BELL ROAD PROJECT DRAINAGE STUDY

PHASE 1 EVALUATION

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FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PREPARED BY

GREINER ENGINEERING SCIENCE, INC.
PHOENIX, ARIZONA

AUGUST 1986

CONTRACT FCD 86-20
PROJECT E123061

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FOR

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PREPARED BY
GREINER ENGINEERING SCIENCES, INC.
PHOENIX, ARIZONA

AUGUST 1986

CONTRACT FCD 86-20

PROJECT E-123-061

EVALUATION OF EXISTING AND ONGOING HYDROLOGIC STUDIES AND FLOOD CONTROL FACILITIES AFFECTING THE BELL ROAD PROJECT DRAINAGE STUDY

I. INTRODUCTION

This report documents Greiner's evaluation of existing and ongoing hydrologic studies and the hydrology of major flood control, water transport and highway facilities affecting the Bell Road Project Drainage Study. The purpose of this evaluation is to determine what existing information may be utilized in developing the hydrology for the Bell Road Project Drainage Study. This report also represents the accomplishment of Phase I of the Bell Road Drainage Study as described in the Scope of Work.

For the purpose of this investigation, the study area was divided into eight sub-areas. These areas are described below.

Area 1: Bound by Bell Road, Grand Avenue, McMicken Dam Outlet Channel and the Agua Fria.

Area 2: Bound by Bell Road, Agua Fria and New River.

Area 3: Bound by Bell Road, New River, the Outerloop Highway and Skunk Creek.

Area 4: Bound by Bell Road, Skunk Creek, the Outerloop Highway and I-17.

Area 5: Bound by Bell Road, I-17, the Outerloop Highway and Cave Creek.

Area 6: Bound by Bell Road, Cave Creek, East Fork of Cave Creek Drainage Divide.

Area 7: East Fork of Cave Creek Wash Watershed.

Area 8: Bell Road, East Fork of Cave Creek Drainage Divide and the CAP Canal.

In addition to these eight areas, a separate review was made of the drainage area north of the Outerloop Highway and of the major river crossings at Bell Road at the Agua Fria, New River, Skunk Creek and Cave Creek. The limits of these areas are shown on Exhibit 1.

In the second section of this report, the evaluation of the existing hydrology and facilities is presented. Conclusion and recommendations are presented in Section III.

II. Evaluation

Hydrology from a number of different sources was reviewed. These sources include: Master Storm Drainage Studies prepared for the City of Phoenix; recently completed and ongoing Area Drainage Master Studies (ADMS); U.S. Army Corps of Engineers (USCOE) Design Memoranda; Highway Drainage Studies (Outerloop and I-17); drainage reports for major subdivisions (Arrowhead Ranch, Sun City and Sun City West); and the Central Arizona Project, Granite Reef Aquaduct hydrology files. A bibliography of researched material follows in Section IV.

DRAINAGE STUDY SUMMARY SHEET

Report Title: Grand Avenue Corridor Study; Interim Report Volume I, Analysis of Alternatives

Date: April 11, 1986 - Draft

Author: Parsons, Brinckerhoff, Quade & Douglas, Inc. with U.S.D.O.T., Federal Highway Administration and A.D.O.T.

Study Area Description: Twenty-six mile long corridor from Van Buren Street and Seventh Avenue to Deer Valley Road by Sun City West. Study area is limited to area along corridor.

Purpose of Study: "Document the alternative roadway concepts considered as part of the Grand Avenue Corridor Study and to provide a comparative evaluation of those alternatives."

Design Storm: Ten year

Other Frequencies Modeled: 25 and 50-year storms

Precipitation Distribution: N/A

Rainfall-Runoff Model Used: N/A

Storm Frequency Runoff Pattern Modeled: N/A

Watershed Development Status Modeled: N/A

Comments: This report was not intended as a drainage report, it only discusses hydrology briefly (above New River) to identify any existing or future problems associated with future expansion. Not adequate for design. Only on-site hydrology evaluated.

