FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

GILA BEND AREA DRAINAGE MASTER PLAN

RECOMMENDED DESIGN REPORT

November, 2001
(Revised April, 2002)

Engineering and Environmental Consultants, Inc.

GILA BEND AREA DRAINAGE MASTER PLAN
RECOMMENDED DESIGN REPORT

FCD No. 99-18

November 2001
(Revised April 2002)

Prepared For
Flood Control District of Maricopa County

Prepared By

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In Association With

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EXECUTIVE SUMMARY

Overview

This study was initiated by the Town of Gila Bend's request to the Flood Control District of Maricopa County (District) for assistance with the Town's drainage issues. The District responded to the request by commissioning this Area Drainage Master Plan (ADMP). In addition, the District entered into an agreement with the Town to provide technical plan review for floodplain use permits and grading and drainage permits.

Purpose of the Area Drainage Master Plan

The purpose of preparing the Area Drainage Master Plan (ADMP) is twofold: 1) to develop corrective measures for existing drainage and flooding problems in the Gila Bend area and 2) to give the Town a planning tool to ensure that future growth provides adequate floodwater conveyance without adversely impacting existing development. To accomplish these goals, the ADMP includes delineation of existing floodplains, which helps define the existing flooding problems. It also includes development of floodwater management tools, identification of required developer-built flood control improvements, capital improvement projects for flood control on Sand Tank Wash, and a drainage plan for the Town Core Area.

Floodplain Study (see Floodplain Delineation Study, FCD 99-18 – under separate cover)

A major component of the ADMP is the delineation of floodplains in areas expected to experience growth. In 1992, the District commissioned the Gila Bend Area Floodplain Delineation Study. This study resulted in floodplain mapping for Sand Tank Wash, Scott Avenue Wash, and two other unnamed washes as well as ponding areas behind the Gila Bend Canal. The ADMP extended the floodplain mapping previously done on Sand Tank Wash and Scott Avenue Wash and also delineated floodplains on Citrus Valley Wash, Sauceda Wash, Quilotosa Wash, West Quilotosa Wash, Hacker Wash, Evans Wash, and Cemetery Wash. Floodplain mapping for the Gila Bend area is now almost complete and provides the Town and land developers with valuable information with regard to flooding potential along the major washes.

Floodwater Management Tools (see Section 4.2)

The area around Gila Bend is mostly undeveloped therefore, one of the most important aspects of the plan was to provide the Town with floodwater management tools. These tools will help the Town guide future development without adversely impacting existing drainage conditions. There are three main management objectives:

1. To preserve natural washes and their floodwater conveyance capacities,
2. To provide storm water retention/detention, and
3. To discourage development in high-risk flood hazard areas.

Developer-Built Elements (see Section 4.3)

The west side of Gila Bend is largely composed of the planned Citrus Valley land development project; an area subject to flood hazards due to overtopping of the Gila Bend Canal, the Southern Pacific Railroad, and I-8. In addition, the man-made channels through the agricultural area, north of I-8, do not have sufficient capacity to convey a 100-year flood. In order to protect future development from flooding, the plan identifies flood control improvements that the developers will have to make prior to developing. These include a new interceptor channel on the downstream side of I-8, to capture unconfined flood flows that spill over the highway, and channel improvements to the man-made drainageways between I-8 and the Gila River.

Sand Tank Wash Flood Control Improvements (see Section 4.4)

Sand Tank Wash is the primary flooding source for the existing, developed part of Gila Bend. During a 100-year flooding event, it inundates large areas of the Town; flooding approximately 25 structures including apartment buildings, homes, and businesses. Even more problematic, upstream of I-8, a significant amount of floodwater from Sand Tank Wash flows into Scott Avenue Wash, dramatically increasing its flooding potential. The result is flooding of approximately 75 homes in the ponding area behind the Gila Bend Canal and another 30 homes and businesses downstream along Scott Avenue Wash. All together, the flood risk from Sand Tank Wash puts approximately 120 homes and businesses in the floodplain. To reduce the flood risk associated with Sand Tank Wash, the ADMP recommends a phased program of flood control improvements.

Phase 1: Reconstruction of the Sand Tank Wash Levee, to bring it up to FEMA standards, and construction of new canal overchute at Bender Wash and the Gila Bend Canal. Estimated cost is $750,000.

Phase 2: Construction of a 270-acre floodwater retention basin on the upstream side of I-8 that will effectively cut off all flood flows into Scott Avenue Wash, which would drastically reduce its floodplain limits within the Town. Estimated cost is $12.8 million.

Phase 3: Construction of a flood retarding structure (FRS) on Sand Tank Wash located about 3 miles upstream of the Town. It would dramatically reduce the flood potential in town, substantially reducing the floodplain boundaries along Sand Tank Wash thereby preventing overtopping of the existing bridges at the railroad and Pima Street. Estimated cost is $20.1 million.

Town Core Drainage Plan (see Section 5)

A drainage plan was developed for the Town Core Area to control local runoff and minimize the problems associated with local drainage within the Town. The drainage plan includes new culverts at the street crossings of Scott Avenue Wash, storm drains in Harrington Avenue and St. Louis Avenue, a drainage channel and detention basin behind the Gila Bend Canal, and a retention basin upstream of the railroad in the Harrington Avenue watershed. The drainage improvements are to be complemented with a program of re-paving the streets with curb and gutter. The new street gutters will convey runoff without the erosion, puddling, and maintenance problems that currently exist. 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 with the Drainage Regulations for Maricopa County and with the requirements outlined in the Drainage Design Manual for Maricopa County. This ensures that all new development provide storm water retention, culverts at roadway wash crossings, and streets with curbs and gutters designed to convey drainage.

Landscape Design Guidelines (see Section 6)

Landscape design guidelines were developed as part of this study to provide the Town with a tool to manage the aesthetic design of new drainage features and to promote multi-use within its washes, channels, and storm water retention basins. These guidelines give planners, engineers, and landscape architects direction as to the landscape character that the Town desires to achieve. The planners can choose from three different character models described in the landscape guidelines: 1) a natural model, 2) a modified natural model, and 3) a park-like model. Recommended plant palettes are provided for each character model, along with grading recommendations, irrigation considerations, and general design guidelines.

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 ensure that future growth provides adequate floodwater conveyance without adversely impacting existing development.

Recently, there has 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 provides the Town with a tool to properly plan for the floodwater conveyance needs of the anticipated growth.

1.2 Purpose of Report

The purpose of this Recommended Design Report is to document the alternative analysis, present a recommended drainage master plan for the Gila Bend area, and provide preliminary design plans for the constructed elements of the ADMP. This report includes 1) documentation of the hydrologic and hydraulic analysis of the flood control improvements, 2) concept plans for the flood control improvements, and 3) itemized cost estimates for the flood control improvements.

1.3 Study Area

The study area 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 boundaries are shown on Exhibit 1-1. 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 within the above-described boundaries. The planning area objectives are to define the existing flood hazards, develop solutions to the existing problems, and develop an overall drainage plan that will allow growth to occur without adversely impacting existing or future development. The ADMP addresses 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 West Planning Area (west of Gila Boulevard) is primarily undeveloped active and fallow farmlands. Paloma Ranch owns most of the developable lands to the west and refers to the area as Citrus Valley (see Data Collection Report). It is envisioned that flood control improvements proposed for the west area will be built with future land developments within Citrus Valley. For this west area, the ADMP defines floodwater conveyance requirements for future development and provides the Town with a tool that can be used to ensure that sufficient floodwater conveyance is provided as the area develops.

The East 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 located within the floodplain. For this East Planning Area, the ADMP assessed potential flood control alternatives that would benefit existing homes and businesses in the Town Core Area. In addition, the ADMP provides 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 for 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

The following paragraphs describe the scope of work for the ADMP.

1.4.1 Review of Existing Data

Data reviewed included 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.

1.4.2 Survey and Mapping

New mapping was created to supplement the existing mapping from the Gila Bend Area Floodplain Delineation Study. This effort included approximately 5 square miles of 2-ft contour mapping in the immediate vicinity of the Town of Gila Bend. It also included approximately 17 square miles of 4-ft contour mapping within the planning area.

1.4.3 Hydrologic Analysis

The hydrologic analysis reviewed 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 included modification of the existing HEC-1 models in order to assess the impact of the alternative flood control solutions.

1.4.4 Assessment of Environmental Data

An inventory of environmental data to assess environmental impacts of the flood control alternatives was performed. The environmental data included ecological resources, cultural resources, estimated limits of 404 jurisdictional waters, and locations of hazardous waste sites.

1.4.5 Floodplain Delineations

Eighteen stream miles of detailed floodplain/floodway delineations was done on the washes south of I-8 and 15 stream miles of approximate floodplain delineations on the washes north of I-8.

1.4.6 Landscape Guidelines

A landscape character analysis of the Gila Bend area as well as the development of landscape guidelines for the proposed features of the ADMP was performed.

1.4.7 Identification of Drainage Problems and Development of Alternative Solutions

The alternatives analysis included solutions to known flooding problems as well as development of plans to maintain floodwater conveyance as the area develops. The analysis considered environmental impacts, right-of-way costs, incorporation of recreational facilities, impact to major utilities, construction costs, and maintenance.

1.4.8 Preparation of Preliminary Design Plans

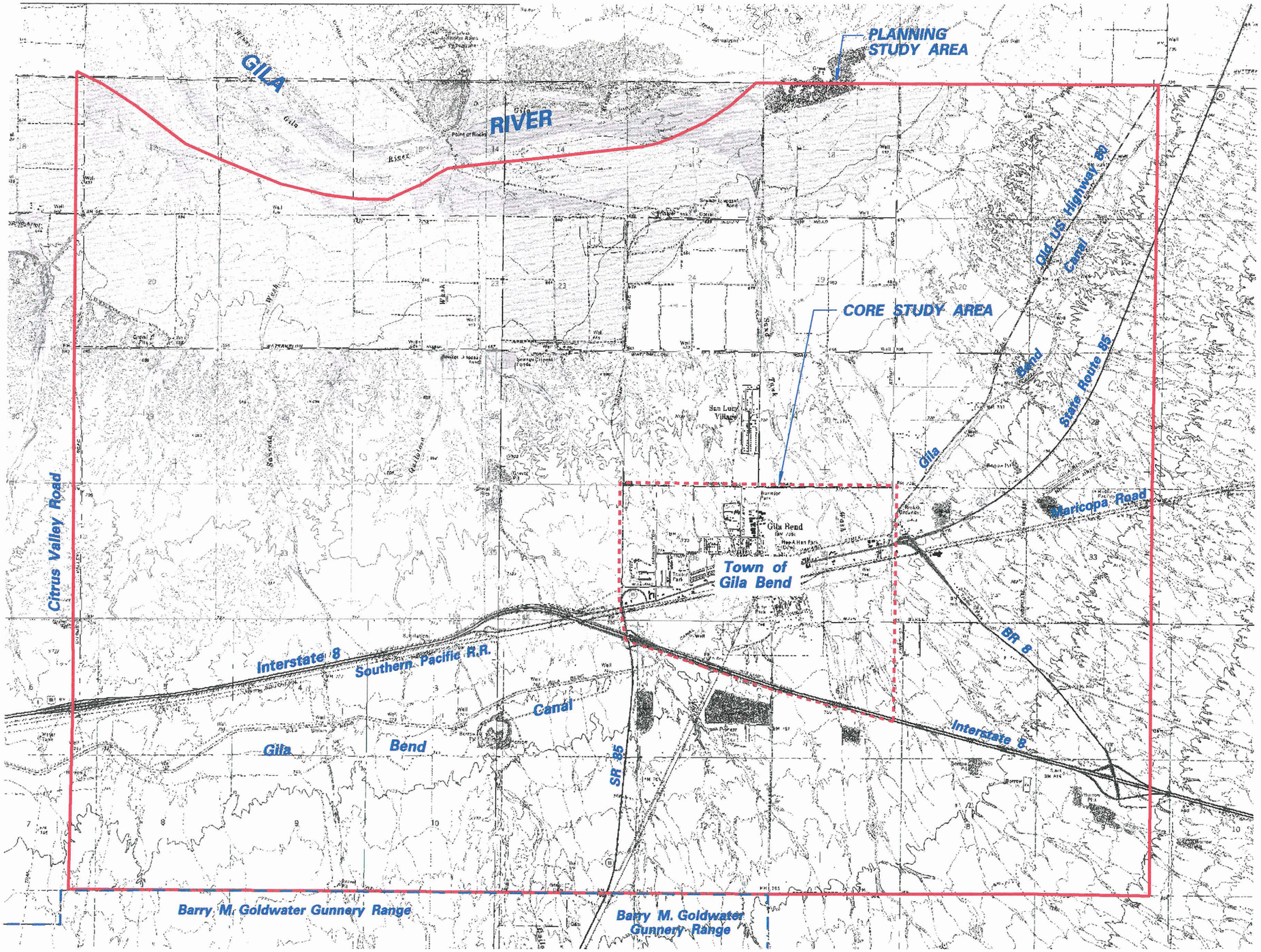
Preliminary design plans of the preferred alternative were prepared.

1.4.9 Public Involvement

Three public meetings were conducted with the intention to 1) inform the public about the study, 2) present the alternative drainage plans, and 3) present the final area drainage master plan.

1.4.10 Reports

A series of reports intended to document the study process were prepared. These include the Data Collection Report, the Alternatives Analysis Report, and the Recommended Design Report. In addition, a Technical Data Notebook was prepared to document the Floodplain Delineation Study.



GILA BEND
Area Drainage Master Plan

PLANNING STUDY AREA
Exhibit 1.1

LEGEND

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

N

0 1000 2000 4000 8000

SCALE: 1" = 4,000'

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 under two previous studies and then modified under the ADMP. Those previous studies, the Gila Bend Area Floodplain Delineation Study and the Gila Bend Canal Floodplain Delineation Study, were both prepared for the 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 Delineation Study, Technical Data Notebook. In most cases, the results of the modified diversions are reflected in Exhibit 2-1, however, in the case of Sand Tank Wash, Scott Avenue Wash, and Bender Wash, the peak flows presented in 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.

It was determined with the Flood Study portion of this ADMP, that the Gila Bend Canal embankment is susceptible to overtopping and washout. Therefore, the washes impacted by the potential washout (Citrus Valley Wash, Sauceda Wash, Quilotosa Wash, West Quilotosa Wash, and Hacker Wash) were modeled with and without the canal embankment. The largest peak discharge from these two conditions is presented on Figure 2-1 (refer to the Gila Bend ADMP, Floodplain Delineation Study, Technical Data Notebook).

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 West 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 man-made channels do not 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 do not 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 intersections with major washes. The floodplain delineations study identified overtopping at Citrus Valley Wash, West Quilotosa Wash, Quilotosa Wash, Hacker Wash and just west of SR85. The wash crossings under I-8 and the railroad, downstream of the Canal, also do not 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 does not.

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 are no homes or buildings in the West Planning Area; therefore, the problems outlined above only impact the Canal, the highway, the railroad, and the agricultural areas. It is envisioned that the West Area flood control improvements will be constructed during 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 that new development is constructed with adequate floodwater conveyance.

2.3.2 East 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 benefits and problems 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 reduced peak discharge) could be exceeded.

2.4 Flooding Problems – Planning Area

Exhibit 2-3 presents the known flooding problems within the planning area. Table 2-1 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.

Table 2-1. Identified Flooding Problems in Planning Area

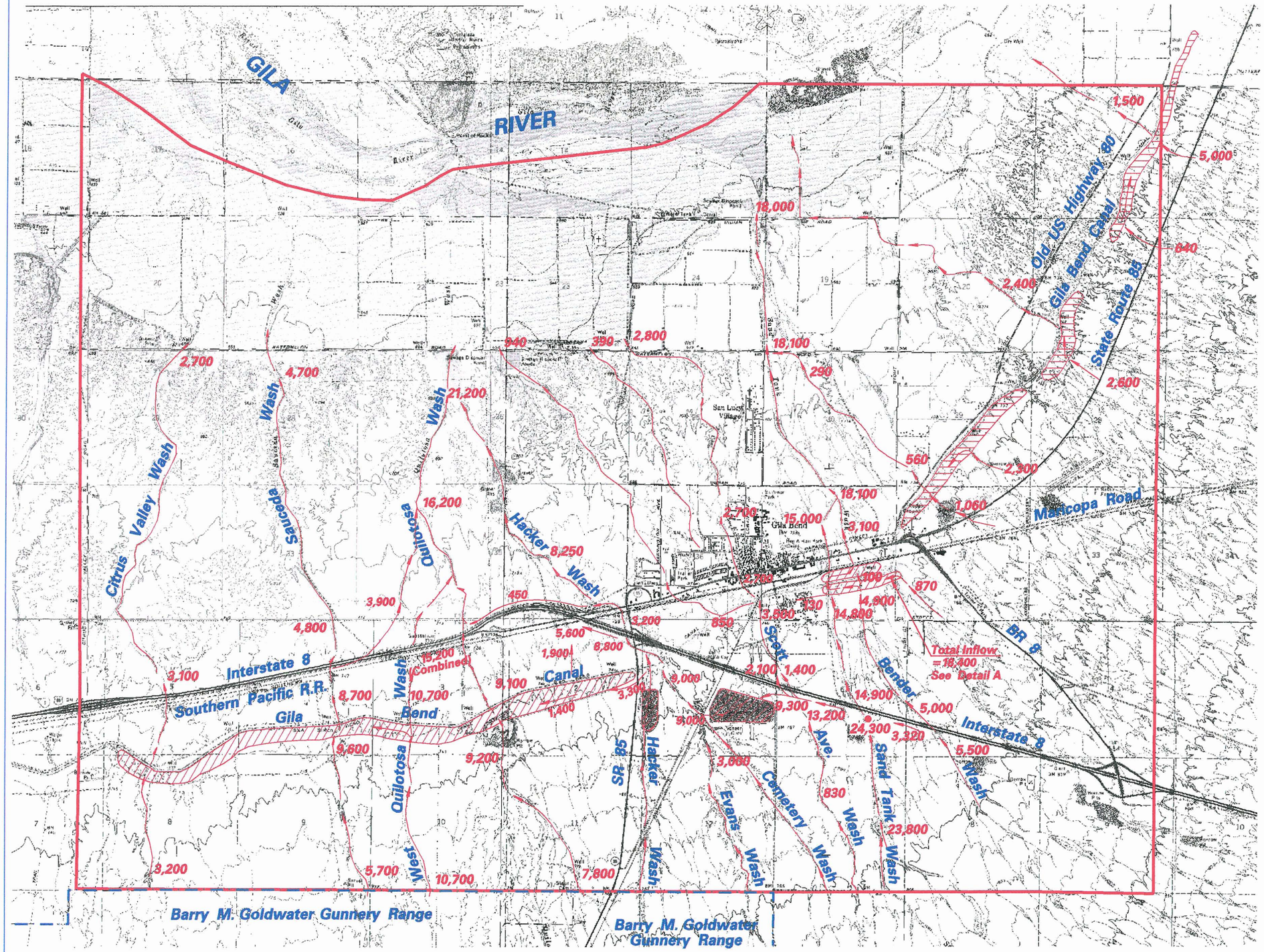
Flooding Source	Identified Flooding Problems
Citrus Valley Wash	• Overtops the Gila Bend Canal • Overtops I-8
Sauceda Wash	• Overtops the Gila Bend Canal • Overtops the Southern Pacific Railroad • Overtops I-8 • Flow diversion to the east at I-8 • Exceeds capacity of man-made channel downstream of I-8
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 man-made 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 man-made 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 man-made 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 25 structures, including apartment buildings, 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 resulting in a split flow with some flow diverting westerly over SR85 and the remainder spilling over the Canal.

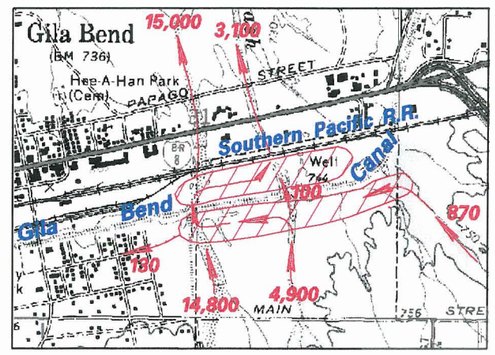
GILA BEND
Area Drainage Master Plan

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

N

0 1000 2000 4000 8000

SCALE: 1" = 4,000'

NOTES:

1. FLOOD FLOWS DOWNSTREAM OF THE GILA BEND CANAL ON CITRUS VALLEY, QUILOTOSA, AND HACKER WASHES ARE BASED ON CONDITION WITH AND WITHOUT THE CANAL; WHICHEVER PRODUCES THE LARGEST PEAK DISCHARGE.
2. 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

GILA RIVER

Old US Highway 80

State Route 85

Maricopa Rd

Citrus Valley Road

Interstate 8

BR 8

Gila Bend Canal

SR 85

San Lucy Village

Gila Bend

133A:
6–16.8'x8'–76' RCBC Qc=6,300
2–12'x8'–77' RCBC Qc=1,500

133B:
9–SPAN (13') WOOD BRIDGE Qc=6,160

135A:
6–10'x8' RCBC Qc=4,440

135B:
3–SPAN (12.5') WOOD BRIDGE Qc=1,950

142A:
1–10'x8' RCBC Qc=510

142B:
1–SPAN(19') WOOD BRIDGE Qc=760

TRAPEZOIDAL CHANNEL
b=40', d=5', z=3:1
Qc=1,800

TRAPEZOIDAL CHANNEL
b=40', d=8', z=2.5:1
Qc=4,900

TRAPEZOIDAL CHANNEL
b=50', d=6', z=2.5:1
Qc=3,800

TRAPEZOIDAL CHANNEL
b=25', d=8', z=2.5:1
Qc=1,200

2–SPAN STEEL BRIDGE
Qc=1,200

3–SPAN CONC. BRIDGE
Qc=1,200

4–SPAN (24.5', 2–30', 24.5')
CONC. BRIDGE – Qc=4,300

4–SPAN (22') CONC. BRIDGE
Qc=4,300

2–10'x8'–45' RCBC
Qc=1,480

2–10'x8'–105' RCBC
Qc=1,480

2–6'x3'–337' CBC
Qc=230

1–6'x3'–71' CBC
Qc=120

1–6'x3'–40' CBC
Qc=120

3–12'x6'–264' CBC
Qc=2,500

3–12'x6'–381' RCBC
Qc=2,500

3–12'x6'–381' RCBC
Qc=2,500

1–SPAN (8', 8')
WOOD BRIDGE
Qc=300

3–SPAN (11.5', 12', 11.5') BRIDGE
Qc=1,170

1–6'x3'–46' CBC
Qc=120

1–60"–30' CMP
Qc=160

1–6'x3'–45' CBC
Qc=120

1–SPAN (8', 8')
WOOD BRIDGE
Qc=300

2–48" CMP's t/t
1–8'x8' RCBC
Qc=395

10.5' Opening
WOOD BRIDGE
Qc=100

5–SPAN (2–13', 3–12.5')
WOOD BRIDGE
Qc=3,100

Conc. Overchute
Qc=12,850

10.5' Opening
CONC. BRIDGE
Qc=120

2–9'x3'–175' CBC
Qc=420

3–SPAN
WOOD BRIDGE

3–SPAN (12.5') BRIDGE
Qc=2,090

Conc. Overchute
Qc=4,075

1–2'x3' CBC

2–36" RCP

3–10'x10'–316' RCBC
Qc=1,900

10.5' Opening
WOOD BRIDGE
Qc=100

1–44"–32' CMP
Qc=80

2–48" CMP's t/t
2–6'x4' RCBC
Qc=380

1–48" CMP t/t
1–6'x4' CBC
Qc=140

2–7' CMP's
Qc=520

1–60",1–54"
& 1–48" CMP
Qc=850

1–30"–45' CMP
Qc=90

3–12'x6'–381' RCBC
Qc=2,500

3–12'x6'–381' RCBC
Qc=2,500

1–78" CMP
Qc=240

1–60" CMP
Qc=135

CONCRETE OVERCHUTE
Qc=4,600

CONCRETE OVERCHUTE
Qc=7,990

2–8'x5'–46' CBC
Qc=630

2–9'x7'–48' CBC
Qc=1,100

8–10'x8'–47' CBC
Qc=4,080

8–10'x6'–47' CBC
Qc=4,080

60"–72" CMP
Qc=135

66"–84" CMP
Qc=165

2–6'x7' 55' CBC
Qc=660

2–9'x6' 46' CBC Qc=920

2–9'x6' 46' CBC Qc=920

2–9'x6' 46' CBC Qc=920

2–9'x6' 46' CBC Qc=920

1–6'x7' 46' CBC Qc=330

1–6'x7' 55' CBC Qc=330

2–6'x4' RCBC
Qc=260

2–6'x6' 46' CBC Qc=460

2–6'x3' 46' CBC Qc=230

2–6'x6' 46' CBC Qc=460

2–6'x5' 54' CBC Qc=460

3–10'x7' RCBC
Qc=1,860

3–SPAN (13') WOOD BRIDGE
Qc=1,250

2–SPAN (13') WOOD BRIDGE
Qc=800

3–30" CMP's t/t
3–6'x4' RCBC
Qc=100

Conc. Overchute
Qc=8,100

4–SPAN (12') BRIDGE

1–6'x4'–237' CBC
Qc=240

2–10'x8'–294' RCBC
Qc=590

3–SPAN (5–13')
WOOD BRIDGE
Qc=4,000

4–SPAN (2–13', 2–13.5', 1–12')
WOOD BRIDGE
Qc=5,400

5–10'x8'–176' RCBC (WB) Qc=3,850
5–10'x8'–176' RCBC (EB) Qc=3,850
7–SPAN(24.5',5–30',24.5')Conc. Br. Qc=12,150
7–SPAN(24.5',5–30',24.5')Conc. Br. Qc=12,150
3–10'x8'–165' RCBC (WB) Qc=1,000
3–10'x8'–165' RCBC (EB) Qc=1,000

5–10'x5'–196' RCBC (WB) Qc=1,850
5–10'x5'–196' RCBC (EB) Qc=1,850
4–10'x5'–196' RCBC (WB) Qc=1,320
4–10'x5'–196' RCBC (EB) Qc=1,320
5–10'x6'–240' RCBC (WB) Qc=2,880
5–10'x6'–240' RCBC (EB) Qc=2,880
3–10'x4'–187' RCBC (WB) Qc=690
3–10'x4'–187' RCBC (EB) Qc=690
3–10'x4'–187' RCBC (WB) Qc=690
3–10'x4'–187' RCBC (EB) Qc=690

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

0 1000 2000 4000 8000

SCALE: 1" = 4,000'

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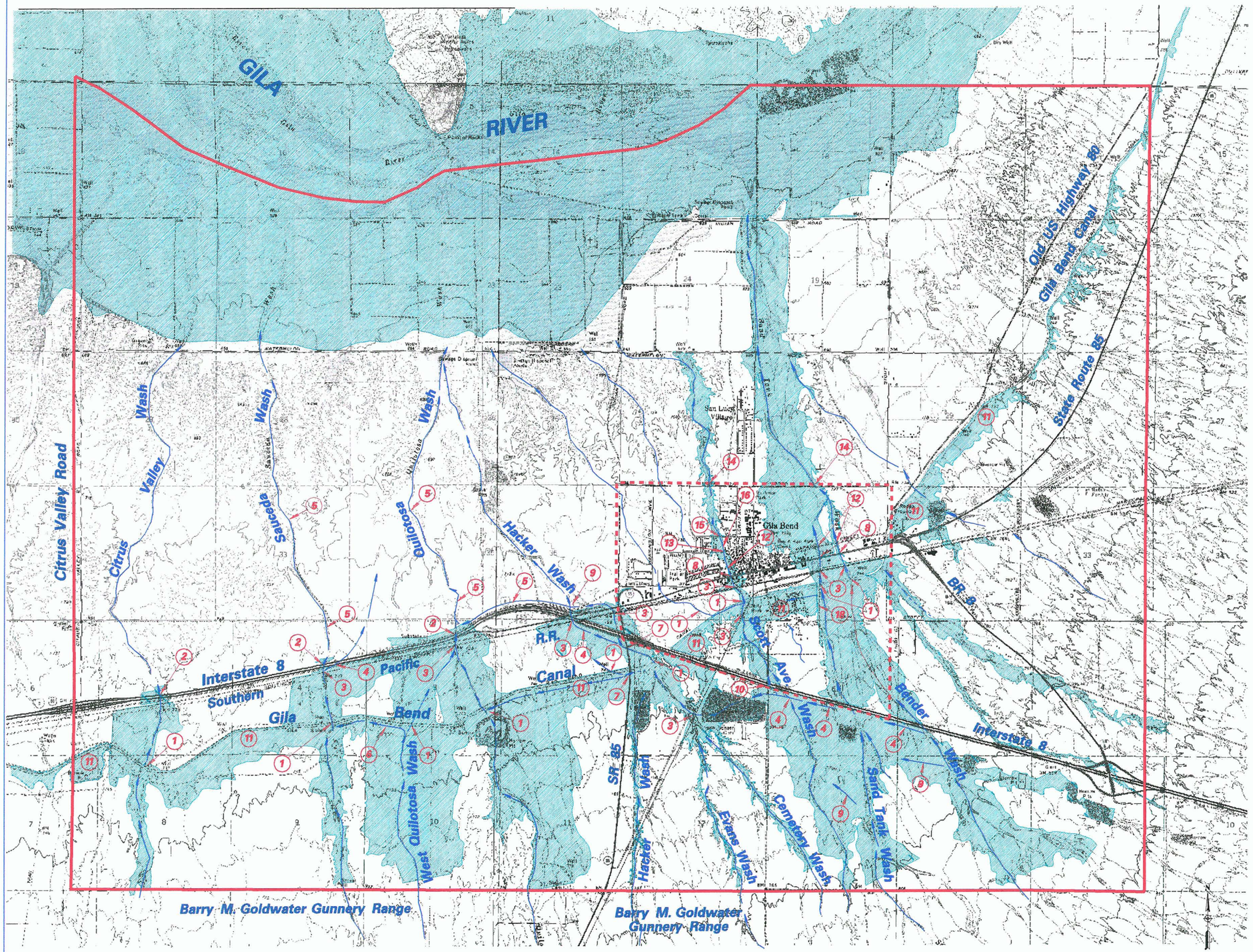

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SCALE: 1" = 4,000'

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

GILA BEND
Area Drainage Master Plan

EXISTING FLOODING PROBLEMS
Exhibit 2.3

LEGEND

- DELINEATED 100-YEAR FLOODPLAIN LIMITS UNDER EXISTING CONDITIONS
- MAJOR RUNOFF AND FLOW DIRECTION
- PLANNING AREA BOUNDARY
- 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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2.5 Flooding Problems – Town Core Area

Exhibit 2-4 presents the known flooding problems within the Town Core Area. Table 2-2 presents the problems identified by the Town officials.

Table 2-2. Problems Identified in Town Core Area

LOCATION	IDENTIFIED FLOODING PROBLEMS
Harrington Avenue Drainage Basin	• Flooding along Harrington Avenue reaching 12-inches deep during larger storms. • Ponded storm water in the alley north of Margaret Street not draining 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 not draining after the rain storms end. • Flooding of homes and yards along the Gila Bend Canal 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

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 the most feasible. This section describes the analysis procedure, the alternatives considered, and the concepts carried forward to Level II and, ultimately, to the recommended design included herein.

3.1 Review Committee/Brainstorming

Two brainstorming sessions were held with the review committee during the Level I Analysis. The committee consisted of representatives from the Town, the District, and the consultant team. The initial session (10/13/99) 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 quantitatively evaluated in the Level I Analysis. The second session (on 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. The evaluation resulted in the alternatives to be carried forward to Level II.

A third committee meeting (on 2/21/01) occurred after the consultant team completed the Level II Analysis. At this meeting, the committee accepted the plan recommended with the Level II Analysis and asked the consultant team to carry it forward to the final recommended plan, including preliminary design plans.

3.2 Public Participation

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

A second public meeting was held on May 11, 2000 at a regular Town Council meeting. The project team described the Level II flood control alternatives and asked the Council and the Town residents to complete a public comment sheet 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 did not 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 ensure that the proposed channel, along the Canal in the South Gila Bend area, be large enough to prevent flooding.

The comment sheet also asked the residents to suggest names for the unnamed washes. Based on comments from the public, the following names were given:

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

A third public meeting was held on the evening of June 12, 2001, also at a regular Town Council meeting. The purpose of this meeting was twofold: to present the new floodplain delineation, prepared as part of the ADMP, and to present the final recommended plan. The only questions raised during the meeting relative to the recommended ADMP, were brought forward by Town Council members. Their questions related to the costs associated with constructing various elements of the Sand Tank Wash flood control improvements and the proposed channel in the South Gila Bend watershed.

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, resulting 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 are no homes or buildings in the West Planning Area; therefore, the problems outlined above only impact the Canal, the Highway, the railroad, and the agricultural areas. It is envisioned that the West Area flood control improvements will be constructed during future land development projects. The purpose of the ADMP for 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 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 man-made 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 natural 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 least expensive and does not require cross drainage improvements to the Gila Bend Canal, the Southern Pacific Railroad, or I-8. Table 3-1 presents the evaluation matrix developed during the Level II brainstorming session.

3.4 East Planning Area – Alternative Selection

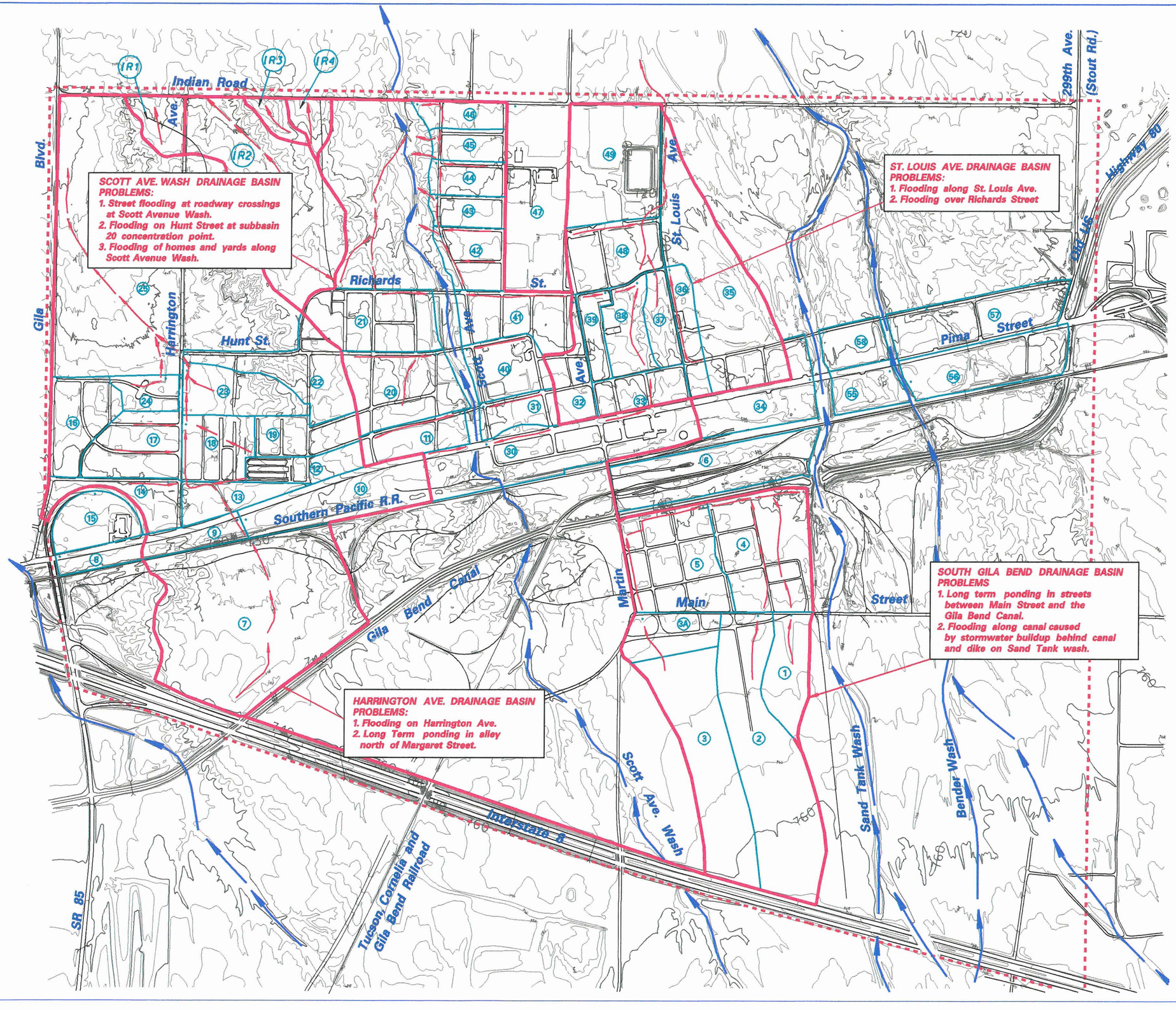
Flooding Problems

The primary flooding source in the East Planning Area are the unconfined flows on Sand Tank Wash that tend to commingle with flows on Bender Wash and Scott Avenue Wash. Upstream of I-8, the 100-year flood flows overland in a westerly direction 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--FRS upstream of I-8 (taller version); and Alternative 5--FRS upstream of I-8 (lower version). Refer to the Level I report for detailed descriptions, cost estimates, and exhibits for each alternative.



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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Selected Alternatives

The concept flood control plans selected for further study included Alternatives 3 and 5. Alternative 3 is an "offline" detention basin, on the upstream side of I-8 that stores the diverted flow and eliminates flows into Scott Avenue Wash. Although this alternative solves the flooding problem along Scott Avenue Wash and eliminates the diverted flow to Hacker Wash, it does not 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 FRS was designed to reduce the outflow down to the capacity of the railroad and highway cross drainage 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 for further study because it was the least expensive solution to flooding along Scott Avenue Wash. With its 270-acre basin, it also offers a wide range of multi-use options. Alternative 5 was also chosen for further study 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 3-1. West Planning Area Evaluation Matrix

Alternative No.	Description	Advantages	Disadvantages	Retain
1	Increased Conveyance	Enhances existing channel conditions; lower maintenance; contains and 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 of 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; channel along I-8 creates buffer to development.	Impact to Waters of the U.S.; changes some existing flow paths; adds flow to Quilotosa Wash; overtopping of Canal, I-8, and R/R.	NO
4	Same as #3 but with Preserving overflow Drainage pattern on Hacker Wash	Same as No. 3 and preserves riparian habitats 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 Quilotosa Wash; overtopping of Canal, I-8 and R/R.	YES

Table 3-2. East Planning Area Evaluation Matrix

Alternative No.	Description	Advantages	Disadvantages	Retain
1	Increased Conveyance	No diversion at I-8; linear park through town; eliminates overtopping of BR-8 and R/R; reduces Harrington Ave. Flooding; eliminates South Gila Bend Floodplain; and reduces flow over SR-85 at Gila Bend Canal	Increased downstream flow; substantial 404 impact; increased liability; high cost; includes major structural improvements; may have environmental permit problems; and requires ADOT and R/R improvements	NO
2	Detention Basins	Reduces flow on Sand Tank Wash; provides 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. Wash and flooding to Harrington, removes South Gila Bend from floodplain, improved "proportionate" recreation area, provides gravel/borrow sources, 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; and unknown cost to purchase flow paths for PMF spillways.	YES
6	Upper watershed multiple dams or stock ponds	Distributes 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 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. Local runoff flows across Main Street into the developed part of the watershed and collects along the elevated embankment of the Gila Bend Canal, ultimately concentrating behind the levee on Sand Tank Wash, along the upstream side of the Canal, and discharging through a 36-inch pipe into Sand Tank Wash. The concentration of runoff at the Sand Tank Wash levee results in ponded water that floods homes and yards lying along the Canal. In addition, the streets do not drain well, resulting in ponded storm water standing 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, a 10-year design concept, chosen because it helps prevent the flooding of homes adjacent to the Gila Bend Canal, is relatively inexpensive, and is consistent with the Town 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, to convey runoff to a new detention basin located at the intersection of the Canal and the Sand Tank Wash levee. To solve the storm water ponding problems, the streets will be repaved in the South Gila Bend area, based upon the Town 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. Storm water runoff originates on the undeveloped land that lies upstream of the railroad, ponds up behind the railroad, discharges through a culvert under the railroad, and continues 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, causing 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-ft x 6-ft 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 plan 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 into 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 do not drain well, do not 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 (see Exhibit 4-1)

The ADMP 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 ensure that future development occurs without adversely impacting existing 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 are not done. These flood risk include unconfined weir flow over I-8, undersized man-made 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 man-made channels on Citrus Valley Wash, Sauceda Wash, West Quilotosa Wash, and Quilotosa Wash and 3) construction of an overflow channel for Hacker Wash.

