

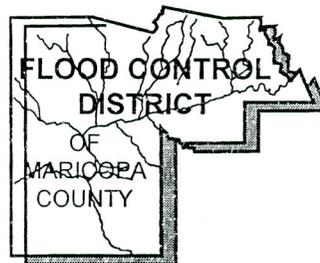
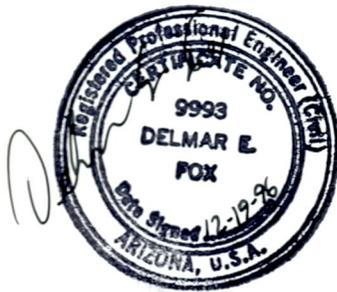
# DOUBLETREE RANCH ROAD REGIONAL DRAINAGE STUDY

FCD 94-28

## STORMWATER MANAGEMENT REPORT VOLUME II

### CONCEPTUAL DESIGN STUDY

DECEMBER 1996



Prepared For:  
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY  
2801 West Durango Street  
Phoenix, Arizona 85007  
602-506-1501



# ***Hook Engineering, Inc.***



FLOOD CONTROL DISTRICT OF MARICOPA  
COUNTY

PLANNING & PROJECT MANAGEMENT DIVISION

---

I N T E R O F F I C E M E M O

**To:** Pedro Calza  
Michael Lopez

**From:** Bert Miller *Bert Miller*

**Date:** January 2, 1997

**Subject:** Hook Engineering Submittal

For your review and comment is Hook Engineering's latest submittal concerning P.V./Doubletree Drainage Improvement Project. Please review the material based upon your previous comments that we supplied to Hook Engineering.

If possible, I would like to have your comments by January 21, 1997. Please contact me at x4771 if I can be of any assistance during your review. Thanks.

**CC:** Ed Raleigh  
John Rodriguez ✓



# Hook Engineering, Inc.

December 20, 1996

Flood Control District of Maricopa County  
Attn: Bert Miller  
Water Resource Planner  
2801 West Durango Street  
Phoenix, Arizona 85007

Regarding: Doubletree Ranch Road Regional Drainage Study  
FCD 94-28

Dear Mr. Miller:

Hook Engineering, Inc. is pleased to submit six (6) copies of the Stormwater Management Report and two (2) full sets of plan and profile sheets for the above project.

This volume summarizes our investigation relating to the hydraulic analysis of the drainage basins for this project.

Should you have any questions concerning the foregoing, please contact our office.

Sincerely,

**HOOK ENGINEERING, INC.**

William S. Snarr, P.E.  
Project Engineer

Delmar E. Fox, P.E.  
Project Manager

Enclosures



**FLOOD CONTROL DISTRICT**  
of  
**Maricopa County**

2801 West Durango Street • Phoenix, Arizona 85009  
Telephone (602) 506-1501  
Fax (602) 506-4601  
TT (602) 506-5859

BOARD OF DIRECTORS  
Betsey Bayless  
Ed King  
Tom Rawles  
Don Stapley  
Mary Rose Garrido Wilcox

June 27, 1996

**HAND-DELIVERED**

Bill Snarr, P.E.  
Project Engineer  
Hook Engineering, Inc.  
3511 East Indian School Road  
Phoenix, AZ 85018

**RE: Doubletree Ranch Road Regional Drainage Study Submittal**

Hook Engineering  
Response

Dear Mr. Snarr:

The Flood Control District has reviewed the Doubletree Ranch Road Regional Drainage Study Pre-Final Submittal Stormwater Management Report Volume II - Conceptual Design Study and Hydraulics, dated May 1996, and has the following comments:

1. In general the report is confusing. The progression of the project from conceptual alternatives to preferred alternative is not clearly stated. Any individual, regardless of familiarity with the project, should be able to read the report and have a clear understanding of how and why the preferred alternative was developed and selected. In addition, the figures and tables used in the report do not reflect data associated with the final, preferred alternative. All graphics in the report should be final versions and need to reflect the preferred alternative. Figures and tables that were part of the public meetings need to be clearly identified as such, and should only be included in an appendix unless directly relevant to the final report. A separate appendix may also be used to reflect working papers not used at public meetings, but helpful in evaluating the concept alternatives.

See Appendices

2. Although the study is of a conceptual level, all elements of the preferred alternatives should be based on acceptable design standards, or if an innovative element is proposed, it needs to be designed to a level appropriate enough for reviewing whether or not it meets District requirements. The need for is comment is common throughout the review of plans. Specifically, the proposed use of the box under Doubletree Ranch Road and the outfall must be substantiated by calculations.

Completed

- |   |  |
|---|--|
| <p>3. The updated runoff rate (Q) should be used, which has been completed by Kaminski-Hubbard, Inc. recently. The design capacity of storm drain system, open channel, detention basin and culverts have to be rechecked for the new inflow. The cost of each facility has to be adjusted accordingly.</p>   | <p>Completed</p>   |
| <p>4. The method used to analyze the Doubletree Corridor system does not address issues relating to tailwater conditions and junction losses. Initial indications suggest a significant backwater condition and Hydraulic Grade Line (HGL) elevations that significantly exceed existing ground elevations. Due to this finding, the capacity of the storm drain is less than the 100-year flood event. A hydraulic grade line analysis of the trunk line and all laterals should be included in the report that meets the Drainage Design Manual for Maricopa County, Volume II, Hydraulics. In addition, typical excavation cross sections and volumes for each reach should be included with the report.</p> | <p>Completed</p>   |
| <p>5. In developing the cost estimates, the costs associated with concrete and RCP should be modified so that the unit costs for concrete is \$300 per cubic yard, and the unit cost for 30" and 48" RCP is \$65 and \$110 per lineal foot, respectively.</p>   | <p>Completed</p>   |
| <p>6. Concerns were also raised for Cherokee Wash preferred alternative. Again, there was some confusion as to what was the preferred alternative, associated tables and figures not reflecting the preferred alternative and the progression and development of the preferred alternative was unclear.</p>   | <p>Progression in Appendices</p>   |
| <p>7. Although the actual design of the wash is unknown at this time, some indication should be given as to what design features were evaluated to determine potential costs. For example, a trapezoidal channel with a dirt bottom and reinforced sides. Also based on the conceptual level design, potential flow velocity should be determined so that adequate protection is provided to the wash.</p>  | <p>Completed</p>   |
| <p>8. According to the Drainage Design Manual for Maricopa County, Volume II, Hydraulics, the grass and earth lined channels are restricted to subcritical flow; all concrete channels carrying supercritical flow shall be lined with continuously reinforced concrete extending both longitudinally and laterally. Drop structures should be considered in the open channel to slow the flow velocity. The drop structure conceptual design and cost analysis should be included in the report. In addition, the calculation of freeboard should be provided with the channel design according to requirements outlined in the Drainage Design Manual for Maricopa County.</p>                                | <p>Completed</p>   |
| <p>9. If possible, high degree turning bends should be avoided where high water velocity occurs. In particular the bending area on the dip section at Caballo Lane (2+00, 3+00), the east side of 59th Place (13+00 to 15+00), the east side of 56th Street (37+00, 38+00), the north side of Crestview Drive (95+00) and the south side of Road Runner Road (111+00) should be evaluated for potential problems associated with high degree turns in combination with high water velocity. Some type of protection may be necessary at the bends that should be included in the cost estimates. Additional freeboard should be</p>   | <p>See superelevation calculations<br/>Proposed gabions for rise in water at bends</p> |

provided around bends to accommodate superelevation.

10. It does not appear that costs associated with necessary road work for installing the culverts were addressed in the report. Completed

11. Fences should be installed at both side of the channel if the side slope are steeper than 4:1, according to the Drainage Design Manual for Maricopa County, Volume II, Hydraulics. Completed

12. The detention basins along Cherokee Wash also raised quite a few questions. Items need to be addressed before evaluating the potential costs and benefits of these structures. Items such as the following will need to be addressed: Deleted

A. The runoff rate and volume should be given at the bottom of the stage storage table calculations for comparison purposes.

B. The storage calculation equations and references should be given.

C. Fences are required for ponding water greater than 3 feet deep.

D. A method for draining the water needs to be specified to meet Drainage Design Manual for Maricopa County requirement of a drain time less than 36 hours.

