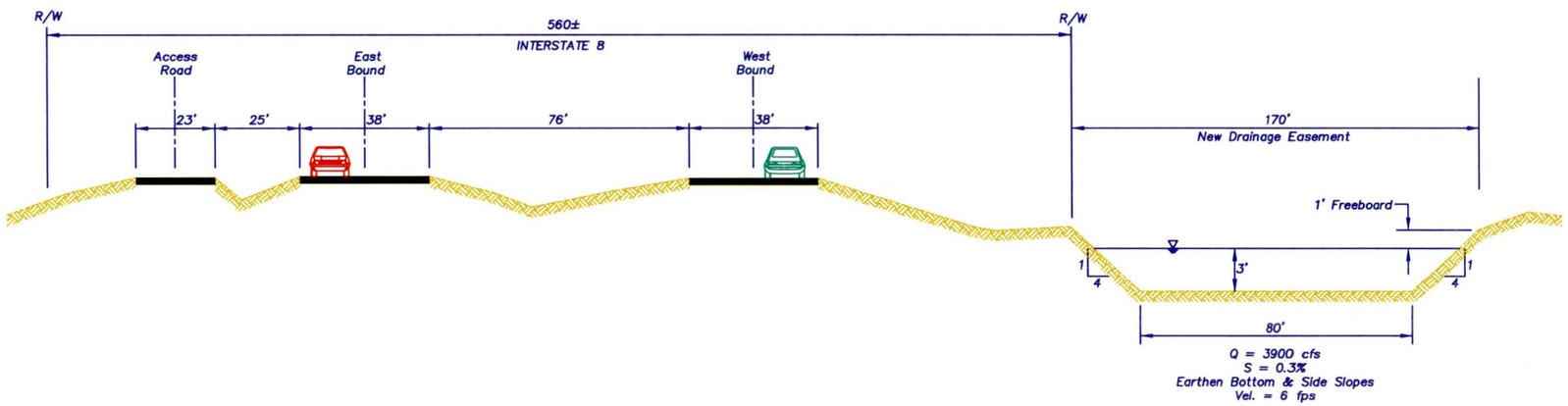
GILA BEND
Area Drainage Master Plan

I-8 INTERCEPTOR CHANNEL
EXHIBIT 4.3



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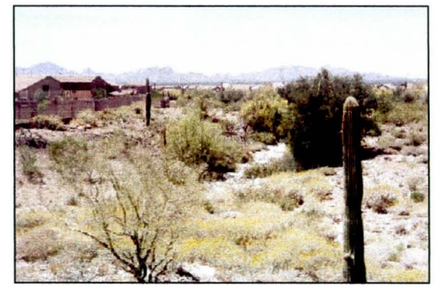
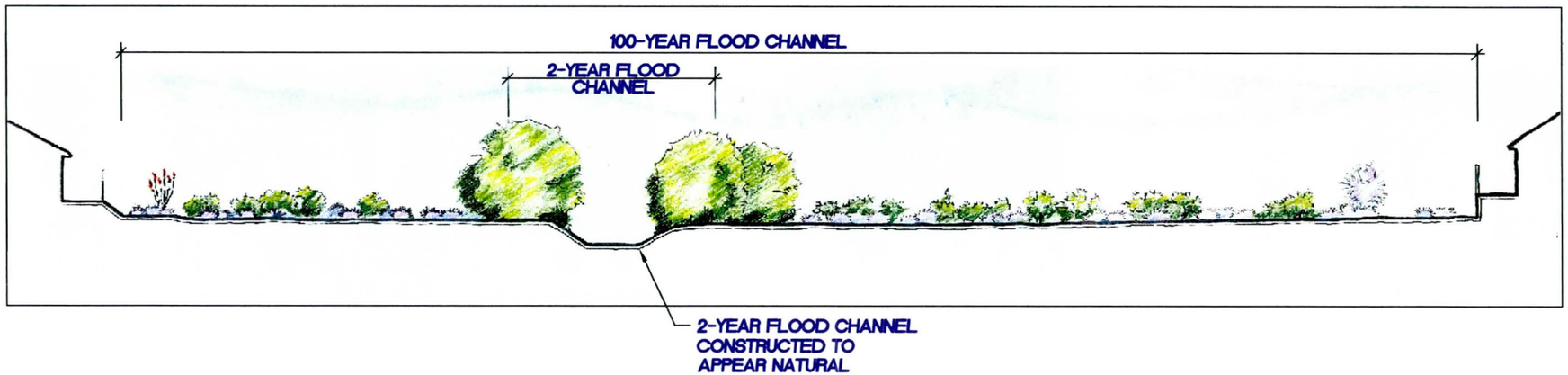
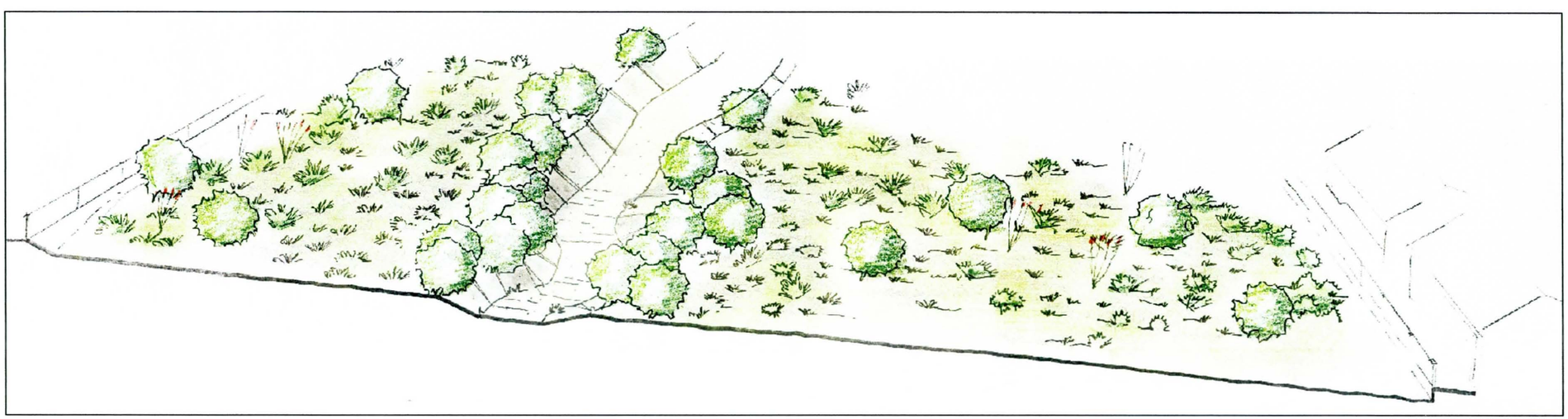


GILA BEND
Area Drainage Master Plan

RECONSTRUCT NATURAL WASH
EXHIBIT 4.4





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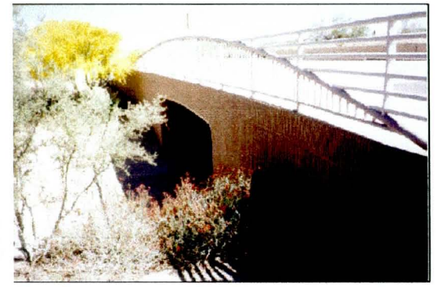
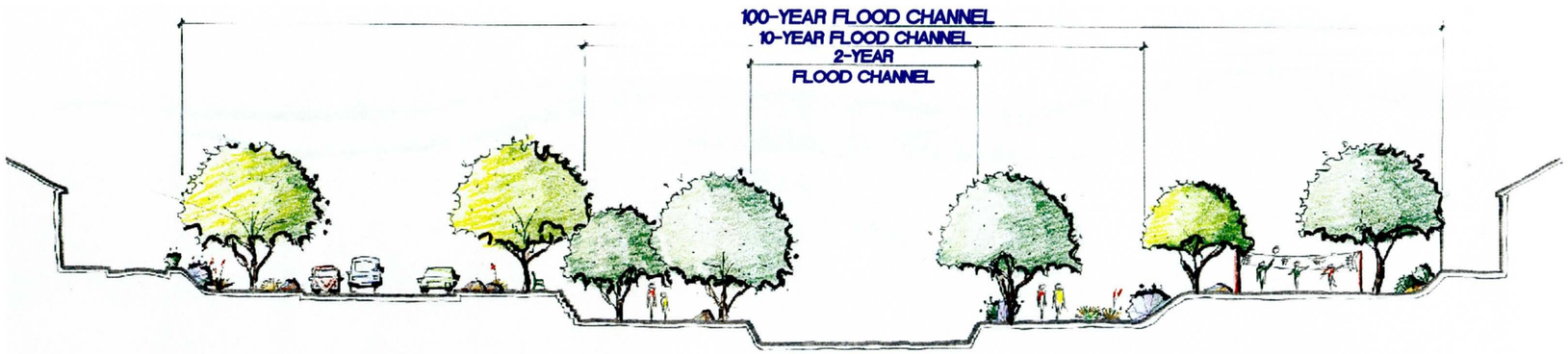


GILA BEND
Area Drainage Master Plan

MODIFIED NATURAL WASH
EXHIBIT 4.5



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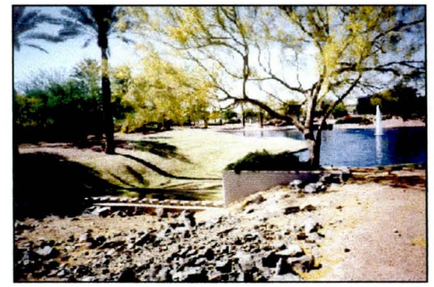
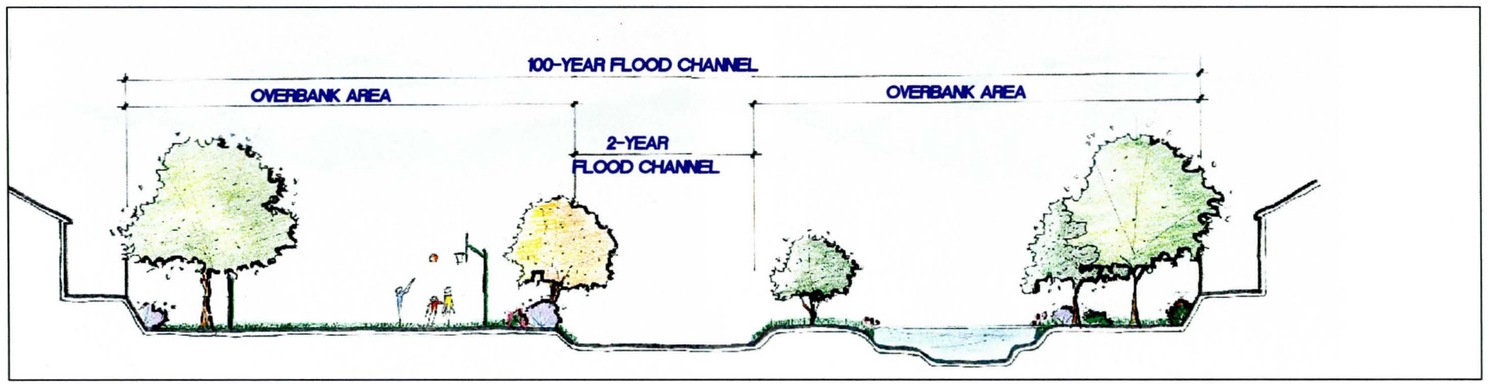
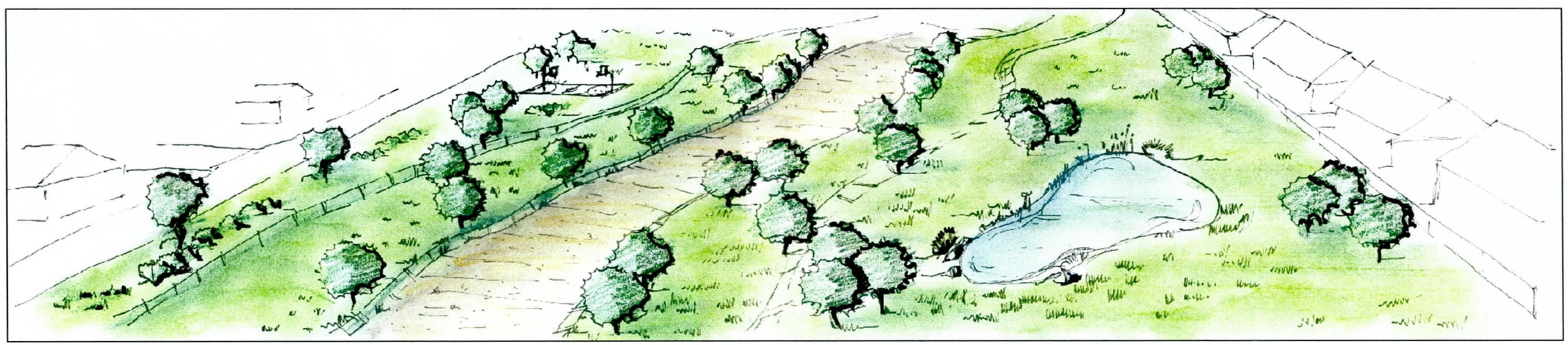


GILA BEND
Area Drainage Master Plan

PARK LIKE WASH
EXHIBIT 4.6





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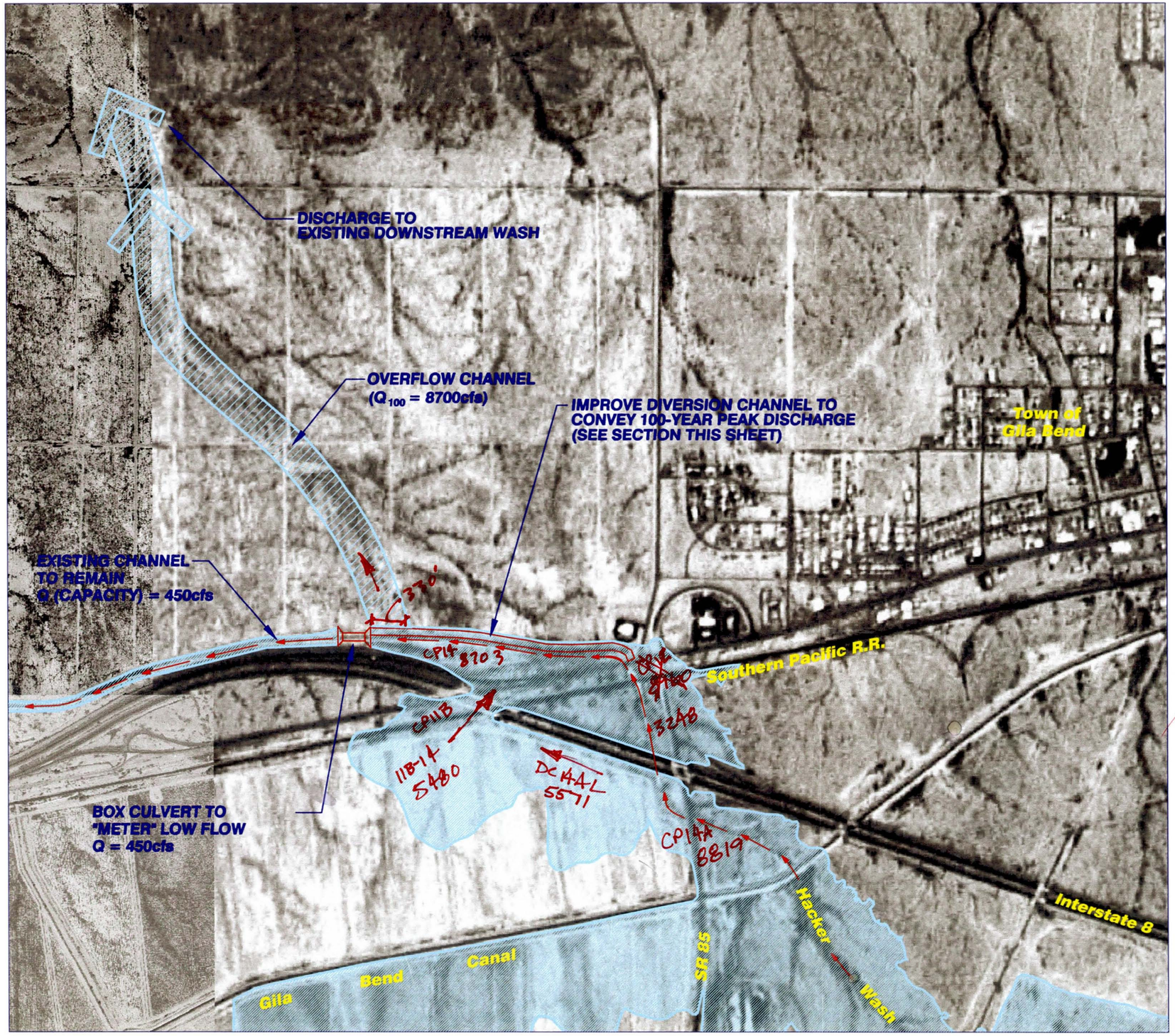
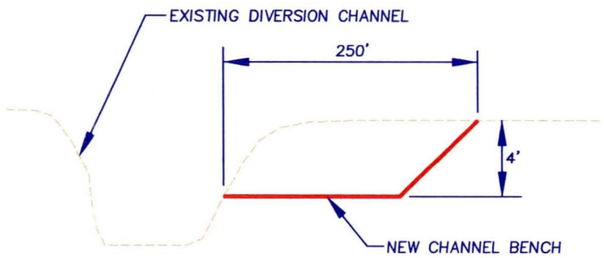