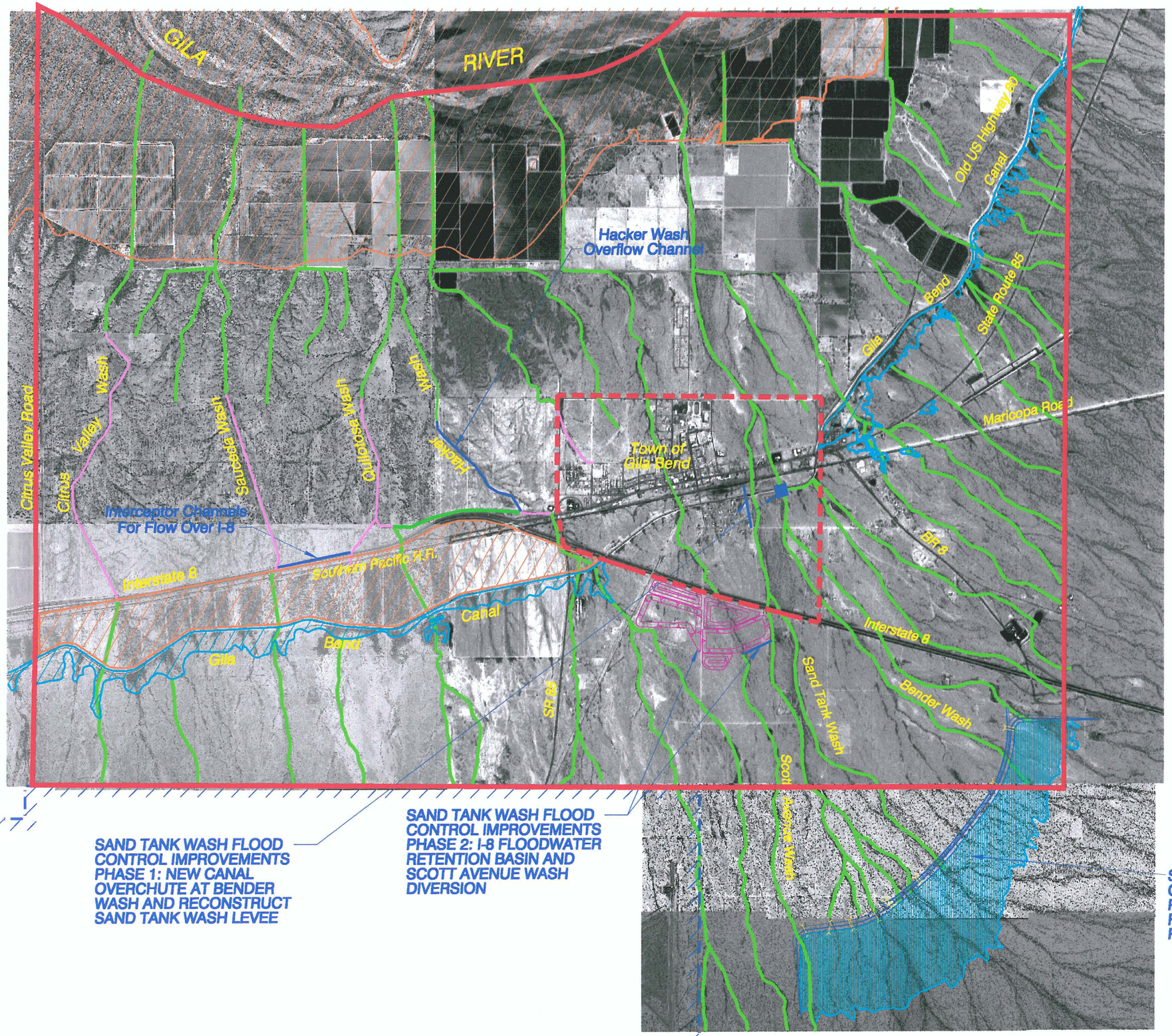
The most prominent feature of the ADMP is the Sand Tank Wash flood control improvements which consists of publicly funded, flood control improvements to protect existing homes and businesses that are subject to flooding from Sand Tank Wash. The improvements are phased and include Phase 1--reconstruction 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 retention basin upstream of I-8; and Phase 3--an upstream floodwater detention facility.

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.



SAND TANK WASH FLOOD CONTROL IMPROVEMENTS PHASE 1: NEW CANAL OVERCHUTE AT BENDER WASH AND RECONSTRUCT SAND TANK WASH LEVEE

SAND TANK WASH FLOOD CONTROL IMPROVEMENTS PHASE 2: I-8 FLOODWATER RETENTION BASIN AND SCOTT AVENUE WASH DIVERSION

SAND TANK WASH FLOOD CONTROL IMPROVEMENTS PHASE 3 (OPTIONAL): FLOODWATER DETENTION FACILITY

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

GILA BEND
Area Drainage Master Plan

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 1000 2000 4000 8000

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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 residents have expressed a desire to preserve the natural washes. In addition, preserving the washes avoids having to obtain a 404 permit from the US Army Corps of Engineers (USACE).

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. To make that determination the following rules (based on the unofficial guidelines employed by the USACE to delineate jurisdictional waters relative to 404 permit requirements) are proposed:

1. If the wash appears as a green line on Exhibit 4-1.
2. If the wash originates upstream of the property to be developed and has a sandy bottom width of 5 ft or greater.
3. If the wash originates upstream of the property to be developed, is incised with banks of 2 ft or greater, and has a sandy bottom width of 3 ft or more.
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 should be made clear that these rules do not relieve the developer from obtaining a 404 permit from the USACE. Washes that do not 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 does not 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 (see Exhibit 4-2)

Another determination 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. 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 1-ft 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 ft.

4.2.2 Provide Storm Water Detention/Retention with New Development

It is important to provide storm water retention with new development; otherwise the cumulative effects of increased runoff due to the impervious surfaces, introduced with development, will increase flood risks to downstream property owners. In addition, the detention/retention basins provide a means of filtering out pollutants 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 1 ft, 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 0.50 inches of runoff (rainfall excess) from the entire site that the basin is servicing. The maximum depth of the low water pool shall be 1 ft.
5. Maximum side slopes for the basins shall be 4H:1V.
6. Maximum water depth in the basins shall be 4 ft in the center and 3 ft 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, creating a potential for overtopping in numerous locations. Once the Canal is overtopped, the area downstream is subject to severe flooding. Furthermore, there is considerable uncertainty associated with the location of the overtopping, making 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 USACE purchased flood easements that cover the impoundment up to the spillway elevation (661). The flood of 1993, however, overtopped the spillway, causing inundation outside the flood easement and flooding the Town's sewage lagoons. The water surface elevation over the spillway was approximately 667. The spillway is actually designed to pass 620,000 cfs at an elevation of 699. But this design is intended to protect the dam from an extreme, rare event. The 1993 flood was also a rare event, far exceeding the 100-year flood. Nonetheless, it did occur, therefore it is advised that the Town discourage development and maintain as open space/agriculture land, those lands below a flood elevation of 670 (1993 flood elevation rounded up to the nearest 10-ft level). (Exhibit 4-13 in Section 4, depicts the area subject to inundation from Painted Rock Dam.)

4.2.4 Preserve Floodwater Storage behind Gila Bend Canal

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

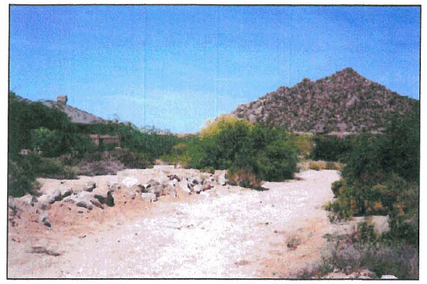
4.3 Developer-Built Elements of the ADMP (West Planning Area)

The west side of the planning area is largely composed of the planned Citrus Valley land development project; an area subject to flood hazards associated with inadequate conveyance capacity and overtopping of the Gila Bend Canal, the Railroad, and I-8. In addition, the man-made channels through the agricultural area north of I-8 do not have the capacity to convey a 100-year flood. A number of alternatives for solving these flooding problems were investigated in the Level I analysis. The alternative selected for further study, Alternative 4, includes an interceptor channel on the downstream side of I-8, along with improvement of the man-made channels from I-8 to the Gila River. These improvements are required to protect future development from flooding. There are no homes or businesses currently in the area, therefore, the developers will be responsible for construction of flood control improvements prior to developing areas downstream of I-8.

4.3.1 I-8 Interceptor Channel

The interceptor channel, which contains contain flood flows on Sauceda Wash that overtop the railroad and I-8. is located on the downstream side of I-8, between Sauceda and Quilotosa Washes. 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 does not 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.

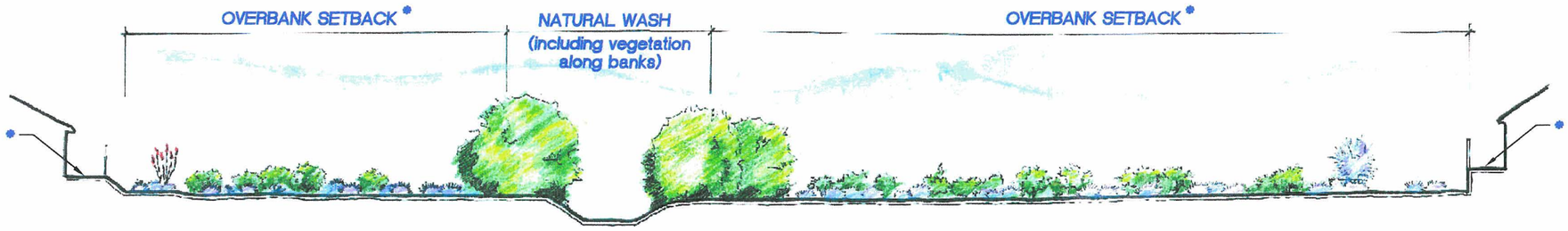
In the case of Sauceda Wash, however, the overtopping flow is not confined in a sag vertical curve. Instead, there is a continuous roadway grade downhill, to the east, toward Quilotosa Wash. Flood flows that exceed the capacity of the Sauceda Wash bridges, at the railroad and I-8, are diverted easterly along the railroad and highway embankments. The 100-year diverted flow is 3900 cfs, which overtops the highway and the railroad. 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. See Exhibit 4-1 for the extent of the interceptor channel and Exhibit 4-3 for a typical cross section of the channel. Also refer to the concept channel plan at the back of this report.



GILA BEND
Area Drainage Master Plan

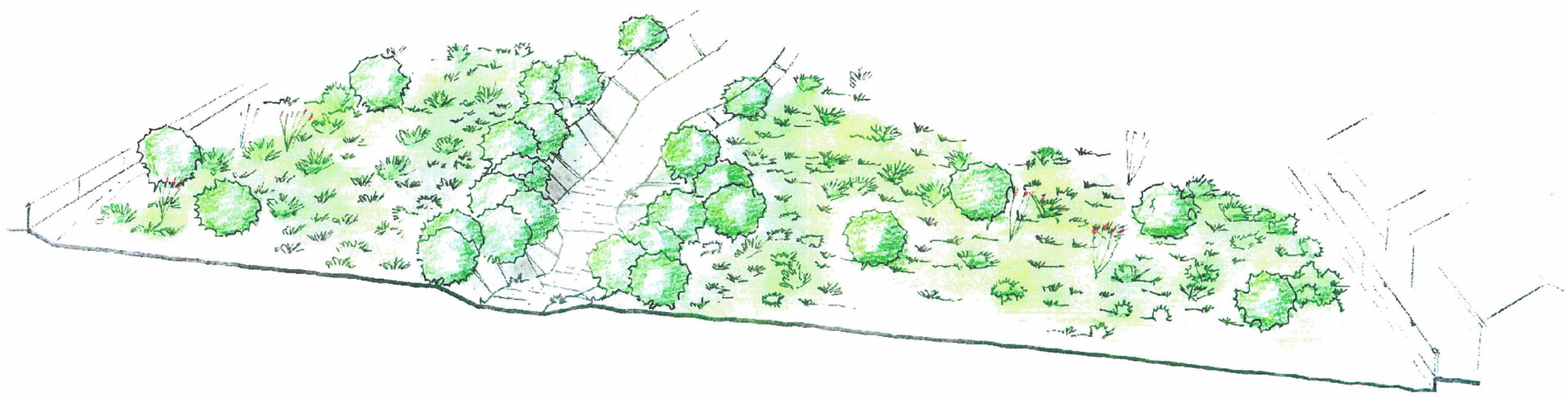
PRESERVATION OF NATURAL WASH
(PROVIDES FLOODWATER CONVEYANCE & PRESERVES HABITAT)

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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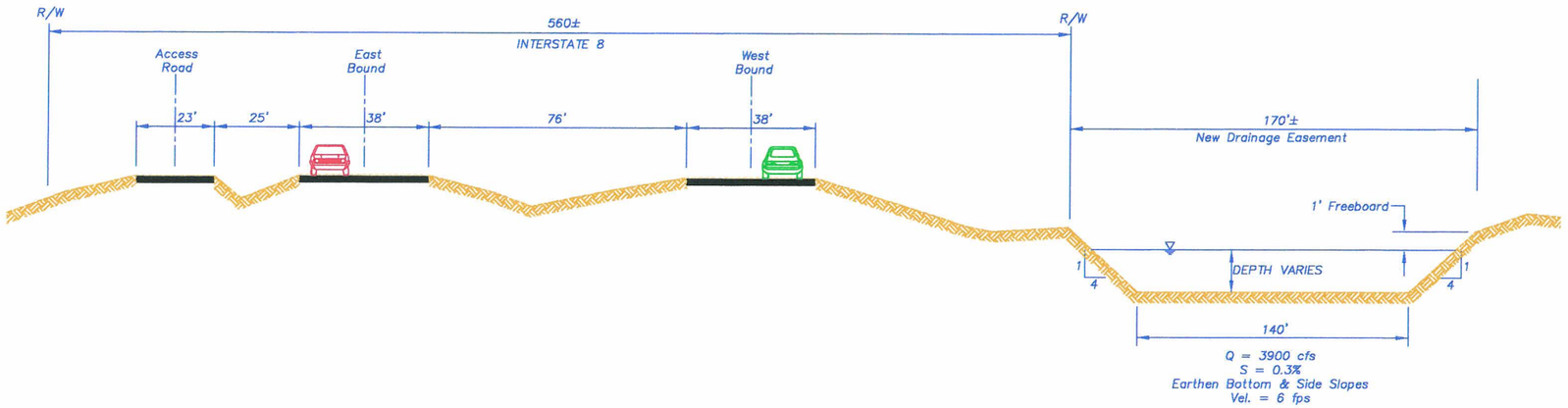
GILA BEND
Area Drainage Master Plan

I-8 INTERCEPTOR CHANNEL
EXHIBIT 4.3



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4.3.2 Improve Existing Man-made Channels

The existing washes north of I-8 consist of man-made channels, amid graded agricultural land, that do not have adequate capacity for 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 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 District.

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: a constructed natural channel, a modified natural channel, and a park-like channel. Which type is 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. These three channels are described below. Technical appendices E, F, and G contain hydraulic calculations for the modified natural type channel on Citrus Valley Wash, Sauceda Wash, and Quilotosa Wash. In addition, concept plans for the improvement of these channels are provided at the back of this report.

Constructed Natural Channel (see Exhibit 4-4)

The natural cross sections consist of a benched, or single-tiered, configuration intended to replicate the geometry of the existing channels upstream of the Gila Bend Canal. 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

The Hacker Wash flood problem is a special problem associated with the inadequate conveyance capacity of the man-made channel north of I-8. At the I-8/SR 85 traffic interchange there is an existing man-made channel, running parallel to the I-8 frontage road, constructed to divert flow from Hacker Wash where it passes under the frontage road to Quilotosa Wash. This channel is constructed with very little longitudinal slope, and as such, has little hydraulic capacity and is 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 8700 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; concept plans for the channel improvements are provided at the back of this report. 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 and 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 are not be disturbed, but the hydraulic capacity of the channel would increase sufficiently to carry the 100-year flow of 8700 cfs. This widening is proposed for a length of 2,400 ft downstream from the Pima Street bridge crossing. Near the downstream end of the widening, a 510-ft-long notch is proposed in the north bank of the channel to allow flow in excess of 450 cfs to spill into the adjacent land in Section 35. The proposed development in this section 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 8-ft x 4-ft concrete box culvert, with a capacity of 450 cfs., is proposed in the diversion channel at the downstream end of the spillway notch. Although the box culvert structure is needed primarily for hydraulic reasons, it could also serve as an access road, across the channel, onto 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: an offline detention basin, just upstream of I-8, and an upstream online detention facility. These two alternatives are not directly comparable as 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 does not 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, was estimated to cost about three times as much: $15 million for the offline basin compared with $45 million for the upstream, inline facility. Because they do not 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. Phase 1 includes downstream improvements to the Sand Tank Wash levee and a new overchute on the Gila Bend Canal; Phase 2 is the offline detention basin at I-8; and Phase 3 is the upstream detention facility. Phasing the alternatives provided a number of benefits: 1) the offline basin (Phase 2) provides considerable benefit on its own, eliminating much of the floodplain area within the Town, at much smaller cost; 2) the spoil from the excavation of the offline basin (Phase 2) can be used to construct the upstream impoundment structure (Phase 3), and 3) 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 for much deeper basins. The disadvantage is that if a flood occurs, floodwater will stand in the basin for long periods of time. 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 than the 100-year flood out of their natural drainage pattern. Positioning them at the major washes preserves the natural drainage pattern floods in excess of the 100-year flood, which eliminates the need for flowage easements.

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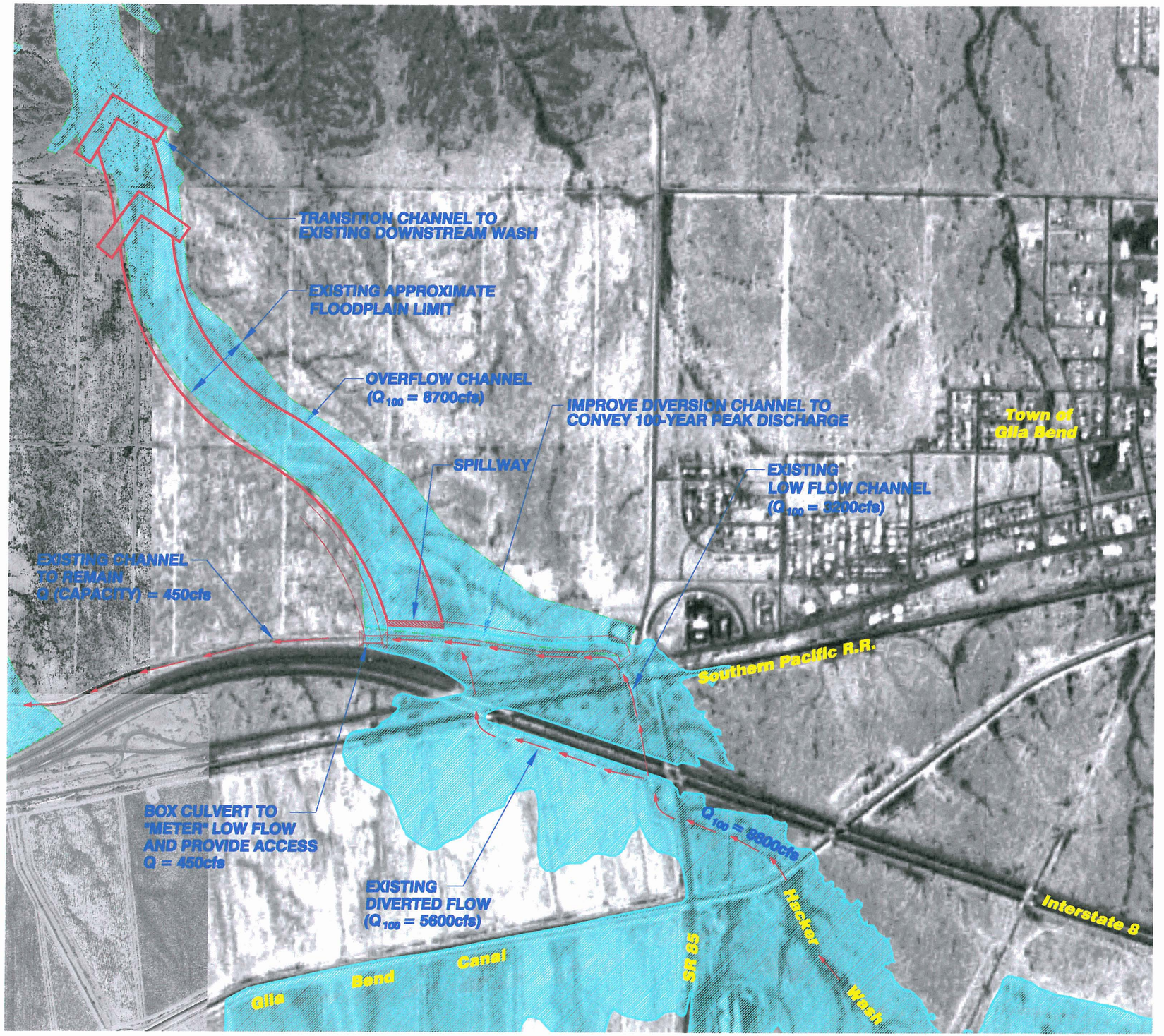
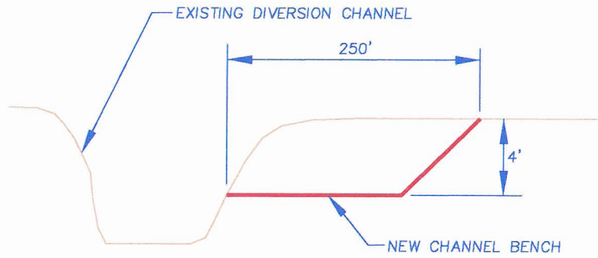


GILA BEND
Area Drainage Master Plan

HACKER WASH OVERFLOW CHANNEL
EXHIBIT 4.7



IMPROVED DIVERSION CHANNEL
TYPICAL SECTION

LEGEND

←	FLOW DIRECTION
▨	EXISTING 100-YEAR FLOODPLAIN
Q_{100} = 8800cfs	100 YEAR PEAK DISCHARGE IN cfs

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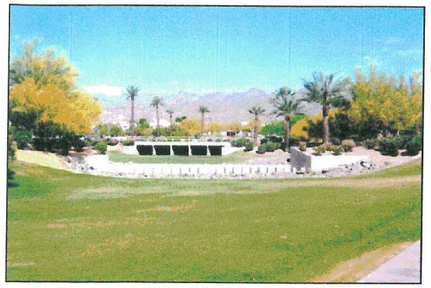
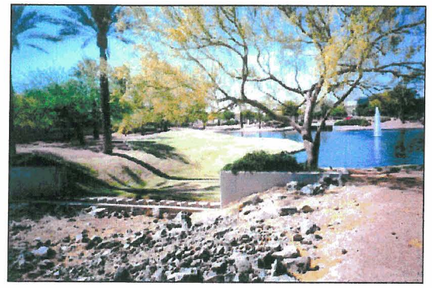
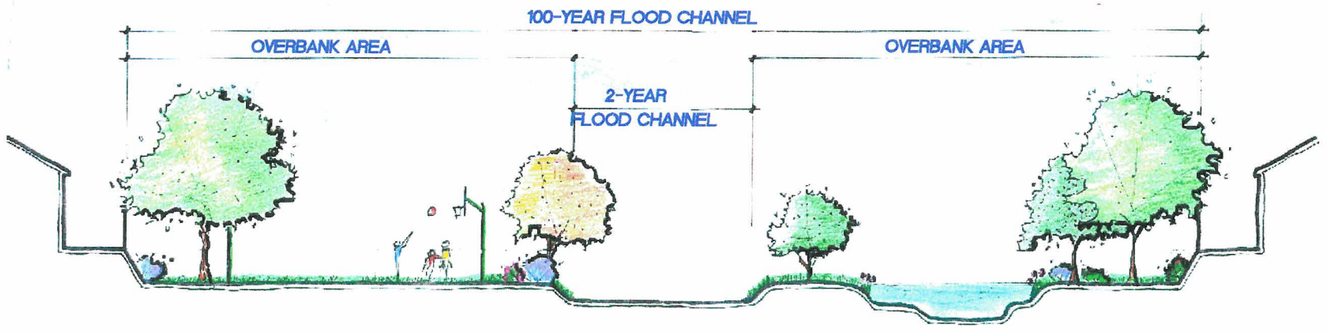
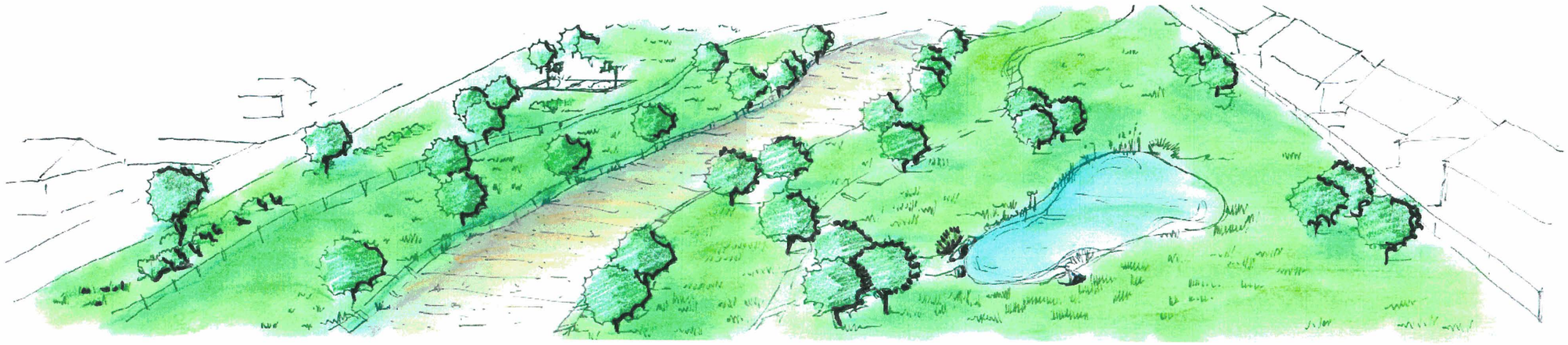




GILA BEND
Area Drainage Master Plan

PARK-LIKE WASH
EXHIBIT 4.6





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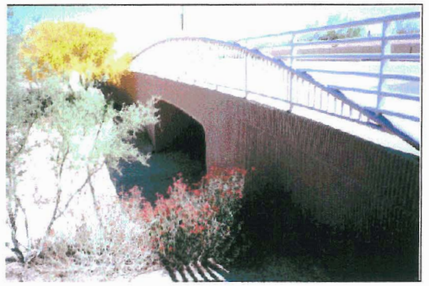
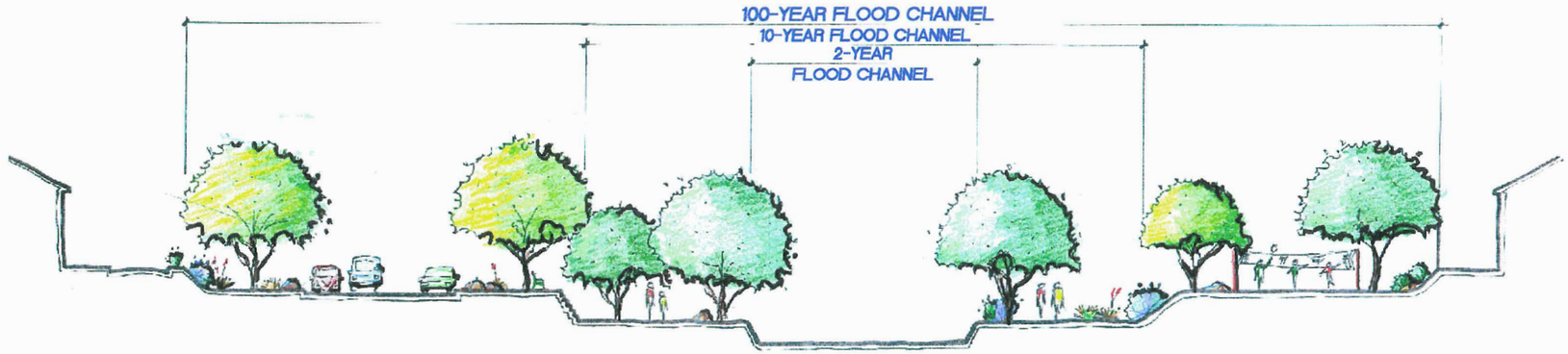
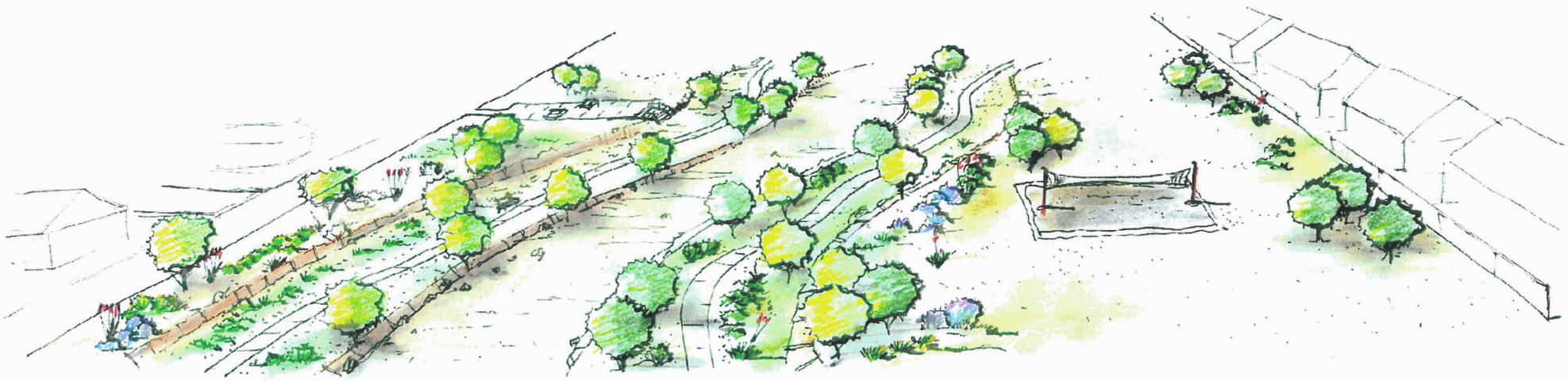


FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

GILA BEND
Area Drainage Master Plan

MODIFIED NATURAL WASH
EXHIBIT 4.5





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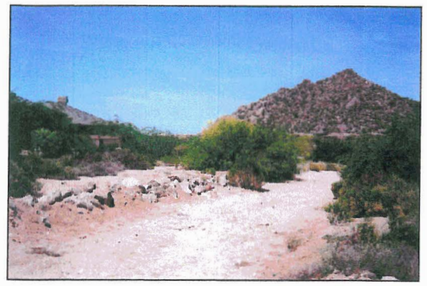
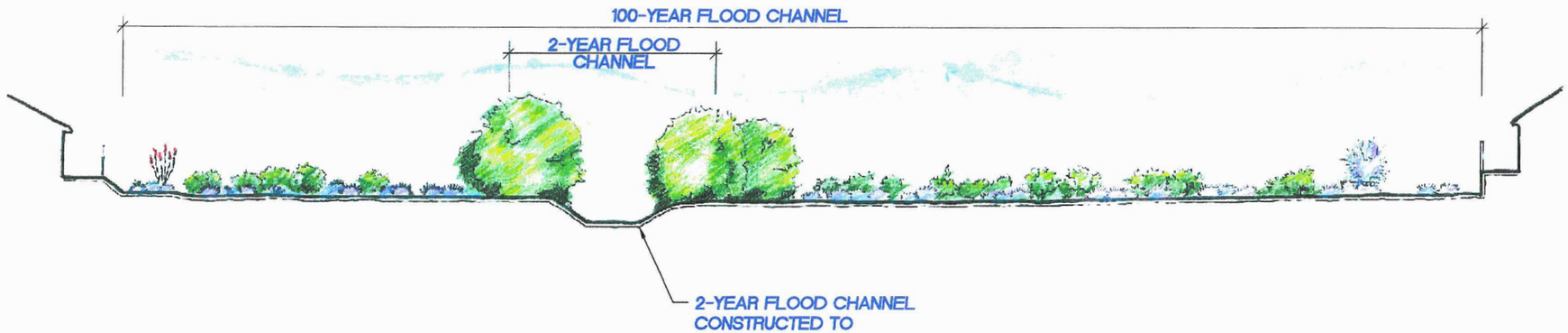
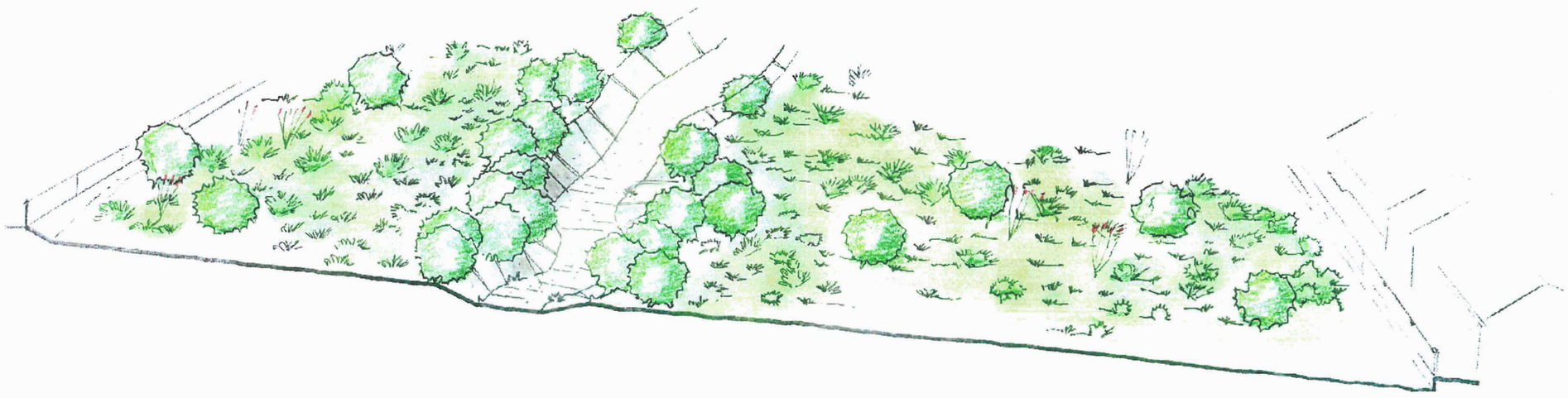


GILA BEND
Area Drainage Master Plan

RECONSTRUCT NATURAL WASH

EXHIBIT 4.4





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4.4.1 Phase 1: Reconstruct Levee and New Canal Overchute

Elements of Phase 1 (see Exhibit 4-8 and enclosed concept plans)

- Reconstruct Sand Tank Wash Levee – Improve existing levee on Sand Tank Wash to meet FEMA standards.
- Bender Wash Canal Overchute – Replace the existing three 30-inch culverts with an 80-ft wide concrete overchute.

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

Levee Reconstruction	$ 275,000
Bender Wash Overchute Construction	223,000
Land Acquisition (Levee)	6,000
Engineering Costs	50,000
Construction Administration Costs	75,000
Contingency (@ 20%)	125,000
Total Costs	*$754,000*

Description of Phase 1 (see Appendix K for Hydraulic Design Calculations)

Levee design: The existing Sand Tank Wash levee, upstream of the Gila Bend Canal, was not 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 3 ft 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 some reconstruction of the main street to help contain the 100-year flood.

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. It then combines with flow from Sand Tank Wash for a combined peak discharge of 18,300 cfs. Under current conditions, there are only three 30-inch culverts under the canal at Bender Wash with a flow capacity of about 100 cfs. Therefore, almost all of the Bender Wash flow is diverted to the existing Sand Tank Wash overchute; approximately 1,200 ft to the west. But then downstream of the canal, flow 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 from Bender Wash to Sand Tank Wash overtaxes the Sand Tank Wash overchute and presents an erosion hazard to the canal embankment.

To improve flow conditions at the canal, the Phase 1 improvements include a new 80-ft wide canal overchute at Bender Wash which is designed to pass about 6,800 cfs. The work will include a new Canal siphon. This will require excavation of the existing Canal, installation of a double 96-inch pipe to siphon the Canal water, installation of new concrete headwalls on either end of the pipes, and reconstruction of the Canal at each end of the new Canal siphon.

Need for Investigation of Downstream Impacts: Prior to the design and construction of the Bender Wash overchute, an evaluation of the floodwater impacts to downstream properties should be conducted to obtain acceptance from property owners along Bender Wash from the Canal downstream about 3,000 ft. to the confluence with Sand Tank Wash. Currently only about 200 cfs can pass through the Canal's three 30-inch culverts at Bender Wash. The overchute addition will dramatically increase that conveyance capacity to about 6,800 cfs. In terms of the 100-year flood, the overchute will improve downstream conditions as it will prevent the Canal overtopping that occurs under current conditions. However, during smaller, more frequent floods, that do not currently overtop the Canal, Bender Wash will experience significantly greater flows. It is this increase in flow rate for the more frequent flooding events that property owners between the Canal and the Sand Tank Wash confluence will need to accept. The Town and/or the District should secure the downstream property owners' acceptance prior to the construction of the new overchute.

4.4.2 Phase 2: I-8 Floodwater Retention Basin

Elements of Phase 2 (see Exhibit 4-9 and enclosed concept plans)

- Floodwater Retention Basin (East Basin) – 1,500 ac-ft retention basin between Sand Tank Wash and Martin Avenue.
- Floodwater Retention Basin (West Basin) – Enlarge existing borrow pit, west of Martin Avenue, to contain 1,200 ac-ft.
- 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 (see Appendix C for itemized cost estimate).

Retention Basin Excavation	$7,485,000
Inflow Spillway	468,000
Overflow Spillway	511,000
Scott Avenue Wash Diversion/Return	118,000
Revegetation (seed, mulch & temp. irrig.)	675,000
Land Acquisition	540,000
Flood Easement Acquisition	622,000
Engineering Costs	500,000
Construction Administration	750,000
Contingency	1,167,000
Total (Phase 2)	*$12,836,000*

Description of Phase 2

Phase 2 is a 2,700 ac-ft, offline floodwater retention 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 (see Appendix L 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 2,700 ac-ft; 1,500 ac-ft in the east basin and 1,200 ac-ft 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.

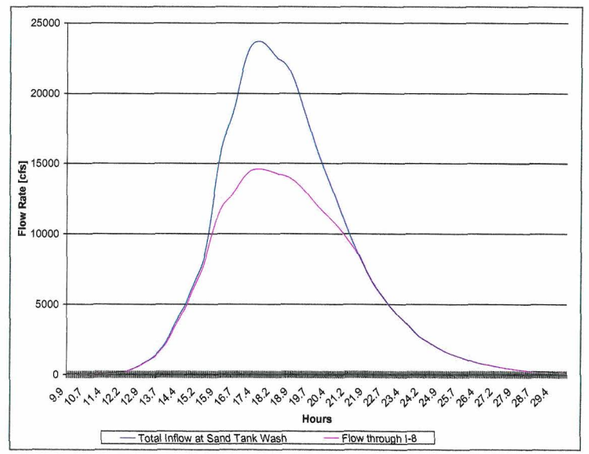
The following list summarizes the physical and hydrologic features of the floodwater basin.