DRAINAGE STUDY SUMMARY SHEET

Report Title: Sun City West - Phase I Development Master Plan

Date: July 1977

Author: Hennington, Durham & Richardson (HDR)

Study Area Description: Land bound on the north by the McMicken Dam Outlet Channel, on the south by Bell Road, on the west by A.T. & S.F. Railroad and Grand Avenue, and on the east by the Agua Fria.

Purpose of Study: Master Drainage planning for new major development.

Design Storm: 100-year, 24-hour

Other Frequencies Modeled: None

Precipitation Distribution: SCS Type I

Rainfall-Runoff Model Used: TR-20

Storm Frequency Overland and Street Flow Pattern Modeled: 100-year

Watershed Development Status Modeled: Fully developed per Master Plan

Comments: The on-site and off-site drainage was calculated using the 100-year, 24-hour storm plus flows from McMicken Dam. The entire on-site flows for 100-year, 24-hour storm exit the property at El Mirage and Bell Road, and then to the Agua Fria River. Since this report was prepared, the western half changed design to incorporate more golf course and detention facilities. Therefore, the 1977 report is conservative in the total discharge from on-site. There appears to be no impact from on-site drainage to Bell Road.

DRAINAGE STUDY SUMMARY SHEET

Report Title: Sun City West Master Plan Update

Date: 1984

Author: Hennington, Durham & Richardson (HDR)

Study Area Description: 4.1 square miles of 8.9 square miles area of Phase I, area is bound on west by AT & SF Railroad and Grand Avenue, on the east by El Mirage Road, on the north by Deer Valley Road and the south by Bell Road.

Purpose of Study: Revise hydrology for development of subdivision.

Design Storm: 100-year with the storm duration yielding the highest peak flow (either the 1-hour, 2-hour, 6-hour, or 24-hour)

Other Frequencies Modeled: None

Precipitation Distribution: SCS Type II

Rainfall-Runoff Model Used: TR-20

Storm Frequency Overland and Street Flow Patterns Modeled: 100-year

Watershed Development Status Modeled: Fully developed per Master Plan

Comments: This development was designed to handle the 100-year frequency storm with whatever duration gave the highest Q (usually 1 or 2-hour). The project contains 22 detention ponds which reduces peak flows calculated in the original study. All flows are kept on-site until the outfall at El Mirage and Bell Road and to the Agua Fria River.

DRAINAGE STUDY SUMMARY SHEET

Report Title: City of Peoria, Master Plan of Storm Drainage

Date: May 1986 - Draft

Author: James M. Montgomery, Consulting Engineers, Inc.

Study Area Description: Approximately 62 square miles, 32 square miles with land plan, 30 square miles without land plan. This area is bound by Carefree highway on north, City of Glendale on south and east, to the west by Sun City, and north of Beardsley approximately along the east side of the Agua Fria River.

Purpose of Study: "Plans for the City of Peoria to develop a storm drain system which will diminish flood hazards from local runoff within the City, particularly from runoff from relatively minor but frequent storm events."

Design Storm: 2-year, 2-hour (For ultimate conditions only)

Other Frequencies Modeled: 10, 25 and 100-year, 2-hour for both existing and ultimate conditions

Precipitation Distribution: City of Phoenix s-curve

Rainfall-Runoff Model Used: Storm Water Management Model for urban areas (southern areas)/ HEC-1 for natural areas (northern areas)

Storm Frequency Runoff Pattern Modeled: Routing was the same for each storm

Watershed Development Status Modeled: Both existing and ultimate

Comments: Existing storm drain (1984) was designed with rational method drainage patterns shown.

DRAINAGE STUDY SUMMARY SHEET

Report Title: Glendale Storm Water Management Plan

Date: January 1986

Author: Camp Dresser and McKee Inc.

Study Area Description: North - Pinnacle Peak Road
South - Camelback Road
East - 51st Avenue and 43rd Avenue
West - New River, Northern Avenue, 67th Avenue and Arizona Canal

Purpose of Study: The reduction of existing storm drainage problems in the City.

Design Storm: 10-year, 6-hour

Other Frequencies Modeled: None

Precipitation Distribution: City of Phoenix s-curve

Rainfall-Runoff Model Used: Stormwater Management Model (SWMM)

Storm Frequency Overland/Street Flow Routing Pattern Modeled: 10-year, 6-hour

Watershed Development Status Modeled: Future conditions

Comments: Study provides discharge values for a 10-year storm at Bell Road. Overland flow patterns will still need to be developed for the 2, 5, 50 and 100-year frequency storms. The proposed storm drain system at Bell Road is not adequate for a 100-year storm.