GILA BEND
Area Drainage Master Plan

HACKER WASH OVERFLOW CHANNEL
EXHIBIT 4.7



IMPROVED DIVERSION CHANNEL
TYPICAL SECTION

LEGEND

- FLOW DIRECTION
- 100-YEAR FLOODPLAIN
- OVERFLOW CHANNEL

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GILA BEND

Area Drainage Master Plan

SAND TANK WASH
FLOOD CONTROL IMPROVEMENTS (PHASE 1)
EXHIBIT 4.8

PHASE 1: RECONSTRUCT EXIST. DIKE AND NEW CANAL OVERCHUTE

LOCATION MAP

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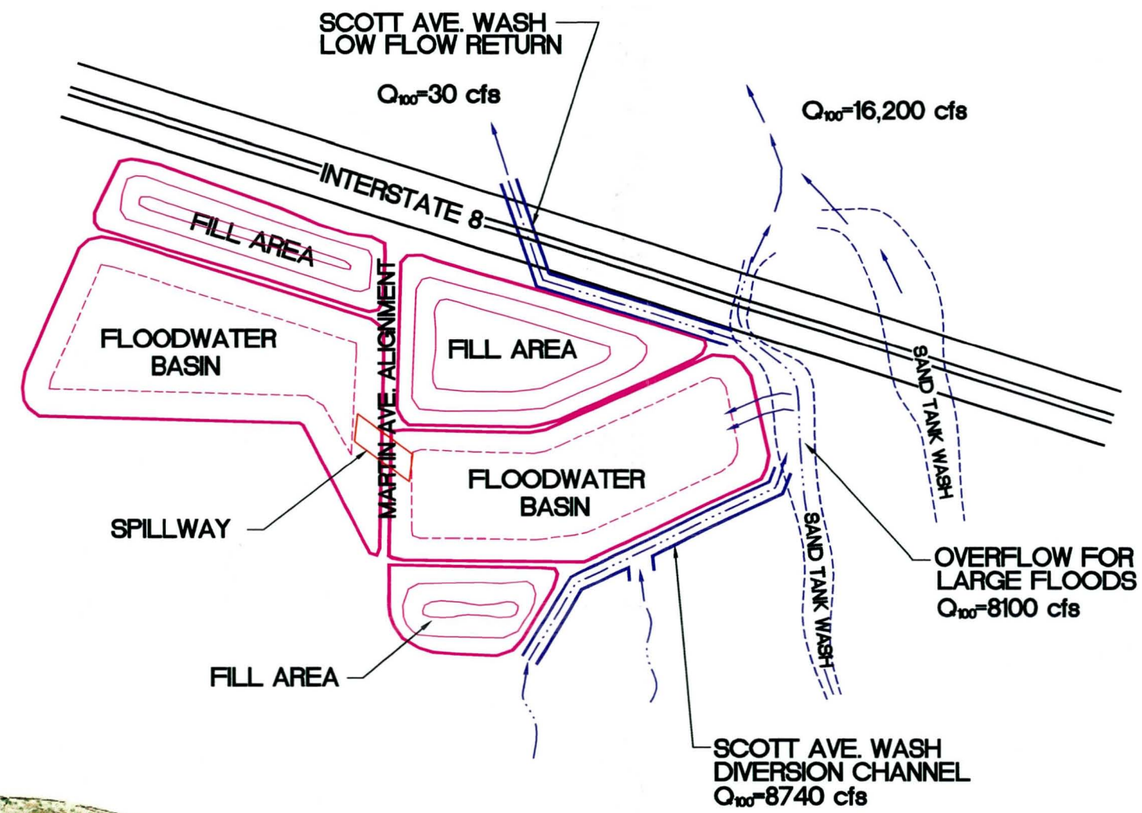
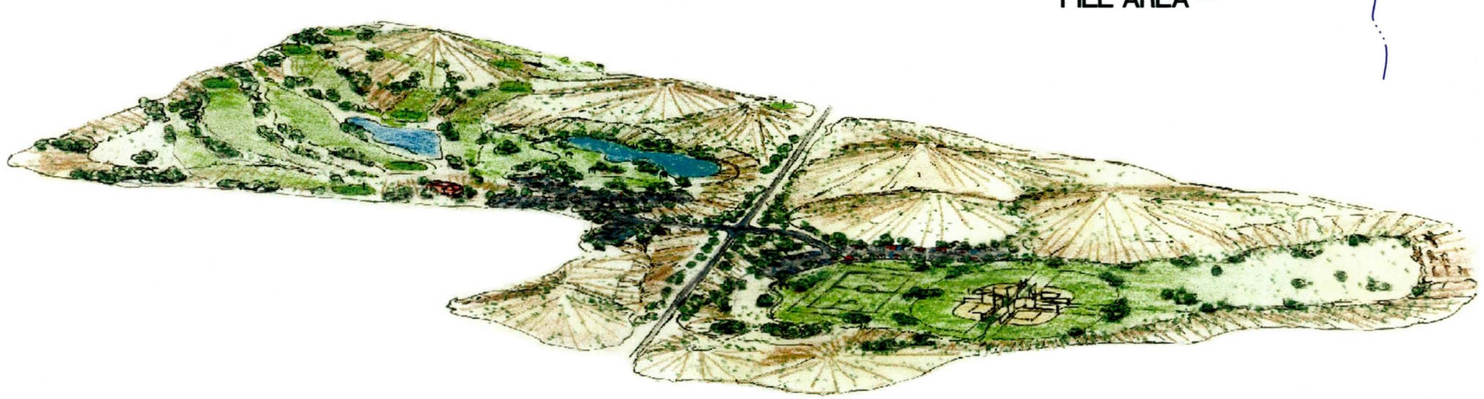
GILA BEND
Area Drainage Master Plan

SAND TANK WASH FLOOD CONTROL IMPROVEMENTS
FLOODWATER RETENTION BASINS AT I-8 (PHASE 2)
EXHIBIT 4.9





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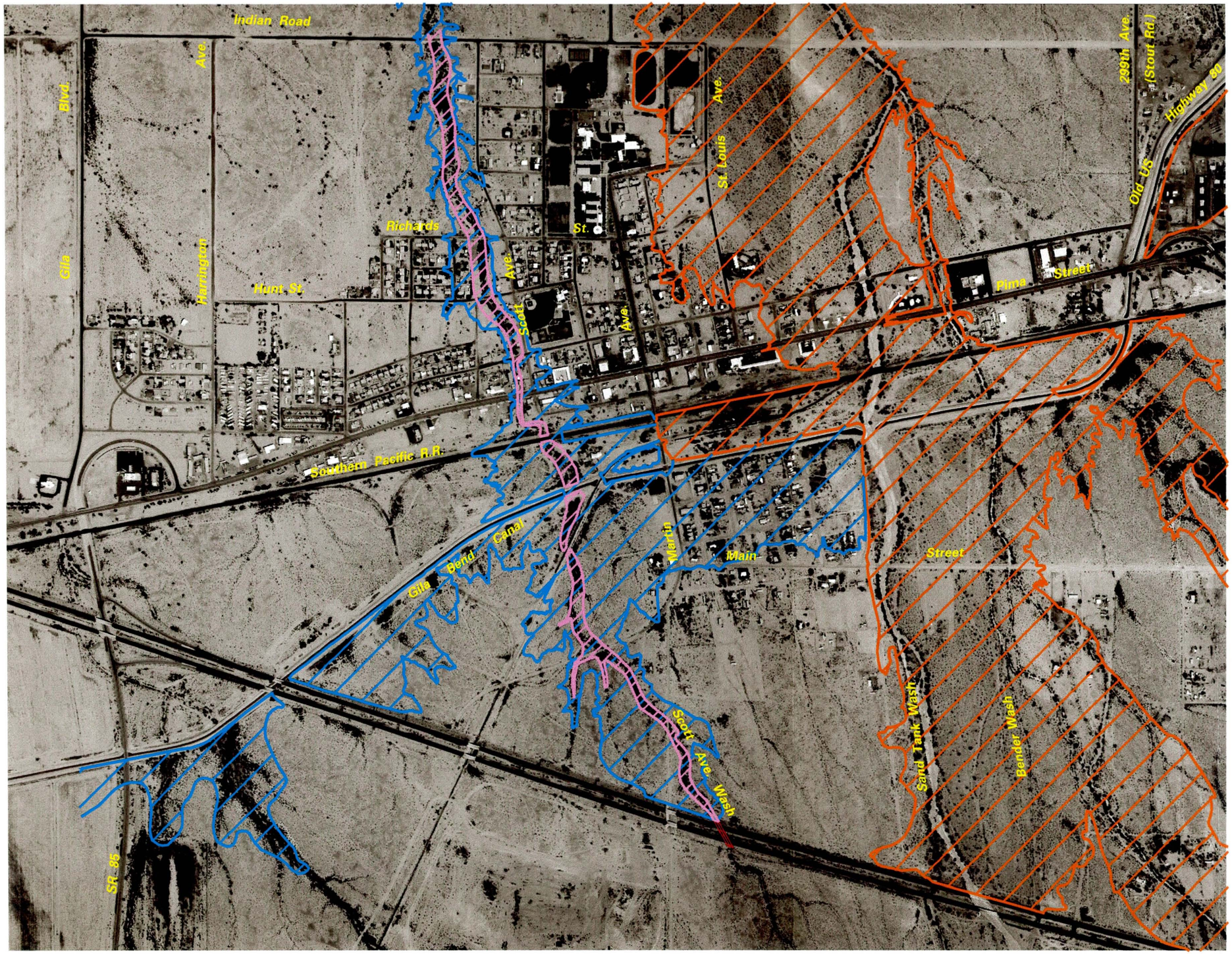

GILA BEND
Area Drainage Master Plan

REVISED 100-YR FLOODPLAIN WITH SAND TANK WASH FLOOD CONTROL IMPROVEMENTS (PHASE 1 AND PHASE 2)
EXHIBIT 4.10

LEGEND

- EXISTING 100-YR FLOODPLAIN
- REVISED 100-YR FLOODPLAIN
- SAND TANK WASH FLOODPLAIN - UNCHANGED

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SCALE: 1" = 1000'

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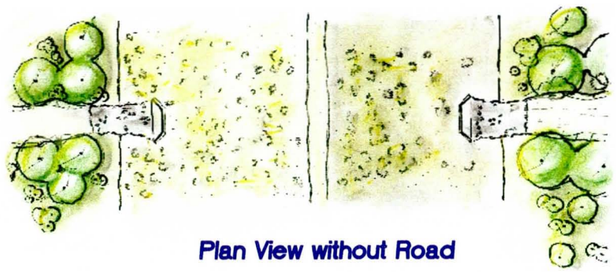
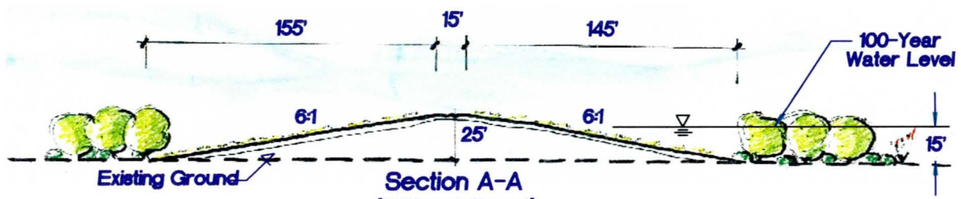
GILA BEND
Area Drainage Master Plan

SAND TANK WASH
FLOOD CONTROL IMPROVEMENTS
(PHASE 3)
EXHIBIT 4.11

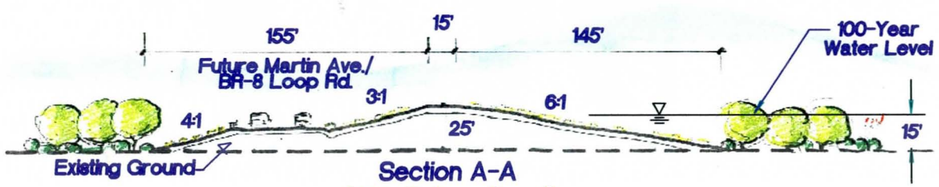


Plan View without Road

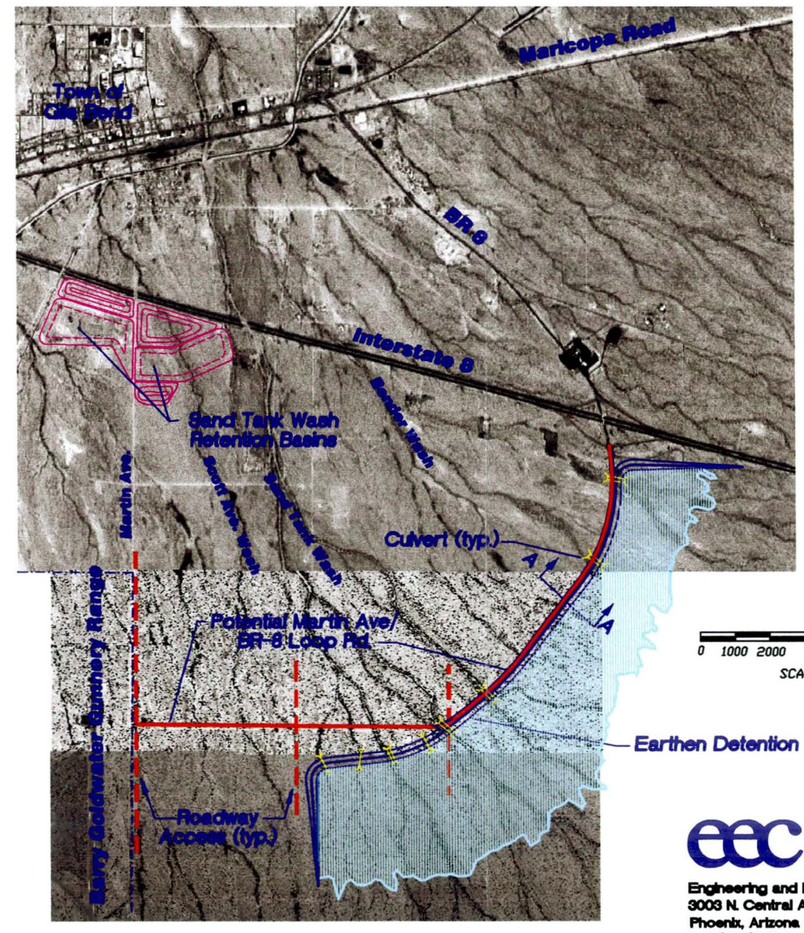


Section A-A
(Without Road)

Plan View with Future Road



Section A-A
(With Future Road)



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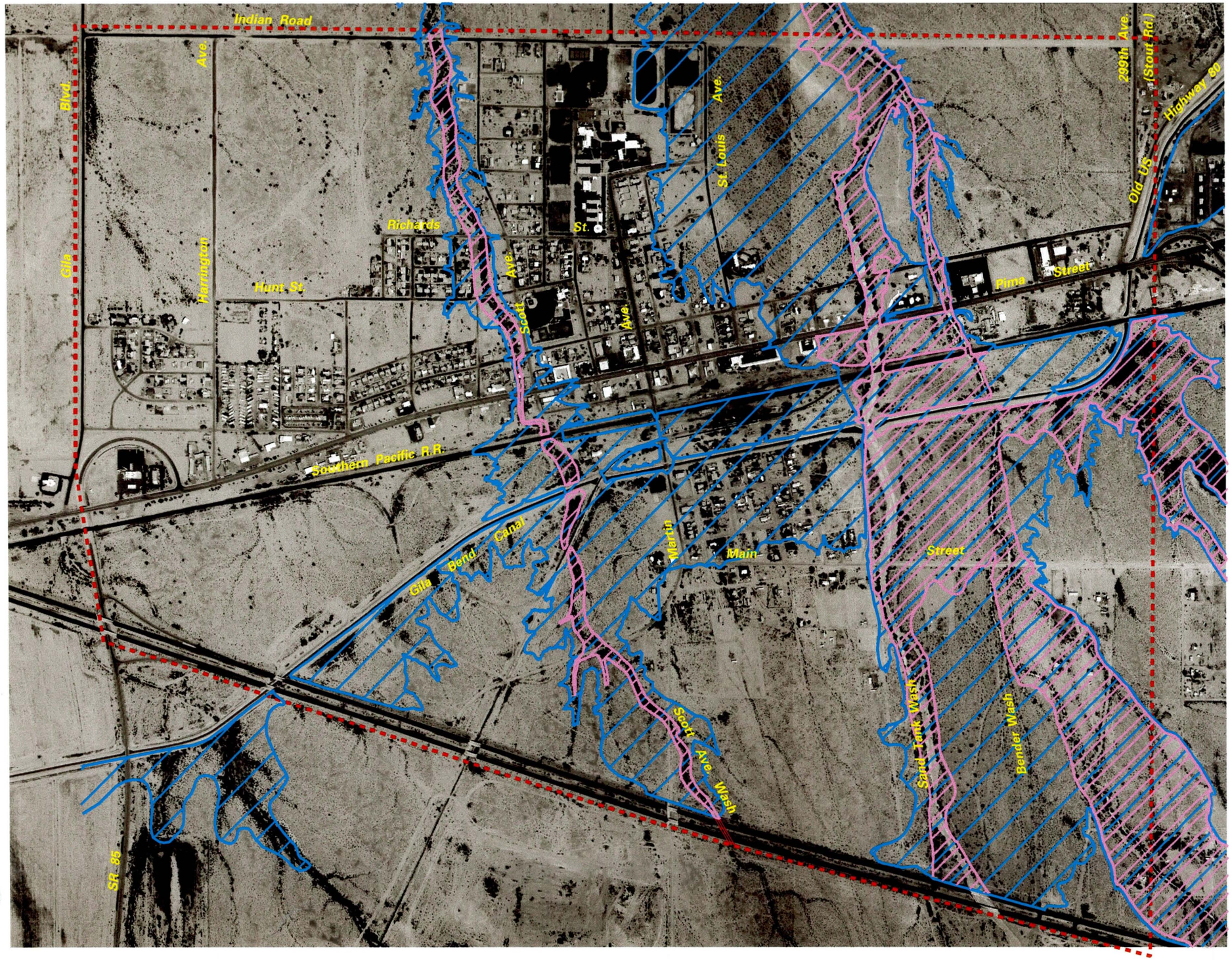

GILA BEND
Area Drainage Master Plan

REVISED 100-YR FLOODPLAIN WITH SAND TANK WASH FLOOD CONTROL IMPROVEMENTS (PHASES 1, 2 AND 3)
EXHIBIT 4.12

LEGEND

- CORE STUDY AREA BOUNDARY
- EXISTING 100-YR FLOODPLAIN
- REVISED 100-YR FLOODPLAIN

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SCALE: 1" = 500'

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SECTION 5: TOWN CORE DRAINAGE PLAN

5.1 Summary of Drainage Plan

The purpose of the Town Core drainage plan is to control local runoff and minimize the problems associated with local drainage within the Town. The drainage plan for the Town Core does not address flooding on the three major washes; Scott Avenue Wash, Sand Tank Wash, and Bender Wash. Instead, flood control improvements for these washes are included in the Area Drainage Master Plan (see Section 4).

The problems addressed with the Town Core drainage plan are local problems caused by storm water runoff within the Town. The local flooding problems are summarized in Section 2.5 and include street flooding, ponding along the Gila Bend Canal, and puddling in streets and alleys. For the most part, these problems consist of nuisance flooding and driver safety issues. However, the ponding along the Gila Bend Canal results in significant flooding of homes and yards in the south part of Gila Bend.

Capital Improvements:
The drainage plan for the Town Core includes new culverts at the street crossings of Scott Avenue Wash, storm drains in Harrington Avenue and St. Louis Avenue, a drainage channel along the Gila Bend Canal, a detention basin in the South Gila Bend Area, and a retention basin upstream of the Railroad in the Harrington Avenue watershed. The drainage improvements are to be complimented with a program of paving the existing streets with curb and gutter. The new street gutters will convey runoff without the erosion and puddling problems that currently exist. (see Exhibit 5.1)

Management of New Development:
The drainage plan also includes management of new development to help control runoff within the Town Core area. All new land development projects shall conform to the requirements outlined in the Drainage Design Manual for Maricopa County. This criteria will result in new development providing 1) 100-year, 2-hour stormwater retention, 2) all weather (100-year design) street crossings of existing washes, and 3) streets with curb and gutter designed to convey the 10-year flood.

5.2 Hydrologic Analysis

Appendix Q contains the existing and proposed conditions hydrologic analysis for the Town Core area. The hydrologic analysis includes HEC-1 models for the 2-year, the10-year, and the 100-year storm events.

5.3 Design Assumptions/Design Flood

Assumptions:

a. Existing Conditions – The design flows are based on existing condition land uses.

b. Upstream control on Scott Avenue Wash – Flood flows on Scott Avenue Wash were assumed to be collected upstream of I-8 (except for a low flow of 30 cfs) with the Sand Tank Wash Flood Control Improvements. (see Section 4)

Design Flood:

- Storm Drains – 2-year
- Roadside Channels – 2-year (10-year in South Gila Bend Watershed)
- Gila Bend Canal Channel – 10-year
- Retention/Detention Basins – 100-year, 2-hour
- Roadway Culvert Crossings – 10-year through culvert, 100-year contained in "dip" section over roadway

5.4 Drainage Plan Description

The drainage plan is described separately for each of the four main watersheds in the Town Core Area; the South Gila Bend watershed; the Harrington Avenue watershed, the Scott Avenue Wash watershed, and the St. Louis Avenue watershed (see Exhibit 5.2).

