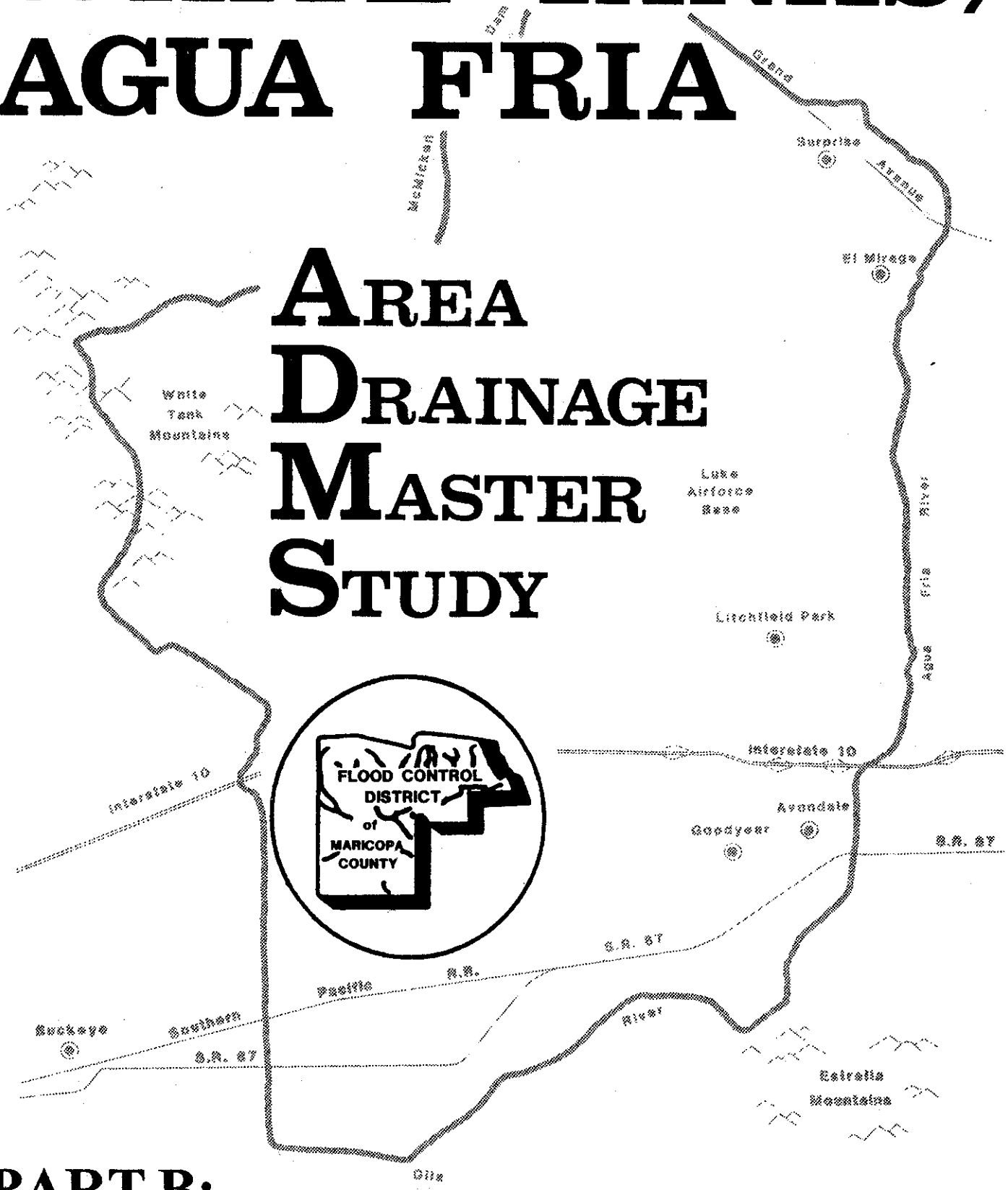
WHITE TANKS/ AGUA FRIA

AREA DRAINAGE MASTER STUDY



FLOOD CONTROL DISTRICT of MARICOPA COUNTY

PART B: AREA DRAINAGE MASTER PLAN

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WHITE TANKS/AGUA FRIA
AREA DRAINAGE MASTER STUDY

Part B:

Area Drainage Master Plan

Prepared For:

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

2801 West Durango

Phoenix, Arizona 85009

December 1994

REGISTERED PROFESSIONAL ENGINEER (CIVIL)
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REGISTERED PROFESSIONAL ENGINEER (CIVIL)
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SECTION 1 INTRODUCTION

1.1 Study Purpose

The White Tanks/Agua Fria area, located on the west side of metropolitan Phoenix, is expected to experience a significant increase in population. In fact, the area is expected to double from a population of about 40,000 currently, to 80,000 by the year 2000 (reference 1). In order to properly plan for the stormwater conveyance needs of the anticipated development, the Flood Control District of Maricopa County contracted with The WLB Group to conduct an area drainage master study (ADMS).

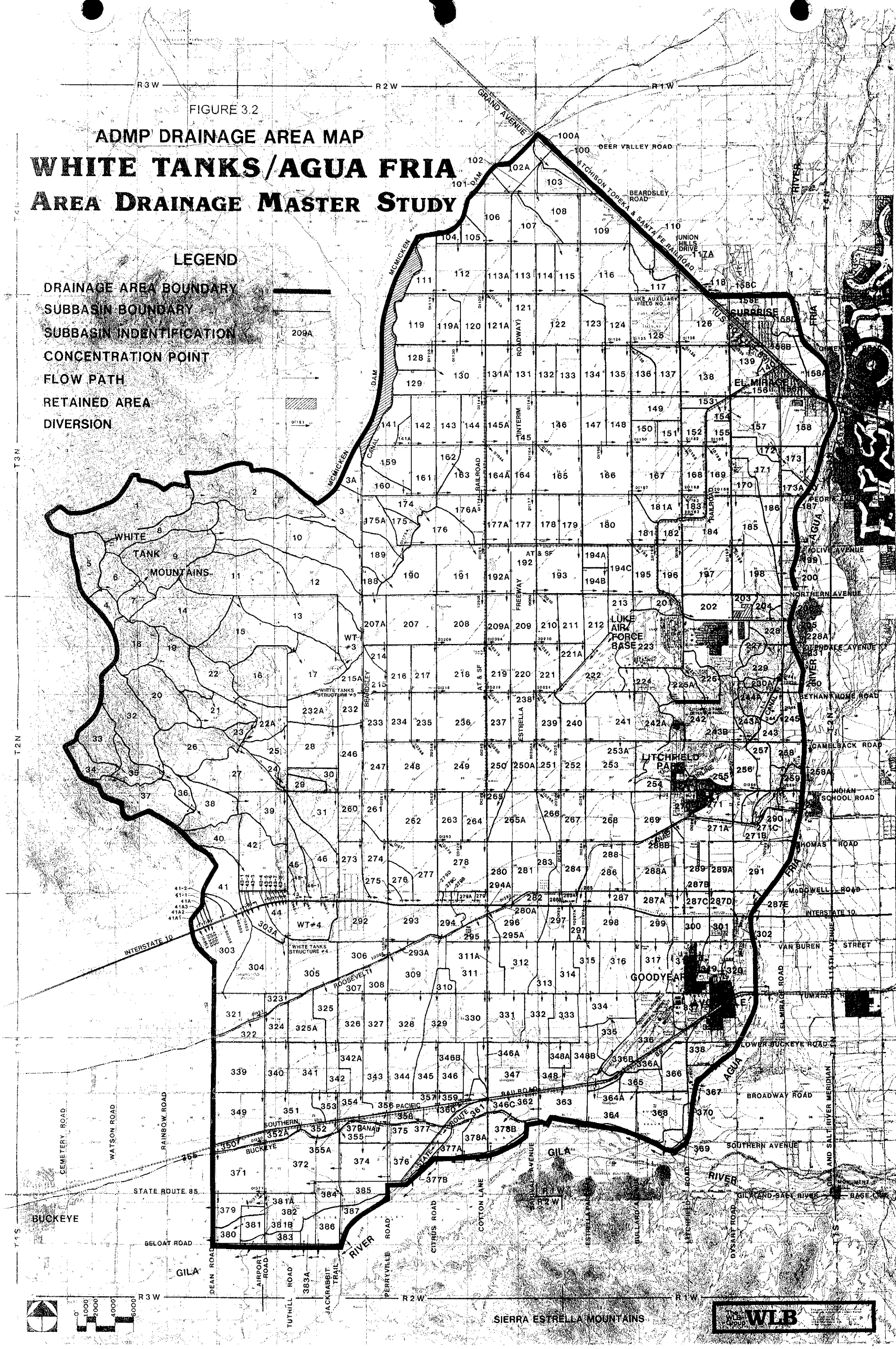
The purpose of the ADMS is 1) to delineate existing floodplain boundaries, 2) identify known flood hazards and develop corrective measures and, 3) develop a stormwater management plan for the study area. The ADMS is presented in two parts. Part A is the Flood Study Technical Data Notebook. Completed in October 1992; it documented the floodplain delineation portion of the ADMS for submittal to the Federal Emergency Management Agency. Part B is the area drainage master plan (ADMP) which includes corrective measures for existing flood hazards as well as a master plan for regional flood control.

This study is part of the Flood Control District's Area Drainage Master Study Program that was started in 1983. A number of basin-wide studies have been carried out under the program which address stormwater management for specific regions of Maricopa County. The program's purpose is to identify flooding problems and develop solutions for the existing and future development on a regional basis.

FIGURE 3.2

ADMP DRAINAGE AREA MAP

WHITE TANKS/AGUA FRIA AREA DRAINAGE MASTER STUDY



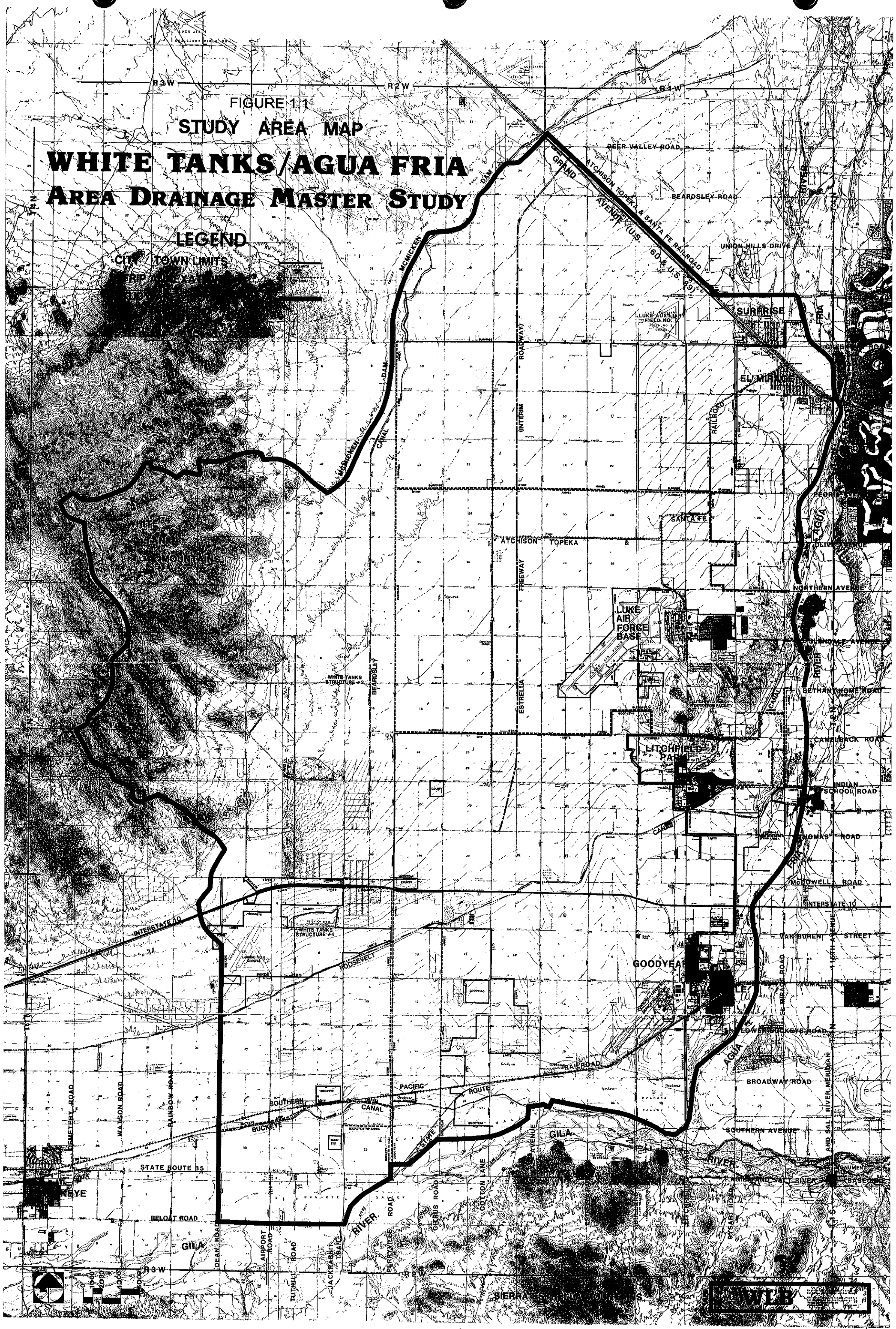


FIGURE 1.1
STUDY AREA MAP
WHITE TANKS/AGUA FRIA
AREA DRAINAGE MASTER STUDY
LEGEND
CITY / TOWN LIMITS
R3W
R2W
R1W
DEER VALLEY ROAD
BEARDSLEY ROAD
UNION HILLS DRIVE
GRAND AVENUE (U.S. 60 & U.S. 89)
ATCHISON TOPEKA & SANTA FE RAILROAD
SURPRISE
EL MIRAGE
LUKE AUXILIARY FIELD NO. 3
MCMICKEN DAM
MCMICKEN CANAL
ROADWAY
(INTERIM
RAILROAD
SANTA FE
ATCHISON TOPEKA &
WHITE TANK MOUNTAINS
NORTHERN AVENUE
LUKE AIR FORCE BASE
GLENDALE AVENUE
WHITE TANKS STRUCTURE #3
BEARDSLEY
ESTRELLA
FREEWAY
BETHANY HOME ROAD
CAMELBACK ROAD
LITCHFIELD PARK
INDIAN SCHOOL ROAD
THOMAS ROAD
McDOWELL ROAD
INTERSTATE 10
WHITE TANKS STRUCTURE #4
ROOSEVELT
VAN BUREN STREET
GOODYEAR
LOWER BUCKEYE ROAD
RAILROAD
PACIFIC
ROUTE
SOUTHERN
CANAL
BUCKEYE
BROADWAY ROAD
SOUTHERN AVENUE
GILA
RIVER
AGUA
FRIA
STATE ROUTE 85
BUCKEYE
BELOAT ROAD
CEMETERY ROAD
WATSON ROAD
RAINBOW ROAD
DEAN ROAD
AIRPORT ROAD
TUTHILL ROAD
JACKRABBIT TRAIL
PERRYVILLE ROAD
ORTHIS ROAD
COTTON LANE
BUCKEYE ROAD
BASELINE
SIERRA ESTRELLA MOUNTAINS
GILA AND SALT RIVER
BASE LINE
AND SALT RIVER MERIDIAN
WLB

1.2 Study Area

The White Tanks/Agua Fria ADMS covers a 215 square mile drainage basin on the west side of the metropolitan Phoenix area. The name of the study is derived from the basin boundaries. The western boundary is the ridge line in the White Tank Mountains and the eastern boundary is the Agua Fria River; hence the name White Tanks/Agua Fria ADMS. The other study limits are the Gila River on the south and McMicken Dam and Grand Avenue on the north.

The study area is largely undeveloped. The predominant land use is agriculture. Of the 215 square miles in the study area, approximately 120 square miles is farmland. Another 70 square miles, or so, is undeveloped desert and mountain areas. The remaining area, approximately 25 square miles, is developed and includes the cities of Surprise, El Mirage, Litchfield Park, Goodyear and Avondale; several small outlying residential communities; Luke AFB; Phoenix-Litchfield Airport; Perryville Prison; and several large scale land developments under construction which include Pebble Creek Golf Resort, Sun Village Resort, Clearwater Farms, Palm Valley, and the Airport Commerce Center. In addition to these, there are several other large scale developments which are in the planning stages. They include an expansion of Sun City known as Sun City Grand, Litchfield, Spencer Development, Litchfield Commerce Center, Goodyear Gateway, Estrella Aerospace Center, Estrella Distribution Center, Estrella Vista, and Goodyear 1000 (reference 2).

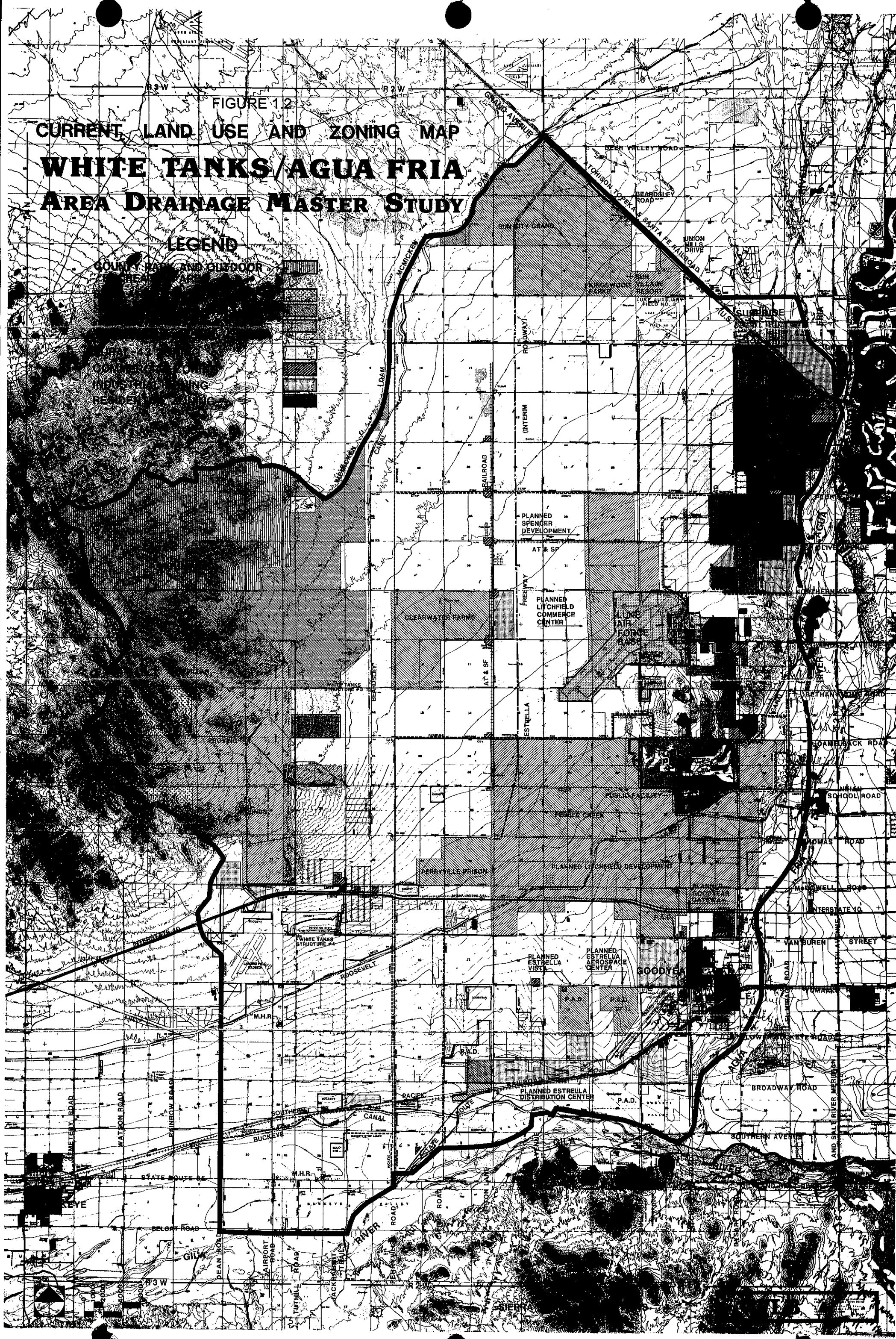


FIGURE 1.2
CURRENT LAND USE AND ZONING MAP
WHITE TANKS/AGUA FRIA
AREA DRAINAGE MASTER STUDY
LEGEND
COUNTY PARK AND OUTDOOR
INDUSTRIAL ZONING
RESIDENTIAL ZONING
R3W
R2W
R1W
GRAND AVENUE
DEER VALLEY ROAD
BEARDSLEY ROAD
TOPEKA & SANTA FE RAILROAD
UNION MILLS DRIVE
SUN CITY GRAND
SUN VILLAGE RESORT
LUKE AUXILIARY FIELD NO. 3
MCMICKEN DAM
CANAL
RAILROAD
FREEWAY
(INTERIM ROADWAY)
PLANNED SPENCER DEVELOPMENT
AT & SF
PLANNED LITCHFIELD COMMERCE CENTER
CLEARWATER FARMS
LUKE AIR FORCE BASE
WHITE TANKS STRUCTURE #3
ESTRELLA
PEORIA AVENUE
NORTHERN AVE
BETHANY HOME ROAD
GLENDALE AVENUE
CAMELBACK ROAD
INDIAN SCHOOL ROAD
PUBLIC FACILITY
PEORIA CREEK
THOMAS ROAD
PERRYVILLE PRISON
PLANNED LITCHFIELD DEVELOPMENT
PLANNED GOODYEAR GATEWAY
MCDOWELL ROAD
INTERSTATE 10
VAN BUREN STREET
WHITE TANKS STRUCTURE #4
ROOSEVELT
PLANNED ESTRELLA VISTA
PLANNED ESTRELLA AEROSPACE CENTER
GOODYEAR
M.H.R.
P.A.D.
LOWER BUCKEYE ROAD
PACIFIC
SOUTHERN
BUCKEYE
PLANNED ESTRELLA DISTRIBUTION CENTER
BROADWAY ROAD
SOUTHERN AVENUE
STATE ROUTE 85
BELORT ROAD
GILA
RIVER
SIERRA
CEMETERY ROAD
WATSON ROAD
RAINBOW ROAD
DEAN ROAD
AIRPORT ROAD
TURTLE HILL ROAD
JACKRABBIT TRAIL
PEBBLE HILL ROAD
CRAIS ROAD
BOSALE ROAD
AGUA FRIA
SALT RIVER MERIDIAN

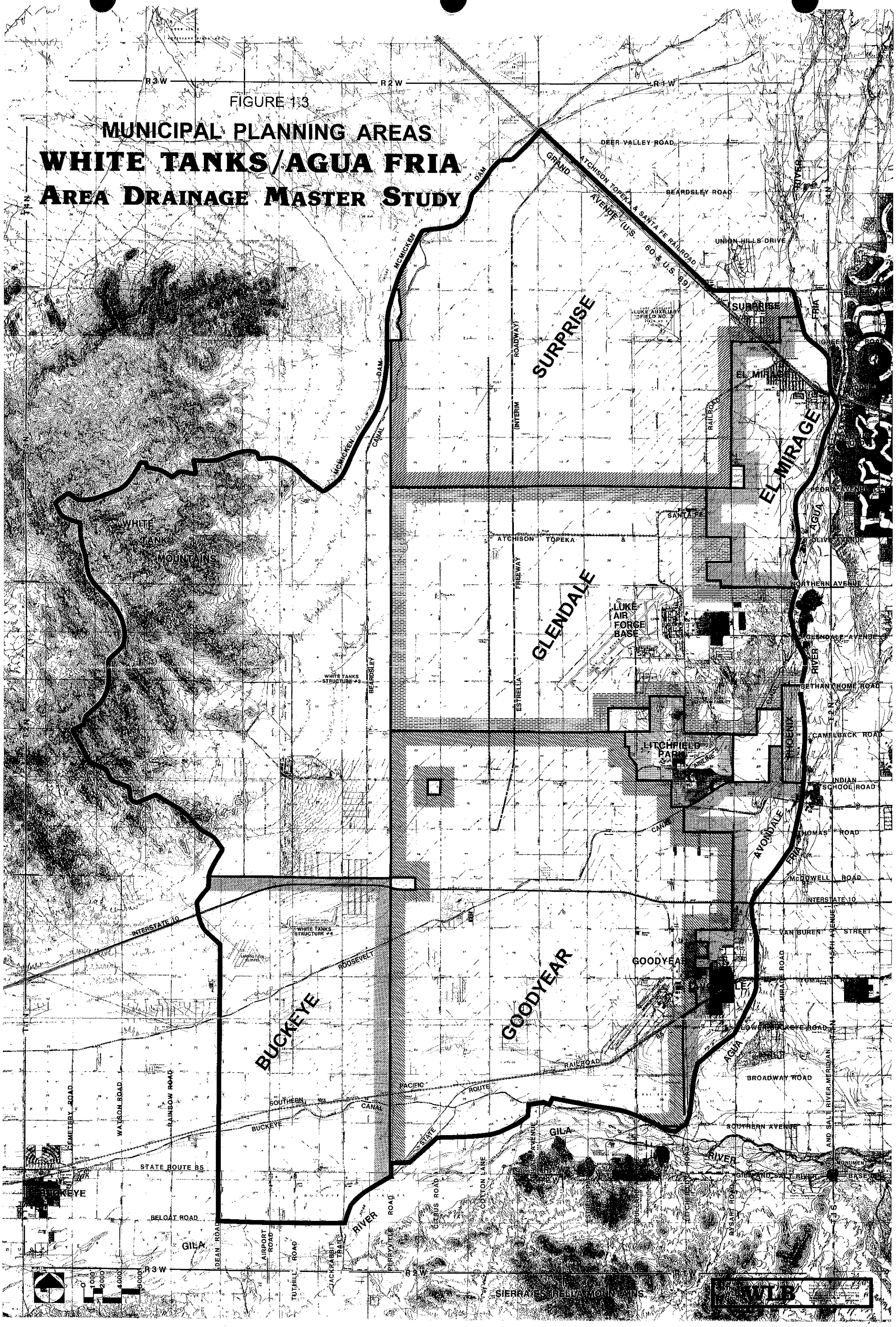
1.3 Municipal Planning Areas

With the exception of the White Tank Mountain area west of Perryville Road, nearly the entire study area is within one of eight municipal planning areas. Municipal planning areas are defined by the outermost strip annexation of each municipality. The municipalities include Surprise, El Mirage, Glendale, Phoenix, Litchfield Park, Avondale, Goodyear and Buckeye.

FIGURE 1.3

MUNICIPAL PLANNING AREAS

WHITE TANKS/AGUA FRIA AREA DRAINAGE MASTER STUDY



1.4 Report Organization

Sections 1, 2 and 3 of this report provide overall information for the entire study area. Section 1 presents introductory information. Section 2 describes the existing drainage conditions including the existing floodplains and flood control facilities. Section 3 explains the overall planning concept and summarizes the major elements of the proposed regional drainage system. Section 3 also describes the hydrologic model used to prepare the area drainage master plan.

The remainder of this report is organized into separate smaller study areas which correspond to the drainage basins for each major element of the proposed regional flood control system. For example, Section 4 covers the plan for the White Tanks Structure No. 3 drainage area. Included in Section 4 is a description of the required corrective measures on Beardsley Canal Wash as well as an overall plan for the watershed that drains to White Tanks Structure No. 3. Similarly, Sections 5 through 13 present the plan for the other major watersheds within the study area. Refer to Figure 1.4 which presents each of the major drainage basins and its corresponding section in this report.

The cross hatched areas on Figure 1.4 drain directly to either the Agua Fria River or the Gila River. These areas were not included within any of the major drainage basins because, under existing conditions, they drain directly to a major outfall. They are, however, included in the hydrologic model (refer to Section 3.4 and Appendix A).

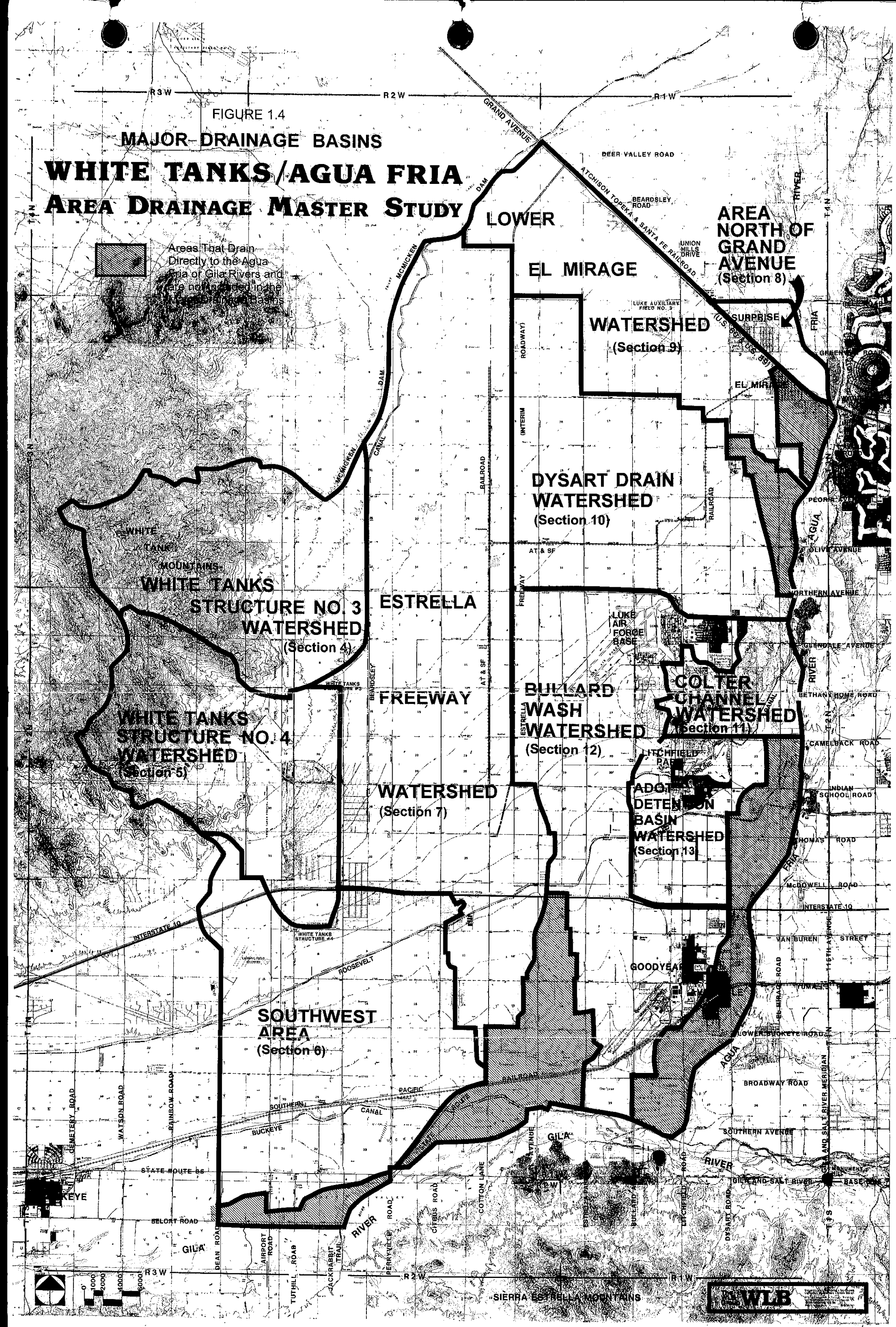


FIGURE 1.4
MAJOR DRAINAGE BASINS
WHITE TANKS/AGUA FRIA
AREA DRAINAGE MASTER STUDY
Areas That Drain Directly to the Agua Fria or Gila Rivers and are not included in the Major Drainage Basins
LOWER EL MIRAGE WATERSHED (Section 9)
AREA NORTH OF GRAND AVENUE (Section 8)
DYSART DRAIN WATERSHED (Section 10)
WHITE TANKS STRUCTURE NO. 3 WATERSHED (Section 4)
ESTRELLA FREEWAY WATERSHED (Section 7)
WHITE TANKS STRUCTURE NO. 4 WATERSHED (Section 5)
BULLARD WASH WATERSHED (Section 12)
COLTER CHANNEL WATERSHED (Section 11)
ADOT DETENTION BASIN WATERSHED (Section 13)
SOUTHWEST AREA (Section 6)
WHITE TANKS MOUNTAINS
SIERRA ESTRELLA MOUNTAINS
GRAND AVENUE
ATCHISON TOPEKA & SANTA FE RAILROAD
BEER VALLEY ROAD
BEARDSLEY ROAD
UNION HILLS DRIVE
LUKE AUXILIARY FIELD NO. 3
SURPRISE
EL MIRAGE
PEORIA AVENUE
OLIVE AVENUE
NORTHERN AVENUE
GLENDALE AVENUE
BETHANY HOME ROAD
CAMELBACK ROAD
INDIAN SCHOOL ROAD
THOMAS ROAD
McDOWELL ROAD
INTERSTATE 10
VAN BUREN STREET
YUMA
LOWER BUCKEYE ROAD
BROADWAY ROAD
SOUTHERN AVENUE
GILA AND SALT RIVER
BUCKEYE
BELOAT ROAD
STATE ROUTE 85
ROOSEVELT
SOUTHERN PACIFIC RAILROAD
BUCKEYE CANAL
GILA RIVER
AGUA FRIA RIVER
LUKE AIR FORCE BASE
GOODYEAR
LITCHFIELD PARK
WHITE TANKS STRUCTURE #3
WHITE TANKS STRUCTURE #4
R3W
R2W
R1W
T4N
T3N
T2N
T1N
T1S
T2S
0 1000 2000 4000 6000
WLB

1.5 Scope of Work

The following paragraphs briefly describe the major items of work included in the ADMS.

Topographic Mapping

Approximately 210 square miles of topographic mapping was compiled for the ADMS. This included about 30 square miles within the White Tank Mountains which the Flood Control District obtained previously in 1987. The remaining 180 square miles was developed as part of the ADMS. The aerial photography was taken in December 1989 and February 1990. The mapping scale is 1" = 400' with a 2' contour interval. Refer to Part A, Flood Study Technical Data Notebook, for a detailed description of the topographic mapping and survey control.

Hydrologic Model

A HEC-1 hydrologic model was developed for the study area. The model is described in detail in Part A. The model predicts peak rates of runoff for the existing conditions in the watershed. This same model was modified to predict flood flows for the planned facilities identified in this Area Drainage Master Plan (ADMP).

Floodplain Delineation

Approximately 150 stream miles of floodplain delineations were prepared and documented in Part A. These delineations are scheduled to be included in the 1995 map revision to the Federal Emergency Management Agency's flood insurance rate maps for Maricopa County.

Area Drainage Master Plan (ADMP)

The ADMP is the last major item of work. It includes identification, and concepts for mitigation, of the known flood hazards; as well as long term stormwater management plans for the study area.

SECTION 2 EXISTING CONDITIONS

2.1 Existing Drainage Characteristics

The study area generally slopes in a southeasterly direction from the White Tank Mountains toward the Agua Fria and Gila Rivers. The rate of slope ranges from about 0.4% to 0.8% in the agricultural areas which cover the majority of the study area. The remaining area is in the White Tank Mountains which are very steep and rugged. The peaks exceed 4000 feet in elevation which is about 3000 feet above the farmland below. The mountain slopes range from about 1% in the foothill areas up to over 100% at the peaks.

There are three existing major flood control dams which provide considerable flood protection for the study area. The largest is McMicken Dam which forms the northern study limit. It contains runoff from the 250 square mile watershed to the north that would otherwise flood across the study area. The other two are the White Tank Structures number 3 and 4. They contain runoff from the White Tank Mountains. These three major flood control structures are described in more detail in Section 2.2. Their contribution to flood control is considerable since they contain runoff from the mountainous areas that surround the watershed.

Downstream from the flood control dams, agricultural development has obscured the natural drainage patterns. Natural channels that existed prior to the development of agriculture have, for the most part, been obliterated by the grading necessary to create uniformly sloped irrigated fields. The result is a distinct lack of stormwater conveyance. Consequently, in most of the study area, flooding is characteristically wide, shallow and uncontained. Smaller, more frequent flooding is conveyed along irrigation ditches and roadside channels. Larger floods exceed these relatively insignificant conveyances and flow across the farmlands in wide, shallow floodplains. Ponding occurs in numerous locations along elevated structures, such as, canals, roadways and railroads.

2.2 Existing Flood Control Facilities

McMicken Dam

McMicken Dam forms the north boundary of the White Tanks/Agua Fria ADMS. It was constructed to control flooding from the 250 square mile Trilby Wash basin to the north. Efforts to construct the dam began with the onset of agricultural development in the 1920's and 1930's (reference 3). Frequent flood damage caused by Trilby Wash prompted the local farmers to request help from the US Department of Agriculture, Soil Conservation Service (SCS). These requests resulted in considerable flood control planning done in the 1940's. In August of 1951 a major 3-day storm occurred. The Trilby Wash basin received an average of 7 inches of rainfall which resulted in widespread flood damage to farms, roadways, utilities, railroads, Luke AFB and the towns of Litchfield Park, Goodyear and Avondale (references 3 and 4).