E. The inlet and outlet design should be provided, and the inflow and outflow rate and volume should be calculated.

F. The basin and dams should meet state jurisdictional criteria for freeboard requirements and spillway capacity.

G. The design and cost of the dams should be included.

In addition to the above comments, a red-lined set of full plans are included with this letter. Please return the red-lined plans when submitting a new report and full plans. Concerns with the overall validity of the proposed systems should be addressed prior to the red-lined comments on the full plans.

If you have any questions, please phone me at 506-1501.

Sincerely,

*Bert E. Miller*

Bert E. Miller, AICP  
Project Manager

BEM

FLOOD CONTROL DISTRICT  
of  
Maricopa County

Interoffice Memorandum

DATE: August 19, 1996

TO: BEM

VIA: *MAY 1997*

FROM: RPH

SUBJECT: Double Tree Ranch Road Storm Drain, Revised  
Conceptual Analysis

Hook Engineering  
Response

I have reviewed the subject materials. Table 3, "Recommended Peak Discharges for Doubletree Ranch Road Storm Drain System", is acceptable for the report. Also, the discharges shown on the storm drain schematic which we've discussed (that weren't identifiable in the K-H Hydrology Report) are acceptable.

I offer the following comments:

Hydrology

1) Future submittals should include detailed hydrologic analyses specific to the locations of proposed catch basins/inlets. Peak Discharge estimation should follow suggestions given in the Drainage Design Manual for Maricopa County, Volume I, Hydrology, then input into the final STORMCAD model.

Not in scope

Hydraulics

1) In general, the format of the STORMCAD output submittals is acceptable. However, the future submittal should include detailed reports for each pipe. To ease checking, I suggest some sort of label clarification for each profile sheet to easier relate it to the overall schematic plan. Color coding or line coding are common methods.

Drawings revised  
accordingly

- |   |   |
|---|---|
| <p>2) Further analysis of the Hydraulic System should only be done based upon an approved outlet. The outlet probably will lie within a jurisdictional Floodplain (show FP limits on plans). Necessary approvals for construction within a FP will be needed (if applicable) prior to our approval.</p>   | <p>Shown on conceptual Construction Drawings Permit beyond scope</p>  |
| <p>3) The system capacity should be checked for a 100-year TW and 10-year storm drain flow scenario.</p>  | <p>Completed</p>  |
| <p>4) Output messages for many of the pipe segments read "hydraulic jump formed", and "critical depth assumed upstream", suggesting computational difficulties. Please address.</p>   | <p>See Section 5.4 in report</p>  |
| <p>5) Although the schematic suggests the modeler's intent was to identify the pipe segments with increasing numbers starting from downstream and continuing upstream, they don't for the following locations: pipes P-23 and P-26 on Tatum Boulevard/Tomahawk Trail segment; pipe P-56 on 52nd Street; and pipes on the Butler Drive segment.</p>  | <p>Completed</p>  |
| <p>6) Due to anticipated catch basin and connector pipe head losses, the design should include at least 2' difference between the HGL of the main culvert segments and the ground surface. According to the DOT report, at least eleven location have less than this, and one (J-28) shows the HGL above the ground surface. Please rectify.</p>  | <p>Completed</p>  |
| <p>7) The Manhole loss coefficients used throughout the model need to be revised. The coefficient recommended for flow-through conditions without change in Q or pipe size is 0.05, per Drainage Design Manual of Maricopa County, Volume II, Hydraulics (revised draft, 1996). MH loss determination for the each Special Structure will require detailed analysis due to an anticipated complex nature of flows (losses may need to be calculated separately and then input directly into the STORMCAD model). The remaining manhole loss coefficients should be selected per situation (attached are some examples from STORMCAD).</p> | <p>Completed</p>  |
| <p>8) Based upon information in this submittal, the designed inlets to the storm drain at several locations remain perched. This design will require training dykes to direct flows into the inlets. These features will require design details, and will tend to cause water to back-up into the adjacent areas. These areas will need to be determined, purchased, and shown on the plans. Also, sediment management must be addressed.</p>   | <p>High water shown at inlets. Designed for the level of protection. Sediment management under separate report.</p> |
| <p>9) Given an existing (quoted) eighty foot wide R-O-W for Doubletree Rd., it would be very difficult to construct the proposed 6-10' x 5' RCBC within it. An alternative design or additional R-O-W, including temporary construction, must be considered and reflected in the cost estimate.</p>   | <p>Box sizes have been reduced</p>  |



# TABLE OF CONTENTS

	Page
<b>1.0 EXECUTIVE SUMMARY</b>	1
<b>2.0 INTRODUCTION</b>	3
2.1 PROJECT OVERVIEW	
2.2 FLOODING DESCRIPTION OF THE EXISTING BASINS	
2.2.1 DOUBLETREE CORRIDOR	
2.2.2 CHEROKEE CORRIDOR	
<b>3.0 STUDY PROCEDURE</b>	10
<b>4.0 MAJOR DESIGN FEATURES</b>	11
4.1 GOALS	
4.2 HORIZONTAL AND VERTICAL ALIGNMENT	
4.3 ACCESS	
4.4 UTILITIES	
4.5 ROADWAY CROSSINGS	
4.6 RIGHT-OF-WAY, DRAINAGE EASEMENTS AND TEMPORARY CONSTRUCTION EASEMENTS, AND LAND ACQUISITIONS	
4.7 PERMITS	
4.8 VEGETATION MANAGEMENT	
<b>5.0 DEVELOPMENT OF ALTERNATIVES</b>	14
5.1 DETENTION BASINS	
5.2 OPEN CHANNEL FLOW	
5.3 CULVERTS	
5.4 STORM DRAINS	
<b>6.0 ALTERNATIVE EVALUATIONS</b>	24
6.1 NO ACTION ALTERNATIVE	
6.2 DOUBLETREE CORRIDOR ALTERNATIVES	
6.3 CHEROKEE WASH CORRIDOR ALTERNATIVES	
<b>7.0 ENVIRONMENTAL CONSIDERATIONS</b>	32
7.1 LAND USE	
7.2 HAZARDOUS MATERIALS	
7.3 CULTURAL RESOURCES	
7.4 FLOOD PLAIN CONSIDERATIONS	
7.5 THREATENED AND ENDANGERED SPECIES	
7.6 VEGETATION	
7.7 WATER QUALITY	
7.8 CONSTRUCTION IMPACTS	



	<b>Page</b>
<b>8.0 COST ESTIMATES</b>	37
<b>9.0 PUBLIC INVOLVEMENT PROGRAM</b>	39
9.1 TOWN OF PARADISE VALLEY PUBLIC MEETING PROGRAM	
9.2 FLOOD CONTROL DISTRICT PUBLIC INVOLVEMENT PROGRAM	
9.3 TOWN COUNCIL MEETING	
<b>10.0 DISCUSSION (RESULTS AND CONCLUSIONS)</b>	47
<b>11.0 REFERENCES</b>	50

#### **LIST OF FIGURES**

FIGURE 1	PREFERRED ALTERNATIVES DOUBLETREE RANCH ROAD REGIONAL DRAINAGE STUDY	2
FIGURE 2	LOCATION MAP	4
FIGURE 3	DRAINAGE AREA BOUNDARIES	5
FIGURE 4	DRAINAGE AREA A BOUNDARY	6
FIGURE 5	DRAINAGE AREA B BOUNDARY	7
FIGURE 6	DETENTION BASIN LOCATIONS	15
FIGURE 7	ALTERNATIVE CHANNEL CROSS SECTIONS FOR CHEROKEE WASH	17
FIGURE 8	CHEROKEE WASH ALTERNATIVES	18
FIGURE 9	CHEROKEE WASH CROSS SECTION	19
FIGURE 10	ALTERNATIVE STORM DRAIN CAPACITY CROSS SECTIONS	21
FIGURE 11	SUMMARY OF CONSIDERED ALTERNATIVES	25
FIGURE 12	CHEROKEE WASH ALTERNATIVES	28
FIGURE 13	FIRM (FLOOD INSURANCE RATE MAP) NORTH	33
FIGURE 14	FIRM (FLOOD INSURANCE RATE MAP) SOUTH	34
FIGURE 15	QUESTIONNAIRE RESPONSE SUMMARY	41
FIGURE 16	DOUBLETREE RANCH ROAD WASH	43
FIGURE 17	PROPOSED CHEROKEE WASH ALTERNATIVES	44
FIGURE 18	SUMMARY OF JANUARY PUBLIC INVOLVEMENT MEETINGS	45
FIGURE 19	SUMMARY OF JANUARY PUBLIC INVOLVEMENT MEETINGS (PAGE 2)	46
FIGURE 20	DOUBLETREE PUBLIC INPUT	49