5.4.1 South Gila Bend Drainage Improvements (Refer to Exhibit 5.3)

Elements of South Gila Bend Drainage Plan:

- Main Street Channel – Extend the existing roadside channel from Barnes Road to St. Louis Avenue, designed for the 10-year flood.

- Gila Bend Canal Channel – Enlarge channel along the Gila Bend Canal from Capitol Avenue to the Sand Tank Wash Levee; designed for the 10-year flood.

- Detention Basin – Construct a new detention basin at the downstream end of the Gila Bend Canal Channel with a new 36" outlet pipe into Sand Tank Wash; designed for the 100-year flood.

- Repave Streets with Curb and Gutter – Repave streets with curb and gutter to direct flow into the Gila Bend Canal Channel. Main Street paving to include scuppers along the south curb line to collect flow and direct it down the north/south streets.

Summary of Project Cost: (For an itemized cost estimate refer to Appendix D.)

Drainage Components Construction Costs =		$176,200
Land Acquisition Cost =		$ 10,200
Engineering/Permitting Costs =		$ 31,400
Construction Administration Cost =		$ 26,400
Contingency Cost (@ 20%) =		$ 48,900
	Subtotal =	$293,100
Roadway Improvement Construction Costs =		$197,000
Land Acquisition Cost =		$ 0
Engineering/Permitting Costs =		$ 29,600
Construction Administration Cost =		$ 29,600
Contingency Cost (@ 20%) =		$ 51,200
	Subtotal =	$307,400
	Total Cost =	**$600,500**

Description of Drainage Plan:
The South Gila Bend drainage improvements consist of enlarging the existing drainage channel along the Gila Bend Canal, constructing a new detention basin on the upstream side of the Sand Tank Wash Levee, replacing the culvert that discharges through the Levee into Sand Tank Wash, and widening/extending the roadside channel along Main Street. It also includes repaving the collector streets with curb and gutter to collect and convey runoff and help prevent standing water.

Homes in the south Gila Bend area suffer from a common problem associated with elevated canals. That is, storm water runoff concentrates along the upstream side of the Gila Bend Canal embankment and, since the Canal is constructed on a relatively flat slope with little lateral conveyance, water accumulates and causes flooding problems on the upstream, adjacent lots.

Currently there is a small, undersized drainage channel, built on a very flat slope that runs along the Canal to the Sand Tank Wash levee. At the levee, there is an existing 36-inch culvert that drains out through the levee and into the wash. The invert elevation of the existing culvert is only 2 to 3 feet below the lots. Runoff tends to accumulate along the Canal and back up at the culvert. This causes flooding of the yards and homes on the lots adjacent to the Canal. The plan is to enlarge the existing channel to convey the 10-year flood. The new detention basin will be excavated about 4 feet which provides an outlet for the enlarged channel. The deeper outlet allows the channel to have an adequate slope.

Another problem is that the flap gate on the existing culvert tends to get clogged with debris on the wash side of the levee, which causes it to get stuck in an open position. This increases the risk of flooding from Sand Tank Wash, because if a flood were to occur on the Wash, and the flap gate was stuck open, floodwater

would flow through the culvert and back into the south Gila Bend area behind the levee. The plan is to reconstruct the flap gate with a Tideflex check valve that is less susceptible to clogging.

Hydrologic/Hydraulic Design (refer to Appendix M)

Contributing watershed: The contributing local watershed is approximately 140 acres in size and is bounded by the Gila Bend Canal on the north, I-8 on the south, Sand Tank Wash on the east, and Scott Avenue Wash on the west. (refer to Exhibit 5.3)

Design flood: The design flood for the interceptor channel along the Canal and the roadside channel along Main Street is based on the 10-year storm. The design for the detention basin at the Sand Tank levee is based on the 100-year, 2-hour storm.

Gila Bend Canal Channel design: The new earthen interceptor channel will have a six-foot wide bottom width and 4H:1V side slopes. The depth of flow for the 10-year flood will vary from about 1.5 to 2.5 feet and the velocity of flow will be 2 to 3 feet per second. The channel will be re-vegetated with native grass seed to help control erosion and provide an attractive aesthetic treatment.

Detention basin design: The new detention basin will also be earthen with 4H:1V side slopes. The basin will be about 3 acres in size and will store approximately 7.4 acre-feet of runoff. The depth of water in the basin during the 100-year, 6-hour flood will be about 4.5 feet, and for the 10-year, 6-hour flood it will be about 3 feet.

The design volume of the detention basin is actually based on the runoff from the future condition, 100-year, 2-hour storm. Future conditions assume that the undeveloped area between Main Street and I-8 will be developed with stormwater retention for the 100-year, 2-hour runoff. This assumption reduced the contributing area from 140 acres, down to about 67 acres. In order to make sure that the basin will function adequately under existing conditions, both the 10-year, 6-hour and the 100-year, 6-hour existing conditions flood were routed through the basin. Since there is a relatively large, 36" outlet pipe, the peak stage for both floods stays within the basin.

Main Street Channel: The new roadside channel along Main Street will consist of widening and extending the channel recently constructed by the Maricopa County Department of Transportation. The existing channel is "V" shaped with a 6:1 slope down from the shoulder and a 4:1 backslope. The new channel will be widened to include a 4-foot bottom. The new channel will extend from Sand Tank Wash to St. Louis Avenue. The depth of flow for the 10-year flood will be about 1.5 feet and the velocity will range from 2 to 2.5 feet per second. The channel will be re-vegetated with native grass seed to help prevent erosion and to provide an aesthetic treatment.

5.4.2 Harrington Avenue Drainage Improvements (refer to Exhibit 5.4)

Elements of Harrington Avenue Drainage Plan:

- Upstream Retention Basin – Construct a new retention basin, upstream of Southern Pacific Railroad; designed to store the runoff from a 100-year, 2-hour storm.

- Harrington Avenue Storm Drain – Construct a new storm drain in Harrington Avenue from Williams Street to Hunt Street; designed to convey the 2-year flood. why 2? ! not 10

- Interim Outlet Channel – Construct a new earthen channel for the Harrington Avenue Storm Drain outlet, located downstream of Hunt Street. Designed to "daylight" the 2-year peak discharge from the storm drain.

- Harrington Avenue Street Improvements – As part of the storm drain construction, improve Harrington Avenue with curb and gutter to the standard 40' wide collector street width. Built in conjunction with the storm drain in order to provide standard curb opening type storm drain inlets. Designed for one dry lane in each direction during 2-year storm.

- Roadway Culverts at Wash Crossings – Construct culverts at local wash crossings along Indian Road and Harrington Avenue. Designed for 10-year flood.

- Local Street Improvements – Improve local streets to the standard 34' width with curb and gutter that will convey local runoff to the Harrington Avenue storm drain.

- Future Developer-Built Channel and Culvert – Future development of the land between Hunt Street and Indian Road shall provide a channel to convey the discharge from the Harrington Avenue storm drain outlet. The channel will be designed to convey the 100-year flood. The development will also provide a culvert under Gila Boulevard designed for the 10-year flood (with the 100-year flood contained in a "dip" section over the top of the culvert).

Summary of Project Cost: (For an itemized cost estimate refer to Appendix D.) These costs do not include the cost of the "developer built" channel and Gila Boulevard culvert.

Drainage Components Construction Costs =	$736,700
Land Acquisition Cost =	7,500
Engineering/Permitting Costs =	115,500
Construction Administration Cost =	110,500
Contingency Cost (@ 20%) =	194,000
Subtotal =	$1,164,200

Roadway Improvement Construction Costs =		$ 974,300
Land Acquisition Cost =		0
Engineering/Permitting Costs =		146,000
Construction Administration Cost =		146,100
Contingency Cost (@ 20%) =		253,300
	Subtotal =	$1,519,700
	Total Cost =	**$2,684,000**

Description of Drainage Plan:
The Harrington Avenue drainage improvements consist of a series of features to help control/reduce street flooding along Harrington Avenue. These improvements include an upstream retention basin, a new storm drain, and repaving streets with curb and gutter. The plan also includes new culverts at wash crossings along Harrington Avenue and Indian Road.

The planned retention basin will effectively eliminate the watershed upstream of the Railroad from contributing to Harrington Avenue. The existing 2 – 36-inch culverts under the Railroad will remain and serve as an emergency outfall should the capacity of the retention basin be exceeded.

Under existing conditions, the runoff downstream of the Railroad is collected in the Pima Street storm drain. The storm drain outlets into an open channel, east of Harrington Avenue, that drains northerly toward Williams Street. This part of the existing storm drain system will remain.

A new storm drain is planned for Harrington Avenue that begins on Williams Street at the outlet of the existing open channel. From there, it runs west in Williams Street to Harrington Avenue and then north on Harrington to Hunt Street. At Hunt Street the storm drain outlets to an existing drainage swale that flows northwesterly. The bottom of the existing swale will have to be excavated to a depth of about 6 feet in order to outlet the new storm drain. This will require an interim channel to "daylight" the storm drain outlet. The length of the interim outlet channel is about 1350 feet.

In the future, when the undeveloped land between Hunt Street and Indian Road is developed, a new channel will have to be constructed by the developer, which will replace the interim channel. The future channel will be built to convey the 100-year flood and will include a culvert under Gila Boulevard.

The plan also includes repaving the streets with curb and gutter. This is particularly important for Harrington Avenue because the gutters will provide a means of collecting stormwater in the storm drain with standard cub opening inlets. New curb and gutter in the other streets will drain to Harrington Avenue.

One additional component of the drainage plan is to re-grade the alley north of Margaret Street to eliminate the low point that results in standing water. The plan is to re-grade the north-south section of the alley and install a concrete valley gutter to drain the low point. The new valley gutter will drain to Robert E. Lee Lane.

Hydrologic/Hydraulic Design (refer to Appendix N)
Retention Basin Design: The new retention basin will be about 3 feet deep with 6H:1V side slopes. The basin is designed to store the runoff from the 100-year, 2-hour storm, a volume of 6 ac-ft. The basin will be drained in a 36-hour period with approximately 10 drywells. The existing 2-36" culverts under the Railroad will serve as an emergency outlet if the water level gets higher than 3 feet deep. The basin will be re-vegetated with native grass seed to help control erosion and provide an aesthetic treatment.

Storm Drain Design: The Harrington Avenue storm drain is designed for the 2-year flood. It was designed with concrete pipe; varying in size from 36 inches to 48 inches in diameter. Harrington Avenue and Williams Street will be repaved with curb and gutter which will provide curb opening inlets to capture the stormwater. The design flow varies from 33 cfs up to 65 cfs with velocities ranging from 6 to 9 feet per second. The storm drain will outlet at Hunt Street into an excavated channel. The outlet structure will be a concrete headwall.

Interim Outlet Channel: The interim outlet channel for the storm drain will be earthen with a 2-foot bottom width and 4H:1V side slopes. It will daylight approximately 1350 feet downstream at elevation 704. The depth of flow for the 2-year peak discharge (65 cfs) is 2.6 feet with a velocity of 2 feet per second. The channel will be re-vegetated with native grass seed to help control erosion and provide an attractive aesthetic treatment.

Future Outlet Channel: The future, developer-built, outlet channel will be designed to convey the 100-year peak discharge of 441 cfs. The concept for this channel includes a 2-foot deep low flow channel that has a 10-foot bottom width and 4H:1V side slopes. On either side of the low flow channel is a 2-foot deep, 20-foot wide terrace with 6H:1V side slopes. The total channel width is 86 feet. The depth of flow is 3.5 feet and the velocity is 3.5 feet per second. The freeboard depth is one foot.

Future Gila Boulevard Culvert: The future, developer-built, culvert at the end of the outlet channel, under Gila Boulevard will require 3 – 6'x3' concrete box culverts. This design allows the 10-year peak discharge of 233 cfs to pass through the culverts and the 100-year peak discharge to flow over the roadway at a depth of about 0.5 feet. The culvert will require excavation of a downstream channel to a depth of about 3 feet in order to "daylight" the culvert bottom. The downstream channel will have a bottom width of 20 feet, 4H:1V side slopes, a velocity of 2.5 feet per second, and a length of about 800 feet.

5.4.3 Scott Avenue Wash Drainage Improvements (refer to Exhibit 5.5)

Elements of the Scott Avenue Wash Drainage Plan:

- Culvert Crossings – Provide culvert crossings at each of the existing "dip" street crossings (Papago Street, Hunt Street, Richards Street, and Indian Road). Designed to convey future conditions 10-year flood through the culverts and 100-year flood in a dip section over the roadway.

- Detention Basin – Construct a new detention basin on the south side of Hunt Street, between Johnny Street and Weidner Street. Includes an 18-inch outlet pipe to Scott Avenue Wash. Designed for the 100-year, 2-hour storm.

- Local Street Improvements – Improve local streets to the standard 34' width with curb and gutter that will convey local runoff to Scott Avenue wash.

- Preserve Existing Storage – The existing storage upstream of the Gila Bend Canal shall be preserved.

Summary of Project Cost: (For an itemized cost estimate refer to Appendix D.)

Drainage Components Construction Costs =		$201,700
Land Acquisition Cost =		2,500
Engineering/Permitting Costs =		30,300
Construction Administration Cost =		30,300
Contingency Cost (@ 20%) =		53,000
	Subtotal =	$317,800
Roadway Improvement Construction Costs =		1,342,500
Land Acquisition Cost =		0
Engineering/Permitting Costs =		201,400
Construction Administration Cost =		201,400
Contingency Cost (@ 20%) =		349,100
	Subtotal =	$2,094,400
	Total Cost =	**$2,412,200**

Flow from Upstream of I-8:

For purposes of the Scott Avenue Wash drainage plan, the peak discharge through I-8 was assumed to be limited to 30 cfs. The existing conditions, 100-year peak discharge through I-8 is actually 3500 cfs which is very large relative to its channel capacity and represents one of the primary flooding problems in Gila Bend. This flooding problem, however, is addressed as part of the Sand Tank Wash flood control improvements (refer to Section 4). Those flood control improvements include a large retention basin upstream of I-8 that will effectively

cut off the flow on Scott Avenue Wash. Only a small flow, of about 30 cfs, will be discharged into Scott Avenue in order to maintain the existing riparian vegetation.

Description of Drainage Plan:
The Scott Avenue Wash drainage plan consists of new culverts at street crossings, preserving existing storage upstream of the Gila Bend Canal, and construction of a local retention basin. It also includes paving the existing streets with curb and gutter to convey runoff to the wash.

The local drainage issues are mostly associated with the street crossings of Scott Avenue Wash. With the exception of Pima Street, the local streets are dip sections through the wash. Therefore, every time the wash flows, the streets become flooded and are occasionally impassable. The plan is to provide new culverts along Scott Avenue Wash at Papago, Hunt, Richards and Indian Road. In most cases, concrete box culverts are required due to the limited cover.

In addition to the road crossings, roadway improvements to the adjacent streets with curb and gutter are included in this alternative. The street improvements provide conveyance capacity to drain local runoff to the wash.

Another problem is the concentration of runoff that occurs at Hunt Street, between Johnny Street and Weidner Street. Storm water accumulates on the south side of Hunt Street and spills through yards over to Scott Avenue Wash. The plan includes construction of a detention basin in the undeveloped lot located on the south side of Hunt Street. The basin will provide capacity for the 100-year 2-hour storm and have a positive outflow from the basin using an 18-inch drainage pipe into Scott Avenue Wash.

Another element of the plan is to preserve the existing storage behind the Gila Bend Canal. There is approximately 6 ac-ft of storage that significantly reduces the 100-year peak discharge. Future development upstream of the Canal shall be required to preserve the storage volume.

Hydrologic/Hydraulic Design (refer to Appendix O)
Preserve Existing Storage: The existing peak storage volume upstream of the Gila Bend Canal is approximately 6 ac-ft during the 100-year flood. Flow is restricted through the Canal by a 6'x3' box culvert. The storage has little effect on the 10-year flood, but has a significant effect on the 100-year flood (see table below).

Return Interval	Peak Stage (ft)	Inflow* (cfs)	Outflow (cfs)
10-year	735.6	163	146
100-year	737.6	314	192

*assumes Flows upstream of I-8 are cut off.

New Culverts: Refer to Appendix O for design calculations of new culvert crossings. Due to lack of cover, the crossings at Papago, Hunt, and Richards are designed with shallow, 3-foot high box culverts; using the top of the box for the roadway surface. The Indian Road culvert is designed with Corrugated Metal Pipe culverts (5 – 42"). In all cases, the 10-year flood is conveyed through the culvert, under the roadway and the 100-year flood is contained in a dip section over the roadway with depths less than one foot.

Detention Basin: The new detention basin at Hunt Street is designed for the 100-year, 2-hour storm runoff. The required volume is 2.15 ac-ft. The concept design volume is 3 ac-ft at a depth of 3.75 feet. The outlet pipe is 18 inches in diameter and discharges to Scott Avenue Wash. The 10-year, 6-hour peak discharge is 9 cfs at a depth of 2.4 feet. The 100-year, 6-hour peak discharge is 13 cfs at a depth of 3.5 feet (refer to proposed condition HEC-1 models, Appendix Q).

5.4.4 St. Louis Avenue Drainage Improvements (refer to Exhibit 5.6)

Elements of St. Louis Avenue Drainage Plan:

- St. Louis Avenue Storm Drain – Construct a new storm drain in St. Louis Avenue from Indian Road to Richards Street with short laterals on Richards Street and Stout Street; designed for the 2-year flood.

- Street Improvements – Improve Martin Avenue, Richards Street, and St. Louis Avenue with curb and gutter to collect and convey runoff to new storm drain.

- St. Louis Avenue Roadside Ditches – Construct a roadside ditch along the east side of St. Louis Avenue from Richards Street to Indian Road.

- Storm Drain Outlet Channel – Construct a new outlet channel from the new St. Louis Avenue Storm Drain outlet. The channel will begin at Indian Road and proceed to the north to tie into an existing swale that drains to Sand Tank Wash.

Summary of Project Cost: (For an itemized cost estimate refer to Appendix D.)

Drainage Components Construction Costs =	$274,700
Land Acquisition Cost =	3,000
Engineering/Permitting Costs =	41,200
Construction Administration Cost =	41,200
Contingency Cost (@ 20%) =	72,000
Subtotal =	$432,100
Roadway Improvement Construction Costs =	$342,000
Land Acquisition Cost =	0
Engineering/Permitting Costs =	51,300

Construction Administration Cost =		51,300
Contingency Cost (@ 20%) =		88,900
	Subtotal =	$533,500
	Total Cost =	**$965,600**

Description of Drainage Plan:
The St. Louis Avenue drainage improvements include a new storm drain in St. Louis Avenue, repaving of streets with curb and gutter to convey stormwater to the new storm drain, and a roadside channel to collect runoff along the east side of St. Louis Avenue.

St. Louis Avenue collects much of the runoff from the east side of the Town core area. Runoff accumulates in roadside ditches along St. Louis Avenue as well as in a drainage swale that runs between St. Louis and Martin Avenue. The swale flows across Richards Street and Stout Street. It then combines with the St. Louis Avenue roadside ditches further downstream. The runoff flowing across Richards and Stout Streets is an undesirable situation. In addition, the existing roadside ditches on St. Louis Avenue don't drain well, don't have culverts at the crossing streets, and experience a considerable amount of standing water after the floods have passed.