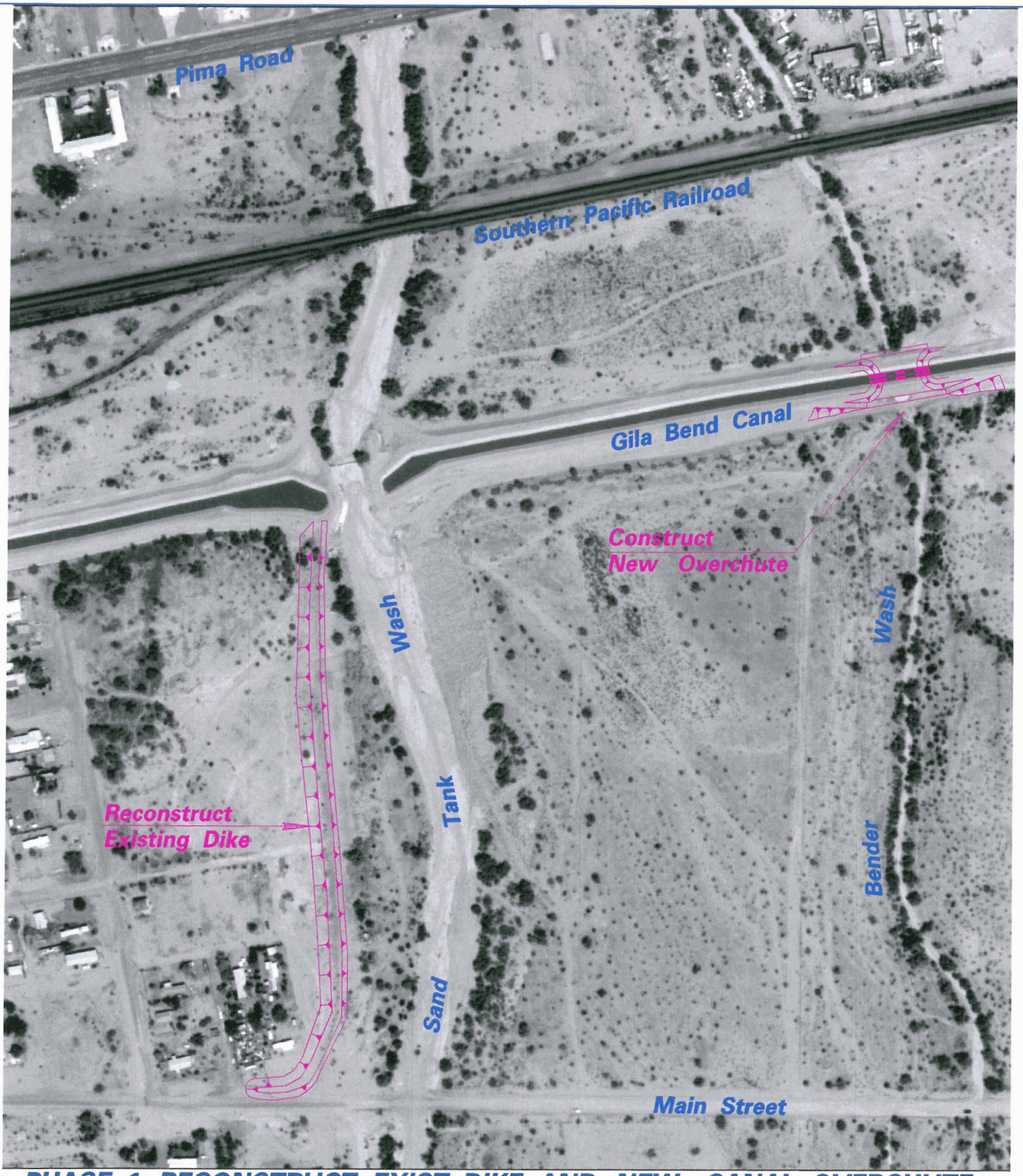
Design Data

Design Flood:	100-yr, 24-hr
Basin Volume (total):	2,720 ac-ft
West Basin Volume:	1,220 ac-ft
East Basin Volume:	1,500 ac-ft
Sand Tank Wash 100-year Peak Discharge:	24,500 cfs
Sand Tank Wash Flowby at Spillway Crest Elevation:	9,000 cfs
100-year Peak Inflow to Basin:	9,200 cfs
Reduced 100-year Peak Discharge on Sand Tank Wash (through I-8):	15,300 cfs
Sand Tank Wash Flowline Elevation:	760 ft
Spillway Crest Elevation:	768.5 ft
100-year Water Surface Elevation:	771 ft

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.

Figure 4-1. Reduction in Sand Tank Wash Flood Hydrograph by Phase 2 Floodwater Basin





PHASE 1: RECONSTRUCT EXIST. DIKE AND NEW CANAL OVERCHUTE

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

Phase 2:
I–8 Floodwater Retention Basin

LOCATION MAP

eac
Engineering and Environmental Consultants, Inc.
3003 N. Central Avenue, Suite 600
Phoenix, Arizona 85012-2905
TEL(602)248-1702 FAX(602)248-7851

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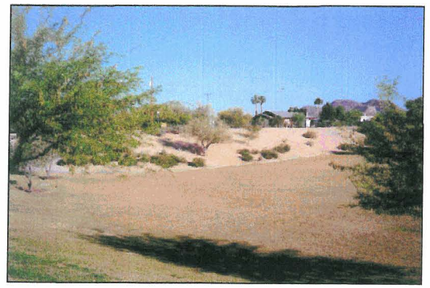
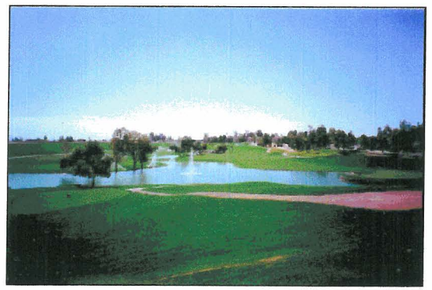
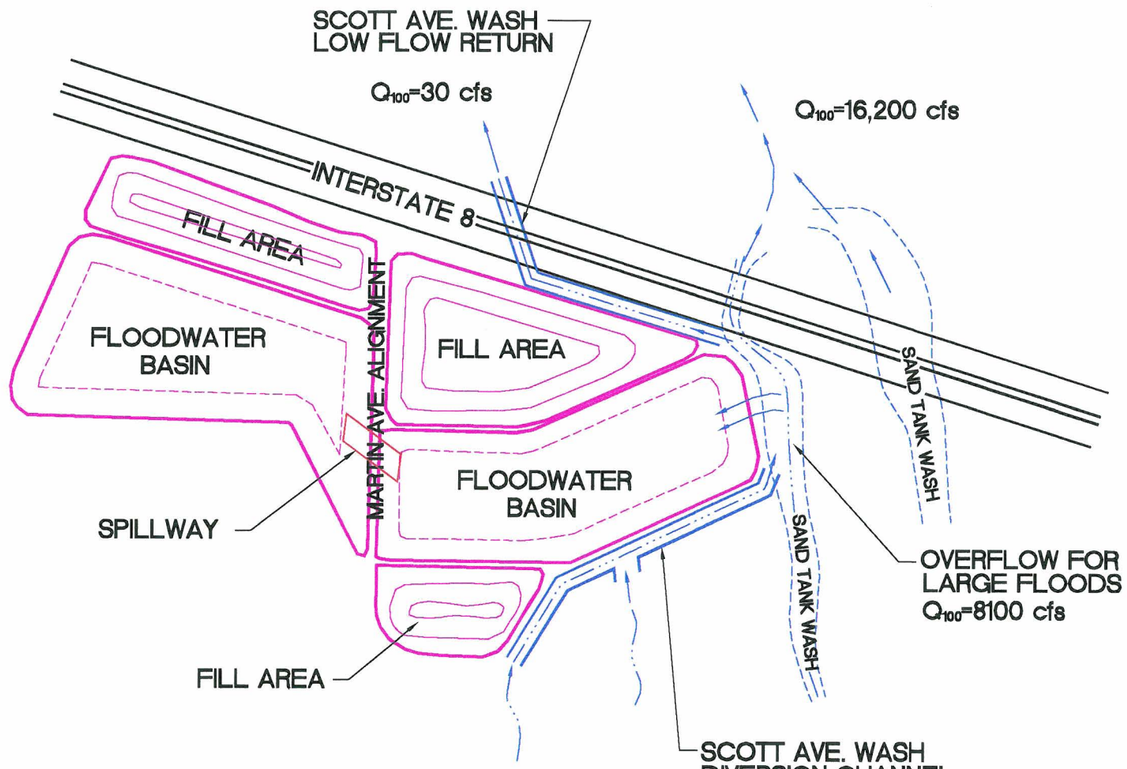
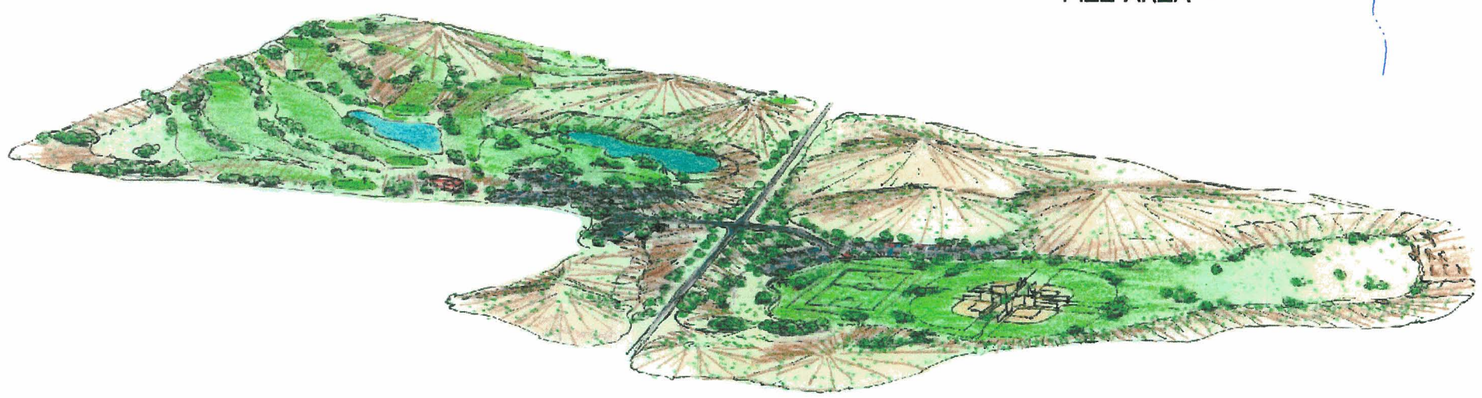




GILA BEND
Area Drainage Master Plan

SAND TANK WASH FLOOD CONTROL IMPROVEMENTS (PHASE 2) EXHIBIT 4.9





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2/01

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Floodplain Reduction (see 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 Canal. This floodplain covers a large part of the south Gila Bend area. Phase 2, combined with implementation of the Drainage Plan for the South Gila Bend Watershed (see Section 5.4.1) will eliminate the floodplain behind the Canal. In addition, Phase 2 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, this ADMP determined 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 to about 8,300 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 is 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 is 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 is no 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 showed 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 (see Exhibit 4-11 and enclosed concept plans)

- Upstream Detention Facility – 5,700 ac-ft 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 (see Appendix C for itemized cost estimate)

Excavation/Fill	$6,444,000
Sand Filter and Toe Drains	3,080,000
Spillways	630,000
Culverts	1,041,000
Reconstruct I-8 Basin Spillway	207,000
Revegetation (seed, mulch & temp. irrig.)	250,000
Land Acquisition	3,056,000
Engineering	1,000,000
Construction Administration	1,500,000
Contingency	3,441,000
Total (Phase 3)	*$20,650,000*

Description of Phase 3 (see Exhibit 4-11 and enclosed concept plans)

Phase 3 is a 5,700 ac-ft 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 ft 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 (see Appendices M and N for the hydrologic calculations)

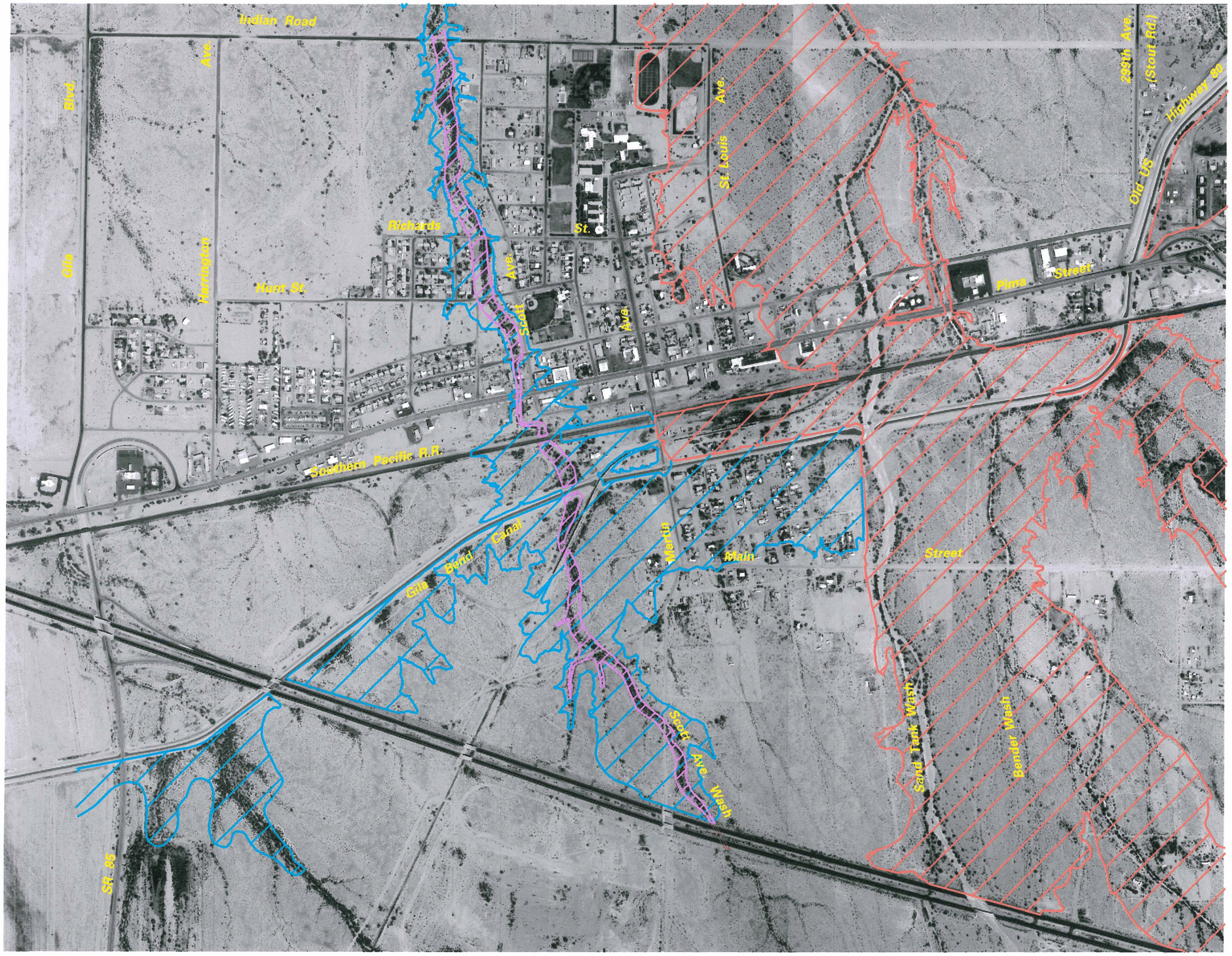
Phase 3 is an upstream flood retarding structure (FRS) across Sand Tank and Bender Washes. The goal of the FRS is to reduce flows in Sand Tank and Bender Washes sufficiently so that the capacities of the Pima Street bridge structures over the washes are not exceeded. The capacity of those structures was estimated at 8,500 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 FRS is an earthen structure, approximately 24-ft high. The downstream side slopes (visible from Town) were assumed to vary from 4:1 to 10:1 in order to increase aesthetic appeal and reduce the "engineered" look. The FRS would actually serve to detain only large floods. It would have 13 outlet structures ranging in size from six 10-ft x 6-ft concrete box culverts down to two 36-inch reinforced concrete pipes. The peak stage for the 100-year event is 15.6 ft 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, so that the relative amount of flooding in each wash downstream of the FRS 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 FRS with short-duration ponding upstream of the FRS. In the 100-year or larger event, ponding depths would be 16 ft 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 FRS 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 FRS 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 FRS) would vary according to the amount of discharge each is designed for, but the spillway elevation for each would be 16.6 ft above the upstream toe of the FRS. The spillway elevation was set 1 ft 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 ft, and allowing 4 ft of freeboard per ADWR requirements, the height from each spillway crest to the top of the FRS would be 7.4 ft.



FLOOD CONTROL DISTRICT MARICOPA COUNTY

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

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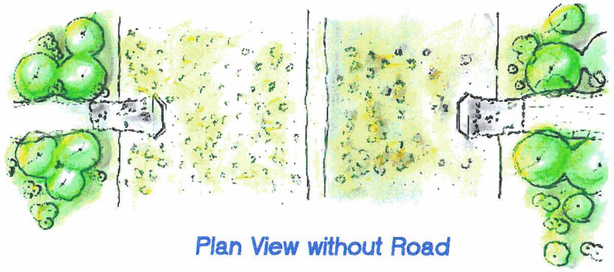
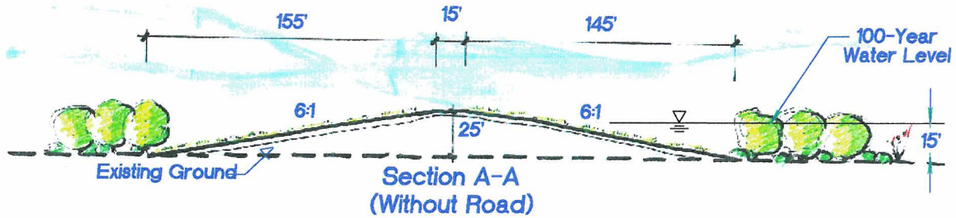
GILA BEND
Area Drainage Master Plan

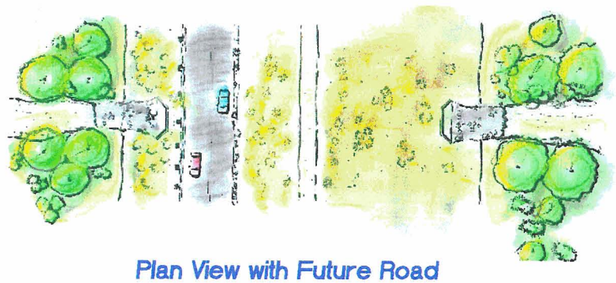
SAND TANK WASH
FLOOD CONTROL IMPROVEMENTS
(PHASE 3)
EXHIBIT 4.11



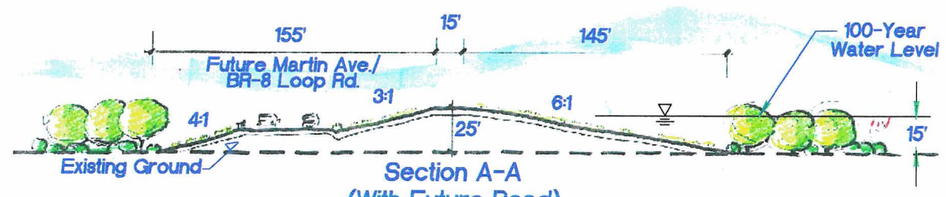
Plan View without Road



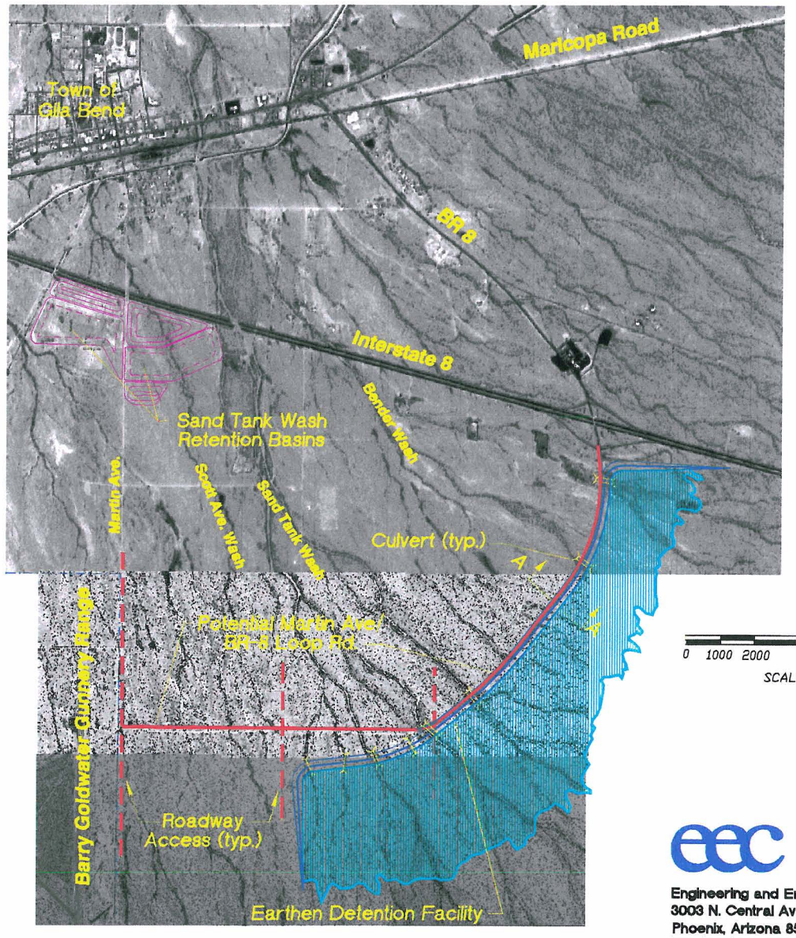
Section A-A
(Without Road)



Plan View with Future Road



Section A-A
(With Future Road)



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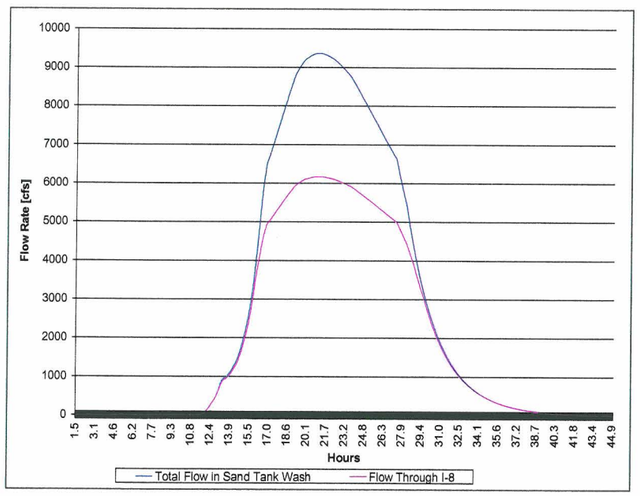
The following list summarizes the physical, hydrologic, and hydraulic features of the FRS (see Figure 4-2 for inflow/outflow hydrograph).

Height at center of FRS:	24 ft
Length of downstream face:	13,800 ft
Length of wings:	3,700 ft
Upstream side slope:	4:1
Downstream side slope	varies 4:1 to 10:1
Top width:	20 ft
Peak 100-year storage volume:	5,690 ac-ft
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 FRS:	18,100 cfs
Peak 100-year flow at Pima Street after FRS:	8,300 cfs
Peak 100-year flood stage behind FRS:	15.6 ft
Outlet structures:	Eleven – 10-ft x 6-ft CBC One – 8 x 6 ft CBC Two – 36 inch RCP's
½ PMF peak inflow:	53,000 cfs
½ PMF peak outflow:	31,800 cfs
½ PMF peak storage volume:	9,650 ac-ft
½ PMF spillway elevations:	16.6 ft above base of FRS
Number of ½ PMF spillways:	5
Cumulative length of ½ PMF spillways:	1,000 ft
Cubic yards of excavation required:	276,000 c.y.
Cubic yards of fill material:	2.9m c.y.
Land area required for FRS:	130 acres
Land area of impoundment:	1,400 acres

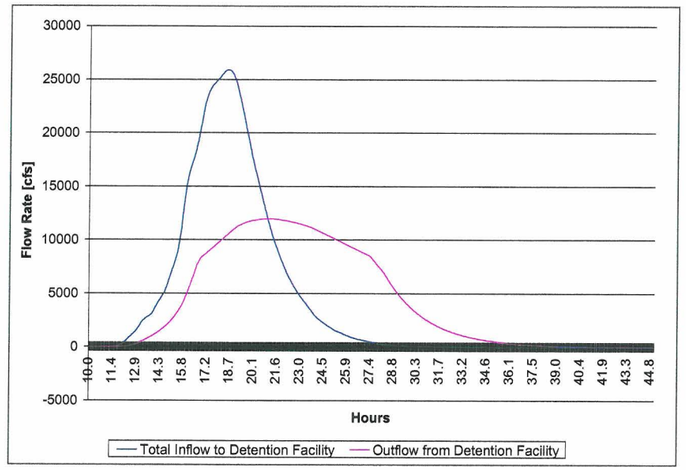
Figure 4-2. Inflow/Outflow Hydrographs for Phase 3 Detention Facility



Modification to Phase 2 Retention Basin (see Appendix K)

In Phase 3, the side wier spillway at the Phase 2, 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 ft to an elevation of 765.75 and the length would be shortened from 900 ft down to 725 ft. This would allow the retention basin to accept its design volume of 2,700 ac-ft. Figure 4-3 shows the 100-year design hydrographs for the modified retention 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 8,300 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 Phase 2, I-8 retention basin. The spoil from the retention basin is about 4.2 million cubic yards. This is more than enough to construct the detention facility, which is about 2.9 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 FRS will come from the I-8 retention basin spoil. Therefore, the area disturbed will be limited to the footprint of the FRS. 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 (Phases 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 (Exhibit 4-13). Although this was, by far, the least expensive flood control alternative, it still cost over $15 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.

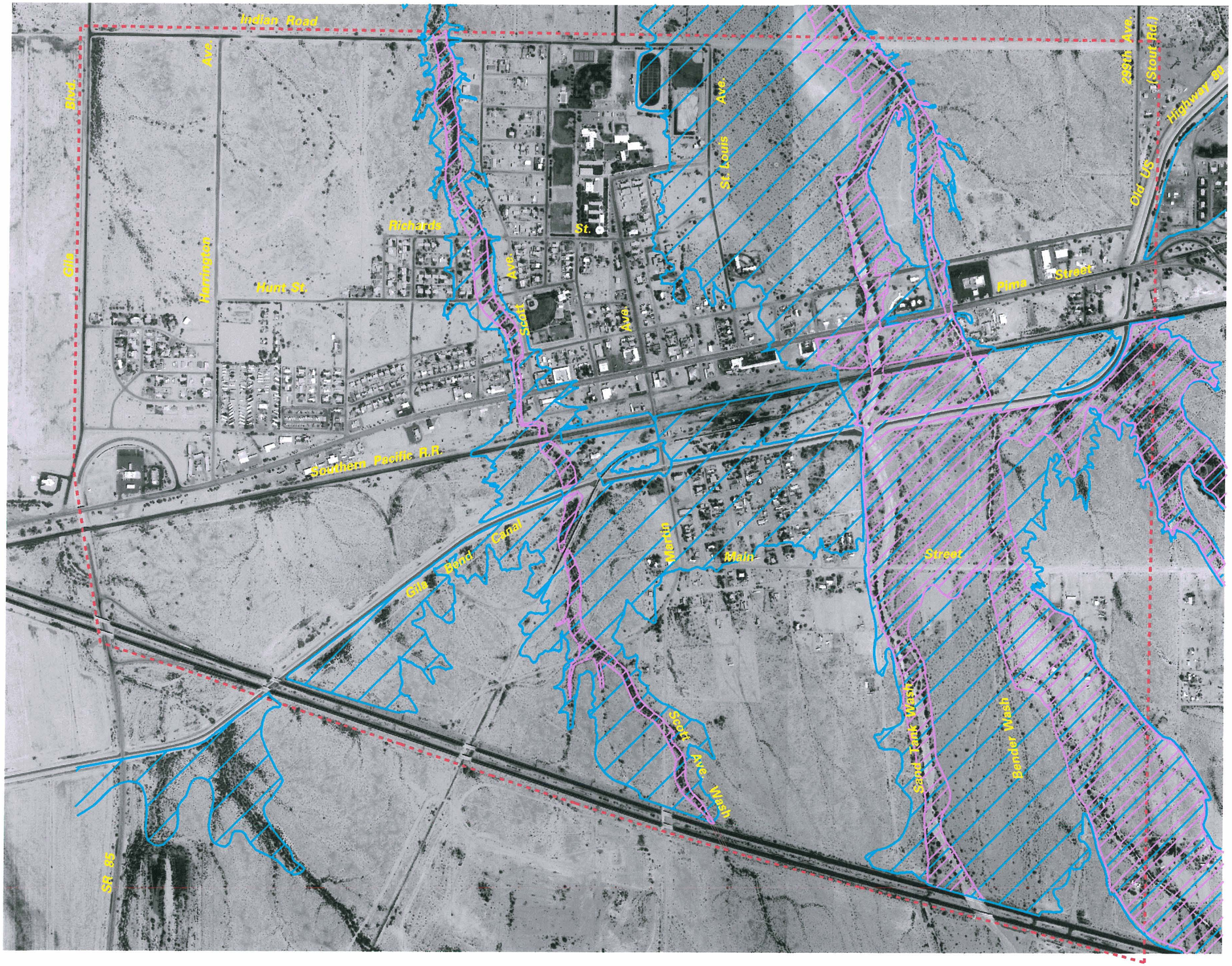
It should be pointed out that this buyout option cannot be directly compared to the Sand Tank Wash Flood Control Improvements (Phases 1 and 2). That is because the flood control improvements provide many more benefits than just protecting houses and businesses. These benefits include: 1) eliminating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

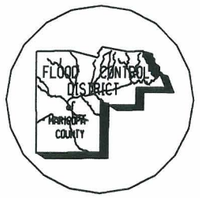
It should also be pointed out that the Town Core drainage plans for the Scott Avenue Wash watershed are based on the assumption that the Sand Tank Wash flood control improvements are in place. If the upstream flood control improvements are not constructed it would be impractical to construct all-weather crossings over Scott Avenue Wash because the flood flows are too high.

Buyout Computation

See Figure 4-4 for the properties used to compute the buyout costs. Also see 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 Area 1	$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 Area 2	$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 Area 3	$2,912,000
Total Costs	*$7,057,000*





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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0 250 500 1000 2000

SCALE: 1" = 1000'

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Phoenix, Arizona 85012-2905
TEL:(602)248-7702 FAX:(602)248-7851

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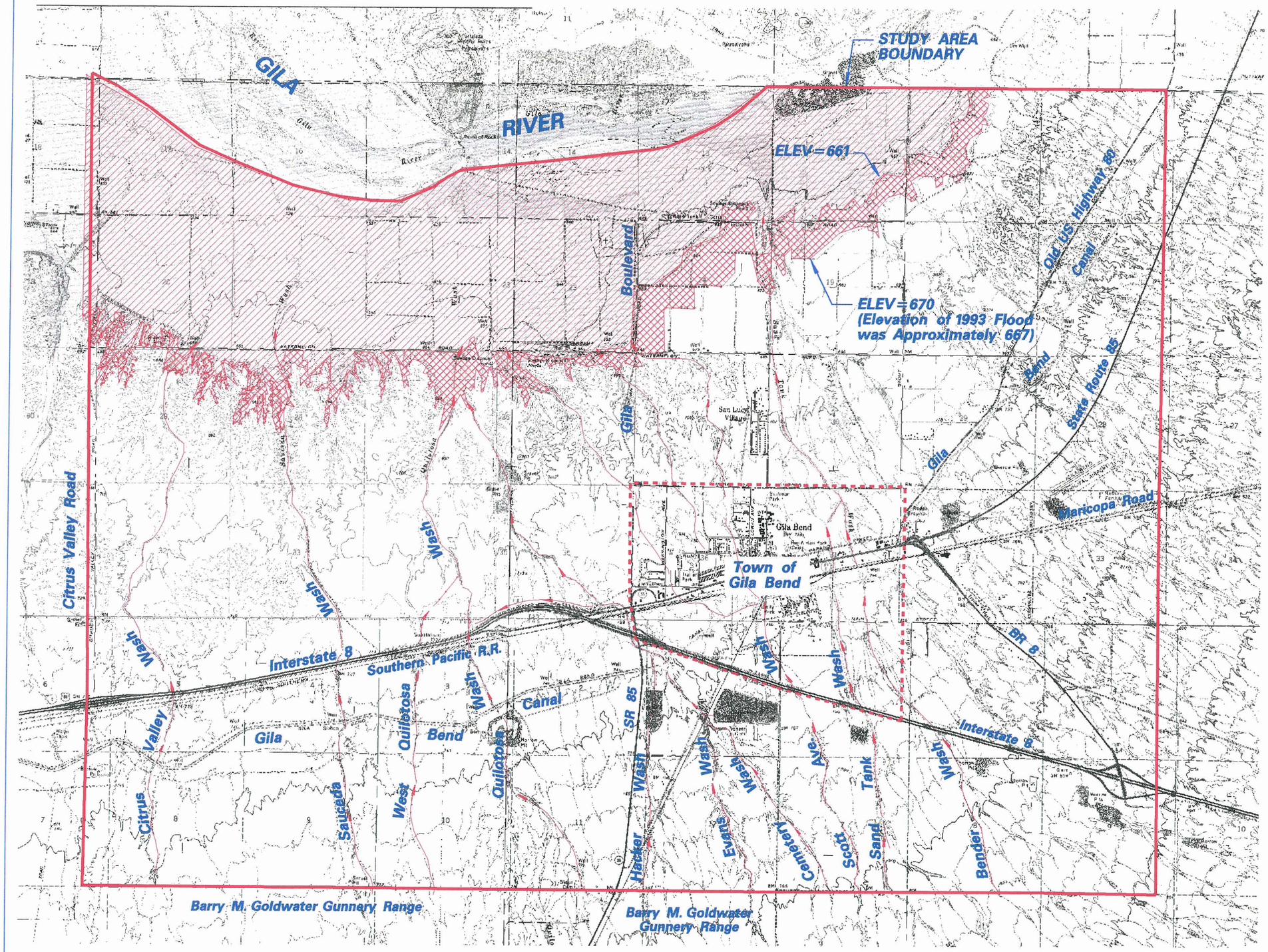

GILA BEND
Area Drainage Master Plan

GILA RIVER
FLOOD HAZARD AREA
Exhibit 4.13

LEGEND

- PLANNING STUDY AREA BOUNDARY
- CORE STUDY AREA BOUNDARY
- EXISTING CORPS OF ENGINEERS' GILA RIVER FLOOD EASEMENT (NO HABITABLE STRUCTURES ALLOWED)
- HIGH FLOOD HAZARD AREA (RECOMMEND NO HABITABLE STRUCTURES)

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SCALE: 1" = 4,000'

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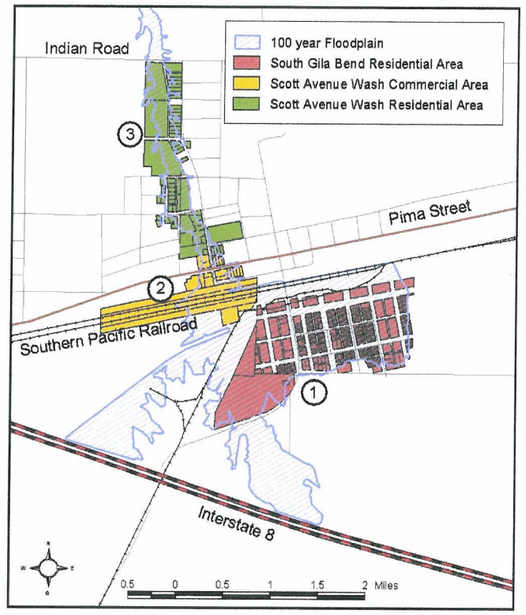
Figure 4-4 Properties Used to Compute the Buyout Costs



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 does not address flooding on the three major washes -- Scott Avenue Wash, Sand Tank Wash, and Bender Wash. Instead, flood control improvements for those 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. 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 storm water retention, 2) all weather (100-year design) wash crossings of roadways, and 3) streets with curb and gutter designed to convey the 10-year flood.

5.2 Hydrologic Analysis

Appendix S provides the existing and proposed conditions hydrologic analysis for the Town Core Area. The hydrologic analysis includes HEC-1 models for the 2-year, 10-year, and 100-year floods.

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 – 100-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 (see Exhibit 5-3 and enclosed concept plans)

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 100-year local runoff.
- Detention Basin – Construct a new detention basin at the downstream end of the Gila Bend Canal Channel with a new 36-inch outlet pipe into Sand Tank Wash; designed for the 100-year local runoff.
- 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 (see Appendix D for an itemized cost estimate)

Drainage Components Construction Costs		$222,200
Land Acquisition Cost		$10,200
Engineering/Permitting Costs		$38,300
Construction Administration Cost		$33,300
Contingency Cost (@ 15%)		$45,600
	Subtotal	$349,600
Roadway Improvement Construction Costs		$197,000
Land Acquisition Cost		$0
Engineering/Permitting Costs		$29,600
Construction Administration Cost		$29,600
Contingency Cost (@ 15%)		$38,400
	Subtotal	$294,600
Total Cost		*$644,200*

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. They also include repaving local 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: 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 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 ft to 3 ft below the lots. Runoff tends to accumulate along the Canal and backs 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 100-year flood. The local runoff, 100-year flood was used for design so that in the future the floodplain can be completely removed from behind the Canal. If the channel were designed for less than the 100-year flood, which is common for small local watersheds, a small floodplain would remain after construction of the Sand Tank Wash flood control improvements.

FLOOD CONTROL DISTRICT MARICOPA COUNTY

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

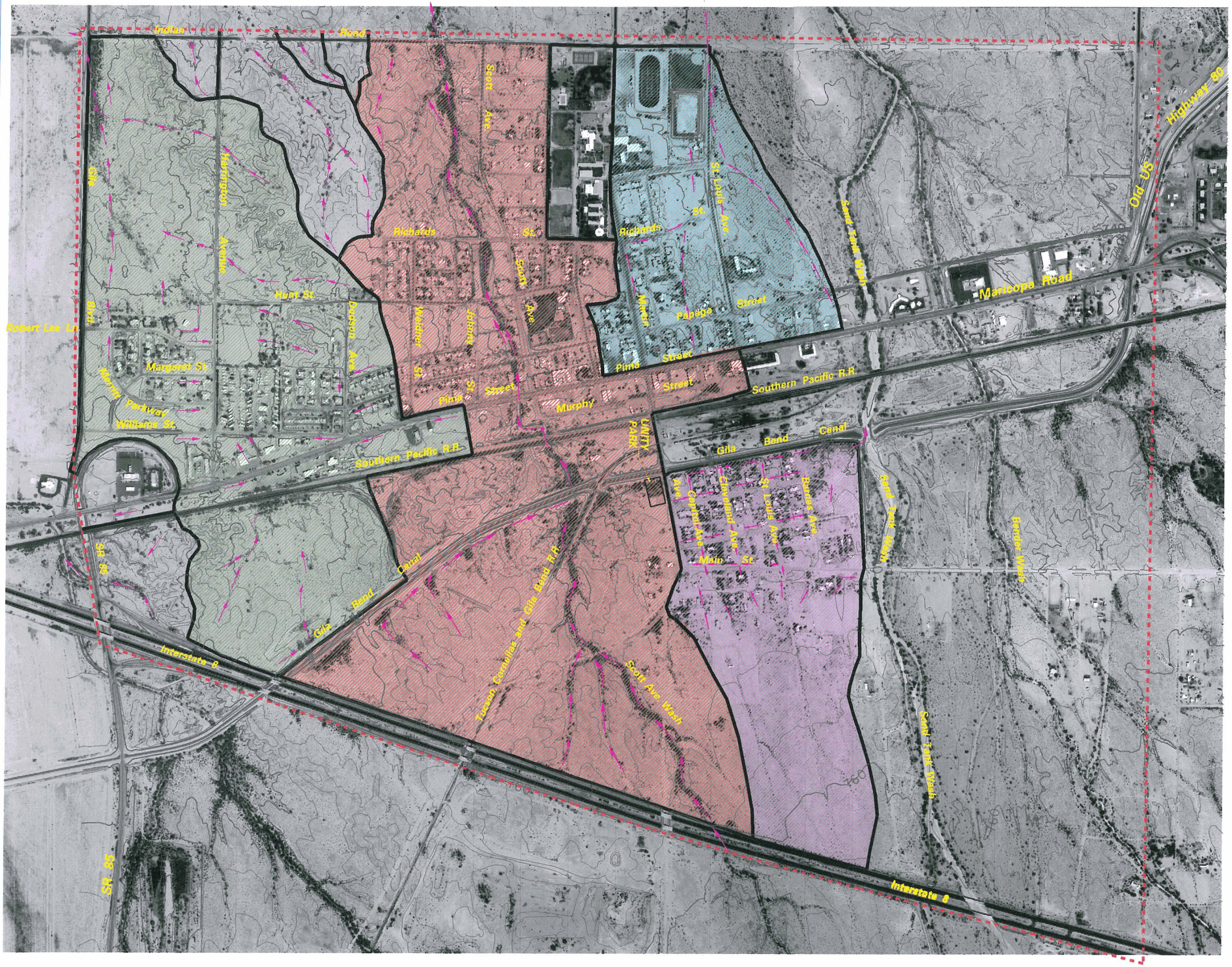
N

0 200 400 600 800 1000 2000

SCALE: 1" = 1000'

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" = 1000'

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

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Design for the 100-year flood will allow the area to be completely removed in the future after construction of Phase 1 and 2 of the upstream flood control improvements. The new detention basin will be excavated about 4 ft to provide 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, causing 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 (see Appendix O)

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 (see Exhibit 5-3).