#### **LIST OF TABLES**

TABLE 1	UTILITY AND AGENCY CONTACTS
TABLE 2	DOUBLETREE RANCH ROAD PRELIMINARY COST ESTIMATE SUMMARY
TABLE 3	CHEROKEE WASH PRELIMINARY COST ESTIMATE SUMMARY

**PLAN AND PROFILE SHEETS**

DESCRIPTION	STATION	STATION	SHEET #
TITLE SHEET			1
LOCATION MAP			2
DOUBLETREE RANCH ROAD (0+00)	5+17	8+00	3
	8+00	20+00	4
	20+00	33+00	5
	33+00	46+00	6
	46+00	59+00	7
	59+00	72+00	8
	72+00	82+00	9
56TH STREET (500+00)	504+00	511+00	10
	511+00	523+00	11
52ND STREET (300+00)	305+00	310+00	3
(400+00)	310+00	323+00	12
	323+00	336+00	13
	336+00	413+50	14
	413+50	405+00	15
BUTLER DRIVE (200+00)	205+65	210+00	16
	210+00	222+00	17
TATUM BOULEVARD (100+00)	105+65	109+00	18
	109+00	120+00	19
CHEROKEE WASH (600+00)	605+00	614+00	20
	614+00	627+00	21
	627+00	640+00	22
	640+00	653+00	23
	653+00	666+00	24
	666+00	679+00	25
	679+00	692+00	26
	692+00	705+00	27
	705+00	718+00	28

***PREFERRED ALTERNATIVE APPENDICES - SEE VOLUME III***

***STUDY PROGRESSION INFORMATION - SEE VOLUME IV***



## 1.0 EXECUTIVE SUMMARY

In 1994, the Town of Paradise Valley applied to the Flood Control District of Maricopa County (hereafter called District) for funding to address the serious flooding which has occurred repeatedly during moderate storm events in the areas adjacent to Doubletree Ranch Road and Cherokee Wash. Multiple residences have been damaged by various storms in the past.

In response to this application, the District initiated the Doubletree Ranch Road Regional Drainage Study. The purpose of this study is to specifically define the hydrology in this area and develop elements of a District project which will control this flooding in this area.

This water shed drains approximately four (4) square miles and is bounded by the Phoenix Mountain Preserve, Mummy Mountain, Indian Bend Wash and Mountain View Road. Tasks completed to accomplish this goal include defining the volume of stormwater to be conveyed by the 100-year 6-hour storm event, developing alternative flood control solutions, evaluating these solutions, selecting preferred alternatives, and developing conceptual plan and profile drawings for the system.

A total of eleven (11) alternative solutions were identified for the two drainage corridors in the study area: five for the Doubletree Corridor and six for the Cherokee Wash Corridor. Following the evaluation, two have been selected as the preferred alternatives. Together, these alternatives comprise an integrated system to convey the stormwater runoff through the residential neighborhoods in question. The preferred alternatives are:

### DOUBLETREE CORRIDOR - ALTERNATIVE 5

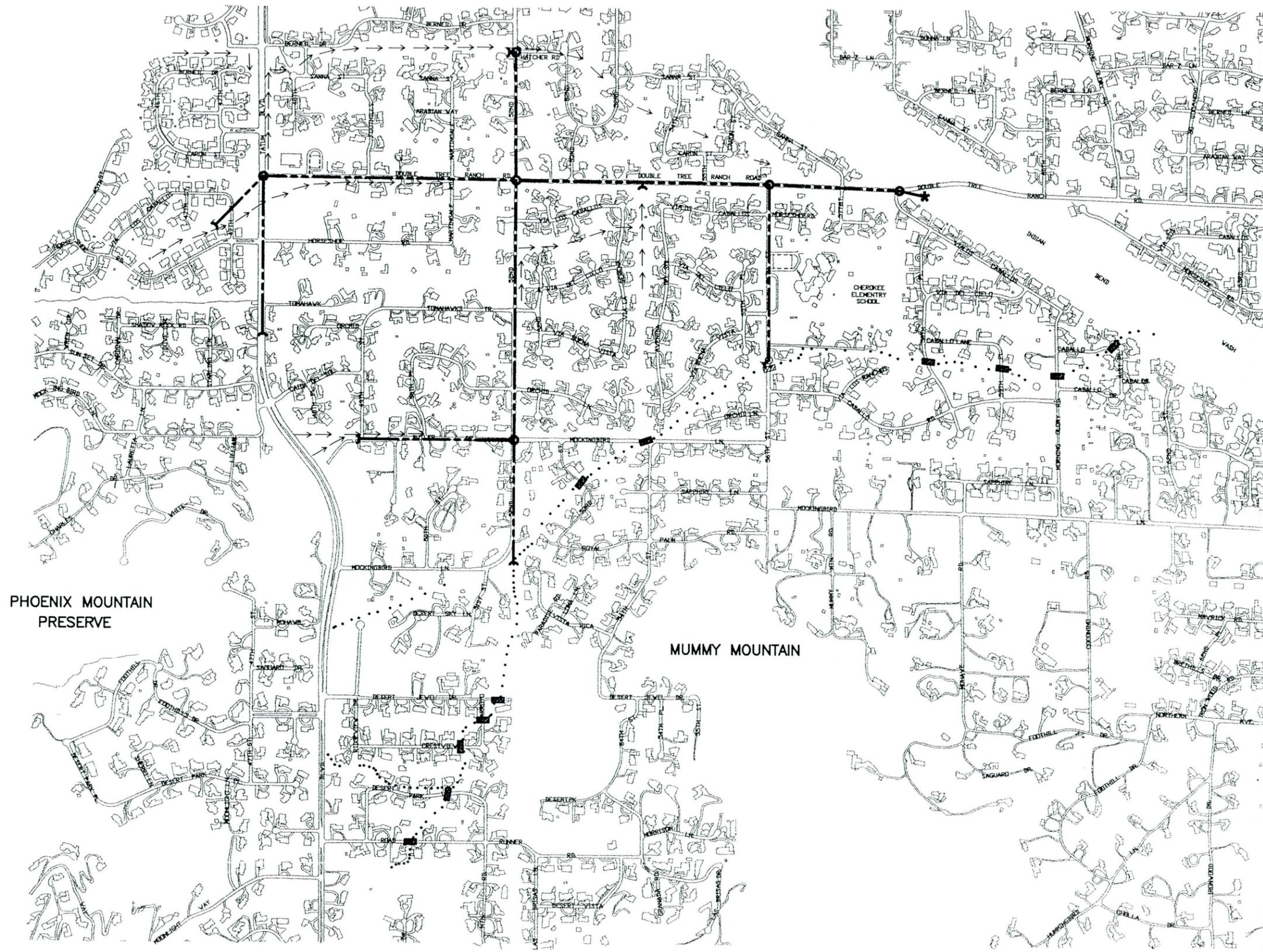
- Box culvert storm drain system with 100-year 6-hour storm event capacity. This alternative does not include any detention basins.

### CHEROKEE WASH CORRIDOR - ALTERNATIVE 6

- Channel improvements in Cherokee Wash to include stabilizing the channel lining from 52nd Street to Indian Bend Wash. Potential treatment considered was gabions or wire tied rip rap in a trapezoidal section.

To enhance the capacity of the Wash at this time, two additional reaches of storm drain will be built to accept water from Cherokee Wash into the Doubletree storm drain at 52nd Street and 56th Street. The 10-year 6-hour storm was selected for the diversion of Cherokee Wash to Doubletree Drainage System.

A graphic depicting both preferred alternatives and how they are integrated is included as Figure 1.



PHOENIX MOUNTAIN  
PRESERVE

MUMMY MOUNTAIN

LEGEND

- — — — — STORM DRAIN PIPE
- └─ MAJOR STORM DRAIN INLET
- JUNCTION BOX
- ★ ENERGY DISSIPATOR
- CULVERT
- ..... CHEROKEE WASH
- DRAINAGE PATHS

DOUBLETREE RANCH ROAD REGIONAL DRAINAGE STUDY  
PREFERRED ALTERNATIVES

FIGURE 1



## 2.0 INTRODUCTION

### 2.1 PROJECT OVERVIEW

In cooperation with the City of Phoenix and the Town of Paradise Valley, the District has retained Hook Engineering, Inc. to perform a study of the drainage conditions which are causing flooding problems in the Doubletree Ranch Road area (see Figures 2 and 3) and develop alternative solutions. This report summarizes the process the project team followed, identifies the solutions developed, and provides recommendations for drainage improvements consistent with current District standards.