DRAINAGE STUDY SUMMARY SHEET

Report Title: Glendale - Peoria Area Drainage Master Plan

Date: April 1986 - Final Draft

Author: Camp Dresser and McKee, Inc. and James M. Montgomery, Consulting Engineers, Inc.

Study Area Description: North - Roughly the CAP Canal
South - Camelback Road
East - 43rd Avenue and 51st Avenue
West - Agua Fria River

Purpose of Study: Determine potential benefits of combining storm drain systems for Cities of Glendale and Peoria.

Design Storm: 10-year, 6-hour

Other Frequencies Modeled: 100-year, 6-hour

Precipitation Distribution: City of Phoenix s-curve

Rainfall-Runoff Model Used: Storm Water Management Model (SWMM)

Storm Frequency Overland and Street Flow Patterns Modeled: 10-year storm drains, 100-year storm drains, streets and channels

Watershed Development Status Modeled: Future conditions with ultimate development of current land use plans

Comments: Provides rough drainage patterns only, no areas or timing information. Discharge given for storm drains only. Adequate for flow patterns for 10-year, 6-hour flows.

DRAINAGE STUDY SUMMARY SHEET

Report Title: Northwest Storm Drainage Study

Date: 1977

Author: Arthur Beard Engineers, Inc.

Study Area Description: North - Skunk Creek
South - The Arizona Canal
East - Black Canyon Freeway
West - 51st Avenue
Approximately 23 square miles

Purpose of Study: Developing a stormwater drainage master plan.

Design Storm: 2-year

Other Frequencies Modeled: 1, 10, and 50-year

Precipitation Distribution: SCS Type II, 24-hour storm distribution

Rainfall-Runoff Model Used: SCS TR-20 Program

Storm Frequency Runoff Pattern Modeled: 2-year storm with the Illinois Storm Sewer System Simulation Model (ISS)

Watershed Development Status Modeled: Existing and ultimate land use

Comments: Study provides the flow patterns of existing condition for the 1, 2, 10 and 50-year storms. Drainage sub-areas and flow patterns may be utilized. The proposed storm drain system at Bell Road is not adequate for a 100-year storm.

DRAINAGE STUDY SUMMARY SHEET

Report Title: North Central Master Storm Drainage Study (West Half)

Date: July 1980

Author: SCI Consulting Engineers, Inc.

Study Area Description: North - Scatter Wash
South - Thunderbird Road
East - Cave Creek
West - The Black Canyon Freeway
Approximately 12 square miles

Purpose of Study: Developing a stormwater drainage master plan.

Design Storm: 2-year

Other Frequencies Modeled: 1, 5, and 10-year

Precipitation Distribution: City of Phoenix s-curve

Rainfall-Runoff Model Used: SCS TR-20 Program

Storm Frequency Runoff Pattern Modeled: 2-year

Watershed Development Status Modeled: The ultimate development based on existing zoning

Comments: Watershed sub-areas and flow patterns may be utilized. The proposed storm drain system at Bell Road is not adequate for a 100-year storm.

DRAINAGE STUDY SUMMARY SHEET

Report Title: North Central Area Master Storm Drainage Study (East Half)

Date: April 1981

Author: Cella Barr Associates

Study Area Description:
North - The Central Arizona Project Granite Reef Aqueduct
South - The ridge line in the mountains
East - 32nd Street
West - Cave Creek Wash

Purpose of Study: Present solutions for storm drainage in the study area.

Design Storm: 2-year

Other Frequencies Modeled: 1, 5, 10, 50 and 100-year

Precipitation Distribution: City of Phoenix s-curve

Rainfall-Runoff Model Used: SCS TR-20 Program

Storm Frequency Runoff Pattern Modeled: 2-year

Watershed Development Status Modeled: Fully developed conditions

Comments: Drainage sub-areas and flow patterns may be utilized. The proposed storm drain system at Bell Road is not adequate for a 100-year storm.