Design Flood: The interceptor channel along the Canal is designed for the local runoff, 100-year flood with no freeboard. The roadside channel along Main Street is designed for the 10-year flood. 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 bottom width that varies from 10 ft to 3 ft and 4H:1V side slopes. The depth of flow for the 100-year flood will vary from about 2.0 ft to 3.5 ft and the velocity of flow will be 1.5 ft to 3 ft per second. The channel will be revegetated 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 6H:1V side slopes. The basin will be about 2.3 acres in size and will store approximately 7.4 ac-ft of runoff. Water depth in the basin during the 100-year, 6-hour flood will be about 5.5 ft, and for the 10-year, 6-hour flood it will be about 4 ft.

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 storm water 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-ft 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 ft and the velocity will range from 2 to 2.5 ft per second. The channel will be revegetated with native grass seed to help prevent erosion and to provide an aesthetic treatment.

5.4.2 Harrington Avenue Drainage Improvements (see Exhibit 5-4 and enclosed concept plans)

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.
- 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 ft 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 34ft 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 (see Appendix D for an itemized cost estimate)

These costs do not include the cost of the "developer-built" channel and Gila Boulevard culvert.

Drainage Components Construction Costs	$686,800
Land Acquisition Cost	7,500
Engineering/Permitting Costs	108,000
Construction Administration Cost	103,000
Contingency Cost (@ 15%)	135,800
Subtotal	$1,041,100
Roadway Improvement Construction Costs	974,300
Land Acquisition Cost	0
Engineering/Permitting Costs	146,000
Construction Administration Cost	146,100
Contingency Cost (@ 15%)	190,000
Subtotal	$1,456,400
Total Cost	*$2,497,500*

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 two 36-inch culverts under the railroad will remain and serve as an emergency outlet 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 5 ft 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 1,350 ft.

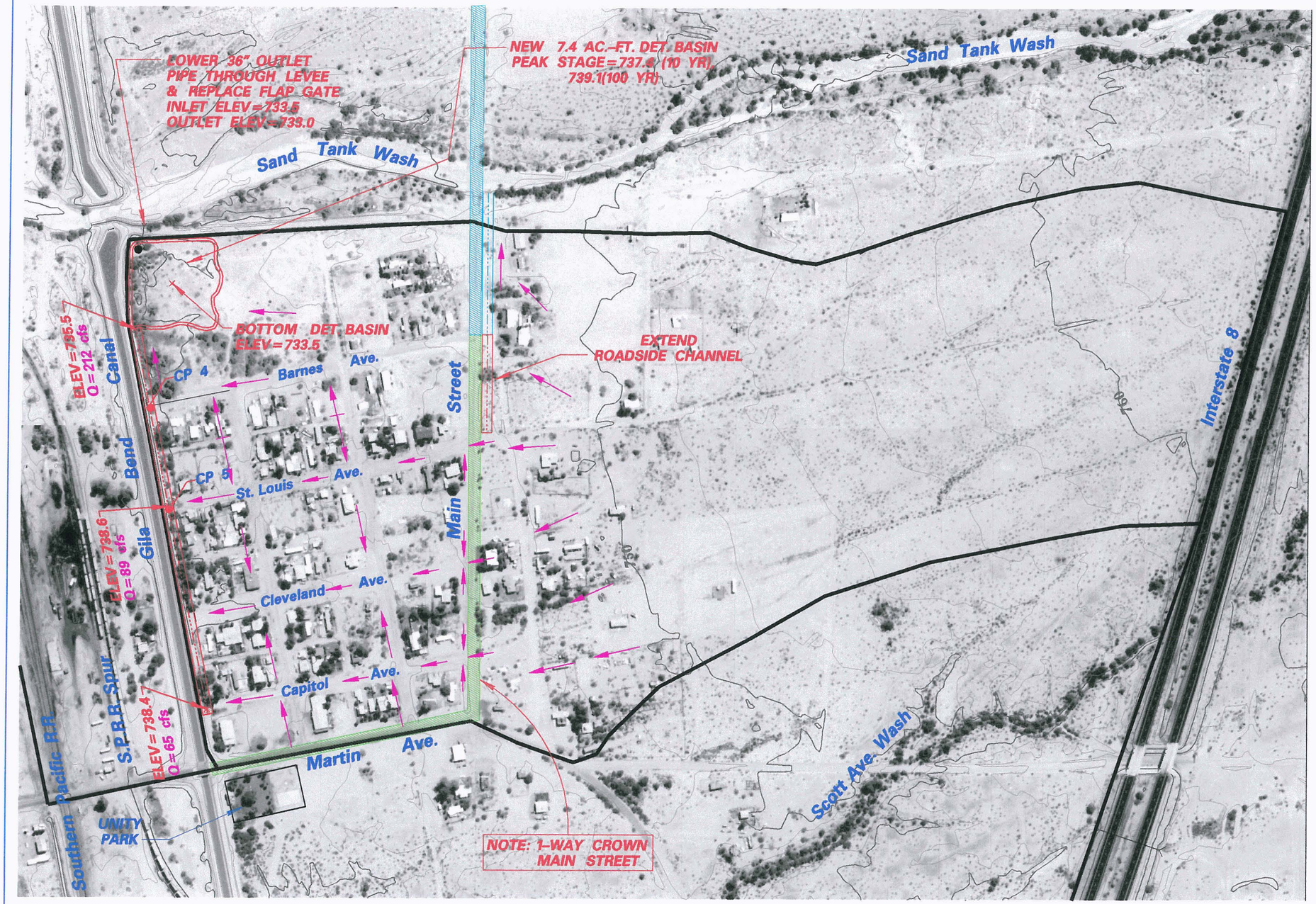
In the future, when the undeveloped land between Hunt Street and Indian Road is developed, a new channel will have to be constructed by the developer to replace the interim channel. The future channel will be built to convey the 100-year flood and will include a culvert under Gila Boulevard.

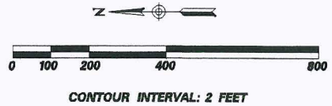
The plan also includes repaving the streets with curb and gutter. This is particularly important for Harrington Avenue because the gutters will provide a means of collecting storm water in the storm drain with standard curb opening inlets. New curb and gutter in the other streets will drain to Harrington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

Retention Basin Design: The new retention basin will be about 4 ft deep with 10H:1V side slopes and is designed to store runoff from the 100-year, 2-hour storm, a volume of 6 ac-ft. The basin will drain with 4 drywells. The existing two 36-inch culverts under the railroad will serve as an emergency outlet when the water level exceeds a depth of 3 ft. The basin will be revegetated with native grass seed to help control erosion and provide an aesthetic treatment.





CONTOUR INTERVAL: 2 FEET

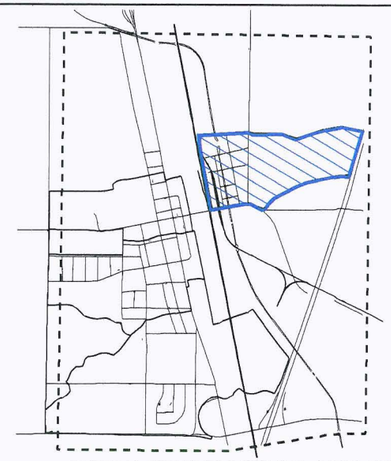
GILA BEND
Area Drainage Master Plan

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=65 cfs — 100-YEAR PEAK DISCHARGE

KEYMAP



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Exist. Channel to Remain
Exist. 1–42" RCP Culvert to Remain
Exist. 1–3'x2' CBC to Remain
Exist. 1–36" RCP Culvert to Remain
Exist. 2–36" RCP Culverts to Remain

Scott Ave.
Richards Road
Pima St.
Street
Southern Pacific R.R.
Railroad Spur
Gila Bend Canal
Dodson Ave.
Hunt St.
Harrington Avenue
Indian
Gila Blvd.
Merritt Parkway
Williams St.
Margaret St.
Robert Lee Ln.
Interstate 8
SR 85

Q_{10} = 7cfs
Q_{10} = 6cfs
Q_{10} = 41cfs
Q_{10} = 20cfs
Q_{10} = 3cfs
Q_{10} = 31cfs
Q_{10} = 11cfs
Q = 79cfs
Q = 67cfs
Q = 39cfs
Q_{100} = 441cfs
Q_{10} = 235cfs
Q = 95cfs

Bottom Elev = 720
6.0 Ac-Ft. Retention Basin With Drywells
36"
48"
42"
36"
Elev = 706
Elev = 704
Elev = 696
2–10'x3' CBC
Channel "Daylights" at Elevation 694 ±

0 150 300 600 1200
CONTOUR INTERVAL: 2 FEET

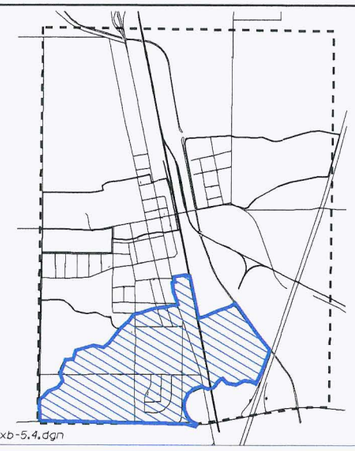
GILA BEND
Area Drainage Master Plan

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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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 42 inches in diameter. Harrington Avenue and Williams Street will be repaved with curb and gutter which will provide curb opening inlets to capture the storm water. The design flow varies from 33 cfs up to 65 cfs with velocities ranging from 6 ft to 9 ft 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-ft bottom width and 4H:1V side slopes. It will daylight approximately 1,350 ft downstream at elevation 704. The depth of flow for the 2-year peak discharge (65 cfs) is 2.6 ft with a velocity of 2-ft per second. The channel will be revegetated 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-ft deep low flow channel that has a 10-ft bottom width and 3H:1V side slopes. On either side of the low flow channel is a 2-ft deep, 20-ft wide terrace with 4H:1V side slopes. The total channel width is about 80 ft. The depth of flow varies from 4 ft to 2 ft and the velocity is 1.5 ft to 4 ft per second. The freeboard depth is 1 ft.

Future Gila Boulevard Culvert: The future, developer-built, culvert at the end of the outlet channel, under Gila Boulevard will require two 10 ft x 3 ft concrete box culverts. This design will allow 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 ft. The culvert will require excavation of a downstream channel to a depth of about 3 ft in order to "daylight" the culvert bottom. The downstream channel will have a bottom width of 20 ft, 4H:1V side slopes, a velocity of 2.5 ft per second, and a length of about 800 ft.

5.4.3 Scott Avenue Wash Drainage Improvements (see Exhibit 5-5 and enclosed concept plans)

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-ft 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 (see Appendix D for an itemized cost estimate)

Drainage Components Construction Costs	$194,100
Land Acquisition Cost	7,000
Engineering/Permitting Costs	33,300
Construction Administration Cost	29,100
Contingency Cost (@ 15%)	39,500
Subtotal	$303,000
Roadway Improvement Construction Costs	1,342,500
Land Acquisition Cost	0
Engineering/Permitting Costs	107,400
Construction Administration Cost	201,400
Contingency Cost (@ 15%)	247,700
Subtotal	$1,899,000
Total Cost	*$2,202,000*

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 3,500 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 part of the drainage plan. 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. To solve this problem, 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 Q)

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-ft x 3-ft box culvert. The storage has little effect on the 10-year flood, but has a significant effect on the 100-year flood (see 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 Q for design calculations of new culvert crossings. Due to lack of cover, the crossings at Papago, Hunt, and Richards are designed with shallow, 3-ft high box culverts; using the top of the box for the roadway surface. The Indian Road culvert is designed with five 42-inch Corrugated Metal Pipe culverts. 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 1 ft.

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 2.64 ac-ft at a depth of 3.5 ft. 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 ft. The 100-year, 6-hour peak discharge is 13 cfs at a depth of 3.5 ft (refer to proposed condition HEC-1 models, Appendix S).

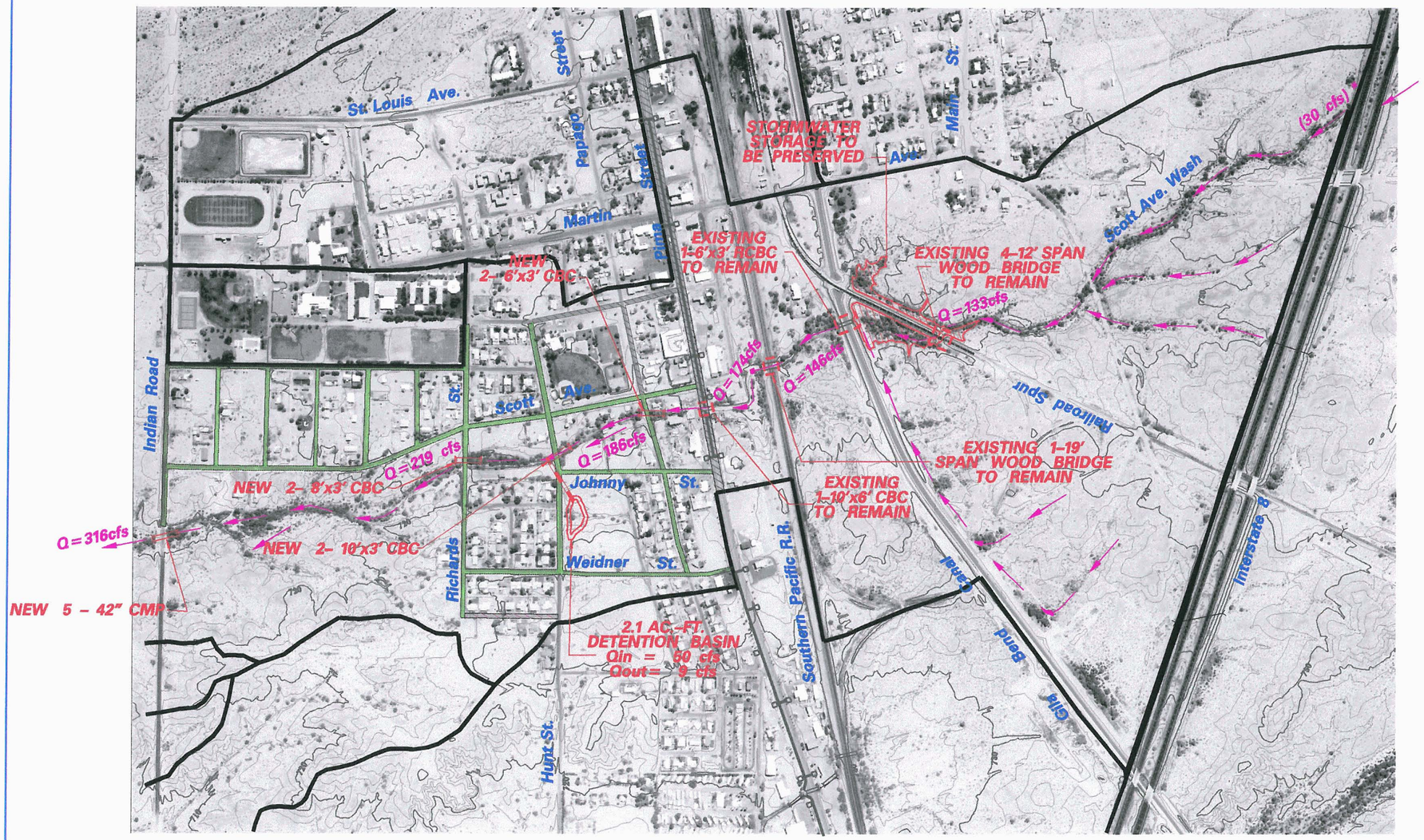
5.4.4 St. Louis Avenue Drainage Improvements (see to Exhibit 5-6 and enclosed concept plans)

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.

GILA BEND
Area Drainage Master Plan

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)*

N

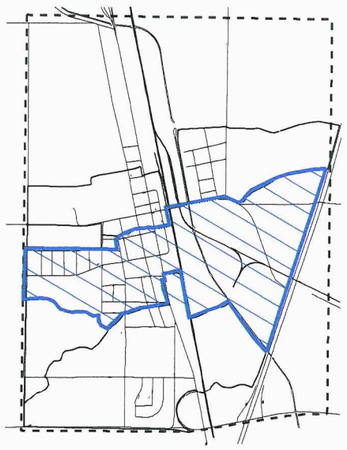
0 200 400 800 1600

CONTOUR INTERVAL: 2 FEET

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



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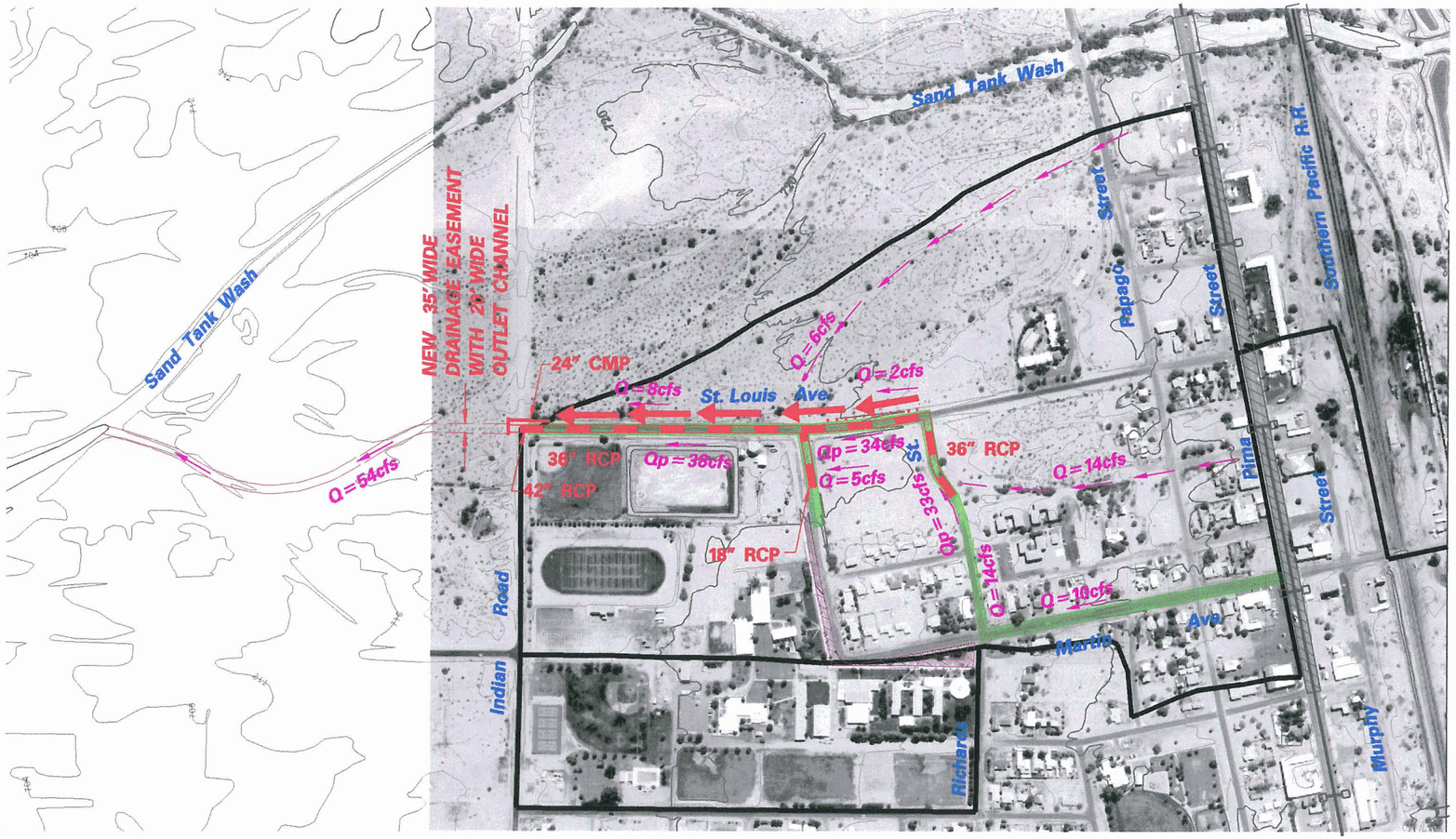
GILA BEND
Area Drainage Master Plan

DRAINAGE PLAN FOR THE ST. LOUIS AVENUE WATERSHED

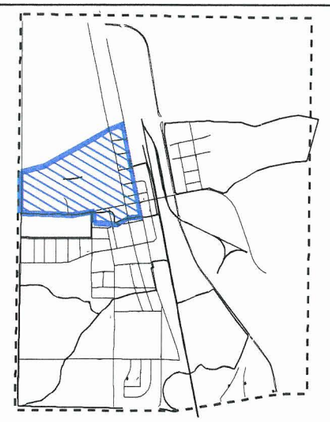
EXHIBIT 5.6



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



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CONTOUR INTERVAL: 2 FEET

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Summary of Project Cost (see Appendix D for an itemized cost estimate)

Drainage Components Construction Costs	$277,100
Land Acquisition Cost	3,000
Engineering/Permitting Costs	32,700
Construction Administration Cost	41,600
Contingency Cost (@ 15%)	53,200
Subtotal	*$407,600*
Roadway Improvement Construction Costs	$342,000
Land Acquisition Cost	0
Engineering/Permitting Costs	34,200
Construction Administration Cost	51,300
Contingency Cost (@ 20%)	64,100
Subtotal	$491,600
Total Cost	*$899,200*

Description of Drainage Plan

The drainage improvements include a new storm drain in St. Louis Avenue, repaving of streets with curb and gutter to convey storm water 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. This 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 do not drain well, do not 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 1,800 ft 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 (see to Appendix R)

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 ft to 8 ft 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 6-ft bottom width and 4H:1V side slope and will daylight into Sand Tank Wash approximately 1,900 ft downstream from Indian Road. The depth of flow will vary from about 6.5 ft at Sand Tank Wash to 1.4 ft at the storm drain outlet at Indian Road. The corresponding channel velocities vary from 0.25 ft to 3.3 ft per second. The channel will be revegetated 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 ft deep with a corresponding velocity of 2 ft per second.

SECTION 6: LANDSCAPE DESIGN GUIDELINES

6.1 Purpose

The purpose of these landscape design guidelines is to provide the Town of Gila Bend with a tool to manage the aesthetic design of new drainage features within the Town. These guidelines apply to both public works projects and to land development projects and are intended to give planners, engineers, and landscape architects direction as to the landscape character that the Town desires to achieve.

6.2 Approach

The general approach is to create drainage features that are multi-use and become an asset and benefit to the Town. Drainage features, such as, washes, channels, and basins provide a wide range of recreational uses as well as wildlife habitat. A successful example of a multi-use drainage project is Indian Bend Wash in the City of Scottsdale -- a several-mile long flood control greenbelt through an urbanized area.

Indian Bend Wash is a very successful and popular attraction for the local community. The channel is characterized by extensive amounts of turf, large trees and shrubbery in the overbank areas, a low flow channel, and several water features. There are a number of recreational amenities including golf, tennis, frisbee-golf, basketball, soccer, volleyball, baseball/softball fields, and a continuous multi-use path for jogging, walking, biking, and rollerblading. Recreational amenities, such as tennis fences that are of concern for obstructing flow in the channel, are designed to swing up in the event of a flood. Besides the recreational benefits, infrastructure and residential development is quite extensive along the edges of the greenbelt.

There are also many examples of storm water retention basins being used as community park sites. Grovers Park in the City of Phoenix is a storm water detention basin, with turfgrass in the bottom and low-water use desert landscaping on the side slopes. The park also includes recreational amenities such as a basketball court, sand playground, stabilized decomposed granite jogging path and a small parking lot.

Another good example, which is part of a residential development, is the drainage channels at Desert Ridge. These channels, although trapezoidal with an "engineered look", have concrete paths, rest areas, bollard path lights, and low-water use desert landscaping with supplemental irrigation. An interesting feature of these channels is that the path meanders from one overbank to the other across concrete drop-structures.

The drop structures were built utilizing color additives in the concrete and a textured face, which blends with the design of the bridges and retaining walls. The drop structures also provide space for rest stops along the main path. Another good feature is that surrounding residential development provides numerous access points. This was achieved by laying out the public streets to run parallel with and intermittently cross the channel.

This type of layout avoids the long, walled-off look created when all the lots back up to the channel with privacy walls along the back lot line. Intermittently aligning the streets parallel to the channel opens up the views, provides security, reduces the "trashy" appearance that can occur along privacy walls, provides easy and frequent trail access, and makes maintenance easier.

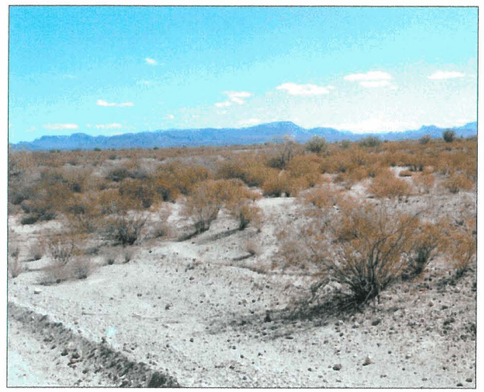
An example of a channel with minor recreational amenities and a more natural, less refined appearance would be the Greenway channel between 7th Street and Cave Creek Road in Phoenix. This channel is basically a large, sandy bottom channel lined with Palo Verde trees, and other desert vegetation and a concrete sidewalk meandering along the overbank.

Observation of these and other examples along with the Landscape Character Analysis has culminated in the identification of the three character models described below. These models can serve as references for development of drainage features, either private or public.

6.3 Character Models for the Gila Bend ADMP

The three landscape character models for the Gila Bend ADMP will be referred to as Natural, Modified Natural and Park-Like (see Exhibit 6-1).

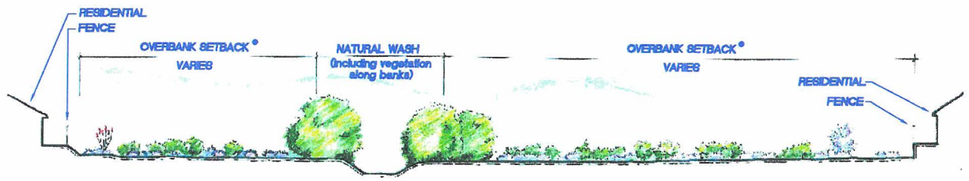
Natural Model



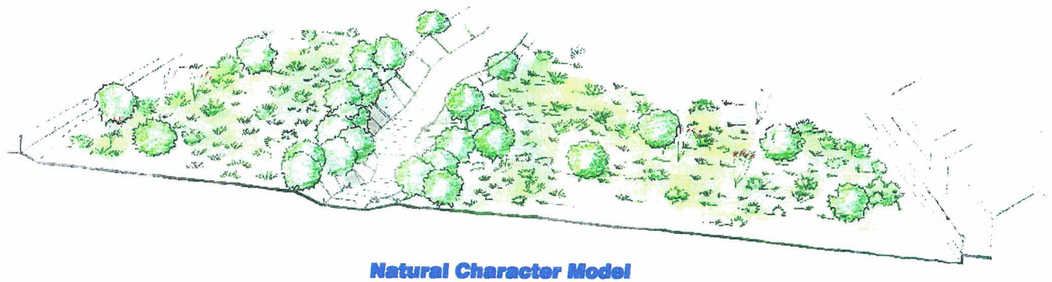
This theme is essentially preservation of native landscape by minimizing impacts during construction and other activities. In the case where existing inadequate, man-made channels are to be improved, this theme would require that the improved channel be constructed to mimic the existing desert washes in the Gila Bend area.

GILA BEND
Area Drainage Master Plan

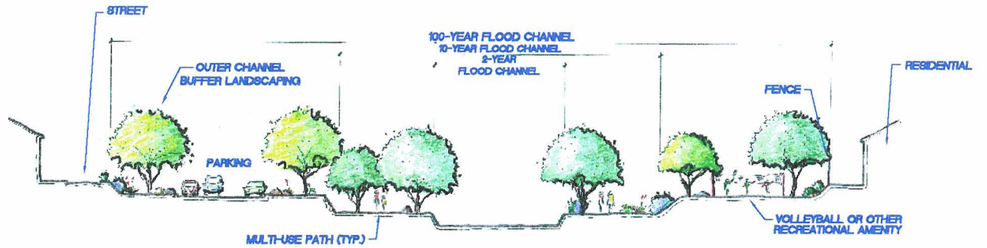
CHARACTER MODELS OF DRAINAGE CHANNELS EXHIBIT 6.1



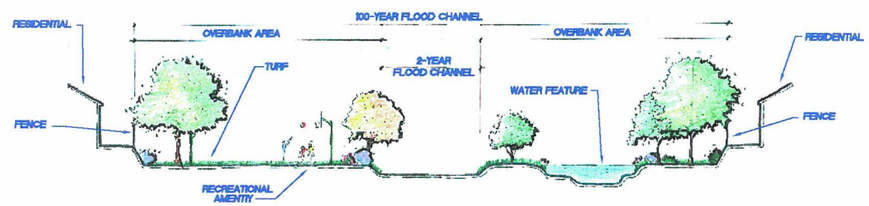
* Setback to be the greater of:
1) Prediction of wash lateral migration, 2) Floodway width, or 3) A minimum setback width of 25 feet.

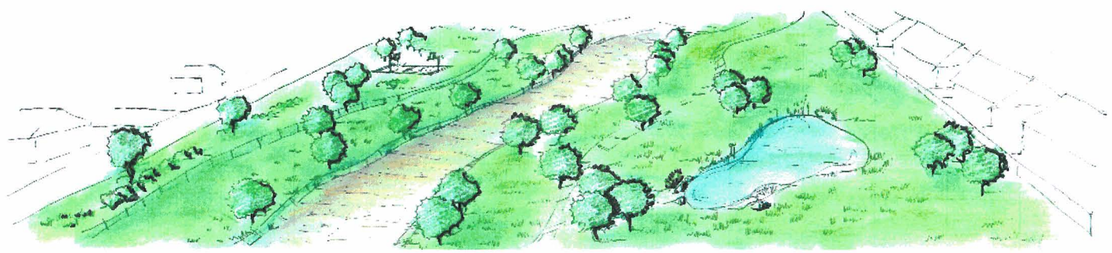


Natural Character Model



Modified Natural Character Model





Park-like Character Model

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April 2001

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Concept Plans for Developer-Built Elements

Natural channel areas affected by development should be revegetated by hydroseeding and use of salvaged or nursery grown plants or a combination thereof. The revegetation effort should be intended as a means to restore the general appearance, both in type and density of native vegetation, to create a smooth visual transition to the existing vegetation not affected.

The use of this character model is particularly prudent in drainage corridors that fall under 404 permit requirements as 404 permitting encourages the preservation of existing trees and the habitat they provide. However, preserving habitat tends to limit the amount and level of maintenance when it comes to the pruning of existing trees which, in turn, limits the recreational use. Therefore, recreational use within natural channels is generally limited to primitive hiking trails and walking paths.

Plant types for this character model are listed in the plant palette table following this section. Because of the lack of rainfall in the Gila Bend region, the list of suggested plants, which are suitable, is very limited and primarily native to the area.

Modified Natural Model

This theme is similar to the natural model in general appearance yet goes beyond by integrating multi-use trails and introducing additional plant species generally not observed in the area, but adapted to the desert climate. In addition to the use of various plant species not found in the natural model, the use of inert ground covers (decomposed granite, crushed rock etc.) is also part of the theme.

Recreational components include multi-use paths, either paved or non-paved, with access points at ¼ or ½ mile intervals and at key points along the length of the channel. Access could be enhanced with the addition of trailheads with small parking lots, ramadas, seating areas, and drinking fountains.

Park-Like Model

The park-like model is similar to the modified natural model in that both could have potential recreational uses. The landscape materials that could be used would be considerably different from the natural model, although still considered low-water use.

Many of the suggested plants for this model would include imports or exotics from other regions. By placing the plants in groupings, larger expanses of turf grass are left open, thereby providing better growing conditions and more opportunity for recreational open space.

The use of turf grass really sets this model apart from the other two models. The turf could be bank to bank or only in selective areas for active recreation. Turf should be of a high grade and weed free. Also, it is imperative that the turf species not go to seed and therefore would not be invasive in the landscape.

As with the modified natural model, the use of inert groundcovers could be utilized in combination with turf and other landscape materials.

The inclusion of recreational amenities may be more intensive than in the modified model. Amenities could include: golf, baseball/softball, soccer, football, tennis, shuffleboard, volleyball, multi-use paths and water features.

6.4 Landscape Maintenance Considerations

Landscape maintenance costs and requirements will vary between the different landscape character models. Since the natural character model does not include the use of recreational amenities its maintenance cost will be the least of the three models. Maintenance for the natural model will primarily come with maintaining the functionality of the drainage feature which would mostly involve the removal of debris, pruning trees, and repairing erosion problems. The modified natural model would cost more to maintain because there would most likely be recreational amenities and other improvements to care for and repair, in addition to landscaping and supplemental irrigation that would need to be looked after and repaired as necessary. The park-like model, as one would expect, is the most costly to maintain, involving mowing of turf grass, trimming trees, maintaining irrigation systems, etc.

Gila Bend gets an average of only 5 inches per year in rainfall, compared to the Phoenix metropolitan area, which receives about 7 inches per year. This lack of rainfall makes it difficult to establish new plant material. Even in the natural setting, there is little more than creosote bush in the overbank areas. Therefore, at least temporarily, it will be necessary to irrigate plant material, even in the case of the natural model.

Mitigation measures should be employed to deal with possible discharge of fertilizers into drainage corridors, from areas with turf grass.

Security and visibility is an important issue when it comes to the maintenance of drainage features, which contain recreational uses. Trees should be pruned up with a bottom canopy at least 10 ft from the existing ground to provide visibility.

6.5 Landscape Planting Considerations

The following are general considerations that should be observed regarding landscape planting:

- The use of water conserving plants that stand a better chance to survive in the Gila Bend area and are more readily available.
- Soil testing should be done to determine proper soil amendments and supplemental irrigation requirements for plantings. Many locations within the Gila Bend area do not have ideal soils for landscape plantings according to the "Soil Survey of Gila Bend-Ajo Area, Arizona, Parts of Maricopa and Pima Counties". It is reported that much of the soil in the study area is characterized as having poor water capacity, high instances of calcium carbonate (caliche) at a shallow depth and a high lime content.
- New plantings for landscape projects utilizing nursery grown stock should be based on ANA (Arizona Nursery Association) standards for trees.
- Salvage or relocate existing native trees and Arizona protected species when possible. For information on Arizona native plant law refer to ARS 3-901 through ARS 3-934 and the Arizona Department of Agriculture for information on protected native plants.
- Damage to plantings by wildlife such as rabbits and other rodents should be considered in the design process, either by using plant species not as susceptible or some type of protection until mature enough to not risk losing the plant.
- Landscaping or other aesthetic features incorporated into any development should be designed and used in a way that it does not adversely affect the functionality of flood control and drainage features.
- Drainage improvements in waters of the U.S. will have 404 permitting stipulations regarding landscape mitigation. In any 404 permit areas, existing trees will most likely need to be preserved, regardless of the position of the tree in the channel and its influence on floodwater conveyance.

Table 6-1 presents a list of plant palette recommendations.

Table 6-1. Plant Palette Recommendations

Botanical Name	Common Name	Landscape character model
Trees & Shrubs		
Acacia species	Acacia	N, M, P
Ambrosia deltoides	Triangle-leaf bursage	N, M,P
Ambrosia dumosa	White bursage	N, M, P
Atriplex lentiformis	Quail Brush	M
Atriplex polycarpa	Desert Saltbush	M
Baileya multiradiata	Desert Marigold	M,P
Brachychiton populneus	Bottle tree	P
Caesalpinia spp.	Bird of Paradise	M, P
Calliandra spp.	Fairy Duster	M,P
Celtis pallida	Desert Hackberry	M
Cercidium floridum	Blue Palo Verde	N, M,P
Cercidium microphyllum	Littleleaf Palo Verde	N, M,P
Chilopsis linearis	Desert Willow	M, P
Chrysactinia mexicana	Damianita	M,P
Dalbergia sissoo	Sissoo Tree	P
Dasylirion spp.	Desert Spoon	M,P
Encelia farinosa	Brittlebush	M,P
Encelia frutescens	Green Brittlebush	M,P
Ericameria larcifolia	Turpentine Bush	M,P
Geijera parviflora	Australian willow	M,P
Gleditsia triacanthos	Honey Locust	P
Hyptis emoryi	Desert Lavender	M
Isomeris arborea	Bladderpod	M
Krameria grayi	White Ratany	N, M
Lantana spp.	Lantana	M
Larrea tridentata	Creosote	N, M
Leucaena retusa	Golden Leadball Tree	M
Lysiloma thornberi	Desert Fern	M, P
Nerium oleander varieties	Oleander	M,P
Olea europaea 'Swan Hill'	Fruitless Olive	P
Olneya tesota	Desert Ironwood	N, M
Pinus eldarica	Mondel Pine	P
Pinus halepensis	Afghan Pine	P
Prosopis spp.	Mesquite	M, P
Quercus spp.	Oak	P
Rhus lancea	African sumac	M, P
Sophora secundiflora	Texas Mountain Laurel	M
Ulmus parvifolia	Evergreen Elm	P
Viguiera deltoidea	Goldeneye	M
Washigntonia robusta	Mexican fan palm	M, P
Washingtonia filifera	California fan palm	M, P
Grasses		
Aristida purpurea	Purple Threeawn	M
Bouteloua aristoides	Needle grama	M
Bouteloua curtipendula	Sideoats grama	M
Cynodon dactylon Hybrids	Bermuda Hybrids	P
Hilaria rigida	Big galleta	M
Sporobolus cryptandrus	Sand Dropseed	M
Wildflowers		
Lupinus arizonicus	Arizona lupine	M
Lupinus sparsifolius	Desert lupine	M
Orthocarpus purparascens	Owl's clover	M
Schscholtzia mexicana	Mexican gold poppy	M
Cacti & Accents		
Agave spp.	Agave	M
Cactaceau	Cactus family	N, M
Carnegiea gigantea	Saguaro	N, M
Dasylirion spp.	Desert Spoon	M,P
Fouquieria splendens	Ocotillo	N, M
Hesperaloe parviflora	Hesperaloe	M,P
Nolina spp.	Nolina	M
Yucca spp.	Yucca	M

Abbreviation key: **N**- Natural model, **M**- Modified Natural model **P**- Park-like model

6.6 Grading Considerations

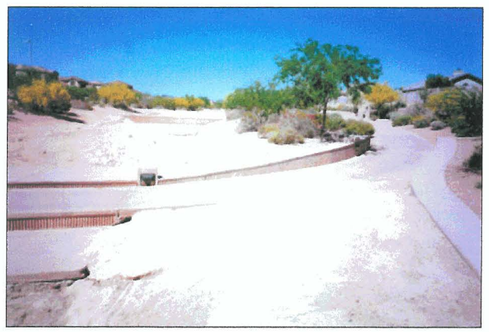
The design of drainage features should allow for fine grading that creates a landscape of undulating slopes and berms to provide a more "natural" appearance pleasing to the eye and that blends in with adjacent areas. The grading of drainage channels should include a low flow channel that meanders across the channel bottom. The design of berms should consider security and safety issues. It is important to avoid having too many areas with poor visibility either into or out of the site. In order to promote successful plantings in a new landscape, avoid the occurrence of soil erosion, and provide ease of access, graded slopes should be 4H:1V or flatter.

6.7 Inert Groundcovers

In some cases, the use of inert ground materials such as decomposed granite or crushed rock may be needed. Benefits to using this type of material are: minimization of soil erosion, air quality, dust control, and visual aesthetics by adding color, texture and interest to an area.

In addition to the use of inert ground covers as an aid to alleviate soil erosion, the use of hydroseeding and erosion control blankets can be used as another alternative. Soil erosion blankets should be considered if slopes must exceed 4H:1V.

6.8 Supplemental Landscape Irrigation



The use of supplemental irrigation is highly recommended for any landscape projects undertaken in the Gila Bend area. Even though the use of plants indigenous to the region would have the best chance of survival on existing rainfall, the native plants in the region, especially some of the larger species such as Cercidium (Palo Verde) could be more vigorous and sustainable with supplemental irrigation.