Doubletree Ranch Road Regional Drainage Study is divided into two sub-basin drainage corridors. One drainage corridor is identified as the Doubletree Corridor and the second is the Cherokee Wash Corridor (see Figures 4 and 5). Both of these corridors contribute to Indian Bend Wash which is the limit of the study on the east. The basins drain from the headwaters in the steep mountains of the Phoenix Mountain Preserve which is the limit of the study on the west. Mountain View Road is the limit of the study on the north and Mummy Mountain is the limit of study on the south. This watershed drains approximately four square miles of natural desert, mountainous desert and residential development in Township 2 and 3 North and Range 4 East of the Gila and Salt River Base and Meridian.

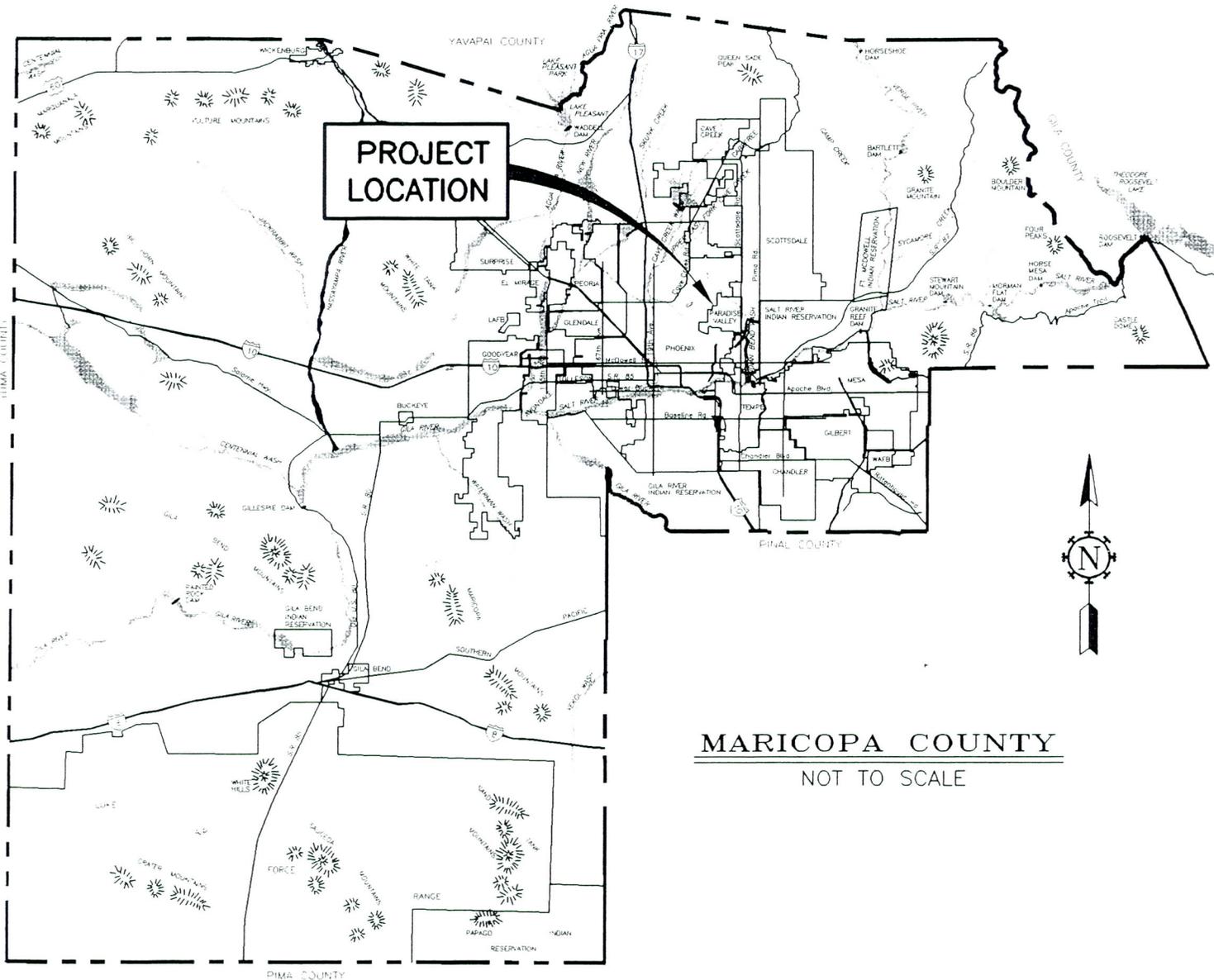
The Doubletree Ranch Road Regional Drainage Study presents analyses of improvement alternatives to collect and convey stormwater runoff to Indian Bend Wash by enhancing the existing channel in the case of Cherokee Wash and by providing a new method of conveyance along Doubletree Ranch Road and cross streets.

Public involvement activities have been an integral part of this study to involve the local residents in the development and selection of the preferred alternatives. Through the course of the project, the local residents have provided a large amount of specific flooding history information which has helped in the hydraulic analysis as well as determining what local drainage facility improvements should be included as part of this project.

### 2.2 FLOODING DESCRIPTION OF THE EXISTING BASINS

#### 2.2.1. Doubletree Corridor

The stormwater runoff in the Doubletree Corridor historically traveled overland in sheet flow and through numerous small washes. Development has altered many of these flow paths due to subdividing, lot splits, landscaping and construction of other obstructions. The result is that many homes experience flooding during rainfall events with excessive water flowing through the streets during the storm and standing in some streets and isolated areas of the community. Many