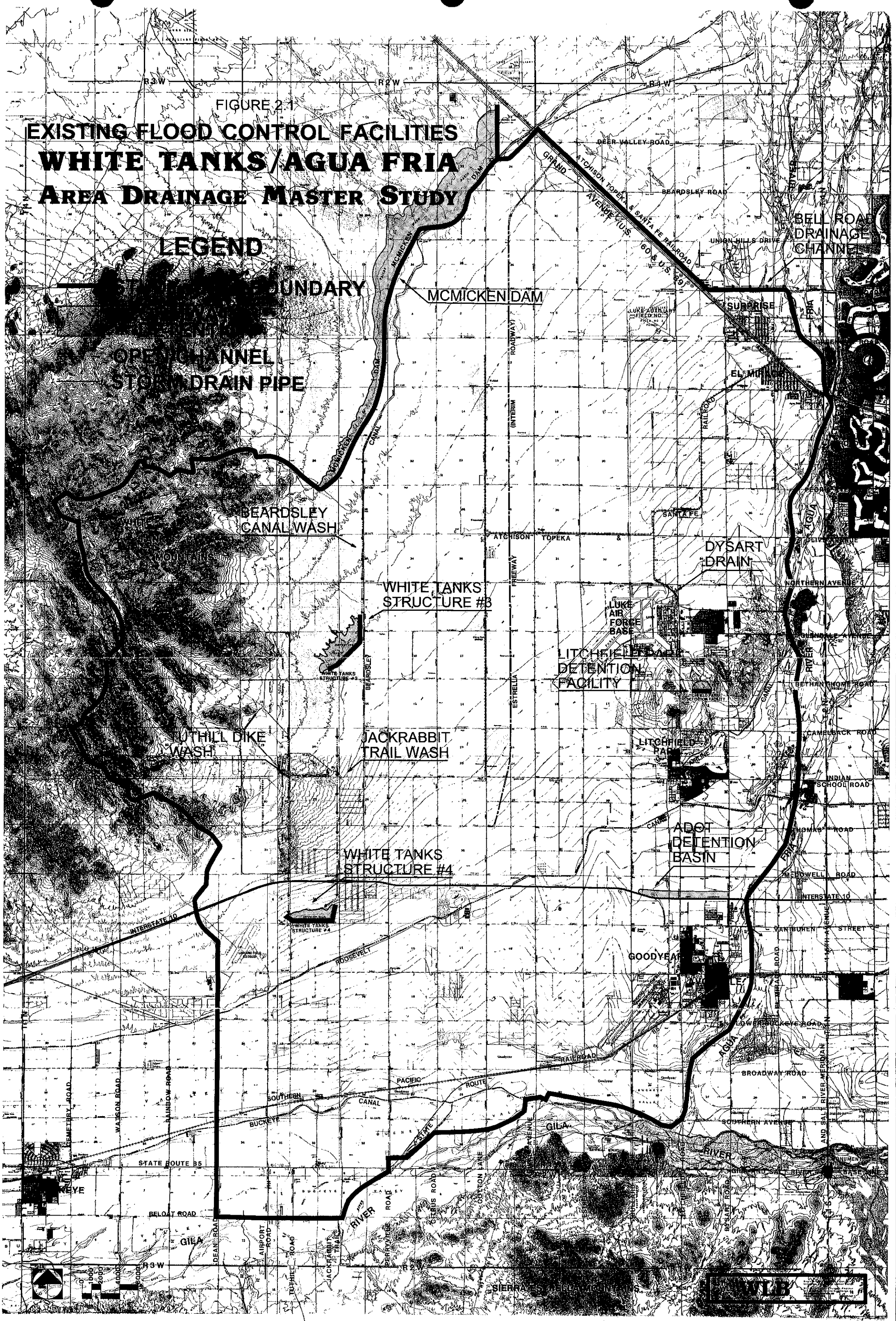


FIGURE 2.1
EXISTING FLOOD CONTROL FACILITIES
WHITE TANKS/AGUA FRIA
AREA DRAINAGE MASTER STUDY
LEGEND
OPEN CHANNEL
STORM DRAIN PIPE
MCMICKEN DAM
BEARDSLEY CANAL WASH
WHITE TANKS STRUCTURE #3
DYSART DRAIN
LITCHFIELD PARK DETENTION FACILITY
TUTHILL DIKE WASH
JACKRABBIT TRAIL WASH
ADOT DETENTION BASIN
WHITE TANKS STRUCTURE #4
BELL ROAD DRAINAGE CHANNEL
R3W
R2W
R1W
DEER VALLEY ROAD
BEARDSLEY ROAD
UNION HILLS DRIVE
SURPRISE
EL MIRAGE
SANTA FE
NORTHERN AVENUE
GLENDALE AVENUE
BETHANY HOME ROAD
CAMELBACK ROAD
INDIAN SCHOOL ROAD
THOMAS ROAD
MCDOWELL ROAD
INTERSTATE 10
VAN BUREN STREET
GOODYEAR
LOWER BUCKEYE ROAD
BROADWAY ROAD
SOUTHERN AVENUE
STATE ROUTE 85
BELOAT ROAD
GILA RIVER
SIERRA ESTRELLA MOUNTAINS
WLB

In response to the devastating 1951 flood, McMicken Dam was constructed by the US Army Corps of Engineers in 1956. The Corps also constructed an outlet channel which conveys the outflow from the dam to the Agua Fria River.

A major restoration project was completed on McMicken Dam in the early 1980's. The dam and outlet channel have capacity in excess of the 100-year flood. The protection to the study area provided by the dam is considerable. The 100-year peak inflow to the Dam is 20,400 cfs (reference 5). If the dam were not there, this flow would spread out over large areas within the study area and cause severe flooding damage. Instead, the runoff is contained behind the dam and the entire outflow is directed to the Agua Fria River.

White Tank Structures No. 3 and No. 4

White Tank Structures No. 3 and No. 4 were built by the SCS in 1954. As was the case with McMicken Dam, they were constructed in response to the flood of 1951. Although not nearly as large as McMicken Dam, these structures provide much needed control of the floodwaters that come off the White Tank Mountains. The drainage areas for Structures No. 3 and 4 are 20.5 and 19.2 square miles, respectively; and they both have more than enough capacity to contain the 100-year flood. However, the diversion channels that collect and convey floodwaters to the structures are, at both dams, inadequate to convey the 100-year flood. Therefore, the entire volume of the 100-year flood does not reach the structures. This problem is discussed in more detail in Sections 4 and 5.

It seems worth noting that White Tanks Structures No. 1 and No. 2 were planned by the SCS; but never constructed. They were to be located in the same general location as McMicken Dam. Therefore, when the US Army Corps of Engineers decided to construct McMicken Dam to protect Luke AFB, the SCS abandoned their efforts on Structures No. 1 and No. 2.

Bell Road Drainage Channel

The Bell Road Drainage Channel is located along the north side of Bell Road from Dysart Road to the Agua Fria River. It is a concrete lined channel that drains a portion of Sun City West. As is the case with McMicken Dam, the Bell Road Drainage Channel is located outside of the study limits. It is mentioned here, however, because it provides conveyance of floodwaters that would otherwise enter the study area.

Dysart Drain

The existing Dysart Drain channel is located along the north side of Luke AFB. It begins at Reems Road and flows easterly about 4.5 miles to the Agua Fria River. The channel is earthen lined from Reems Road downstream to the railroad crossing (just west of Litchfield Road) and concrete lined from there to its point of discharge into the Agua Fria River.

The Dysart Drain was built by the U.S. Army Corps of Engineers in 1958 to collect offsite stormwater flows and prevent them from entering Luke AFB. It was constructed in conjunction with McMicken Dam. Its purpose is to collect and convey floodwaters from the local drainage area downstream of McMicken Dam.

The Dysart Drain has slowly, through time, lost a major amount of its capacity due to land subsidence in the area. The conveyance capacity has decreased from an original design capacity of 1100 cfs down to a current capacity of approximately 300 cfs. Section 10 describes the corrective measures needed on the Dysart Drain.

Litchfield Park Detention Facility

The Litchfield Park Detention Facility is located 3/4 of a mile north of Camelback Road, between Litchfield Road and Dysart Road. It was constructed in 1991 to replace the deteriorated Litchfield Park Dam (a.k.a. Murphey's Dam). It was designed to detain the 100-year flood on Litchfield Wash which has a drainage area of 8/10 of a square mile. The uncontrolled outlet is a 42" pipe. Section 11 provides additional data relative to the Litchfield Park Detention Facility.

ADOT Detention Basins

As part of the construction of Interstate 10, the Arizona Department of Transportation (ADOT) excavated a series of four large detention basins on the north side of I-10 between Bullard Avenue and Dysart Road. The basins contain the 100-year runoff from the 7 square mile drainage basin to the north. They are drained through a 48" pipe to the Agua Fria River. See Section 13 for additional data.

2.3 Floodplains

Figure 2.2 presents the floodplain boundaries within the study area. With the exception of the Agua Fria and Gila Rivers, all of the floodplains shown were delineated as part of this ADMS and are documented in Part A, Flood Study Technical Data Notebook.

Detailed flooding analyses were performed on the following washes. Each wash was numbered to provide identification for the HEC-2 input and output file (refer to Part A).

- Beardsley Canal Wash - Wash 1
- Cholla Wash - Wash 1A
- North For Cholla Wash - Wash 1A1
- Waterfall Wash - Wash 1B
- White Tank #3 Wash - Wash 2
- Bedrock Wash - Wash 3
- North For Bedrock Wash - Wash 3A
- Jackrabbit Trail Wash - Wash 4

- Tuthill Dike Wash - Wash 5
- Bulldozer Wash - Wash 5A
- Osborn Road Wash - Wash 5B (Previously named Caterpillar Wash in Part A)
- Tractor Wash - Wash 5C
- Diversion Dike Wash - Wash 5D (Previously named Caterpillar Dike Wash in Part A)
- White Granite Wash - Wash 5E
- North Fork White Granite Wash - Wash 5E1
- 191st Avenue Wash - Wash 6
- Perryville Road Wash - Wash 7
- Bullard Wash - Wash 10
- AT&SF Railroad Channel - Agua Fria River to Greenway Road - Wash 12
- Lower El Mirage Wash - Wash 13
- Lower El Mirage Wash Tributary - Wash 13A
- Interstate 10 - Jackrabbit Trail to Tuthill Dike - Wash 14-2
- Dale Creek Wash - Wash 21 (Previously named Litchfield Wash in Part A)

Detailed flood studies with 100-year water surface elevations were also delineated for the following ponding areas.

- Roosevelt Irrigation District Canal
- Southern Pacific Railroad
- Buckeye Canal
- Agua Fria River Dike - West Side
- Litchfield Park Detention Facility

Approximate floodplain delineations were developed for the following areas.

- Cotton Lane Wash - Indian School Road to Olive Avenue - Wash 8
- Cotton Lane Wash - Olive Avenue to Waddell Road - Wash 9
- Bullard Wash - From Gila River to south end of Phoenix-Goodyear Municipal Airport - Wash 10
- Bullard Wash - From south end of Luke AFB to Reems Road - Wash 10
- Interstate 10 - Perryville Road to Jackrabbit Trail - Wash 14-3
- Interstate 10 - RID Canal to Cotton Lane - Wash 14-6
- Dysart Drain - Agua Fria River to Reems Road - Wash 17
- Atchison, Topeka and Santa Fe Railroad Spur - Northern Avenue north to Waddell Road - Wash 18, 19 and 20
- Ponding behind White Tanks Flood Retarding Structures No. 3 and No. 4
- Ponding behind Interstate 10
- Ponding behind Airline Canal
- Approximate delineations of conveyance behind Interstate 10
- Approximate delineations behind Southern Pacific Railroad where appropriate
- Approximate delineation of Bullard Wash breakout west of Estrella Parkway and south of State Route 80
- Approximate delineations of breakouts along the Dysart Drain onto Luke AFB
- Reems Road approximate delineation from Northern Avenue to Beardsley Road

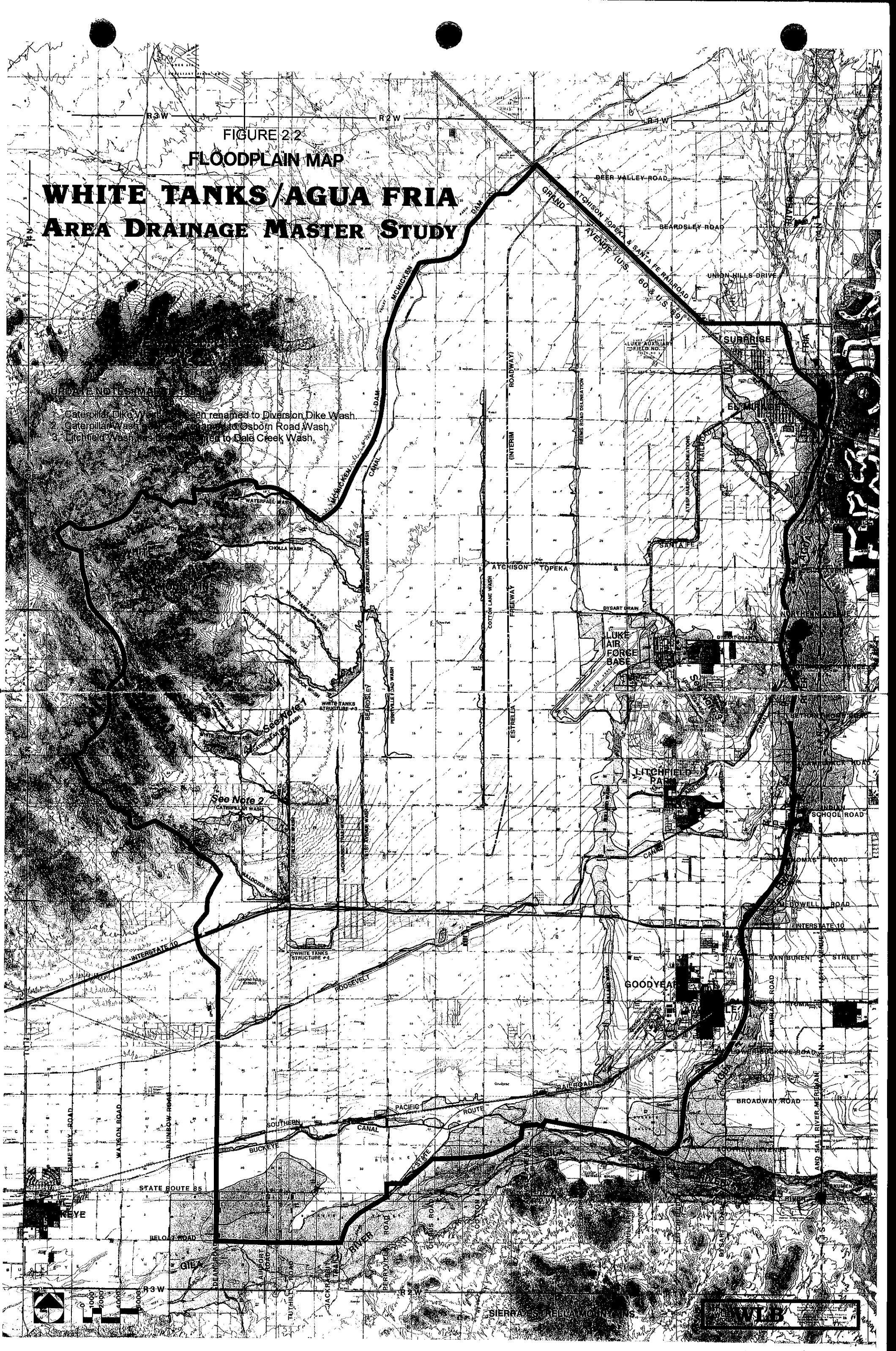


FIGURE 2.2
FLOODPLAIN MAP
WHITE TANKS/AGUA FRIA
AREA DRAINAGE MASTER STUDY
UPDATE NOTES MAR 1 1994
1. Caterpillar Dike Wash has been renamed to Diversion Dike Wash.
2. Caterpillar Wash has been renamed to Osborn Road Wash.
3. Litchfield Wash has been renamed to Dale Creek Wash.
See Note 1
See Note 2
R3W
R2W
R1W
DEER VALLEY ROAD
BEARDSLEY ROAD
UNION HILLS DRIVE
GRAND AVENUE (U.S. 60 & U.S. 89)
ATCHISON TOPEKA & SANTA FE RAILROAD
SUNRISE
LUKE AUXILIARY FIELD NO. 3
EL MIRAGE
WATERFALL WASH
CHOLLA WASH
WHITE TANKS
MOUNTAINS
WHITE TANKS WASH
NORTH FORK BERRICK WASH
BERRICK WASH
WHITE TANKS STRUCTURE #3
CATERPILLAR WASH
BEARDSLEY CANAL WASH
PERRYVILLE ROAD WASH
COTTON LANE WASH
ESTRELLA FREEWAY (INTERIM)
REEMS ROAD DELINEATION
ATSF RAILROAD DELINEATIONS
SANTA FE
ATCHISON TOPEKA & SANTA FE
DYSART DRAIN
NORTHERN AVENUE
LUKE AIR FORCE BASE
LITCHFIELD PARK
CAMELBACK ROAD
INDIAN SCHOOL ROAD
THOMAS ROAD
McDOWELL ROAD
INTERSTATE 10
VAN BUREN STREET
GOODYEAR
LOWER BUCKEYE ROAD
BROADWAY ROAD
SOUTHERN PACIFIC RAILROAD
BUCKEYE CANAL
STATE ROUTE 85
BELOAT ROAD
GILA RIVER
SIERRA ESTRELLA MOUNTAINS
INTERSTATE 10
ROOSEVELT
WHITE TANKS STRUCTURE #4
JACKRABBIT TRAIL WASH
BULLDOZER WASH
LITTLE DIKE WASH
DEAN ROAD
AIRPORT ROAD
TUTHILL ROAD
JACKRABBIT TRAIL
PERRYVILLE ROAD
COTTON
CITRUS ROAD
BULLARD
CHILDS
BASIN ROAD
CEMETERY ROAD
WATSON ROAD
RAINBOW ROAD
MIRAGE ROAD
AGUA FRIA
SALT RIVER MERIDIAN
0 1000 2000 4000 6000
WLB

2.4 Land Subsidence

The design of future flood control and drainage works for the study area should consider land subsidence. Much of the northern part of the study area has subsided considerably over the past 40 years. Refer to Figure 2.3, Map of Land Subsidence, 1957-1990. This map is based on a comparison of the mapping control used for this ADMS versus the 1957 US Geological Survey (USGS), 7 1/2 minute quadrangle maps. The comparison reveals subsidence levels as great as 18 feet.

The USGS quadrangle maps that were used to obtain the 1957 elevations are: Tolleson, 1957; Perryville, 1957; Valencia, 1957; El Mirage, 1957; Waddell, 1957; Calderwood Butte, 1957; and McMicken Dam 1957. The 1990 data is the ground control established for the aerial mapping done as part of this study. The datum for both sets of elevations is the National Geodetic Vertical Datum of 1929. The 1990 elevations are based on five National Geodetic Survey monuments located in the White Tank Mountains which are not in the subsidence area (see Part A, Flood Study Technical Data Notebook). It should be pointed out that, although the USGS maps were published in 1957, the elevations were, most likely, established several years prior to 1957. Therefore, the time period for the land subsidence is probably somewhat longer than 33 years.

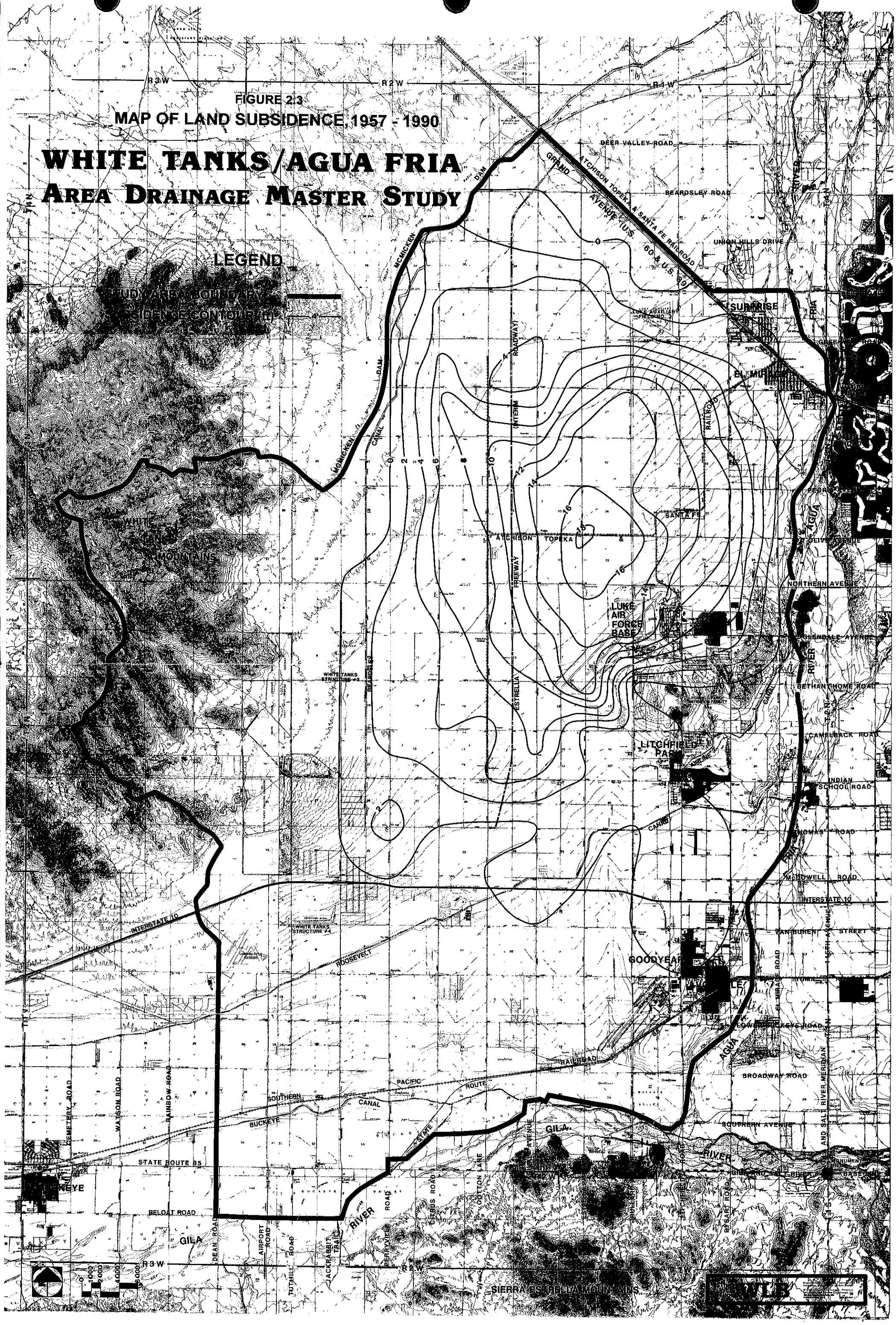


FIGURE 2.3
MAP OF LAND SUBSIDENCE, 1957 - 1990
WHITE TANKS/AGUA FRIA
AREA DRAINAGE MASTER STUDY
LEGEND
STUDY AREA BOUNDARY
SUBSIDENCE CONTOUR (m)
R3W
R2W
R1W
T4N
T2N
T1N
DEER VALLEY ROAD
BEARDSLEY ROAD
UNION HILLS DRIVE
GRAND AVENUE (U.S. 60 & U.S. 89)
ATCHISON TOPEKA & SANTA FE RAILROAD
SURPRISE
EL MIRAGE
PEORIA AVENUE
OLIVE AVENUE
NORTHERN AVENUE
GLENDALE AVENUE
BETHANY HOME ROAD
CAMELBACK ROAD
INDIAN SCHOOL ROAD
THOMAS ROAD
McDOWELL ROAD
INTERSTATE 10
VAN BUREN STREET
LOWER BUCKEYE ROAD
BROADWAY ROAD
SOUTHERN AVENUE
BUCKEYE
STATE ROUTE 85
BELOAT ROAD
SIERRA ESTRELLA MOUNTAINS
WHITE TANKS MOUNTAINS
LUKE AIR FORCE BASE
LITCHFIELD PARK
GOODYEAR
SANTA FE
ATCHISON TOPEKA & SANTA FE RAILROAD
PACIFIC SOUTHERN RAILROAD
ESTRELLA FREEWAY
McMICKEN DAM
McMICKEN CANAL
BEARDSLEY CANAL
ROOSEVELT CANAL
ROOSEVELT DAM
WHITE TANKS STRUCTURE #3
WHITE TANKS STRUCTURE #4
AGUA FRIA RIVER
GILA RIVER
GILA AND SALT RIVER MERIDIAN
CEMETERY ROAD
WATSON ROAD
RAINBOW ROAD
DEAN ROAD
AIRPORT ROAD
TUTHILL ROAD
JACKRABBIT TRAIL
PERRYVILLE ROAD
CITRUS ROAD
COTTON LANE
BOOTH ROAD
SARGENT ROAD
0 1000 2000 4000 6000
WLB

For flood control and drainage works, or for that matter any type of gravity flow system, the major problem is differential land subsidence. This is where adjacent areas of land subside at different rates. Some areas within the study limits have subsided as much as 18 feet; while others have not subsided at all. The result has been a considerable decrease, or even reversal, in the slope of the land. The most dramatic example of this problem is the Dysart Drain. From 1958, when it was constructed, to 1990 there has been approximately 12 feet of differential land subsidence between Litchfield Road and Dysart Road. The channel invert at Litchfield Road was originally about 6 feet higher than the channel invert downstream at Dysart Road. Now the channel invert at Litchfield Road is about 6 feet lower than the invert at Dysart Road. The result of this differential land subsidence has been a severe loss in conveyance capacity from an original design of 1100 cfs down to a current capacity of about 300 cfs.

The preliminary design for corrective measures on the Dysart Drain (see Section 10) include provision for future land subsidence. The Flood Control District commissioned SHB AGRA, Inc. to investigate the Dysart Drain subsidence problem in order to predict future land subsidence. Their report (reference 6) includes a recommended design subsidence profile that predicts 10.5 feet of future subsidence at Reems Road by the year 2035. The channel improvements were designed to provide 100-year flood protection in the future with 10.5 feet of additional subsidence at Reems Road. This same procedure should be used for the design of other drainage and flood control works that are in the land subsidence area.

SECTION 3 AREA DRAINAGE MASTER PLAN (ADMP)

As explained in Section 2.1, the overriding challenge in providing adequate drainage for the study area is dealing with the lack of natural drainage channels. Therefore, the main goal of the ADMP is to establish a system of regional drainage routes that are capable of conveying the 100-year flood. The system described herein utilizes existing drainageways wherever possible along with new routes. The plan includes corrective measures for several existing drainageways as well as floodplain management on the existing washes to preserve their flood conveyance capacity.

The local drainage system is addressed conceptually for each subwatershed. For the most part, it is assumed that the 10-year flood will be collected and conveyed along the major streets which will result in a 10-year drainage system on a one mile grid. The regional drainage system will provide an outfall for the 10-year drainage system as well as collect and convey overland flows during times of major flooding.

3.1 Regional vs. Local Drainage

In discussing the ADMP, it is important to draw a distinction between regional and local drainage facilities. The Uniform Drainage Policies and Standards for Maricopa County (reference 7) defines regional drains as the main outfalls for drainage that serve watershed areas that are generally larger than 10 square miles. The local drainage system are those facilities within the contributing watershed that discharge to the regional drain.

Regional drainage systems are normally open channels designed to collect and convey the 100-year flood. Often times the regional system includes stormwater detention basins which are incorporated to reduce the size of the regional flood control channels. Local drainage systems, on the other hand, are a combination of flow in the streets and storm drains (or roadside ditches) designed to convey the 10-year flood. The local system is also designed to contain the 100-year flood between buildings and houses; while allowing the streets, yards, parking areas and open spaces to be flooded. This is often referred to as the emergency (or major) drainage system while the 10-year drainage facilities are referred to as the convenience (or minor) system. The convenience system is designed to contain more frequent flooding with little disruption and inconvenience. The emergency system is designed to protect buildings from less frequent, major floods while, at the same time, allowing the inconvenience of flooded streets and parking lots.

3.2 Major Elements of the Regional Drainage System

Figure 3.1 presents the proposed Regional Drainage System for the White Tanks/Agua Fria Area. The following is a brief description of each major element.

White Tanks Structure No. 3

As described in Section 2.2, the White Tanks Structure No. 3 is an existing flood control dam that contains the 100-year runoff from a 20.5 square mile watershed in the White Tank Mountains. It plays an important role in the regional drainage system by collecting the concentrated flows and relatively high peak discharges that flow out of the mountain washes.

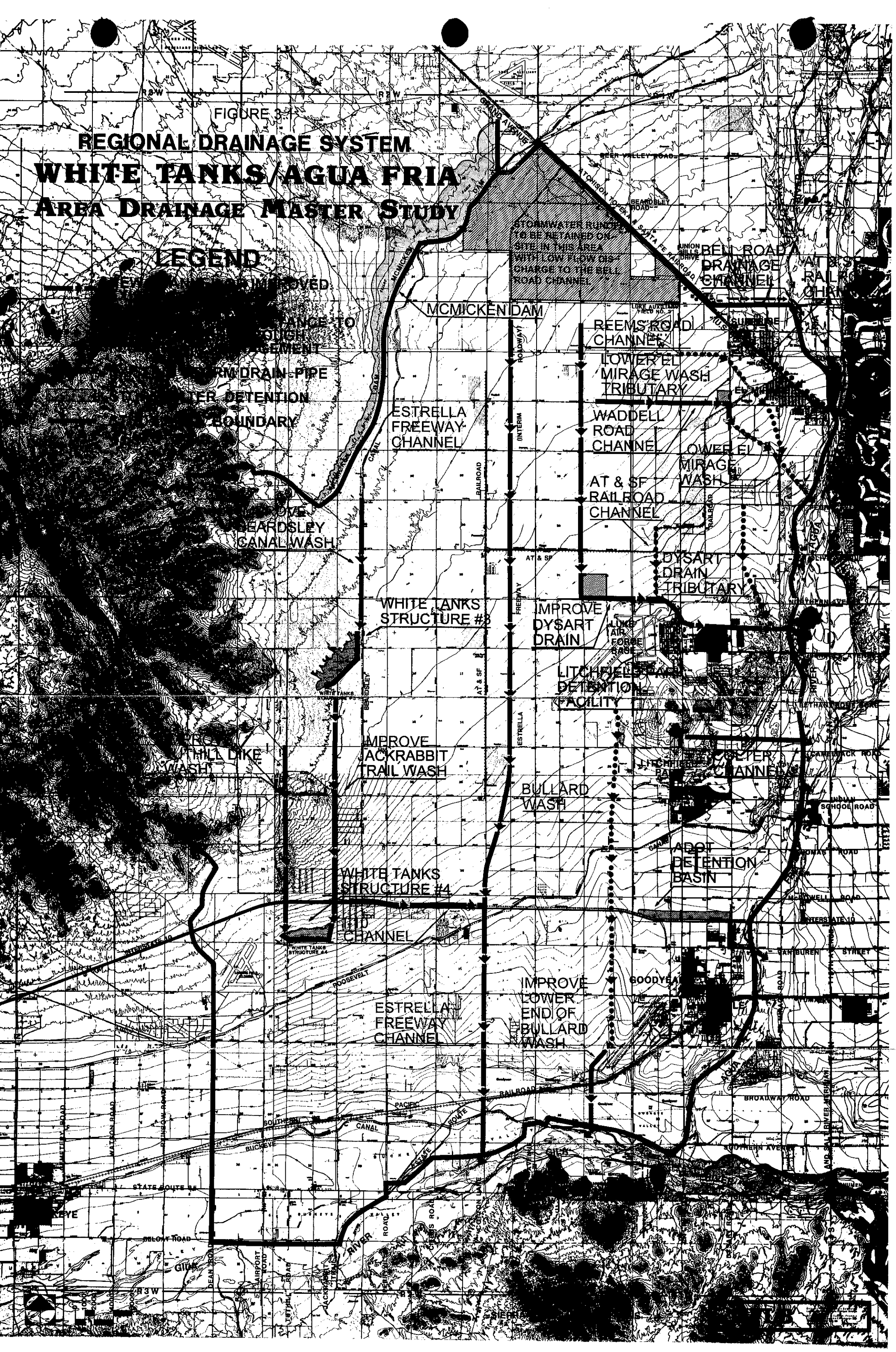


FIGURE 3-1
REGIONAL DRAINAGE SYSTEM
WHITE TANKS/AGUA FRIA
AREA DRAINAGE MASTER STUDY
LEGEND
STORMWATER RUNOFF TO BE RETAINED ON-SITE IN THIS AREA WITH LOW FLOW DISCHARGE TO THE BELL ROAD CHANNEL
BELL ROAD DRAINAGE CHANNEL
MCMICKEN DAM
REEMS ROAD CHANNEL
LOWER EL MIRAGE WASH TRIBUTARY
ESTRELLA FREEWAY CHANNEL
WADDELL ROAD CHANNEL
LOWER EL MIRAGE WASH
AT & SF RAILROAD CHANNEL
BEARDSLEY CANAL WASH
DYSART DRAIN TRIBUTARY
WHITE TANKS STRUCTURE #3
IMPROVE DYSART DRAIN
LITCHFIELD PARK DETENTION FACILITY
IMPROVE JACKRABBIT TRAIL WASH
BULLARD WASH
ADOT DETENTION BASIN
WHITE TANKS STRUCTURE #4
CHANNEL
IMPROVE LOWER END OF BULLARD WASH
ESTRELLA FREEWAY CHANNEL

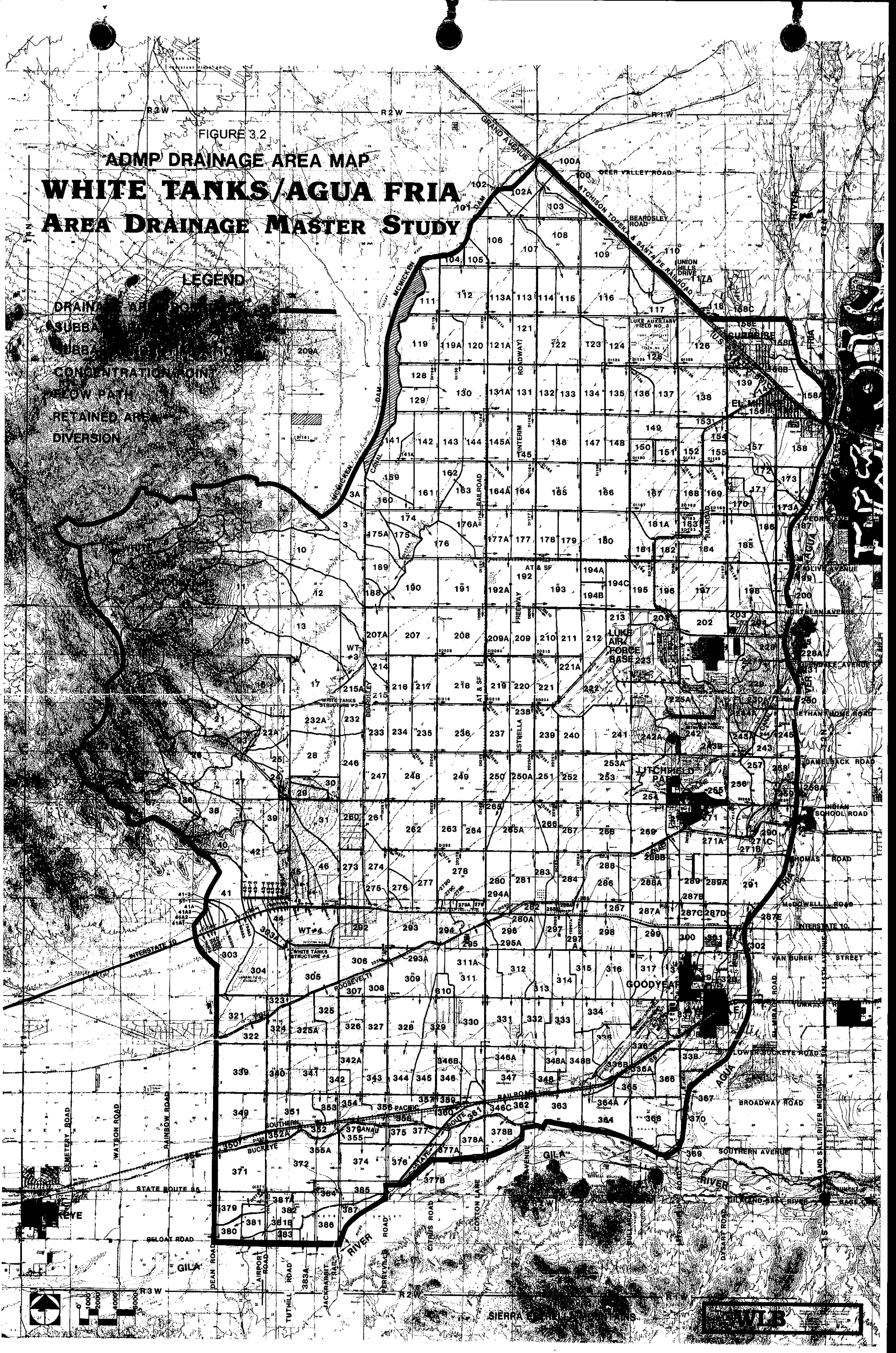


FIGURE 3.2
ADMP DRAINAGE AREA MAP
WHITE TANKS/AGUA FRIA
AREA DRAINAGE MASTER STUDY
LEGEND
CONCENTRATION POINT
BELOW PATH
RETAINED AREA
DIVERSION
R3W
R2W
R1W
GRAND AVENUE
DEER VALLEY ROAD
BEARDSLEY ROAD
UNION HILLS DRIVE
LUKE AUXILIARY FIELD NO. 2
LUKE AIR FORCE BASE
LITCHFIELD PARK
GOODYEAR
INTERSTATE 10
ROOSEVELT
BROADWAY ROAD
SOUTHERN AVENUE
BUCKEYE
STATE ROUTE 85
BELOAT ROAD
GILA RIVER
SIERRA ESTRELLA MOUNTAINS
WHITE TANKS MOUNTAINS
WT #3
WT #4
WHITE TANKS STRUCTURE #3
WHITE TANKS STRUCTURE #4
MCMICKEN DAM
MCMICKEN CANAL
INTERIM FREEWAY
AT & SF RAILROAD
ESTRELLA FREEWAY
ROADWAY
CEMETERY ROAD
WATSON ROAD
RAINBOW ROAD
DEAN ROAD
AIRPORT ROAD
TUTHILL ROAD
JACKRABBIT TRAIL
PERRYVILLE ROAD
CITRUS ROAD
COTTON LANE
BULLARD AVENUE
ESTRELLA ROAD
DISART ROAD
EL MIRAGE ROAD
LITCHFIELD ROAD
AGUA FRIA RIVER
GILA AND SALT RIVER MERIDIAN
0 1000 2000 4000 6000
WLB

Beardsley Canal Wash Improvements

Beardsley Canal Wash is an existing diversion channel that was constructed along with White Tanks Structure No. 3. It collects floodwaters that come down from the White Tank Mountains and conveys them to White Tanks Structure No. 3. In its existing condition it doesn't have sufficient capacity to contain the 100-year flood. A concept channel plan is presented in Section 4 that will improve the Beardsley Canal Wash to a 100-year level of service.

White Tanks Structure No. 4

White Tanks Structure No. 4, as described in Section 2.2, is an existing flood control dam that contains the 100-year runoff from a 19.2 square mile watershed in the White Tank Mountains. As is the case with White Tanks Structure No. 3, this flood retarding structure provides a considerable amount of flood control by impounding floodwaters that come out of the mountain washes. Together with Structure No. 3, they have capacity to impound virtually all of the upslope maintain runoff that would otherwise flood across the study area.

Tuthill Dike Wash

Tuthill Dike Wash is an existing diversion channel that was constructed to convey floodwaters to White Tanks Structure No. 4. It is called Tuthill Dike Wash because it runs along the Tuthill Road alignment. It collects floodwaters that come down from the White Tank Mountains and diverts them to Structure No. 4. The channel and dike require improvements in order to contain the 100-year flood. These corrective measures are part of the area drainage master plan (see Section 5).

Jackrabbit Trail Wash

As is the case with Tuthill Dike Wash, Jackrabbit Trail Wash was also constructed to collect and convey floodwaters to White Tanks Structure No. 4. It intercepts runoff from the area that lies downslope from Tuthill Dike Wash and diverts it to Structure No. 4. Also, as is the case with Tuthill Dike Wash, it has insufficient capacity to contain the 100-year flood and therefore will require channel improvements (see Section 5).

Estrella Freeway Channel

The most prominent single element of the ADMP is a flood control channel along the future Estrella Freeway from the Gila River upstream to Bell Road. The alignment of the Freeway will divide the study area into nearly equal east and west halves. It begins at State Route 85 (about 1.3 miles north of the Gila River) and extends northward to Grand Avenue; generally along the alignment of Cotton Lane. An interim highway has already been constructed along the Freeway alignment from Thomas Road to Grand Avenue. The alignment offers an excellent opportunity to collect sheet flow that accumulates on the agricultural lands west of Cotton Lane. The channel will provide much needed stormwater conveyance where none now exists (See Section 7).

I-10 Channel

A new channel is proposed along the north side of I-10 from Jackrabbit Trail downstream to the proposed Estrella Freeway Channel. The channel will collect flow from 191st Avenue Wash and convey it easterly to the Estrella Freeway Channel. The channel will also collect culvert flows that currently pass under the freeway in numerous locations. This will provide flood control to the area downstream of I-10 (See Section 7).

Dysart Drain

The Dysart Drain is an existing flood control channel that was constructed by the U.S. Army Corps of Engineers in 1958 to protect Luke AFB. The channel begins at Reems Road and Northern Avenue and flows easterly about 4.5 miles to the Agua Fria River. It was designed to convey the 100-year flood. However, due to land subsidence in the area, its capacity has diminished considerably. The Flood Control District is currently preparing construction plans to improve the capacity of the channel to the 100-year level of service. The improvements include a detention basin at the corner of Reems Road and Northern Avenue. Construction is scheduled for 1995 (See Section 10).