Some types of supplemental irrigation that could be used include:

- Automatic low-water use drip irrigation
- Automatic turf irrigation
- Overhead spray irrigation
- Temporary above ground irrigation for plant or seeding establishment
- Manual hand watering or water trucks until plants are established.

Other issues to consider with choice of irrigation system type:

- Available source for water use within range of proposed irrigation system.
- Design to minimize potential damage to irrigation lines by wildlife. The use of PVC pipe rather than polyethylene (PE) can be helpful.
- Utilize opportunities for water harvesting techniques, to capture rainfall runoff.

6.9 Design Recommendations

Drainage Channels and Basins (see Exhibit 6-2)

- Design and installation of multi-use paths should meet AASHTO Multi-use trail guide-lines. It is recommended that paths with linkages to primary amenities be paved with concrete or asphalt pavement. Remaining paths could be built with stabilized decomposed granite. The paths should meander, having minimal long straight sections.
- Provide regular access opportunities for pedestrians, bicyclists or vehicles especially along channel areas.
- Fine grading of channels or basins should be done in such a way to create an undulating surface, thereby eliminating a hard-edged appearance.
- Any perimeter fencing used at the edges of channel improvements should be a combination of masonry and wrought iron, 6 ft high, rather than a full masonry wall. This will allow better views into the channel area, lessening the "boxed-in" appearance. The masonry for the fence should be a decorative concrete block in an earth tone color, preferably with a split-face or fluted face.
- Drainage channels and basins have potential for playgrounds and other site amenities. A commercial manufacturer should supply necessary hardware or equipment. Sand used for playgrounds, volleyball courts or other uses should be mortar wash sand.
- In instances where a modified natural or park-like character model is used, the size of proposed plantings at maturity should provide 50% live cover. For instances when the natural character model is used, the preference is to match the densities of naturally occurring vegetation for the region.
- Any proposed turf should be a Bermuda hybrid or a non-invasive turfgrass species. If turf is installed in combination with decomposed granite, a concrete header should be utilized.
- Proposed trees should not be planted any closer to paths than 6 ft, while any trees overhanging the paths should be maintained with a minimum 10 ft clearance from finished grade to the tree canopy.

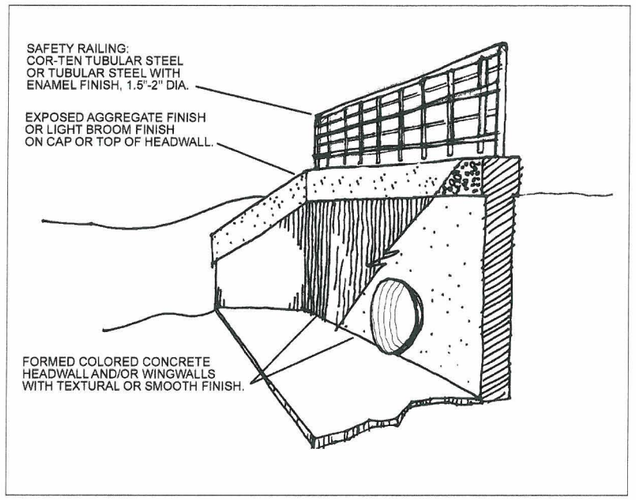
Aesthetic treatment for headwalls

"Desert Pavement" is prevalent in the Gila Bend Area

Concrete headwalls used at culverts and bridges should be designed with aesthetic enhancements characterized by the naturally occurring desert pavement in the Gila Bend area. As these structures are visible to the trail user, aesthetic enhancements help create a pleasing experience for those that take advantage of the open space that desert washes offer. Desert pavement (found throughout Gila Bend) is created naturally by the erosion of the desert soils, leaving an armored layer of cobbles and small rocks that produce a naturally occurring, exposed aggregate surface. Using colored concrete and exposing the aggregates in the headwalls will produce an affordable, aesthetically pleasing structure that blends with the natural desert surroundings.

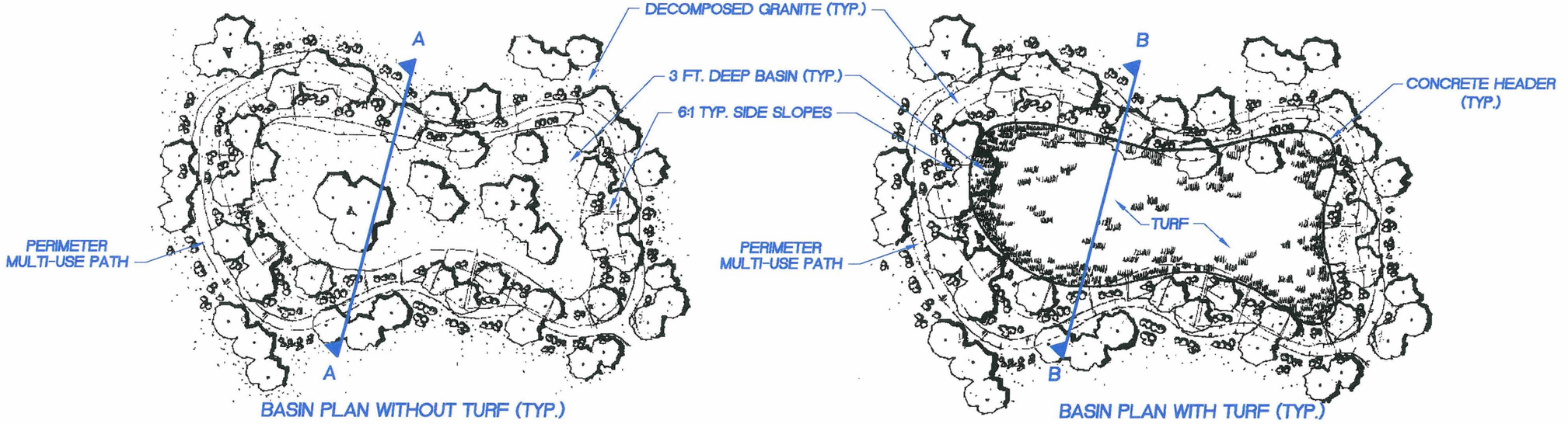
Figure 6-1 provides a graphic representation of enhancements that can be made to improve visual appearances. It is recommended that concrete for new headwalls include a color pigment additive such as Davis color #5084" Omaha Tan" or #64H-inch Sequoia Sand". The use of an exposed aggregate or a fluted texture finish provides additional enhancements. If the headwall is adjacent to or near pedestrian access protective railing should be used. Use either corten or regular tubular steel with a 1½-inch to 2-inch diameter. The use of regular tubular steel should be finished with enamel paint. With a color, which compliments the color, used for the headwall.

Figure 6-1. Typical Aesthetic Treatment-Concrete Headwall



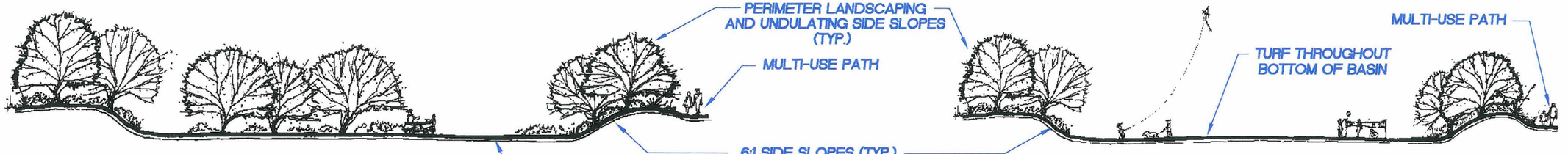
GILA BEND
Area Drainage Master Plan

STORMWATER RETENTION
LANDSCAPE TREATMENT
EXHIBIT 6.2



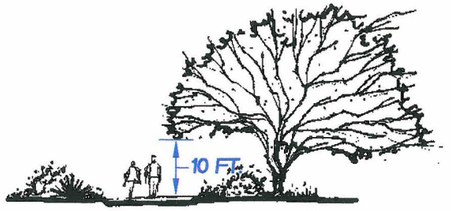
BASIN PLAN WITHOUT TURF (TYP.)

BASIN PLAN WITH TURF (TYP.)



TYPICAL SECTION A-A
BASIN WITHOUT TURF

TYPICAL SECTION B-B
BASIN WITH TURF



MULTI-USE TRAIL
CLEARANCE

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November 2001

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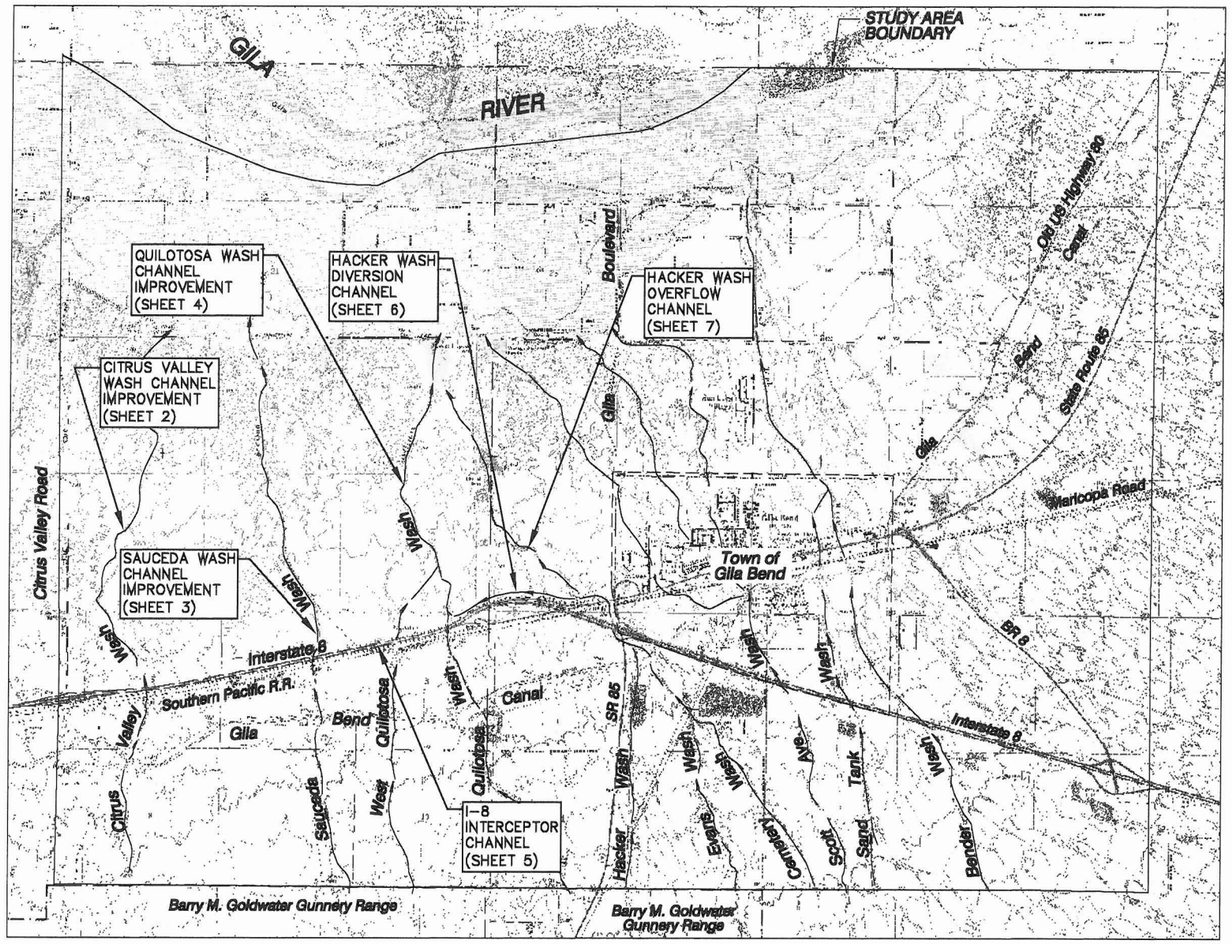
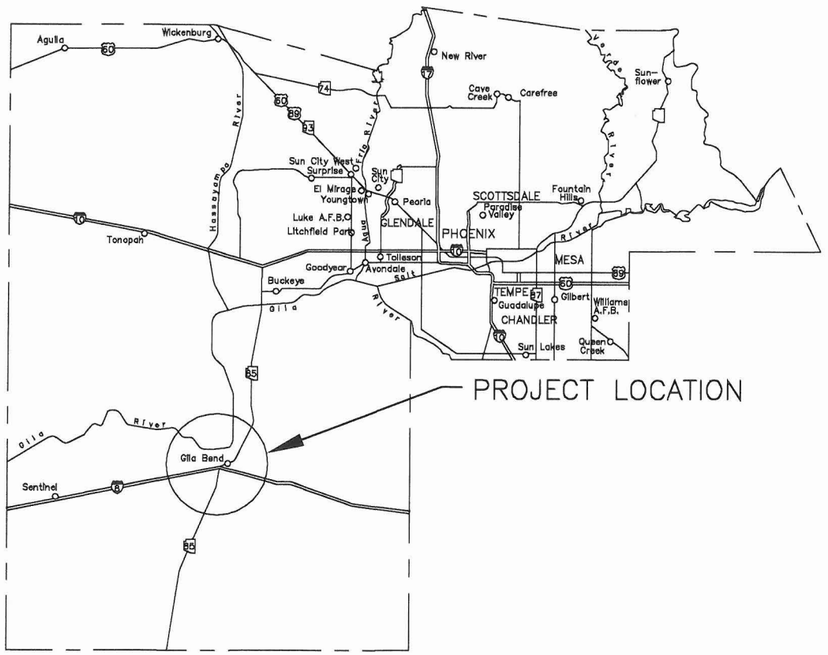
GILA BEND ADMP
Concept Plans for Developer–Built Elements
FCD PROJECT NO. 99–18



VICINITY MAP

Not to Scale



MARICOPA COUNTY

Not to Scale

SHEET INDEX

COVER SHEET

NO.	REVISION	BY	DATE
3			
2			
1			

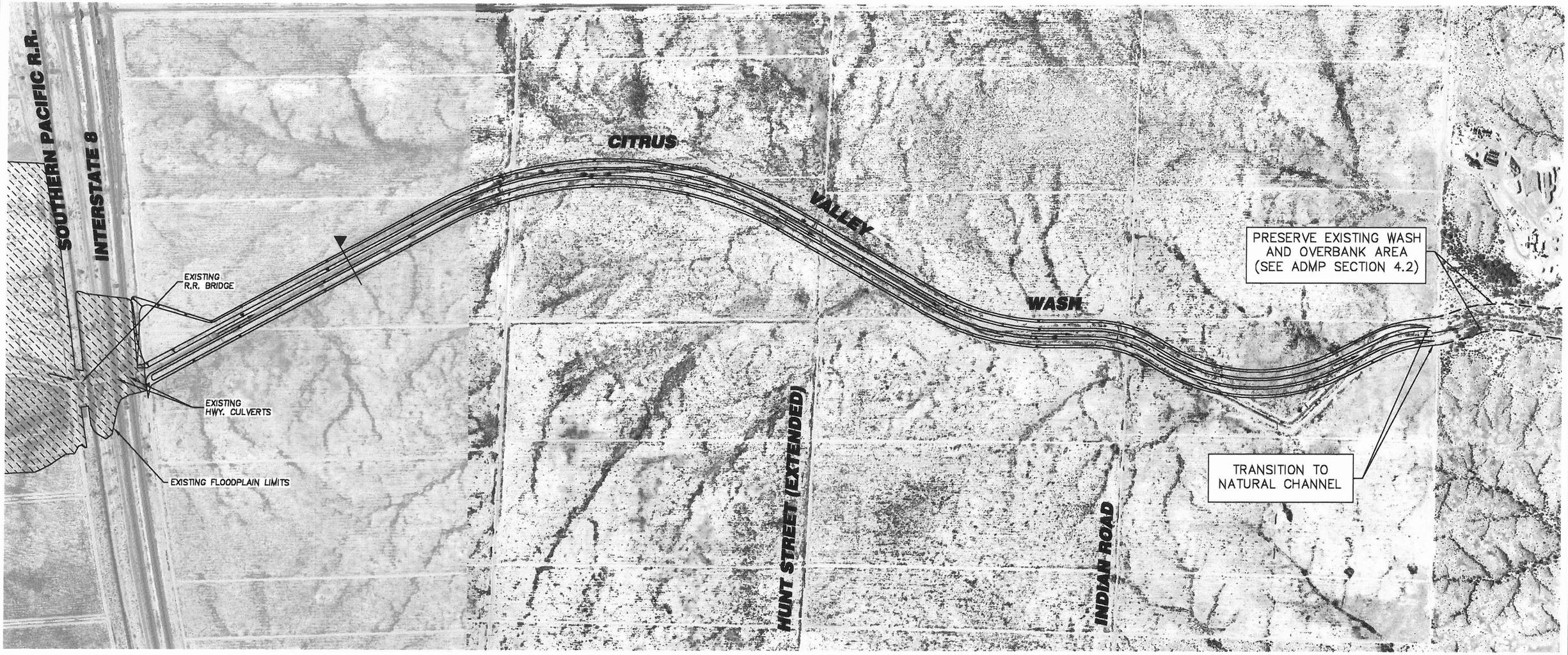
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

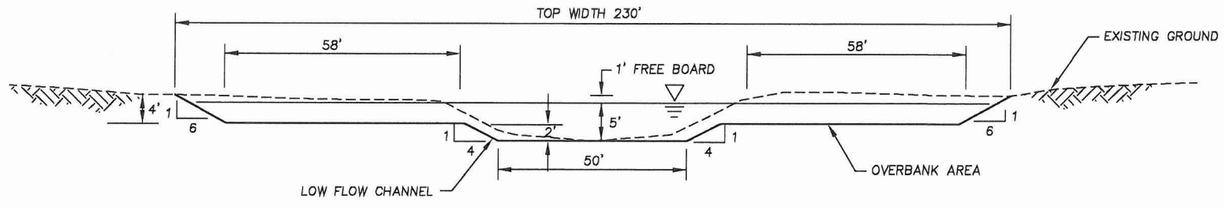
GILA BEND ADMP
Concept Plans for Developer–Built Elements
FCD PROJECT NO. 99–18

	BY	DATE
DESIGNED	MJR	04/01
DRAWN	KLH	04/01
CHECKED	MTG	04/01

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

COVER SHEET — SHEET OF 1 7





CITRUS VALLEY WASH
TYPICAL CHANNEL SECTION
NTS

S=0.4%
Q_{100} =3,100 cfs

N

400 200 0 400 800

GRAPHIC SCALE: 1in. = 400ft.

CITRUS VALLEY WASH
CHANNEL IMPROVEMENT PLAN

NO.	REVISION	BY	DATE
3			
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1			

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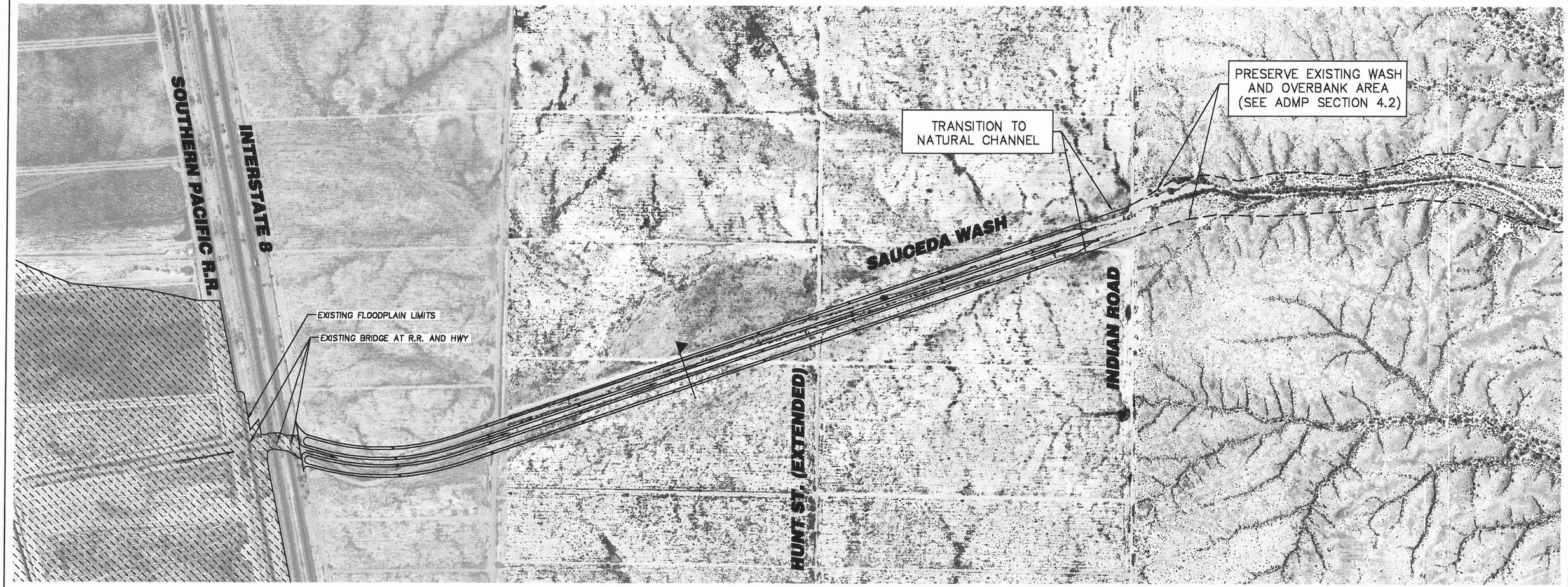
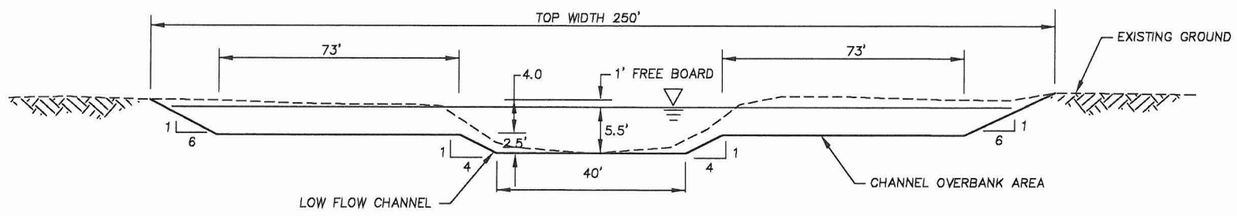
CITRUS VALLEY WASH

SHEET OF 2 7





SAUCEDA WASH
TYPICAL CHANNEL SECTION
NTS

S=0.59%
Q_{100} =4,800 cfs

N

400 200 0 400 800

GRAPHIC SCALE: 1in. = 400ft.

SAUCEDA WASH
CHANNEL IMPROVEMENT PLAN

NO.	REVISION	BY	DATE
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SAUSEDA WASH

SHEET OF 3 7

I-8 INTERCEPTOR CHANNEL

FLOODPLAIN LIMITS

EXISTING 3-12'x8' CBC

SOUTHERN PACIFIC R.R.

INTERSTATE 8

TRANSITION TO NATURAL CHANNEL

Quilotosa Wash

PRESERVE EXISTING WASH AND OVERBANK AREA (SEE ADMP SECTION 4.2)

WATERMELON ROAD

OHE

100 YEAR FLOOD SPILLS OVER I-8

EXISTING 3-12'x8' CBC

EXISTING HACKER WASH DIVERSION CHANNEL

HUNT ST. (EXTENDED)

INDIAN ROAD

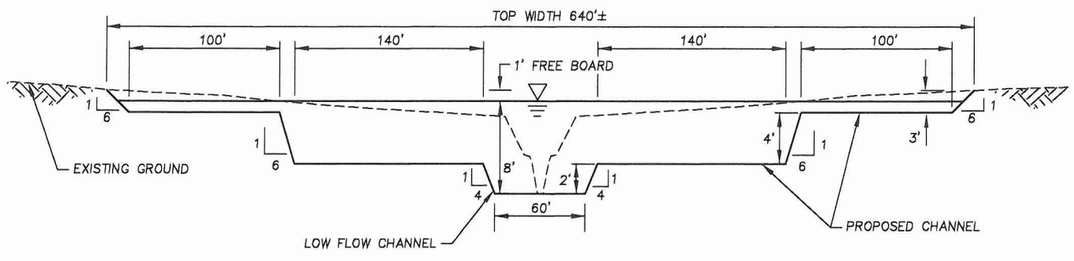
LEGEND

EXISTING 100 YEAR FLOODPLAIN (DETAILED STUDY)

N

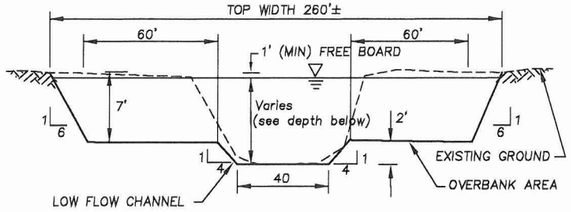
400 200 0 400 800

GRAPHIC SCALE: 1In. = 400ft.



QUILOTOSA WASH
TYPICAL CHANNEL SECTION
1 NTS

S=0.4%
Q_{100} =16,950 cfs



QUILOTOSA WASH AND
WEST QUILOTOSA WASH
TYPICAL CHANNEL SECTION
2 NTS

S=0.4%
Q_{100} =8,900 cfs QUILOTOSA (Depth=7.75')
Q_{100} =8,050 cfs W. QUILOTOSA(Depth=7.4')

QUILOTOSA WASH
CHANNEL IMPROVMENT PLAN

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QUILOTOSA WASH

SHEET OF 4 7

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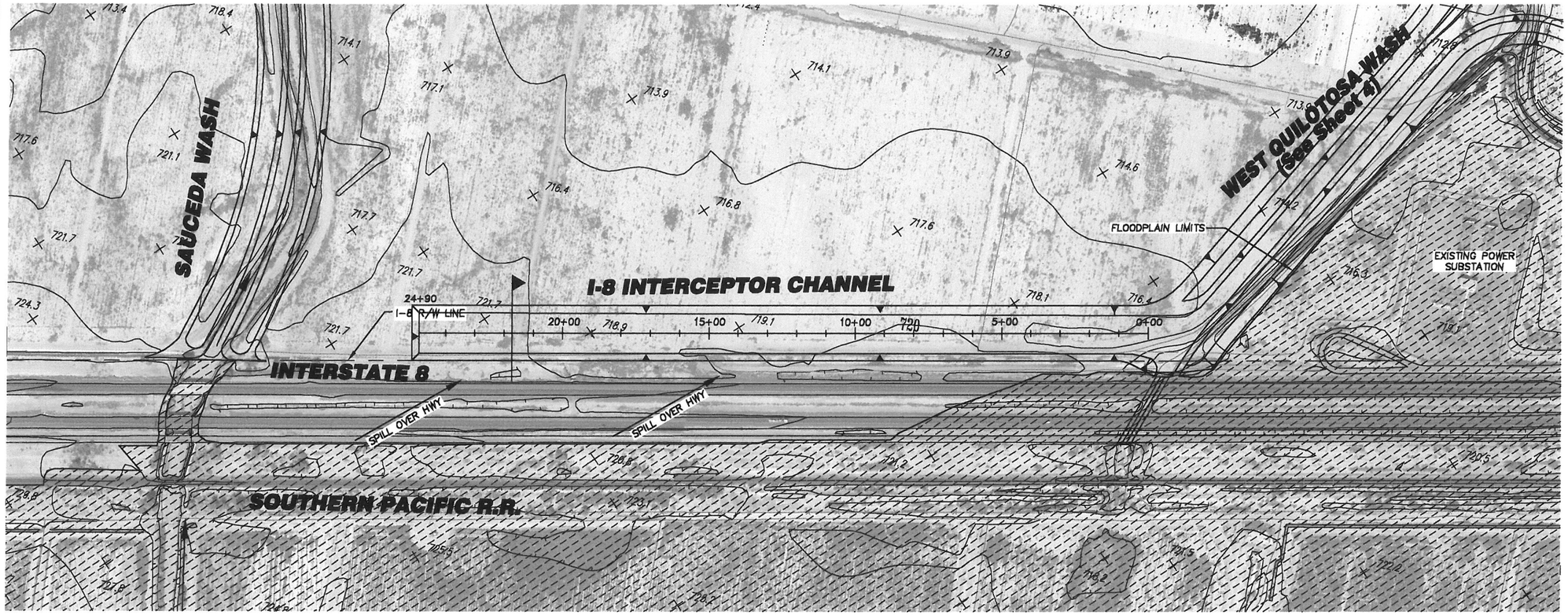
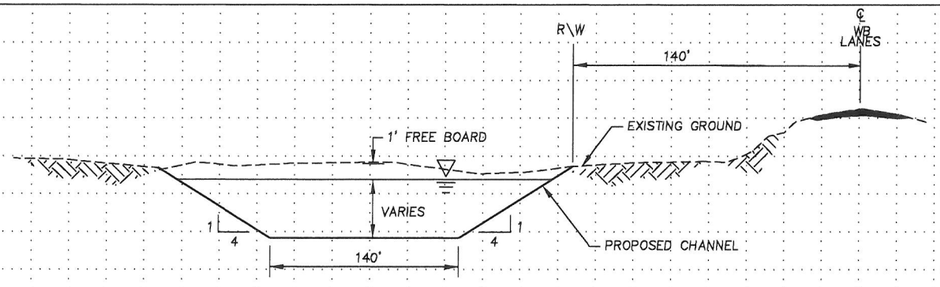
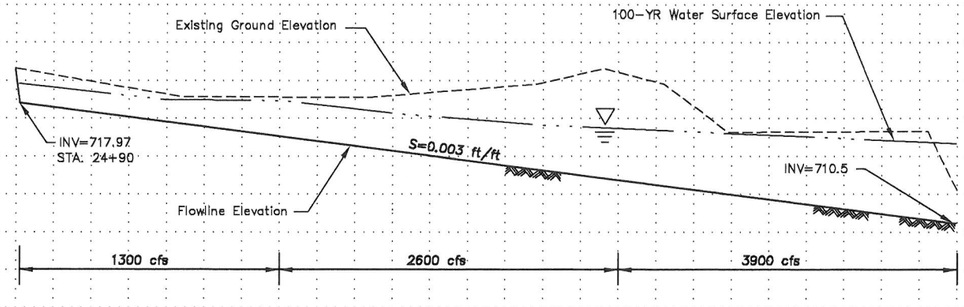




I-8 INTERCEPTOR CHANNEL
TYPICAL SECTION
NTS

S=0.003%
Q_{100}=SEE PROFILE BELOW



LEGEND

EXISTING 100 YEAR FLOODPLAIN (DETAILED STUDY)

724.5 EXISTING GROUND ELEVATION

716 PROPOSED GROUND ELEVATION

200 100 0 200 400

GRAPHIC SCALE: 1 in. = 200 ft. H
1 in. = 5 ft. V

I-8 INTERCEPTOR CHANNEL
PRELIMINARY
PLAN AND PROFILE

NO.	REVISION	BY	DATE
3			
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1			

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

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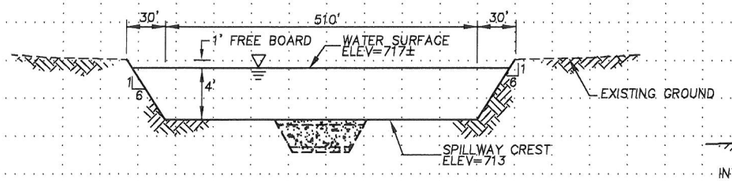
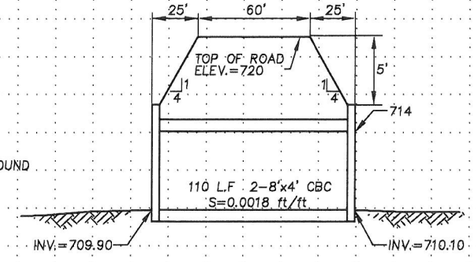
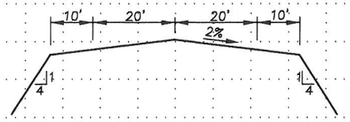


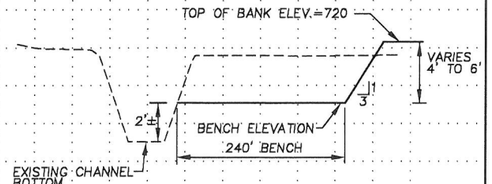
▲NTS SPILLWAY SECTION A-A



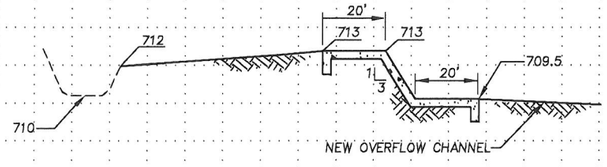
▲NTS HACKER WASH DIVERSION LENGTHEN CULVERT



▲NTS NEW ACCESS ROAD TYPICAL SECTION

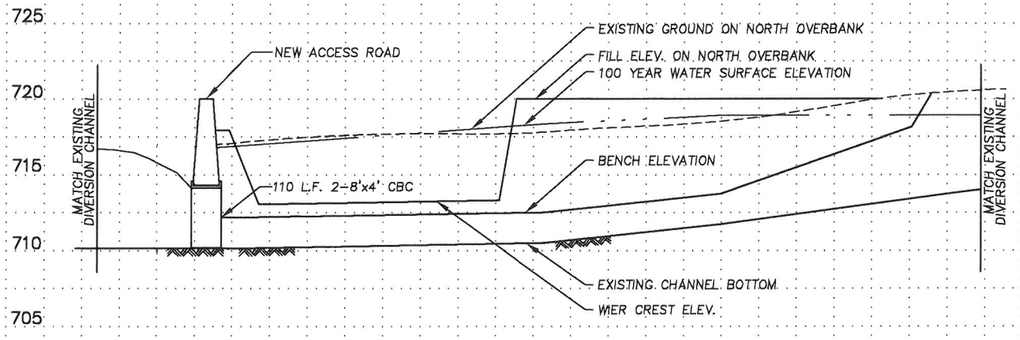


▲NTS HACKER WASH DIVERSION CHANNEL



▲NTS SPILLWAY SECTION B-B

SECTION SHOWN WITH THE SPILLWAY DROPPING DOWN TO THE LOW FLOW CHANNEL OF THE HACKER WASH OVERFLOW CHANNEL. THE VERTICAL DISTANCE VARIES ACROSS THE CROSS SECTION, FROM 0' AT THE EDGES OF THE SPILLWAY TO 3.5' AT THE CENTER. EROSION PROTECTION SHOULD BE INCLUDED AT THE LOW FLOW CHANNEL.



LEGEND

EXISTING 100 YEAR FLOODPLAIN (DETAILED STUDY)

724.5 EXISTING GROUND ELEVATION

716+ PROPOSED GROUND ELEVATION

200 100 0 200 400

GRAPHIC SCALE: 1in. = 200ft. H
1in. = 5ft. V

HACKER WASH DIVERSION CHANNEL PLAN AND PROFILE

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FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

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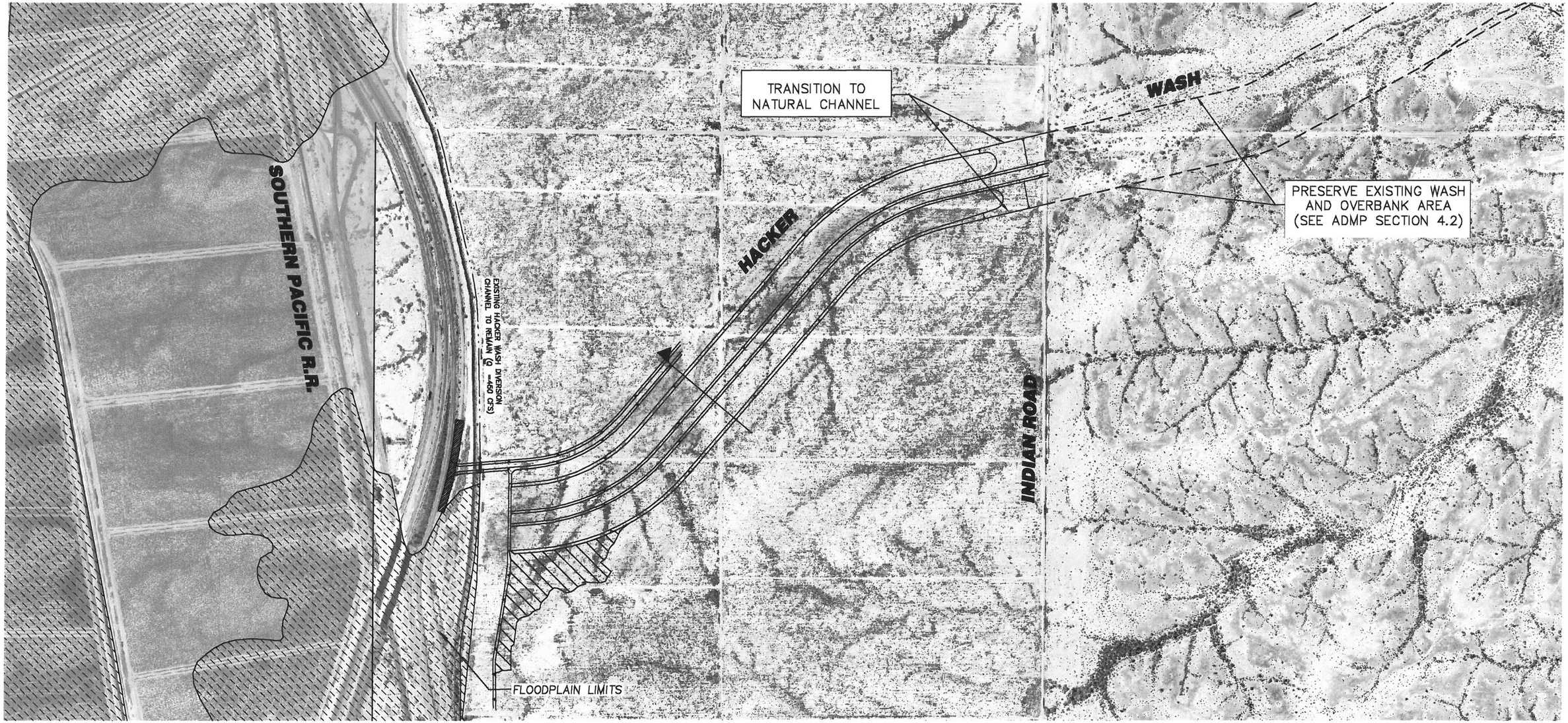
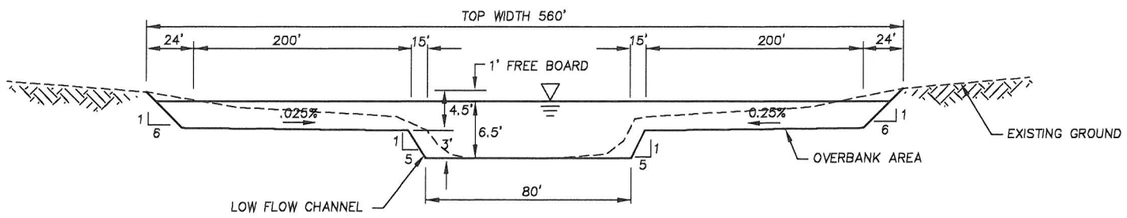
HACKER WASH DIVERSION CHANNEL

SHEET OF 6 7





HACKER WASH
TYPICAL OVERFLOW CHANNEL SECTION
NTS

S=0.3%
Q_{100} = 8250 cfs

N

400 200 0 400 800

GRAPHIC SCALE: 1in. = 400ft.