**LOCATION MAP**

**FIGURE 2**

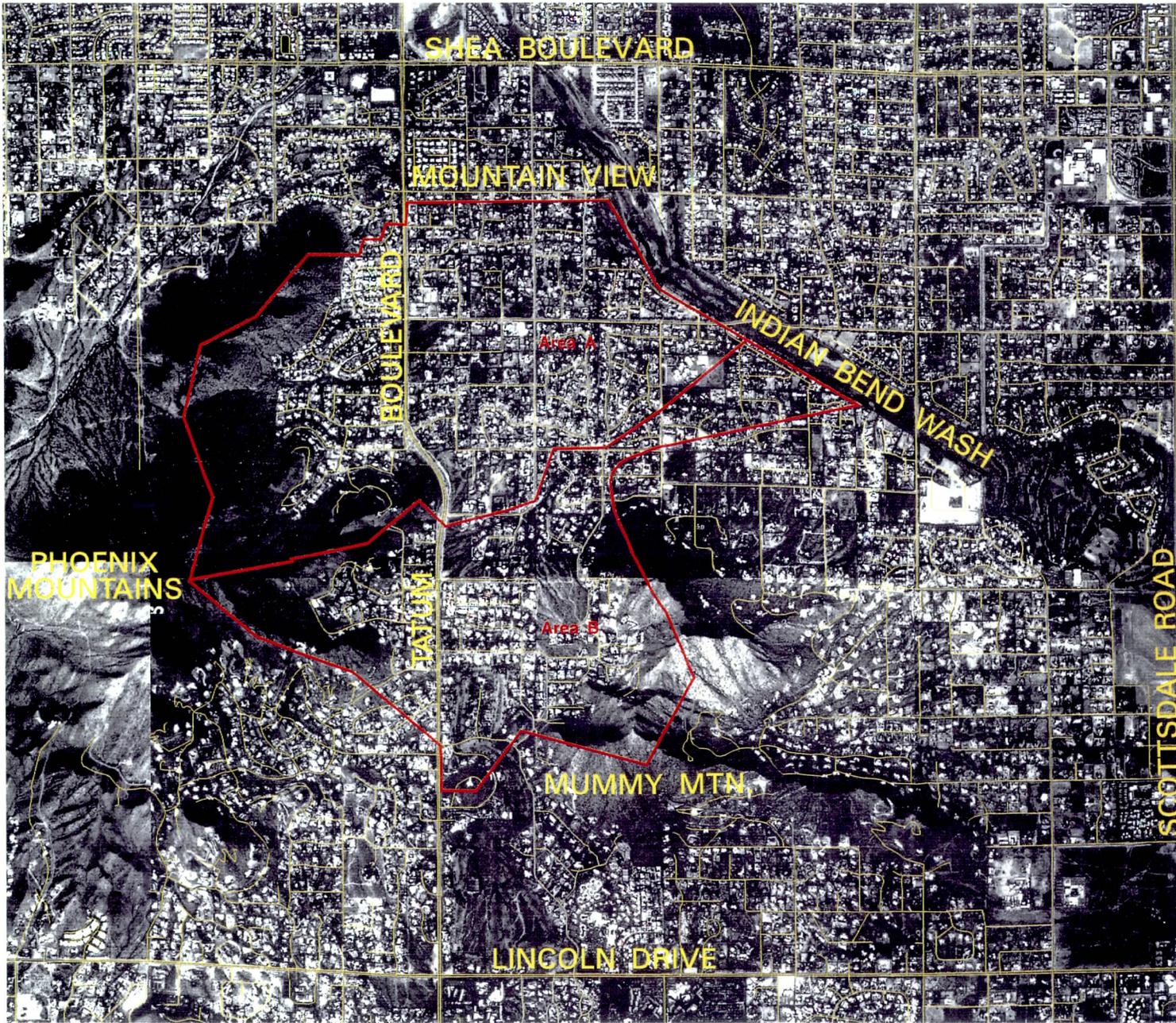


FIGURE 3



Scale = 1:7200

- Area A = Doubletree Ranch Road Drainage Area
- Area B = Cherokee Wash Drainage Area
- = Street Centerlines

### Doubletree Ranch Road Regional Drainage System Drainage Area Boundaries





FIGURE 4



- = Doubletree Ranch Road Drainage Area - A
- = Street Centerlines

### Doubletree Ranch Road Regional Drainage System Drainage Area A Boundary





FIGURE 5



- = Cherokee Wash Drainage Area - B
- = Street Centerlines

### Doubletree Ranch Road Regional Drainage System Basin B Boundary



roadways were not constructed with curb and gutter and are incapable of conveying flows. Most of the older homes in the Paradise Valley area have been constructed at grade. This results in some homes being flooded during the 2-year event.

In October 1993, a major storm caused extensive flooding throughout this area. Doubletree Ranch Road and 56th Street were both full of water, which forced children to remain at Cherokee Elementary School for several hours until the flooding receded.

One of the primary sources of this stormwater is the Phoenix Mountain Preserve. A concrete channel within a subdivision to the west of Tatum Boulevard collects 700 cubic feet per second of storm runoff. Once the water passes through the subdivision, the channel ends and the water sheet flows across Tatum Boulevard.

Approximately 75 percent of this water continues east across the vacant parcel at the southeast corner of Doubletree Ranch Road and Tatum Boulevard. The water then makes the 45 degree turn onto Doubletree Ranch Road and continues east towards Indian Bend Wash. The existing drainage ditches and structures along Doubletree Ranch Road are under-sized to accommodate the flows currently generated by a 1-year storm.

In addition to flooding Doubletree Ranch Road, stormwater continues in a northeasterly direction and enters the Foothills Manor neighborhood. The storm runoff enters the neighborhood in two locations: just east of Tesseract School through a drainage easement and through Foothills Manor Drive.

The remaining quarter of this stormwater continues north along the east side of Tatum Boulevard to a low point in the road where it heads east in a drainage easement becoming Hatcher Wash. Hatcher Wash travels east to 52nd Street. At 52nd Street, Hatcher Wash flows on to Hatcher Road which carries the stormwater in an inverted crown for approximately 600 feet. Then the stormwater re-enters the Wash which is obstructed by vegetation and debris. The stormwater next crosses 53rd Place just south of Sanna Street and continues easterly in a path which crosses multiple residential lots. At 54th Place, the stormwater sheet flows across a corner lot onto Caron Street then turns south along 55th Place to empty onto the north side of Doubletree Ranch Road.

North of Doubletree Ranch Road and south of Mountain View Road, additional runoff sheet flows east across Tatum Boulevard, then through various streets and yards to Indian Bend Wash. Part of this water is picked up by Berneil Wash which begins at the "T" intersection of Berneil Drive and 52nd Street and flows east to Indian Bend Wash.

An additional source of storm runoff from the Phoenix Mountain Preserve is a 48" corrugated metal pipe which crosses under Tatum Boulevard at Butler Drive. After exiting the pipe, the water is contained in a drainage ditch until it reaches 50th Place, where the ditch abruptly ends, and the stormwater rebounds off an elevated yard protected by railroad ties. The runoff continues east on Butler Drive until it reaches 52nd Street where the increase in roadway elevation forces the runoff north onto 52nd Street through the residential property located on the northwest corner of Butler Drive and 52nd Street.

The runoff continues north on 52nd Street until reaching several subdivision streets where stormwater invades the subdivision heading in a northeasterly direction. At Tomahawk Trail, a speed bump has been placed at an angle to allow stormwater to enter a drainage swale. Several homeowners in this subdivision would like the drainage improvements to be designed to keep as much water as possible in 52nd Street instead of routing through the subdivision. There are drainage channels in the neighborhood which appear to have reasonable capacity, however, the slope is not sufficient. Runoff backs up into homeowners' yards and into nearby cul-de-sacs because it can not flow fast enough into the existing Doubletree Ranch Road drainage channel.

#### 2.2.2 Cherokee Wash Corridor

The last major source of flood water in this area is Cherokee Wash. Cherokee Wash carries stormwater from Mummy Mountain and meanders through subdivided residential parcels where drainage easements are used to define the channel.

At Mockingbird Lane the water in Cherokee Wash backs up at the dip crossing because the channel becomes substantially smaller downstream of the crossing. As the storm runoff proceeds east through Cherokee Wash, it crosses 56th Street. The four existing drainage culverts which are 24" x 36" elliptical pipes have silted in and basically cause 56th Street to act as a dam. The stormwater then flows over the curb onto the street. Approximately 50% of the flow crosses the roadway and re-enters the Wash. The rest of the flow is channeled north along 56th Street which does not have runoff capacity adequate to maintain emergency vehicle access in a 10-year event. This flooding pattern causes Cherokee Elementary School to become inaccessible during intense storms. At Caballo Drive and 59th Place, the stormwater fills the channel to the top of berms that have been built to protect properties. Brush and debris in Cherokee Wash further impede the flow.

Further downstream, former flooding problems may have been resolved when the Town of Paradise Valley improved Morning Glory Road and Caballo Lane with dip crossings by grading the channel. This effort was completed during the last six months in an effort to improve flow characteristics into Indian Bend Wash.



### 3.0 STUDY PROCEDURE

Hook Engineering retained Kaminski-Hubbard Engineering, Inc. (KHE) to prepare an existing condition hydrologic analysis for the stormwater discharges. This study was reviewed by the District and approved on November 29, 1995. The report has been revised to reflect the recommended changes for the preferred alternative and changes will need to be reviewed and approved by the District.

Following the completion of the Hydrology Study, Hook Engineering proceeded to investigate alternative concepts for improving Doubletree Ranch Road and Cherokee Wash. Specific tasks performed to define these alternatives included:

1. Obtain aerial topographic mapping (hard copy and computer data files) provided by the District.
2. Identify existing drainage easements.
3. Identify existing right-of-way and land acquisition necessary for potential alternatives.
4. Identify existing utility locations
5. Describe existing structures (culverts, dip crossings).
6. Consider such intangibles as safety and maintenance in the design alternatives.
7. Conduct a Public Involvement Program to obtain public comment regarding the proposed improvements and aesthetics.
8. Contact public agencies for input to the project (see Table 1).
9. Develop construction cost estimates for the alternatives.
10. Evaluate alternatives relative to constructability, compatibility with adjacent existing improvements, construction cost, right-of-way requirements, safety, access control, and environmental impacts.

Next, Hook Engineering aided the District in evaluating the developed alternatives by providing comparative costs. A preferred alternative for each corridor was selected.

Last, conceptual plan and profile sheets have been designed for the preferred alternatives (see Appendices) and the stormwater management report has been compiled.