Reems Road Channel

Reems Road currently conveys a significant amount of stormwater from Beardsley Road down to the upstream end of Dysart Drain at Reems Road and Northern Avenue. For much of its length, Reems Road has an inverted crown with agricultural berms on each side that will allow it to convey as much as 1000 cfs. The planned improvement of Dysart Drain will include a Detention Basin at Northern Avenue that will provide an outfall for the Reems Road drainage. The ADMP includes a channel along Reems Road that will collect and convey the 100-year flood from the watershed area between Reems Road and the Estrella Freeway (See Section 10).

AT & SF Railroad Channel (Between Dysart Drain and Olive Avenue)

There is an existing channel along the Atchison Topeka and Santa Fe Railroad that reaches from the Dysart Drain upstream to Olive Avenue. In addition to the channel, the Railroad is elevated which allows the 100-year flood to be contained in a combination of flow in the channel and flow along the Railroad. This channel and overbank floodplain areas will be managed to preserve their floodwater carrying capacity (See Section 10).

Dysart Drain Tributary

The Dysart Drain Tributary is an existing shallow floodplain that discharges to the Dysart Drain just upstream of the Agua Fria River. As is the case with the AT & SF Railroad Channel, this floodplain will be managed in order to preserve the floodwater carrying capacity (See Section 10).

Lower El Mirage Wash and Lower El Mirage Wash Tributary

These two existing washes drain the northern part of the City of El Mirage which is located in the northeastern part of the study area. They contain the 100-year flood in wide, shallow floodplains and were identified in Part A (Flood Study Technical Data Notebook) as special flood hazard areas; delineated with Zone AE. Proper floodplain management will allow these washes to provide long term flood conveyance for this part of the study area (See Section 9).

Waddell Road Channel

Waddell Road Channel is essentially an extension of Lower El Mirage Wash. It will collect runoff along Waddell Road, between Reems Road and Dysart Road, and discharge to Lower El Mirage Wash (see Section 9). It includes a detention basin at Dysart Road to limit the 100-year flow discharged to Lower El Mirage Wash.

Colter Channel

The proposed Colter Channel is located 1/4 mile north of Camelback Road from Litchfield Road out to the Agua Fria River. It is currently under construction. It collects drainage from the hilly area north of Camelback Road and conveys it to the Agua Fria River; protecting Litchfield Park which lies south of Camelback Road (See Section 11).

Bullard Wash

Bullard Wash provides floodwater conveyance for a large portion of the southeastern part of the study area. It begins at Luke AFB and flows southerly about 10 miles to the Gila River. For most of its length, it consists of what is essentially a large irrigation tailwater ditch with the 100-year flood contained in the agricultural fields on either side of the ditch. Flow becomes uncontained, however, where Bullard Wash meets Phoenix-Litchfield Airport. From the airport to the Gila River, Bullard Wash requires improvement in order to convey the 100-year flood (See Section 12).

ADOT Detention Basins

With the construction of Interstate 10, ADOT built a series of four detention basins between Bullard Avenue and Dysart Road. These basins have sufficient capacity to contain the 100-year flood and are drained by a 48-inch storm sewer pipe that discharges into the Agua Fria River. The basins provide an outfall for the area south of Colter Channel; between Bullard Avenue and Dysart Road (See Section 13).

AT&SF Railroad Channel (Along Grand Avenue)

The Atchison Topeka and Santa Fe (AT&SF) Railroad, which parallels Grand Avenue, collects runoff from the area north of Grand Avenue and conveys it to the Agua Fria River. Preserving the conveyance along the Railroad will provide drainage for the area north of Grand Avenue (see Section 8).

3.3 Existing vs. Future Land Use

The hydrologic design for the ADMP is based on existing land uses. This will provide adequate long term stormwater conveyance since future runoff will be limited by stormwater retention requirements. On a County-wide basis, City and County regulations require new developments to provide stormwater retention for the 100-year, 2-hour storm. As a result, future 100-year peak flow rates and volume of runoff will be substantially reduced. In the meantime, the existing condition design will provide the necessary management of floodwaters.

3.4 Hydrology

The hydrologic analysis for this study was carried out to compute flood hydrographs for each element of the proposed regional drainage system. The analysis was done using the existing conditions HEC-1 model which was previously developed for the Flood Study portion of the ADMS (refer to: Part A, Flood Study Technical Data Notebook, White Tanks/Agua Fria ADMS, October 1992). The existing conditions model was modified to route floodwaters through the proposed features of the regional drainage system. The ADMP drainage area map, Figure 3.2, presents the subbasins and channel routing used to compute the flood hydrographs for the regional drainage system. The HEC-1 model is included in Appendix A.

The proposed condition peak discharges for the regional drainage system are presented in this report. In the case of the proposed improvements on Bullard Wash, the peak discharges used for design are for an interim condition that is different from the peak discharges computed from the above described ADMP HEC-1 model. The interim design is based on the assumption that the Estrella Freeway Channel is not in place. If it were in place, the design flows for Bullard Wash would be reduced. The Estrella Freeway Channel, however, will most likely be constructed after the Bullard Wash improvements are completed. Therefore, the Bullard Wash design flows were increased to account for the existing condition where stormwater crosses through the Estrella Freeway alignment (see Section 12).

Except for Dysart Drain, all of the other proposed channels and channel improvements are based on the proposed condition peak discharges obtained from the ADMP HEC-1

model. Dysart Drain, however, has been designed for existing conditions. The proposed condition peak discharges on Dysart Drain are substantially less than the existing condition. However, Dysart Drain will be constructed in 1995; whereas, the regional drainage channels that will reduce flow to Dysart Drain are not funded nor scheduled at this time. These include the Estrella Freeway Channel and the Waddell Road Channel. Consequently, Dysart Drain should have conveyance capacity in excess of the 100-year flood in the future when regional drainage channels are constructed along the Estrella Freeway and Waddell Road.

SECTION 4 WHITE TANKS STRUCTURE NO. 3 WATERSHED

4.1 Introduction

This section presents the drainage master plan for the White Tanks Structure No. 3 watershed. The area covered is shown on Figure 4.1. It includes all of the tributary area (20.5 square miles) to the White Tanks No. 3 Flood Retarding Structure. It also includes the diversion channel and dike along the Beardsley Canal known as Beardsley Canal Wash.

4.2 Existing Conditions

4.2.1 Drainage Characteristics

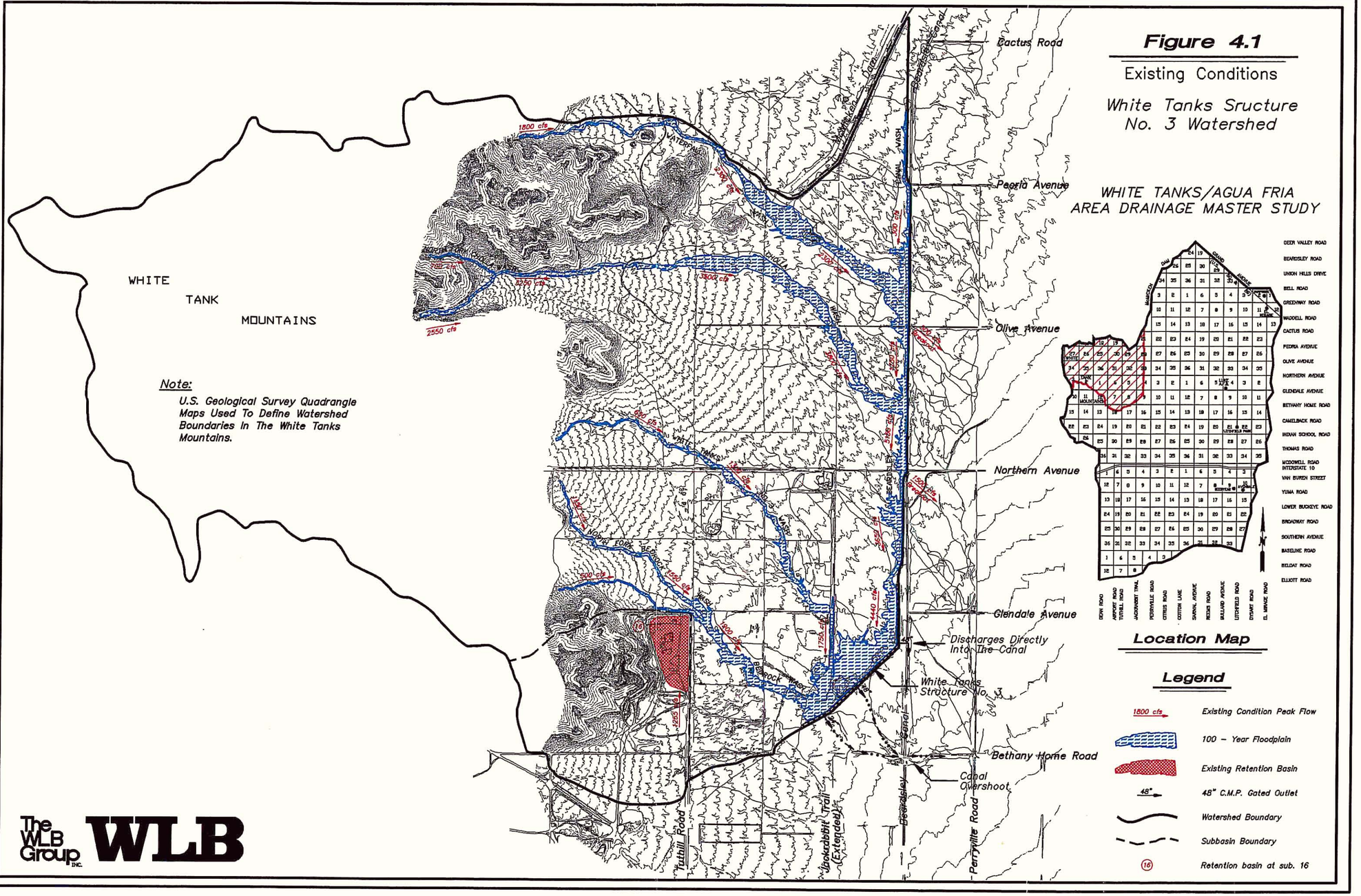
The White Tanks No. 3 watershed consists of mountainous and foothill areas within the White Tank Mountains. Land slopes range from 1% in the foothills up to over 100% in the steepest mountain areas. The elevation is about 1200 feet at the flood retarding structure and rises to over 4000 feet at the highest peaks.

Figure 4.1

Existing Conditions

White Tanks Sructure No. 3 Watershed

WHITE TANKS/AGUA FRIA AREA DRAINAGE MASTER STUDY



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Stormwater runoff is collected in natural washes that flow east, southeasterly out of the mountains. The floodplains of the most significant of these washes were delineated as part of this study and are documented in Part A. Those washes include: Waterfall Wash, Cholla Wash, North Fork of Cholla Wash, White Tanks No. 3 Wash, Bedrock Wash and the North Fork of Bedrock Wash. Of these washes, only White Tanks No. 3 Wash and Bedrock Wash (and its North Fork) discharge directly to the White Tanks No. 3. The others drain to Beardsley Canal Wash which diverts flow to White Tanks No. 3 that would otherwise continue to flow in a southeasterly direction across the study area.

Stormwater runoff from subbasin No. 16 (refer to Figure 4.1 and Appendix A) drains to a large detention basin at the northeast corner of the Caterpillar Proving Grounds. The basin is large enough to retain the entire 100-year flood from the 1.13 square mile subbasin. In fact, the basin is so large that the 100-year high water level is over 40 feet below the basin spillway. The volume of 100-year runoff from subbasin 16 is only 86 acre-feet, while the basin volume is over 1300 acre-feet.

4.2.2 Land Use

The majority of the land in the watershed is either State Land or part of the County's White Tank Mountain Regional Park (see Current Land Use Map, Section 1). About 10% of the watershed is privately owned; most of which is on the Caterpillar Proving Grounds. The J.I. Case Company also operates an earthmoving equipment proving ground within the watershed which is located on State lands. Other than the grading done on the two proving grounds and some park roads and picnic sites, the watershed retains its natural character and drainage patterns.

4.2.3 White Tanks Structure No. 3 Background Information

The White Tanks Flood Retarding Structure No. 3 is owned and operated by the Flood Control District of Maricopa County. It was constructed by the U.S. Soil Conservation Service (S.C.S.) in 1954. The cost of construction was shared between the SCS and the Agua Fria Soil Conservation District (AFSCD). AFSCD is now known as the Agua Fria - New River Natural Resource Conservation District. The primary purpose of building the structure was to protect downstream agricultural lands from flood damage.

Structure No. 3 was part of a larger plan proposed by the SCS in 1952. That plan, called the White Tanks Erosion Control Project, included four structures. Structures No. 3 and No. 4 were both constructed in 1954. The SCS abandoned efforts, however, on structures No. 1 and No. 2 because the U.S. Army Corps of Engineers (Corps) proposed the construction of McMicken Dam which essentially took their place. The Corps built McMicken Dam in 1956.

White Tanks Structures No. 3 was designed to contain the runoff from a 4 inch rainfall while the emergency spillway was designed for a 6 inch rainfall (reference 6). The original design also provided for a 50 year sediment load. The existing conditions hydrologic model prepared for this ADMS (see Part A, Flood Study Technical Data Notebook) indicates that the 100-year flood is well contained within the reservoir with the 100-year water surface elevation approximately 11 feet below the spillway crest.

The outlet works consist of two gated 48" CMP's and one gated 24" CMP (see Figure 4.1). The northern most outlet pipe drains directly to the Beardsley Canal. The other two drain across an overchute of the Canal at Bethany Home Road extended.

4.2.4 Known Flood Hazards

The primary flood hazard in the White Tanks No. 3 area is the Beardsley Canal Wash. The problem is that the wash does not have sufficient capacity to contain the 100-year flood. Consequently, during major floods, stormwater runoff will overtop the east bank and cause wide, shallow flooding on the land downstream. Other flooding in the watershed includes the mountain washes and the ponding behind White Tanks Structure No. 3.

Beardsley Canal Wash was created by a diversion dike constructed along the Beardsley Canal, to divert stormwater to White Tanks Structure No. 3. The diversion dike was constructed as part of Structure No. 3 by the SCS in 1954. It is approximately 3 miles long, extending from Structure No. 3 upstream to a point north of Peoria Avenue.

Part A of this study, as well as another previous study conducted by the Flood Control District (reference 8), identified the fact that the diversion dike along the Beardsley Canal Wash has insufficient capacity to convey the 100-year flood. Under existing conditions the 100-year flood will cause a breakout of 500 cfs at Olive Avenue and 1500 cfs at Northern Avenue (see figure 4.1). Moreover, for much of its three mile reach, the diversion dike does not have adequate freeboard to meet FEMA standards.

In regard to flooding upstream in the watershed, there are several mountain washes that present significant flood hazards. They include Waterfall Wash, Cholla Wash and its North Fork, White Tanks No. 3 Wash, and Bedrock Wash and its North Fork. The 100-year peak discharges in these washes range from 500 cfs up to 3800 cfs (see Fig. 4.1). Floodplain limits for each of these washes were delineated in Part A of the ADMS.

In addition to flooding in the mountain washes, ponding behind White Tanks Structure No. 3 also inundates a large area. This, however, does not pose a significant flood hazard since the land in the ponding area is owned by the Flood Control District.

4.3 Area Drainage Master Plan

The regional flood control system for the watershed is essentially in place. The mountain washes provide a natural system of regional drainageways which can be preserved by requiring future development to comply with the Floodplain Regulation for Maricopa County. The Beardsley Canal Wash and White Tanks No. 3 Structure provide the necessary outfall for the washes. The Beardsley Canal Wash, however, will have to be improved in order to convey the 100-year flood.

4.3.1 Corrective Measures on Beardsley Canal Wash

As described above in Section 4.2.4, the containment dike on Beardsley Canal Wash is susceptible to overtopping during times of major flooding. This should be corrected for two reasons. First, the overtopping results in flooding on the lands that lie east of the Beardsley Canal. Even worse is that the dike concentrates floodwaters that could potentially break out in greater quantity than what would have occurred in the natural condition; without the dike in place. Second, all of the runoff which was designed to contribute to White Tanks No. 3 does not get there because of the overtopping. Structure No. 3 was designed to contain the 100-year flood from the land west of the Beardsley Canal. However, since the diversion dike along the Canal has insufficient capacity, the entire 100-year flood cannot reach the structure. The result is an underutilization of the flood retarding structure.

A concept channel plan for improving the Beardsley Canal Wash has been prepared as part of this ADMS. Appendix B includes the conceptual channel plan and profile, an itemized cost estimate and the hydraulic calculations.

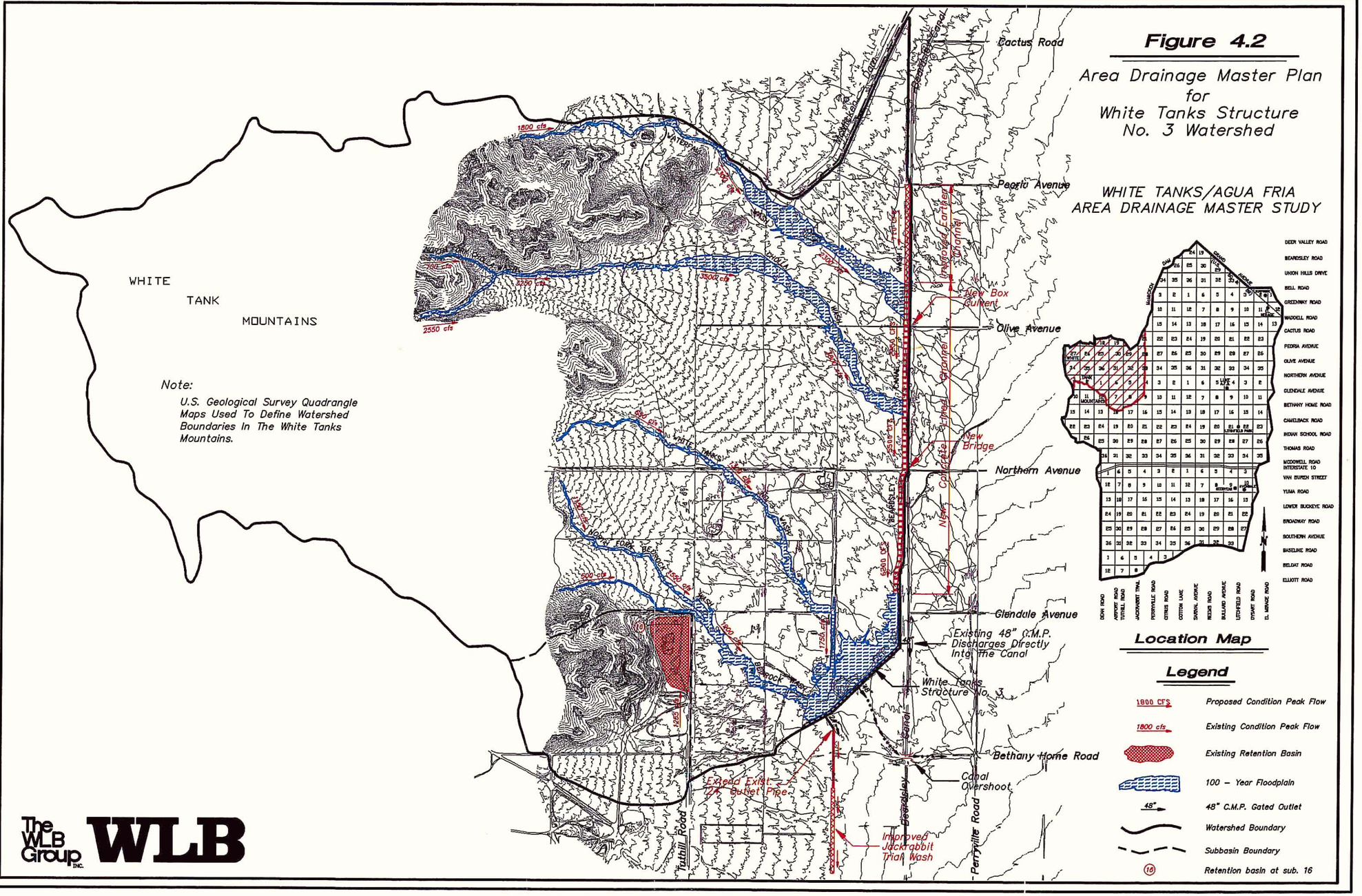


Figure 4.2

Area Drainage Master Plan for White Tanks Structure No. 3 Watershed

WHITE TANKS/AGUA FRIA AREA DRAINAGE MASTER STUDY

The concept plan calls for a concrete lined channel from the north end of White Tanks Structure No. 3 to a point approximately 1100 feet north of Olive Avenue. An earthen channel is proposed from that point to the upstream end of the channel; about ½ mile north of Peoria Avenue (extended). The existing culverts at Olive Avenue and Northern Avenue are the primary causes for the existing breakout flows. The concept plan is to replace the existing two 72 inch pipe culverts at Northern Avenue with a bridge and replace the two existing 96 inch culverts at Olive Avenue with three 12' by 8' box culverts.

4.3.2 Effect on White Tanks Structure No. 3

The improvement of Beardsley Canal Wash will increase the volume and peak rate of runoff into White Tanks Structure No. 3. The hydrologic model of the future conditions (see Section 3) includes the channel improvement on the Beardsley Canal Wash. The model results indicate that the structure can safely store the entire 100-year flood. The following table summarizes the existing condition versus future condition hydrologic data for White Tanks Structure No. 3. For purposes of this study, the only change from existing to future conditions is the improvement of Beardsley Canal Wash to prevent breakout flows during the 100-year flood. It was assumed that future development will provide stormwater retention so as not to increase runoff in the post development condition.

TABLE 4.1

Hydrologic Data for White Tanks Structure No. 3 Existing versus Future Conditions 100-year Flood		
	EXISTING CONDITIONS[1]	FUTURE CONDITIONS
Drainage Area (sq.mi.)	20.48	20.48
Rainfall Depth (in.)	3.95	3.95
Runoff Volume (ac-ft)	720	850
Peak Inflow (cfs)	6650	8120
Peak Stage (ft) [2,3]	1198.1	1199.1
[1] Refer to Part A, Flood Study Technical Data Notebook, October 1992.		
[2] Emergency Spillway Elev = 1209 ft.		
[3] Dam Crest Elev = 1212.1 ft.		

As may be seen from the table, precluding the breakouts from Beardsley Canal Wash results in only a one foot rise in peak stage. Moreover, there remains 10 feet of freeboard below the emergency spillway elevation. Therefore, it would appear that White Tanks Structure No. 3 has more than adequate capacity to contain the 100-year flood.

It should be pointed out, however, that the hydrologic model for this study was based on an earlier version of the Drainage Design Manual for Maricopa County. The latest version, dated June 1, 1992, incorporates a modified technique for calculating the composite hydraulic conductivity (XKSAT) which results in lower infiltration rates for the loamy sandy soils found in the White Tank Mountains. The Flood Control District hydrology staff has done some modifications to the hydrologic model which would indicate that there is less than 10 feet of freeboard in the reservoir.

Because there is some uncertainty associated with the 100-year flood volume, no development should be allowed in the watershed that would increase runoff volume. The flood retarding structure has a finite reservoir volume which was designed for the 100-year flood. Future land development should be designed with sufficient stormwater retention so that the runoff will not exceed the capacity of the flood retarding structure. In addition, the existing retention basin volume on the Caterpillar Proving Grounds which retains runoff from subbasin no. 16 should be preserved by future development.

4.3.3 Stormwater Retention Requirements

Future development in the White Tanks No. 3 watershed shall provide stormwater retention for the 100-year, 2-hour rainfall in accordance with the "Uniform Drainage Policies and Standards for Maricopa County, Arizona". This shall apply to all development. The County's current policy would allow low density residential (1 acre lots and larger) to develop without retention. Under normal circumstances, this would be acceptable; particularly in rocky mountainous areas where construction of driveways and roofs don't necessarily increase runoff substantially. However, in this part of the White Tank Mountains, there is a considerable amount of sandy soils which have relatively high infiltration rates. Therefore, development, even low density single family development, will result in greater runoff.

In addition to the soil situation, there are other reasons to require stormwater retention. Most importantly is that the flood retarding structure No. 3 was designed for natural conditions in the watershed. Therefore, any construction that would result in increased runoff will have to retain runoff in order to maintain the integrity of the design.

4.3.4 Existing Retention Volume on Caterpillar Proving Grounds

The existing volume in the retention basin at the northeast corner of the Caterpillar Proving Grounds should be preserved into the future. As described previously, this basin retains all of the 100-year runoff from the 1.13 square mile area identified as subbasin no. 16 (refer to Appendix A, Hydrologic Analysis).

SECTION 5 WHITE TANKS STRUCTURE NO. 4 WATERSHED

5.1 Introduction

The White Tanks Structure No. 4 watershed is presented on Figure 5.1. The watershed boundary covers the tributary area to the White Tanks No. 4 Flood Retarding Structure which is 19.8 square miles. The watershed includes the existing 19.2 square mile drainage area that drains to White Tanks Structure No. 4 plus the area which is added by extending Jackrabbit Trail Wash (see Section 5.3.2). The added area measures 0.6 square miles for a total of 19.8. The diversion channels along Tuthill Dike and Jackrabbit Trail collect and convey floodwaters to Structure No. 4.

5.2 Existing Conditions

5.2.1 Drainage Characteristics

The White Tanks No. 4 watershed consists primarily of mountainous and foothill areas within the White Tank Mountains. Land slopes range from 1% at the flood retarding structure up to over 100% in the steepest mountain areas. The elevation is approximately 1050 feet at structure No. 4 and rises to over 3600 feet in the mountains.

Stormwater runoff concentrates in desert washes that flow easterly out of the mountains. The floodplains associated with the more prominent of these washes were delineated as part of this study and are documented in Part A, Flood Study Technical Data Notebook. They include: White Granite Wash, North Fork of White Granite Wash, Diversion Dike Wash (named Caterpillar Dike Wash in Part A), Tractor Wash, Osborn Road Wash (named Caterpillar Wash in Part A) and Bulldozer Wash. These washes discharge to Tuthill Dike Wash, which collects and conveys runoff from the White Tank Mountains to Structure No. 4. Another diversion channel, known as Jackrabbit Trail Wash, collects runoff from the area between Tuthill Road and Jackrabbit Trail and, like Tuthill Dike Wash, it drains to Structure No. 4.

The Caterpillar Tractor Company previously used a large portion of the watershed to test earth moving equipment. Within these proving grounds the Company built roads, excavated large basins and built dikes. Many of these facilities significantly altered the natural drainage patterns. Figure 5.1 shows the more significant of these structures.

Many of Caterpillar's structures provide a considerable amount of flood control. For example, Tuthill Dike, which was constructed by Caterpillar, diverts a large amount of runoff to White Tanks Structure No. 4. The excavated basins also provide flood control. In fact, the 100-year runoff from subwatersheds 18 through 21, as well as 23, 24 and 29 (refer to Figure 3.2, ADMP Drainage Area Map) is totally contained within the excavated retention basins built by Caterpillar.

5.2.2 Land Use

Approximately 12 square miles, or roughly 60% of the watershed, is owned by the Caterpillar Tractor Company (refer to Figure 1.2, Current Land Use Map). In the past this property was used by Caterpillar for an equipment proving ground. Recently, however, they moved their proving grounds to Green Valley, Arizona and stopped operations at their White Tanks facility. This area will, most likely, be developed into a master planned community at some time in the future. The land west of the Caterpillar Proving Grounds, which is high up in the mountains, is federally owned properties managed by the Bureau of Land Management (BLM). The remaining area in the watershed is privately owned lands that lie, for the most part, between Jackrabbit Trail and Tuthill Dike. This area makes up about 25% of the watershed (about 5 square miles) and is mostly undeveloped natural desert.

5.2.3 White Tanks Structure No. 4 Background Information

The White Tanks Flood Retarding Structure No. 4 is owned and operated by the Flood Control District of Maricopa County. It was constructed by the U.S. Soil Conservation Service (S.C.S.) in 1954. The cost of construction was shared between the SCS and the Agua Fria Soil Conservation District (AFSCD). The primary purpose of building the structure was to protect downstream agricultural lands from flood damage.

Structure No. 4 was part of a larger plan proposed by the SCS in 1952. That plan, called the White Tanks Erosion Control Project, included four structures. Structures No. 3 and No. 4 were both constructed in 1954. The SCS abandoned efforts, however, on structures No. 1 and No. 2 because the U.S. Army Corps of Engineers (Corps) proposed the construction of McMicken Dam which essentially took their place. The Corps built McMicken Dam in 1956.

White Tanks Structures No. 4 was designed to contain the runoff from a 4 inch rainfall while the emergency spillway was designed for a 6 inch rainfall (reference 6). The original design also provided for a 50 year sediment load. The existing conditions hydrologic model prepared for this ADMS (see Part A, Flood Study Technical Data Notebook) indicates that the 100-year flood is well contained within the reservoir with the 100-year water surface elevation approximately 7 feet below the spillway crest.

It is interesting to point out that the original design of White Tanks No. 4 was based on a drainage area of 10.3 square miles; whereas the current drainage area is 19.2 square miles. The increase in drainage area can be attributed to two changes since the Structure was designed. One change is that approximately 4 square miles, which was assumed to drain to White Tanks No. 3, now flows to White Tanks No. 4 (Subbasins No. 18 through 22 and the north half of 22A). From inspection of the topographic maps, it is not clear whether this change in flow direction was caused by physical changes on Caterpillar Proving Grounds or whether the original assumption on flow direction was incorrect. However, regardless of the cause, the change in flow path does not have a tremendous effect on Structure No. 4 because runoff from 3.5 square miles of the drainage area (Subbasins No. 18 through 21) is retained in Caterpillar's retention basins. The other change that has occurred is the construction of Jackrabbit Trail Wash and Tuthill Dike Wash which divert another 4.5 square miles to White Tanks No. 4 that was not provided for in the original design.

One would think that the increase in drainage would cause the structure to be undersized for the 100-year flood. Yet it has not; the 100-year water surface is approximately 7 feet below the spillway crest. There are at least two reasons why the increase in drainage area has not caused the runoff to exceed the storage capacity of the structure. First, the current storage volume is about 235 acre-feet larger than the design capacity; existing storage capacity is 1270 acre-feet versus a design capacity of 1036 acre-feet. Second, as described previously, the Caterpillar Tractor Company has excavated several large

retention basins which dramatically reduce runoff from the mountain watersheds. These basins totally contain runoff from 4 square miles of drainage area and greatly reduce flows from other parts of the watershed. Exhibit 5.1 presents the considerable flood control which is associated with these retention basins.

The outlet works for Structure No. 4 consist of a 30" CMP located in the eastern part of the dam, and a 36" CMP located on the western side (See Figure 5.1). Both of the outlet pipes drain into existing irrigation ditches downstream of the Structure.

5.2.4 Known Flood Hazards

As is the case with the White Tanks No. 3 area, the primary flood hazards in the White Tanks No. 4 watershed are the channels that divert runoff to the flood retarding structure. With the White Tanks No. 3 area, the problem is the lack of conveyance in the diversion channel along the Beardsley Canal. In the case of White Tanks No. 4, the problem is insufficient conveyance in both Tuthill Dike Wash and Jackrabbit Trail Wash.

Tuthill Dike Wash

The floodplain delineation portion of this study (refer to Part A, Flood Study Technical Notebook) revealed several flood hazards associated with Tuthill Dike Wash. They include insufficient culvert capacity under Interstate 10, inadequate freeboard capacity in several locations along the dike and erosion of the dike in the vicinity of McDowell Road.

At Interstate 10 there are four 10' x 8' box culverts which convey flood waters under the roadway and toward White Tanks No. 4 which lies to the south. These culverts have insufficient capacity to pass the 100-year flood. The 100-year peak discharge reaching I-10 is 6600 cfs. The storage created by ponding on the upstream end of the I-10 culverts reduces the peak discharge from 6600 cfs down to 5500 cfs. Of this flow, 4060 cfs is conveyed through the culverts and the remaining 1440 cfs overtops the dike. The flows that overtop the dike travel easterly along Interstate 10 and inundates a fairly large area on the north side of the Freeway.

Interstate 10 is the only location where Tuthill Dike is overtopped during the 100-year flood. However, the dike has inadequate freeboard in other locations. The Federal Emergency Management Agency (reference 9) requires a minimum of 3 feet of freeboard for dikes. At two other locations, one upstream of Thomas Road extended and the other upstream of Camelback Road extended, the dike has less than 3 feet of freeboard. In fact, upstream of Thomas Road it has less than 1 foot of freeboard.

In addition to the lack of conveyance capacity, the dike has experienced considerable erosion in the area of McDowell Road. One of Caterpillar's retention basins is located north of McDowell Road along the west side of Tuthill Dike. Floodwaters spill out of the retention basin in a

southeasterly direction toward the dike. These outlet flows have caused erosion along the toe of the dike as well as erosion of the retention basin spillway. Structural improvements are needed in this location in order to preclude the possibility of dike failure due to erosion.

Jackrabbit Trail Wash

Jackrabbit Trail Wash has insufficient capacity to convey the 100-year flood. The wash begins upstream of Camelback Road and conveys floodwaters downstream to White Tanks Structure No. 4. The drainage area for the wash is the land downhill of Tuthill Dike. In several locations, the 100-year flood exceeds the capacity of the wash and spills over the roadway. These breakouts occur upstream of Camelback Road, downstream of Thomas Road and downstream of I-10 (see Figure 5.1).

Mountain Washes

In addition to the two diversion channels, there are several mountain washes that present significant flood hazards. They include White Granite Wash and its North Fork, Diversion Dike Wash (named Caterpillar Dike Wash in Part A), Tractor Wash, Osborn Road Wash (named Caterpillar Wash in Part A), and Bulldozer Wash. The 100-year peak discharges in these washes range from 400 cfs up to 3250 cfs (see Figure 5.1). Floodplain limits for each were delineated in Part A of the ADMS.

5.3 Area Drainage Master Plan

A fairly extensive system of flood control is already in place for the watershed. The mountain washes provide a natural system of drainageways which can be preserved by requiring future development to comply with the floodplain regulations for Maricopa County. Runoff from the mountain washes is collected in Tuthill Dike Wash and Jackrabbit Trail Wash and conveyed to White Tanks Structure No. 4 (see Figure 5.1). Although this drainage system is currently in place, improvements are necessary on both Tuthill Dike Wash and Jackrabbit Trail Wash in order to provide sufficient conveyance capacity for the 100-year flood.

In addition to the existing system of conveyance, there are a number of large retention basins in the watershed which considerably decrease peak flows in the downstream washes as well as reducing the volume of runoff that reaches White Tanks No. 4. These basins should be preserved in order to maintain the integrity of White Tanks No. 4 and to prevent increased peak flows in the washes.

5.3.1 Corrective Measures on Tuthill Dike Wash

As was described in section 5.2.4, Tuthill Dike is susceptible to overtopping during the 100-year flood. The culverts underneath I-10 do not have capacity to convey the entire 100-year flood which leads to a breakout of 1400 CFS on the upstream side of the Freeway. In addition, there is a lack of adequate freeboard to meet FEMA standards in several other locations along the Dike.

Two alternatives have been investigated for solving the conveyance problem on Tuthill Dike Wash. Alternative 1 is a channel improvement plan. Alternative 2 is a plan to reduce peak discharges along Tuthill Dike by utilizing excess retention capacity upstream in the watershed.

Alternative No. 1

Alternative 1 is a plan to improve Tuthill Dike Wash for its entire length from White Tanks Structure No. 4 upstream to a point 1/2 mile north of Camelback Road. Appendix C includes a conceptual plan and profile, itemized cost estimate and hydraulic calculations.

The major features of the Alternative 1 channel plan are described below.

A. Concrete Lined Channel From Structure No. 4 to the Retention Basin (North of McDowell Road):
The plan includes a concrete lined channel from White Tanks Structure No. 4 upstream to the retention basin north of McDowell Road. The channel bottom width is 50 feet and the depth varies from 6 feet to 11 feet. The culverts under I-10 remain as is.

B. *Dike Improvements Upstream of I-10:*

Alternative 1 calls for raising the top of Tuthill Dike upstream of I-10. The dike needs to be raised about 5 feet; from an existing elevation of 1091.5 up to 1096.5. Elevation 1096.5 will provide four feet of freeboard above the 100-year water surface elevation of 1092.5. Four feet of freeboard is required by FEMA (reference 9) on the upstream side of bridges and culverts.

C. Enlarge Existing Retention Basin (North of McDowell Road):

The major flooding problem associated with Tuthill Dike Wash is the crossing at I-10. The existing box culverts are inadequate to pass the 100-year flood. The solution to this problem in Alternative No. 1 is to enlarge the existing retention basin north of McDowell Road from an existing volume of 161 ac-ft to a new volume of 334 ac-ft. This will enable the peak of the flood hydrograph to be stored in the basin and reduce the peak discharge on Tuthill Dike Wash from 6200 cfs down to 4000 cfs. The box culverts under I-10 have enough capacity to convey 4000 cfs. It should also be noted that Bulldozer Wash drains to the existing retention basin; and that the proposed volume of 334 ac-ft will provide enough storage for the 100-year runoff in Bulldozer Wash as well as the peak flow above 4000 cfs on Tuthill Dike Wash.

D. Concrete Lined Channel From the Retention Basin (North of McDowell Road) to the Confluence with Osborn Road Wash (named Caterpillar Wash in Part A):

The plan calls for a concrete lined channel from Caterpillar's retention basin, on the north side of McDowell Road, upstream to the confluence with Osborn Road Wash. The peak flow in this reach of Tuthill Dike Wash exceeds 6000 cfs and the channel slope is greater than 1%. These factors make it difficult and costly to construct a stable earthen channel, therefore, this section of Tuthill Dike Wash is proposed to be concrete lined.