HACKER WASH
PRELIMINARY
OVERFLOW CHANNEL PLAN

NO.	REVISION	BY	DATE
3			
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1			

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

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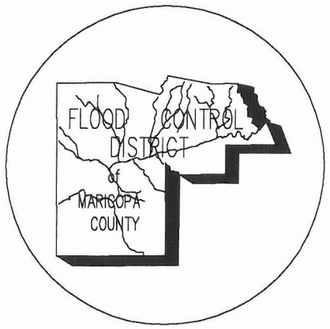
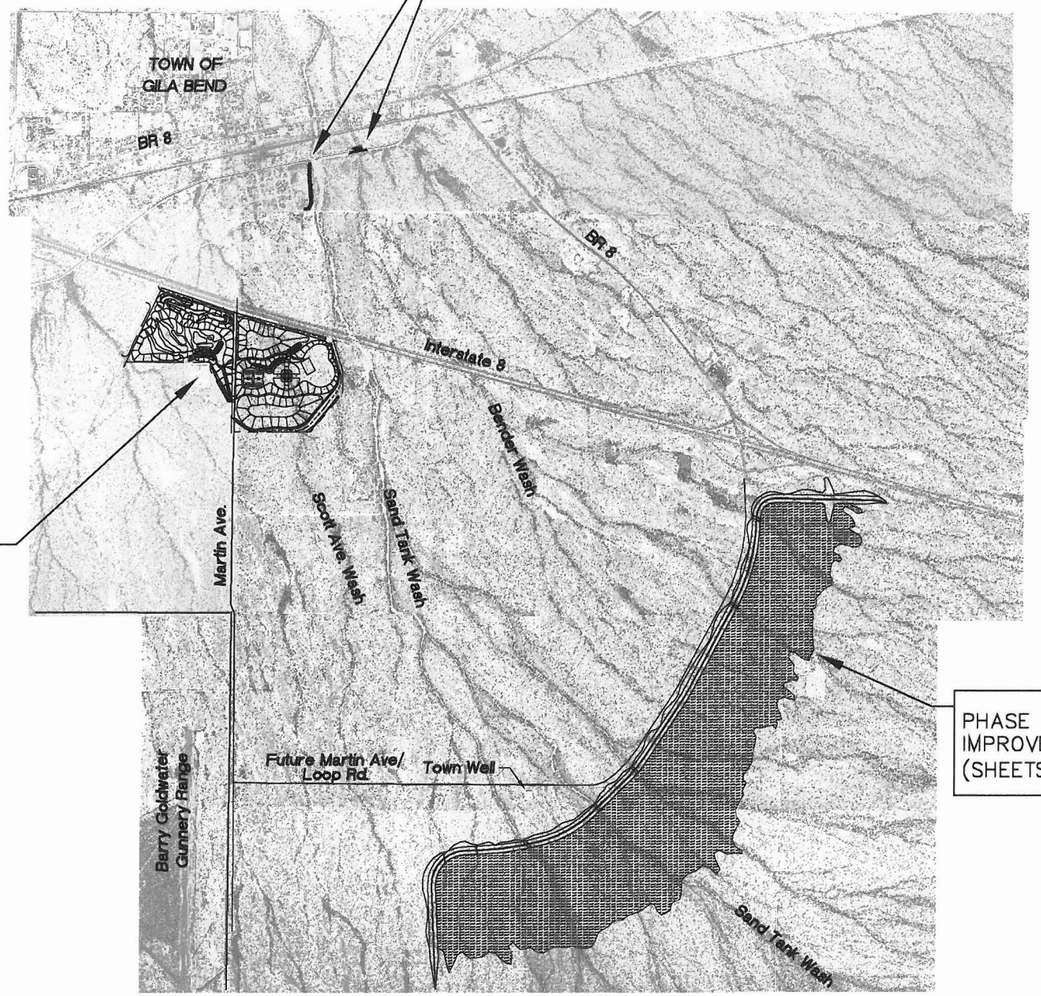
HACKER WASH OVERFLOW

SHEET OF 7 7

Sand Tank Wash Flood Control Improvements

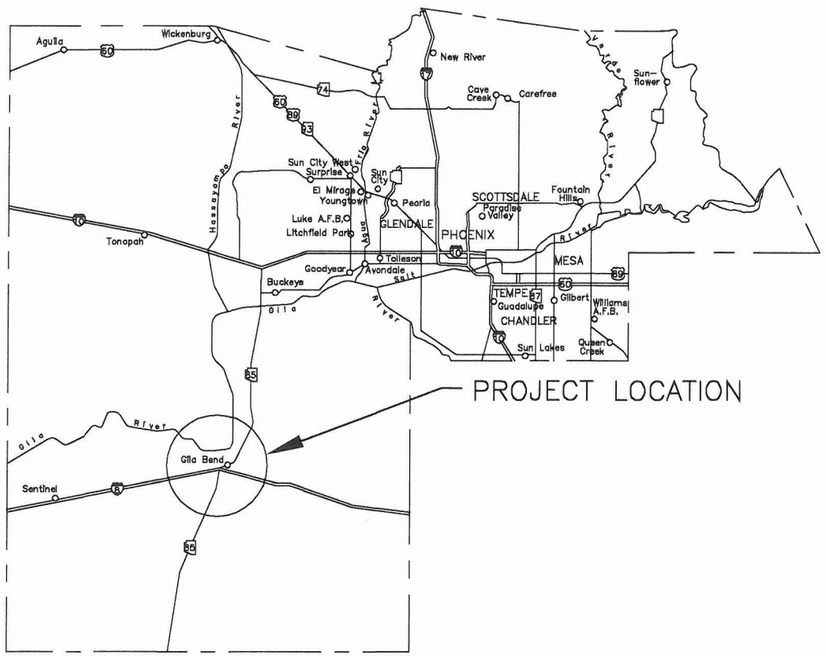
GILA BEND ADMP
Sand Tank Wash Flood Control Improvements
FCD PROJECT NO. 99-18





VICINITY MAP

Not to Scale



MARICOPA COUNTY

Not to Scale

SHEET INDEX

COVER SHEET

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FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

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Sand Tank Wash Flood Control Improvements
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COVER SHEET — SHEET OF 1 6

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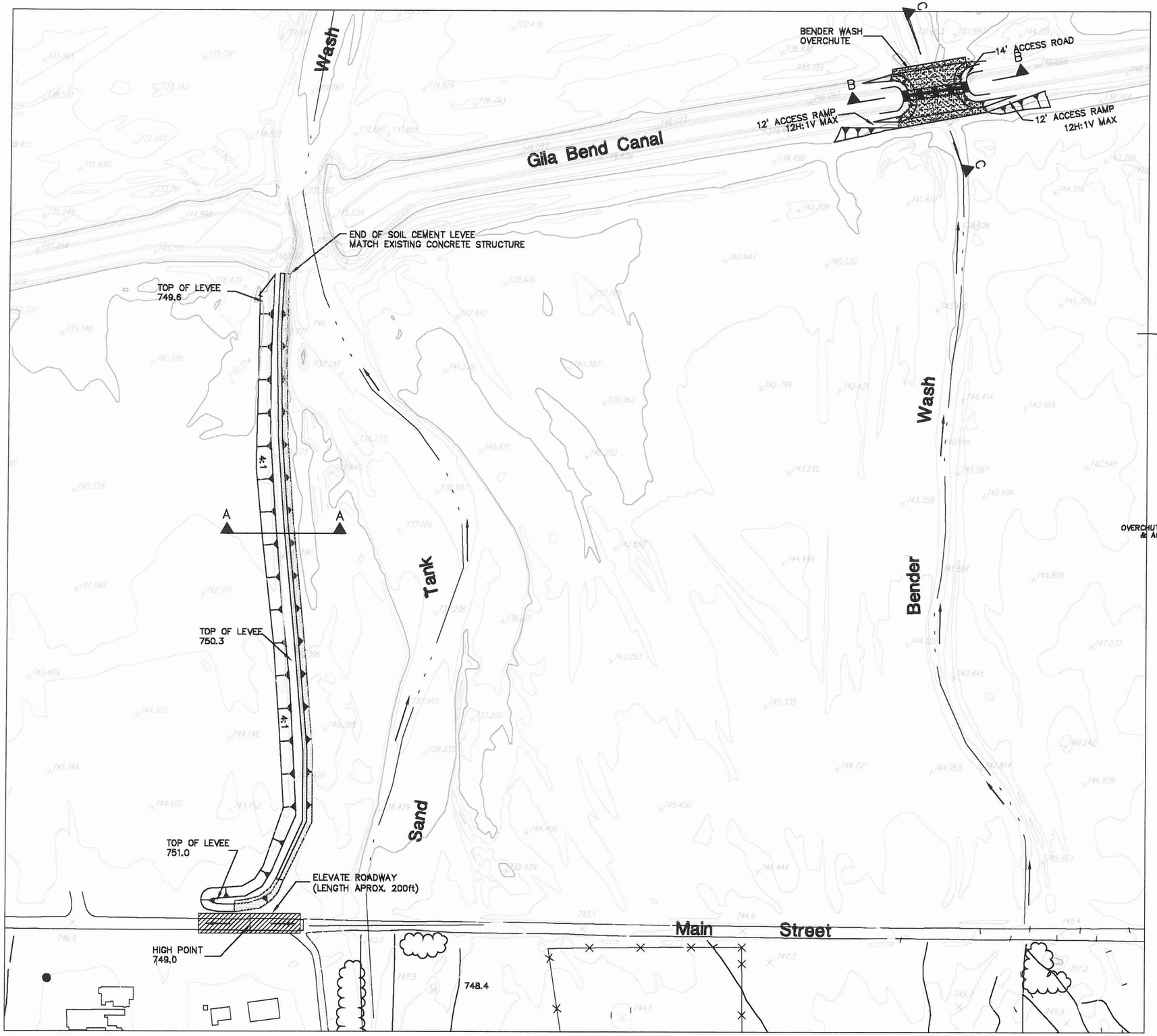
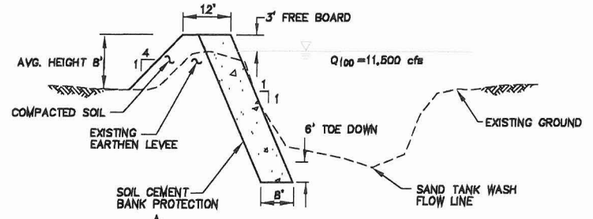
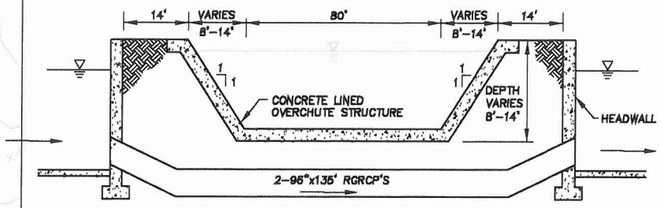
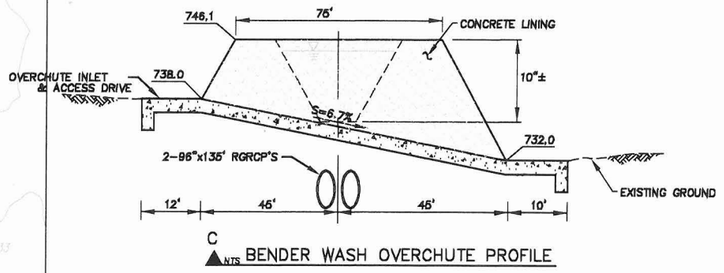




A NTS SAND TANK WASH LEVEE



B NTS BENDER WASH OVERCHUTE CROSS SECTION



C NTS BENDER WASH OVERCHUTE PROFILE

N:\99541\dwg\Level3\CP-SandTankW-FC-IMPS\fci-ex04-8.dwg, 06/20/02 12:58:17 PM

PHASE 1
FLOOD CONTROL IMPROVEMENTS
SAND TANK WASH
LEVEE RECONSTRUCTION
BENDER WASH OVERCHUTE

NO.	REVISION	BY	DATE
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1			

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

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Sand Tank Wash Flood Control Improvements
FCD PROJECT NO. 99-18

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CHECKED	MTG	04/01

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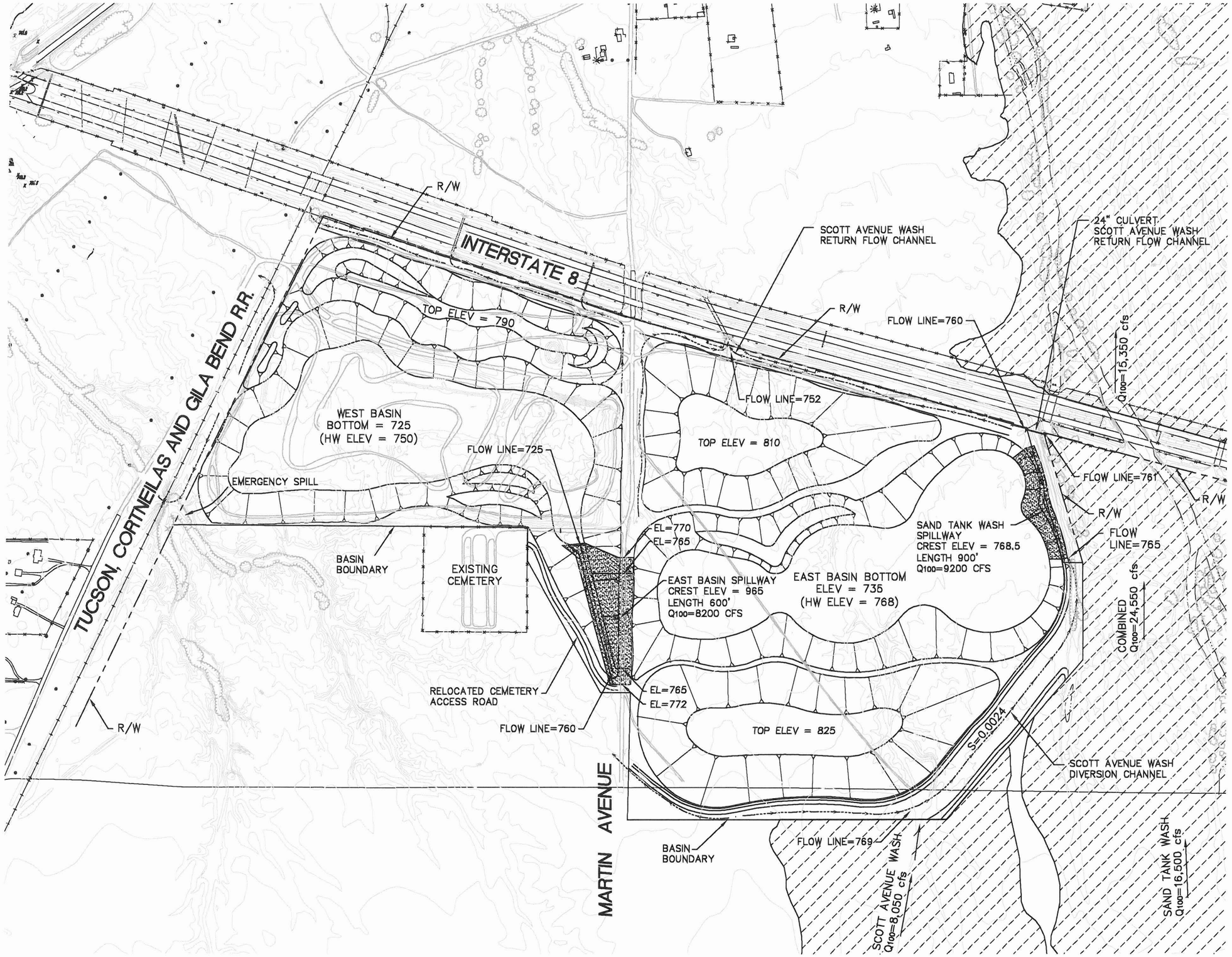
N

100 50 0 100 200

GRAPHIC SCALE: 1 in. = 100 ft.



LEGEND

- 100-YEAR FLOODPLAIN
- SOIL CEMENT SPILLWAY
- DIRECTION OF FLOW
- SIDE SLOPES

N

300 150 0 300 600

PHASE 2
FLOOD CONTROL IMPROVEMENTS
I-8 FLOODWATER RETENTION BASIN &
SCOTT AVENUE WASH DIVERSION

NO.	REVISION	BY	DATE
3			
2			
1			

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

GILA BEND ADMP
Sand Tank Wash Flood Control Improvements
FCD PROJECT NO. 99-18

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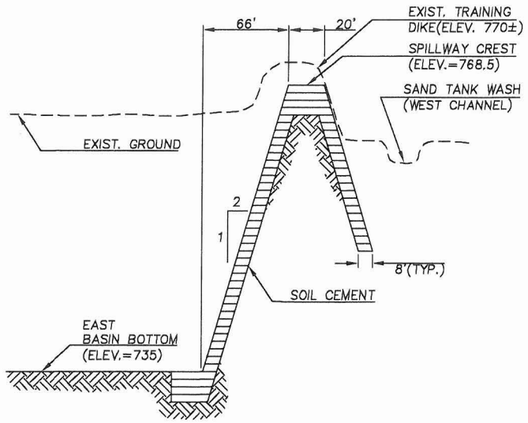
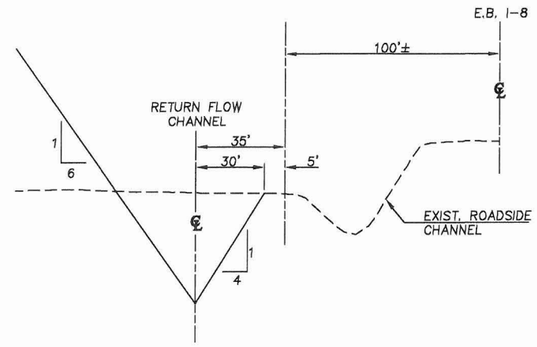
PHASE 2
FLOOD CONTROL IMPROVEMENTS

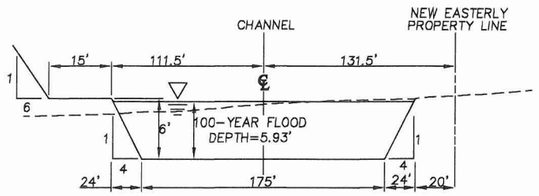
SHEET OF 3 6



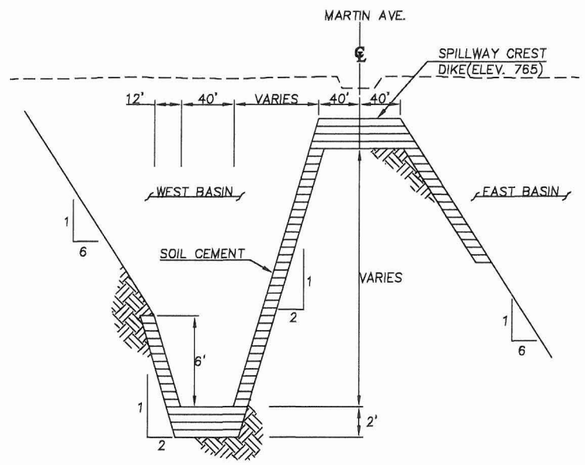
▲NTS FLOODWATER DETENTION BASINS AT I–8
SAND TANK WASH SPILLWAY (INTO EAST BASIN)



▲NTS FLOODWATER RETENTION BASINS AT I–8
SCOTT AVENUE WASH RETURN FLOW CHANNEL



▲NTS FLOODWATER RETENTION BASINS AT I–8
SCOTT AVENUE WASH DIVERSION CHANNEL



▲NTS FLOODWATER RETENTION BASINS AT I–8
EAST BASIN SPILLWAY(INTO WEST BASIN)

PHASE 2
DETAIL SHEET

NO.	REVISION	BY	DATE
3			
2			
1			

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

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Sand Tank Wash Flood Control Improvements
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PHASE 2
FLOOD CONTROL IMPROVEMENTS DETAILS

SHEET OF
4 6

Spoil from Retention Basins to be used for construction of phase 3 Earthen Dam

Spoil

Existing Basin

Spoil

Existing Basin

Spoil

Phase 2 Flood Control Improvement : I-8 Floodwater Retention Basin

Interstate 8

BR 8

Pioneer Cem.

Borrow Pit

Giant BM 819

Borrow Pits

Bender Wash

Sand Tank Wash

Scott Ave. Wash

Martin Ave.

1- 8 ft. x 6 ft. Box Culvert and 60 ft. spillway

1- 10 ft. x 6 ft. Box Culvert and 120 ft. spillway

Future Loop Road

A

A

2- 10 ft. x 6 ft. Box Culvert and 190 ft. spillway

Town Well

36 in. RCP

Future Martin Ave/ BR-8 Loop Rd.

W

6- 10 ft. x 6 ft. Box Culvert and 470 ft. spillway

2- 10 ft. x 6 ft. Box Culvert and 160 ft. spillway

W Sand Tank Wash

Barry Goldwater Gunnery Range

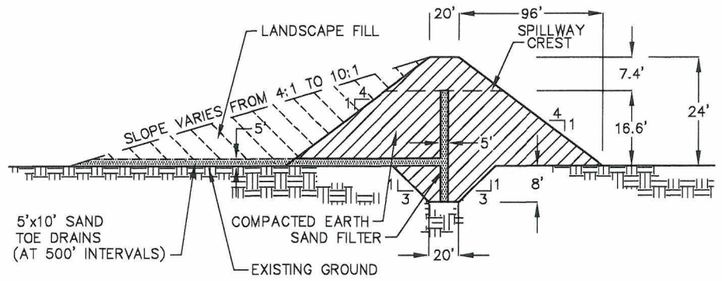
BM 796

BM 802

BM 837

BM 874X

Tower



EARTHEN DAM
TYPICAL SECTION A–A
NTS

LEGEND

- W — EXISTING TOWN OF GILA BEND WELL
- — PIPE CULVERT
- ▭ — BOX CULVERT WITH SPILLWAY
- — · — · — U.S.A.F. RANGE BOUNDARY
- ▨ — 100–YEAR FLOOD PONDING LIMITS

N
0 500 1000 2000

PHASE 3 FLOOD CONTROL IMPROVEMENTS – UPSTREAM DETENTION FACILITY

NO.	REVISION	BY	DATE
3			
2			
1			

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

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Sand Tank Flood Control Improvements
FCD PROJECT NO. 99–18

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TEL:(602)248–7702 FAX:(602)248–7851

SAND TANK WASH FLOOD CONTROL IMPROVEMENTS

SHEET OF 5 6

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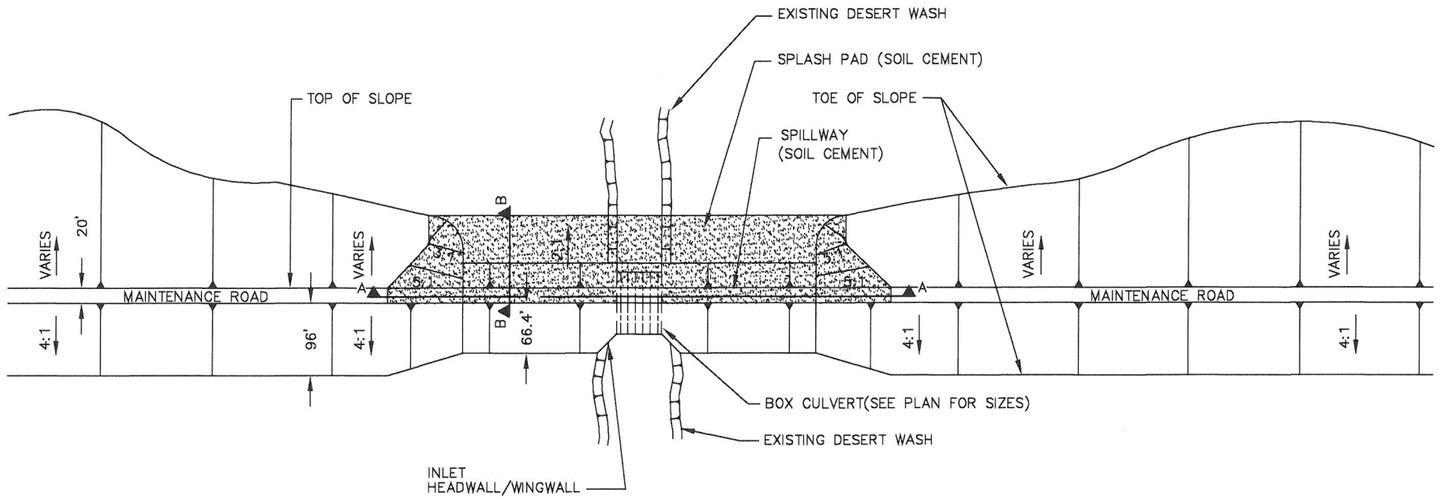
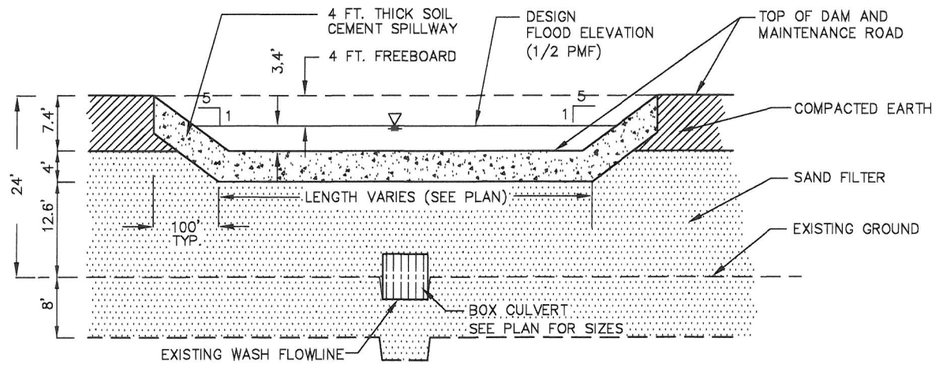


TYPICAL CULVERT/SPILLWAY PLAN DETAIL

HORIZ.: 1"=100'

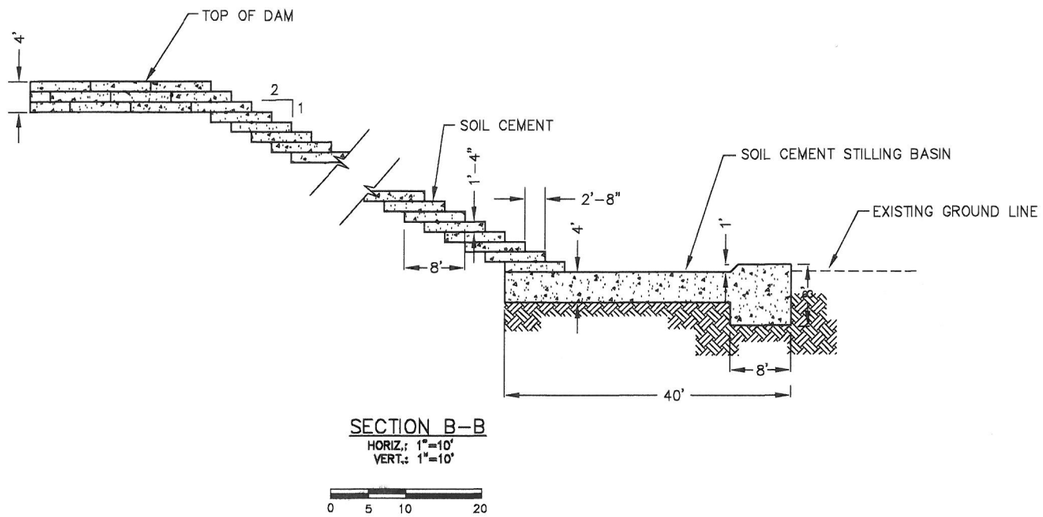
0 50 100 200



SECTION A–A

HORIZ.: 1"=100'
VERT.: 1"=10'

0 50 100 200



SECTION B–B

HORIZ.: 1"=10'
VERT.: 1"=10'

0 5 10 20

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UPSTREAM DETENTION FACILITY SPILLWAY/CULVERT DETAILS

NO.	REVISION	BY	DATE
3			
2			
1			

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

GILA BEND ADMP
Sand Tank Wash Flood Control Improvements
FCD PROJECT NO. 99-18

	BY	DATE
DESIGNED	LAV/MJR	04/01
DRAWN	CDW	04/01
CHECKED	MTG	04/01

eec
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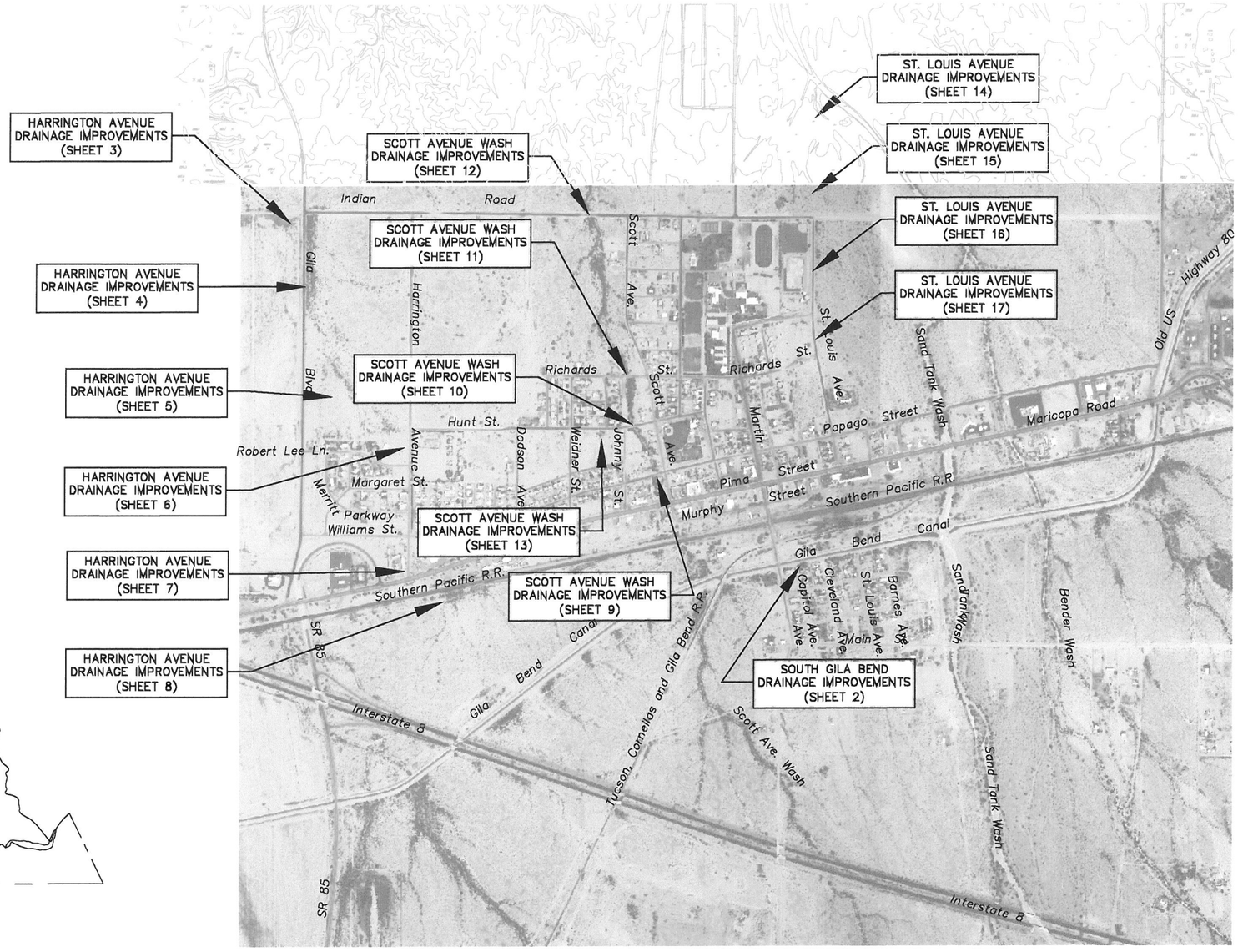
PHASE 3 FLOOD CONTROL IMPROVEMENTS

SHEET OF 6 6

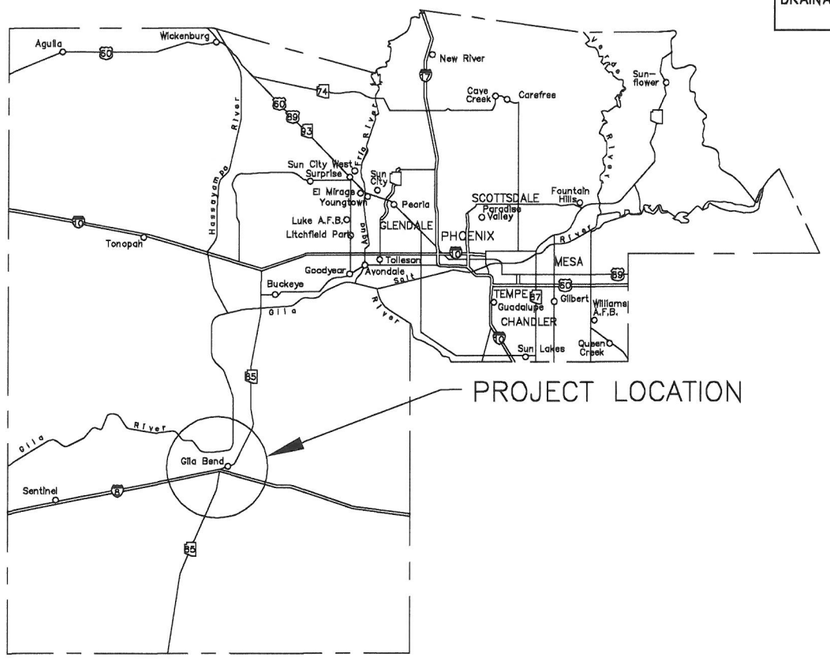
Town Core Area Drainage Improvements

GILA BEND ADMP
Town Core Area
Drainage Improvements
FCD PROJECT NO. 99-18



VICINITY MAP

Not to Scale



PROJECT LOCATION

MARICOPA COUNTY

Not to Scale

SHEET INDEX

COVER SHEET

NO.	REVISION	BY	DATE
3			
2			
1			

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

GILA BEND ADMP
Town Core Area Drainage Improvements
FCD PROJECT NO. 99-18

	BY	DATE
DESIGNED	MJR/LAV	04/01
DRAWN	RTJ	04/01
CHECKED	MTG	04/01

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COVER SHEET | SHEET OF 1 17

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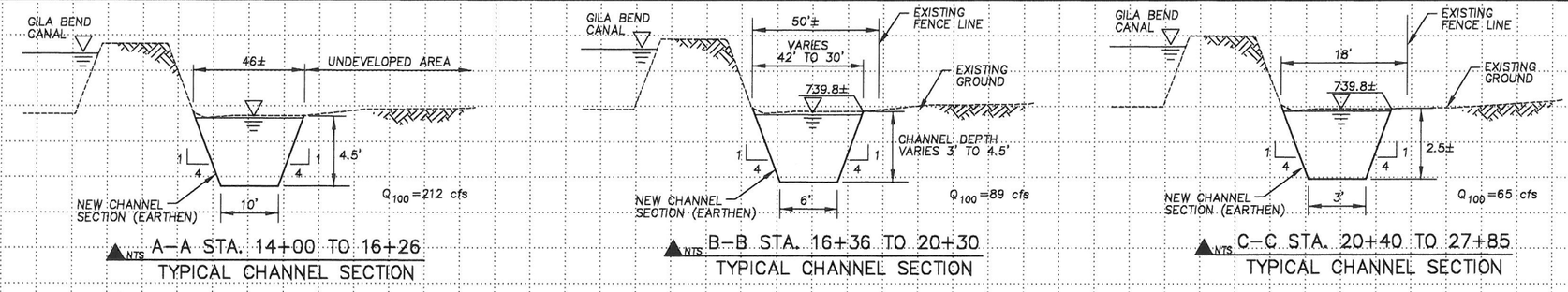

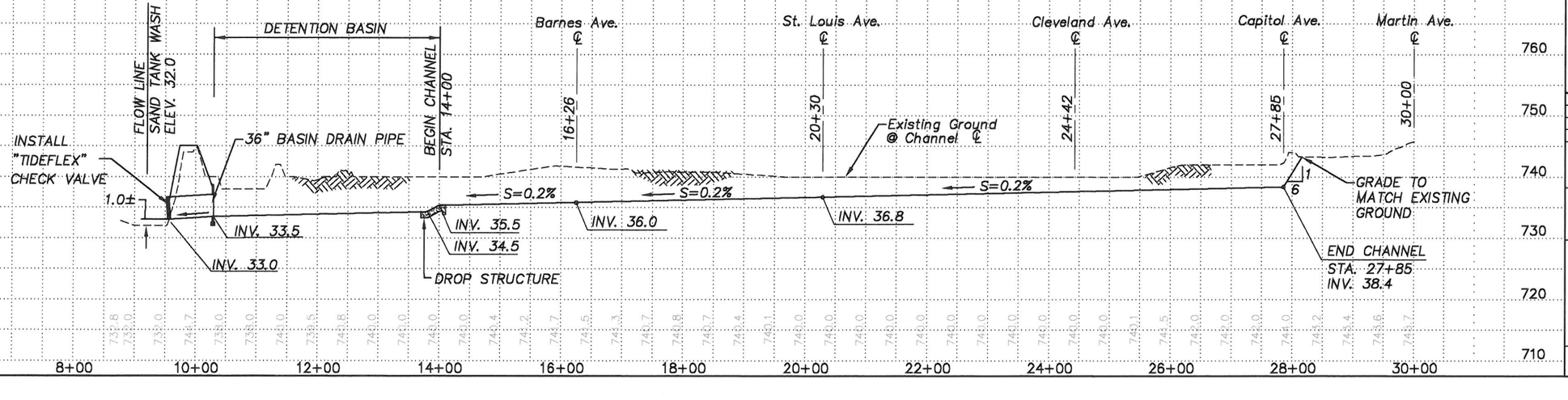

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IMPORTANT NOTE:

THE UNDEVELOPED PORTION OF THE CONTRIBUTING WATERSHED BETWEEN MAIN STREET AND I–8 MUST INCLUDE 100–YEAR, 2–HOUR STORM WATER RETENTION (IN ACCORDANCE WITH THE DRAINAGE REGULATIONS) IN THE FUTURE AS THE AREA DEVELOPS. THE CHANNEL AND DETENTION BASIN SHOWN HERON ARE DESIGNED WITHOUT FREEBOARD TO CONTAIN THE EXISTING CONDITIONS, 100–YEAR FLOOD. IF THE UNDEVELOPED AREA WERE TO DEVELOP WITHOUT PROVIDING STORM WATER RETENTION, THE LONG TERM LEVEL OF FLOOD PROTECTION WILL BE REDUCED.

100 50 0 100 200

GRAPHIC SCALE: 1 in. = 100 ft. H
1 in. = 10 ft V.

GILA BEND CANAL CHANNEL
PLAN AND PROFILE

NO.	REVISION	BY	DATE
3			
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1			

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

GILA BEND ADMP
Town Core Area Drainage Improvements
FCD PROJECT NO. 99–18

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DESIGNED	LAV/MJR	04/01
DRAWN	KLH	04/01
CHECKED	MTG	04/01

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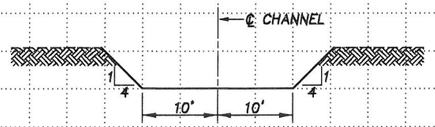
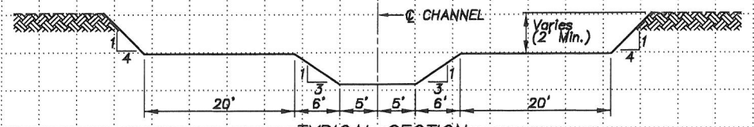
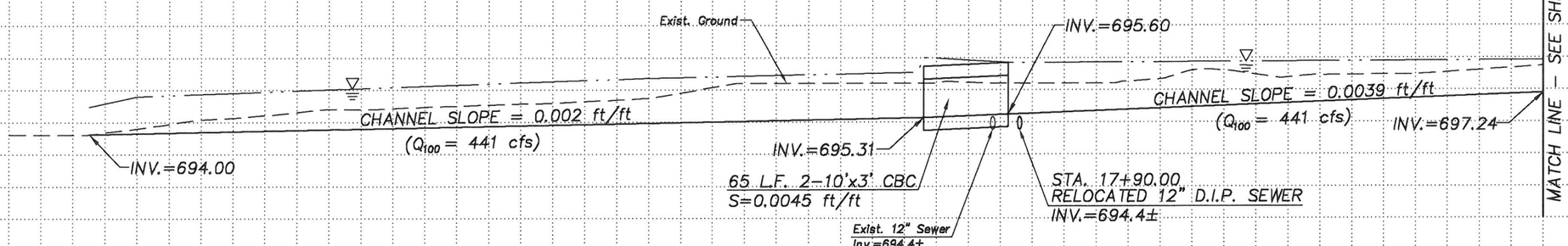


TYPICAL SECTION
DEVELOPER BUILT OUTLET CHANNEL
STA. 10+63 TO STA. 17+10



TYPICAL SECTION
DEVELOPER BUILT CHANNEL
STA. 17+80 TO STA. 48+30



50 25 0 50 100

GRAPHIC SCALE: 1 in. = 50 ft. HOR.
1 in. = 5 ft. VERT.