DRAINAGE STUDY SUMMARY SHEET

Report Title: Northeast Area Master Storm Drainage Study

Date: December 1979

Author: Southwest Computing, Inc.

Study Area Description: North - The Central Arizona Project Canal
South - The Indian Bend Wash
East - 56th Street
West - 32nd Street
Approximately 14 square miles

Purpose of Study: Provide an optimized solution of storm drainage for the study area.

Design Storm: 2-year

Other Frequencies Modeled: 1, 5, and 10-year

Precipitation Distribution: City of Phoenix s-curve

Rainfall-Runoff Model Used: SCS TR-20 Program

Storm Frequency Runoff Pattern Modeled: 2-year

Watershed Development Status Modeled: Full development based on existing zoning

Comments: Drainage sub-areas and flow patterns may be utilized. The proposed storm drain system at Bell Road is not adequate for a 100-year storm.

DRAINAGE STUDY SUMMARY SHEET

Report Title: Greenway Road Location Study

Date: August 1982

Author: Dibble and Associates

Study Area Description: A five mile reach between Greenway Road extended and Bell Road from 19th Avenue to 32nd Street around the north slope of Lookout Mountain.

Purpose of Study: Establish the required right-of-way corridor for the roadway and drainageway.

Design Storm: N/A

Other Frequencies Modeled: N/A

Precipitation Distribution: N/A

Rainfall-Runoff Model Used: N/A

Storm Frequency Runoff Pattern Modeled: N/A

Watershed Development Status Modeled: N/A

Comments: Study used flows established in the Cella Barr & Associates 1981 Master Storm Drainage Study.

DRAINAGE STUDY SUMMARY SHEET

Report Title: Drainage Study of East Fork Cave Creek Wash for Haspro Development

Date: March 1985

Author: Cella Barr Associates

Study Area Description: A 44 acre shopping and commercial center at the northeast corner of Bell Road and 16th Street.

Purpose of Study: Analyze the off-site flows that are presently directed toward the property from the East Fork of Cave Creek Wash.

Design Storm: 100-year

Other Frequencies Modeled: None

Precipitation Distribution: N/A

Rainfall-Runoff Model Used: N/A

Storm Frequency Runoff Pattern Modeled:

Watershed Development Status Modeled: Existing conditions

Comments: Although this study provides discharge values for a 100-year storm at Bell Road, a hydrologic model should be redeveloped or the whole watershed.

DRAINAGE STUDY SUMMARY SHEET

Report Title: East Fork of Cave Creek Wash Area Drainage Master Study

Date: Ongoing

Author: NBS Lowry

Study Area Description: Watershed of East Fork of Cave Creek Wash

Purpose of Study: Develop alternate drainage mitigation schemes for East Fork.

Design Storm: 100-year, 24-hour

Other Frequencies Modeled: 10, 50, 500

Precipitation Distribution: City of Phoenix s-curve

Rainfall-Runoff Model Used: SCS TR-20 and Diffusion Model

Storm Frequency Runoff Pattern Modeled: 100-year

Watershed Development Status Modeled: Existing, Future

Comments: Study will provide discharge values at Bell Road. Overland flow patterns will have to be redeveloped for 2-year storm.

DRAINAGE STUDY SUMMARY SHEET

Report Title: ADOT Project #IR-17-1(151) Phoenix-Cordes Junction Highway, Peoria Avenue-Deer Valley Road

Date: Ongoing

Author: PRC

Study Area Description: All watersheds tributary to I-17 between Peoria Avenue and Deer Valley Road, westward to 35th Avenue.

Purpose of Study: Analyze existing drainage problems at I-17 and develop alternate solutions.

Design Storm: 25, 50-year, 24-hour

Other Frequencies Modeled: 100-year

Precipitation Distribution: NOAA Atlas II

Rainfall-Runoff Model Used: SCS TR-20

Storm Frequency Runoff Pattern Modeled:

Watershed Development Status Modeled: Existing and future fully developed

Comments: Study will develop discharge values at Bell Road west of I-17 and east of 35th Avenue. Watershed sub-area limits and characteristics may be utilized.