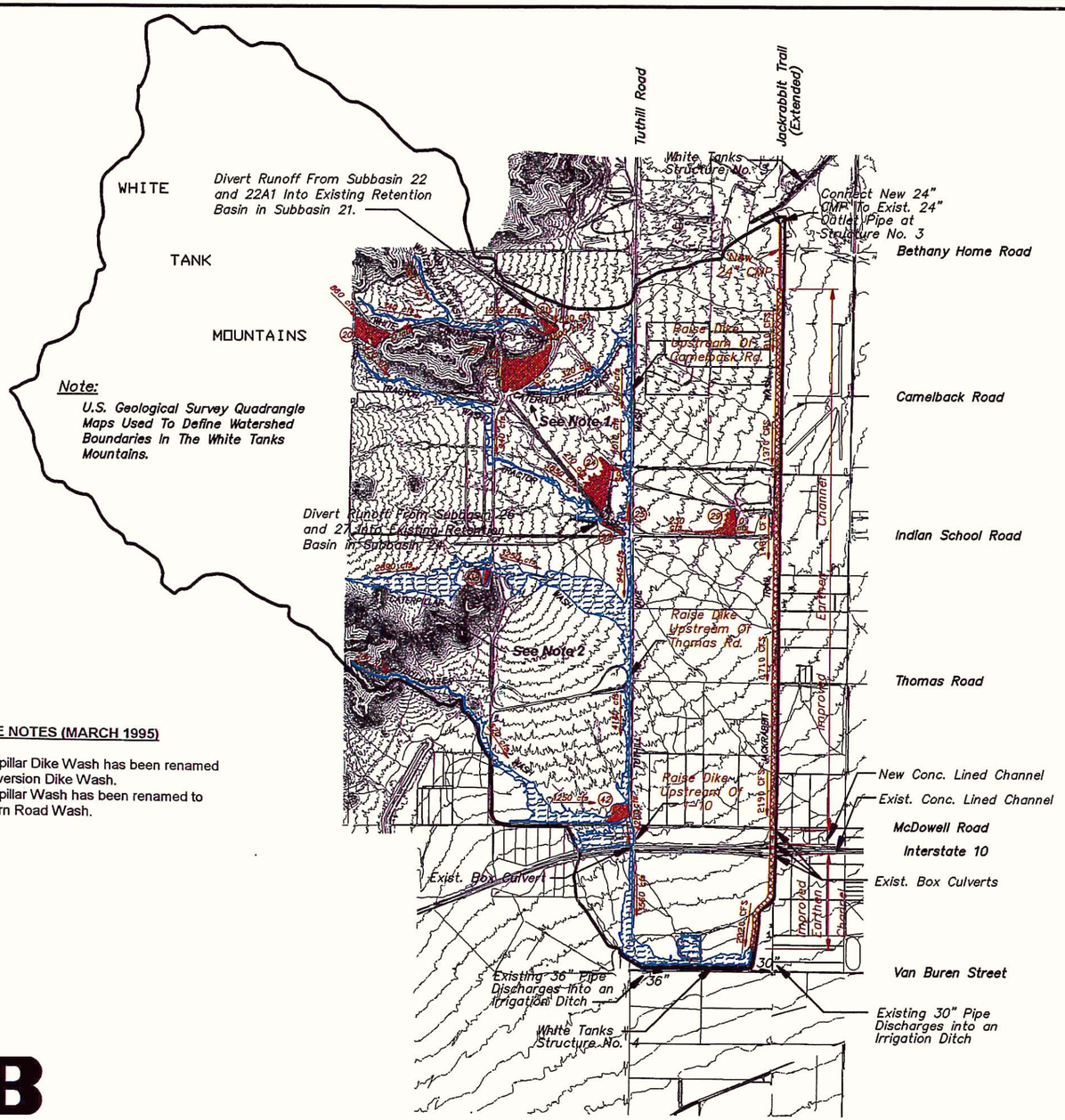
E. Earthen Channel Upstream of Osborn Road Wash (named Caterpillar Wash in Part A):

The upstream portion of Tuthill Dike Wash is earthen lined. This reach is from Osborn Road Wash upstream to Diversion Dike Wash (named Caterpillar Dike Wash in Part A); approximately 2 miles in length. Peak flows are considerably lower in this reach of the channel, ranging from 3000 cfs down to 1200 cfs, which makes it practical to construct an earthen channel. Four drop structures are required, however, in order to maintain non-erosive velocities.

Figure 5.3

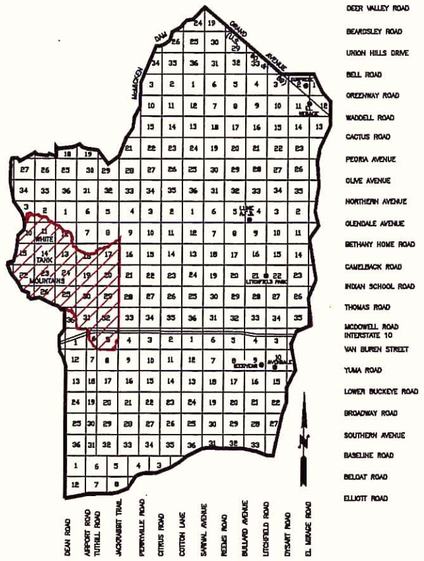
Area Drainage Master Plan For White Tanks Structure No. 4 Watershed (Tuthill Dike Wash Alternative No. 2)

WHITE TANKS/AGUA FRIA AREA DRAINAGE MASTER STUDY



UPDATE NOTES (MARCH 1995)

1. Caterpillar Dike Wash has been renamed to Diversion Dike Wash.
2. Caterpillar Wash has been renamed to Osborn Road Wash.



Location Map

Legend

1800 CFS	Proposed Condition Peak Flow
1800 cfs	Existing Condition Peak Flow
	100 – Year Floodplain
	Existing Retention Basin
48"	48" C.M.P. Gated Outlet
	Watershed Boundary
	Existing Dike
(20)	Retention basin at sub. 20

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Alternative 2

Alternative 2 for solving the conveyance problems on Tuthill Dike Wash is to reduce the peak flow that enters the wash rather than increase its flow capacity. This alternative takes advantage of excess storage capacity in several existing retention basins which are located upstream within the Caterpillar Proving Grounds. Appendix D includes a cost estimate, concept plans and hydraulic calculations.

The plan calls for two upstream diversions to redirect flow from 2.8 square miles of watershed area into existing retention basins which have enough excess capacity to retain the additional 100-year runoff. These diversions can be accomplished with relatively little effort and result in a substantial reduction in peak flow on Tuthill Dike Wash. The result is a peak flow reduction of 2350 cfs at McDowell Road; from 6600 cfs down to 4250 cfs.

The reduction in peak flow allows the entire 100-year flood to pass through the I-10 culverts without raising the existing water surface elevation. However, in order to prevent the breakout flow at I-10 and provide sufficient freeboard depth, the dike will have to be raised approximately 4 feet. Even though the dike is elevated, the resulting water surface elevation does not increase above the existing case; where 1500 cfs breaks out to the east, because the peak flow is reduced over 2000 cfs.

In addition to the dike improvement at I-10, some minor dike improvements are required upstream of Thomas Road and upstream of Camelback Road. The dike will have to be raised 0.5 to 1.0 feet in these locations to achieve the FEMA freeboard requirement.

It should be pointed out that, although the flow reduction solves the problem of insufficient conveyance capacity on Tuthill Dike Wash, there is still the problem of erosion. For most of its length, even with the reduced flow, the wash experiences erosive velocities. Flow velocities in the wash range from 2 fps up to over 12 fps. Therefore, with this alternative, the channel will continue to require a high degree of maintenance.

The following paragraphs describe the major features of Alternative No. 2:

A. Flow Diversion into Subbasin 21 (See Figure 5.4):
Alternative No. 2 calls for a diversion of the 100-year runoff from subbasin 22 and a portion of subbasin 22A into the existing retention basin located at the point of concentration in subbasin 21. For purposes of this investigation, subbasin 22A has been divided into 22A1 and 22A2. Subbasin 22A1 is the part which is diverted, 22A2 continues to flow in its existing drainage path (refer to Appendix C for the revised HEC-1 model).

This diversion is relatively simple to accomplish. As can be seen from Figure 5.4, the concentration point for subbasin 22A1 is a small retention basin, approximately 5 feet deep, at the intersection of Tuthill Road and a diagonal road within the Caterpillar Proving Grounds. The larger retention basin in subbasin 21 lies just south of the diagonal roadway. The construction of 2 - 10' x 4' box culverts will divert the 100-year peak discharge of 520 cfs into subbasin 21.

The existing retention basin in subbasin 21 has a capacity of 96 acre-feet which is not enough to retain the entire runoff from the 100-year flood. However, the excess flows spill into a much larger retention basin in subbasin 23 (see Figure 5.4). Under existing conditions, 190 cfs spills into retention basin 23. With the added runoff from subbasin 22 and 22A1, this flow increases to 800 cfs. Therefore, another new double 10' x 4' box culvert is introduced to convey flows from retention basin 21 into retention basin 23. Retention basin 23 has a storage capacity of 645 acre-feet which is much more than adequate to store the entire 100-year runoff; including the diverted flows. In fact the peak storage, with the diverted flows, is only 67 acre-feet (see Table 5.1).

B. Flow Diversions into Subbasin 24:

Alternative No. 2 also includes a diversion that directs all of the runoff from subbasins 26 and 27 into an existing retention basin in subbasin 24 which has a storage capacity of 283 acre-feet and can retain the entire 100-year runoff; including the diverted flows.

The diversion will require a short diversion dike, approximately 200 feet long, and 3 - 10' x 4' box culverts. The box culverts are needed to convey the flow under an existing roadway on the Caterpillar Proving Grounds (see Figure 5.5).

C. Raise Tuthill Dike at I-10:

As described previously, Tuthill Dike will have to be raised approximately 4 feet at I-10 in order to prevent breakout flows and provide 4 feet of freeboard required by the Federal Emergency Management Agency (FEMA). Refer to HEC-2 model (5RET.H2I) in Appendix D for water surface elevations on Tuthill Dike Wash for Alternative No. 2. FEMA requires 4 feet of freeboard on dikes at the upstream end of culverts and bridges.

D. Raise Tuthill Dike Upstream of Thomas Road and Camelback Road:

Tuthill Dike will also have to be raised upstream of Thomas Road and Camelback Road to meet the FEMA minimal requirement which is 3 feet of freeboard. The amount it has to be raised, however, is minimal. Upstream of Thomas Road it has to be raised about 0.5' for about 1000'. Similarly, upstream of Camelback Road it will have to be raised an average of about 0.5' for 1800'. Again, refer to the HEC-2 model in Appendix D for water surface elevations on Tuthill Dike Wash for Alternative No. 2.

TABLE 5.1

Effect of Tuthill Dike Wash Alternative No. 2 on the Existing Retention Basins							
Ret. Basin No.	Total Contrib Area (Sq.Mi.)	Spill-Way Elev. (Ft.)	Capacity at Spill. (Ft.)	Peak Stor. (Ac.Ft.)	Peak Stage (Ft.)	Peak Inflow (CFS)	Peak Out-Flow (CFS)
20	1.07 (1.07)	1469.0	176	54 (54)	1457.97 (1457.97)	861 (861)	0 (0)
21	4.10 (3.46)	1347.0	96	110 (101)	1349.00 (1347.78)	2445 (1933)	796 (191)
23	4.26 (3.62)	1305.0	645	67 (34)	1284.76 (1281.64)	796 (288)	0 (0)
24	2.30 (0.14)	1243.0	283	124 (9)	1232.80 (1217.79)	1721 (207)	0 (0)
25	7.45 (5.29)	1213.0	13	20 (22)	1214.77 (1215.17)	1008 (1414)	945 (1374)
27	0.00 (2.16)	1213.0	11	0 (15)	--- (1214.56)	0 (1648)	0 (1642)
29	0.22 (0.22)	1177.5	55	9 (9)	1168.80 (1168.80)	228 (228)	0 (0)
38	4.64 (4.64)	1297.5	39	51 (51)	1300.24 (1300.24)	3253 (3253)	3220 (3220)
42	14.56 (14.56)	1095.0	70	129 (142)	1101.47 (1102.50)	5205 (7140)	4252 (6601)

1. Values in parenthesis ( ) denote existing condition.
2. See HEC-1 file WT4RET.24 in Appendix D for Alternative No. 2 Hydrologic Analysis.
3. Existing Retention Basins were not modified. Therefore, the spillway elevation and capacity at spillway is the same for both the existing condition and Alternative No. 2.

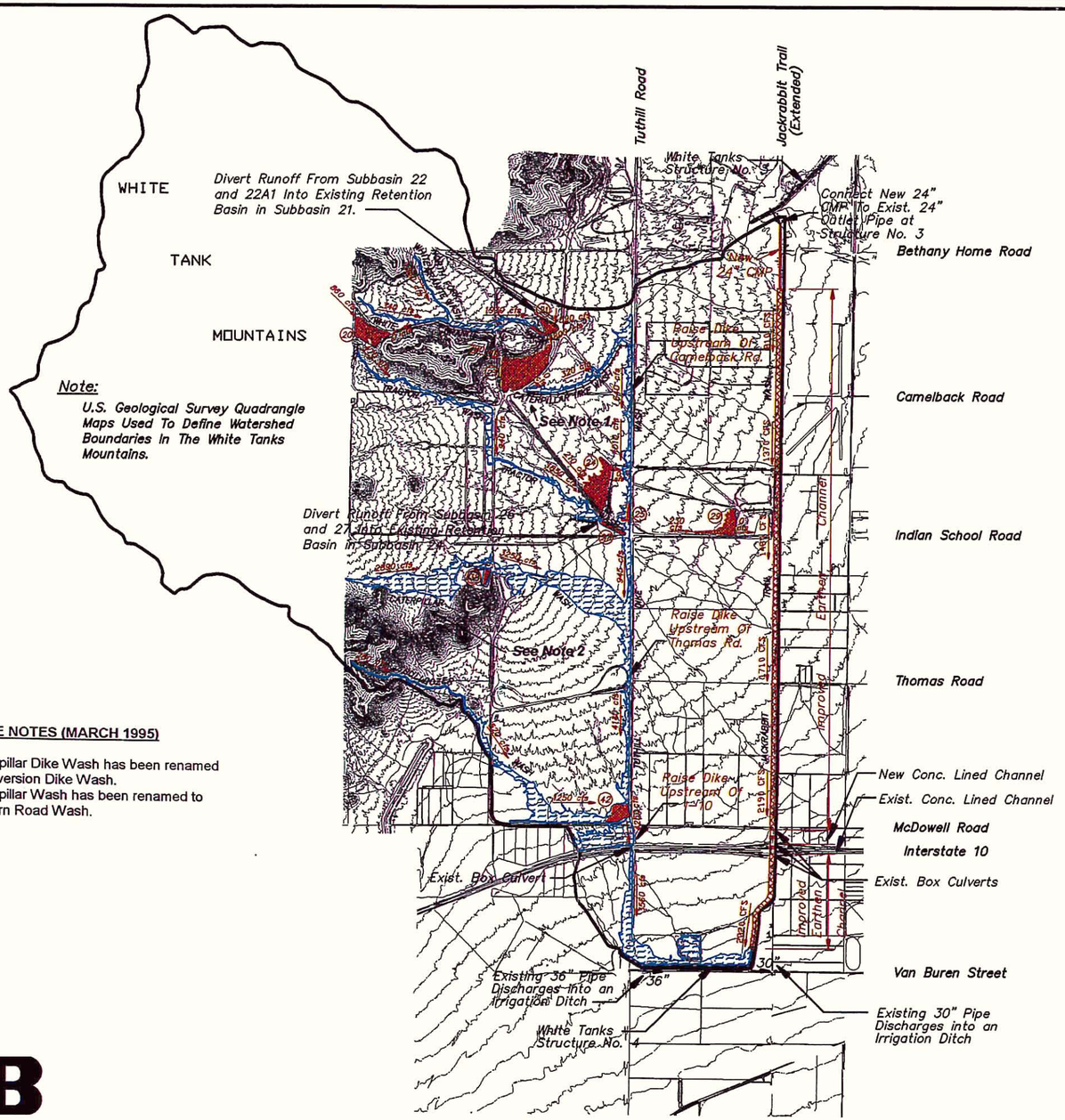
Other Alternatives

There are many other possible alternatives, similar to Alternative 2, for utilizing the existing retention basins on the Caterpillar Proving Grounds. One of these other alternatives would be to channelize the flow in Diversion Dike Wash (named Caterpillar Dike Wash in Part A) northerly to the large existing retention basin in subbasin no. 16 (refer to Figure 4.1 and Figure 5.1). In correspondence from the Caterpillar Tractor Co. to the Flood Control District (Reference 19), it is apparent that the purpose of constructing the Diversion Dike was to divert flow from the White Tanks No. 4 watershed to the White Tanks No. 3 watershed. The dike, however, stops short of where it would have to extend in order to force floodwaters to the north into the White Tanks No. 3 watershed. Therefore, channelizing the flows in Diversion Dike Wash, into the White Tanks No. 3 watershed, would seem to follow the original intent of the dike. The result would be a significant reduction in the peak flow on Tuthill Dike Wash. Runoff from subbasins 18-23 and 22A would be diverted to the retention basin in subbasin no. 16 which has more than enough capacity to store the additional runoff.

Figure 5.3

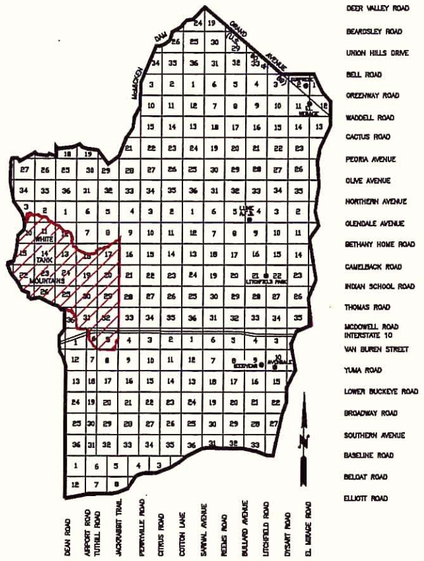
Area Drainage Master Plan For White Tanks Structure No. 4 Watershed (Tuthill Dike Wash Alternative No. 2)

WHITE TANKS/AGUA FRIA AREA DRAINAGE MASTER STUDY



UPDATE NOTES (MARCH 1995)

1. Caterpillar Dike Wash has been renamed to Diversion Dike Wash.
2. Caterpillar Wash has been renamed to Osborn Road Wash.



Location Map

Legend

1800 CFS	Proposed Condition Peak Flow
1800 cfs	Existing Condition Peak Flow
	100 – Year Floodplain
	Existing Retention Basin
48"	48" C.M.P. Gated Outlet
	Watershed Boundary
	Existing Dike
(20)	Retention basin at sub. 20

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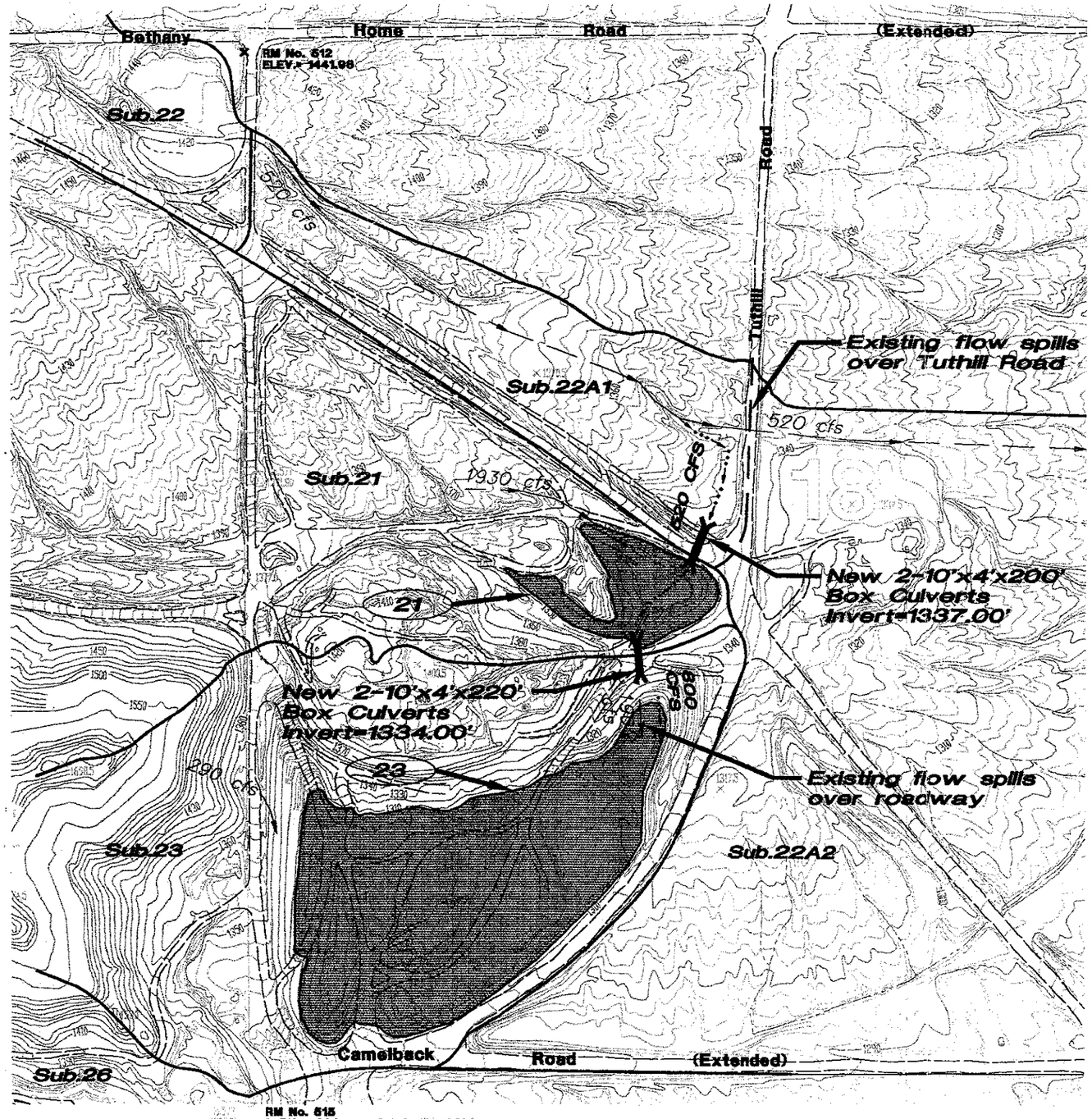

Figure 5.4

Area Drainage Master Plan
for
White Tanks Structure #4
Watershed

(Tuthill Dike Wash Alternative No. 2)
Flow diversions into
Subbasins 21 and 23

LEGEND

———	Subbasin Boundary
Sub.23	Subbasin Number
21	Existing Retention Basin at Subbasin 21
— — →	Existing Flow
···→···→···	Proposed Flow
520 cfs	Existing 100-Yr Flow
520 CFS	Proposed 100-Yr Flow
	Retention Basin

North

SCALE: 1"=600'

0 300 600 1200

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5.3.2 Corrective Measures on Jackrabbit Trail Wash

Under existing conditions, Jackrabbit Trail Wash is not capable of conveying the 100-year flood. As described in Section 5.2.4, breakout flows occur at several locations along the wash. These breakouts range from 150 cfs to 400 cfs and occur in three locations; one location is south of I-10, another is south of Thomas Road and the third is north of Camelback Road (see Figure 5.1).

The wash currently extends from White Tanks Structure No. 4 upstream to Medlock Drive, which is about 1000 feet north of Camelback Road. The plan is to extend it further north about 3000 feet in order to capture additional runoff which now flows across Jackrabbit Trail and continues to the east. This additional contributing drainage area is identified as subbasin 232A on the drainage area map (refer to Figure 3.2, ADMP Drainage Area Map).

Extending the channel further north will also enable the existing southern most outlet on White Tanks Structure No. 3 to be piped to Jackrabbit Trail Wash. Thereby containing the discharge from White Tanks No. 3 rather than allowing it to flow overland as it does now.

A concept channel plan for improving Jackrabbit Trail Wash has been developed as part of this study. Appendix E includes the conceptual channel plan and profile, an itemized cost estimate and the hydraulic calculations.

The concept plan calls for improving the existing earthen channel from White Tanks Structure No. 4 upstream to about 1500 feet south of Bethany Home Road. The objective of the channel improvement is to provide adequate conveyance for the 100-year flood; capture the additional runoff from subbasin 232A; and provide an outlet for discharges from White Tanks Structure No. 3.

The existing box culverts under the I-10 access ramps and under McDowell Road have sufficient capacity to convey the 100-year flood. Therefore, the concept plan calls for leaving them in place. In addition, the existing concrete lined channel between the access ramps has sufficient capacity and therefore it will also remain. The existing earthen channel, on the other hand, that lies between McDowell Road and I-10 does not have sufficient capacity. The concept plan is to enlarge and concrete line this reach of the channel.

5.3.3 Effect on White Tanks Structure No. 4

The improvement of Tuthill Dike Wash (Alternative No. 1) and Jackrabbit Trail Wash will increase the volume and peak rate of runoff into White Tanks Structure No. 4. The hydrologic model of the future conditions (see Section 3 and Appendix A) includes the channel improvement on the two washes. The model results indicate that the structure can safely store the entire 100-year flood. The following table summarizes the existing condition versus future condition hydrologic data for White Tanks Structure No. 4. For purposes of this study, the only difference from existing to future conditions is the improvement of Tuthill Dike Wash and Jackrabbit Trail Wash. It was assumed that future

development will provide stormwater retention so as to not increase runoff in the post development condition. The Table is based on Alternative No. 1 for Tuthill Dike Wash. The effects of Alternative No. 2 are not presented since it will reduce the runoff volume to Structure No. 4 and therefore will result in a peak stage that is lower than the existing condition.

TABLE 5.2

Hydrologic Data for White Tanks Structure No. 4 Existing versus Future Conditions 100-year Flood		
	EXISTING CONDITIONS[1]	FUTURE CONDITIONS
Drainage Area (sq.mi.)	19.2	19.8
Rainfall Depth (in.)	3.95	3.95
Runoff Volume (ac-ft)	635	674
Peak Inflow (cfs)	6030	6860
Peak Stage (ft) [2,3]	1041.1	1041.6
[1] Refer to Part A, Flood Study Technical Data Notebook, October 1992.		
[2] Emergency Spillway Elev = 1048.5 ft.		
[3] Dam Crest Elev = 1054.9 ft.		

As may be seen from the table, precluding the breakouts from Tuthill Dike Wash and Jackrabbit Trail Wash result in only a 0.5 foot rise in peak stage. Moreover, there remains 7 feet of freeboard below the emergency spillway elevation. Therefore, it would appear that White Tanks Structure No. 4 has more than adequate capacity to contain the 100-year flood.

It should be pointed out, however, that the hydrologic model for this study was based on an earlier version of the Drainage Design Manual for Maricopa County. The latest version, dated June 1, 1992, incorporates a modified technique for calculating the composite hydraulic conductivity (XKSAT) which results in lower infiltration rates for the loamy sandy soils found in the White Tank Mountains. The Flood Control District hydrology staff has done some modifications to the hydrologic model which would indicate that there is less than 7 feet of freeboard in the reservoir.

Because there is some uncertainty associated with the 100-year flood volume, no development should be allowed in the watershed that would increase runoff volume. The flood retarding structure has a finite reservoir volume which was designed for the 100-year flood. Future land development should be designed with sufficient stormwater retention so that the runoff will not exceed the capacity of the flood retarding structure.

5.3.4 Stormwater Retention Requirements

Future development in the White Tanks No. 4 watershed shall provide stormwater retention for the 100-year, 2-hour rainfall in accordance with the "Uniform Drainage Policies and Standards for Maricopa County, Arizona". This shall apply to all development. The County's current policy would allow low density residential (1 acre lots and larger) to develop without retention. Under normal circumstances, this would be acceptable; particularly in rocky mountainous areas where construction of driveways and roofs don't necessarily

increase runoff substantially. However, in this part of the White Tank Mountains, there is a considerable amount of sandy soils which have relatively high infiltration rates. Therefore, development, even low density single family development, will result in greater runoff.

In addition to the soil situation, there are other reasons to require stormwater retention. Most importantly is that the flood retarding structure No. 4 was designed for natural conditions in the watershed. Therefore, any construction that would result in increased runoff will have to retain runoff in order to maintain the integrity of the design.

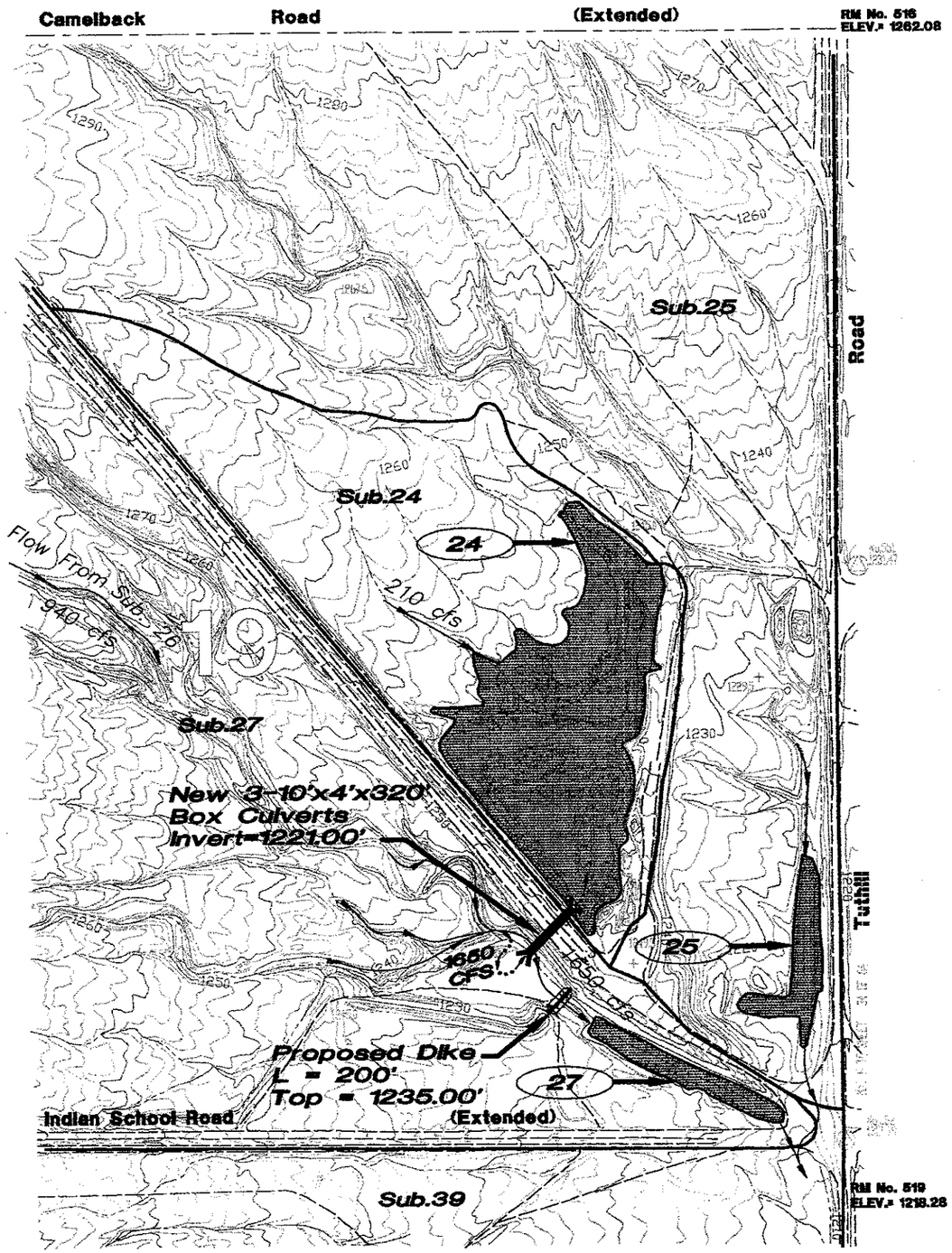

Figure 5.5

Area Drainage Master Plan
for
White Tanks Structure #4
Watershed

(Tuthill Dike Wash Alternative No. 2)
Flow diversions into
Subbasin 24

LEGEND

———	Subbasin Boundary
Sub.23	Subbasin Number
21	Existing Retention Basin at Subbasin 21
——→	Existing Flow
···→···	Proposed Flow
520 cfs	Existing 100-Yr Flow
520 CFS	Proposed 100-Yr Flow
	Retention Basin

North

SCALE: 1"=600'

0 300 600 1200

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SECTION 6 SOUTHWEST AREA WATERSHED

6.1 Introduction

The southwest part of the White Tanks/Agua Fria ADMS watershed lies south of Interstate 10 and west of the future Estrella Freeway. It is roughly 30 square miles in size and is shown on Figure 6.1. The watershed drains directly to the Gila River which provides an outfall for future local drainage systems. No regional drains are envisioned for this part of the watershed.

6.2 Existing Conditions

6.2.1 Drainage Characteristics

This part of the study area is, for the most part, agricultural land that slopes at a rate of about 0.7% toward the Gila River. The watershed drains in a southerly direction; parallel to the major mile streets and the farm roads and irrigation ditches which are all typically aligned north and south. The result is numerous parallel drainage patterns which don't combine until they reach south of the Buckeye Canal. Below the Canal, floodwaters concentrate in a very wide, shallow, low-lying area that flows westerly, paralleling the Gila River. A subtle ridge which is about 5 feet high separates it from the Gila River. A large part of this low lying area south of Buckeye Canal is actually inundated by the Gila River floodplain.

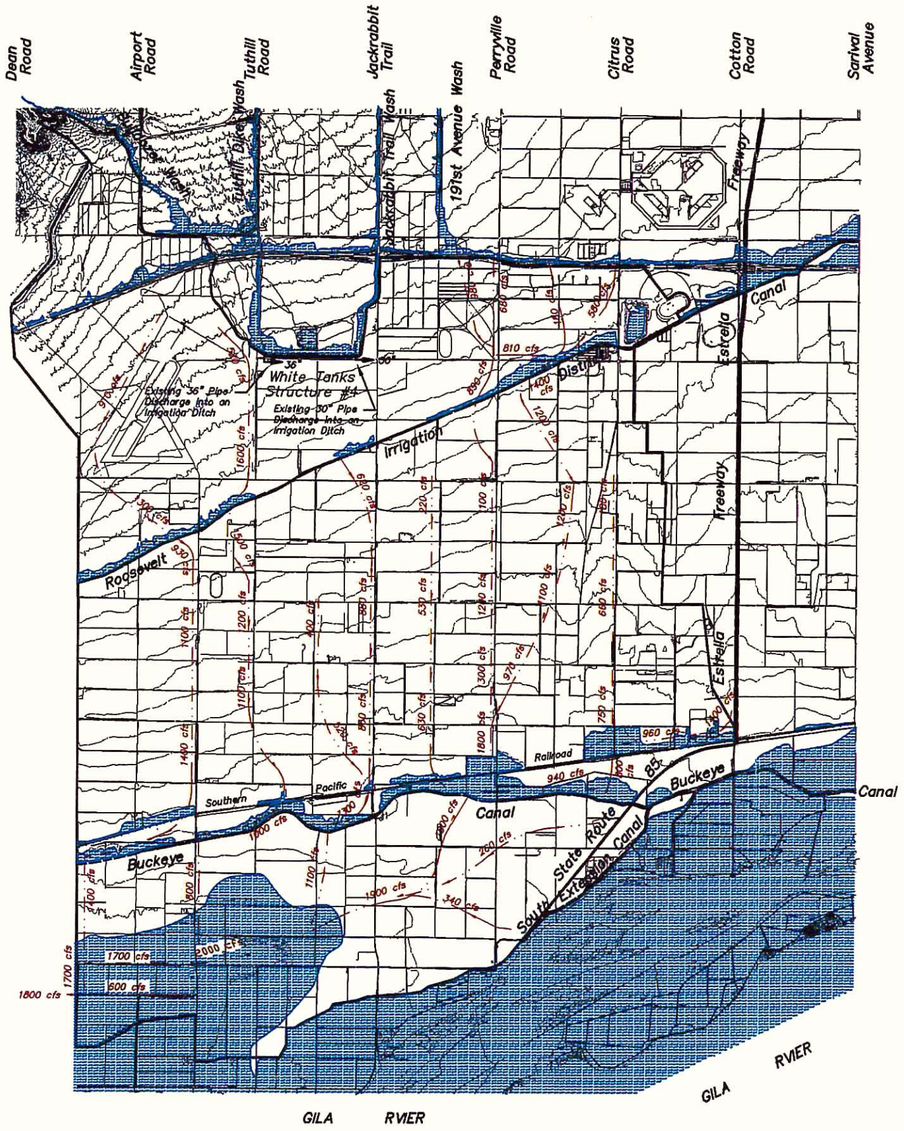
6.2.2 Land Use

Almost the entire watershed is agricultural land. The only exceptions are 1) a small amount of housing; mostly along I-10 between Jackrabbit Trail and Citrus Road, 2) a portion of the Harness Race Track, and 3) the abandoned Air Force landing field area north of the Roosevelt Canal and west of Tuthill Road.

Figure 6.1

Existing Conditions

Southwest Area Watershed



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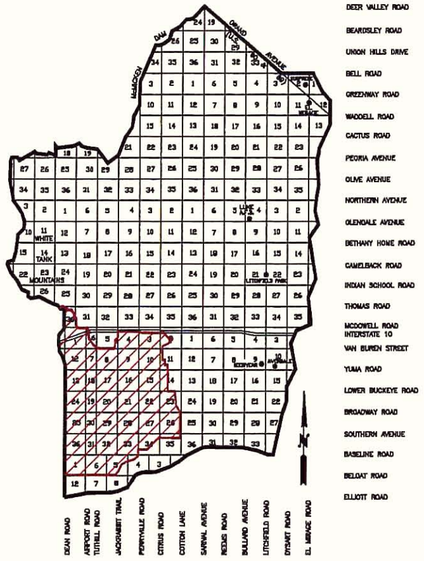

Location Map

Legend

- 1800 cfs — Existing Condition Peak Flow
- 100 – Year Floodplain
- Watershed Boundary
- Railroads
- Existing Channels

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6.2.3 Known Flood Hazards

The existing flood hazards consists of 1) ponding behind the Roosevelt Canal and the Buckeye Canal, 2) ponding behind the Southern Pacific Railroad, 3) accumulation of runoff in the low lying area south of the Buckeye Canal, and 4) concentrated flows from culverts under I-10. In addition there is the ever present shallow flooding problem in the agricultural areas where there are no well defined channels to convey the larger, less frequent floods.

The ponding behind the Canals as well as the Railroad was delineated as part of this study and is documented in Part A, Flood Study Technical Data Notebook.

The low lying area south of the Buckeye Canal is subject to flooding from two different sources. The first source is runoff from the watershed. It accumulates in this area and results in 100-year peak discharges that exceed 2000 cfs. The second source is backwater from the Gila River. Much of the low lying area is inundated by the 100-year flood on the Gila River.

There are numerous culverts under I-10 that discharge into the watershed. The peak discharges from the culverts are relatively small and therefore, with the existing downstream agricultural land uses, they don't present a major flood hazard. However, in many cases, the culverts outlet to channels that do not have sufficient capacity to contain the 100-year peak discharge. And in some cases, they discharge in areas where there is no visible channel at all.

6.3 Area Drainage Master Plan

6.3.1 Local Drainage System

The drainage plan for the watershed does not include a regional drain. Instead, local drainage systems of channels or storm drains, constructed along the north/south mile streets, together with onsite stormwater retention, is proposed for the watershed. The outfall for these systems is the Gila River. As described in Section 3.1, these conveyance structures are normally designed for the 10-year flood with provision to contain the 100-year flood between houses and buildings while allowing the streets to flood. This type of system will provide adequate stormwater conveyance for the watershed because, as described earlier, the stormwater runoff tends to flow southerly in numerous parallel drainage patterns; not combining until they reach the southern end of the watershed which is located within the floodplain of the Gila River. Consequently, the contributing drainage area for the local drainage systems remain relatively small which results in 100-year peak discharges that can be contained in a combination of low flow in roadside channels and/or storm drains and overland flow in the streets and open spaces.

6.3.2 Retention Requirements

As is the case for the rest of the study area, onsite retention will be required within the watershed in accordance with the Uniform Drainage Policies and Standards for Maricopa County (reference 7). Stormwater retention for this part of the study area is particularly important because there is no regional drain proposed to capture overland floodwaters. The local drainage conveyance structures will be designed to convey the 10-year flood while allowing the 100-year flood to inundate adjacent streets and open areas, but without flooding adjacent buildings and houses. Therefore, if onsite retention were not provided, the 100-year peak flows could easily exceed the capacity of the streets and flood the adjacent buildings.