HARRINGTON AVENUE STORM DRAIN & OUTLET CHANNEL PLAN & PROFILE

NO.	REVISION	BY	DATE
3			
2			
1			

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

GILA BEND ADMP
Town Core Area Drainage Improvements
FCD PROJECT NO. 99-18

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CHECKED	MTG	04/01

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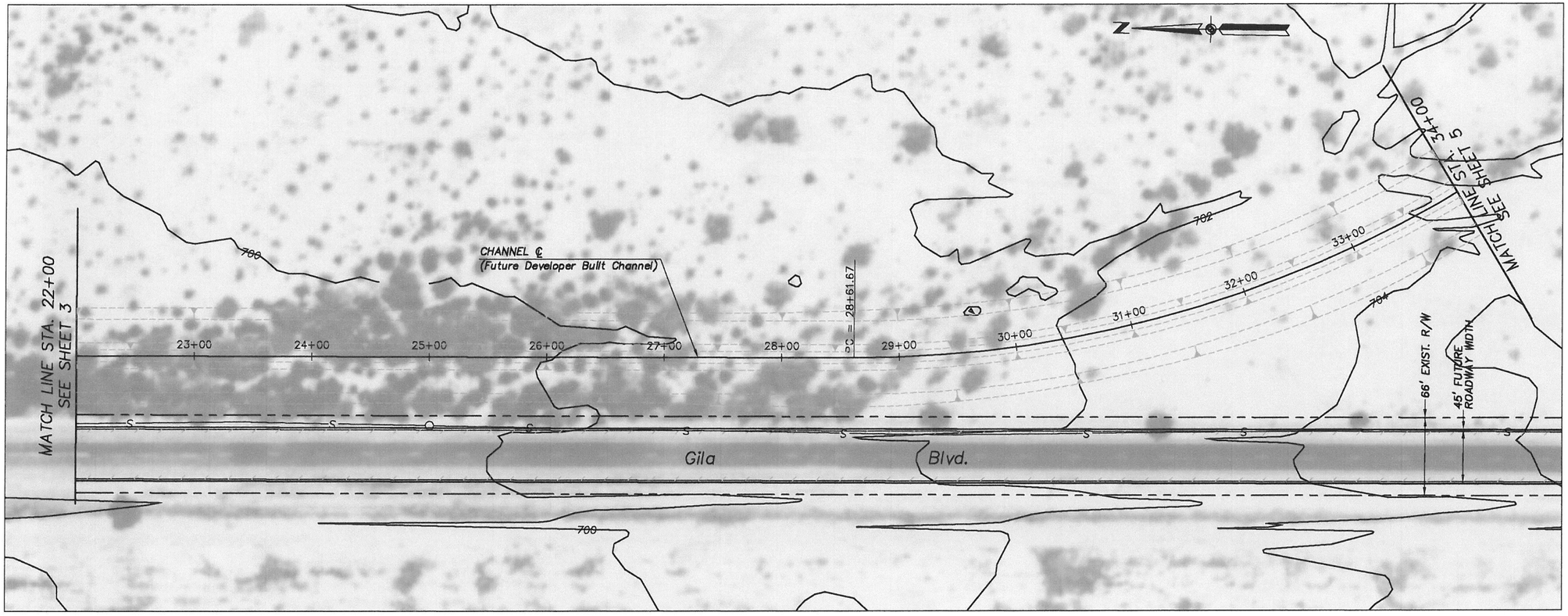

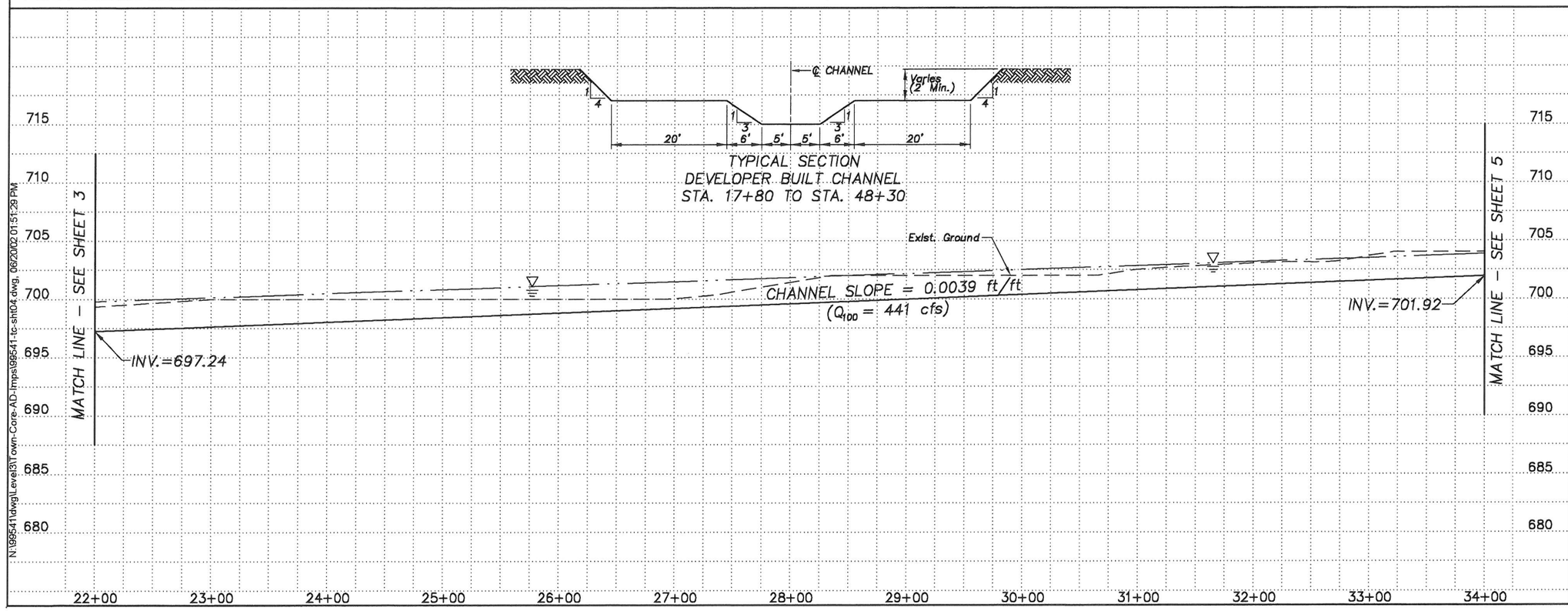

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50 25 0 50 100

GRAPHIC SCALE: 1 in. = 50 ft. HOR.
1 in. = 5 ft. VERT.

HARRINGTON AVENUE STORM DRAIN & OUTLET CHANNEL PLAN & PROFILE

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FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

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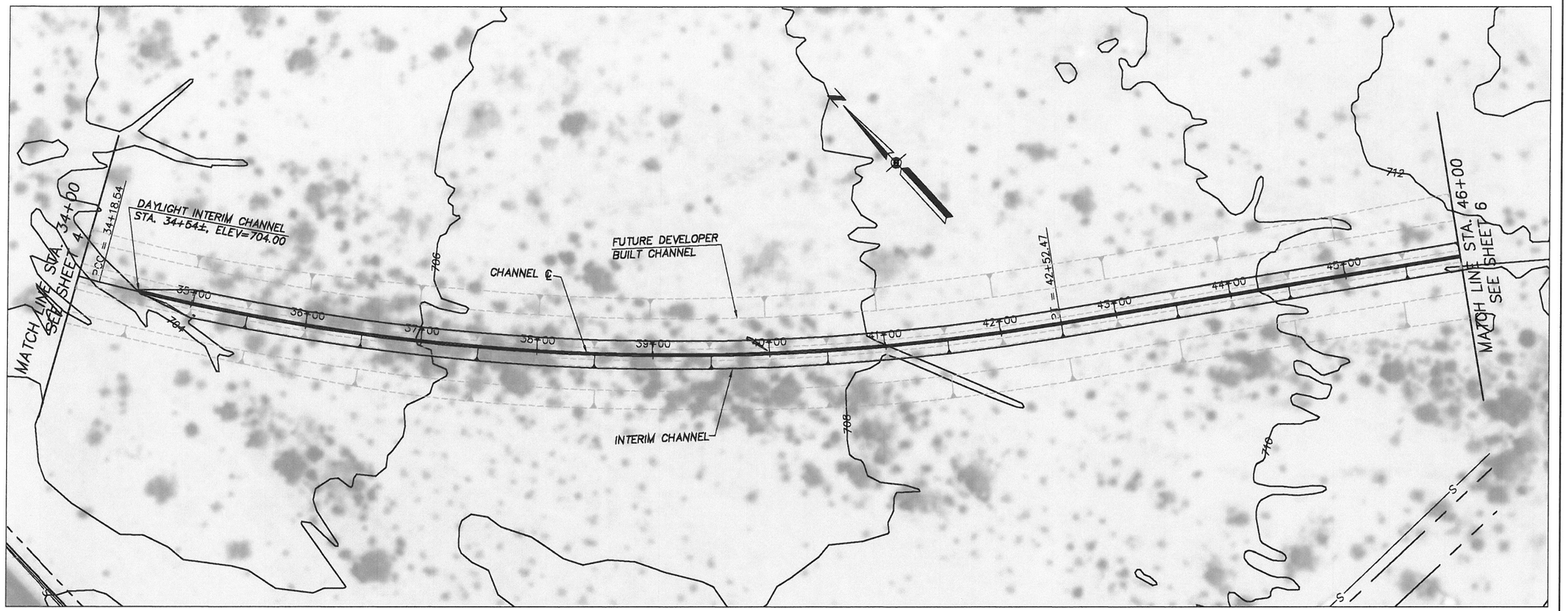
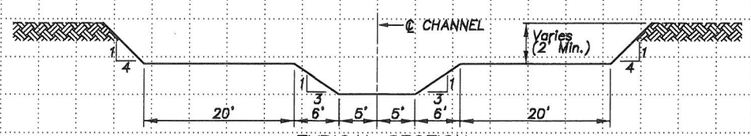
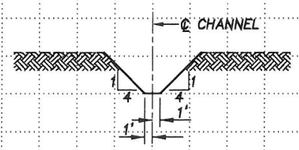
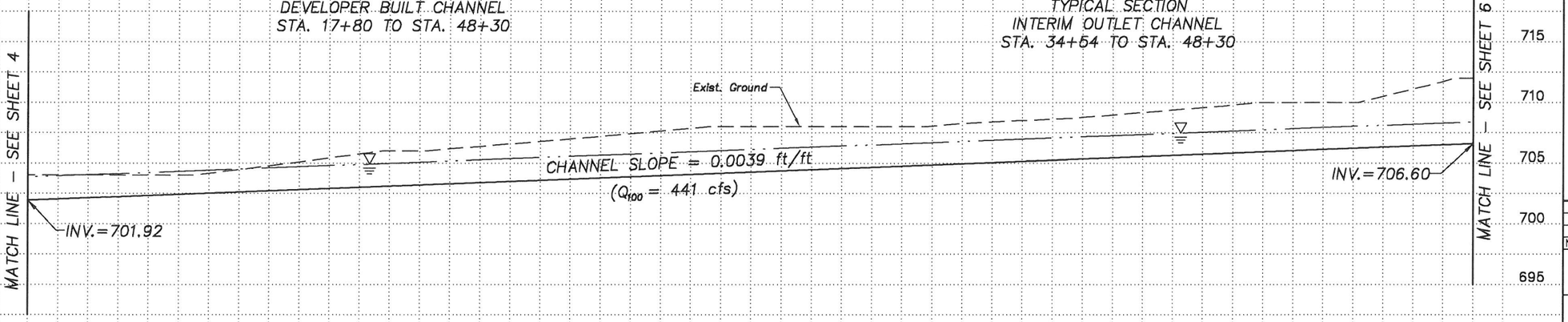




TYPICAL SECTION
DEVELOPER BUILT CHANNEL
STA. 17+80 TO STA. 48+30



TYPICAL SECTION
INTERIM OUTLET CHANNEL
STA. 34+54 TO STA. 48+30



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GRAPHIC SCALE: 1 in. = 50 ft. HOR.
1 in. = 5 ft. VERT.

HARRINGTON AVENUE STORM DRAIN & OUTLET CHANNEL PLAN & PROFILE

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FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

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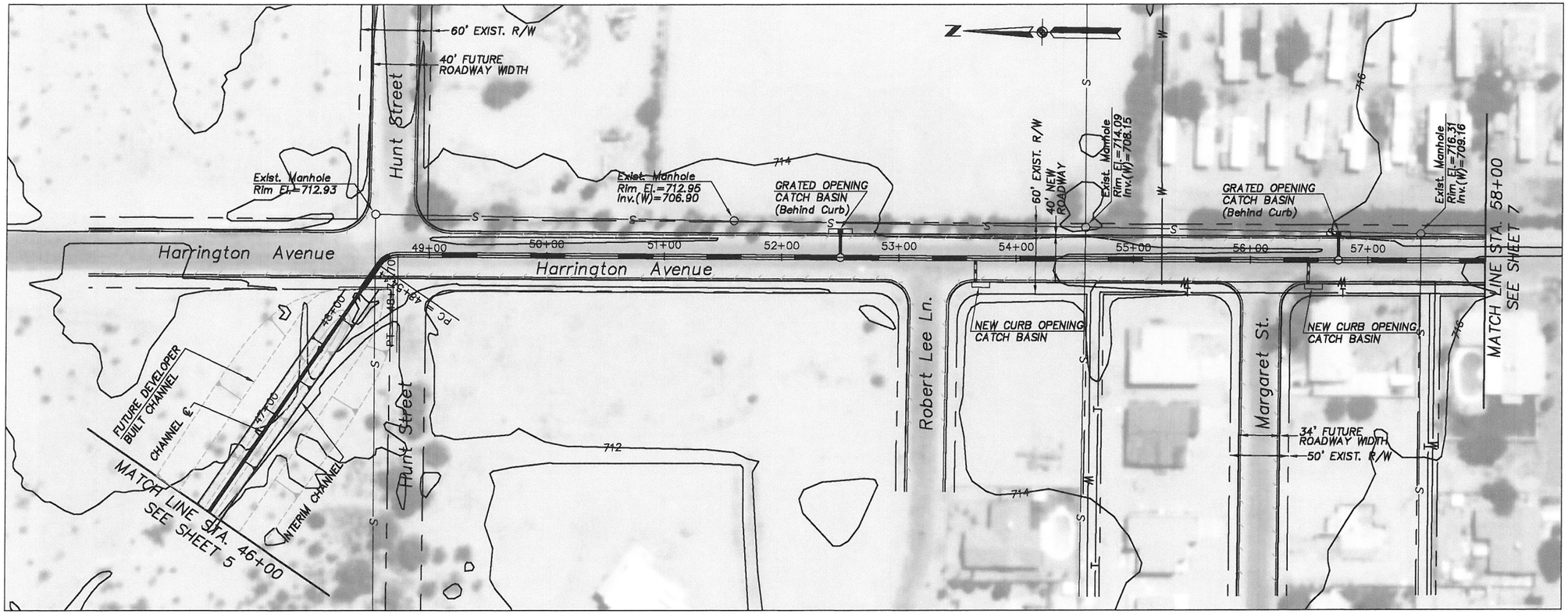

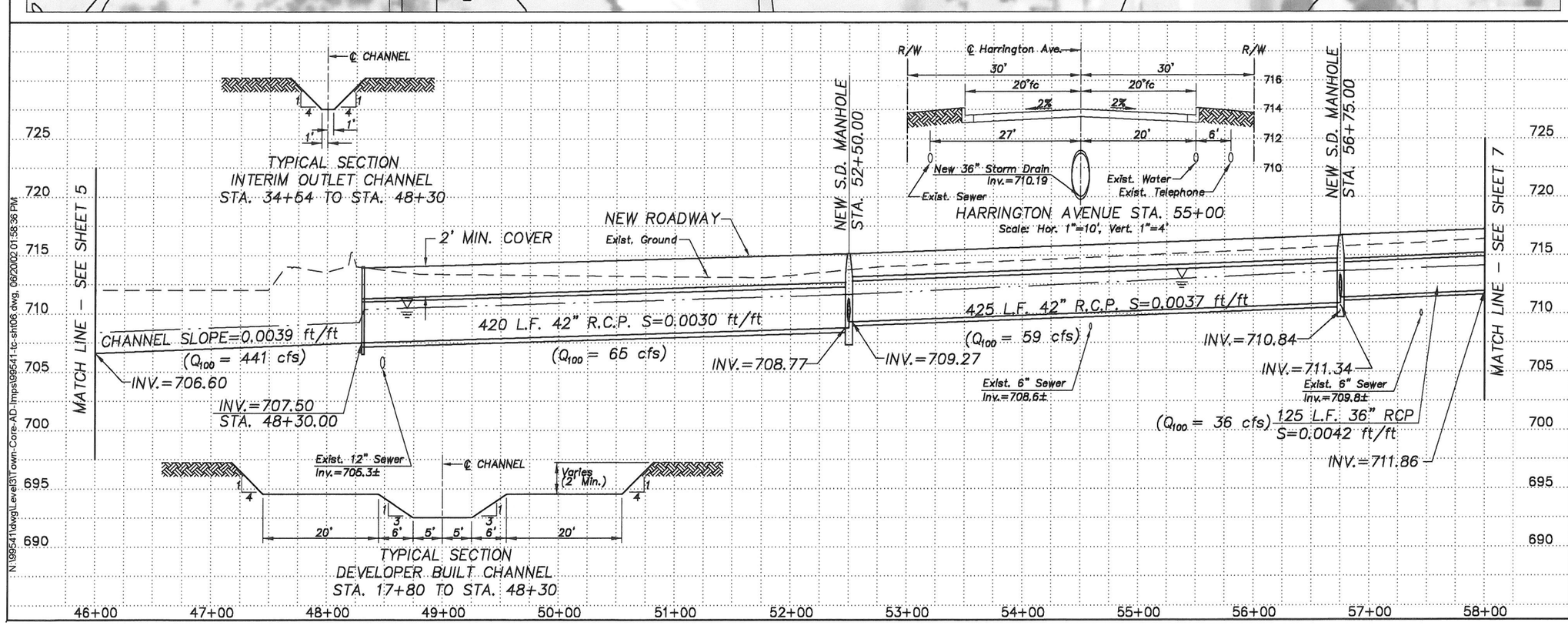

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GRAPHIC SCALE: 1 in. = 50 ft. HOR.
1 in. = 5 ft. VERT.

HARRINGTON AVENUE STORM DRAIN & OUTLET CHANNEL PLAN & PROFILE

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NO.	REVISION	BY	DATE
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FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

GILA BEND ADMP
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FCD PROJECT NO. 99-18

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CHECKED	MTG	04/01

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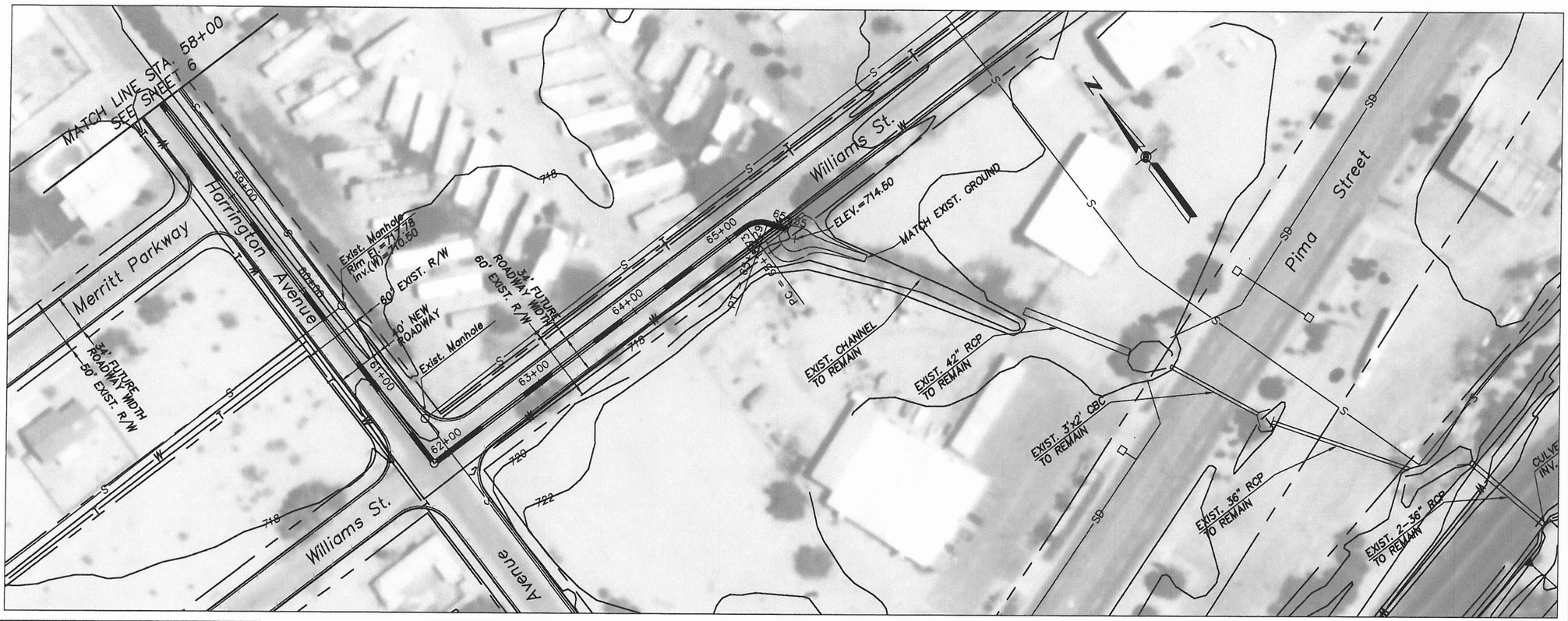

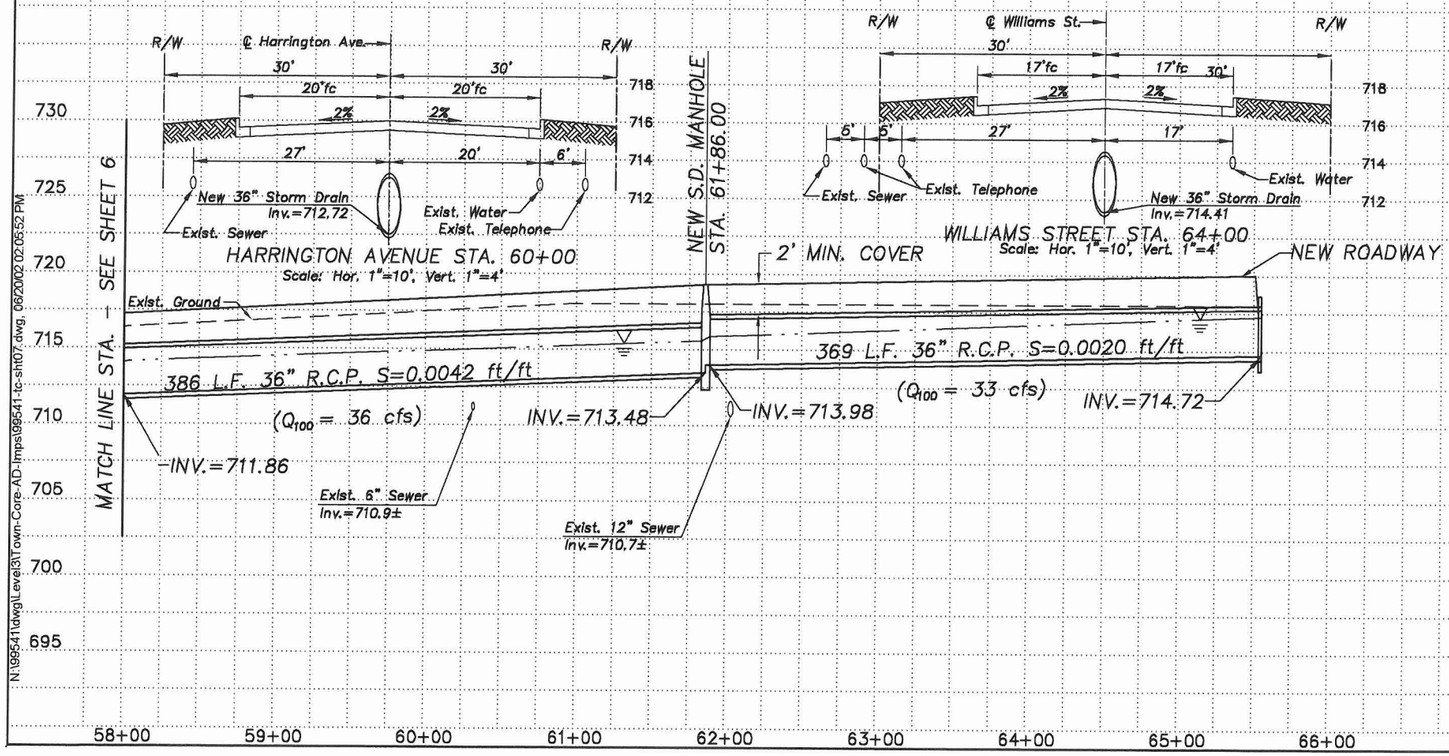

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GRAPHIC SCALE: 1 in. = 50 ft. HOR.
1 in. = 5 ft. VERT.

HARRINGTON AVENUE STORM DRAIN & OUTLET CHANNEL PLAN & PROFILE

NO.	REVISION	BY	DATE
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FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

GILA BEND ADMP
Town Core Area Drainage Improvements
FCD PROJECT NO. 99-18

	BY	DATE
DESIGNED	LAV/MJR	04/01
DRAWN	RTJ	04/01
CHECKED	MTG	04/01

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Ⓦ = NEW DRY WELL

50 25 0 50 100

GRAPHIC SCALE: 1 in. = 50 ft. HOR. 1 in. = 5 ft. VERT.

HARRINGTON AVENUE STORM DRAIN & OUTLET CHANNEL PLAN & PROFILE

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FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

GILA BEND ADMP
Town Core Area Drainage Improvements
FCD PROJECT NO. 99-18

	BY	DATE
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DRAWN	RTJ	04/01
CHECKED	MTG	04/01

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Phoenix, Arizona 85012-2905
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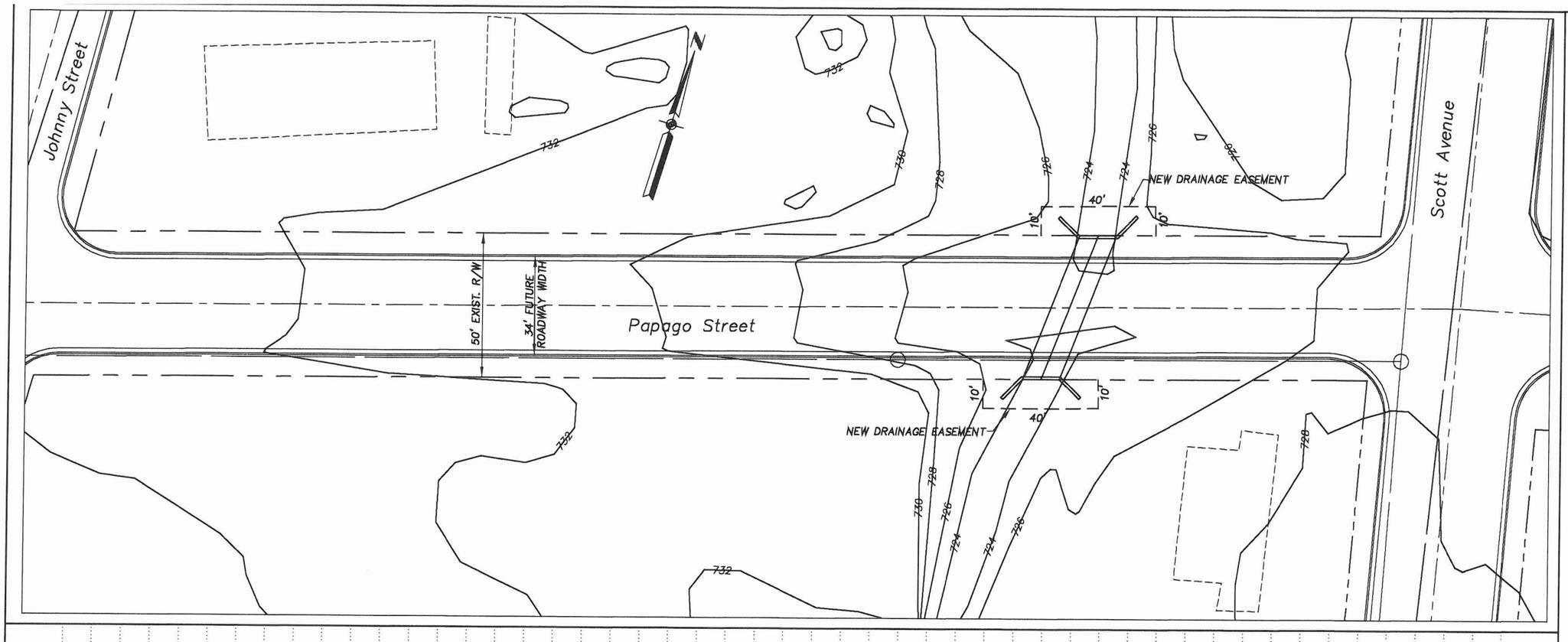

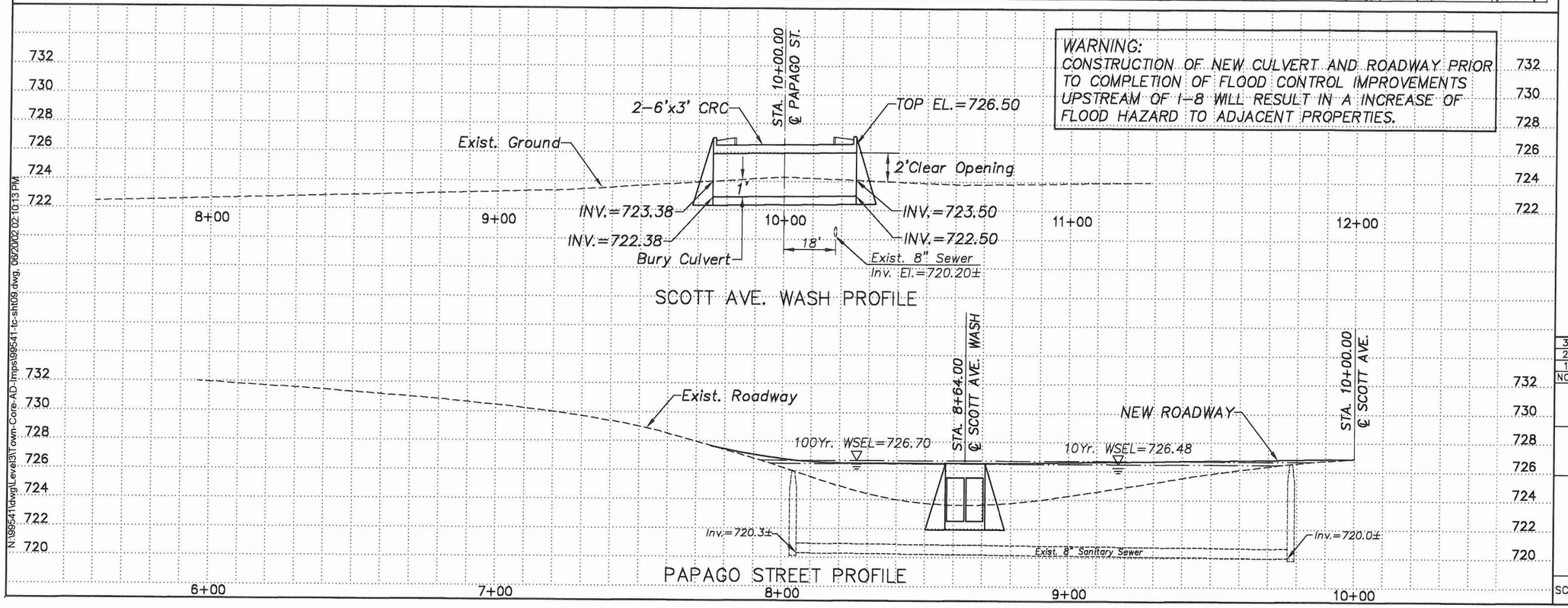

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20 10 0 20 40

GRAPHIC SCALE: 1 in. = 20 ft. HOR.
1 in. = 4 ft. VERT.

SCOTT AVENUE WASH CULVERT PLAN & PROFILES PAPAGO STREET

NO.	REVISION	BY	DATE
3			
2			
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FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

GILA BEND ADMP
Town Core Area Drainage Improvements
FCD PROJECT NO. 99-18

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DESIGNED	LAV/MJR	04/01
DRAWN	RTJ	04/01
CHECKED	MTG	04/01

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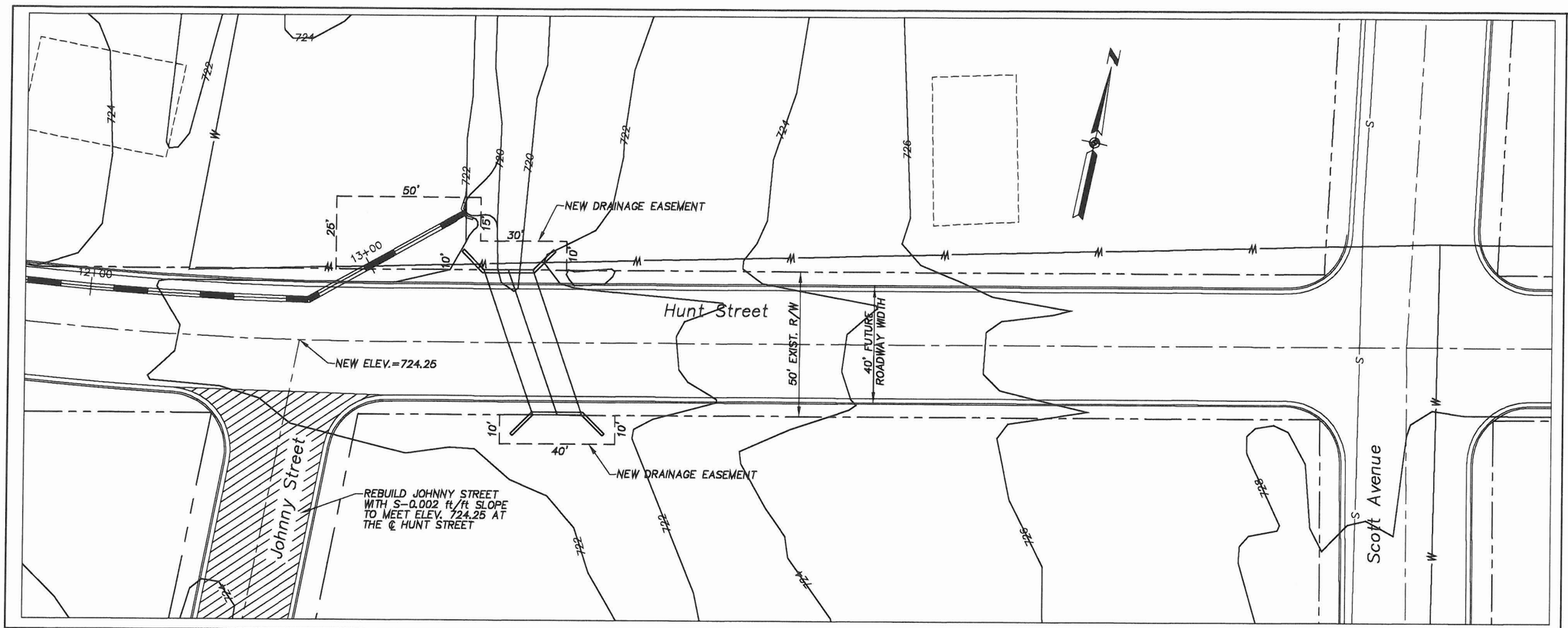
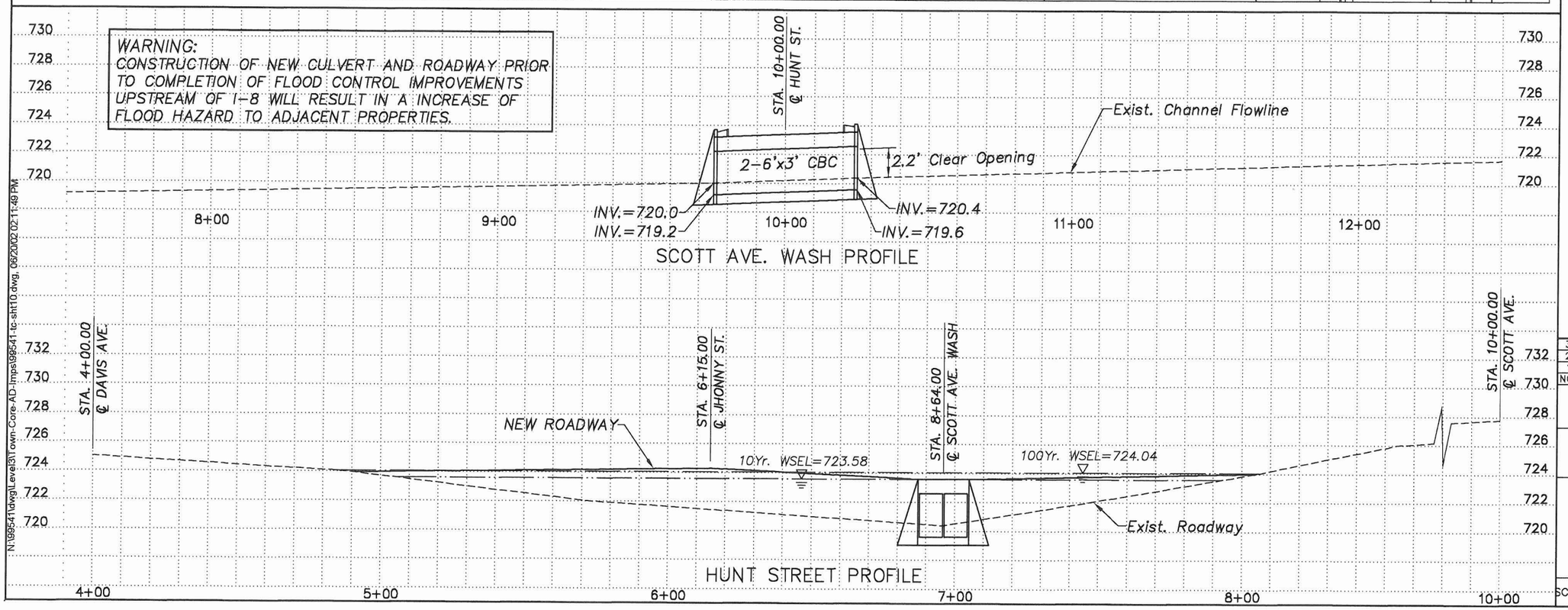
Phoenix, Arizona 85012-2905
TEL:(602)248-7702 FAX:(602)248-7851





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20 10 0 20 40

GRAPHIC SCALE: 1 in. = 20 ft. HOR.
1 in. = 4 ft. VERT.