## TABLE 1

### UTILITY AND AGENCY CONTACTS

#### Water and Wastewater (Sanitary Sewer)

City of Phoenix  
Attn: Ralph Mosca  
200 West Washington Street, 8<sup>th</sup> Floor  
Phoenix, Arizona 85003  
602-495-5601

#### Sanitary Sewer

City of Scottsdale  
Attn: Dave Petty  
9312 North 94<sup>th</sup> Street  
Scottsdale, Arizona 85258  
602-391-5650  
602-391-5661

#### Electrical (Power)

Arizona Public Service  
Attn: John Rael  
Post Office Box 53999, Station 3539  
Phoenix, Arizona 85072  
602-371-6945

#### Cable Television

Cox Dimension Cable (Insight)  
Attn: Carl McKay  
115 North 51<sup>st</sup> Avenue  
Phoenix, Arizona 85043  
602-352-5860  
602-269-1679 Fax

#### Natural Gas (Heating)

Southwest Gas  
Attn: Dominique Mitchell  
Franchise Department  
9 South 43<sup>rd</sup> Avenue, Mail Station 420-586  
Phoenix, Arizona 85009  
602-484-5306

#### Telephone

US West Communications  
Attn: Helen Sutt  
6350 South Maple Avenue, Room 125  
Tempe, Arizona 85283  
602-831-4771

#### Utility Line Locations

Blue Stakes  
602-263-1100

## TABLE 1 (CONTINUED)

### CITY AND COUNTY GOVERNMENT CONTACTS

Flood Control District Maricopa County  
Bert Miller  
Water Resource Planner  
2801 West Durango Street  
Phoenix, Arizona 85009  
602-506-1501

Town of Paradise Valley  
Bill Mead  
Town Engineer  
6401 East Lincoln Drive  
Paradise Valley, Arizona 85343  
602-948-7411

City of Phoenix  
Jim Matteson  
City Engineer  
200 West Washington Street  
Phoenix, Arizona 85003  
602-262-6136

City of Phoenix  
John Bethill  
Street Transportation Department  
1034 East Madison Street  
Phoenix, Arizona 85034-2292  
602-495-2050

Recorded Documents  
Maricopa County Recorder's Office  
111 South 3<sup>rd</sup> Avenue  
Phoenix, Arizona 85003  
602-506-3535



## 4.0 MAJOR DESIGN FEATURES

### 4.1 GOALS

The goals for the improvements to the Doubletree Ranch Road Regional Drainage Study, including both the Doubletree Corridor and the Cherokee Wash Corridor, are to increase conveyance capacity, provide a conceptual design for storm drain system, and provide continuity between existing and proposed improvements. In attaining these goals, the intent was to provide improvements that would maximize the utilization of the existing channels of both corridors, minimize the right-of-way and drainage easement acquisition, and minimize construction cost. In addition to the stated goals, several other factors were considered in the alternatives development and evaluation:

- Cost: Realistic construction costs are to be determined for each alternative.
- Safety: Safety is of paramount importance in the development of any alternative. Culvert inlets should have child resistant trash racks. Channel side slopes must allow people to climb out of the channel should they fall in during a storm event. Flooded dip crossings should not be greater than one foot of depth for traffic safety.
- Maintenance: Consideration is to be given to the frequency and extent of maintenance for each alternative.
- Access: Access into and out of the Cherokee Wash channel for maintenance purposes will be provided at street crossings.
- Environment and Aesthetics: Minimizing and/or mitigating environmental impacts and aesthetics are to be an integral part of the development and evaluation of alternatives.

### 4.2 HORIZONTAL AND VERTICAL ALIGNMENT

The horizontal alignment of the proposed improvements to Cherokee Wash and the storm drain in Doubletree Ranch Road will follow the existing alignments as closely as possible to minimize channel and roadway disruption, to maximize the use of the existing channel and roadways, and to avoid utilities that have been identified. The vertical alignment of channel and storm drain improvements are contingent upon the final roadway profile, final slope stability analysis and sediment transportation. Grade control structures, if necessary, will be placed upstream of the roadway culverts to channel the stormwater into the special improved inlet structures. A grade control structure downstream of a roadway culvert can be placed to minimize potential head-cutting into the structure footings. Grade control structures may be recommended elsewhere if the channel slope must be flattened.

#### 4.3 ACCESS

Due to drainage easement size restriction, a seven foot wide entrance ramp will allow access to the bottom of Cherokee Wash for small maintenance vehicles. Access into the wash will be from the existing roadway cross sections next to the pipe and box culverts down to the thalweg of the channel because of the width of the drainage easements. Wider access ramp widths would restrict the size of the culverts and reduce the level of protection. Access manholes will be provided for cleaning, inspection, and the maintenance of the storm drain system.

#### 4.4 UTILITIES

Utilities which are present within the storm drain and channel corridors include, water, wastewater, electric, gas, storm culverts, telephone, and cable television.

Initial contact has been made with all the utility companies in the project limits (see Table 1). The following appear to have facilities within the project limits:

- Arizona Public Service Company
- US West Communications
- City of Phoenix
- Cox Dimension Cable
- Southwest Gas
- Town of Paradise Valley
- City of Scottsdale

This report locates existing utilities for the preferred alternate. The extent of required utility relocations has been established and appears on the conceptual construction drawings.

#### 4.5 ROADWAY CROSSINGS

Tatum Boulevard is a major arterial street and special consideration will be needed during construction to extend the concrete box structure across the intersection. The storm drain along Tatum Boulevard will be placed outside the traveled roadway for construction traffic safety.

In the preferred alternative, roadway crossings for Cherokee Wash include three categories:

1. Existing culverts to be replaced by storm drain culverts (56th Street).
2. Existing dip crossing to be upgraded to storm drain culverts to operate at the maximum capacity of the improved channel (Caballo Lane, Morning Glory Road, 59th Place, 58th Place, Mockingbird Lane, 53th Place, Desert Jewel Drive, Arroyo Drive, Crestview Drive, Desert Park Lane).
3. Existing culverts to remain (Road Runner Road).

#### 4.6 RIGHT-OF-WAY, DRAINAGE EASEMENTS, TEMPORARY CONSTRUCTION EASEMENTS, AND LAND ACQUISITIONS

One of the goals of this study is to minimize the requirement for additional right-of-way, drainage easements, and land acquisitions due to the high cost of real estate in Paradise Valley as compared to construction and maintenance costs. The Doubletree Corridor storm drain system for the most part is located within the road right-of-way. Required right-of-way acquisitions and drainage easements are identified on the conceptual plan and profile sheets provided in this report. Indian Bend Wash is in a Town of Paradise Valley drainage easement; but permission and land acquisition will be needed from the golf course owners to build an energy dissipator.

Cherokee Wash has a 40 foot drainage easement for most of its length. The specific width of the easement for the entire length of the Wash is identified on the plan and profile sheets in this report. Various locations will require the acquisition of channel drainage easements for the future. These locations are also identified on the plans.

Temporary construction easements will be required where the construction cannot be completed within the existing right-of-way. These locations are also identified on the plans.

#### 4.7 REQUIRED PERMITS

Improvements will impact the corridors and any entity making improvements will be required to obtain permits. An application for a 404 permit from the US Army Corps of Engineers will be needed for the storm drain energy dissipator in Indian Bend Wash. It will then be determined whether a Letter of Permission, a nationwide permit, or an individual permit applies.

In addition, National Pollution Discharge Elimination System (NPDES) permits will be required during construction from the Arizona Department of Environmental Quality.

Methods of erosion control will be in accordance with "Drainage Design Manual for Maricopa County, Arizona, Volume III, Erosion Control" prepared for the District.

#### 4.8 VEGETATION MANAGEMENT

Vegetation management requires trimming of bushes and small trees to the level of the streambed in all of the washes in the corridors. Plant roots will remain and continue to stabilize the streambed. These plants will eventually grow back; therefore, an annual maintenance schedule should be enforced to remove the excess vegetation. Trees add to the aesthetics and public acceptance of washes, particularly near residential areas. Larger existing trees should be trimmed from the bottom to a height of four (4) feet. This vegetation management plan would lower the channel roughness (n value) for the majority of the runoff flows.



## 5.0 DEVELOPMENT OF ALTERNATIVES

The goal of this study has been to develop alternatives capable of conveying the 100-year storm runoff flow for the Doubletree Corridor and provide a reasonable level of protection for the Cherokee Wash Corridor within the existing drainage easement. In addition to the No Action Alternative five basic concepts were investigated during the course of the study for Doubletree Corridor and six concepts for the Cherokee Wash Corridor.