6.3.3 I-10 Channel

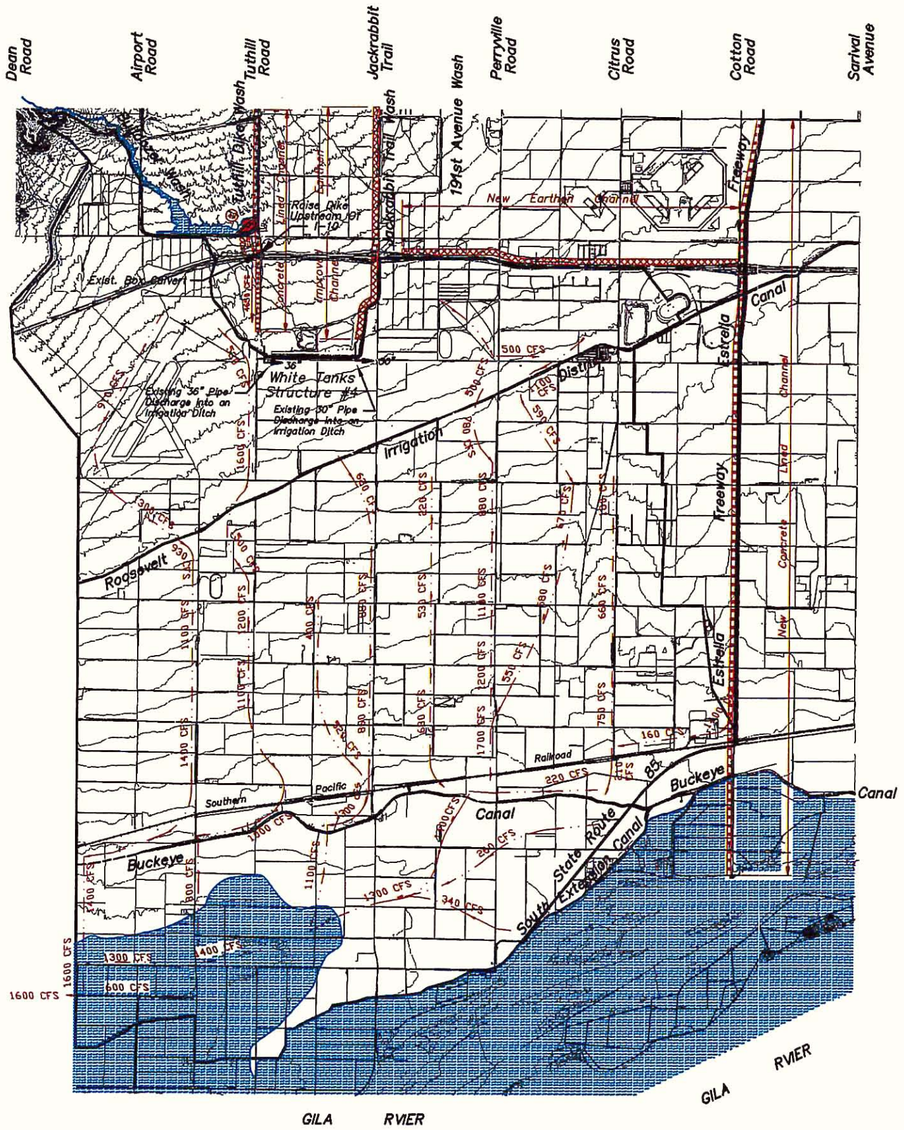
As part of the area drainage master plan for the Estrella Freeway watershed (see Section 7.3), a channel is proposed along the north side of I-10. This channel will collect the flows that currently pass through culverts under I-10 and convey them to the Estrella Freeway Channel. The Channel has two purposes. One is to contain floodwaters on the upstream side of I-10. The other is to prevent floodwaters from discharging on the downstream side of the Freeway into what, in many cases, are channels with insufficient capacity or, in some cases, into nonexistent channels. The I-10 Channel provides significant flood protection for the southwestern area and will allow the area to develop without the need for a regional drain.

6.3.4 Ponding at the Roosevelt Canal, Buckeye Canal and the Southern Pacific Railroad

As described in Section 6.2.3, there are several ponding areas that currently exist behind the Canal and Railroad embankments. These present two flood hazards. One is the inundation on the upstream side. The other is the overtopping of the embankments which results in downstream flooding that is often more severe than what would have occurred in the natural condition; without the embankments in place. The inundation on the upstream side of the embankments is fairly easy to mitigate. Buildings can simply be constructed above the top of the embankments. Downstream flooding, however, is more difficult to prevent. Consequently, future development will have to provide canal overshoots and railroad culverts which are capable of conveying the 100-year flood in order to prevent floodwaters from overtopping and washing out the embankments.

Figure 6.2

Area Drainage Master Plan for Southwest Area Watershed



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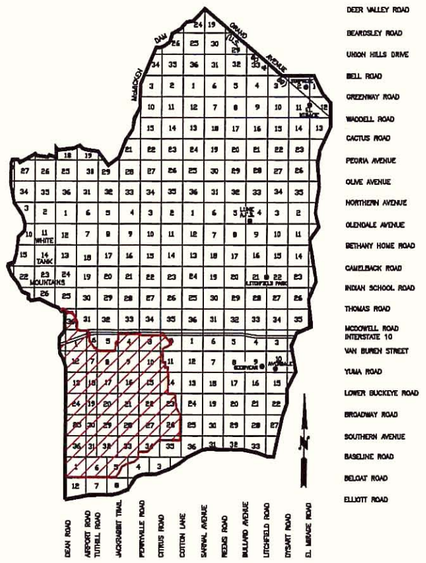

Location Map

Legend

- 1800 CFS — 100-Year Peak Flow
- 100 – Year Floodplain
- Existing Detention Basin
- Watershed Boundary
- Railroads
- Existing Channels

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SECTION 7 ESTRELLA FREEWAY WATERSHED

7.1 Introduction

The Estrella Freeway watershed includes one of the most prominent features of the White Tanks/Agua Fria ADMP. That feature is a flood control channel along the future Estrella Freeway. The channel will parallel the Freeway alignment for nearly the entire length of the study area and will provide much needed stormwater conveyance in an area where none now exists.

The future Estrella Freeway will begin at State Route 85 and proceed northward, through the middle of the study area, generally along the alignment of Cotton Lane. At Grand Avenue the freeway will curve to the east and continue in an easterly direction to its connection with Interstate 17. The portion of the freeway between State Route 85 and Grand Avenue is located entirely within the study limits of the White Tanks/Agua Fria ADMS and therefore introduces an important element for consideration in developing the area drainage master plan.

Figure 7.1 presents the Estrella Freeway watershed. The drainage boundaries are based on future conditions which include:

A. A flood control channel along the future Estrella Freeway that extends from the Gila River upstream to Bell Road.

B. *Channel improvements on Beardsley Canal Wash, Tuthill Dike Wash and* Jackrabbit Trail Wash. These channel improvements will preclude the mountain runoff from entering the Estrella Freeway watershed (refer to Sections 4 and 5).

C. A new channel along Interstate 10 from Jackrabbit Trail to the Estrella Freeway.

D. The future Sun City Grand project north of Union Hills Drive which will provide onsite detention/retention for the 100-year flood (refer to Section 9).

7.2 Existing Conditions

7.2.1 Drainage Characteristics

The drainage area that contributes runoff to the proposed Estrella Freeway is predominantly agricultural land with fairly flat, uniform slopes that range from 0.4% up to 1.0%. The watershed measures 46 square miles and generally slopes in a southeasterly direction toward the future Freeway.

The agricultural development has obscured, for the most part, the natural drainage patterns. The result is wide, shallow, uncontained flooding in most of the watershed. *Smaller, more frequent flooding is conveyed along irrigation* ditches and roadside channels; whereas, larger floods exceed these relatively insignificant conveyances and cause wide, shallow flooding across the farmlands.

There are several man-made features within the watershed that collect, pond and/or convey considerable amounts of floodwater. The floodplains associated with these were delineated as part of this study and documented in Part A. They include Cotton Lane Wash, Perryville Road Wash, 191st Avenue Wash, Interstate 10 and the Roosevelt Canal (see Figure 7.1).

7.2.2 Land Use

The watershed is largely undeveloped land which is being used primarily for agriculture. Within the 46 square mile drainage area, approximately 31 square miles is farmland and another 8 square miles is undeveloped desert. The remaining 7 square miles is made up developed lands which include Clearwater Farms, Perryville Prison, part of the Harness Racing Track and several smaller outlying residential developments.

7.2.3 Known Flood Hazards

Existing flood hazards within the watershed include the floodplains documented in Part A, the shallow flooding within the agricultural areas and the potential breakouts from the diversion channels along Beardsley Canal Wash and Jackrabbit Trail.

Beardsley Canal Wash and Jackrabbit Trail Wash

The existing diversion channels along Beardsley Canal Wash and Jackrabbit Trail do not have sufficient capacity to contain the 100-year flood. Therefore, during major floods, stormwater runoff will overtop the Beardsley Canal and Jackrabbit Trail and flow southeasterly into the Estrella Freeway watershed. As part of this study, improvements are planned for both Beardsley Canal Wash and Jackrabbit Trail Wash which will prevent these breakout flows from occurring. Refer to Sections 4 and 5 for a more detailed description of each of these flood hazards. Also included in Sections 4 and 5 are the concept channel improvements.

Cotton Lane Wash

The floodplain for Cotton Lane Wash was delineated as part of this study and is documented in Part A. Cotton Lane and the Atchison Topeka and Santa Fe Railroad run parallel to each other from Indian School Road up to Waddell Road. The Railroad is elevated somewhat and therefore collects floodwaters and conveys them to the south. The conveyance capacity, however, is not nearly enough to convey the 100-year flood. Therefore, the Railroad is overtopped in several locations which include the intersections with the major mile streets as well as in several intermediate locations. Some of the flood flows which overtop the Railroad are conveyed in Cotton Lane. The remaining flows simply continue flowing is a southeasterly direction across the agricultural fields.

It is important to point out that the Railroad embankment and the berms along Cotton Lane create two flood hazards. One hazard is the flooded area on the upstream side of the Railroad. This is a fairly easy flood hazard to deal with. New development can simply build with floor elevations which are higher than the top of the Railroad. The second hazard is more difficult to deal with. It is the hazard that elevated dikes, berms or embankments create for downstream property. They concentrate floodwater which could potentially break over and wash out the dike or berm. This results in greater flood flows than what would have occurred in the natural condition without the berm in place.

Perryville Road Wash

Perryville Road Wash is a diversion channel which is located along the west side of Perryville Road. At its upstream end it is a natural occurring wash which collects the breakout flows over Beardsley Canal at Northern Avenue. The wash flows southeasterly until it reaches Perryville Road at about Glendale Avenue. At that point the flows are channelized to the south along Perryville Road. The channel ends at an irrigation reuse reservoir located 1/2 mile east of Perryville Road along the north side of Camelback Road. From there floodwaters continue in a southeasterly direction causing shallow flooding across agricultural lands.

As was the case with Cotton Lane Wash, the channel along Perryville Road does not have adequate capacity to contain the 100-year flood. Therefore, several breakouts occur along its reach. (See Figure 7.1)

191st Avenue Wash

191st Avenue Wash is a diversion channel along the west side of 191st Avenue. It collects floodwater from Bethany Home Road downstream to I-10. Much like Perryville Road Wash, it does not have sufficient capacity to convey the 100-year flood and therefore numerous breakouts occur along its reach (see Figure 7.1).

Interstate 10 (I-10)

I-10 is elevated through the Estrella Freeway watershed and therefore tends to collect stormwater runoff. There are two flood hazards associated with I-10. It ponds stormwater and inundates land on its upstream side and it also concentrates flows on its downstream side at the discharge points of culverts and roadway underpasses (see Figure 7.1).

Roosevelt Irrigation District (RID) Canal

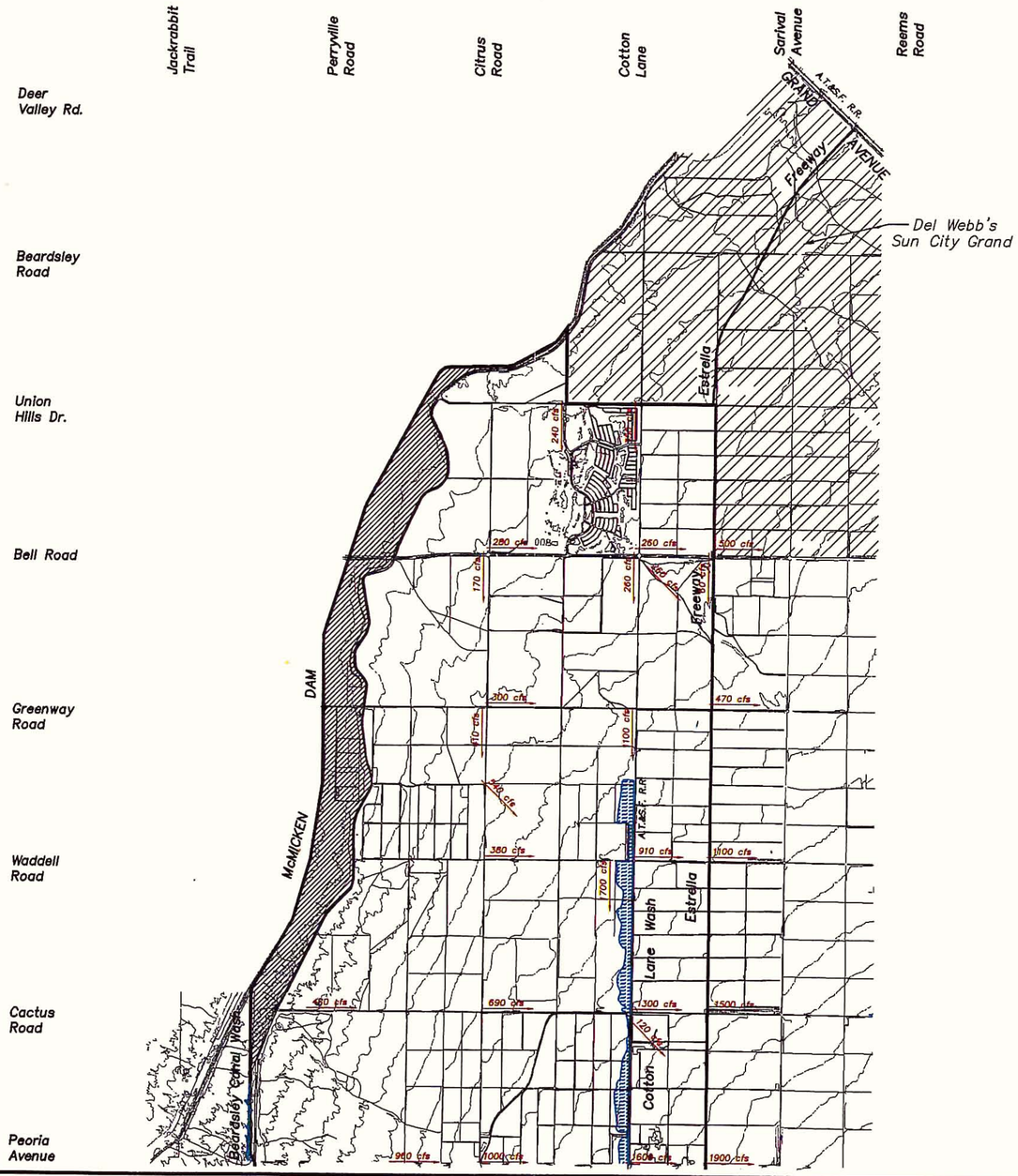
The RID Canal is also elevated through much of the study area and therefore causes floodwaters to pond on its upstream side (see Figure 7.1).

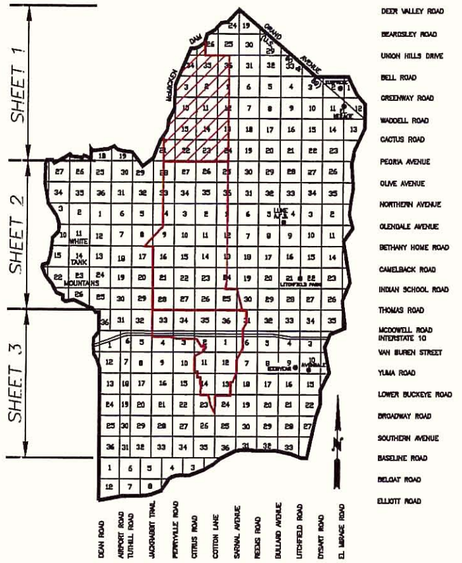
Figure 7.1-1

Existing Conditions

Estrella Freeway Watershed
Sheet 1 of 3

WHITE TANKS/AGUA FRIA
AREA DRAINAGE MASTER STUDY





Location Map

Legend

- 1800 cfs — Existing Condition Peak Flow
- 100 – Year Floodplain
- Watershed Boundary
- Retained Area Behind Beardsley Canal
- Railroads
- Existing Channels

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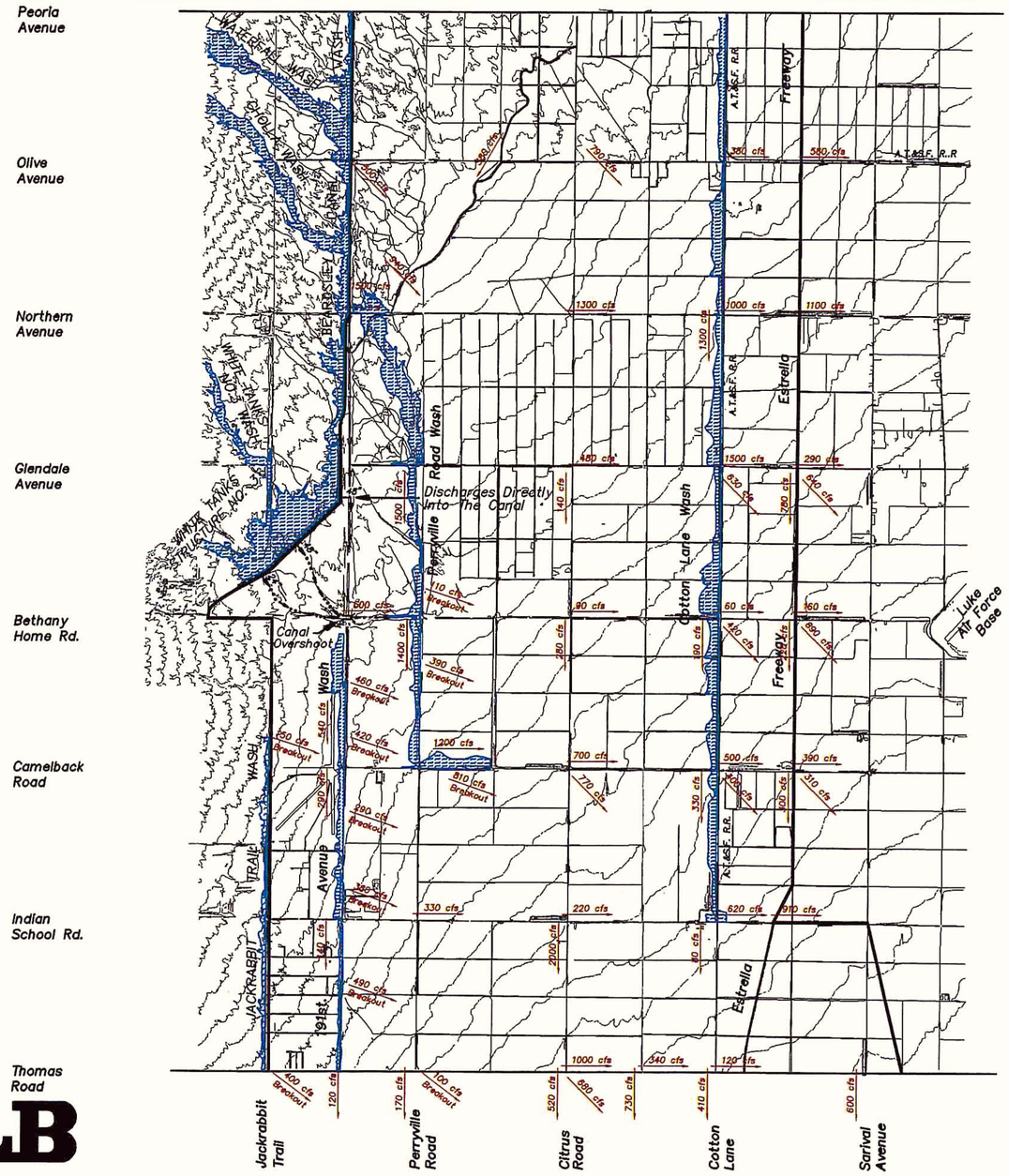
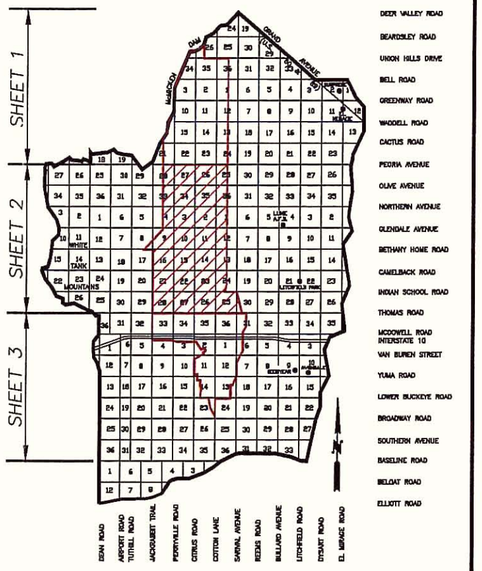
Figure 7.1-2

Existing Conditions

Estrella Freeway Watershed
Sheet 2 of 3



WHITE TANKS/AGUA FRIA
AREA DRAINAGE MASTER STUDY



Location Map

Legend

- 1800 cfs — Existing Condition Peak Flow
- 100 – Year Floodplain
- Watershed Boundary
- Railroads
- Existing Channels

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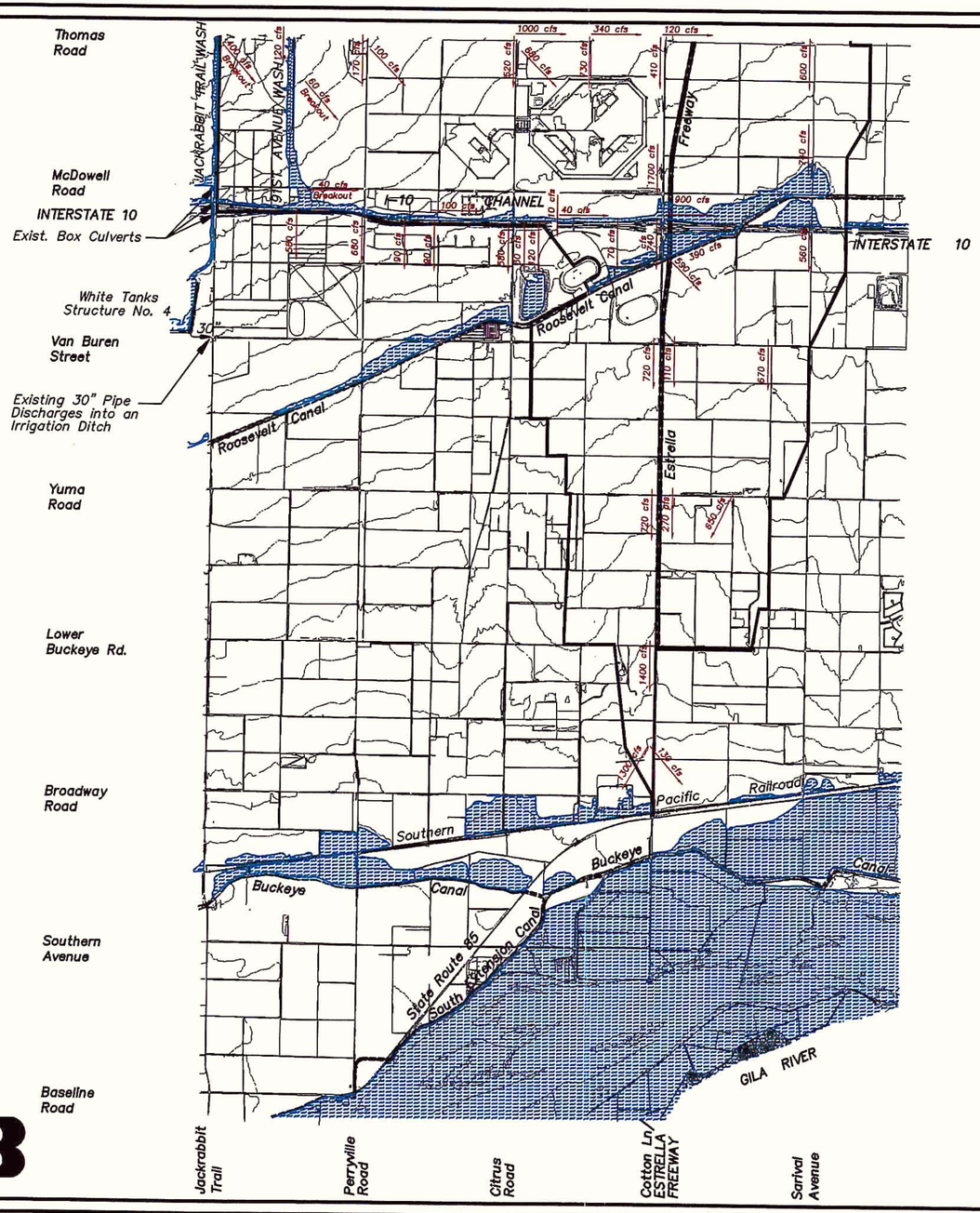
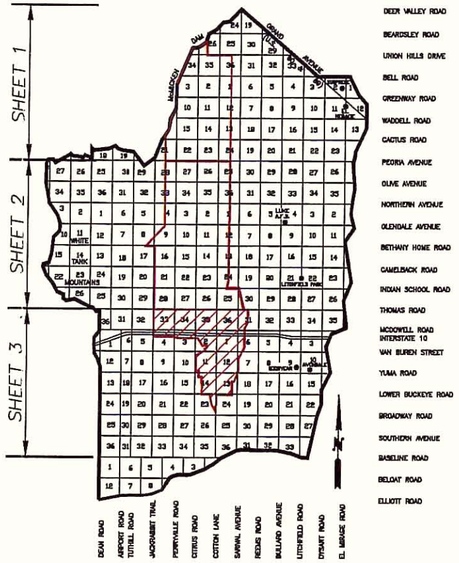
Figure 7.1-3

Existing Conditions

Estrella Freeway Watershed
Sheet 3 of 3



WHITE TANKS/AGUA FRIA
AREA DRAINAGE MASTER STUDY



Location Map

Legend

- 1800 cfs — Existing Condition Peak Flow
- 100 – Year Floodplain
- Watershed Boundary
- Railroads
- Existing Channels

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7.3 Area Drainage Master Plan

The area drainage master plan for the Estrella Freeway watershed includes a future regional flood control channel along the Estrella Freeway as well as a future channel along Interstate 10 (I-10). These channels will provide capacity to convey the 100-year flood and will serve as outfalls for the local drainage system.

7.3.1 Background Information on the Estrella Freeway

The Estrella Freeway (State Route 303L) is part of the valley freeway system that is being constructed by the Arizona Department of Transportation (ADOT). It will loop around the northwest valley; connecting State Route 85 and I-10 with I-17. Its alignment through the study area runs northward from State Route 85, generally along Cotton Lane, to Grand Avenue. At Grand it turns to the east and continues in that direction to I-17.

Approximately two years ago, a two lane interim roadway was built within the right of way for the Estrella Freeway from Thomas Road, north to Grand Avenue. The interim roadway will remain until the freeway is constructed. The freeway, however, is unfunded at this point in time and is not in ADOT's 5-year construction plan.

According to the Location Study Plan (reference 12), the Estrella Freeway will be a 4-lane, divided highway; constructed at or above existing ground. That is, its profile will rise up to pass over the mile streets; and come down, to near existing grade, between the mile streets. The hydrologic Investigation Report for the Estrella Freeway (reference 13) states that the freeway drainage system is to provide a 50-year level of service for cross drainage.

Due to its elevated profile, and due to the 50-year cross drainage requirement, the Freeway will collect the floodwater runoff that comes off the agricultural land to the west. The concentration of these shallow flood flows presents a drainage design challenge because adequate outfalls do not exist on the downstream side of the Freeway to accept the discharge of concentrated flows. As described previously, this part of the study area is almost entirely used for farming which has obscured the natural drainage patterns. The result is a distinct lack of stormwater conveyance. The conveyance structures that do exist are minor roadside channels and agricultural ditches; none of which have nearly enough capacity to provide an outfall for the concentrated flows collected by the Freeway.

ADOT carried out an investigation of drainage alternatives (reference 14) to address this issue for the Cotton Lane section of the Estrella Freeway. The investigation considered three alternatives which included: 1) a "continuous channel" from Bell Road, south to the Gila River, 2) a "continuous channel with on-line detention" from Bell Road to the Gila River, and 3) a "pass-through" concept where floodwater is passed through the Freeway at the mile streets.

ADOT's estimated costs for these three alternatives is $48 million, $41 million and $27 million, respectively. Based on these costs the "pass-through" concept is ADOT's preferred alternative. ADOT's investigation, however, points out the fact that the pass-through concept "offers little benefit in solving the overall drainage problem in the area." (Reference 14) The memorandum goes on to state that "there is a potential for future liability to exist as a result of continued downstream flooding, even though the proposed drainage facilities will maintain or reduce the extent of downstream flooding from a technical perspective." In other words, ADOT recognizes that the pass-through concept, although $20 million less expensive, could pose a liability problem for downstream flooding.

Staff at the Flood Control District and ADOT have discussed, and are continuing to explore, the concept of a partnership wherein the Flood Control District would provide funds to upgrade the drainage design for the Estrella Freeway from a pass-through system to a continuous channel. This partnership would be of great benefit to the area by providing a major regional drain in an area that is subject to substantial shallow flooding. It would also benefit ADOT by significantly reducing their future liability for downstream flooding. Therefore, this drainage master plan is based on the assumption that ADOT and the Flood Control District will join in a partnership to construct a regional flood control channel along the Estrella Freeway.

7.3.2 Estrella Freeway Channel

A concept plan, for a future 100-year flood channel located along the west side of the proposed Estrella Freeway, has been prepared as part of this ADMS. Appendix F includes the concept channel plan, an itemized cost estimate and the hydraulic calculations.

The concept is to construct a concrete lined channel from Bell Road downstream to the Gila River; approximately 17 miles long. The concept plan is based on a trapezoidal cross section with 2H:1V side slopes that averages about 10 feet deep. The bottom width varies from 10 feet to 100 feet; with corresponding top widths ranging from 50 to 150 feet.

The 100-year peak flows in the proposed channel range from 800 cfs, at the upstream end, to 10,700 cfs at the Gila River. This compares fairly well to the 50-year peak flow of 9300 cfs that ADOT used to develop their "continuous channel concept" (reference 14).

The design presented in Appendix D maintains subcritical flow for the entire 17 mile long channel. In order to keep the channel within the subcritical flow range, a channel slope of 0.2% was used for most of its length. This results in the requirement for numerous drop structures which increase the cost of the channel.

The channel concept presented herein is only one possible solution to providing conveyance for the 100-year flood along the Estrella Freeway. There are many other possible options which should be studied prior to construction. Some of these other options include 1) minimizing the channel cross section by providing detention basins, 2) building an earthen channel which would provide opportunities for recreation development, 3) reducing the cross section in areas by designing supercritical flow sections, and 4) using bridges at the cross streets rather than box culverts.

7.3.3 I-10 Channel

The area drainage master plan includes a channel along the north side of I-10. The purpose of the channel is to contain flooding on the north side of the freeway and to collect flow that currently passes under the freeway in culverts. Appendix G includes the concept channel plan, an itemized cost estimate and the hydraulic calculations.

As described in Section 7.2.3, I-10 is elevated and therefore collects stormwater. The freeway was designed as a rural type highway that collects cross drainage flows and passes them under the roadway in culverts. I-10, however, has a similar problem as the proposed Estrella Freeway. That is, the outfall channels downstream of the highway are either nonexistent, or they lack the necessary conveyance capacity to provide an adequate outfall for the culverts. Therefore, the highway culverts tend to concentrate flows and discharge them in a shallow flooding situation. These culverts don't create problems under existing

conditions because the area is almost entirely farmland and the culverts are, for the most part, small diameter pipe with limited flow capacity. As the area develops however, the concentrated outflow from these culverts could present downstream conveyance problems.

7.3.4 Local Drainage System

The Estrella Freeway Channel will provide an excellent outfall for local drainage. Figure 7.2 presents the concept for the local drainage system which consists of channels and/or storm drains on the east-west mile streets. Since the watershed is long and narrow, these local drains are only 2 to 3 miles in length with corresponding drainage areas of 2 to 3 square miles.

It is assumed that these local drains will be designed for the 10-year flood to be in accordance with the Drainage Design Manual for Maricopa County (reference 15). Larger, less frequent floods will be conveyed in a combination of flow in the 10-year drains and overland flow in the streets and open spaces. The Estrella Freeway Channel will provide an outfall for the drains as well as the overland flows resulting from large floods.

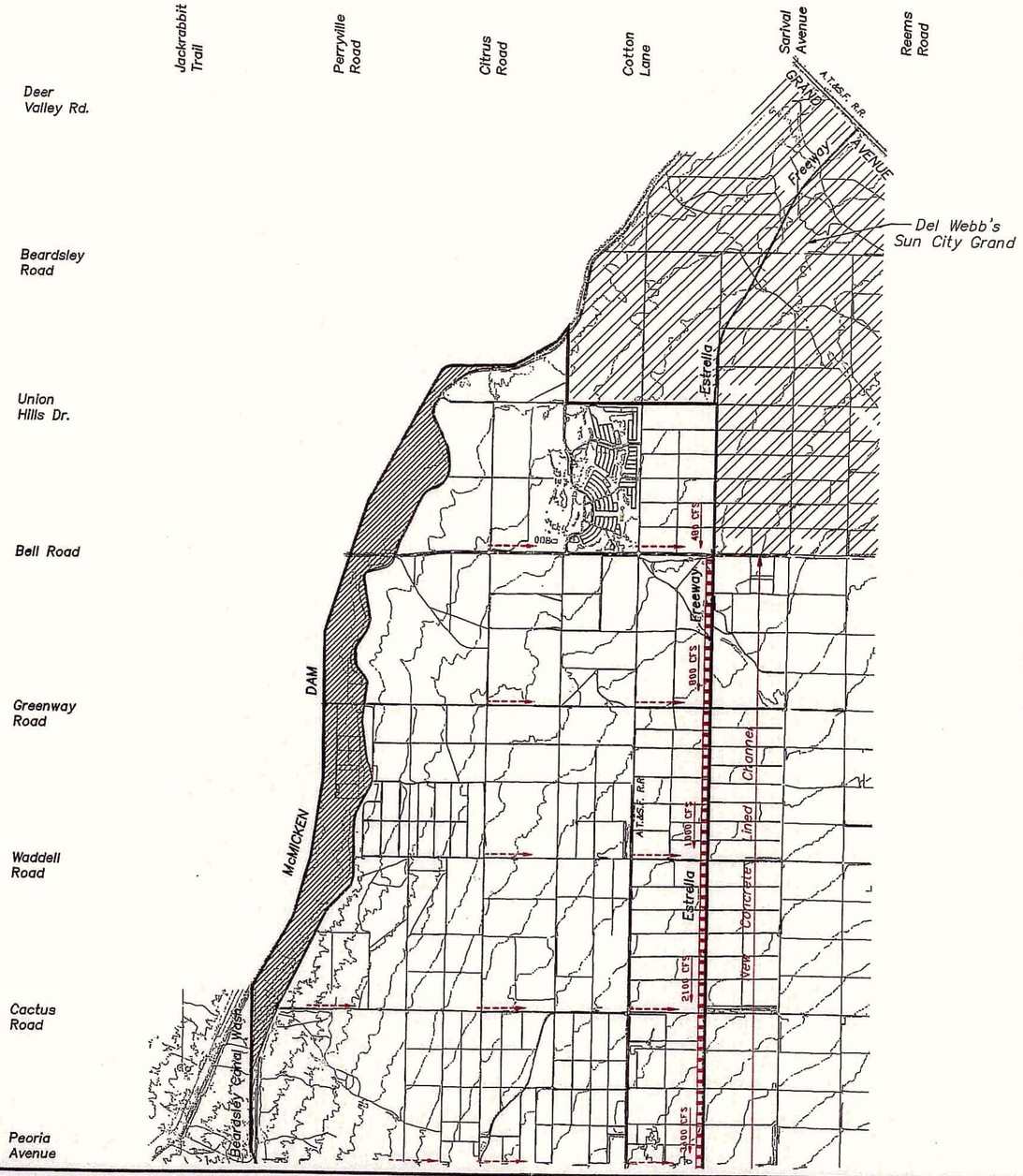
7.3.5 Floodplains along 191st Avenue, Perryville Road and Cotton Lane

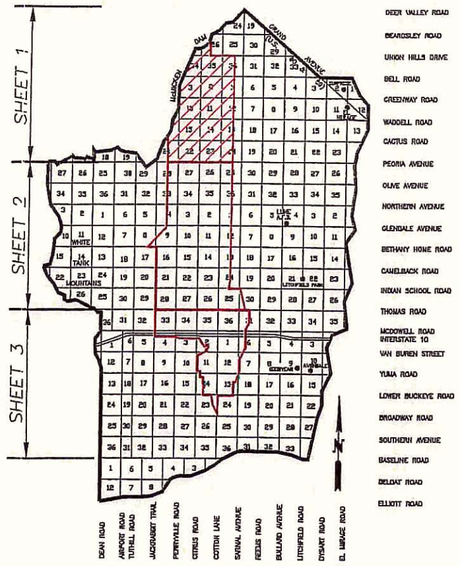
The combination of future drainage improvements within the watershed will eliminate the existing floodplains along 191st Avenue, Perryville Road and Cotton Lane. These improvements include the proposed channelization on Beardsley Canal Wash and Jackrabbit Trail Wash which will significantly reduce the peak discharges along Perryville Road and 191st Avenue. In addition, the future local drainage systems along the east/west mile streets will provide the conveyance necessary to prevent the concentration of floodwaters along all three of the roadways.