SCOTT AVENUE WASH CULVERT PLAN & PROFILES HUNT STREET

NO.	REVISION	BY	DATE
3			
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1			

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

GILA BEND ADMP
Town Core Area Drainage Improvements
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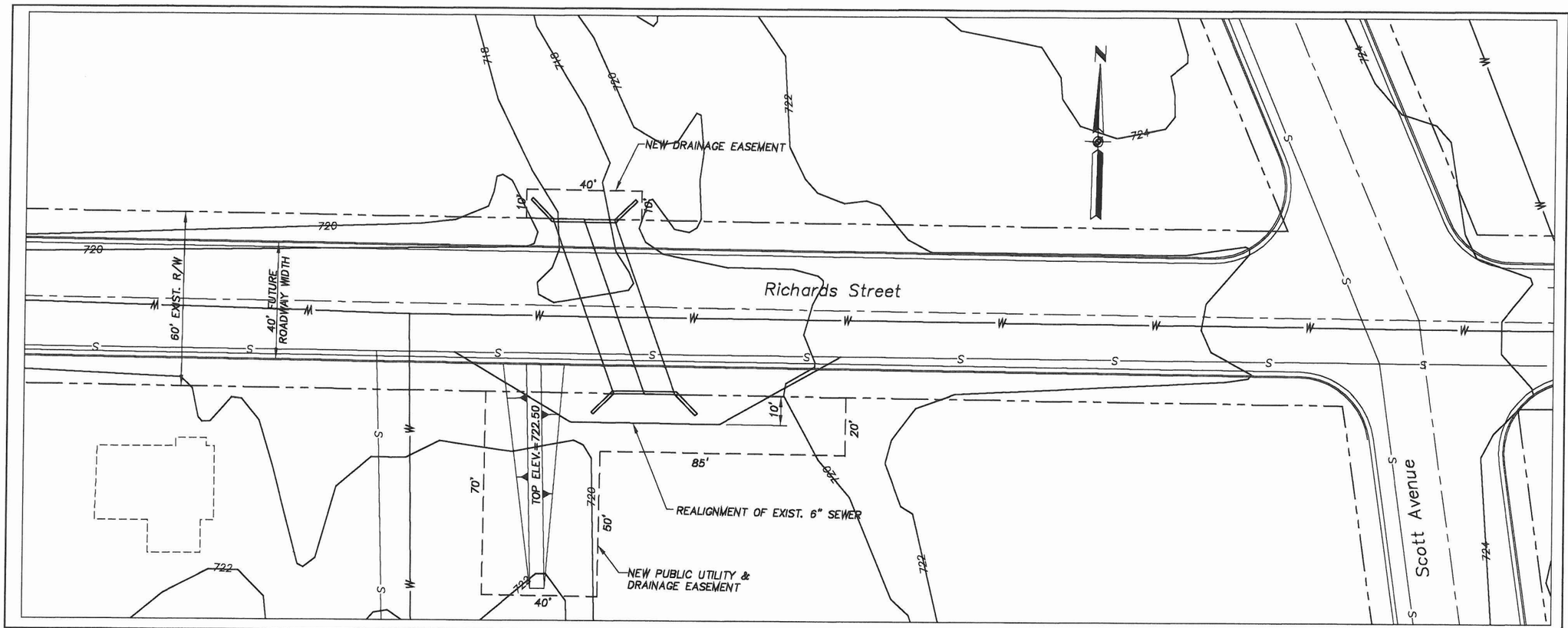

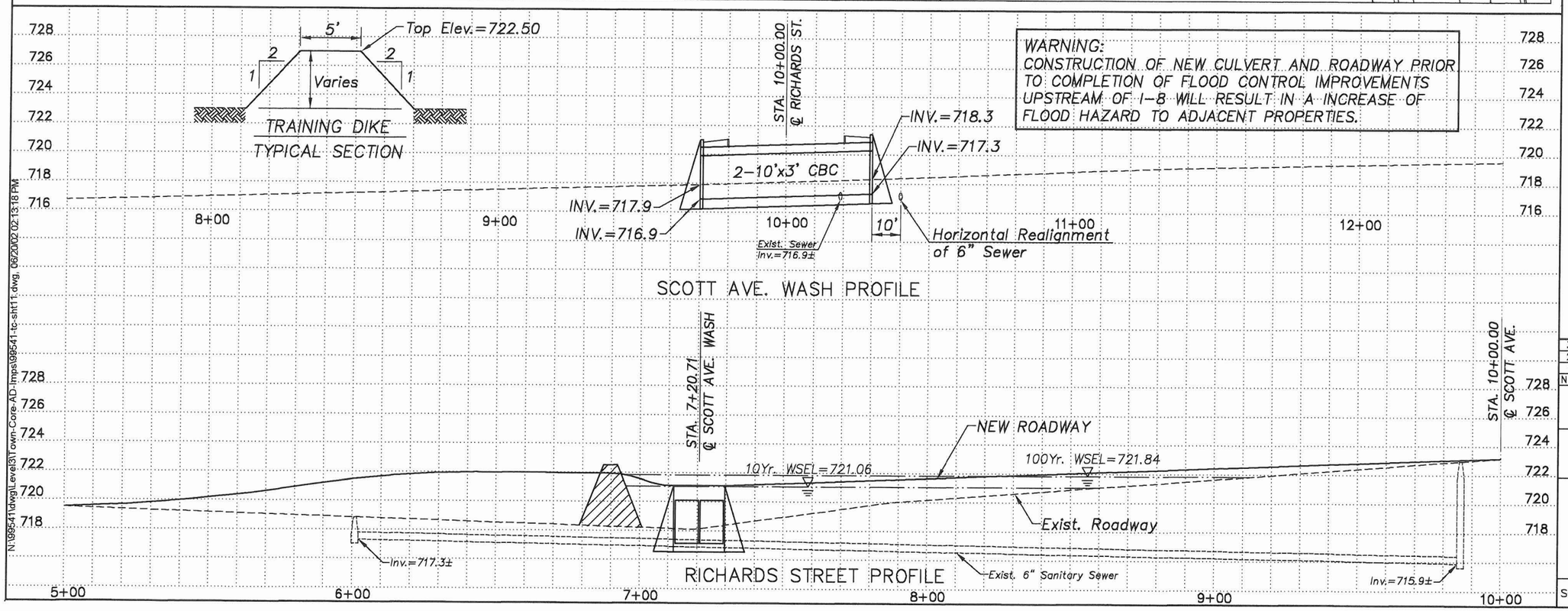

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GRAPHIC SCALE: 1 in. = 20 ft. HOR.
1 in. = 4 ft. VERT.

SCOTT AVENUE WASH CULVERT PLAN & PROFILES RICHARDS STREET

NO.	REVISION	BY	DATE
3			
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FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

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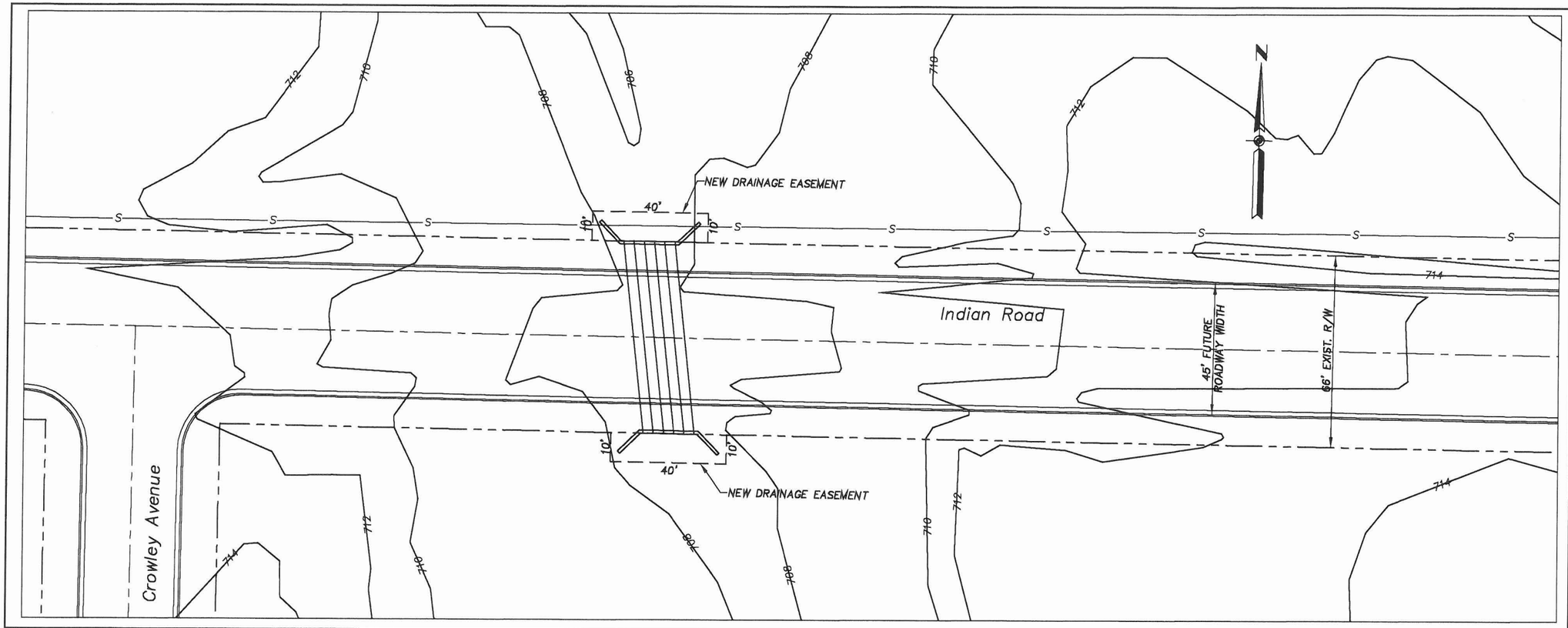
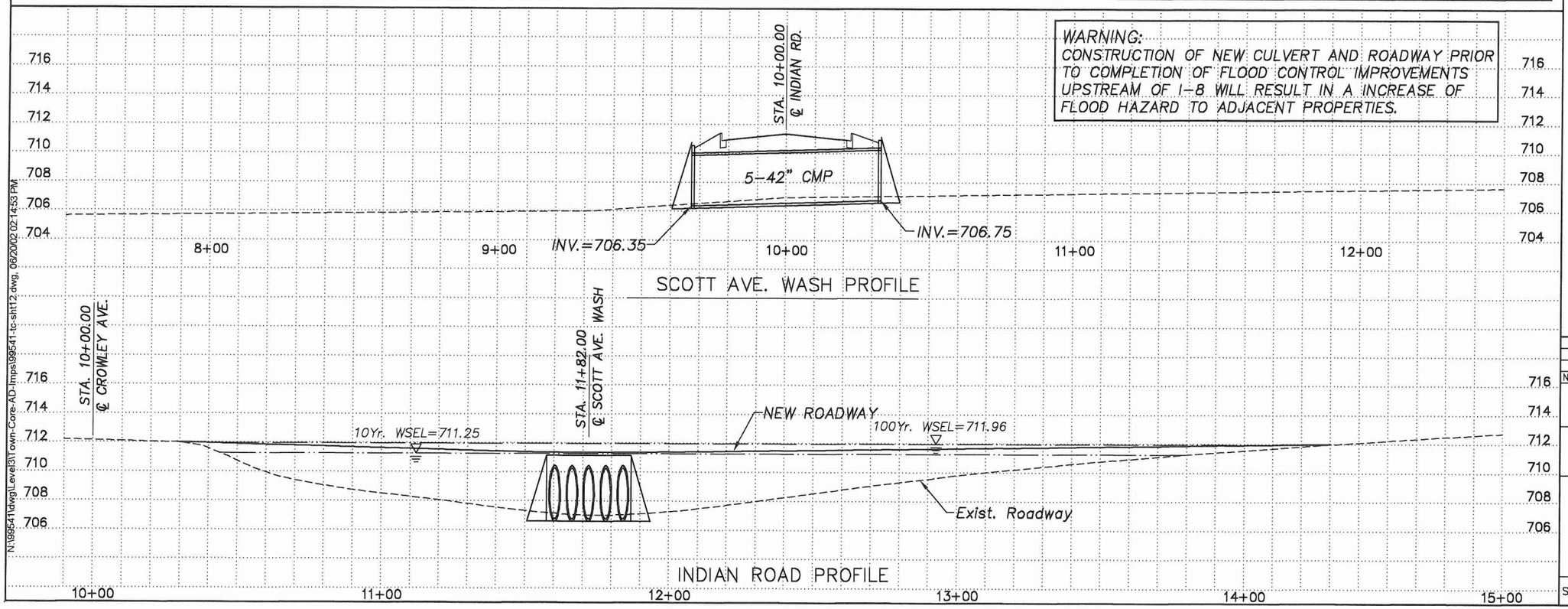
SCOTT AVENUE WASH DRAINAGE IMPROVEMENTS | SHEET OF 11 17





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GRAPHIC SCALE: 1 in. = 20 ft. HOR.
1 in. = 4 ft. VERT.

SCOTT AVENUE WASH CULVERT PLAN & PROFILES INDIAN ROAD

NO.	REVISION	BY	DATE
3			
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FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

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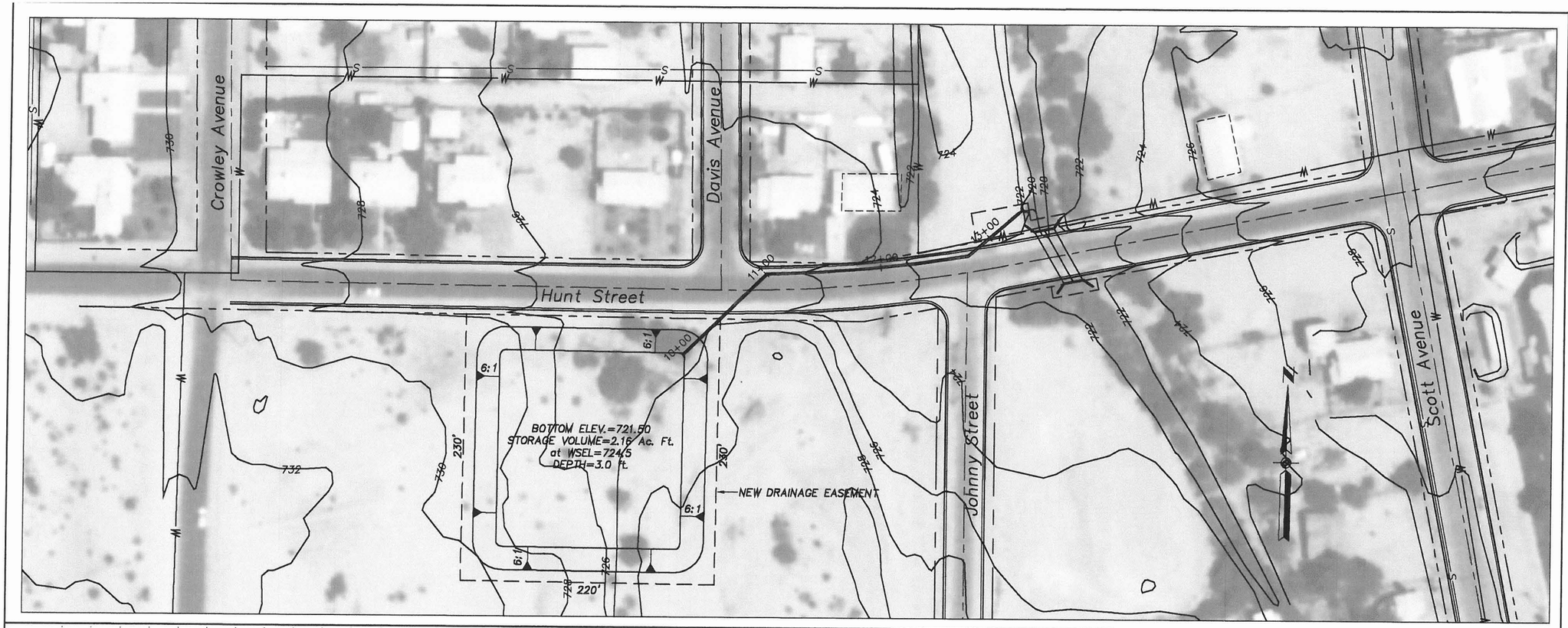

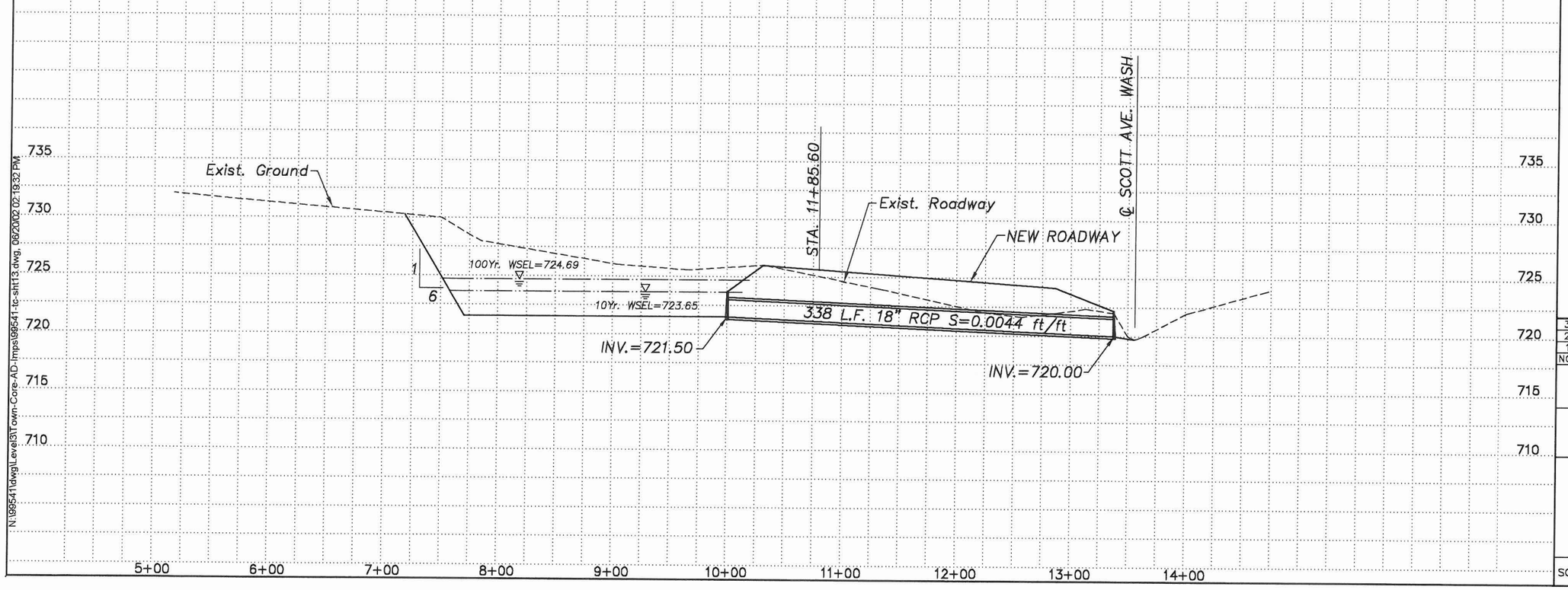

50 25 0 50 100

GRAPHIC SCALE: 1 in. = 50 ft. HOR.
1 in. = 5 ft. VERT.

HUNT STREET DETENTION BASIN & STORM DRAIN PLAN & PROFILE

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FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

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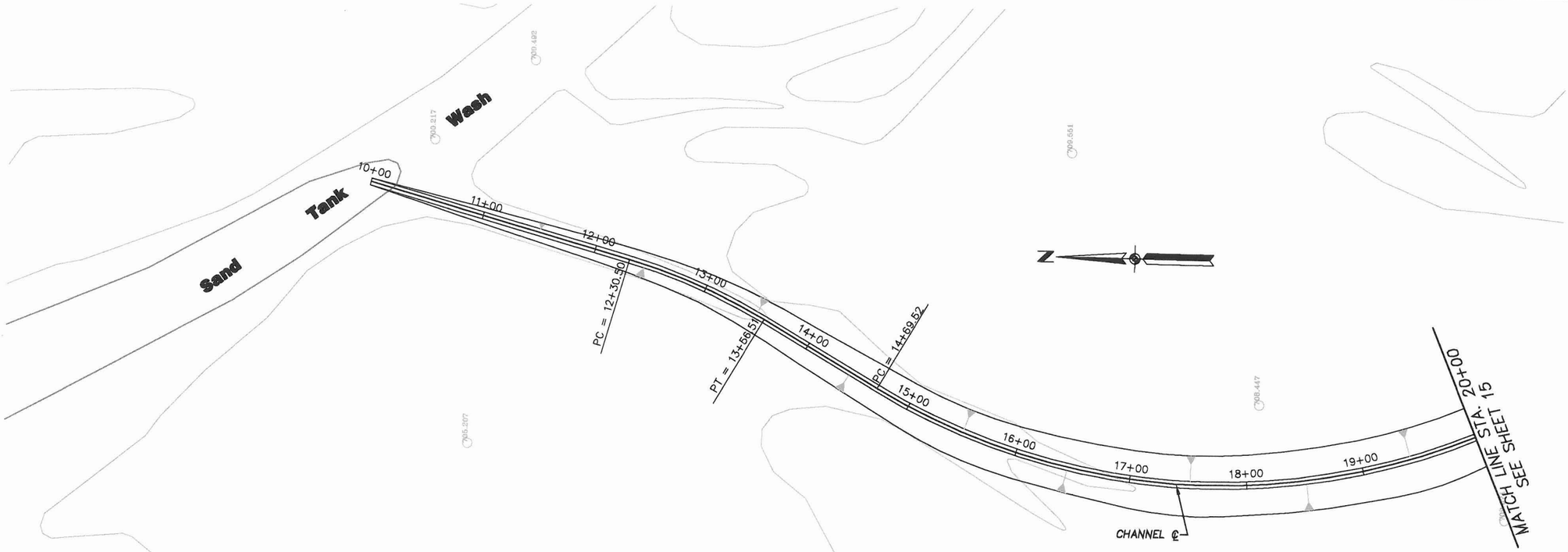
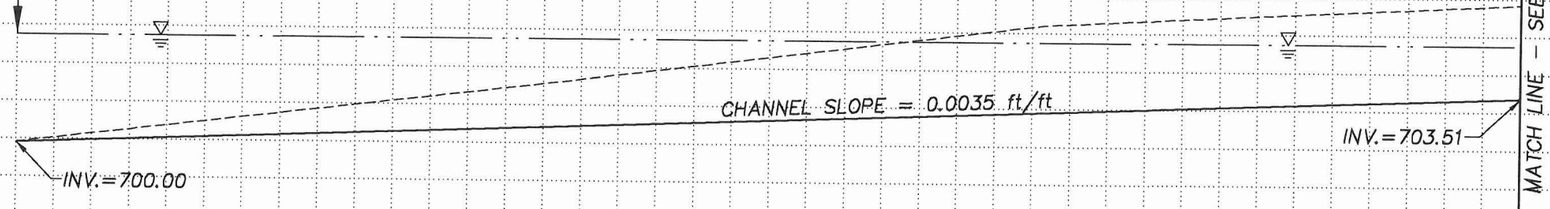
SCOTT AVENUE WASH DRAINAGE IMPROVEMENTS | SHEET OF 13 17



TYPICAL SECTION
ST. LOUIS AVENUE OUTFALL CHANNEL
STA. 10+00 TO STA. 20+00



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GRAPHIC SCALE: 1 in. = 50 ft. HOR.
1 in. = 5 ft. VERT.

ST. LOUIS AVENUE STORM DRAIN & OUTLET CHANNEL PLAN & PROFILE

NO.	REVISION	BY	DATE
3			
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1			

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

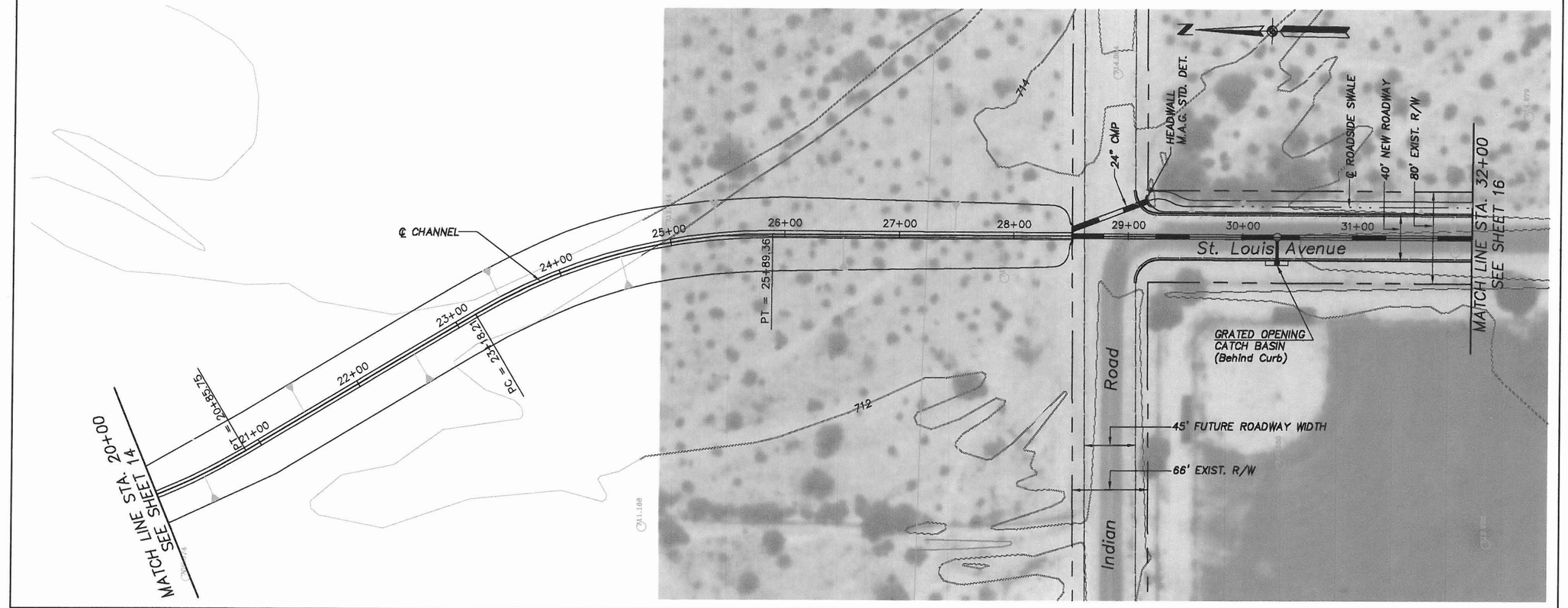
GILA BEND ADMP
Town Core Area Drainage Improvements
FCD PROJECT NO. 99-18

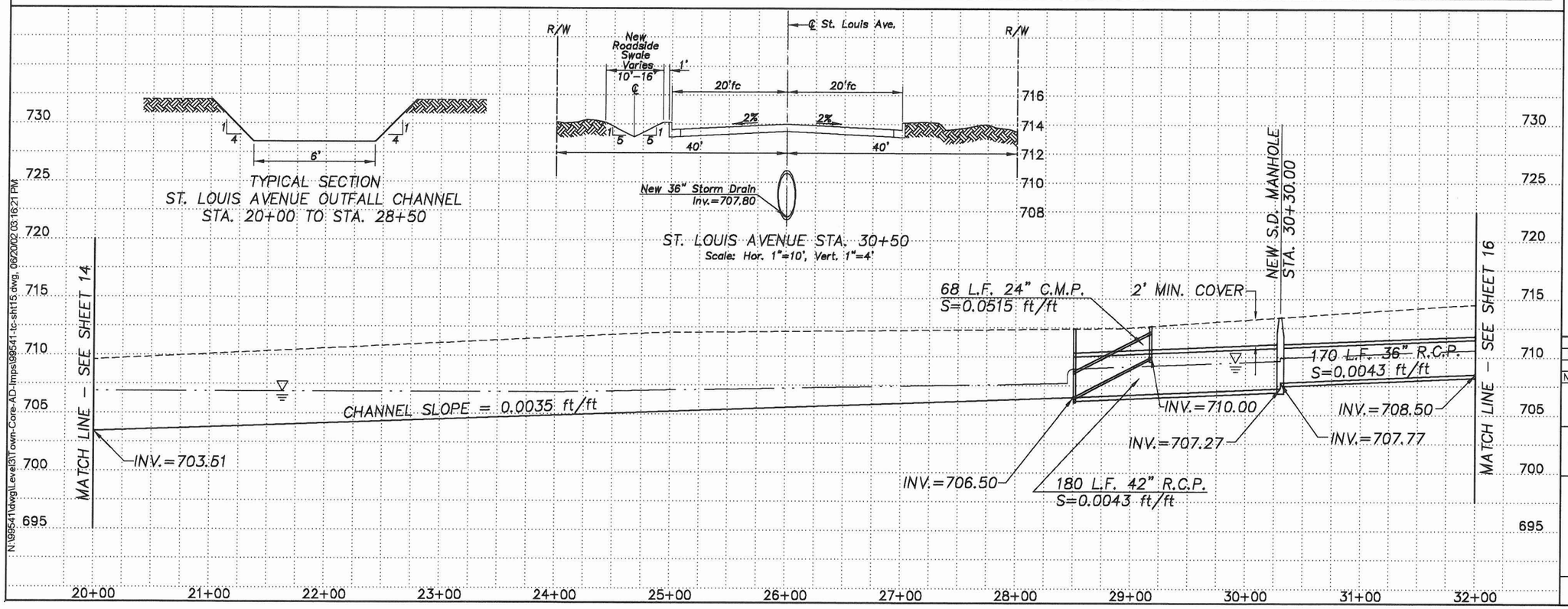
	BY	DATE
DESIGNED	MJR/LAV	04/01
DRAWN	KLH/RTJ	04/01
CHECKED	MTG	04/01

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

ST. LOUIS AVE. DRAINAGE IMPROVEMENTS

SHEET OF 14 17





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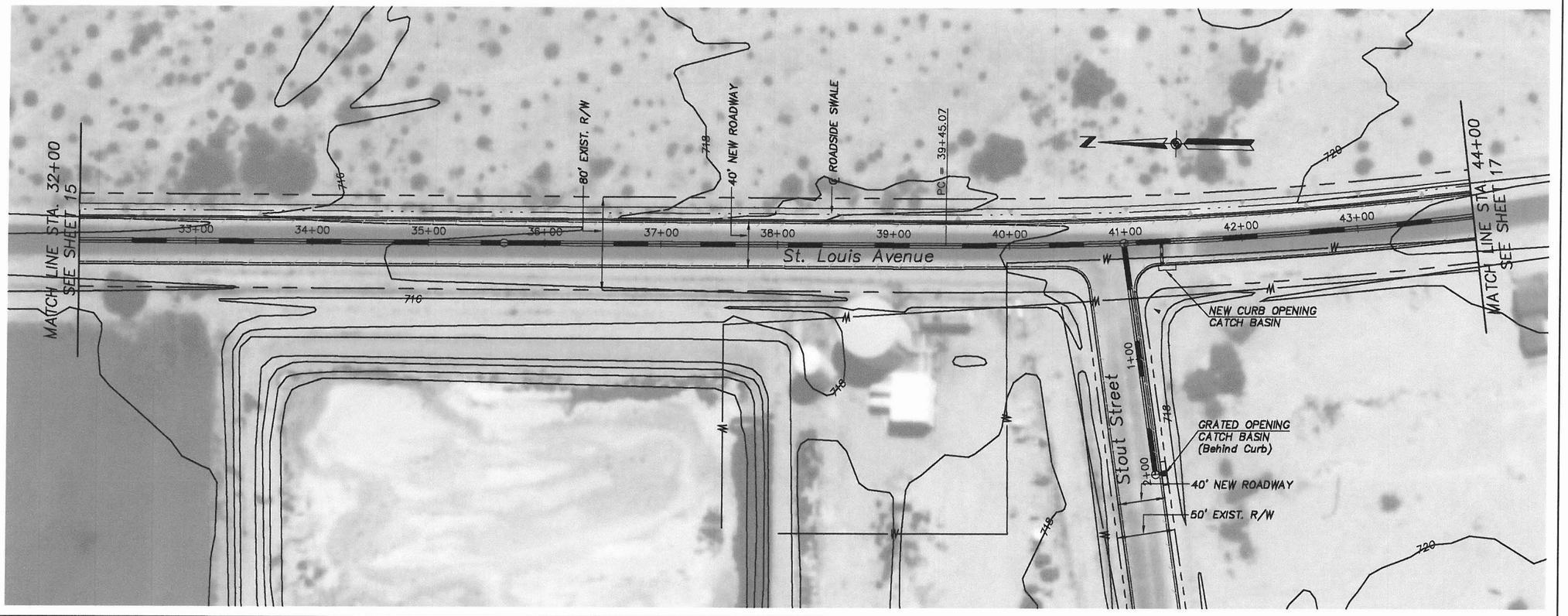

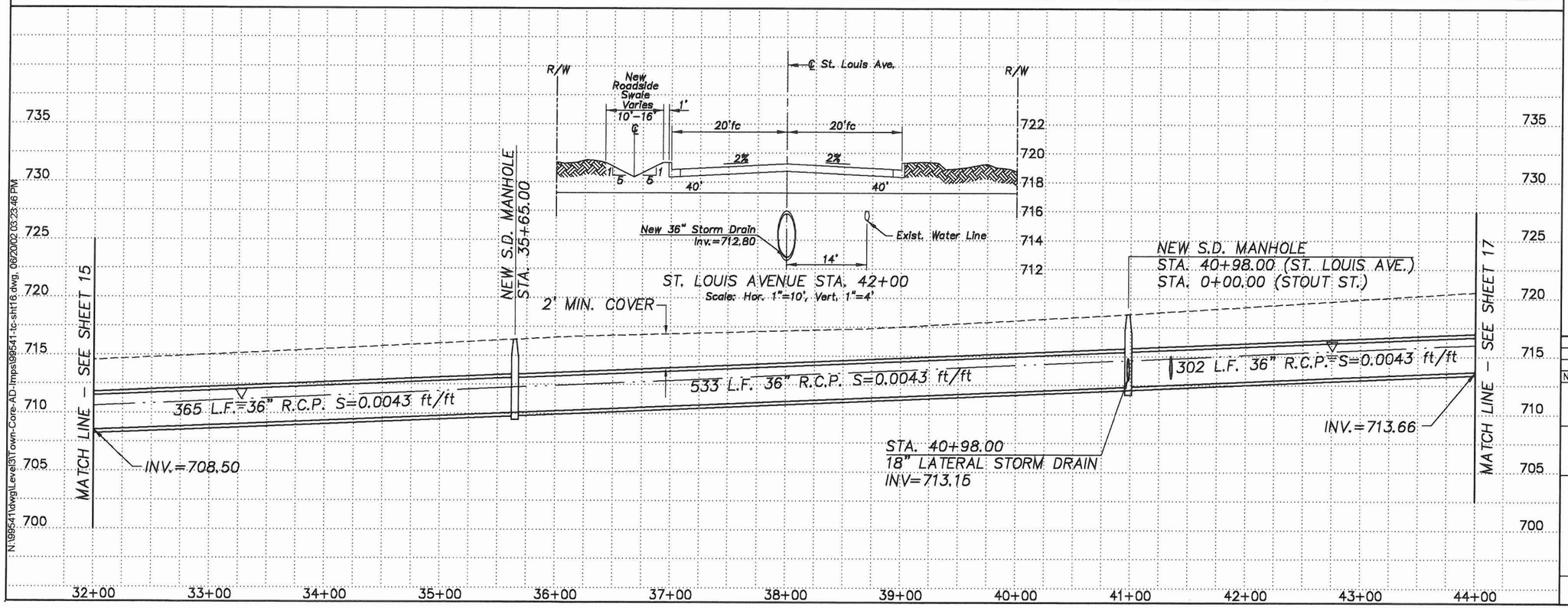

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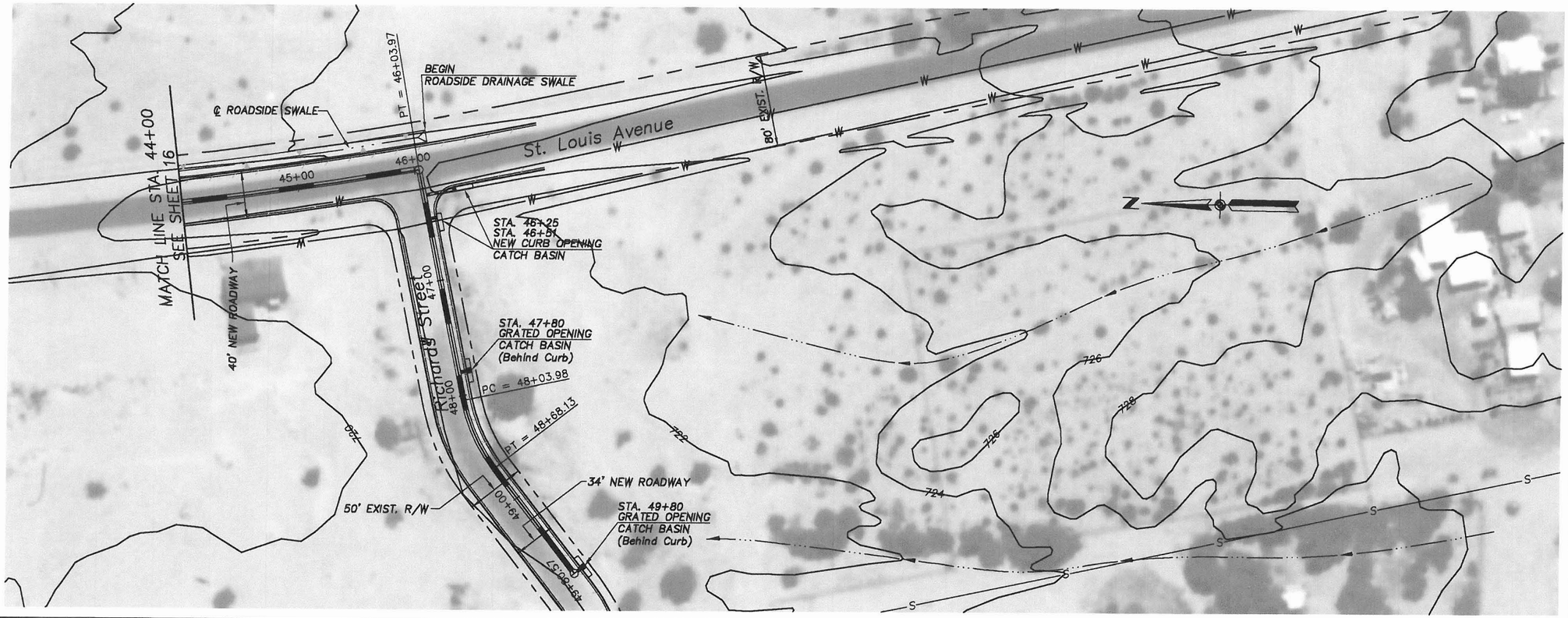
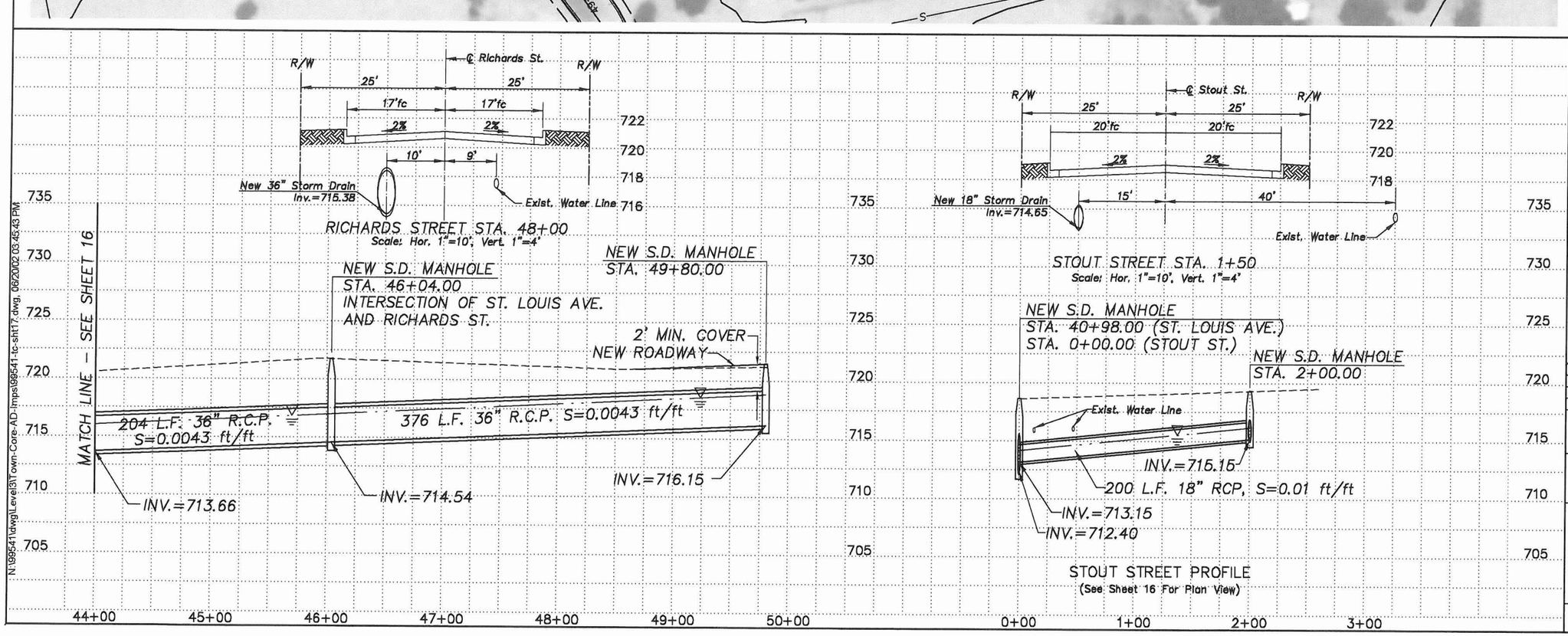
ST. LOUIS AVE. DRAINAGE IMPROVEMENTS

SHEET OF 16 17





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SHEET OF 17 17