The drainage plan calls for a new storm drain in St. Louis Avenue with laterals in Stout Street and Richards Street. The laterals have inlets to collect the flow in the swale that crosses over the streets. The new storm drain will discharge to an existing drainage swale downstream of Indian Road. The existing swale will have to be widened and deepened to convey the peak discharge from the storm drain. Approximately 1800 feet downstream, the open channel discharges to Sand Tank Wash.

Repaving the streets with curb and gutter is also part of the drainage plan. The gutters will collect local runoff and convey it to the new storm drain.

Repaving of St. Louis Avenue will result in a wider road which will impact the existing roadside ditches. The roadside ditches on the west side of the road can be eliminated because that runoff will be collected in the new storm drain. However, the roadside ditch on the east side will be reconstructed. The runoff entering from the east side is from a mostly undeveloped drainage basin that is within the Sand Tank Wash floodplain.

Hydrologic/Hydraulic Design (refer to Appendix P):
Storm Drain Design: The St. Louis Avenue storm drain is designed for the 2-year flood. It was designed with concrete pipe; varying in size from 36 inches to 42 inches in diameter. The lateral on Richards Street is 36 inches in diameter and the lateral on Stout Street is 18 inches in diameter. The design flow varies from 33 to 57 cfs with velocities ranging from 6 to 8 feet per second.

Storm Drain Outfall Channel: The storm drain requires excavation of an open channel to convey flows from the storm drain outlet to Sand Tank Wash. The channel will be earthen with 4-foot bottom width and 4H:1V side slopes. it will daylight into Sand Tank Wash approximately 1900 feet downstream from Indian Road. The depth of flow for 2-year peak discharge (54 cfs) is 1.5 feet with a corresponding velocity of 3.5 feet per second. The channel will vary in depth from about 6 feet at Indian Road to about 4 feet at Sand Tank Wash. The channel will be re-vegetated with native grass seed to help control erosion.

Roadside Channel: The new roadside channel along the east side of St. Louis Avenue will consist of replacing the existing ditch to a new location just behind the back of curb. The new ditch will be "V" shaped with a 6H:1V slope down from the back of curb and a backslope of 4H:1V. The new channel will include a new 24-inch culvert under Indian Road which will outlet into the St. Louis Avenue storm drain outlet channel. The depth of flow for the 2-year flood is 1.0 feet deep with a corresponding velocity of 2 feet per second.

GILA BEND
Area Drainage Master Plan

TOWN CORE DRAINAGE PLAN EXHIBIT 5.1

LEGEND

- CORE STUDY AREA BOUNDARY
- WATERSHED BOUNDARY
- FLOW DIRECTION
- STORM DRAIN
- OPEN CHANNEL
- ROADWAY CULVERT
- RETENTION/DETENTION BASIN

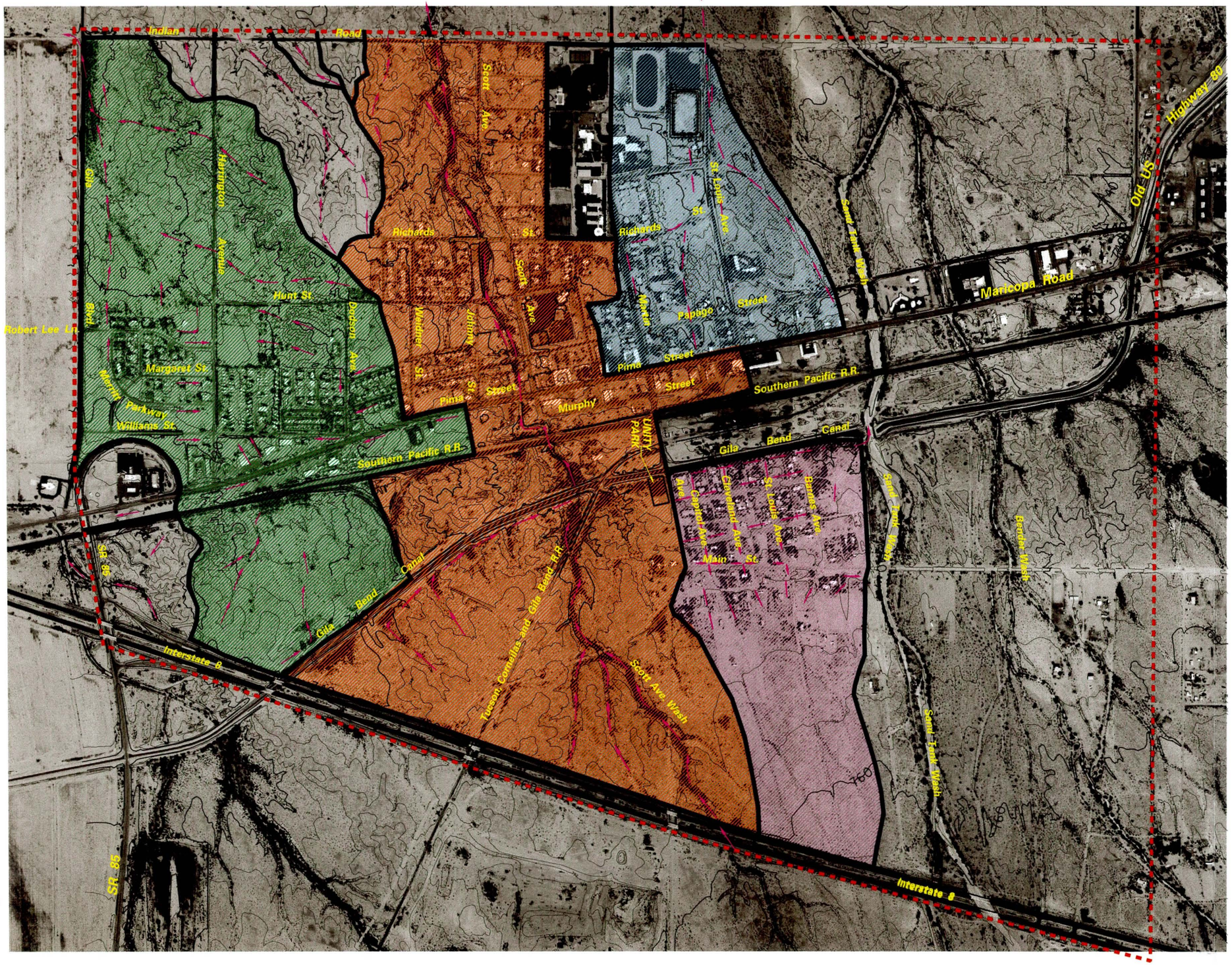
N

0 200 400 600 800 1000 2000

SCALE: 1" = 500'

Engineering and Environmental Consultants, Inc.
3003 N. Central Avenue, Suite 600
Phoenix, Arizona 85012-2905
TEL:(602)248-7702 FAX:(602)248-7851

N/99541/DGN/ALTS/LEVEL2/5-1-TCDP/TCDP-EXB-5-1.DGN



GILA BEND
Area Drainage Master Plan

TOWN CORE WATERSHED BOUNDARIES EXHIBIT 5.2

LEGEND

- CORE STUDY AREA BOUNDARY
- WATERSHED BOUNDARY
- HARRINGTON AVENUE WATERSHED
- SOUTH GILA BEND WATERSHED
- SCOTT AVENUE WASH WATERSHED
- ST. LOUIS AVENUE WATERSHED
- FLOW DIRECTION

N

0 200 400 600 800 1000 2000

SCALE: 1" = 500'

eec
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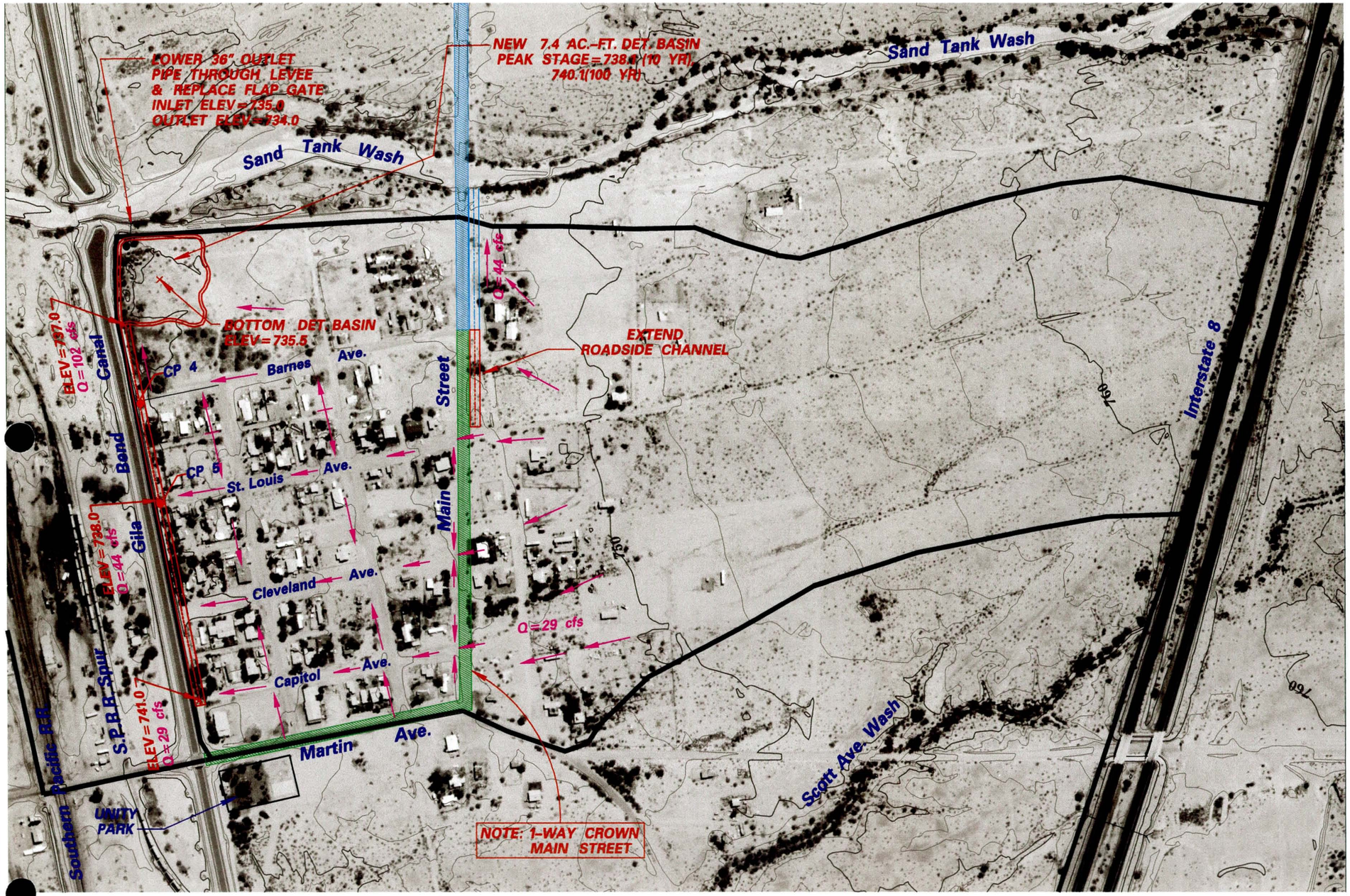
3003 N. Central Avenue, Suite 600
Phoenix, Arizona 85012-2905
TEL:(602)248-7702 FAX:(602)248-7851

N/99541/DGN/ALTS/LEVEL2/5-2-TCWB/TCWB-EXB-5-2.DGN

GILA BEND
Area Drainage Master Plan

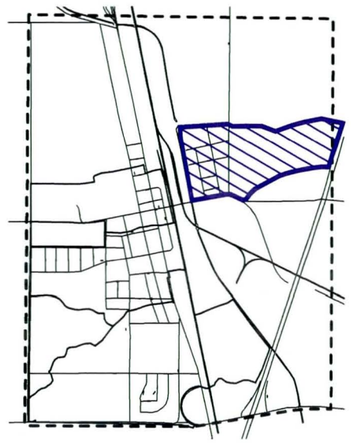
PRELIMINARY DRAINAGE PLAN FOR THE SOUTH GILA BEND WATERSHED
EXHIBIT 5.3



LEGEND

- DRAINAGE BASIN BOUNDARY
- NEW GRADING, PAVEMENT, CURB & GUTTER
- ROADWAY IMPROVEMENTS PER MCDOT PROJECT No. 16092
- CHANNEL PER MCDOT PROJECT No. 16092
- NEW INTERCEPTOR CHANNEL
- DRAINAGE FLOW DIRECTION
- Q=29 cfs — 10-YEAR PEAK DISCHARGE

KEYMAP



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CONTOUR INTERVAL: 2 FEET

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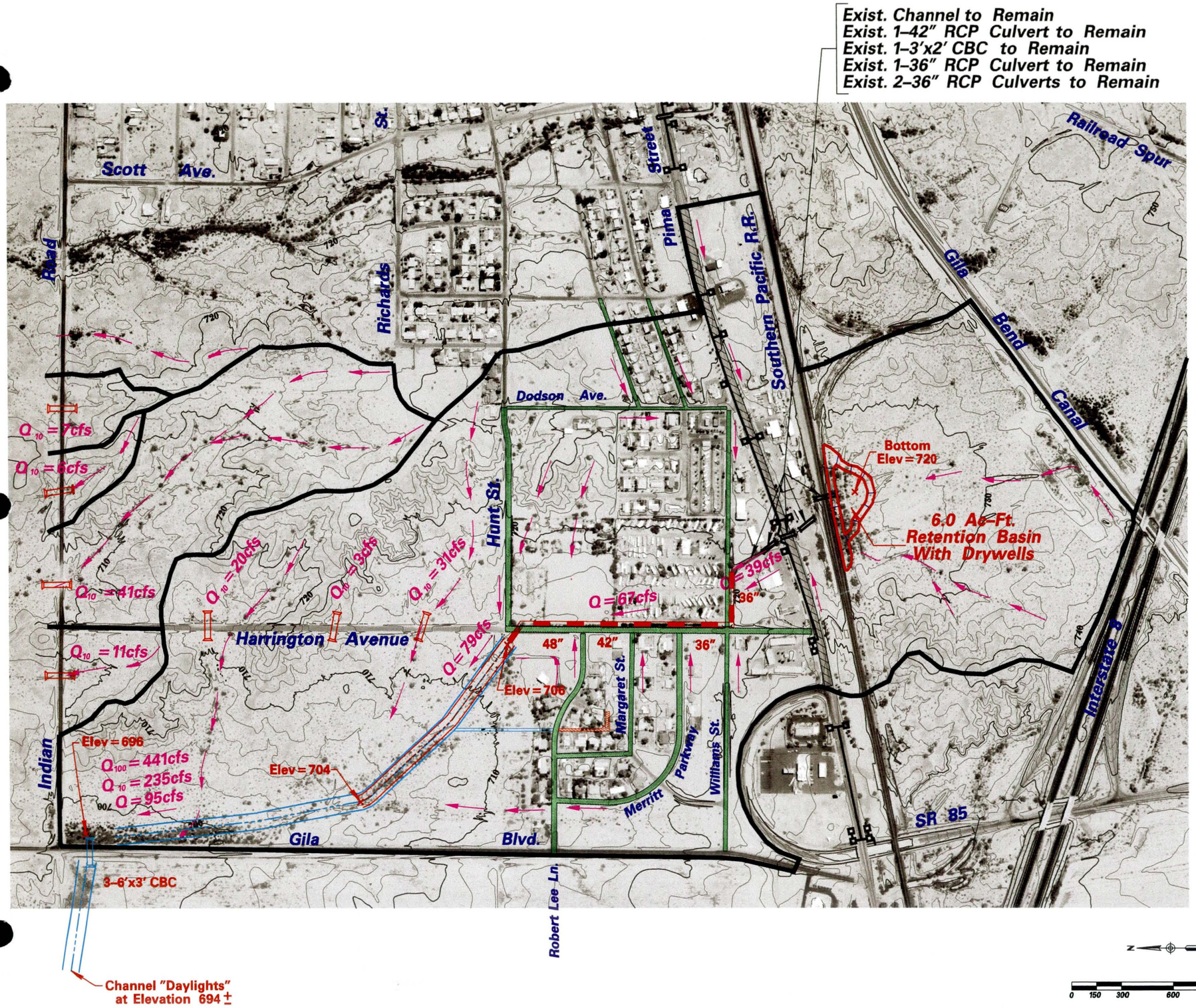


GILA BEND
Area Drainage Master Plan

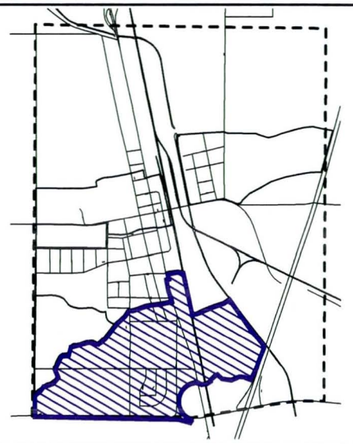
PRELIMINARY DRAINAGE PLAN FOR THE HARRINGTON AVE. WATERSHED
EXHIBIT 5.4

LEGEND

EXISTING

- DRAINAGE BASIN BOUNDARY
- EXISTING CURB & GUTTER
- DRAINAGE FLOW DIRECTION
- EXISTING STORM DRAIN
- EXISTING CULVERTS
- NEW PAVEMENT, CURB & GUTTER
- REGRADE ALLEY w/ VALLEY GUTTER
- INTERIM OUTLET CHANNEL
- 30" NEW STORM DRAIN & PIPE SIZE
- NEW CULVERTS
- Q = 67cfs 2-YEAR PEAK DISCHARGE
- FUTURE DEVELOPER BUILT CHANNEL AND CULVERT

KEYMAP



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GILA BEND
Area Drainage Master Plan

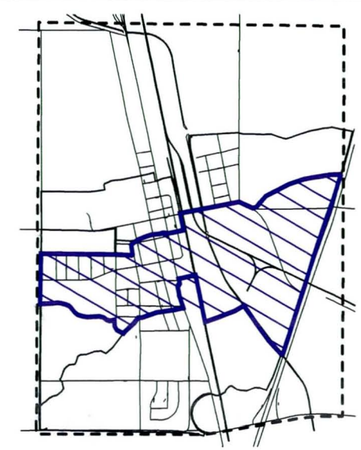
PRELIMINARY DRAINAGE PLAN FOR THE SCOTT AVENUE WASH WATERSHED
EXHIBIT 5.5

* SCOTT AVENUE WASH IMPROVEMENTS ARE BASED ON THE ASSUMPTION THAT UPSTREAM FLOOD CONTROL IMPROVEMENTS WILL REDUCE FLOW THROUGH I-8 DOWN TO 30 cfs (LOW FLOW TO MAINTAIN WASH VEGETATION)

LEGEND

- DRAINAGE BASIN BOUNDARY
- NEW PAVEMENT, CURB & GUTTER
- EXISTING CURB & GUTTER
- NEW CULVERT
- DRAINAGE FLOW DIRECTION
- Q=500 cfs — 10-YEAR PEAK DISCHARGE
- EXISTING STORM DRAIN
- 18" OUTLET PIPE