Figure 7.2-1

Area Drainage Master Plan
for
Estrella Freeway Watershed
Sheet 1 of 3

WHITE TANKS/AGUA FRIA
AREA DRAINAGE MASTER STUDY





Location Map

Legend

- 1800 CFS — Proposed Condition Peak Flow
- 100 – Year Floodplain
- Retained Area Behind Beardsley Canal
- 48" — 48" C.M.P. Gated Outlet
- Watershed Boundary
- Railroads
- Existing Channels
- Future Local Drainage System

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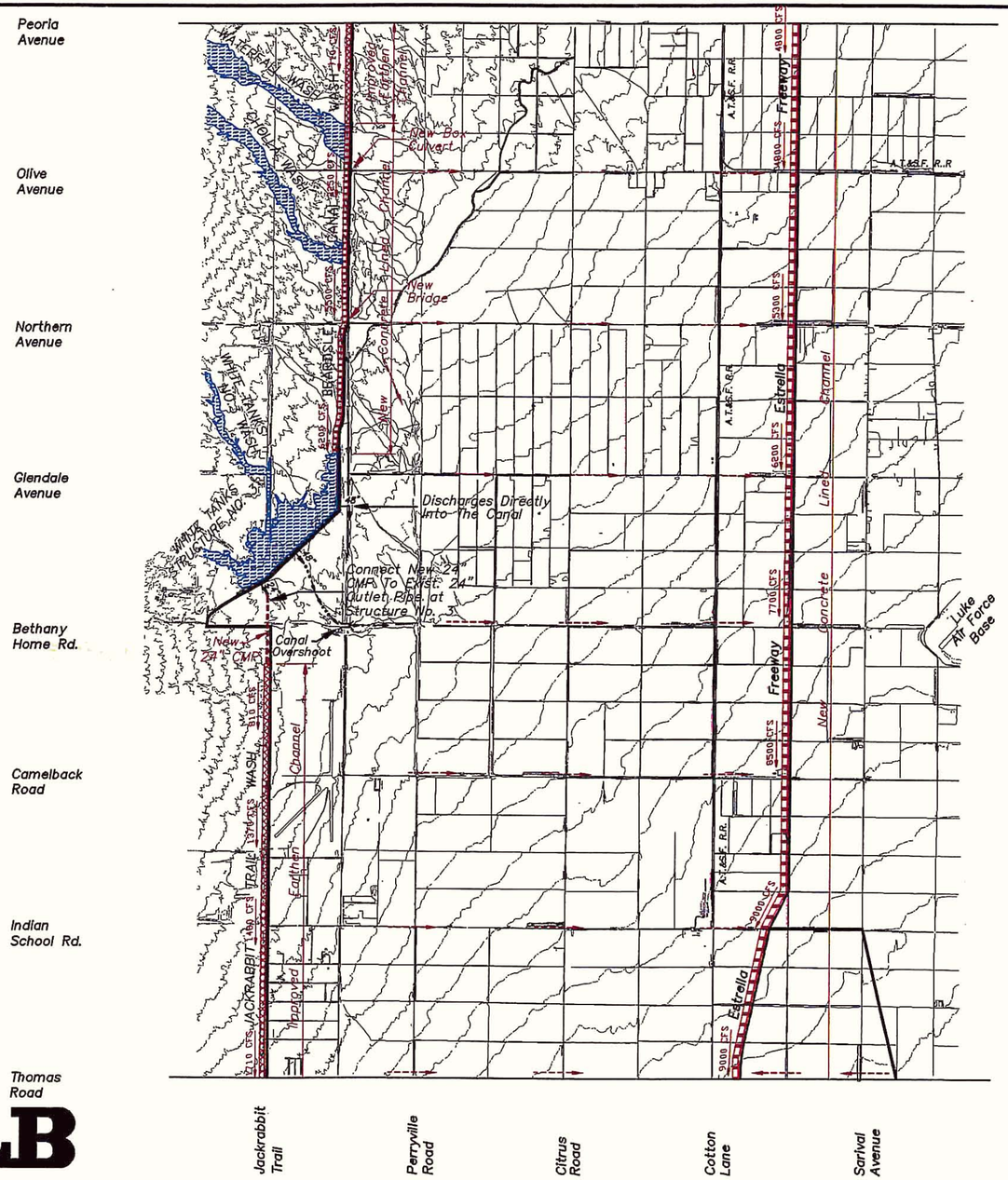
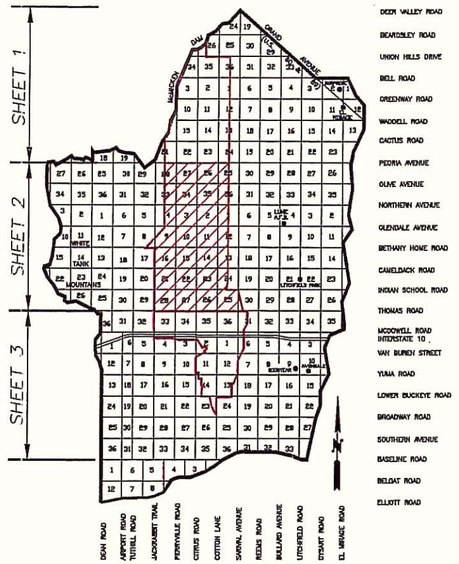
Figure 7.2-2

Area Drainage Master Plan
for
Estrella Freeway Watershed
Sheet 2 Of 3

WHITE TANKS/AGUA FRIA
AREA DRAINAGE MASTER STUDY





Location Map

Legend

- 1800 CFS — Proposed Condition Peak Flow
- 100 – Year Floodplain
- Retained Area Behind Beardsley Canal
- 48" — 48" C.M.P. Gated Outlet
- Watershed Boundary
- Railroads
- Existing Channels
- Future Local Drainage System

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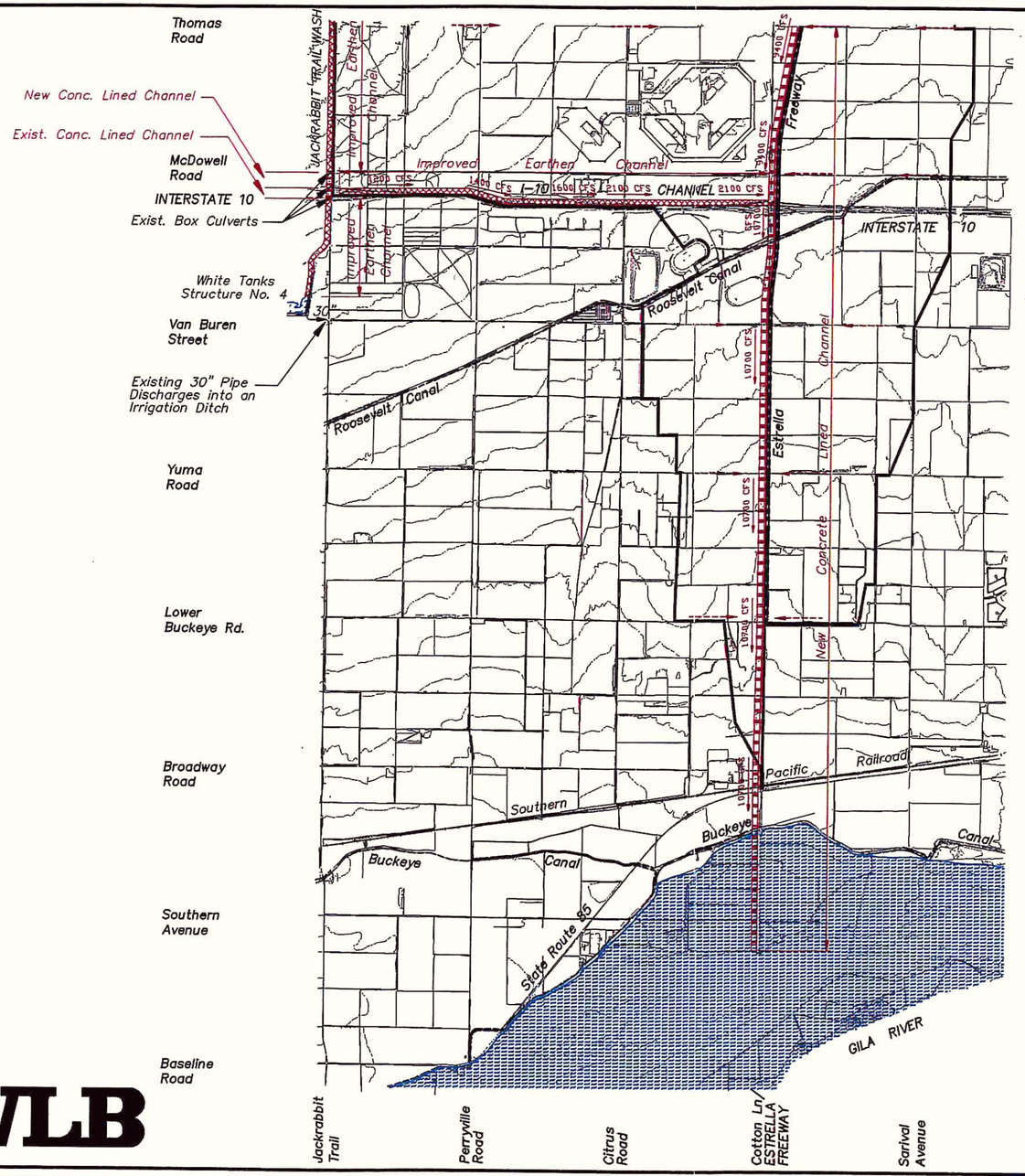
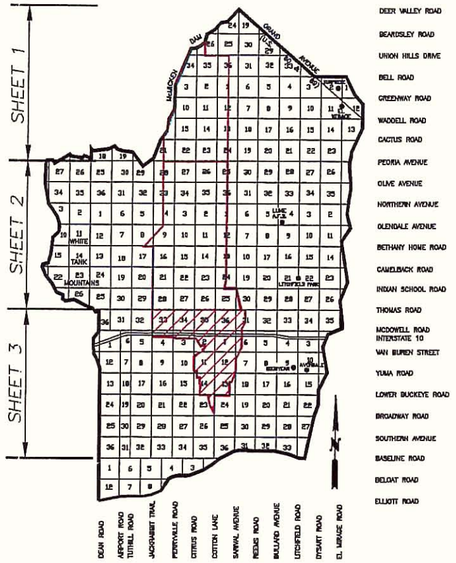
Figure 7.2-3

Area Drainage Master Plan for Estrella Freeway Watershed Sheet 3 of 3

WHITE TANKS/AGUA FRIA AREA DRAINAGE MASTER STUDY





Location Map

Legend

- 1800 CFS — Proposed Condition Peak Flow
- 100 – Year Floodplain
- Retained Area Behind Beardsley Canal
- 48" — 48" C.M.P. Gated Outlet
- Watershed Boundary
- Railroads
- Existing Channels
- Future Local Drainage System

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SECTION 8 AREA NORTH OF GRAND AVENUE

8.1 Introduction

The portion of the study area that lies north of Grand Avenue represents a relatively small part of the overall study area; covering only about 2 square miles. It is bordered by Sun City West on the north, Grand Avenue on the southwesterly side and the Agua Fria River on the east.

8.2 Existing Conditions

8.2.1 Drainage Characteristics

The watershed is bounded on the north by the Bell Road Drainage Channel which collects runoff from Sun City West and diverts it to the Agua Fria River. Constructed as part of the Sun City West development, it has sufficient capacity to convey the 100-year flood. Consequently, runoff from areas north of Bell Road do not enter the study area.

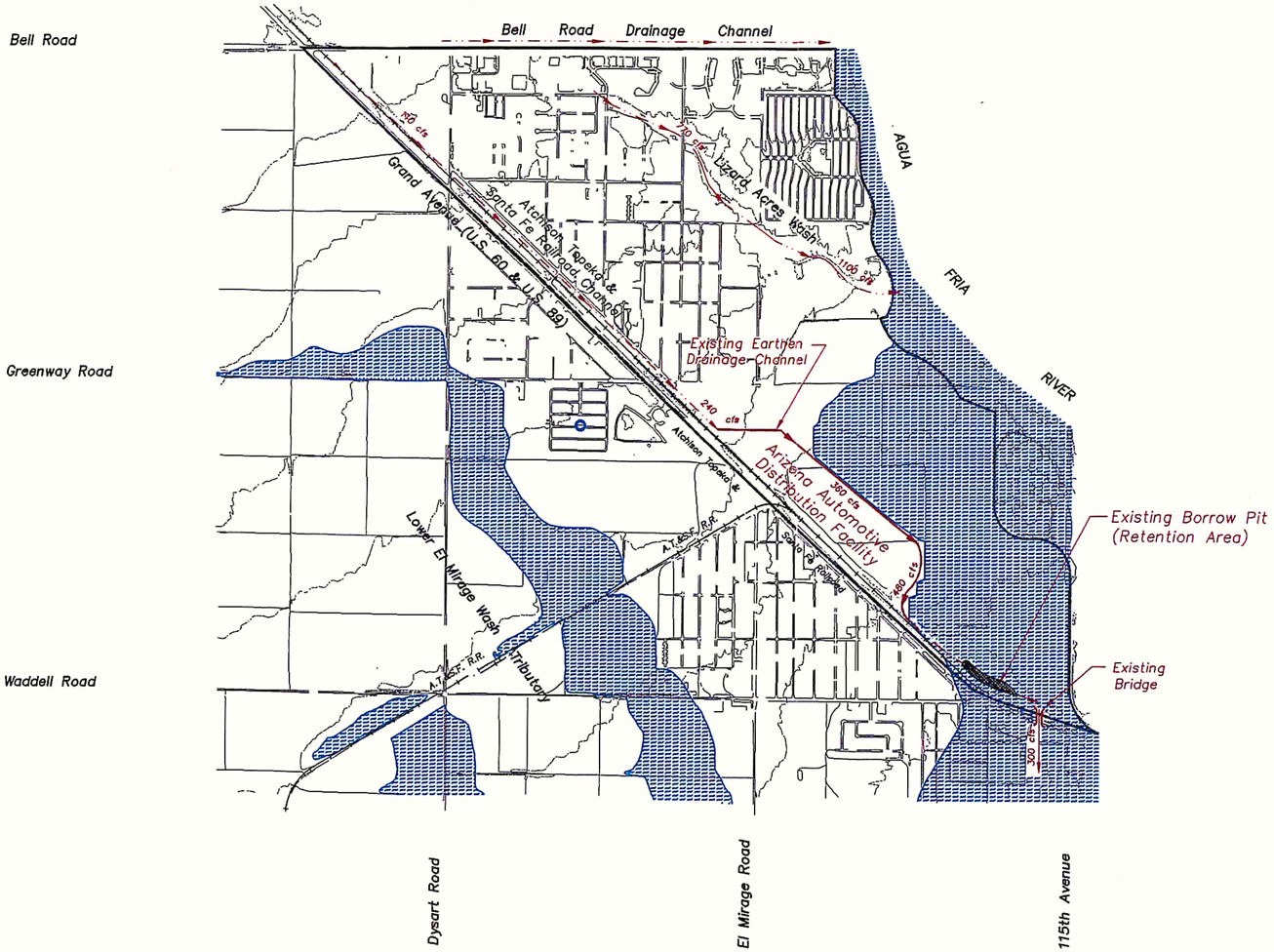
The Atchison Topeka and Santa Fe (AT&SF) Railroad, which parallels Grand Avenue, creates a drainage boundary along the watershed's southwest side. Runoff collects along the Railroad, which is elevated, and flows southeasterly to the Agua Fria River.

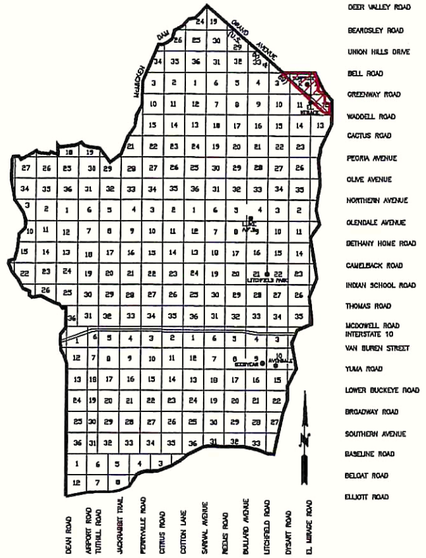
Runoff from the watershed concentrates and discharges to the Agua Fria River in two locations. One location is at the AT&SF Railroad discussed above. The other location is Lizard Acres Wash which drains the northern part of the watershed. It discharges to the Agua Fria River at about Greenway Road (see Figure 8.1).

Figure 8.1

Area North of
Grand Avneue

WHITE TANKS/AGUA FRIA
AREA DRAINAGE MASTER STUDY





Location Map

Legend

- 1800 cfs — Existing Condition Peak Flow
- 100 – Year Floodplain
- Watershed Boundary
- Railroads

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8.2.2 Land Use

The portion of the watershed that lies south of Lizard Acres Wash and west of El Mirage Road is the old part of the City of Surprise which consists primarily of single family residential housing. The northern part of the watershed, north of Lizard Acres Wash, is mostly developed with newer commercial buildings and an RV Park that fronts onto Bell Road. In addition to these areas, the AT&SF Railroad recently constructed an 85 acre automobile distribution center on the north side of Grand Avenue, east of El Mirage Road. The remainder of the watershed, which lies south of Lizard Acres Wash and east of El Mirage Road is used for agricultural purposes.

8.2.3 Known Flood Hazards

The known flood hazards for the watershed include flooding associated with the Agua Fria River, runoff that concentrates along the AT&SF Railroad, and flows that collect in Lizard Acres Wash. Flooding associated with the Agua Fria River was previously delineated and is shown on the Federal Emergency Management Agency's Flood Insurance Rate Map as well as the Flood Boundary Floodway Map. The flooding limits for the Agua Fria River are presented on Figure 8.1. Nearly all of the watershed area south of Greenway Road is located within the overbank floodplain area of the River. The flooding along the AT&SF Railroad

was delineated as part of this study and is documented in Part A. The flooding on Lizard Acres Wash was not defined with a floodplain because the drainage area is small; less than one square mile. However, it is included in the hydrologic model and the peak discharges are shown on Figure 8.1.

The AT&SF Railroad channel begins at Bell Road and flows southeasterly to the Agua Fria River. Between Bell Road and Greenway Road it consists of a shallow swale between the railroad and Santa Fe Drive. The swale has insufficient capacity to contain the 100-year flood but the peak discharge is small (approximately 200 cfs) and therefore does not pose a significant flood hazard. Southeast of Greenway Road, the AT&SF Railroad recently constructed an automobile distribution center. This new facility is not reflected on the ADMS topographic mapping. However, the facility includes an earthen channel around its perimeter which is sized for the 100-year flood that accumulates along the Railroad. The channel discharges to a large existing borrow pit located southeast of the facility that, in turn, discharges to the Agua Fria River.

8.3 Area Drainage Master Plan

Preserving the two existing drainage channels (i.e., Lizard Acres Wash and AT&SF Railroad Channel) will provide an adequate drainage system for the watershed.

Lizard Acres Wash provides drainage for the north part of the watershed. Its drainage area was considerably reduced with the construction of the Bell Road Channel. Most of its remaining drainage area has already been developed. Preserving the conveyance capacity of the channel to a level required to convey the 100-year flood will insure flood protection and provide sufficient stormwater conveyance for the north part of the watershed.

The AT&SF Railroad channel will provide drainage for the remainder of the watershed. A portion of the channel, between El Mirage Road and Thompson Ranch Road, has already been improved by the Railroad. They constructed an 85-acre automobile distribution center (see Figure 8.1). Future development, downstream of the AT&SF automobile facility, will need to maintain the capacity of the channel to its confluence with the Agua Fria River.

SECTION 9 LOWER EL MIRAGE WASH WATERSHED

9.1 Introduction

This section covers the drainage master plan for the Lower El Mirage Wash watershed. The watershed boundary shown on Figure 9.1 is for future conditions which includes a channel along Reems Road and along Waddell Road. It also includes Del Webb's new Sun City Grand Project which is currently in the planning stages.

9.2 Existing Conditions

9.2.1 *Drainage Characteristics*

The watershed slopes in a southeasterly direction toward the Agua Fria River. The land is primarily used for agricultural purposes and therefore stormwater runoff tends to spread out and cause shallow flooding. East of Dysart Road, runoff concentrates in Lower El Mirage Wash and Lower El Mirage Wash Tributary. Lower El Mirage Wash begins as a wide, shallow swale in the farm fields and then transitions into a series of storage ponds upstream of El Mirage Road. Downstream of El Mirage Road it is channelized through the Pueblo El Mirage Golf Course and discharges to the Agua Fria River. Lower El Mirage Wash Tributary is a wide, shallow swale for its entire length until it combines with Lower El Mirage Wash. The floodplains associated with both of these flooding sources were delineated as part of this study and are documented in Part A.

9.2.2 Land Use

Currently the land within the watershed is used primarily for agricultural purposes. There are, however, several areas that have been developed and a large area that is planned for development by the Del Webb Corporation which is known as Sun City Grand.

The areas that have already been developed include 1) the Pueblo El Mirage Country Club located east of El Mirage Road between Peoria Avenue and Cactus Road, 2) an older developed area of El Mirage which lies west of El Mirage Road and north of Waddell Road, 3) an older area of Surprise which lies north of Greenway Road and east of Dysart Road, 4) the Sun Village Resort which is a new residential development located north of Bell Road between Litchfield Road and El Mirage Road and 5) Kingswood Parke which is located north of Bell Road and west of Bullard Avenue. Kingswood Parke is a residential community located within Del Webb's Sun City Grand property.

Sun City Grand covers approximately 7 square miles of the watershed that is currently undeveloped. It lies north of Bell Road and east of Bullard Avenue. Del Webb's plan is to provide stormwater retention for the project which will "bleed off" via storm drains to the Bell Road Channel.

9.2.3 Known Flood Hazards

The known flood hazards include the flooding along Lower El Mirage Wash and Lower El Mirage Wash Tributary as well as the concentration of floodwaters along Reems Road. In addition, there is the widespread shallow flooding problem associated with the lack of adequate stormwater conveyance within the agricultural areas.

9.3 Area Drainage Master Plan

For purposes of discussing the area drainage master plan, the watershed can be separated into two parts. One part is the area north of Bell Road where most of the land is either currently being developed or is planned for development. The drainage plan for this area is to provide stormwater retention and/or detention with low flow storm drains discharging to the existing Bell Road Channel which lies east of Grand Avenue. The other part of the watershed is that area which lies south of Bell Road. This area is, for the most part, farmland which is not currently planned for development. A regional drain is envisioned for this area along Waddell Road which would take advantage of the outfall provided by Lower El Mirage Wash.

9.3.1 Area North of Bell Road

The area north of Bell Road is, for the most part, either under development or has been planned for development. These developments include the Sun Village Resort, Kingswood Parke and Del Webb's Sun City Grand Project. Kingswood Parke is located within Del Webb's property at the northwest corner of Bell Road and Bullard Avenue.

All of these projects have been, or will be, designed with retention and/or detention for the 100-year flood. At this time a master drainage plan is not available for Sun City Grand but the concept, according to their engineers, is to provide stormwater detention with low flow "bleed off" that will discharge to the existing Bell Road Channel. The Bell Road Channel is aligned along the north side of Bell Road from Dysart Road to the Agua Fria River. It was constructed as part of the Sun City West project.

The combined effect of these three developments will be to effectively eliminate the land north of Bell Road from the contributing drainage area. The future condition peak discharges, therefore, along the proposed Waddell Road Channel are based on the assumption that none of the land north of Bell Road will contribute to the flow (see Figure 9.2).

9.3.2 Waddell Road Drainage Channel and Detention Basin

The area south of Bell Road will discharge to a proposed regional drain along Waddell Road. Included in Appendix I are hydraulic calculations, a conceptual plan and profile and an itemized cost estimate.

For at least two reasons, the Waddell Road alignment is a logical location for a regional drain. One reason is that the roadway, under existing conditions, diverts a substantial amount of stormwater. Therefore, the alignment follows an existing flow path. Secondly, Lower El Mirage Wash provides an outfall that can convey flows out to the Agua Fria River.

The channel, however, will require a detention basin in the vicinity of Dysart Road prior to discharging to Lower El Mirage Wash. The purpose of the detention basin is to reduce the future conditions peak discharge to an amount equal to or less than the existing conditions peak flow on Lower El Mirage Wash. This is necessary because under current conditions a considerable amount of floodwaters cross over Waddell Road and flow to the south. Therefore, if the entire 100-year flood is collected along the roadway, it will concentrate more runoff in Lower El Mirage Wash than what gets there under existing conditions. Of course, if areas within the watershed are developed prior to construction of the Waddell Road Channel, and if they provide enough stormwater retention, the detention basin may not be necessary.

The basin shown on this plan is designed for future watershed boundaries but with existing land use. Future watershed boundaries include no contributing drainage from north of Bell Road or west of Reems Road.

9.3.3 Lower El Mirage Wash and Tributary

Both the Lower El Mirage Wash and the Lower El Mirage Wash Tributary provide considerable stormwater conveyance for the watershed. The floodplain and floodway associated with each of these flooding sources was delineated as part of this study and are documented in Part A. Floodplain management will preserve the flow capacity of these washes and provide long term floodwater conveyance for the area.

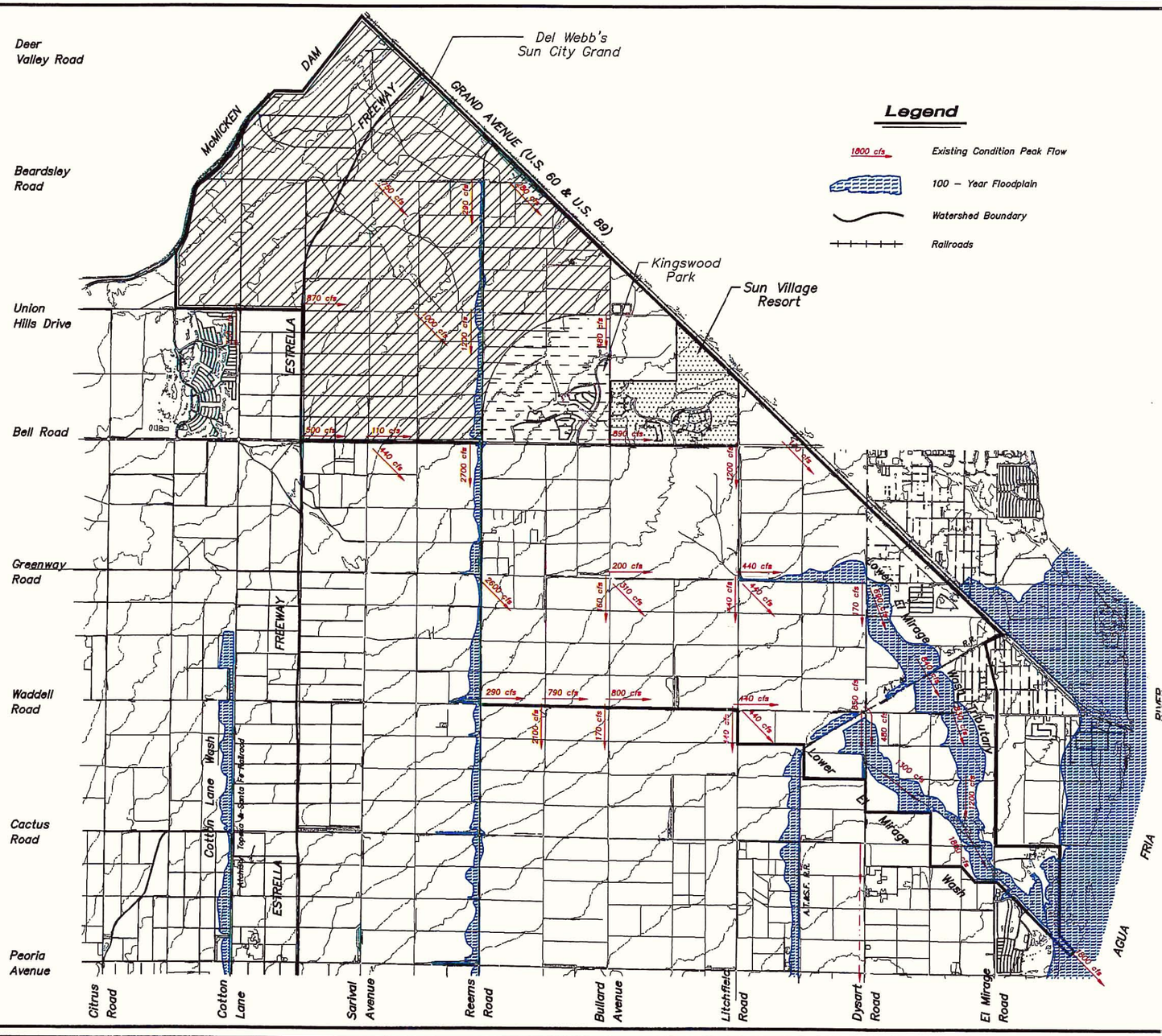
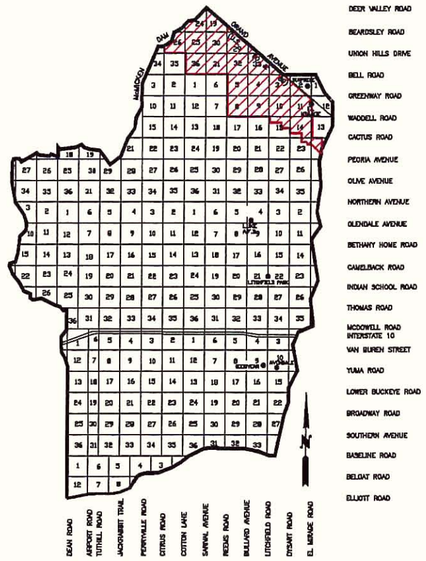


Figure 9.1

Existing Conditions

Lower El Mirage Wash Watershed

WHITE TANKS/AGUA FRIA
AREA DRAINAGE MASTER STUDY



Location Map

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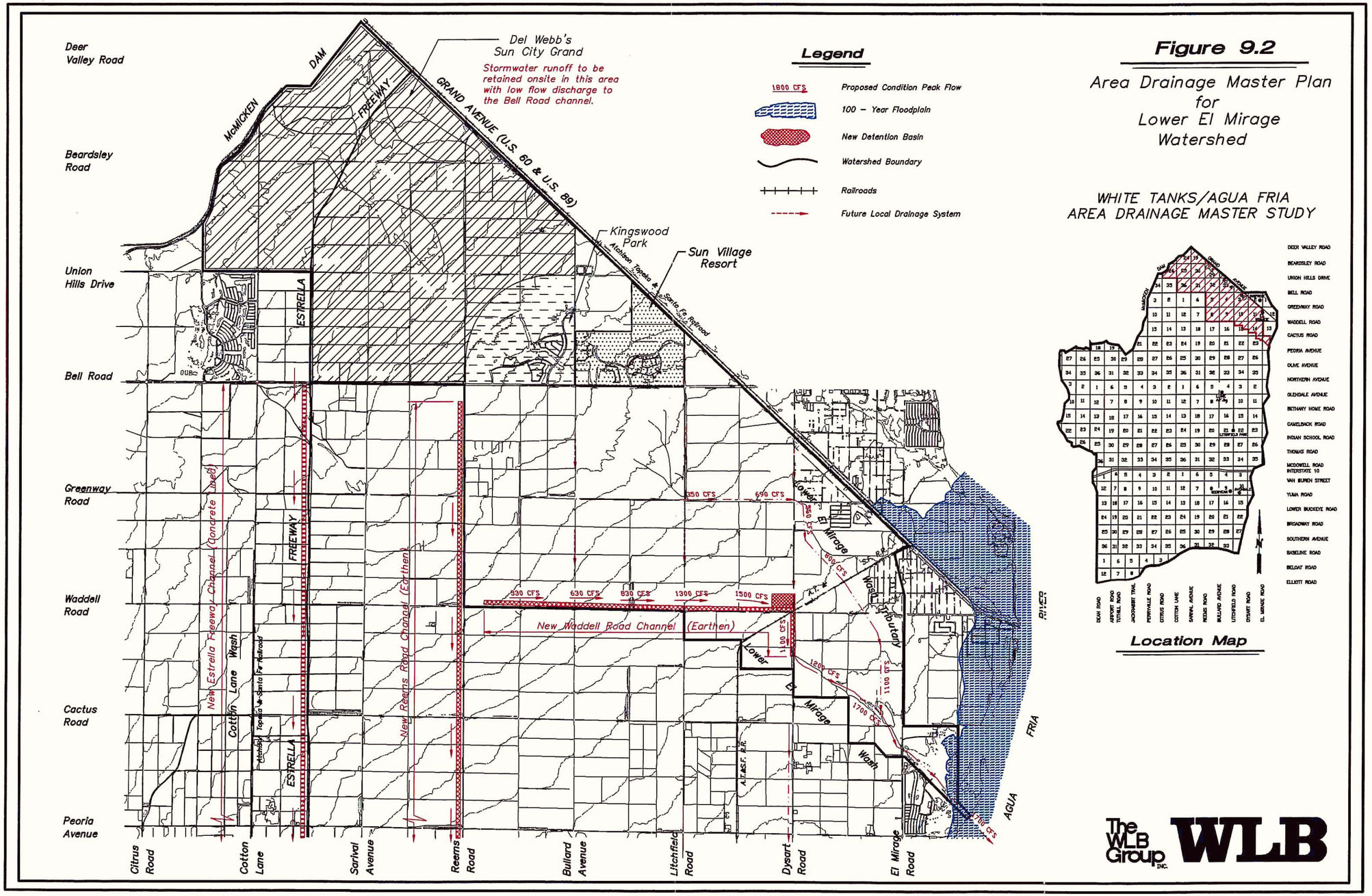
Figure 9.2
Area Drainage Master Plan for Lower El Mirage Watershed
WHITE TANKS/AGUA FRIA AREA DRAINAGE MASTER STUDY
Legend
1800 CFS Proposed Condition Peak Flow
100 - Year Floodplain
New Detention Basin
Watershed Boundary
Railroads
Future Local Drainage System
Del Webb's Sun City Grand
Stormwater runoff to be retained onsite in this area with low flow discharge to the Bell Road channel.
Kingswood Park
Sun Village Resort
Deer Valley Road
Beardsley Road
Union Hills Drive
Bell Road
Greenway Road
Waddell Road
Cactus Road
Peoria Avenue
Citrus Road
Cotton Lane
Sarival Avenue
Reems Road
Bullard Avenue
Litchfield Road
Dysart Road
El Mirage Road
McMICKEN DAM
GRAND AVENUE (U.S. 60 & U.S. 89)
ESTRELLA FREEWAY
Atchison Topeka & Santa Fe Railroad
New Estrella Freeway Channel (Concrete lined)
Cotton Lane Wash
New Reems Road Channel (Earthen)
New Waddell Road Channel (Earthen)
Lower El Mirage Wash
Lower El Mirage Wash Tributary
A.T.&S.F. R.R.
AGUA FRIA RIVER
350 CFS
690 CFS
930 CFS
630 CFS
830 CFS
1300 CFS
1500 CFS
1100 CFS
1200 CFS
1700 CFS
Location Map
DEER VALLEY ROAD
BEARDSLEY ROAD
UNION HILLS DRIVE
BELL ROAD
GREENWAY ROAD
WADDELL ROAD
CACTUS ROAD
PEORIA AVENUE
OLIVE AVENUE
NORTHERN AVENUE
GLENDALE AVENUE
BETHANY HOME ROAD
CAMELBACK ROAD
INDIAN SCHOOL ROAD
THOMAS ROAD
MCDOWELL ROAD INTERSTATE 10
VAN BUREN STREET
YUMA ROAD
LOWER BUCKEYE ROAD
BROADWAY ROAD
SOUTHERN AVENUE
BASELINE ROAD
BELDAT ROAD
ELLIOTT ROAD
DEAN ROAD
AIRPORT ROAD
TUTHILL ROAD
JACKRABBIT TRAIL
PERRYVILLE ROAD
CITRUS ROAD
COTTON LANE
SARIVAL AVENUE
REEMS ROAD
BULLARD AVENUE
LITCHFIELD ROAD
DYSART ROAD
EL MIRAGE ROAD
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WLB

SECTION 10 DYSART DRAIN WATERSHED

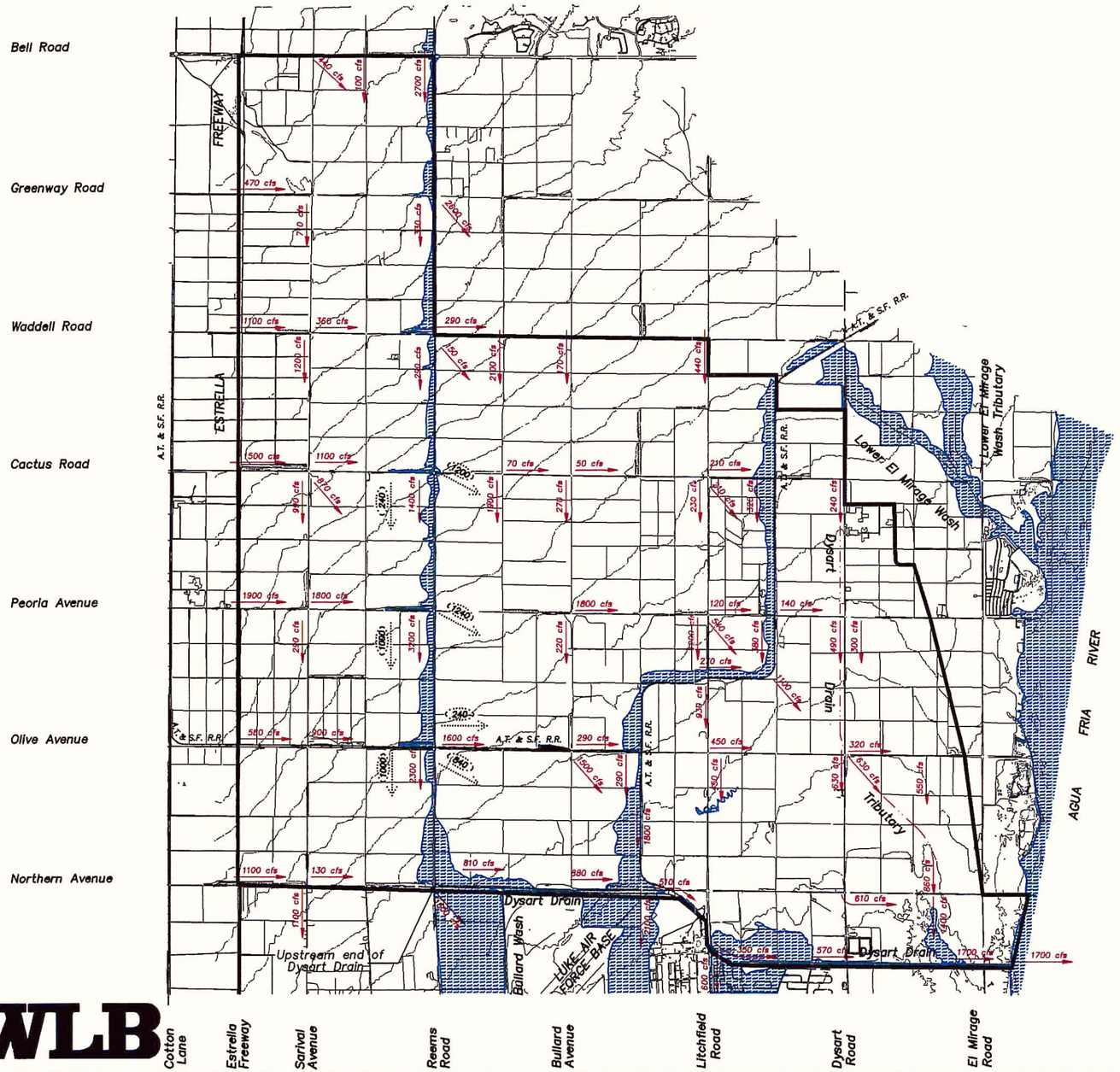
10.1 Introduction

The Dysart Drain watershed is shown on Figure 10.1. The watershed boundary depicted on the figure is for future conditions which includes a channel along the Estrella Freeway and a channel along Waddell Road. The existing watershed boundary actually reaches well beyond the one shown. Therefore, under existing conditions, significant stormwater flows enter the watershed from outside these boundaries. These flows are presented on Figure 10.1.

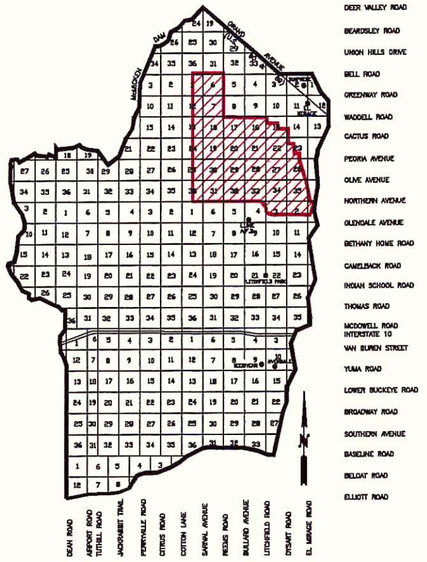
Figure 10.1

Existing Conditions

Dysart Drain Watershed



WHITE TANKS/AGUA FRIA
AREA DRAINAGE MASTER STUDY



Location Map

Legend

- (1000) Reevaluated Existing Condition peak flow [2]
- 1800 cfs Existing Condition Peak Flow [1]
- 100 – Year Floodplain
- Watershed Boundary
- Railroads
- Existing Channels

1 – Peak flows used in the flood study (part A)

2 – Peak flows based on Reevaluation for design of Dysart Drain Improvement Project (Addendum to Dysart Drain Improvement Project, Reference 11).