DRAINAGE STUDY SUMMARY SHEET

Report Title: Hydrology and Concept Drainage Plan Development, Outerloop Highway Project, Section B

Date: Ongoing

Author: Greiner Engineering Sciences, Inc.

Study Area Description: All watersheds tributary to the Outerloop Highway between Bell Road and the CAP Canal Crossing.

Purpose of Study: Develop preliminary drainage plans for off-site drainage to the Outerloop Highway.

Design Storm: 100-year, 24-hour

Other Frequencies Modeled: 10, 50

Precipitation Distribution: NOAA Atlas II

Rainfall-Runoff Model Used: HEC-1

Storm Frequency Runoff Pattern Modeled: 100-year

Watershed Development Status Modeled: Ultimate development of existing zoning +20% to account for future development

Comments: Basic model may be adopted with modifications to reflect MCFCD and COP criteria.

DRAINAGE STUDY SUMMARY SHEET

Report Title: Untitled hydrologic studies for Reaches 10 and 11 of the Granite Reef Aqueduct (CAP)

Date:

Author: Bureau of Reclamation

Study Area Description: Reach 10 extends across the north of the study area from the west study limit at Grand Avenue to Cave Creek Road. Reach 11 extends from Cave Creek Road to the east study limit at Bell and Scottsdale Roads intersection.

Purpose of Study: Develop flow-through discharges for Reach 10 and detention design for the Reach 11 Paradise Valley Detention Dikes.

Design Storm: Reach 10 - Q_{100}; Reach 11 - Combined maximum probable and 100-year floods

Other Frequencies Modeled: 50-year

Precipitation Distribution: Unknown

Rainfall-Runoff Model Used: Unknown

Storm Frequency Runoff Pattern Modeled: Unknown

Watershed Development Status Modeled: Unknown

Comments: Stage storage data is available for routing flows through Reach 10 overchutes (used in Outerloop Study). No flow through from Reach 11; no further study is required.

III. CONCLUSION AND RECOMMENDATIONS

The hydrology studies were evaluated on the basis of whether the peak discharges developed by these studies meet the hydrologic criteria established by the Maricopa County Flood Control District (MCFCD) for the Bell Road Project Drainage Study. This criteria is briefly summarized below.

a. Rainfall/Runoff Model - HEC-1
b. Storm Frequencies - 2, 5, 10, 50, 100-year
c. Storm Duration - 24-hour
d. Precipitation Distribution - City of Phoenix s-curve
e. Flow Paths to Be Modelled - 2, 5, 10, 50, 100-year
f. Development Status - Existing and Future Fully Developed Conditions

On the basis of this criteria, none of the studies provide the full range of design discharges at Bell Road for both existing and future conditions. The Sun City West development, however, may be excluded from further study if all on-site drainage is diverted to the Agua Fria as described in the Master Plan.

All drainage reports provide some useful data, however, which may be incorporated into the Bell Road Project Drainage Study, particularly subarea delineations, routing paths and curve numbers. Table 1 summarizes the findings of our investigation.

The following recommendations are presented regarding the course of the Phase II hydrologic investigation with the adoption of appropriate information from previous or concurrent hydrologic studies.

a. On-site drainage and as-builts for Sun City West will be reviewed to determine whether all flows are diverted away from Bell Road and to the Agua Fria River.

b. Drainage patterns developed by previous studies will be evaluated in the field and adopted wherever appropriate.

c. Curve number (CN) values will be adopted from the previous research wherever appropriate.

d. Bureau of Reclamation stage storage data developed for the CAP Canal overchutes will be utilized.

e. The hydrologic results and design recommendations for the East Fork of Cave Creek ADMS, I-17 Project and the Outerloop Highway, Section B study will be reviewed and adopted wherever appropriate.

f. The Corps of Engineers discharge values and current F.E.M.A. floodplain delineations will be adopted for design and analysis purposes at Agua Fria, New River, Skunk Creek and Cave Creek.