KEYMAP



N

0 200 400 800 1600

CONTOUR INTERVAL: 2 FEET

eec
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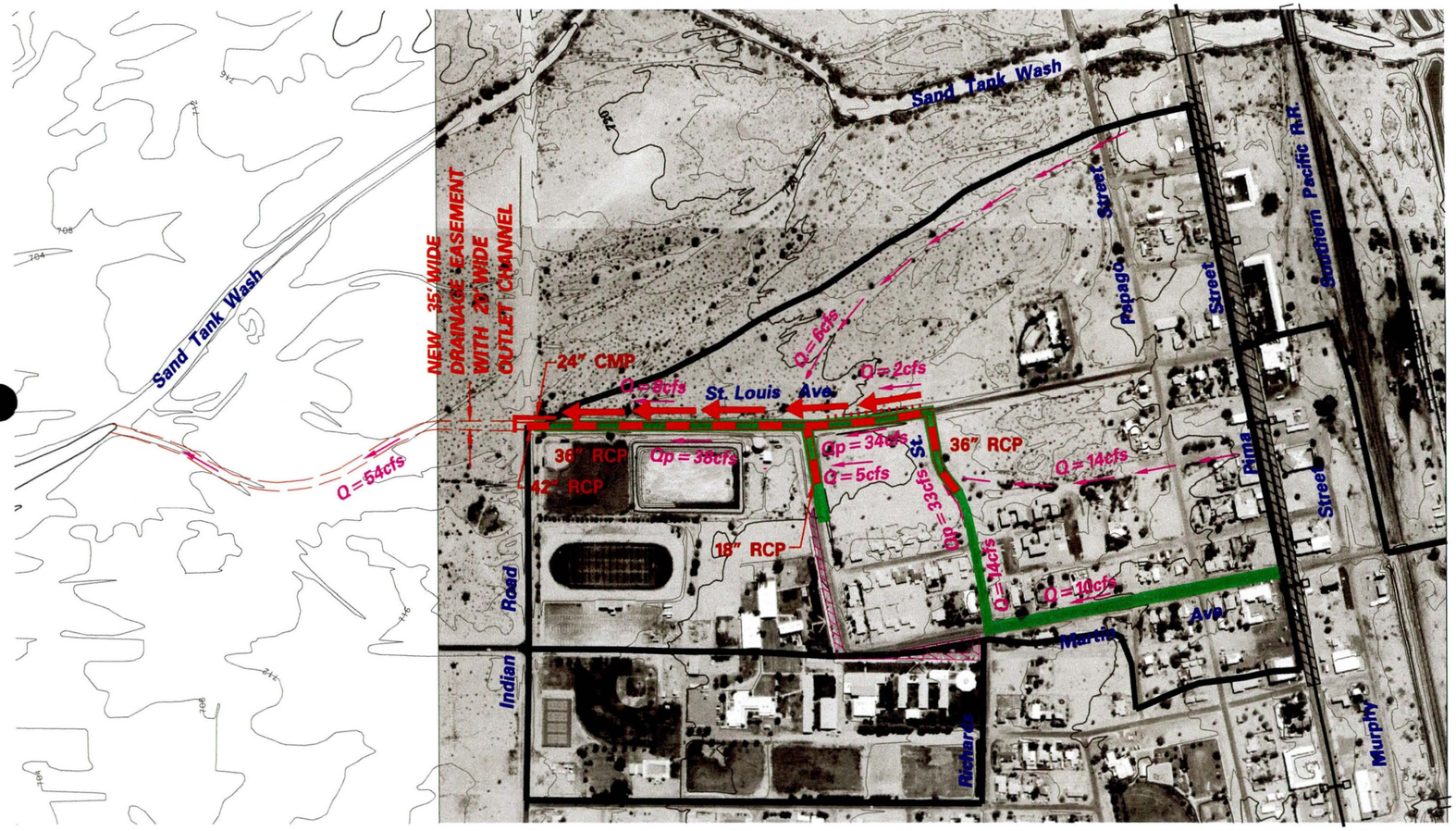
3003 N. Central Avenue, Suite 600
Phoenix, Arizona 85012-2905
TEL:(602)248-7702 FAX:(602)248-7851

N:/99541/DGN/ALTS/LEVEL2/5-5/SCO-EXB-5-5.DGN



GILA BEND

Area Drainage Master Plan

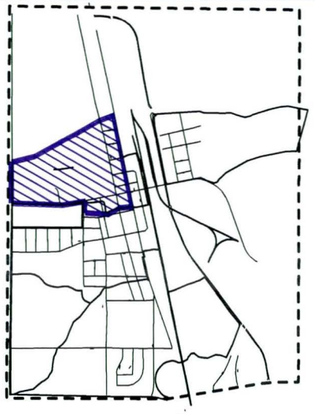
PRELIMINARY DRAINAGE PLAN FOR THE ST. LOUIS AVENUE WATERSHED

EXHIBIT 5.6

LEGEND

- DRAINAGE BASIN BOUNDARY
- NEW ROADSIDE CHANNEL
- EXISTING CURB & GUTTER
- NEW ROAD WIDENING WITH CURB & GUTTER
- NEW STORM DRAIN
- 24" NEW CMP PIPE CULVERT & SIZE
- DRAINAGE FLOW DIRECTION
- EXISTING STORM DRAIN
- Qp = 34cfs PIPE FLOW (2-Year Peak Discharge)
- Q = 15cfs SURFACE FLOW (2-Year Peak Discharge)

KEYMAP



N

0 150 300 600 1200

CONTOUR INTERVAL: 2 FEET

eec
Engineering and Environmental Consultants, Inc.
3003 N. Central Avenue, Suite 600
Phoenix, Arizona 85012-2905
TEL:(602)248-7702 FAX:(602)248-7851

N:/99541/DGN/ALTS/LEVEL2/5-6/St1-exb-5-6

Appendix A
PUBLIC COMMENT

5-15-00

GILA BEND AREA DRAINAGE MASTER PLAN
PUBLIC WORKSHOP
MAY 11, 2000

PUBLIC COMMENT SHEET

We are interested in your thoughts about the preliminary Master Drainage Plan for the Town of Gila Bend and its surrounding planning area. Please take a few minutes to complete this sheet.

- Name and Address Wm E. Ehrner + John Laird

  Name _____

  Address _____

  City, State, Zip: _____

- Are you a resident, property owner, merchant or developer within the study area?

  ☐ Resident ☐ Property Owner ☐ Merchant ☐ Developer

  ☐ Other _____

- Do you want to suggest any names for the following unnamed washes? (refer to attached exhibit)

Unnamed Wash	Suggested Name
Unnamed Wash No. 1	Black Gap Wash
Unnamed Wash No. 2	Hacker Wash
Unnamed Wash No. 3	Evans Wash
Unnamed Wash No. 4	Cemetary Wash
Unnamed Wash No. 5	Little Black Gap
Unnamed Wash No. 6	West Quilotosa

GILA BEND AREA DRAINAGE MASTER PLAN
PUBLIC WORKSHOP
MAY 11, 2000

PUBLIC COMMENT SHEET

We are interested in your thoughts about the preliminary Master Drainage Plan for the Town of Gila Bend and its surrounding planning area. Please take a few minutes to complete this sheet.

- Name and Address

  Name Fred Hull

  Address 516 Main PoBox 494

  City, State, Zip: Gila Bend AZ 85337

- Are you a resident, property owner, merchant or developer within the study area?

  ☑ Resident ☑ Property Owner ☐ Merchant ☐ Developer

  ☐ Other_____

- Do you want to suggest any names for the following unnamed washes? (refer to attached exhibit)

Unnamed Wash	Suggested Name
Unnamed Wash No. 1	citrus valley wash
Unnamed Wash No. 2	
Unnamed Wash No. 3	
Unnamed Wash No. 4	Centaury Wash
Unnamed Wash No. 5	
Unnamed Wash No. 6	Switch yard Wash.

Do you have a preference for the landscape character of flood control channels?

- ☐ Natural. Comment: _____

- ☑ Modified Natural (with trails and other uses). Comment: _____

- ☐ Park-Like (with grass, trees, and recreation). Comment: _____

- Do you have comments on the preliminary flood control plan for Sand Tank Wash?

  ☑ Favorable Opinion ☐ Unfavorable Opinion

  Comments: _____

- Do you have any comments regarding the preliminary drainage plan for the Town Core Area?

  Comments: Southwest Watershed need to be sure enough capacity built in along canal.

- Any other comments: _____

Thank you. Your input is valuable.

GILA BEND AREA DRAINAGE MASTER PLAN
PUBLIC WORKSHOP
MAY 11, 2000

PUBLIC COMMENT SHEET

We are interested in your thoughts about the preliminary Master Drainage Plan for the Town of Gila Bend and its surrounding planning area. Please take a few minutes to complete this sheet.

- Name and Address

  Name Duane Holt

  Address Box 30

  City, State, Zip: Gila Bend, AZ., 85337

- Are you a resident, property owner, merchant or developer within the study area?

  ☑ Resident ☑ Property Owner ☑ Merchant ☑ Developer

  ☐ Other_____

- Do you want to suggest any names for the following unnamed washes? (refer to attached exhibit)

Unnamed Wash	Suggested Name
Unnamed Wash No. 1	
Unnamed Wash No. 2	
Unnamed Wash No. 3	
Unnamed Wash No. 4	
Unnamed Wash No. 5	
Unnamed Wash No. 6	

Do you have a preference for the landscape character of flood control channels?

☒ Natural. Comment:_____

_____

☐ Modified Natural (with trails and other uses). Comment:_____

_____

☐ Park-Like (with grass, trees, and recreation). Comment:_____

_____

- Do you have comments on the preliminary flood control plan for Sand Tank Wash?

☒ Favorable Opinion ☐ Unfavorable Opinion

Comments:_____

_____

_____

- Do you have any comments regarding the preliminary drainage plan for the Town Core Area?

Comments:_____

_____

_____

_____

- Any other comments:_____

_____

_____

_____

Thank you. Your input is valuable.

GILA BEND AREA DRAINAGE MASTER PLAN
PUBLIC WORKSHOP
MAY 11, 2000

PUBLIC COMMENT SHEET

We are interested in your thoughts about the preliminary Master Drainage Plan for the Town of Gila Bend and its surrounding planning area. Please take a few minutes to complete this sheet.

- Name and Address

  Name FLOYD D. HAMMAN

  Address 730 E. ROWLANDS LANE

  City, State, Zip: PHOENIX, AZ 85022

- Are you a resident, property owner, merchant or developer within the study area?

  ☐ Resident ☒ Property Owner ☐ Merchant ☒ Developer

  ☐ Other_____

- Do you want to suggest any names for the following unnamed washes? (refer to attached exhibit)

Unnamed Wash	Suggested Name
Unnamed Wash No. 1	
Unnamed Wash No. 2	
Unnamed Wash No. 3	
Unnamed Wash No. 4	
Unnamed Wash No. 5	
Unnamed Wash No. 6	

Do you have a preference for the landscape character of flood control channels?

☐ Natural. Comment:_____

_____

☒ Modified Natural (with trails and other uses). Comment:_____

_____

☐ Park-Like (with grass, trees, and recreation). Comment:_____

_____

- Do you have comments on the preliminary flood control plan for Sand Tank Wash?

  ☒ Favorable Opinion ☐ Unfavorable Opinion

  Comments:_____

  _____

  _____

- Do you have any comments regarding the preliminary drainage plan for the Town Core Area?

  Comments:_____

  _____

  _____

  _____

- Any other comments:_____

  _____

  _____

  _____

Thank you. Your input is valuable.

GILA BEND AREA DRAINAGE MASTER PLAN
PUBLIC WORKSHOP
MAY 11, 2000

PUBLIC COMMENT SHEET

We are interested in your thoughts about the preliminary Master Drainage Plan for the Town of Gila Bend and its surrounding planning area. Please take a few minutes to complete this sheet.

- Name and Address

  Name BUD & BEVERLY TURNER

  Address P.O. BOX 2059

  City, State, Zip: Gila Bend AZ 85337

- Are you a resident, property owner, merchant or developer within the study area?

  ☒ Resident ☒ Property Owner ☐ Merchant ☐ Developer

  ☐ Other_____

- Do you want to suggest any names for the following unnamed washes? (refer to attached exhibit)

Unnamed Wash	Suggested Name
Unnamed Wash No. 1	
Unnamed Wash No. 2	
Unnamed Wash No. 3	
Unnamed Wash No. 4	
Unnamed Wash No. 5	
Unnamed Wash No. 6	

Do you have a preference for the landscape character of flood control channels?

☐ Natural. Comment:_____

_____

☐ Modified Natural (with trails and other uses). Comment:_____

_____

☒ Park-Like (with grass, trees, and recreation). Comment:_____

_____

- Do you have comments on the preliminary flood control plan for Sand Tank Wash?

☐ Favorable Opinion ☐ Unfavorable Opinion

Comments: The plan is great, however I am concerned about the location to the south and what that will do to the proposed property site.

- Do you have any comments regarding the preliminary drainage plan for the Town Core Area?

Comments:_____

_____

_____

_____

- Any other comments:_____

_____

_____

_____

Thank you. Your input is valuable.

GILA BEND AREA DRAINAGE MASTER PLAN
PUBLIC WORKSHOP
MAY 11, 2000

PUBLIC COMMENT SHEET

We are interested in your thoughts about the preliminary Master Drainage Plan for the Town of Gila Bend and its surrounding planning area. Please take a few minutes to complete this sheet.

- Name and Address

  Name DONNA HUBBARD

  Address PO BOX 475

  City, State, Zip: GILA BEND, AZ 85337

- Are you a resident, property owner, merchant or developer within the study area?

  ☒ Resident ☒ Property Owner ☐ Merchant ☐ Developer

  ☐ Other_____

- Do you want to suggest any names for the following unnamed washes? (refer to attached exhibit)

Unnamed Wash	Suggested Name
Unnamed Wash No. 1	Brophy
Unnamed Wash No. 2	Jordan
Unnamed Wash No. 3	O'Hara ← kids?
Unnamed Wash No. 4	Rebecca
Unnamed Wash No. 5	Terry
Unnamed Wash No. 6	Miller

Do you have a preference for the landscape character of flood control channels?

☐ Natural. Comment:_____

_____

☒ Modified Natural (with trails and other uses). Comment:_____

_____

☐ Park-Like (with grass, trees, and recreation). Comment:_____

_____

- Do you have comments on the preliminary flood control plan for Sand Tank Wash?

☒ Favorable Opinion ☐ Unfavorable Opinion

Comments: necessary

_____

_____

- Do you have any comments regarding the preliminary drainage plan for the Town Core Area?

Comments: OK

_____

_____

_____

- Any other comments: Would like stock tank on BLM south of town (Sec 17 or farther off Sand Tank.

Thank you. Your input is valuable.

GILA BEND AREA DRAINAGE MASTER PLAN
PUBLIC WORKSHOP
MAY 11, 2000

PUBLIC COMMENT SHEET

We are interested in your thoughts about the preliminary Master Drainage Plan for the Town of Gila Bend and its surrounding planning area. Please take a few minutes to complete this sheet.

- Name and Address

  Name STEVEN HOLT

  Address Box 564

  City, State, Zip: GILA BEND, AZ 85337

- Are you a resident, property owner, merchant or developer within the study area?

  ☒ Resident ☒ Property Owner ☐ Merchant ☐ Developer

  ☐ Other_____

- Do you want to suggest any names for the following unnamed washes? (refer to attached exhibit)

Unnamed Wash	Suggested Name
Unnamed Wash No. 1	
Unnamed Wash No. 2	
Unnamed Wash No. 3	
Unnamed Wash No. 4	
Unnamed Wash No. 5	
Unnamed Wash No. 6	

Do you have a preference for the landscape character of flood control channels?

☒ Natural. Comment: Have new developments & homeowners leave the washes along. Have setbacks.

☐ Modified Natural (with trails and other uses). Comment:

☐ Park-Like (with grass, trees, and recreation). Comment:

- Do you have comments on the preliminary flood control plan for Sand Tank Wash?

☒ Favorable Opinion ☐ Unfavorable Opinion

Comments:

- Do you have any comments regarding the preliminary drainage plan for the Town Core Area?

Comments:

- Any other comments:

Thank you. Your input is valuable.

GILA BEND AREA DRAINAGE MASTER PLAN
PUBLIC WORKSHOP
MAY 11, 2000

PUBLIC COMMENT SHEET

We are interested in your thoughts about the preliminary Master Drainage Plan for the Town of Gila Bend and its surrounding planning area. Please take a few minutes to complete this sheet.

- Name and Address

  Name JULIA HOLT

  Address BOX 564

  City, State, Zip: GILA BEND, AZ 85337

- Are you a resident, property owner, merchant or developer within the study area?