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10.2 Existing Conditions

10.2.1 Drainage Characteristics

The watershed is mostly flat agricultural land that slopes in a southeasterly direction toward the Agua Fria River at a rate of about 0.5%. As is typical for most of the study area; smaller, more frequent flooding is diverted in an easterly and southerly direction along roadside channels and agricultural ditches whereas, larger floods tend to flow overland across the farm fields. In the case of the Dysart Drain watershed, however, there are three notable exceptions; Reems Road, the Atchison Topeka and Santa Fe Railroad (between Olive Avenue and the Dysart Drain), and the Dysart Drain Tributary. All three have capacity to convey large flood flows and therefore, they all divert a considerable amount of stormwater runoff (see Figure 10.1).

10.2.2 Land Use

The watershed area is roughly 24 square miles in size; of which, 23 square miles is used for agriculture. The only developed area is located north of Peoria Avenue on the east side of Dysart Road. This area includes Dysart High School and Junior High School along with a large lot, residential subdivision.

10.2.3 Background Information on Dysart Drain

The Dysart Drain was built by the U.S. Army Corps of Engineers in 1958 to collect off-site stormwater flows and prevent them from entering Luke AFB property. It was constructed in conjunction with McMicken Dam which is located upstream of the Base. McMicken Dam retains flows from a 320 square mile drainage area that would otherwise flood Luke AFB. The floodwaters impounded by the dam are discharged to the Agua Fria River (refer to Section 2.2). Dysart Drain's purpose is to collect and convey floodwaters from the contributing drainage area downstream of McMicken Dam. It is located along the north boundary of the Base; beginning at Reems Road and flowing easterly to the Agua Fria River.

The Dysart Drain has slowly, through time, lost a major amount of its capacity due to land subsidence. The conveyance capacity has decreased from an original design capacity of 1100 cfs down to a current capacity of approximately 300 cfs. Section 2.4 describes this subsidence problem.

10.2.4 Known Flood Hazards

The diversions along Reems Road, the AT&SF Railroad and the Dysart Drain provide stormwater conveyance for the watershed. They also, however, create flood hazards by concentrating flood flows in areas that would otherwise only be subject to shallow flooding. Consequently, these diversions represent the primary flood hazards in the watershed. In addition, runoff that concentrates in the Dysart Drain Tributary also represents a significant flood hazard. Each of these flood hazards are described below.

Dysart Drain

Flooding problems caused by the Dysart Drain are due to the land subsidence that has occurred since the channel was built. Figure 10.2 shows the effect of the differential land subsidence on the channel profile. Currently, there are three separate areas where stormwater from the 100-year flood will breakout of the channel and flow south across Luke AFB.

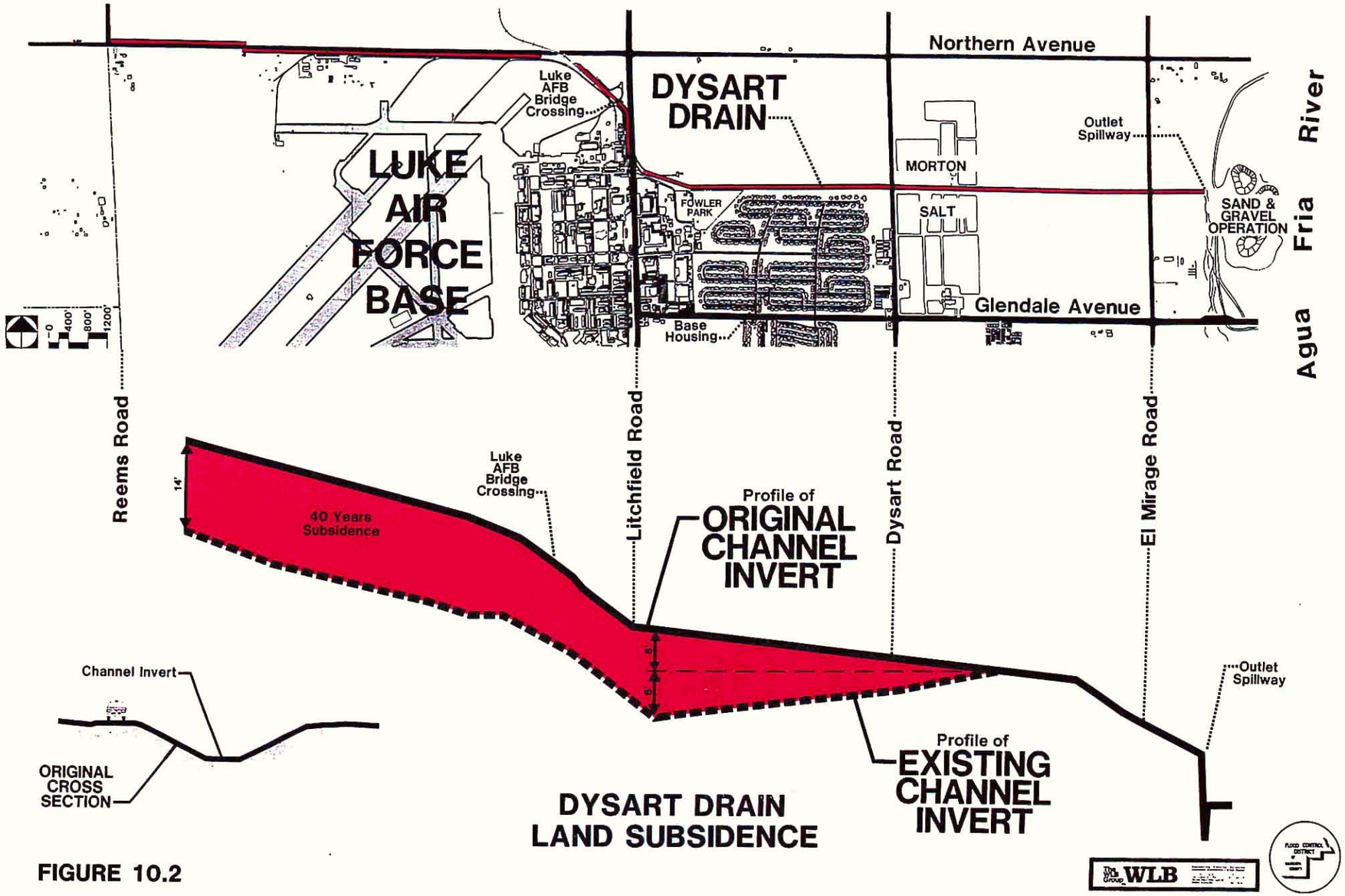

Northern Avenue
Luke AFB Bridge Crossing
DYSART DRAIN
LUKE AIR FORCE BASE
Outlet Spillway
MORTON
SALT
FOWLER PARK
SAND & GRAVEL OPERATION
Glendale Avenue
Base Housing
Agua Fria River
0 400' 800' 1200'
Reems Road
Litchfield Road
Dysart Road
El Mirage Road
14'
40 Years Subsidence
Luke AFB Bridge Crossing
Profile of ORIGINAL CHANNEL INVERT
8'
6'
Outlet Spillway
Channel Invert
ORIGINAL CROSS SECTION
Profile of EXISTING CHANNEL INVERT
DYSART DRAIN LAND SUBSIDENCE
WLB

FIGURE 10.2

The first area is located just east of Litchfield Road. This area has subsided approximately 12 feet over the last 35 years which has caused a "low point" or sag in the channel invert. Stormwater ponds approximately 6 feet deep within the channel before it can flow out to the Agua Fria River. This has severely restricted the conveyance capacity of the Drain. Under current conditions, 945 cfs reaches this point during the 100-year storm event. Of this, only 345 cfs is conveyed east in Dysart Drain while the remainder flow of 600 cfs breaks out south over the bank. The breakout flows flood the Base housing area located south of Dysart Drain and east of Litchfield Road. This problem is compounded by the fact that the Base housing area south of Dysart Drain has also subsided. The subsidence has created a low area where the breakout flows will pond as much as two feet deep before overtopping Litchfield Road and draining out to the west. The existing storm drains in this area cannot handle the flows from the breakout and are not in fact able to handle the flows generated from the local drainage area south of the Dysart Drain. Therefore, this area will still be subject to local flooding even after the Dysart Drain is improved.

The second area where breakouts occur is located just upstream of the two existing 10' x 5.5' x 640' box culverts located under the AT&SF Railroad spur at the north end of the Luke AFB runways. These culverts are undersized (approximately 500 cfs capacity) to contain the flows that come in from the north along the AT&SF Railroad. The combined 100-year flow in Dysart Drain at this point is 2560 cfs. Excess flows (2050 cfs)

breakout over the south bank and continue south as sheet flow across the Base runways. This flooding is typically accompanied by large amounts of sediment and debris that is deposited on the runways. In addition, several buildings adjacent to the runways are normally flooded before the flows exit the Base to the south.

The last area where breakout flows occur is between the west side of Luke AFB and Reems Road. The earthen trapezoidal channel located on the north side of Northern Avenue has insufficient capacity to convey the flows that are collected at Reems Road. Approximately 2350 cfs is carried south in and adjacent to Reems Road. At Northern Avenue Dysart Drain collects flow but only has capacity for approximately 800 cfs. The remainder of the flow (1550 cfs) will breakout to the south over the top of Northern Avenue. The breakout flow continues south-southeast as sheet flow until it is collected in the channel along the west side of the Base. The west side channel collects flows and conveys them around the south side of the Base and discharges to Bullard Wash.

Reems Road

Reems Road and the farm fields to the west collect and convey a significant amount of stormwater. Reems is different from a typical County roadway in that it was constructed with an inverted crown to convey runoff; presumably to carry floodwaters to the Dysart Drain. In addition to the inverted crown, the farm fields are bermed up approximately 2 feet which adds to the roadway's conveyance capacity. The problem with the Reems Road conveyance, and the reason why it causes a flood hazard, is that the agricultural berms are not capable of containing the 100-year flood. Consequently, for its entire length through the watershed, the berms along Reems Road are subject to overtopping and being washed out which could result in floodwaters discharging onto properties to the east in greater quantity than what would otherwise be expected if the berms did not exist.

It should be noted that Figure 10.1 presents the existing conditions 100-year peak discharges which were used in the Flood Study documented in Part A. The peak discharges along Reems Road were reevaluated with the Concept Design Study for the Dysart Drain Improvement Project (reference 11). It was determined that the conveyance capacity for Reems Road is about 1000 cfs. Therefore, the reevaluation resulted in additional split flows at Cactus Road and Peoria Avenue. These flows are

presented on Figure 10.1. Flood flows above 1000 cfs will flow southeasterly and enter the Dysart Drain further downstream. Regardless of the split flow assumptions, however, floodwaters will collect along the Dysart Drain and spill over into Luke AFB.

Atchison Topeka and Santa Fe (AT&SF) Railroad

There is an existing channel along the west side of the AT&SF Railroad that extends from Olive Avenue downstream to the Dysart Drain. In addition to the channel, the Railroad is elevated as much as 3 feet. The combination of conveyance in the channel along with conveyance above the channel, diverted by the Railroad, is able to contain almost all of the 100-year flood. There is a short reach about halfway between Dysart Drain and Olive Avenue (cross sections 0.496 and 0.592, Part A, Flood Study Technical Data Notebook) where floodwaters will overtop the Railroad. The depth of flow over the Railroad, however, is less than one foot and what flow does overtop will be carried south to the Dysart Drain in a channel that is located on the east side of the Railroad.

The Railroad diversion causes two flood hazards. One hazard is the inundation that occurs on the land along the Railroad. The other flood hazard is the breakout at the confluence with the Dysart Drain. The Railroad and channel divert the 100-year flood which results in a 100-year, concentrated peak discharge of 1770 cfs along the Railroad that enters the Dysart Drain. This flow combines with the flow in the Dysart Drain and exceeds its capacity which causes floodwaters to breakout and flood Luke AFB.

Dysart Drain Tributary

Dysart Drain Tributary is a natural occurring wash that discharges to the Dysart Drain about 1/2 mile upstream of the Drain's outlet into the Agua Fria River. Approximately 1400 cfs concentrates in the wash during the 100-year flood which far exceeds the conveyance capacity of its defined channel. In addition, upstream of Northern Avenue the natural channel has been obscured by agricultural development. What's left is a wide, shallow swale through the farmland which concentrates considerable runoff during the 100-year flood.

10.3 Area Drainage Master Plan

Sufficient regional drainage can be provided for the Dysart Drain watershed by improving and/or maintaining the existing floodwater conveyances within the watershed. This includes 1) improvements to the Dysart Drain to increase its stormwater conveyance capacity to a 100-year level of service, 2) development of a channel along Reems Road to convey the future condition 100-year flood and 3) floodplain management along the AT&SF Railroad and the Dysart Drain Tributary to preserve their floodwater conveyance capacities (see Figure 10.4).

10.3.1 *Corrective Measures on Dysart Drain*

As described above in Section 10.2.3, the existing Dysart Drain channel has very little stormwater conveyance capacity due to over 35 years of land subsidence. The diminished capacity has resulted in frequent, and sometimes severe, flooding on Luke AFB. In response to the flooding problem, the Flood Control District of Maricopa County and Luke AFB have agreed to share the cost to improve the conveyance capacity of the Dysart Drain to a 100-year level of service. The Dysart Drain improvement project is scheduled for construction in 1995. Figure 10.3 presents a schematic of the selected alternative. The concept plan and profile along with the hydraulic calculations and cost estimates were previously prepared as part of this study and are summarized in the Dysart Drain Improvement Project, Concept Design Study, Selected Alternative (reference 10).

The Dysart Drain Improvement Project is being designed to convey the existing conditions 100-year flood. Future drainage improvements within the study area should significantly reduce the peak discharges in Dysart Drain which, in turn, will increase the level of service that it will provide. These future improvements include diversion channels along the Estrella Freeway, Waddell Road and Reems Road as well as the development of the Sun City Grand project. Figure 10.4 presents the future conditions 100-year peak discharges.

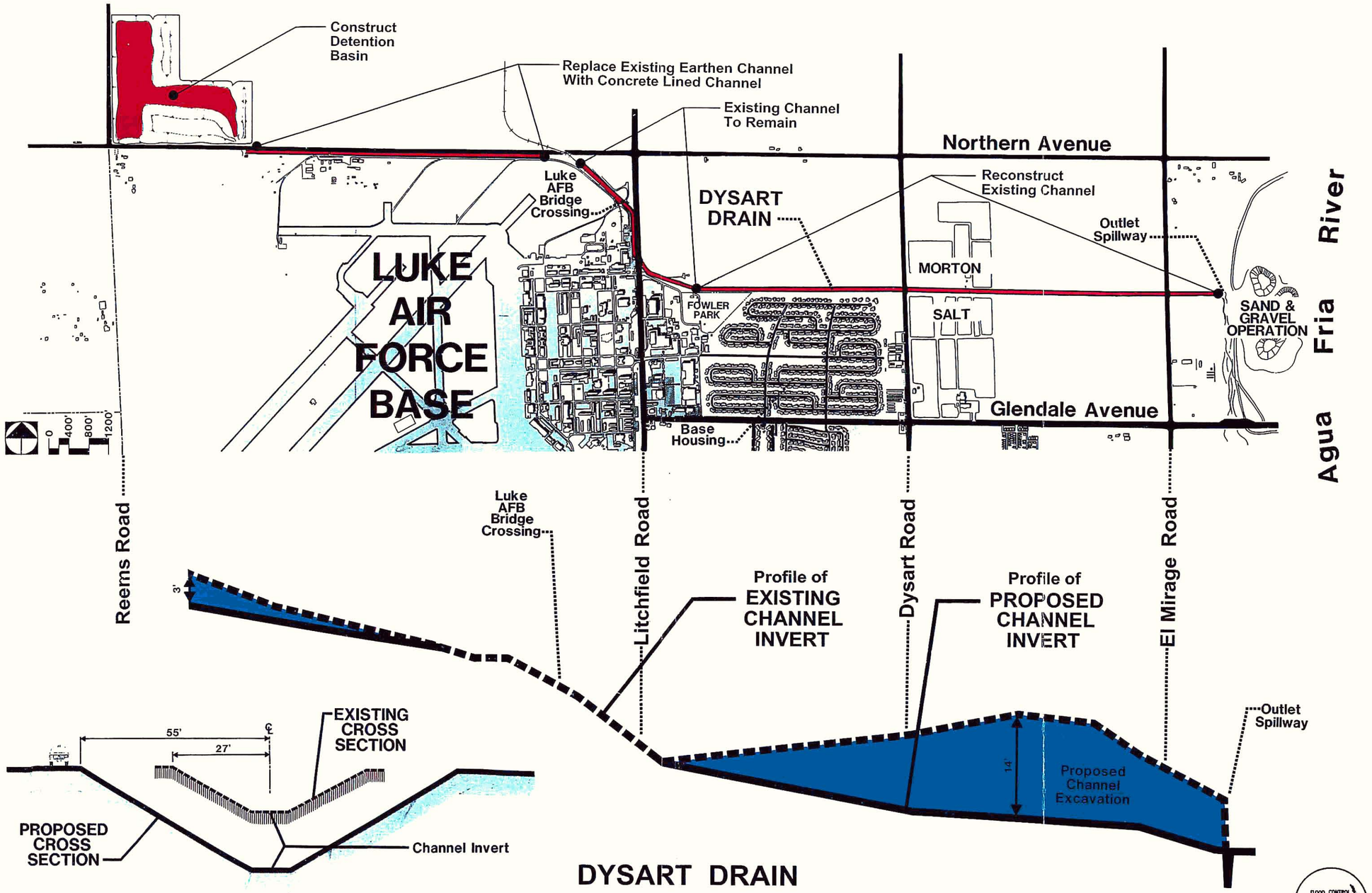


FIGURE 10.3

Cross Section at 3000' East of Dysart Road

DYSART DRAIN
SELECTED ALTERNATIVE

WLB

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

10.3.2 Reems Road Channel

The regional drainage plan includes a channel along Reems Road designed to convey the future condition 100-year flood. Future conditions include the Estrella Freeway Channel and the Sun City Grand project. The proposed channel is earthen lined and reaches from its outfall at the Dysart Drain detention basin upstream to Bell Road. Appendix H includes the conceptual channel profile, the hydraulic calculations and the cost estimate.

As described above in Section 10.2, Reems Road conveys a significant amount of floodwater under existing conditions. Between Peoria Avenue and Northern Avenue it has a capacity of about 1000 cfs which is carried in a combination of flow in the roadway and flow in the farm fields adjacent to the roadway. Much of this existing conveyance capacity is created with agricultural berms adjacent to the roadway which are susceptible to overtopping and wash out. Providing a channel along the roadway alignment will prevent this flood hazard while at the same time preserve and/or increase the conveyance capacity of Reems Road. In addition, the proposed Dysart Drain Detention Basin at Northern Avenue was designed to accept flood flows from Reems Road and, consequently, it has sufficient storage capacity to provide an outfall for a channel along Reems Road.

The concept plan for the Dysart Drain calls for a 600 ac-ft detention basin with a spillway elevation of 1102.0. Under existing conditions the basin high water level for the 100-year flood is 1199.7 with a corresponding peak volume of 440 ac-ft (Reference 10). Under future conditions, which includes the Estrella

Freeway Channel, Reems Road Channel and the Sun City Grand project, the 100-year peak stage will be 1199.0 which corresponds to a volume of 400 ac-ft.

10.3.3 AT&SF Railroad Channel and Dysart Drain Tributary

Both the AT&SF Railroad (between Olive Avenue and Dysart Drain) and the Dysart Drain Tributary currently convey the existing condition 100-year flood in fairly wide shallow floodplains. These conveyances can be preserved with floodplain management. In the case of the AT&SF Railroad, the floodplain delineation was completed as part of this study and is documented in Part A. The floodplain for the Dysart Drain Tributary, however, was not delineated as part of this study. Therefore, the floodplain will require delineation before any future development can take place so that development can be designed to preserve the conveyance capacity without increasing the flood hazard to adjacent property.

As noted in Section 10.2, the AT&SF Railroad is overtopped by the 100-year flood in a short reach between the Dysart Drain and Olive Avenue. This reach is identified with cross sections 0.496 and 0.592 in the Flood Study Technical Data Notebook, Part A. The depth of overtopping is less than one foot. Under current conditions, the flows that overtop the Railroad will simply flow southerly to the Dysart Drain along the east side of the Railroad. Future development in this vicinity should be designed to contain these floodwaters.

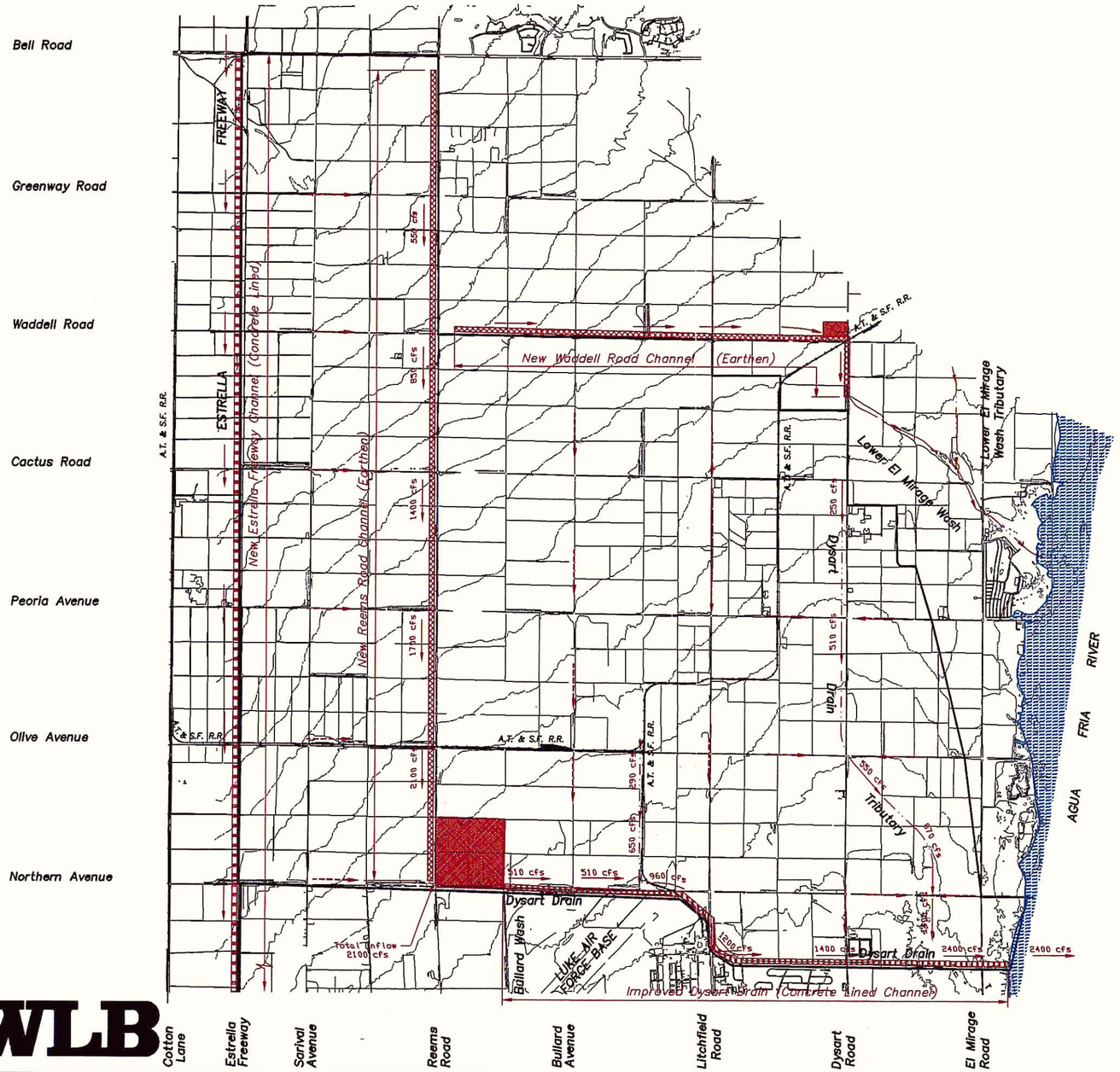
In the case of development on the east side of the Railroad, the property should be elevated in such a way as to prevent overtopping the Railroad and force the floodwater to stay on the west side. This is an acceptable approach from a floodplain management standpoint because it will result in a water surface elevation increase of less than one foot as indicated earlier in this section. In addition, the Dysart Drain Improvement Project is being designed with the assumption that the entire 100-year flood is contained along the west side of the Railroad.

In the case of development on the west side of the Railroad, it shall be designed on the basis that all of the floodwater will be contained on the west side of the Railroad. It shall also be designed to provide freeboard in accordance with FEMA requirements (reference 9) in those areas where the Railroad is elevated and acts as a dike.

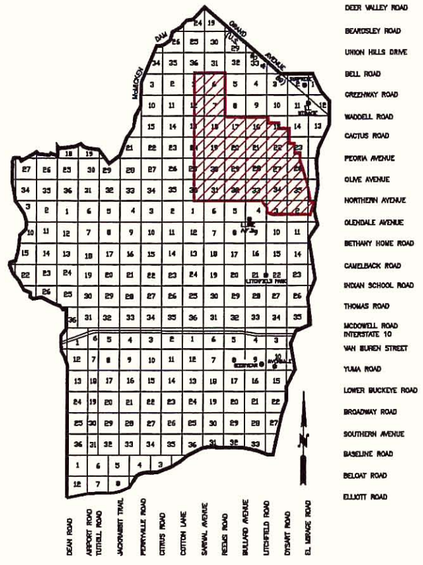
It is important to make clear that the overtopping is an existing condition. The peak discharge will be significantly reduced in the future after diversion channels are constructed along the Estrella Freeway, Reems Road and Waddell Road. In fact, the peak flow is reduced from an existing discharge of 1800 cfs down to 650 cfs (see Figure 10.4). Therefore, even without structural improvements on the Railroad or the Channel, the overtopping problem will be alleviated in the future.

Figure 10.4

Area Drainage Master Plan for Dysart Drain Watershed



WHITE TANKS/AGUA FRIA AREA DRAINAGE MASTER STUDY



Location Map

Legend

- 1800 CFS — Proposed Condition Peak Flow
- 100 – Year Floodplain
- New Detention Basin
- Watershed Boundary
- Railroads
- Future Local Drainage System

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SECTION 11 COLTER CHANNEL WATERSHED

11.1 Introduction

This section presents the drainage plan for the Colter Channel watershed. Colter Channel, which has a drainage area of about 4 square miles, is currently under construction by the Flood Control District. Its purpose is to provide flood protection for Litchfield Park as well as for the planned future widening of Camelback Road. The channel is about 2 miles in length; beginning a little east of Litchfield Road and flowing easterly to its outfall at the Agua Fria River. Its alignment generally follows Colter Street which is 1/4 mile north of Camelback Road; hence the name Colter Channel.

The boundaries for the watershed include the area which lies downstream of Colter Channel; between the Channel and Camelback Road. This area is a strip of land about 1/4 mile wide that actually drains to Camelback Road. It is included herein for two reasons. First, the ADMS hydrologic model is based on the drainage boundary being along Camelback Road, rather than Colter Channel. Second, a future channel is proposed along Camelback Road which will parallel the Colter Channel and convey stormwater to the Agua Fria River.

11.2 Existing Conditions

11.2.1 Drainage Characteristics

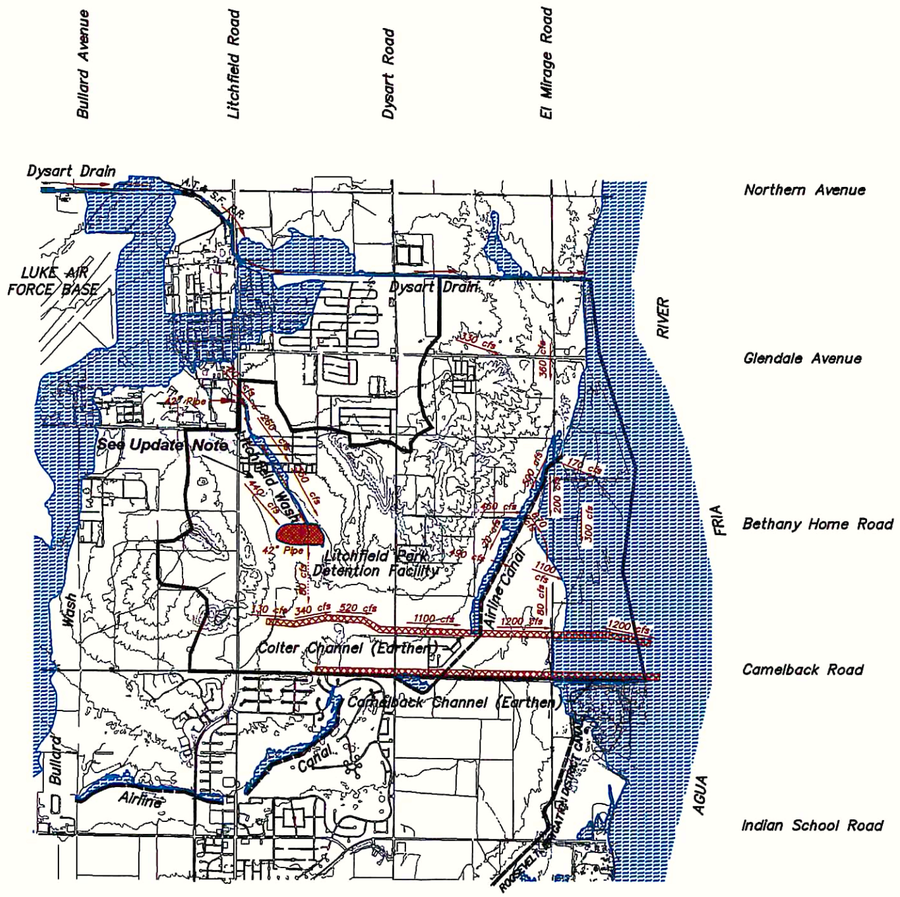
The Colter Channel watershed is relatively small, about 4 square miles and has distinctly hilly terrain in comparison to most of the study area (see Figure 11.1). Slopes range from about 0.5% to over 10% on the steepest hillsides.

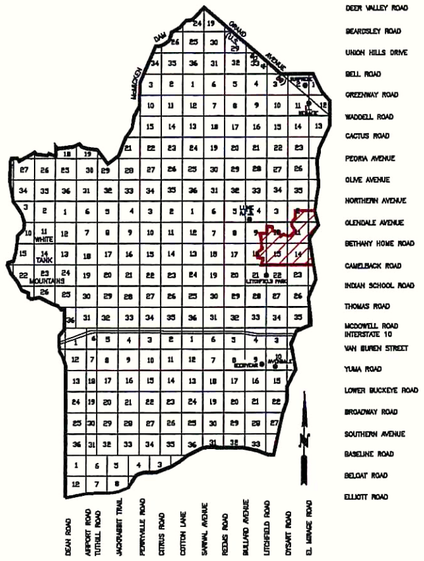
The western part of the watershed drains southerly toward Colter Channel and Camelback Road. The remainder of the watershed drains easterly, flooding over the Airline Canal and El Mirage Road before it reaches the Agua Fria River. The Airline Canal is somewhat elevated and causes ponding of stormwater runoff along its western side.

Figure 11.1

Colter Channel Watershed

WHITE TANKS/AGUA FRIA AREA DRAINAGE MASTER STUDY





Location Map

Legend

- 1800 cfs — Existing Condition Peak Flow
- 100 – Year Floodplain
- Existing Detention Basin
- Watershed Boundary
- Existing Channel
- Railroads

UPDATE NOTES (MARCH 1995)

Litchfield Wash has been renamed to Dale Creek Wash.

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11.2.2 Land Use

In addition to its hilly terrain, the Colter Channel watershed is also somewhat unique because it consists predominantly of undeveloped natural desert. Other than a few scattered residential areas, the entire drainage area is relatively undisturbed natural desert except for about one square mile of agricultural land which lies downstream of the Airline Canal; between the Canal and the Agua Fria River.

11.2.3 Colter Channel

The Flood Control District of Maricopa County is currently constructing Colter Channel. When completed, the channel will have sufficient capacity to convey the 100-year flood and will provide a drainage outfall for the contributing watershed. The purpose for constructing the channel is twofold. First, Litchfield Park has experienced flooding from the runoff north of Camelback Road. Colter Channel will significantly reduce the potential for flooding. Second, the Maricopa County Department of Transportation (MCDOT) has plans to widen Camelback Road. The construction of Colter Channel will allow MCDOT to reduce the size of the roadside channel required to protect Camelback Road from flooding.

Some of the property that drains to the Colter Channel will not require stormwater retention when developed. The owners of these properties gave the District an easement to construct and maintain the channel. In return, the District designed the channel to convey future, developed condition peak discharges from their property (reference 16).

11.2.4 Litchfield Park Detention Facility

The Litchfield Park Detention Facility was constructed in 1991 to replace the deteriorated Litchfield Park Dam (a.k.a. Murphey's Dam). It controls runoff from a 0.8 square mile drainage area located in the northwest part of the watershed (reference 17). The detention facility was designed for the 100-year flood. It reduces the 100-year peak discharge from 900 cfs down to 85 cfs. It should also be mentioned that a 42" storm drain on Luke AFB discharges to Dale Creek Wash (named Litchfield Wash in Part A) which, in turn, discharges to the detention facility. This storm drain discharges at a rate of 60 cfs during the 100-year flood.

11.2.5 Camelback Road Channel

MCDOT plans to construct a drainage channel along the north side of Camelback Road in conjunction with widening the roadway. MCDOT's schedule is to begin construction in 1997. The conceptual design calls for an earthen roadside channel from Litchfield Road to the Agua Fria River. The contributing drainage area is, for the most part, limited to the area downstream of the Colter

Channel which lies between the Channel and Camelback Road. The level of flood protection will be the 5-year flood based on existing conditions, however, the level of protection will increase in the future due to stormwater retention requirements. That is, as the contributing area develops, stormwater retention will be required for the 100-year, 2-hour rainfall which will significantly reduce flows to the channel; thereby increasing the level of protection it will provide to a level greater than the future 100-year flood (reference 18).

11.2.6 Known Flood Hazards

The known flood hazards defined in Part A of this study include the ponding behind the Airline Canal and the flooding along Dale Creek Wash (named Litchfield Wash in Part A). Dale Creek Wash flows into the Litchfield Park Detention Facility. These flood hazards were delineated as part of this study and are documented in Part A.

11.3 Area Drainage Master Plan

Figure 11.2 presents the drainage plan for the watershed. The major elements of the plan have either been constructed or have already been designed. They include the Litchfield Park Detention Facility, the Colter Channel and the Camelback Road Channel. Section 11.2 provides descriptions of each of these flood control facilities. The following paragraphs describe the special stormwater retention requirements for the watershed as well as the need to provide floodwater conveyance in the eastern part of the watershed.

11.3.1 Stormwater Retention Requirements

Stormwater retention is not required for the area that drains to the Litchfield Park Detention Facility; nor is it required for portions of the Colter Channel drainage area. As is usually the case, the remainder of the watershed will require onsite retention of the 100-year, 2-hour rainfall.

The Litchfield Park Detention Facility was designed for future developed conditions (reference 17). The contributing drainage area was assumed to consist of a mix of housing, commercial, and open space development. Therefore, if the future development adheres to the land use plan presented in reference 17, stormwater retention will not be required.

Similarly, some adjacent portions of the Colter Channel drainage area will not require onsite retention. As explained in Section 11.2, the owners of these properties gave the Flood Control District an easement to construct and maintain the channel. In return, the District designed the channel to convey future, developed condition peak discharges from their property.

It should be stressed however, that in both the case of the Colter Channel and the Litchfield Park Detention Facility, certain assumptions were made as to the level of development and corresponding degree of imperviousness. Therefore, future development will have to be designed to conform to these assumptions so that the storage volume of the detention facility and the conveyance capacity of the channel are not exceeded.

11.3.2 Area East of Dysart Road

There is a ridge line east of Dysart Road which results in a drainage divide. The area west of the ridge line drains to Colter Channel and the Camelback Road Channel, whereas most of the area to the east drains directly to the Agua Fria River.

There is a significant concentration of floodwater (Q100 = 1200 cfs) at El Mirage Road, about ½ mile north of Colter Channel. A portion of that flow (Q100 = 80 cfs) is currently diverted south along El Mirage Road and is intercepted by the Channel. The remainder floods across El Mirage Road and flows out the Agua Fria River. The Colter Channel design was based on maintaining this flow across El Mirage Road. Therefore, any future improvement to the roadway will have to be designed to provide adequate cross drainage at this point without diverting additional flow in a southerly direction.

SECTION 12 BULLARD WASH WATERSHED

12.1 Introduction

Bullard Wash is a very prominent, wide floodplain that runs through the agricultural land between Luke AFB and the Phoenix-Litchfield Municipal Airport. It is one of a few natural occurring conveyances within the study area that can contain and convey the 100-year flood. This section presents the area drainage master plan for the Bullard Wash watershed which is located east of the proposed Estrella Freeway between Northern Avenue and the Gila River.

Located in the southeast corner of the Bullard Wash watershed is the older developed part of Avondale and Goodyear which includes two important drainage features. One feature is a large diameter storm drain located in Litchfield Road and the other is a large retention basin located on Loral Corporation's property.

It is important to point out that the boundaries of the watershed presented in Figure 12.1 are based on future conditions which include the Estrella Freeway Channel and improvements on Dysart Drain. The Dysart Drain Improvement Project is scheduled for construction in 1995. The Estrella Freeway, on the other hand, is unfunded at this point in time and, therefore; there is no construction schedule. Taking this into consideration, the proposed improvements on Bullard Wash are based on conditions with Dysart Drain Improvements in place, but without the Estrella Freeway Channel.

12.2 Existing Conditions

12.2.1 Drainage Characteristics

As is the case with most of the study area, the Bullard Wash watershed is predominantly agricultural land with flat, uniform slopes that range from 0.2% up to 0.5%. It is also fairly long and narrow in shape; measuring roughly 28 square miles in area with a length of 11 miles.