BELL ROAD PROJECT DRAINAGE STUDY
SUMMARY OF HYDROLOGY STUDIES*

Study Name	Study Status	Model	Storm Frequencies Modelled 2	5	10	50	100	Storm Duration	Precipitation Distribution	Subarea Delineation	CN's	Modelled Flow Patterns 2	5	10	50	100	Peak Flows Calculated at Bell Rd.	Development Status Exist.	Development Status Future	Adequacy of Hydrology for Design
Sun City West - Phase I Development Master Plan	Final	TR-20	-	-	--	--	X	X	SCS Type I	X	X	-	-	--	--	X	X	-	X	X
Sun City West Master Plan Update	Final	TR-20	-	-	--	--	X	X	SCS Type I	X	X					X	X	-	X	X
City of Peoria Master Plan of Storm Drainage	Draft	SWMM HEC-1	X	-	X	--	X	-	C.O.P. s-curve	X	-	X	-	--	--	--	X	X	X	-
Glendale - Peoria Area Drainage Master Plan	Final	SWMM	-	-	X	--	--	-	C.O.P. s-curve	X	-	-	-	X	--	--	X	X	X	-
Glendale Storm Water Management Plan	Final	SWMM	-	-	X	--	X	-	C.O.P. s-curve	X	-	-	-	X	--	X	X	X	X	-
Northwest Master Storm Drainage Study	Final	TR-20	X	-	X	X	--	X	SCS Type III	X	X	X	-	--	--	--	X	-	X	-
North Central Master Storm Drainage Study (West Half)	Final	TR-20	X	X	X	--	--	X	C.O.P. s-curve	X	X	X	-	--	--	--	X	-	X	-
North Central Area Master Storm Drainage Study (East Half)	Final	TR-20	X	X	X	X	X	X	C.O.P. s-curve	X	X	X	-	--	--	--	X	-	X	-
Northeast Area Master Storm Drainage Study	Final	TR-20	X	X	X	--	--	X	C.O.P. s-curve	X	X	X	-	--	--	--	X	-	X	-
East Fork - Cave Creek Wash Area Drainage Master Study	Ongoing	TR-20	-	-	X	X	X	X	C.O.P. s-curve	X	X	-	-	--	--	X	X	X	X	-
Phoenix - Cordes Junction Highway Peoria Avenue - Deer Valley Road	Ongoing	TR-20	-	-	--	X	X	X	NOAA Atlas II	X	X	-	-	--	X	--	X	X	X	-
Hydrology and Concept Drainage Plan, Outer-loop Highway, Section B	Ongoing	HEC-1	-	-	X	X	X	X	NOAA Atlas II	X	X	-	-	--	--	X	X	X	-	-

* x = yes (Adequate)
- = no (Inadequate)

TABLE 1

IV. BIBLIOGRAPHY

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13. Glendale-Peoria Area Drainage Master Plan, April 1986: Camp Dresser & McKee Inc. and James M. Montgomery, Consulting Engineers, Inc.

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15. Sun City West Master Plan Update, November 1984: HDR.