The Doubletree Corridor alternatives include:

1. An Open Channel with Detention Basins.
2. An Open Channel without Detention Basins.
3. Storm Drain with Detention Basins in Phoenix Mountain Preserve.
4. Storm Drain with Detention Basins in Residential Locations.
5. Storm Drain without Detention Basins.

The Cherokee Wash Corridor alternatives include:

1. Excavated Dirt Channel with Detention Basins.
2. Rock Lined Channel with Detention Basins.
3. Excavated Dirt without Detention Basins.
4. Rock Lined Channel without Detention Basins.
5. Concrete Channel without Detention Basins.
6. Gabions or wire tied rock lined channel improvements from 52nd Street to Indian Bend Wash coupled with diverting runoff to Doubletree Drainage System.

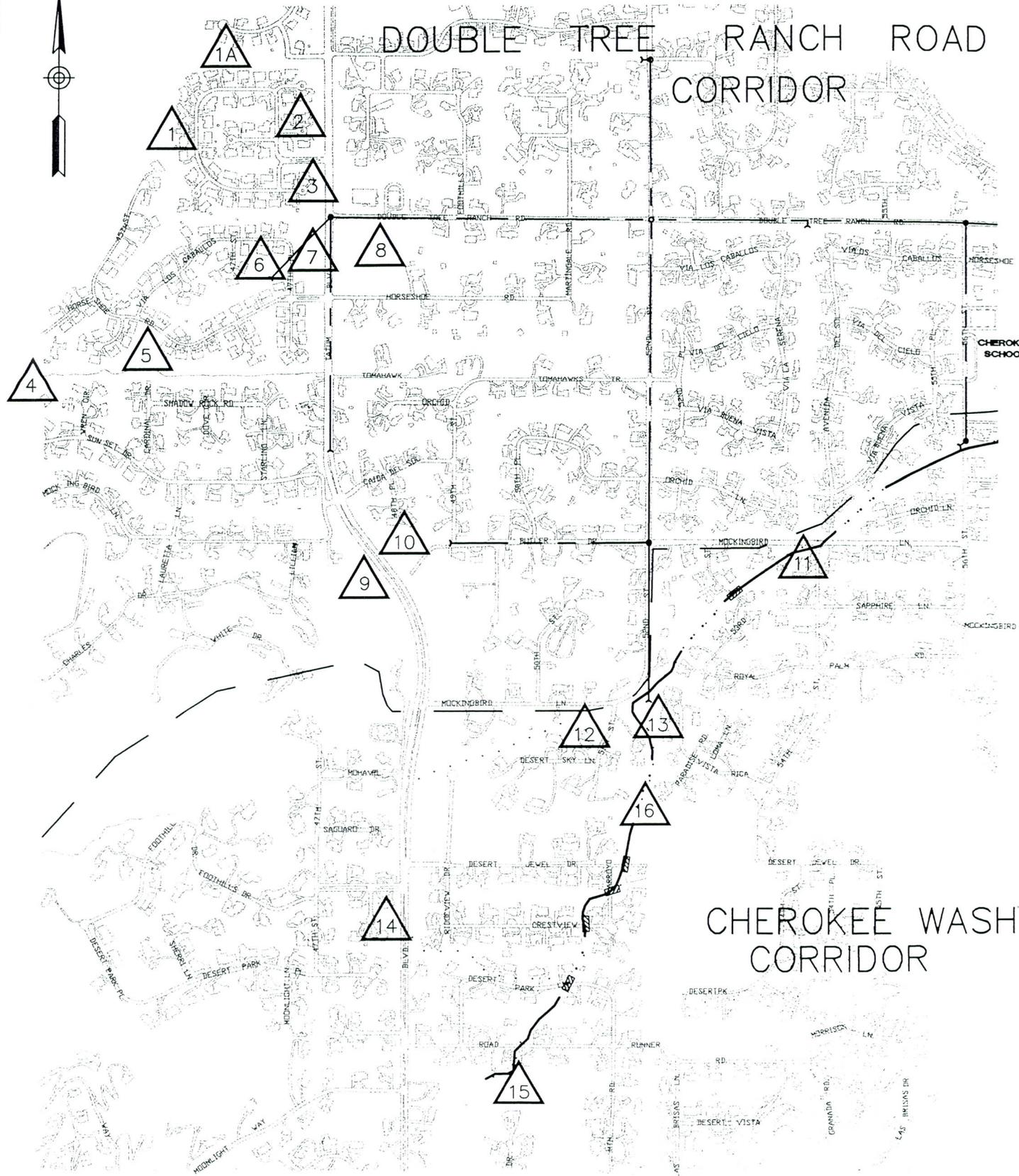
### 5.1. DETENTION BASINS (BOTH CORRIDORS)

Seventeen detention basins were originally located with the following criteria (see Figure 6): 1) Basins were to be placed on vacant property. 2) Basins had to be in the flow path of the existing washes. 3) Pumps should not be used for diverting storm runoff to basins. At this point in the process, it was determined that the Phoenix Mountain preserve property could not be used as a potential site for detention basins because of discouraging results during recent District projects.

Once the locations were identified, a stage storage determination was calculated for each of the basin locations. Three different side slopes were considered: 4:1, 6:1 and 8:1. For safety reasons, it was felt that a 4:1 side slope was the steepest maximum allowed. The depth of the basins were run at a maximum of three feet for safety purposes but with this criteria there was not enough volume present. To maximize the volume, a depth of up to 18 feet was considered. Berms (dams) were placed around the area of the basins to allow as much volume as possible. After the initial stage storage calculations were determined for each of the detention basins, it was found that four basins that did not have sufficient storage volume capacity to attenuate the peak flow of the hydrograph. These basins were numbers 1, 2, 3, and 11. One more basin location was added at this



# DOUBLE TREE RANCH ROAD CORRIDOR



 = PROPOSED RETENTION BASIN LOCATIONS

**DETENTION BASIN LOCATIONS**

**FIGURE 6**

time to be considered at Desert Jewel Drive and Cherokee Wash. Detention Basins 1A, 5, combined 6 and 7, 8, 12, 13, and 15 were reexamined and enlarged to allow greater storage capacity. Basin 14 was in question and was eventually eliminated because of insufficient storage capacity. Overflow spillways were not considered in the calculations because of the need to maximize the storage volume. The overflow spillways would need to be determined for the final design of any detention basins.

Because of political considerations between the City of Phoenix and the Town of Paradise Valley, it was decided that detention basins should be considered on the Phoenix Mountain Preserve. A preliminary cost estimate was completed which showed that because of high land cost, a storm drain system without detention basins was more cost efficient for the Doubletree Corridor.

## 5.2 OPEN CHANNEL FLOW

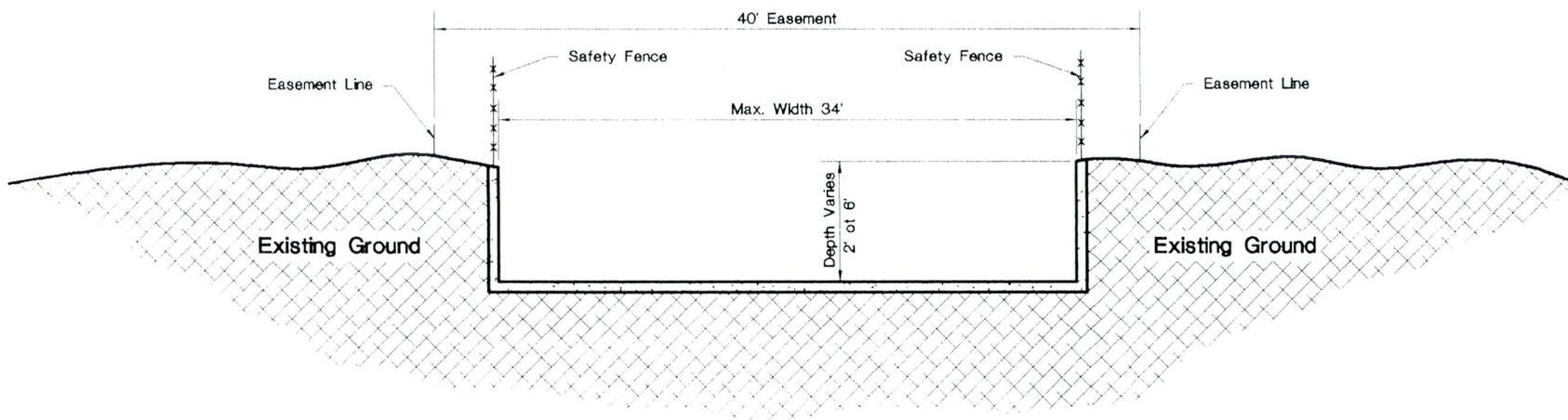
Open channel flow along Doubletree Ranch Road was considered. Shape, lining material, safety (vehicular and pedestrian), and amount of space permitted in the right-of-way were elements of the alternative development. Potential shapes of an open channel which were considered included rectangular, trapezoidal, and triangular. The lining materials evaluated were: concrete, dumped rock rip rap, plasticized granite, and natural dirt. The safety considerations were: depth, speed (velocity), and attractive nuisance. Reaches of the corridor were identified and the slopes were determined. Quantity calculations were determined using the available width, different lining materials, and the shape.