  ☒ Resident ☒ Property Owner ☐ Merchant ☐ Developer

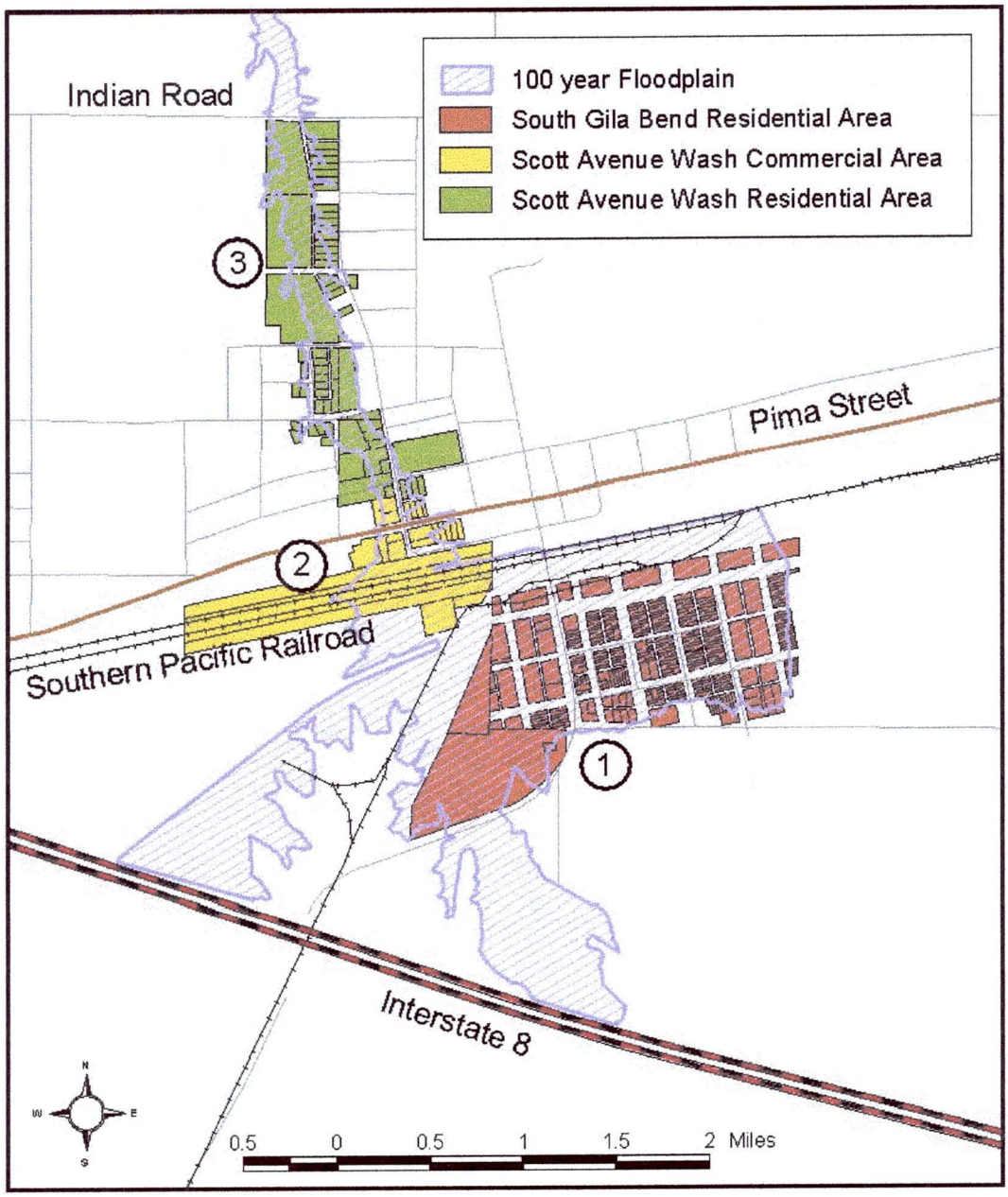
  ☐ Other_____

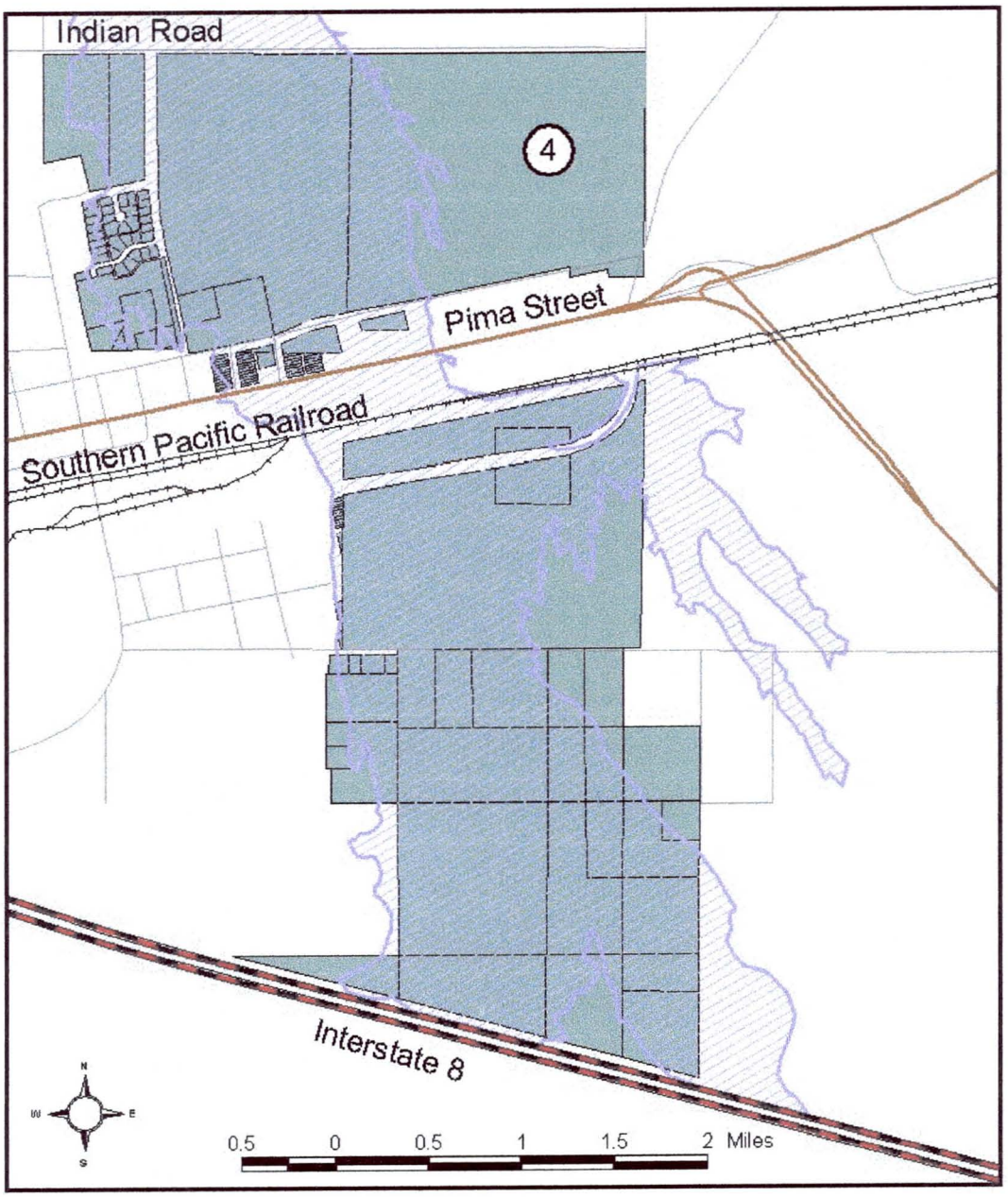
- Do you want to suggest any names for the following unnamed washes? (refer to attached exhibit)

Unnamed Wash	Suggested Name
Unnamed Wash No. 1	
Unnamed Wash No. 2	
Unnamed Wash No. 3	
Unnamed Wash No. 4	
Unnamed Wash No. 5	
Unnamed Wash No. 6	

Appendix B

PROPERTY VALUE DATA


100 year Floodplain
South Gila Bend Residential Area
Scott Avenue Wash Commercial Area
Scott Avenue Wash Residential Area
Indian Road
Pima Street
Southern Pacific Railroad
Interstate 8
3
2
1
N
W
E
S
0.5
0
0.5
1
1.5
2 Miles


Indian Road
4
Pima Street
Southern Pacific Railroad
Interstate 8
N
W
E
S
0.5
0
0.5
1
1.5
2 Miles

DATA DICTIONARY

in sums spreadsheet:

area - geographical area for row of data
parcels - number of parcels in geographic area
struct - number of parcels with sum evaluated development
s_land - sum of value in geographic area for land only
s_FCV - sum of value by geographic area for land and development
s_MV - sum of value divided by .70 by geographic area for FCV
s_structures - sum of value in geographic area for development only
med_land - median value by geographic area for land only
land range - highest and lowest values by geographic area for land only
mean_land - average cost by geographic area for land values only
med_str - median value by geographic area for development only
str_range - highest and lowest values by geographic area for development only
mean_str - average cost by geographic area for development values only

in areas spreadsheets:

parcels_ - unique identifier in database
land - land value of parcel
FCV - land and development value of parcel
market val - FCV divided by .70
STRUCT - FCV minus land
area - geographic group
acres - area of parcel
mv per acre - FCV divided by .70 divided by acres (average market value per acre)

area	parcels	struct	s_land	s_FCV	s_MV	s_structures	med_land	land range	mean_land	med_str	str_range	mean_str	acres
area1	310	75	313018	1323816	1891166	1010798	375	48116-63	1010	9558	94088-121	13477	656.3
area2	23	10	76801	787496	1124994	710695	2250	16411-0	3339	44024	299919-895	71070	365.1
area3	63	23	139646	1636902	2338431	1497256	2000	18000-0	2217	24253	765294-500	65098	462.2
area4	169	29	728635	2851247	4073210	2122612	2000	53856-0	4311	17144	621382-473	73194	6728.0
	565	137	1258100	6599461	9427801	5341361			2227			38988	8211.6

PARCELS_	LAND	FCV	market val	STRUCT	AREA	ACRES	mv per acre
392	7313	7313	10447	0	1	12.2	857
393	7313	7313	10447	0	1	11.8	888
394	7313	7313	10447	0	1	11.6	898
395	7313	7313	10447	0	1	12.9	812
396	317	317	453	0	1	0.7	660
398	375	375	536	0	1	0.9	565
399	5625	5625	8036	0	1	9.9	811
400	375	375	536	0	1	0.9	605
402	4125	4125	5893	0	1	10.5	560
403	375	375	536	0	1	1.1	506
405	2813	2813	4019	0	1	4.8	838
406	375	375	536	0	1	1.0	561
408	4125	4125	5893	0	1	10.5	561
409	375	375	536	0	1	1.0	560
411	7313	7313	10447	0	1	12.0	867
412	375	375	536	0	1	0.9	594
413	1500	1500	2143	0	1	3.0	713
415	375	375	536	0	1	0.8	639
417	1500	1500	2143	0	1	2.0	1084
418	375	375	536	0	1	1.1	506
420	1865	1865	2664	0	1	3.2	826
422	375	9620	13743	9245	1	1.0	13580
423	375	375	536	0	1	1.0	551
424	375	375	536	0	1	0.9	605
426	375	375	536	0	1	1.0	537
427	375	31565	45093	31190	1	0.9	47617
428	375	375	536	0	1	0.8	636
429	375	875	1250	500	1	1.1	1153
431	375	375	536	0	1	1.0	533
432	375	375	536	0	1	0.9	616
433	375	375	536	0	1	0.9	584
435	375	9672	13817	9297	1	1.0	14171
436	375	10539	15056	10164	1	1.0	15162
437	375	375	536	0	1	0.9	580
438	375	375	536	0	1	1.1	501
439	375	375	536	0	1	0.9	605
440	375	1375	1964	1000	1	1.0	1953
441	281	281	401	0	1	0.9	472
442	375	375	536	0	1	1.0	549
443	375	375	536	0	1	1.0	549
444	375	2350	3357	1975	1	1.1	3080
446	375	875	1250	500	1	0.9	1384
447	375	375	536	0	1	0.9	607
448	281	281	401	0	1	0.8	500
449	281	281	401	0	1	0.8	515
450	375	375	536	0	1	1.1	481
451	375	375	536	0	1	1.0	540
452	375	375	536	0	1	1.0	546
453	375	375	536	0	1	1.1	498
454	375	1375	1964	1000	1	1.0	1986
455	281	65695	93850	65414	1	0.7	129270

PARCELS_	LAND	FCV	market val	STRUCT	AREA	ACRES	mv per acre
456	281	19787	28267	19506	1	0.7	38722
457	8625	8625	12321	0	1	1.8	6989
458	375	375	536	0	1	0.9	613
459	375	375	536	0	1	0.9	578
460	2344	96432	137760	94088	1	4.1	34006
461	375	6862	9803	6487	1	0.9	10904
462	375	375	536	0	1	0.9	567
463	375	496	709	121	1	1.0	735
464	4875	4875	6964	0	1	12.2	571
465	281	281	401	0	1	0.7	543
466	281	281	401	0	1	0.7	578
467	375	375	536	0	1	1.0	546
468	375	375	536	0	1	0.9	579
469	375	375	536	0	1	1.0	515
470	8625	8625	12321	0	1	12.0	1028
471	375	9900	14143	9525	1	1.0	14003
472	375	1736	2480	1361	1	0.9	2774
473	281	281	401	0	1	0.8	506
474	1125	5071	7244	3946	1	2.9	2512
475	281	281	401	0	1	0.7	576
476	375	375	536	0	1	0.9	572
477	375	375	536	0	1	0.9	566
479	4875	4875	6964	0	1	12.2	569
480	375	375	536	0	1	1.1	507
481	375	375	536	0	1	1.0	563
482	281	281	401	0	1	0.7	545
483	281	4858	6940	4577	1	0.8	9204
484	4125	4125	5893	0	1	11.0	534
485	188	188	269	0	1	0.5	554
486	375	375	536	0	1	1.0	543
487	188	188	269	0	1	0.5	537
488	375	375	536	0	1	0.9	594
489	281	281	401	0	1	0.8	515
490	281	3746	5351	3465	1	0.7	7591
491	188	188	269	0	1	0.5	596
492	375	42000	60000	41625	1	1.0	59880
493	375	375	536	0	1	0.9	582
494	375	22787	32553	22412	1	1.1	29947
495	188	188	269	0	1	0.5	569
496	562	18139	25913	17577	1	1.4	18184
497	281	281	401	0	1	0.7	542
498	8625	8625	12321	0	1	7.5	1642
499	188	188	269	0	1	0.5	576
500	375	375	536	0	1	1.0	527
501	375	375	536	0	1	0.9	583
502	141	141	201	0	1	0.4	485
503	469	469	670	0	1	0.8	854
504	325	1325	1893	1000	1	0.7	2804
505	188	188	269	0	1	0.5	536
506	75	2496	3566	2421	1	0.2	17740
507	3024	3024	4320	0	1	39.9	108

PARCELS_	LAND	FCV	market val	STRUCT	AREA	ACRES	mv per acre
508	281	15090	21557	14809	1	0.8	28743
509	188	188	269	0	1	0.5	555
510	375	375	536	0	1	0.9	583
511	375	375	536	0	1	1.0	556
512	163	6031	8616	5868	1	0.4	20225
513	141	141	201	0	1	0.4	529
514	469	469	670	0	1	0.8	821
515	188	14381	20544	14193	1	0.5	38763
516	75	75	107	0	1	0.2	503
517	281	281	401	0	1	0.7	589
518	375	375	536	0	1	0.9	585
519	375	1375	1964	1000	1	1.0	2038
520	163	163	233	0	1	0.5	502
521	141	141	201	0	1	0.4	496
522	375	375	536	0	1	0.9	625
523	469	469	670	0	1	0.8	816
524	375	12162	17374	11787	1	1.0	17912
525	281	281	401	0	1	0.7	548
526	375	375	536	0	1	0.9	572
527	375	375	536	0	1	1.0	535
528	375	375	536	0	1	1.1	489
529	562	22231	31759	21669	1	0.4	85603
530	469	469	670	0	1	0.7	914
531	375	1375	1964	1000	1	0.9	2074
532	125	775	1107	650	1	0.3	3898
533	281	26581	37973	26300	1	0.7	55679
534	375	375	536	0	1	0.9	583
535	375	15706	22437	15331	1	1.0	23568
536	500	6976	9966	6476	1	1.7	5801
537	469	469	670	0	1	0.8	841
538	375	375	536	0	1	1.0	539
539	375	3490	4986	3115	1	1.0	5057
540	125	125	179	0	1	0.3	521
541	375	375	536	0	1	1.0	557
542	375	375	536	0	1	0.9	566
543	469	469	670	0	1	0.8	876
544	375	375	536	0	1	0.9	566
545	375	375	536	0	1	1.0	558
546	375	375	536	0	1	0.8	649
547	375	375	536	0	1	1.0	542
548	375	15822	22603	15447	1	0.7	31048
549	63	63	90	0	1	0.2	511
550	375	375	536	0	1	1.0	545
551	188	188	269	0	1	0.5	584
552	250	18431	26330	18181	1	0.9	29989
553	125	125	179	0	1	0.2	720
554	188	1167	1667	979	1	0.5	3664
555	375	375	536	0	1	0.8	671
556	375	375	536	0	1	1.0	542
557	281	22739	32484	22458	1	0.7	46406
558	375	375	536	0	1	1.0	542

PARCELS_	LAND	FCV	market val	STRUCT	AREA	ACRES	mv per acre
559	375	1832	2617	1457	1	1.0	2687
560	125	125	179	0	1	0.4	496
561	250	250	357	0	1	0.7	493
562	375	375	536	0	1	0.9	572
563	281	9869	14099	9588	1	0.8	18286
564	375	2594	3706	2219	1	0.8	4928
565	375	11081	15830	10706	1	0.9	17472
566	375	375	536	0	1	1.0	540
567	514	73413	104876	72899	1	0.7	145056
568	375	375	536	0	1	1.0	548
569	375	375	536	0	1	1.0	537
570	375	375	536	0	1	0.7	749
571	281	14865	21236	14584	1	0.7	28736
572	375	375	536	0	1	1.0	547
573	375	375	536	0	1	0.9	573
574	514	514	734	0	1	0.8	925
575	375	375	536	0	1	0.8	634
576	438	438	626	0	1	1.2	524
577	375	375	536	0	1	0.9	593
578	375	375	536	0	1	0.7	751
579	281	12704	18149	12423	1	0.7	24592
580	323	323	461	0	1	0.7	640
581	4500	4500	6429	0	1	7.6	849
582	375	1375	1964	1000	1	1.0	1920
583	375	27142	38774	26767	1	1.0	38852
584	514	514	734	0	1	0.8	949
585	1125	1125	1607	0	1	2.8	572
586	375	375	536	0	1	1.0	540
587	375	375	536	0	1	0.8	709
588	323	323	461	0	1	0.8	580
589	281	20015	28593	19734	1	0.7	38380
590	1125	58535	83621	57410	1	3.0	28260
591	375	375	536	0	1	1.0	560
592	375	375	536	0	1	0.9	601
593	470	470	671	0	1	0.8	821
594	6750	6750	9643	0	1	12.1	795
595	4500	4500	6429	0	1	5.5	1163
596	281	281	401	0	1	0.7	536
597	323	323	461	0	1	0.8	614
598	375	375	536	0	1	1.0	519
599	375	375	536	0	1	1.0	541
600	938	2287	3267	1349	1	1.6	2019
601	375	375	536	0	1	1.1	503
602	6375	6375	9107	0	1	12.4	735
603	375	375	536	0	1	0.9	584
604	323	323	461	0	1	0.7	660
605	4500	4500	6429	0	1	5.6	1154
606	375	375	536	0	1	0.9	594
607	375	1144	1634	769	1	1.0	1634
608	375	375	536	0	1	1.0	548
609	375	375	536	0	1	0.9	575

PARCELS_	LAND	FCV	market val	STRUCT	AREA	ACRES	mv per acre
610	375	375	536	0	1	1.0	522
611	375	375	536	0	1	1.0	526
612	750	22088	31554	21338	1	2.0	16165
613	323	323	461	0	1	0.7	693
614	6375	6375	9107	0	1	1.5	6063
615	375	26740	38200	26365	1	0.9	42970
616	323	323	461	0	1	0.6	722
617	281	10430	14900	10149	1	0.5	28932
618	281	281	401	0	1	0.5	760
619	281	281	401	0	1	0.4	965
620	375	1741	2487	1366	1	1.0	2596
621	281	4200	6000	3919	1	0.5	12346
622	281	281	401	0	1	0.5	876
623	188	5236	7480	5048	1	0.4	17642
624	375	1875	2679	1500	1	1.0	2647
625	188	188	269	0	1	0.5	594
626	188	188	269	0	1	0.5	525
628	188	188	269	0	1	0.5	537
629	188	188	269	0	1	0.5	581
630	188	838	1197	650	1	0.5	2238
632	188	188	269	0	1	0.5	549
633	375	375	536	0	1	1.0	535
634	375	375	536	0	1	0.9	591
635	188	7893	11276	7705	1	0.5	22779
636	6750	6750	9643	0	1	4.9	1961
637	188	188	269	0	1	0.4	639
638	188	188	269	0	1	0.5	555
639	938	28185	40264	27247	1	1.7	23839
640	1875	6297	8996	4422	1	4.8	1874
641	375	375	536	0	1	0.9	604
642	188	188	269	0	1	0.5	596
643	188	188	269	0	1	0.5	518
644	188	2247	3210	2059	1	0.5	6874
645	1875	1875	2679	0	1	4.9	550
646	188	188	269	0	1	0.5	555
647	125	125	179	0	1	0.3	633
648	188	188	269	0	1	0.5	532
649	375	375	536	0	1	1.0	519
650	375	375	536	0	1	1.7	322
651	188	188	269	0	1	0.5	515
652	500	973	1390	473	1	1.3	1093
653	1125	1125	1607	0	1	2.9	554
654	188	188	269	0	1	0.5	558
655	375	375	536	0	1	0.9	585
656	125	125	179	0	1	0.3	620
657	413	17307	24724	16894	1	0.7	34676
658	125	125	179	0	1	0.3	562
659	188	188	269	0	1	0.5	515
660	188	688	983	500	1	0.5	1998
661	6375	6375	9107	0	1	3.0	3063
662	375	375	536	0	1	1.0	549