16. Grand Avenue Corridor Study, April 1986: Interim Report, Parsons, Brinckerhoff, Quade & Douglas Inc., Draft Report.

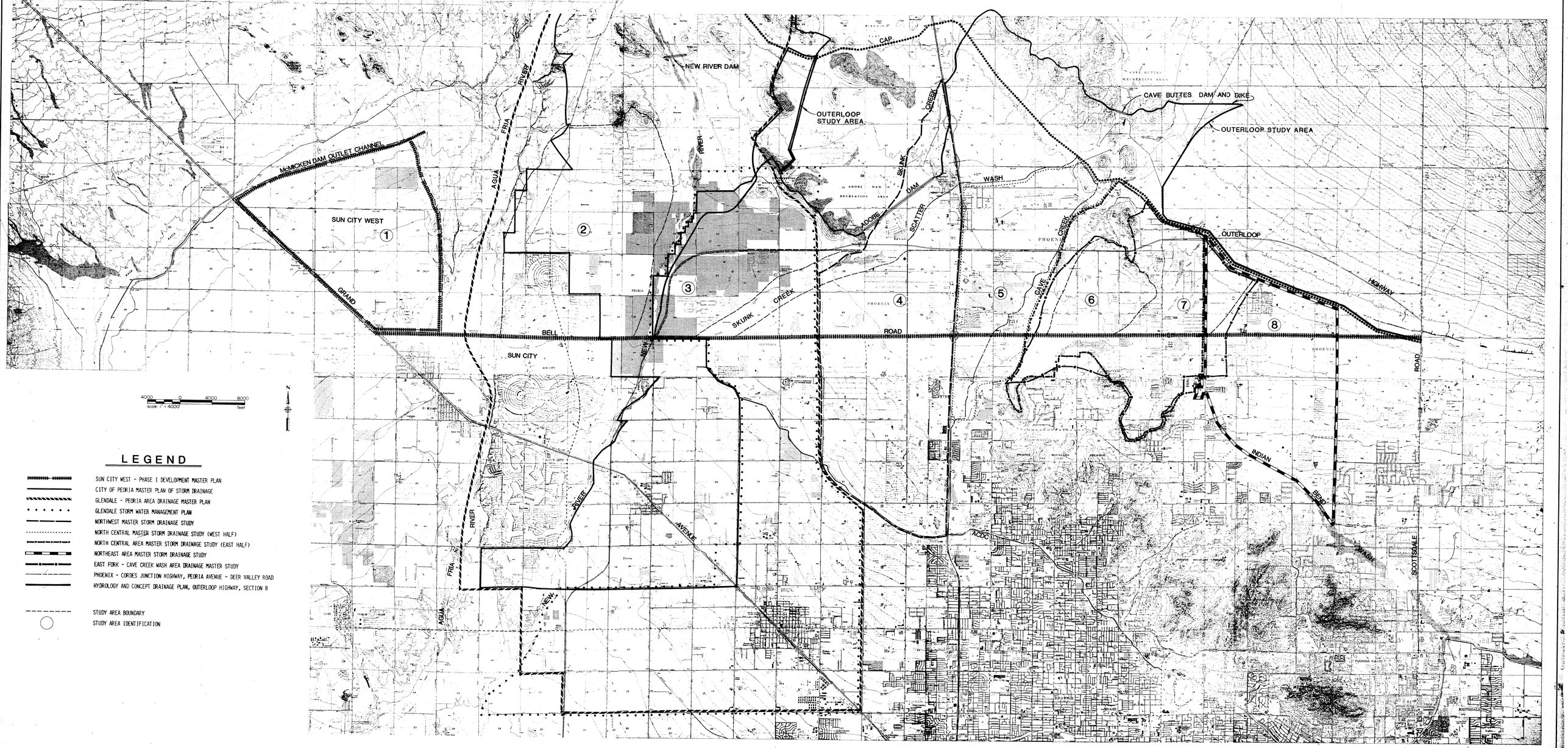
Greiner Greiner Engineering Sciences, Inc.

JOB NO. E123061

FLOOD CONTROL DISTRICT of MARICOPA COUNTY

BELL ROAD PROJECT DRAINAGE STUDY
FOR
THE FLOOD CONTROL DISTRICT
OF
MARICOPA COUNTY

EXHIBIT
FOR THE
EVALUATION OF EXISTING AND ONGOING HYDROLOGIC STUDIES
AND
FLOOD CONTROL FACILITIES



LEGEND

- SUN CITY WEST - PHASE I DEVELOPMENT MASTER PLAN
- CITY OF PEORIA MASTER PLAN OF STORM DRAINAGE
- GLENDALE - PEORIA AREA DRAINAGE MASTER PLAN
- GLENDALE STORM WATER MANAGEMENT PLAN
- NORTHWEST MASTER STORM DRAINAGE STUDY
- NORTH CENTRAL MASTER STORM DRAINAGE STUDY (WEST HALF)
- NORTH CENTRAL AREA MASTER STORM DRAINAGE STUDY (EAST HALF)
- NORTHEAST AREA MASTER STORM DRAINAGE STUDY
- EAST FORK - CAVE CREEK WASH AREA DRAINAGE MASTER STUDY
- PHOENIX - CORDES JUNCTION HIGHWAY, PEORIA AVENUE - DEER VALLEY ROAD
- HYDROLOGY AND CONCEPT DRAINAGE PLAN, OUTERLOOP HIGHWAY, SECTION B
- STUDY AREA BOUNDARY
- STUDY AREA IDENTIFICATION