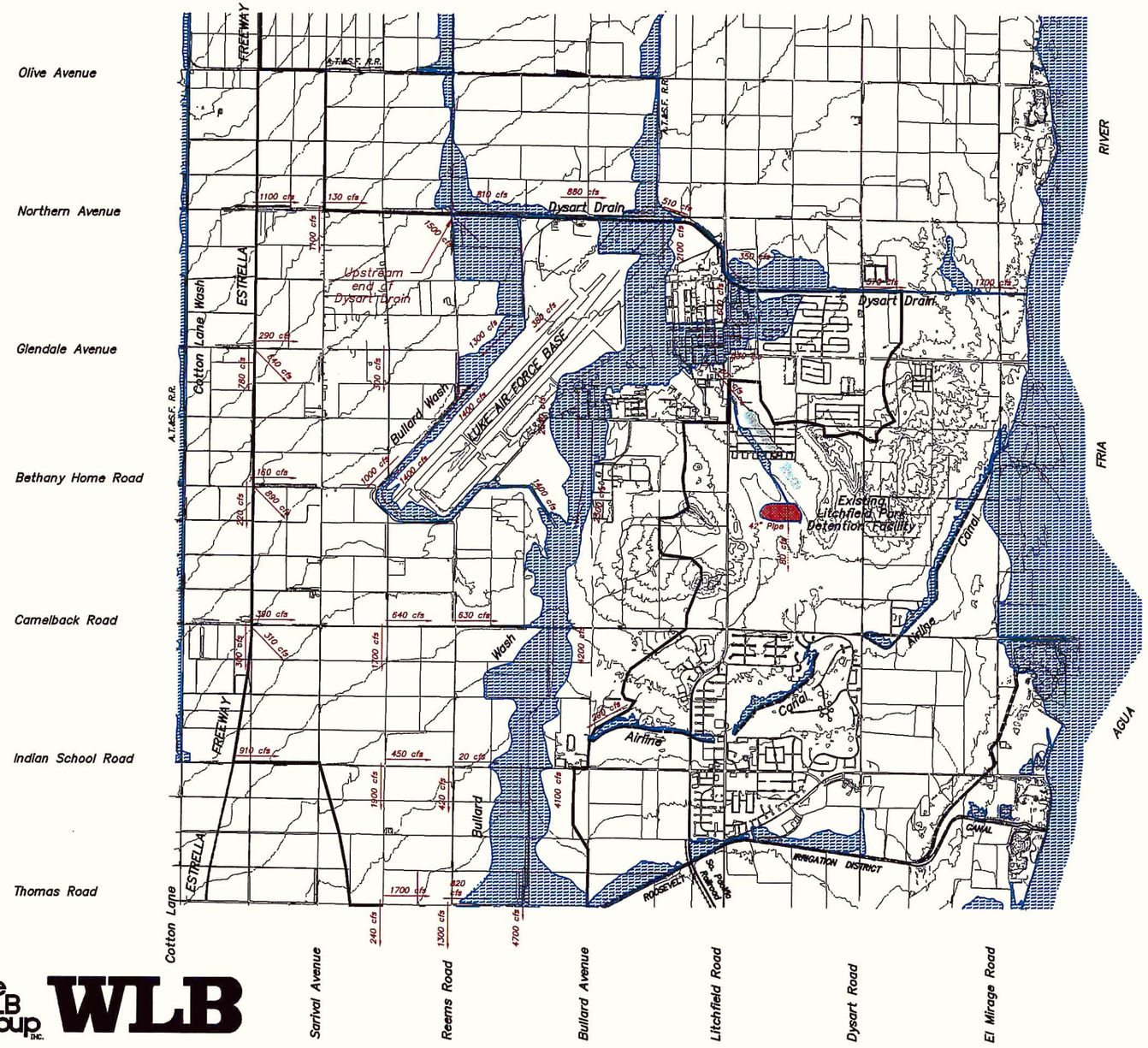
The watershed drains to Bullard Wash which originates on Luke AFB at the upstream end of the watershed. From there it flows southerly, through the middle of the watershed, toward the Gila River. Its alignment is west of, and parallel to, Bullard Avenue. The floodplain for Bullard Wash, as well as ponding areas along the Roosevelt Canal, I-10 and State Route 85 were previously delineated as part of this study and are documented in the Flood Study Technical Data Notebook, Part A.

There is an existing 96" storm drain in Litchfield Road that diverts a considerable amount of stormwater out of the watershed. It collects runoff between I-10 and Lower Buckeye Road and discharges to the Agua Fria River. Its capacity is approximately 370 cfs. The runoff from the 100-year flood will exceed the capacity of the storm drain. However, the excess stormwater is captured in an existing retention basin at the corner of Highway 85 and Litchfield Road. The basin is located on the south side of Loral Corporation and has capacity to contain the 100-year flood.

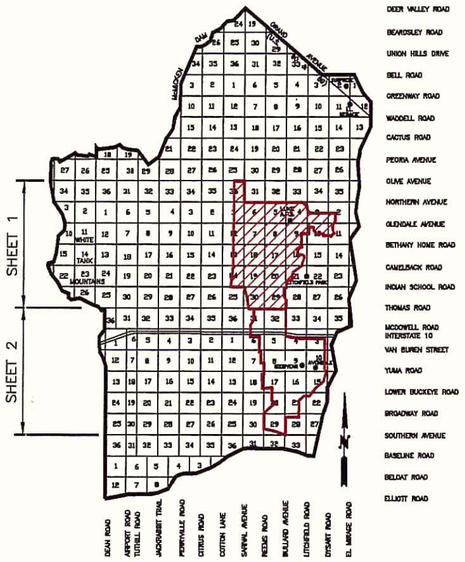
Figure 12.1-1

Existing Conditions

Bullard Wash Watershed
Sheet 1 of 2



Location Map



Legend

- 1800 cfs — Existing Condition Peak Flow
- 100 – Year Floodplain
- Watershed Boundary
- Railroads
- Existing Channels
- Existing Retention Basin

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AREA DRAINAGE MASTER STUDY

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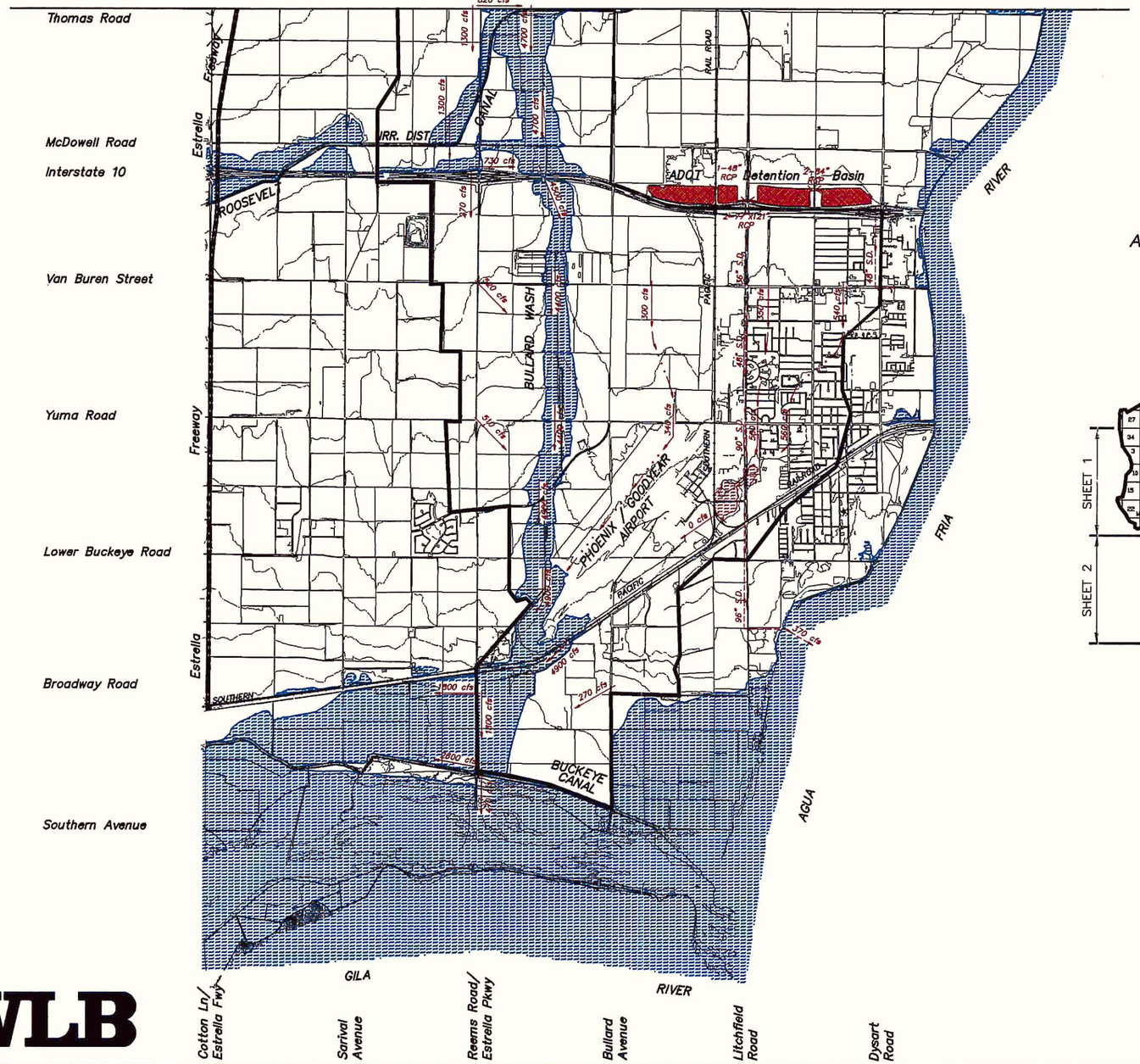
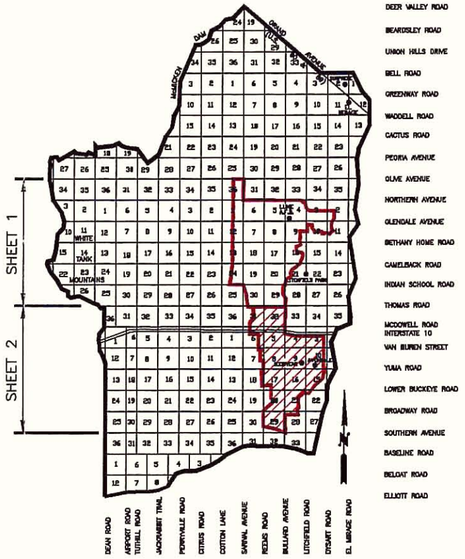


Figure 12.1-2

Existing Conditions

Bullard Wash Watershed
Sheet 2 of 2

WHITE TANKS/AGUA FRIA AREA DRAINAGE MASTER STUDY



Location Map

Legend

- 1800 cfs — Existing Condition Peak Flow
- 100 – Year Floodplain
- Watershed Boundary
- Railroads
- Existing Channels
- Existing Retention Basin

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12.2.2 Land Use

The predominant land use is agriculture. It covers approximately 19 square miles, or roughly 70% of the watershed. Pebble Creek (see Figure 1.2) is a residential community which is in the process of being developed. When completed it will cover about 3 square miles of the farmland. Most of the remaining area (about 7.5 square miles) has been developed which includes Luke AFB and the Phoenix-Litchfield Airport along with a portion of the Cities of Avondale and Goodyear. Only a small portion of the watershed which lies on the south side of Luke AFB is in an undeveloped, natural condition. This area measures about 1.5 square miles and lies largely within an easement area controlled by the Air Force Base.

12.2.3 Known Flood Hazards

As is the case with most of the agricultural areas within the study area, much of the Bullard Wash watershed is subject to shallow flooding which is due to the lack of storm water conveyance. Other than Bullard Wash however, this flooding does not pose a significant flood hazard because the land use is mostly agricultural and the peak flows are relatively low. The watershed is, however, affected by two considerable flood hazards; breakout flows from Dysart Drain and a lack of adequate conveyance at the downstream end of Bullard Wash.

Breakout Flows From Dysart Drain

Dysart Drain is an existing diversion channel located along the north side of Luke AFB. Its purpose is to prevent offsite floodwaters from entering the Base. Its conveyance capacity, however, is insufficient to contain the 100-year flood which results in breakout flows that flood across the Base and, eventually, discharge to Bullard Wash. This flood hazard was identified and delineated in Part A of this study. As a result, improvements to Dysart Drain are scheduled for construction in 1995. Refer to Section 10 for a complete discussion of the flood hazard associated with the Dysart Drain.

Bullard Wash Outfall

The downstream end of Bullard Wash, south of the Phoenix-Goodyear Airport, is subject to considerable uncontrolled flooding. Upstream of the Airport, flooding on Bullard Wash is contained within the agricultural fields in a wide, shallow floodplain. This flooding is a manageable flood hazard that can be controlled by means of traditional floodplain management.

A flooding problem occurs, however, where Bullard Wash meets the Airport. Several past developments in the area (including the Airport, the Southern Pacific Railroad, Highway 85, farming south of Highway 85 and the Buckeye Canal) have severely altered, and nearly eliminated, the natural drainage conveyance. The result is uncontrolled overland flooding that inundates large areas of land. Section 12.3 presents a plan to correct this flooding problem.

12.3 Area Drainage Master Plan

Bullard Wash provides the watershed with a regional drain capable of conveying the 100-year flood. Proper management of its floodplain will preserve its flood conveyance capacity, and at the same time, provide an outfall for local drainage systems. However, as described previously, the downstream end of the wash presents a significant flood hazard which requires corrective measures which go beyond floodplain management.

12.3.1 Corrective Measures on Bullard Wash

As described above, the upstream portion of Bullard Wash is a well defined, manageable floodplain, albeit very wide and shallow. Through traditional floodplain management, it can be preserved to provide regional stormwater conveyance for the contributing watershed. However, the downstream end of the wash is in need of considerable improvement in order to adequately convey floodwater to the Gila River.

The flooding problem occurs where Bullard Wash meets the Phoenix-Goodyear Airport. The wash is channelized around the southern end of the airport and through a bridge under the Railroad and Highway 85. The channel then continues westerly to Estrella Parkway where it parallels the roadway and flows south to the Gila River. The problem is that the capacity of the channel around the airport is only about half of the 100-year flood. As floodwater exceeds the capacity of the channel, it flows over Highway 85 and the Railroad, and continues as uncontained, overland flooding in a southwesterly direction to the Gila River. The problem is compounded by the fact that the channel continues to lose capacity in the downstream direction. In fact, at Estrella Parkway, the channel only has capacity for about 20% of the 100-year flood. Moreover, when it reaches the Buckeye Canal, conveyance is reduced to a 42" CMP over the Canal which can only carry minor flows.

A concept channelization plan has been prepared as part of this study. The plan is to channelize the Bullard Wash outfall in an earthen channel that has a bottom width of 200 feet with side slopes of 6H:1V. The alignment will require new box culverts at the Southern Pacific Railroad and State Route 85. In addition, a box culvert will be required at the Buckeye Canal to convey the Canal water under the new Bullard Wash channel. Appendix J includes an itemized cost estimate, concept plans and hydraulic calculations.

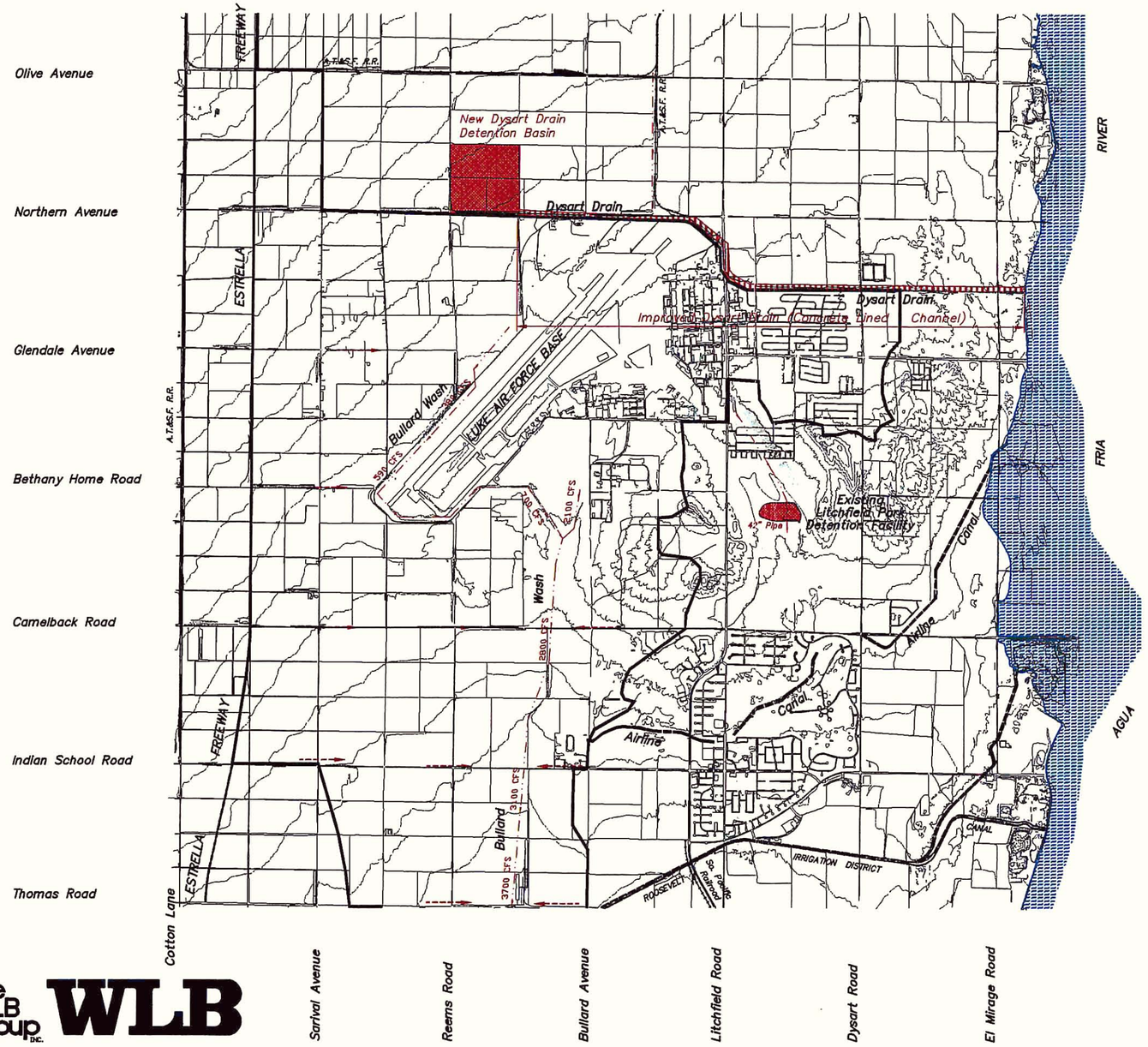
As explained in the introduction, the design flow for the proposed channelization of the Bullard Wash outfall is based on improved conditions on Dysart Drain (i.e., no breakout flows) but without the Estrella Freeway Channel. The Estrella Freeway project is unfunded at this point in time. Therefore, it is reasonable to assume that improvements will take place on Bullard Wash before the Estrella Freeway Channel is constructed. The affect of the Estrella Freeway Channel is actually somewhat insignificant; whereas the Dysart Drain is very significant (refer to the following table, also refer to Figure 12.1 and 12.2). The design flow for the Bullard Wash outfall is 3200 cfs.

TABLE 12.1

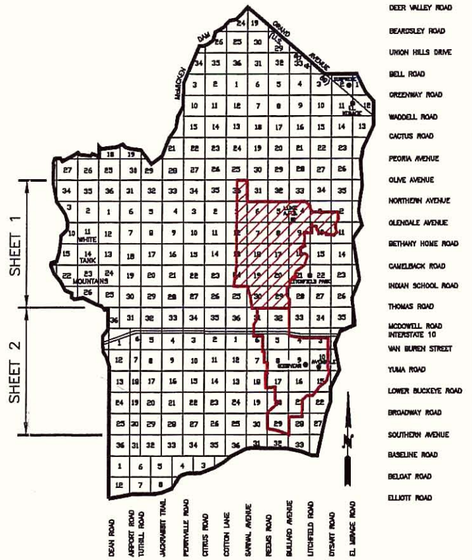
BULLARD WASH PEAK DISCHARGES (at State Route 85)			
		Contributing Drainage Area (Sq.Mi.)	Peak Discharge (CFS)
1.	Existing Conditions w/o Dysart Drain Improvement or Estrella Freeway Channel	98	4900
2.	Conditions w/Dysart Drain Improvements but w/o Estrella Freeway Channel	48	3200
3.	Conditions w/Dysart Drain Improvements and w/Estrella Freeway Channel	28	2900

Figure 12.2-1

Area Drainage Master Plan
for
Bullard Wash Watershed
Sheet 1 of 2



WHITE TANKS/AGUA FRIA
AREA DRAINAGE MASTER STUDY



Location Map

Legend

1800 CFS	Proposed Condition Peak Flow
	100 – Year Floodplain
	Detention Basins
	Watershed Boundary
	Railroads
	Existing Channels
	Future Local Drainage System

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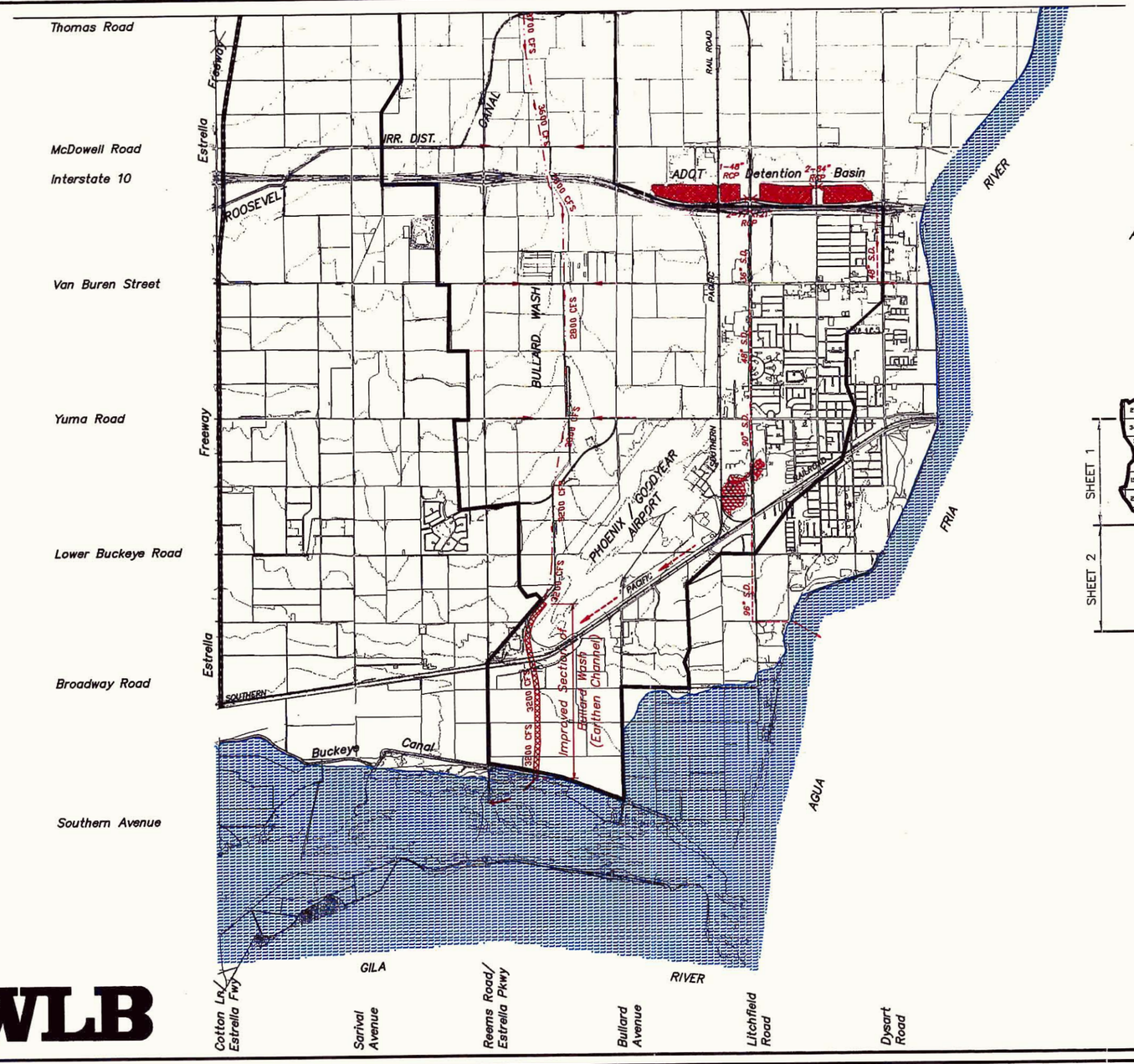
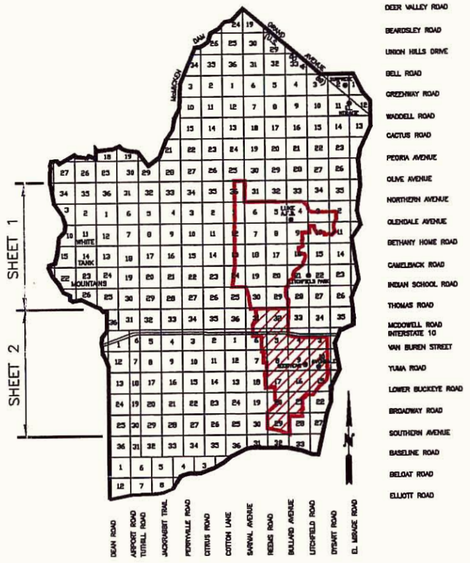
Figure 12.2-2

Area Drainage Master Plan
for
Bullard Wash Watershed
Sheet 2 of 2



WHITE TANKS/AGUA FRIA AREA DRAINAGE MASTER STUDY



Location Map

Legend

- 1800 CFS — Proposed Condition Peak Flow
- 100 – Year Floodplain
- Detention Basins
- Watershed Boundary
- Railroads
- Existing Channels
- Future Local Drainage System

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SECTION 13 ADOT DETENTION BASIN WATERSHED

13.1 Introduction

This section covers the area that drains to the Arizona Department of Transportation's (ADOT's) existing detention basins along the north side of I-10 that lie between Bullard Avenue and Dysart Road. The watershed size is roughly 7 square miles and includes most of the City of Litchfield Park. The boundaries of the watershed are shown on Figure 13.1

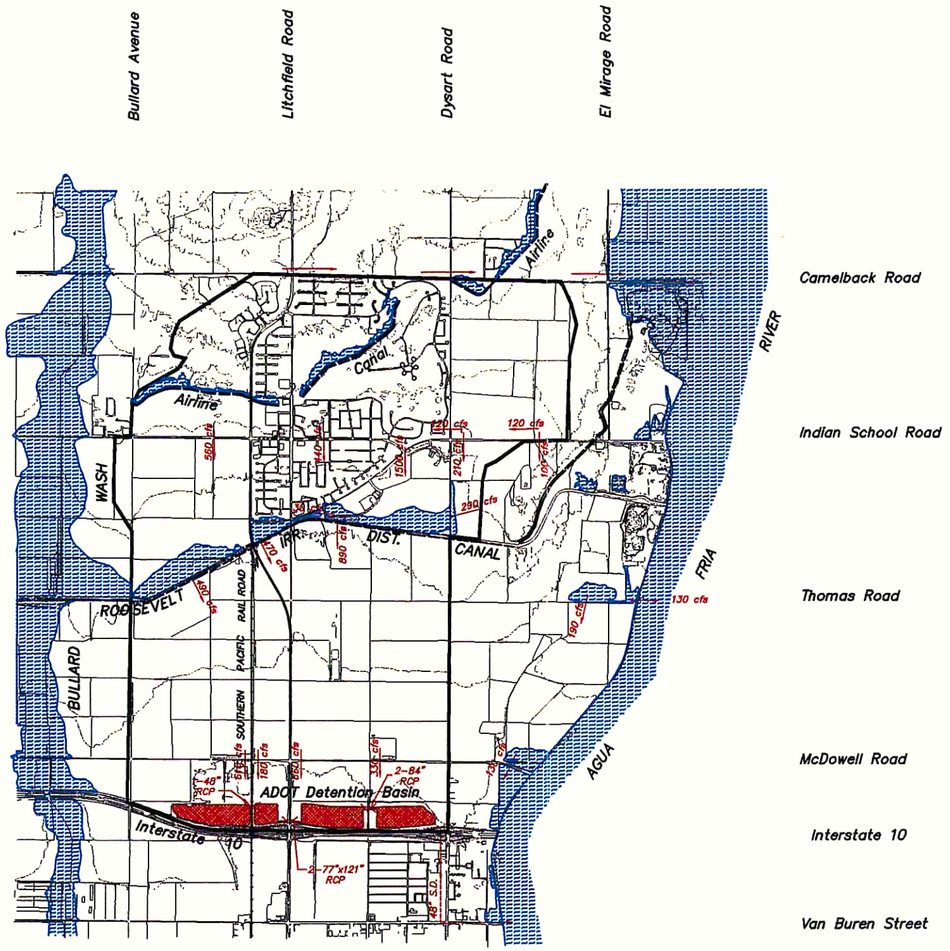
13.2 Existing Conditions

13.2.1 Drainage Characteristics

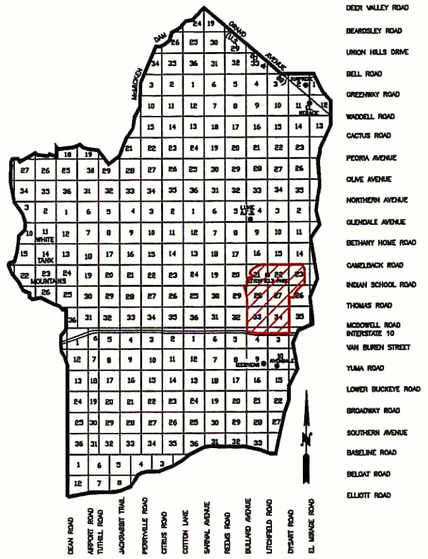
The watershed slopes in a southerly direction from Camelback Road down to I-10. The rate of slope is fairly flat; ranging from 0.2% at I-10 up to 1% at Camelback Road. Runoff generally flows overland; through the streets of Litchfield Park and across the farm fields which lie south and west of the City. Both the Airline Canal and the Roosevelt Canal cause ponding of floodwaters. See Figure 13.1 for the existing drainage patterns and the 100-year peak discharges.

Figure 13.1

ADOT Detention Basin Watershed



WHITE TANKS/AGUA FRIA AREA DRAINAGE MASTER STUDY



Location Map

Legend

- 1800 cfs — Existing Condition Peak Flow
- 100 – Year Floodplain
- Existing Detention Basin
- Watershed Boundary
- Railroads
- Existing Channels

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13.2.2 Land Use

About a third of the watershed consists of the developed portion of Litchfield Park which includes the Wigwam Resort. The remainder of the watershed has been used historically for agricultural purposes. However, portions of the master planned Litchfield project have been recently developed within the watershed and are continuing to be developed. The portion being developed is the Palm Valley Golf Course and residential community. It lies east of Litchfield Road; between McDowell Road and Thomas Road.

13.2.3 ADOT Detention Basins

As part of the construction of Interstate 10 (I-10), the Arizona Department of Transportation (ADOT) excavated a series of four detention basins along the north side of I-10 between Bullard Avenue and Dysart Road. The basins are drained by a 48 inch storm sewer pipe that discharges to the Agua Fria River at Van Buren Street.

The purpose of these basins is twofold. First they protect the freeway from offsite floodwaters. Second, they prevent the freeway from discharging concentrated floodwaters that would otherwise be directed toward the Cities of Goodyear and Avondale.

The basins perform their function well. The existing conditions hydrologic model indicates that the 100-year flood is well contained with over 4 feet of freeboard. The Colter Channel project is responsible for the excess freeboard. It diverts a considerable amount of runoff that would otherwise travel to the basins.

13.2.4 Known Flood Hazards

Stormwater runoff ponds behind the Airline Canal and the Roosevelt Canal. These flood hazards were documented in the flood study portion of this study; refer to Part A.

13.3 Area Drainage Master Plan

ADOT's detention basins provide the watershed with a regional drain. Under existing conditions, with Colter Channel in place, these basins provide more than enough storage capacity to contain the 100-year flood. In the future, as the area develops, new development will be required to provide onsite stormwater retention and therefore the basins should be able to continue to provide the necessary storage capacity.

It is envisioned that the local drainage systems will be constructed as required for new developments. These will consist of drainage channels or pipes aligned along Litchfield Road and Dysart Road, or through the new developments; ultimately discharging to the detention basins along I-10. A right of way encroachment permit will be required by ADOT in order to make any direct connection to the basins with storm drain pipes or channels.

SECTION 14 REFERENCES

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4. *Gila River Basin, New River and Phoenix City Streams, Arizona, Design Memorandum No. 2, Hydrology, Part 2*, U.S. Army Corps of Engineers, 1982.

5. *Wittmann Area Drainage Master Study, Part A, Hydrology and Hydraulics*, Flood Control District of Maricopa County, prepared by The WLB Group, March 10, 1989.

6. *Dysart Drain Subsidence Investigation*, Flood Control District of Maricopa County, prepared by SHB AGRA, Inc., May 19, 1993.

7. *Uniform Drainage Policies and Standards for Maricopa County*, Flood Control District of Maricopa County, February 25, 1987.

8. *A Hydrologic Analysis of the White Tanks Flood Retarding Structures #3 and #4*, Flood Control District of Maricopa County, October 1989.

9. *Flood Insurance Study Guidelines and Specifications for Study Contractors*, Federal Emergency Management Agency, Federal Insurance Administration, March 1991.

10. *Dysart Drain Improvement Project, Concept Design Study Selected Alternative*, Flood Control District of Maricopa County, prepared by The WLB Group, August 4, 1993.

11. *Addendum to Dysart Drain Improvement Project, Concept Design Study Selected Alternative*, Flood Control District of Maricopa County, prepared by The WLB Group, November 1993.

12. *Location Study Plan, Estrella Freeway, State Route 303L, S.R. 85 to Interstate 17*, Arizona Department of Transportation, prepared by Cella Barr Associates, April 1991.

13. *Estrella Freeway Hydrologic Investigation Report*, Arizona Department of Transportation, prepared by Cella Barr Associates, July 1987.

14. *Technical Memorandum, Estrella Freeway Drainage Alternatives, Cotton Lane Section*, Arizona Department of Transportation, prepared by Cella Barr Associates, March 3, 1988.

15. *Drainage Design Manual for Maricopa County, Arizona, Volume 1, Hydrology*, Flood Control District of Maricopa County, June 1, 1992.

16. *Recommendation Report, Colter Channel Project*, Flood Control District of Maricopa County, prepared by CRSS Civil Engineers, Inc. and Wood, Patel and Associates, Inc., November 1992.

17. *Drainage Report for Litchfield Park Detention Facility*, SunCor Development Company, prepared by Coe and Van Loo Consulting Engineers, Inc., June 1989, Revised March 1990.

18. *Camelback Road Channel, Concept Drainage Report*, Maricopa County Department of Transportation, prepared by The WLB Group, November 1993.

19. Letter from CR Brandt, Caterpillar Tractor Company, to L.E. Ohsiek, Flood Control District of Maricopa County, dated March 6, 1972.

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COMPUTATION DATA SHEET

Subject WHITE TANK/AGUA FRIA ADMS Prepared by JSE Date 1-27-91

STAGE - STORAGE - DISCHARGE TABLE

SUBBASIN 293

ELEV. (FT)		AREA (AC)	VOLUME (AC-FT)	DISCHARGE (CFS)
1006.4		0	0	0
		8.72		
1007.4	w Weir Flow Across Road	17.43	8.72	0
		13.60		
1008.0		27.90	22.32	1450
		24.48		
1008.5		35.0	64.79	3600
			Weir Flow	L = 26
			Q = CLH 3/2	L = 2400/2
				H = .6
			at 1008.0 Q = 1450 cfs	
				L = 2400/2
			at 1008.5 Q = 3600	H = 1.1

Form 209

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COMPUTATION DATA SHEET

Subject WHITE TANK/AGUA FRIA ADMS Prepared by JSE Date 1-29-91

STAGE - STORAGE - DISCHARGE TABLE

SUBBASIN (293A)

ELEV. (FT)	AREA (AC)	VOLUME (AC-FT)	DISCHARGE (CFS)
1002.5	0	0	0
	3.50		
1004	4.66	3.50	0
	4.74		
1004.6	11.13	8.24	0
	10.43		
1005.3 x Weir Flow West Over Road & South Over Canal	18.66	18.67	0
	15.70		
1006.0	26.2	34.37	391
	19.05	48.42	2503 cfs
1006.5	30	Weir Flow Over Canal	C=2.6
		$Q = CLH^{3/2}$	H=.7
			L=1050/2
		Q at 1006 = 800 cfs	H=1.2
		Q at 1006.5 = 2050 cfs	L=1700/2
			C=2.6
		Weir Flow West Over Road	H=.7
			L=120/2
		Q at 1006 = 91 cfs	H=1.2
		Q at 1006.5 = 512 cfs	L=300/2

Form 209

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COMPUTATION DATA SHEET

Subject WHITE TANK/AGUA FRIA ADMS Prepared by JSE Date 1-29-91

STAGE - STORAGE - DISCHARGE TABLE

SUBBASIN (294)

ELEV. (FT)	AREA (AC)	VOLUME (AC-FT)	DISCHARGE (CFS)
970.4	0	0	0
	6.32		
972	7.90	6.32	0
	13.24		
980	25.20	19.56	0
	281.35		
990	316.07	300.91	0
	354.44		
1000	354.81	635.31	0
	264.64		
1007 * Weir Flow Over Canal	398	899.95	0
	42.16		
1008	44.52	942.11	715
	37.35		
1008.3	48.35	979.46	2198

Weir Flow
$Q = C L H^{3/2}$

C = 2.6
H = 1.0
L = 550 ft

Qat 1008 = 715 cfs

C = 2.6
H = 1.3
L = 700 ft

Qat 1008.3 2198

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COMPUTATION DATA SHEET

Subject WHITE TANK/AGUA FRIA ADMS Prepared by JSE Date 2-12-91

STAGE - STORAGE - DISCHARGE TABLE

SUBBASIN 294A

ELEV. (FT)	AREA (AC)	VOLUME (AC-FT)	DISCHARGE (CFS)
1006.7	0	0	0
1007.8 x Weir Flow	6.89 (3.78)	3.78	0
1008	3.19 (1.51)	5.29	46
1010	43.82 (52.01)	57.30	169.43

Weir Flow
$Q = CLH^{3/2}$

C = 2.6
L = 200
H = .2

Q at 1008 = 46 cfs

L = 2000
H = 2.2

Q at 1010 = 169.43

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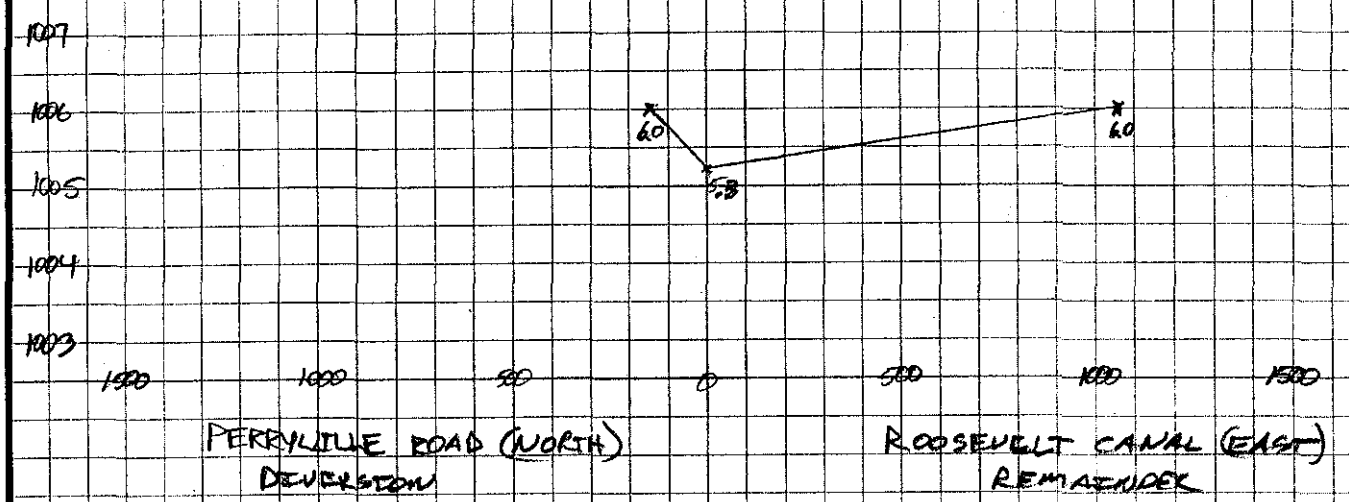
COMPUTATION DATA SHEET

Subject WHITE TANKS / AGUA FRIA ADMS Prepared by JSE Date 1-31-91

DIVERSION TABLES

SUBBASIN 293A

CP293A TO CP306 CP293A TO CP309



Weir Flow $Q = CLH^{3/2}$
C = 2.6

at 1005.8 H=.5 L=90/2 Q=41 cfs H=.5 L=800/2 Q=368 cfs

at 1006 H=.7 L 120/2 Q=91 cfs H=.7 L=1050/2 Q=800 cfs

DT 2D 306

DI	0	409	891
DQ	0	41	91

PLEASE SEE MEMO IN THE MAIN REPORT FOR THE ERRORS CONTAINED IN THIS ADMP