PARCELS_	LAND	FCV	market val	STRUCT	AREA	ACRES	mv per acre
663	125	125	179	0	1	0.3	528
664	125	125	179	0	1	0.3	543
665	608	608	869	0	1	1.8	480
666	188	188	269	0	1	0.5	499
667	375	375	536	0	1	1.0	519
668	715	715	1021	0	1	1.7	597
669	375	375	536	0	1	1.0	547
670	188	188	269	0	1	0.4	615
671	375	375	536	0	1	0.9	572
672	125	125	179	0	1	0.3	528
673	650	650	929	0	1	1.7	554
674	375	375	536	0	1	0.9	580
675	125	125	179	0	1	0.3	524
676	375	375	536	0	1	1.0	558
677	188	188	269	0	1	0.5	567
678	375	375	536	0	1	1.0	531
679	600	600	857	0	1	1.8	490
680	375	375	536	0	1	1.0	548
681	188	188	269	0	1	0.5	570
682	1125	12101	17287	10976	1	2.6	6734
683	375	375	536	0	1	0.9	580
684	125	125	179	0	1	0.4	510
685	375	375	536	0	1	0.9	581
686	375	375	536	0	1	0.9	597
687	188	188	269	0	1	0.5	597
688	188	188	269	0	1	0.5	520
689	1073	21655	30936	20582	1	2.0	15808
692	975	16149	23070	15174	1	1.7	13236
694	375	375	536	0	1	1.0	542
699	3375	3375	4821	0	1	8.9	541
700	1500	1500	2143	0	1	3.8	568
701	563	563	804	0	1	1.1	752
707	630	630	900	0	1	1.8	503
708	630	630	900	0	1	1.8	490
709	630	24107	34439	23477	1	1.9	18231
710	630	630	900	0	1	2.0	450
711	563	563	804	0	1	0.9	882
712	563	563	804	0	1	1.1	750
714	1500	1500	2143	0	1	4.1	525
717	563	563	804	0	1	0.9	875
720	563	563	804	0	1	0.9	898
721	1148	1148	1640	0	1	2.0	834
726	2333	2333	3333	0	1	3.9	857
728	563	563	804	0	1	0.9	871
730	563	563	804	0	1	0.9	877
736	563	563	804	0	1	0.9	869
738	2333	2333	3333	0	1	2.1	1581
739	563	1213	1733	650	1	0.9	1892
743	563	31275	44679	30712	1	0.9	48145
744	563	563	804	0	1	0.8	962
746	563	563	804	0	1	0.9	930

PARCELS_	LAND	FCV	market val	STRUCT	AREA	ACRES	mv per acre
747	500	500	714	0	1	1.0	750
748	48116	48116	68737	0	1	195.7	351
760	132	11160	15943	11028	1	1.9	8356
	313018	1323816	1891166	1010798		656.3	

PARCELS_	LAND	FCV	market val	STRUCT	AREA	ACRES	mv per acre
367	4960	16895	24136	11935	2	4.5	5390
370	7954	93165	133093	85211	2	6.9	19180
371	1260	1260	1800	0	2	1.2	1522
372	2100	2100	3000	0	2	2.0	1517
374	2100	2100	3000	0	2	1.9	1583
375	2100	90019	128599	87919	2	2.0	64916
378	2399	2399	3427	0	2	2.1	1598
379	2399	2399	3427	0	2	2.2	1525
380	2399	2399	3427	0	2	2.2	1528
381	2399	2399	3427	0	2	2.2	1556
382	2399	2399	3427	0	2	2.2	1566
383	6000	305919	437027	299919	2	5.9	74654
385	3659	30823	44033	27164	2	2.4	18188
387	4182	46682	66689	42500	2	4.4	15105
388	16411	16411	23444	0	2	13.9	1687
389	3565	49112	70160	45547	2	3.3	21462
391	8651	37714	53877	29063	2	6.4	8462
421	1448	2343	3347	895	2	19.5	172
790	0	0	0	0	2	70.0	0
791	0	0	0	0	2	133.9	0
792	0	0	0	0	2	68.9	0
793	0	0	0	0	2	0.4	0
795	416	80958	115654	80542	2	6.8	16951
	76801	787496	1124994	710695		365.1	

PARCELS_	LAND	FCV	market val	STRUCT	AREA	ACRES	mv per acre
2	3848	3848	5497	0	3	53.1	103
4	2000	2000	2857	0	3	11.2	255
8	2000	2000	2857	0	3	4.0	718
9	2000	2000	2857	0	3	3.8	759
10	2000	2000	2857	0	3	3.7	776
11	2000	140014	200020	138014	3	3.5	56711
12	4000	24000	34286	20000	3	3.3	10339
13	0	0	0	0	3	3.2	0
14	2000	2000	2857	0	3	3.0	968
15	4504	4504	6434	0	3	60.6	106
18	2000	2000	2857	0	3	3.0	939
19	2000	2000	2857	0	3	2.9	1000
20	2000	2000	2857	0	3	3.0	937
22	2000	2000	2857	0	3	2.9	998
24	2000	2000	2857	0	3	3.1	937
25	2000	2000	2857	0	3	2.9	998
26	2000	2000	2857	0	3	3.1	936
27	2000	2000	2857	0	3	3.0	965
28	2000	2000	2857	0	3	2.8	1005
38	6264	6264	8949	0	3	75.4	119
39	2000	2000	2857	0	3	1.4	2054
40	2000	2000	2857	0	3	2.1	1346
41	2000	2000	2857	0	3	2.3	1233
54	2000	2000	2857	0	3	2.3	1266
61	2000	2000	2857	0	3	2.2	1321
85	2000	110720	158171	108720	3	2.0	78967
109	2000	2000	2857	0	3	1.5	1940
128	5000	44027	62896	39027	3	5.1	12323
129	2000	18076	25823	16076	3	3.0	8712
130	1544	1544	2206	0	3	20.2	109
131	2000	2000	2857	0	3	2.0	1429
145	2000	10847	15496	8847	3	2.2	7131
153	2000	2000	2857	0	3	2.1	1383
160	2000	2000	2857	0	3	2.0	1396
169	2000	20435	29193	18435	3	1.9	15157
174	3000	3000	4286	0	3	4.4	983
176	2000	19066	27237	17066	3	2.1	12939
178	2000	2000	2857	0	3	2.2	1301
179	2000	38429	54899	36429	3	2.2	24863
186	2000	18730	26757	16730	3	2.1	12939
197	2000	25975	37107	23975	3	2.1	17620
199	2000	26530	37900	24530	3	2.3	16197
212	360	360	514	0	3	4.8	106
219	1000	1000	1429	0	3	15.8	90
222	346	56161	80230	55815	3	4.7	17107
225	2000	2000	2857	0	3	1.8	1568
227	2000	2000	2857	0	3	2.2	1310
228	2000	2000	2857	0	3	1.9	1470
229	2000	2000	2857	0	3	1.8	1545
245	262	762	1089	500	3	3.8	290
252	2000	2000	2857	0	3	2.3	1234

PARCELS_	LAND	FCV	market val	STRUCT	AREA	ACRES	mv per acre
257	18000	783294	1118991	765294	3	40.8	27442
274	2000	2000	2857	0	3	1.8	1573
282	206	13258	18940	13052	3	2.8	6678
304	736	30436	43480	29700	3	10.1	4286
315	808	18173	25961	17365	3	12.5	2074
332	2000	20446	29209	18446	3	2.3	12612
353	1768	66373	94819	64605	3	21.6	4388
359	2000	37033	52904	35033	3	2.1	25265
361	2000	23562	33660	21562	3	1.8	18484
787	2000	10035	14336	8035	3	2.1	6849
788	0	0	0	0	3	2.0	0
789	0	0	0	0	3	2.0	0
	139646	1636902	2338431	1497256		462.2	

PARCELS_	LAND	FCV	market val	STRUCT	AREA	ACRES	mv per acre
5	10103	10103	14433	0	4	142.8	101
6	6209	6209	8870	0	4	87.4	102
7	18234	18234	26049	0	4	1317.4	20
29	2000	2000	2857	0	4	1.9	1485
30	2000	2000	2857	0	4	1.9	1499
31	2000	2000	2857	0	4	2.3	1233
32	2000	2000	2857	0	4	1.9	1519
33	2000	2000	2857	0	4	2.3	1245
34	2000	2000	2857	0	4	1.7	1650
42	2000	2000	2857	0	4	1.9	1494
50	2000	2000	2857	0	4	2.7	1058
52	2000	2000	2857	0	4	2.3	1230
53	2000	2000	2857	0	4	1.7	1640
56	2000	2000	2857	0	4	2.0	1432
58	2000	2000	2857	0	4	2.4	1171
59	2000	2000	2857	0	4	1.8	1591
60	2000	2000	2857	0	4	3.1	931
63	2000	2000	2857	0	4	3.3	865
72	2000	2000	2857	0	4	2.4	1213
74	2000	2000	2857	0	4	2.4	1170
76	2000	2000	2857	0	4	1.9	1520
80	2000	2000	2857	0	4	2.5	1162
81	2000	2000	2857	0	4	2.5	1149
82	2000	2000	2857	0	4	2.0	1398
83	2000	2000	2857	0	4	2.4	1190
86	2000	2000	2857	0	4	3.4	844
88	2000	2000	2857	0	4	2.4	1213
98	2000	2000	2857	0	4	2.1	1369
100	2000	2000	2857	0	4	2.4	1187
101	2000	2000	2857	0	4	2.0	1409
103	2000	2000	2857	0	4	2.1	1380
104	2000	2000	2857	0	4	2.3	1231
108	2000	2000	2857	0	4	2.5	1130
111	2000	2000	2857	0	4	2.7	1040
120	26389	647771	925387	621382	4	69.1	13385
122	2000	2000	2857	0	4	2.9	977
124	2000	2000	2857	0	4	2.4	1188
125	2000	2000	2857	0	4	2.3	1217
140	26149	26622	38031	473	4	78.5	485
149	8699	469148	670211	460449	4	21.5	31177
151	10411	10411	14873	0	4	27.3	545
170	18706	18706	26723	0	4	30.6	874
184	8488	27462	39231	18974	4	12.2	3212
191	5702	20805	29721	15103	4	14.3	2081
193	10174	10174	14534	0	4	17.5	829
204	12937	12937	18481	0	4	21.7	853
206	1002	1002	1431	0	4	2.9	486
207	2483	38630	55186	36147	4	6.7	8245
209	11892	128040	182914	116148	4	20.6	8899
221	0	0	0	0	4	2.6	0
233	563	1225	1750	662	4	0.4	3898

PARCELS_	LAND	FCV	market val	STRUCT	AREA	ACRES	mv per acre
234	563	563	804	0	4	0.7	1088
235	3027	3527	5039	500	4	4.6	1097
237	470	470	671	0	4	0.2	2763
238	563	563	804	0	4	0.9	923
240	563	563	804	0	4	0.8	954
241	563	563	804	0	4	1.0	790
242	563	563	804	0	4	1.0	813
243	563	563	804	0	4	1.0	839
244	563	563	804	0	4	0.9	865
246	563	563	804	0	4	0.9	857
249	563	563	804	0	4	0.9	904
254	563	563	804	0	4	0.9	868
255	563	563	804	0	4	0.9	868
258	563	563	804	0	4	0.9	868
260	563	563	804	0	4	0.9	857
261	14265	17982	25689	3717	4	22.5	1141
262	563	563	804	0	4	0.9	868
263	563	563	804	0	4	0.9	868
266	563	563	804	0	4	0.9	868
267	563	563	804	0	4	0.9	859
268	563	563	804	0	4	0.9	868
269	563	563	804	0	4	0.9	868
275	563	563	804	0	4	0.9	868
276	563	563	804	0	4	0.9	860
277	0	0	0	0	4	0.2	0
278	563	563	804	0	4	0.9	868
279	14265	14265	20379	0	4	22.5	905
280	563	22042	31489	21479	4	0.9	33968
283	563	563	804	0	4	0.9	868
284	3375	3375	4821	0	4	5.6	867
285	563	563	804	0	4	0.9	860
286	563	563	804	0	4	0.9	868
287	563	563	804	0	4	0.9	868
289	563	563	804	0	4	0.9	868
290	563	563	804	0	4	0.9	862
292	563	563	804	0	4	0.9	868
293	563	17707	25296	17144	4	0.9	27288
296	183	183	261	0	4	0.4	708
298	563	35131	50187	34568	4	0.9	54081
299	563	563	804	0	4	0.9	862
300	5534	5534	7906	0	4	8.6	915
301	563	3837	5481	3274	4	0.9	5913
302	563	563	804	0	4	0.9	868
305	15420	15420	22029	0	4	29.2	754
308	563	563	804	0	4	0.9	864
309	563	563	804	0	4	0.9	868
310	563	5964	8520	5401	4	0.9	9191
314	563	563	804	0	4	0.9	865
316	563	563	804	0	4	0.9	868
319	2621	2621	3744	0	4	4.5	839
320	563	563	804	0	4	0.9	863

PARCELS_	LAND	FCV	market val	STRUCT	AREA	ACRES	mv per acre
322	563	563	804	0	4	0.9	868
324	563	563	804	0	4	0.9	866
325	47444	47444	67777	0	4	999.1	68
326	10969	10969	15670	0	4	19.5	805
328	563	563	804	0	4	0.9	867
331	563	563	804	0	4	0.9	866
334	47444	47444	67777	0	4	192.6	352
336	563	563	804	0	4	0.9	868
340	6356	150000	214286	143644	4	10.5	20358
343	844	844	1206	0	4	1.4	868
344	844	844	1206	0	4	1.4	867
346	844	844	1206	0	4	1.4	867
347	844	844	1206	0	4	1.4	868
349	844	844	1206	0	4	1.4	867
350	844	844	1206	0	4	1.4	867
352	2363	2363	3376	0	4	3.9	868
355	338	338	483	0	4	0.6	867
356	7459	389579	556541	382120	4	18.9	29405
360	240	240	343	0	4	0.7	527
376	3357	3357	4796	0	4	31.1	154
386	3357	3357	4796	0	4	59.4	81
397	317	317	453	0	4	0.8	580
401	317	317	453	0	4	0.7	653
404	317	317	453	0	4	0.6	702
407	317	317	453	0	4	0.6	738
410	196	196	280	0	4	0.5	522
414	196	196	280	0	4	0.5	568
416	196	196	280	0	4	0.5	513
419	196	196	280	0	4	0.5	579
425	170	170	243	0	4	0.4	598
430	170	170	243	0	4	0.4	664
445	156	156	223	0	4	1.0	225
627	280	280	400	0	4	1.2	338
631	375	375	536	0	4	1.0	560
713	280	280	400	0	4	0.9	429
749	4012	4012	5731	0	4	54.7	105
750	4012	4012	5731	0	4	54.3	106
751	8024	8024	11463	0	4	111.5	103
752	4000	4673	6676	673	4	54.0	124
753	4000	7014	10020	3014	4	56.0	179
756	553	25058	35797	24505	4	7.2	4976
757	312	312	446	0	4	4.3	103
758	648	34550	49357	33902	4	8.8	5637
759	400	400	571	0	4	4.5	127
761	4816	4816	6880	0	4	65.2	106
763	800	13454	19220	12654	4	10.6	1814
764	5704	9852	14074	4148	4	85.6	164
766	16048	16048	22926	0	4	212.6	108
767	4000	26891	38416	22891	4	53.0	725
768	4000	8259	11799	4259	4	53.7	220
769	8032	8032	11474	0	4	109.0	105

PARCELS_	LAND	FCV	market val	STRUCT	AREA	ACRES	mv per acre
770	800	1300	1857	500	4	10.7	174
773	32000	32000	45714	0	4	435.8	105
774	12000	12000	17143	0	4	165.3	104
775	4000	4000	5714	0	4	53.6	107
776	6000	6000	8571	0	4	84.0	102
777	2000	50496	72137	48496	4	28.4	2544
779	8000	8000	11429	0	4	110.4	103
780	4000	88860	126943	84860	4	54.6	2324
781	10016	10016	14309	0	4	135.6	106
782	7776	9301	13287	1525	4	112.3	118
783	11993	11993	17133	0	4	886.8	19
784	500	500	714	0	4	8.9	80
785	2590	2590	3700	0	4	7.4	502
786	198	198	283	0	4	0.7	394
797	53856	53856	76937	0	4	66.4	1159
798	34472	34472	49246	0	4	174.9	282
	728635	2851247	4073210	2122612		6728.0	

Appendix C

SAND TANK WASH FLOOD CONTROL IMPROVEMETS
:COST ESTIMATE

Project Name: Gila Bend ADMP
Project No.: FCD 99-18 (EEC No. 99541)

Sand Tank Wash Flood Control Improvements
Phase 1: Reconstruct Levee and New Overchute at Bender Wash

Item No.	Item Description	Unit	Unit Price	Quantity	Amount
	CONSTRUCTION				
1	Concrete (headwall) for GBC siphon extension	CY	$250.00	82	$20,500
2	Compacted fill for Sand Tank Wash siphon extension	CY	$3.00	504	$1,512
3	Canal siphon pipe (96" RCP) at Sand Tank Wash extension	LF	$500.00	68	$34,000
4	Concrete (headwalls) for new Siphon at Bender Wash	CY	$250.00	160	$40,000
5	Compacted Fill for Bender Wash siphon	CY	$3.00	667	$2,001
6	Concrete siphon pipe (96" RCP) at Bender Wash	LF	$500.00	40	$20,000
7	Compacted fill for reconstructed Levee	CY	$3.00	9,583	$28,749
8	Excavation for reconstructed Levee	CY	$2.00	10,650	$21,300
9	CSA Bank Protection for Reconstructed Levee	CY	$24.00	9,778	$234,672
	Subtotal				**$402,734**
	LAND ACQUISITION				
10	Land Acquisition for Levee	AC	$2,000.00	2	$4,000
	Subtotal				**$4,000**
	ENGINEERING				
11	Design and Construction Documents				**$50,000**
	Subtotal				
	CONSTRUCTION ADMINISTRATION				
12	Construction Admin. and Inspection (@ 15% of Construction)				$60,400
	Subtotal				**$60,400**

Subtotal	$517,134
Contingencies (20%)	$103,427
TOTAL	**$621,000**

Project Name: Gila Bend ADMP
Project No.: FCD 99-18 (EEC No. 99541)

Sand Tank Wash Flood Control Improvements
Phase 2: I-8 Retention Basins (East and West), Sand Tank Wash & Martin Ave. Spillway, Scot Ave. Wash Diversion

Item No.	Item Description	Unit	Unit Price	Quantity	Amount
	CONSTRUCTION				
	East Half				
1	Excavation of new Retention Basin	CY	$1.50	2,100,000	3150000
2	CSA Bank Protection (for new spillway)	CY	$24.00	6,000	$144,000
3	Excavation of Scott Ave. Wash Diversion Channel	CY	$2.00	16,540	$33,080
4	Excavation of Scott Ave. Wash Return Channel	CY	$2.00	2,640	$5,280
5	60" RCP, for Scott Ave. Wash Return Channel	LF	$150.00	100	$15,000
6	Revegetation	AC	$10,000.00	126	$1,260,000
	West Half				
7	Excavation of new Retention Basin	CY	$1.50	1,500,000	$2,250,000
8	CSA Bank Protection (spillway between basins)	CY	$24.00	6,000	$144,000
9	Revegetation	AC	$10,000.00	90	$900,000
	Subtotal				**$7,901,360**
	LAND ACQUISITION				
10	Land Acquisition for East Retention Basin and Channels	AC	$2,000.00	126	$252,000
	Land Acquisition for West Retention Basin	AC	$2,000.00	90	$180,000
	Flood Easement - Land	AC	$200.00	935	$187,000
	Flood Easement - Structures	EA	$15,000.00	29	$435,000
	Subtotal				**$1,054,000**
	ENGINEERING				
11	Design and Construction Documents (8% construction)				$632,000.00
	Subtotal				**$632,000**
	CONSTRUCTION ADMINISTRATION				
12	Construction Admin. and Inspection (@ 15 % Construction)				$1,185,204
	Subtotal				**$1,185,204**

Subtotal	$10,772,564
Contingencies (20%)	$2,154,500
TOTAL	**$12,927,000**

Project Name: Gila Bend ADMP
Project No.: FCD 99-18 (EEC No. 99541)

Sand Tank Wash Flood Control Improvements
Phase 3: Detention Facility upstream of I-8

Item No.	Item Description	Unit	Unit Price	Quantity	Amount
	CONSTRUCTION				
1	Excavation (cost included in Fill construction)	CY	$0.00	103,320	$0
2	Compacted Fill, Core Zone	CY	$2.00	1,562,050	$3,124,100
3	Fill, Landscape Zone	CY	$1.50	1,201,900	$1,802,850
4	Filter, Center made from sand or C33 fine	CY	$22.00	100,500	$2,211,000
5	Toe Drains, spaced 500' apart, made from C33 coarse & C33 fine	CY	$22.00	7,850	$172,700
6	CSA Bank Protection (spillways)	CY	$24.00	61,228	$1,469,472
7	36" RCP	LF	$75.00	700	$52,500
8	Structural Concrete (box culverts)	CY	$250.00	4,183	$1,045,750
9	Steel (box culverts)	lbs	$0.45	593,380	$267,021
10	Revegetaion	AC	$10,000.00	100	$1,000,000
	Subtotal				**$11,145,393**
	LAND ACQUISITION				
10	Land Acquisition	AC	$2,000.00	1,528	$3,056,000
	Subtotal				**$3,056,000**
	ENGINEERING				
11	Design, Construction Documents and Permits (8% Construction)				$892,000
12	404 Permitting				$10,000
	Subtotal				**$902,000**
	CONSTRUCTION ADMINISTRATION				
13	Construction Admin. And Inspection (@15% of Construction)				$1,671,809
	Subtotal				**$1,671,809**

Sub-Total	$16,775,200
Contingencies (20%)	$3,355,040
TOTAL	**$20,130,000**

Appendix D

TOWN CORE AREA DRAINAGE IMPROVEMENTS
:COST ESTIMATES

Project Name: TOWN of GILA BEND
Project No.: FCD 99-18 (EEC NO. 99541)
South Gila Bend Drainage Improvements

Elements Include: Channelize along Main Street, New Paving, Channelize along Canal, Detention Basin at Sand Tank Levee, and lower Outfall Pipe at Levee

Item No.	Item Description	Unit	Unit Price	Quantity	Amount
	CONSTRUCTION				
	Drainage Improvements				
1	Drainage Excavation, Interceptor Channel parallel with Canal	CY	$6.00	1455	$ 8,730.00
2	Drainage Excavation, Detention Basin (7.4 ac-ft)	CY	$6.00	11950	$ 71,700.00
3	Drainage Excavation, Roadside Channel from CP2 to CP1	CY	$6.00	210	$ 1,260.00
4	New 36" Pipe under Levee	LF	$100.00	70	$ 7,000.00
5	New 36" Tideflex Check Valve	EA	$7,500.00	1	$ 7,500.00
6	New Upstream Headwall w/Trash Rack	EA	$5,000.00	1	$ 5,000.00
7	Revegatation/Landscaping	SF	$0.50	150,000	$ 75,000.00
	Subtotal				**$ 176,190.00**
	Roadway Improvements				
8	Prepare Subgrade	SY	$2.50	10620	$ 26,550.00
9	New Paving, Main Street (collector), 3"AC/6"AB	SY	$12.00	6310	$ 75,720.00
10	New Paving, Martin Street (collector), 3"AC/6"AB	SY	$12.00	4310	$ 51,720.00
11	Curb and Gutter, 6" Vertical Curb	LF	$9.00	4780	$ 43,020.00
	Subtotal				**$ 197,010.00**
	Construction Subtotal				**$ 373,200.00**
	LAND ACQUISITION				
12	Land Aquisition along extension of Main Street Channel	AC	$2,000.00	0.1	$ 200.00
13	Land Aquisition along New Interceptor Channel	AC	$2,000.00	1.5	$ 3,000.00
14	Land Acquisition for Detention Basin at Sand Tank Levee	AC	$2,000.00	3.5	$ 7,000.00
	Subtotal				**$ 10,200.00**

Project Name: TOWN of GILA BEND
Project No.: FCD 99-18 (EEC NO. 99541)
South Gila Bend Drainage Improvements

Elements Include: Channelize along Main Street, New Paving, Channelize along Canal, Detention Basin at Sand Tank Levee, and lower Outfall Pipe at Levee

	ENGINEERING					
15	Design and Construction Documents for Drianage Improvements				$	26,400.00
16	Design and Construction Documents for Roadway Improvements				$	29,600.00
17	404 Permitting				$	5,000.00
	Subtotal				**$**	**61,000.00**
	CONSTRUCTION ADMINISTRATION					
18	Construction Admin. and Inspection (@15% of Construction)				$	56,000.00
	Subtotal				**$**	**56,000.00**

Subtotal	$	500,400.00
Contingencies (20%)	$	100,080.00
TOTAL	**$**	**600,480.00**

Project Name: Town of Gila Bend
Project No.: FCD 99-18 (EEC No. 99541)
Harrington Avenue Drianage Improvements

Elements Include: Roadway Improvements, Retention Basin with Drywells, Storm Drain, Outfall Channel and Regrading Alley with Valley Gutter

Item No.	Item Description	Unit	Unit Price	Quantity	Amount
	CONSTRUCTION				
	Drainage Improvements				
1	Drainage Excavation, Retention Basin (6 Ac-Ft)	CY	$3.00	10000	$ 30,000.00
2	Drywell	EA	$4,500.00	10	$ 45,000.00
3	Concrete Pipe, Storm Drain 36"	LF	$100.00	800	$ 80,000.00
4	Concrete Pipe, Storm Drain 42"	LF	$110.00	600	$ 66,000.00
5	Concrete Pipe, Storm Drain 48"	LF	$125.00	400	$ 50,000.00
6	Headwall to Outlet 48" Storm Drain	EA	$5,000.00	1	$ 5,000.00
7	Manhole, Storm Drain	EA	$2,600.00	6	$ 15,600.00
8	Catch Basin, Curb Opening (typ. M1, L=17)	EA	$2,300.00	6	$ 13,800.00
9	Catch Basin, Curb Opening (typ. M2, L=17)	EA	$3,000.00	4	$ 12,000.00
10	Drainage Excavation, Interim Outfall Channel to Daylight at Elev. 704	CY	$3.00	2350	$ 7,050.00
11	Grade Alley north of Margarett Street	SY	$3.00	100	$ 300.00
12	New Concrete Valley Gutter, MAG DET 240	LF	$5.00	300	$ 1,500.00
13	Arch Pipe, 17"x13" Corrugated Metal	LF	$43.00	195	$ 8,385.00
14	Headwall for 17"x13" CMPA	EA	$950.00	2	$ 1,900.00
15	Headwall for 2 barrel 17"x13" CMPA	EA	$1,900.00	4	$ 7,600.00
16	Headwall for 3 barrel 17"x13" CMPA	EA	$2,850.00	2	$ 5,700.00
17	Arch Pipe, 24"x18" Corrugated Metal	LF	$45.00	520	$ 23,400.00
18	Headwall for 3 barrel 24"x18" CMPA	EA	$3,100.00	2	$ 6,200.00
19	Arch Pipe, 28"x20" Corrugated Metal	LF	$48.00	325	$ 15,600.00
20	Headwall for 2 barrel 28"x20"" CMPA	EA	$2,500.00	2	$ 5,000.00
21	Headwall for 3 barrel 28"x20"" CMPA	EA	$3,750.00	2	$ 7,500.00
22	Remove and Replace Asphalt Pavement with 3"AC/6"AB	SY	$15.00	15000	$ 225,000.00
23	Backfill to elevate Roadway (Harrington and Indian Road at culverts)	CY	$3.00	5550	$ 16,650.00
24	Revegetation/Landscaping	SF	$0.50	175000	$ 87,500.00
	Subtotal				**$ 736,685.00**

Project Name: Town of Gila Bend
Project No.: FCD 99-18 (EEC No. 99541)
Harrington Avenue Drianage Improvements

Elements Include: Roadway Improvements, Retention Basin with Drywells, Storm Drain, Outfall Channel and Regrading Alley with Valley Gutter

	Roadway Improvements					
25	New Paving, Harrington Avenue (collector), 3"AC/6"AB	SY	$12.00	8220	$	98,640.00
26	New Paving, Hunt Street (collector), 3"AC/6"AB	SY	$12.00	5860	$	70,320.00
27	New Paving, Williams Street (local), 3"AC/6"AB	SY	$12.00	10000	$	120,000.00
28	New Paving, Papago St. (local), 3"AC/6"AB	SY	$12.00	2640	$	31,680.00
29	New Paving, Norma St. (local), 3"AC/6"AB	SY	$12.00	2640	$	31,680.00
30	New Paving, Dodson St. (local), 3"AC/6"AB	SY	$12.00	6000	$	72,000.00
31	New Paving, Robert E. Lee Lane (local), 3"AC/6"AB	SY	$12.00	5380	$	64,560.00
32	New Paving, Jeb Stuart St. (local), 3"AC/6"AB	SY	$12.00	1700	$	20,400.00
33	New Paving, Margaret St. (local), 3"AC/6"AB	SY	$12.00	2830	$	33,960.00
34	New Paving, Merrit Parkway (local), 3"AC/6"AB	SY	$12.00	6040	$	72,480.00
35	Prepare Subgrade	SY	$2.50	51310	$	128,275.00
36	Curb and Gutter, 6" Vertical Curb	LF	$9.00	9740	$	87,660.00
37	Curb and Gutter, 4" Roll Curb	LF	$9.00	15850	$	142,650.00
	Subtotal				**$**	**974,305.00**
	Construction Subtotal				**$**	**1,710,990.00**
	LAND ACQUISITION					
38	Drainage Easement, Retention Basin	AC	$2,000.00	2.5	$	5,000.00
39	Drainage Easement, Outfall Channel	AC	$2,000.00	1.25	$	2,500.00
	Subtotal				**$**	**7,500.00**
	ENGINEERING					
40	Design and Construction Documents for Drianage Improvements				$	110,500.00
41	Design and Construction Documents for Roadway Improvements				$	146,100.00
42	404 Permitting				$	5,000.00
	Subtotal				**$**	**261,600.00**

Project Name: Town of Gila Bend
Project No.: FCD 99-18 (EEC No. 99541)
Harrington Avenue Drianage Improvements

Elements Include: Roadway Improvements, Retention Basin with Drywells, Storm Drain, Outfall Channel and Regrading Alley with Valley Gutter

	CONSTRUCTION ADMINISTRATION				
43	Construction Admin. and Inspection (@15% of Construction)				$ 256,600.00
	Subtotal				**$ 256,600.00**

Sub-Total	$ 2,236,690.00
Contingencies (20%)	$ 447,338.00
TOTAL	**$ 2,684,028.00**

Project Name: Town of Gila Bend
Project No.: FCD 99-18 (EEC NO. 99541)
Scott Avenue Wash Drainage Improvements

Elements Include: Detention Basin w/Drain Pipe, Culverts, New Paving

Item No.	Item Description	Unit	Unit Price	Quantity	Amount
	CONSTRUCTION				
	Drianage Improvements				
1	Remove Tree, blocking driange way (between Pima and Papago)	EA	$250.00	1	$ 250.00
2	Concrete Box Culvert, 6'x3' CBC, S.A.W. at Papago St. (3-barrels)	LF	$240.00	156	$ 37,440.00
3	Concrete Box Culvert, 8'x3' CBC, S.A.W. at Hunt St.(3-barrels)	LF	$300.00	156	$ 46,800.00
4	Concrete Box Culvert, 8'x3' CBC, S.A.W. at Richards St.(3-barrels)	LF	$300.00	156	$ 46,800.00
5	Corrugated Metal Pipe, 42" Pipe, S.A.W. at Indian Rd. (5-barrels)	LF	$72.00	325	$ 23,400.00
6	Headwall, 42" CMP (5 barrels)	EA	$2.00	6000	$ 12,000.00
7	Drainage Excavation, Det. Basin at Hunt Street	CY	$3.00	3100	$ 9,300.00
8	Concrete Pipe, 18" drain pipe from Det. Basin to S.A.W.	LF	$45.00	250	$ 11,250.00
9	New Headwall w/Trash Rack in Detention Basin	EA	$3,500.00	1	$ 3,500.00
10	Revegetation/Landscaping	SF	$0.50	22000	$ 11,000.00
	Subtotal				**$ 201,740.00**
	Roadway Improvements				
11	Prepare Subgrade	SY	$2.50	71210	$ 178,025.00
12	New Paving, Indian Road (minor Arterial), 3"AC/6"AB	SY	$12.00	5300	$ 63,600.00
13	New Paving, Scott Ave. (local), 3"AC/6"AB	SY	$12.00	13600	$ 163,200.00
14	New Paving, Logan St. (local), 3"AC/6"AB	SY	$12.00	8710	$ 104,520.00
15	New Paving, Trosper St. (local), 3"AC/6"AB	SY	$12.00	2420	$ 29,040.00
16	New Paving, Gatlin St. (local), 3"AC/6"AB	SY	$12.00	2420	$ 29,040.00
17	New Paving, Boyer St. (local), 3"AC/6"AB	SY	$12.00	2420	$ 29,040.00
18	New Paving, Stout St. (local), 3"AC/6"AB	SY	$12.00	2340	$ 28,080.00
19	New Paving, Warren St. (local), 3"AC/6"AB	SY	$12.00	2190	$ 26,280.00
20	New Paving, Richards (collector), 3"AC/6"AB	SY	$12.00	8090	$ 97,080.00
21	New Paving, Weidner St. (collector), 3"AC/6"AB	SY	$12.00	8000	$ 96,000.00
22	New Paving, Hunt St. (collector), 3"AC/6"AB	SY	$12.00	7560	$ 90,720.00

Project No.: FCD 99-18 (EEC NO. 99541)
Scott Avenue Wash Drainage Improvements

Elements Include: Detention Basin w/Drain Pipe, Culverts, New Paving

23	New Paving, Johnny St. (local), 3"AC/6"AB	SY	$12.00	3780	$	45,360.00
24	New Paving, Papago St. (local), 3"AC/6"AB	SY	$12.00	4380	$	52,560.00
25	Curb and Gutter, 6" Vertical Curb	LF	$9.00	34440	$	309,960.00
	Subtotal				**$**	**1,342,505.00**
	Construction Subtotal				**$**	**1,544,245.00**
	LAND ACQUSITION					
26	Drainage Easement for Detention Basin (@ Hunt & Johnny Streets)	AC	$5,000.00	0.5	$	2,500.00
	Subtotal				**$**	**2,500.00**
	ENGINEERING					
27	Design and Construction Documents for Drianage Improvements				$	30,300.00
28	Design and Construction Documents for Roadway Improvements				$	201,400.00
29	404 Permitting				$	-
	Subtotal				**$**	**231,700.00**
	CONSTRUCTION ADMINISTRATION					
30	Construction Admin. and Inspection (@15% of Construction)				$	231,600.00
	Subtotal				**$**	**231,600.00**

Subtotal	$	2,010,045.00
Contingencies (20%)	$	402,000.00
TOTAL	**$**	**2,412,045.00**

Project Name: Town of Gila Bend
Project No.: FCD 99-18 (EEC NO. 99541)
St. Louis Avenue Drainage Improvements

Elements Include: Storm Drain, Channelize along St. Louis Ave., Outfall Channel and Roadway Improvements

Item No.	Item Description	Unit	Unit Price	Quantity		Amount
	CONSTRUCTION					
	Drainage Improvements					
1	Concrete Pipe, Storm Drain 18"	LF	$45.00	200	$	9,000.00
2	Concrete Pipe, Storm Drain 36"	LF	$100.00	1900	$	190,000.00
3	Concrete Pipe, Storm Drain 42"	LF	$120.00	180	$	21,600.00
	Headwall, for 42" pipe and 24" pipe at outfall channel	EA	$2,600.00	1	$	2,600.00
4	Manhole, Storm Drain (every 330 ft.)	EA	$2,600.00	6	$	15,600.00
5	Catch Basin, Curb Opening (typ. M1,L=17)	EA	$2,300.00	4	$	9,200.00
6	Catch Basin, Curb Opening (typ. M1,L=10)	EA	$2,000.00	8	$	16,000.00
7	Drianage Excavation (Outfall Channel)	CY	$3.00	2500	$	7,500.00
8	Drianage Excavation (Roadside Ch. - St. Louis Ave east side)	CY	$3.00	310	$	930.00
9	Pipe, Corrugated Metal, 24" CMP, St. Louis at Indian Road	LF	$38.00	60	$	2,280.00
	Subtotal				**$**	**274,710.00**
	Roadway Improvements					
10	Prepare Subgrade	SY	$2.50	12370	$	30,925.00
11	New Paving, St. Louis Avenue (collector), 3"AC/6"AB	SY	$12.00	7700	$	92,400.00
12	New Paving, Stout Street (collector), 3"AC/6"AB	SY	$12.00	890	$	10,680.00
13	New Paving, Richards Street (local), 3"AC/6"AB	SY	$12.00	3780	$	45,360.00
14	Remove Existing Pavement, Martin Avenue	SY	$2.00	3450	$	6,900.00
15	Roadway Excavation, lower Martin Avenue 1.5 ft (average)	CY	$3.00	2900	$	8,700.00
16	New Paving, Martin Avenue (collector), 3"AC/6"AB	SY	$12.00	5800	$	69,600.00
17	Curb and Gutter, 6" Vertical Curb	LF	$9.00	8600	$	77,400.00
	Subtotal				**$**	**341,965.00**
	Construction Subtotal				**$**	**616,675.00**

Project Name: Town of Gila Bend
Project No.: FCD 99-18 (EEC NO. 99541)
St. Louis Avenue Drainage Improvements

Elements Include: Storm Drain, Channelize along St. Louis Ave., Outfall Channel and Roadway Improvements

	LAND ACQUSITION					
18	Drainage Easement, (35' by 1900' for outfall channel)	AC	$2,000.00	1.5	$	3,000.00
	Subtotal				**$**	**3,000.00**
	ENGINEERING					
19	Design and Construction Documents for Drianage Improvements				$	41,200.00
20	Design and Construction Documents for Roadway Improvements				$	51,300.00
21	404 Permitting				$	-
	Subtotal				**$**	**92,500.00**
	CONSTRUCTION ADMINISTRATION					
22	Construction Admin. and Inspection (@15% of Construction)				$	92,500.00
	Subtotal				**$**	**92,500.00**

Subtotal	$	804,675.00
Contingencies (20%)	$	160,900.00
TOTAL	**$**	**965,575.00**