Doubletree Ranch Road has an 80 foot right-of-way. It was assumed that 40 feet would be needed for street improvements, leaving 40 feet for an open channel. Using open channels would require culverts under driveways and streets for access adding substantially to the cost.

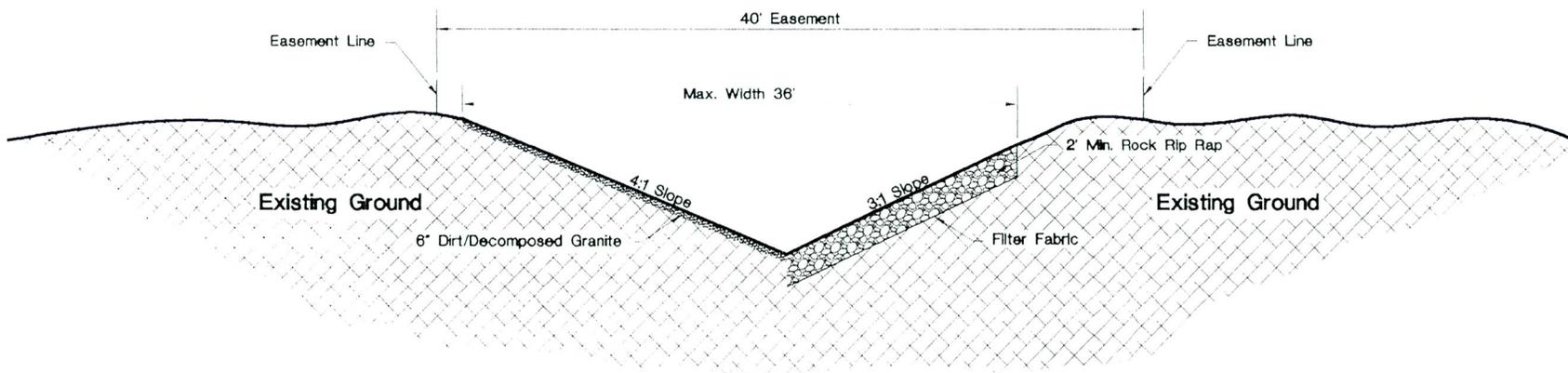
Cherokee Wash for the most part has a 40-foot drainage easement (see Figure 7). Hydraulic determination indicated that the flatter reaches of the existing corridor within the 40-foot drainage easement cannot accommodate 100-year 6-hour storm capacity (see Figures 8 and 9).

An open channel, during a storm event, may be an attractive nuisance to the children attending Cherokee Elementary School. Because of the velocity of the runoff water during a storm event, and the associated depth of the concrete channel required, a non-climbable fence would have to be installed. Linings of rock rip rap or dirt would be unacceptable because the depth of the water would need to be over 3 feet to achieve the necessary capacity. In order to keep the proper flow characteristics, this kind of channel would be maintenance intensive.

# ALTERNATIVE CHANNEL CROSS-SECTIONS FOR CHEROKEE WASH CORRIDOR FLOOD CONTROL DISTRICT OF MARICOPA COUNTY PROJECT NO. FCD 94-28



100-Year Concrete Channel Alternative



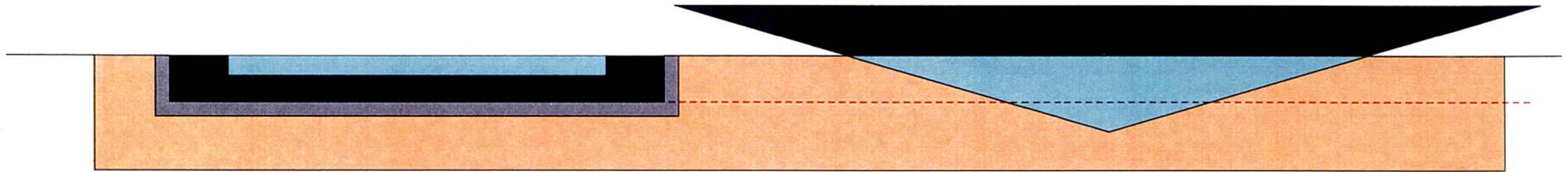
Less than 100-Year Dirt or Rock Channel Alternative

# Cherokee Wash Alternatives Doubletree Ranch Road Drainage Improvement Project



**Concrete Channel**  
CROSS SECTION VIEW

**Rock Channel**  
CROSS SECTION VIEW

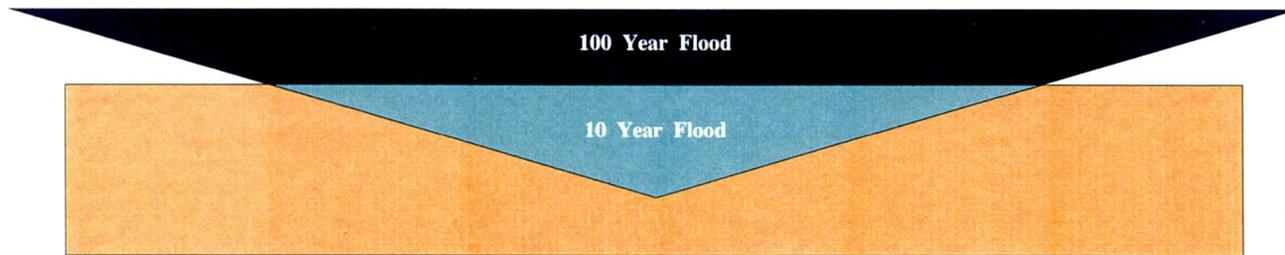


	Maximum Width (feet)	No Detention Maximum Depth (feet)	With Detention Maximum Depth (feet)		Maximum Width (feet)	No Detention Maximum Depth (feet)	With Detention Maximum Depth (feet)
10 Year	26	1.40	0.65	10 Year	36	5.25	3.87
100 Year	34	3.19	1.90	100 Year	60*	8.58	6.32

\* Maximum available right of way is forty (40) feet.

**FIGURE 8**

**Rock Channel**  
Cross Section View



	Maximum Width (feet)	No Detention Maximum Depth (feet)	With Detention Maximum Depth (feet)
10 Year	36	5.25	3.87
100 Year	60*	8.58	6.32

\* Maximum available right of way is forty (40) feet.

**FIGURE 9**

**Cherokee Wash  
Cross Section**



### 5.3 CULVERTS

The existing culverts were hydraulically analyzed where the storm drain channel crossed driveways, streets, and dip crossing. Some of the existing culverts are inadequate to convey the 100-year 6-hour storm flow and will need to be replaced.

Material longevity is an important consideration in this area. Bed loads are high because the runoff is coming off the Phoenix Mountain Preserve and Mummy Mountain. The runoff content is high in sands and silts that act like sandpaper, scouring the finish off metal culverts and later leading to rusting of the culvert. Abrasion (bed loads) and corrosion resistance are problems affecting the longevity of culverts due to adverse hostile environmental conditions. Concrete is the recommended material because of its service life, structural strength, hydraulic roughness, low fills, and traffic loads.

The benefits of constructing a large capacity culvert (see Figure 10) to accommodate all storm events with no detrimental flooding effects are normally outweighed by initial construction cost. Due to the large capacity of the culvert, there will be a decrease in roadway flooding resulting in fewer traffic interruptions, less roadway maintenance, and increased driving safety.

Inlet wing walls will direct the stormwater into the mouth of the culvert. Also gabion or wire tied rip rap will help direct the water into the culvert. Outlet wing walls and aprons will help in dissipating energy and help in erosion protection by slowing down the velocity.

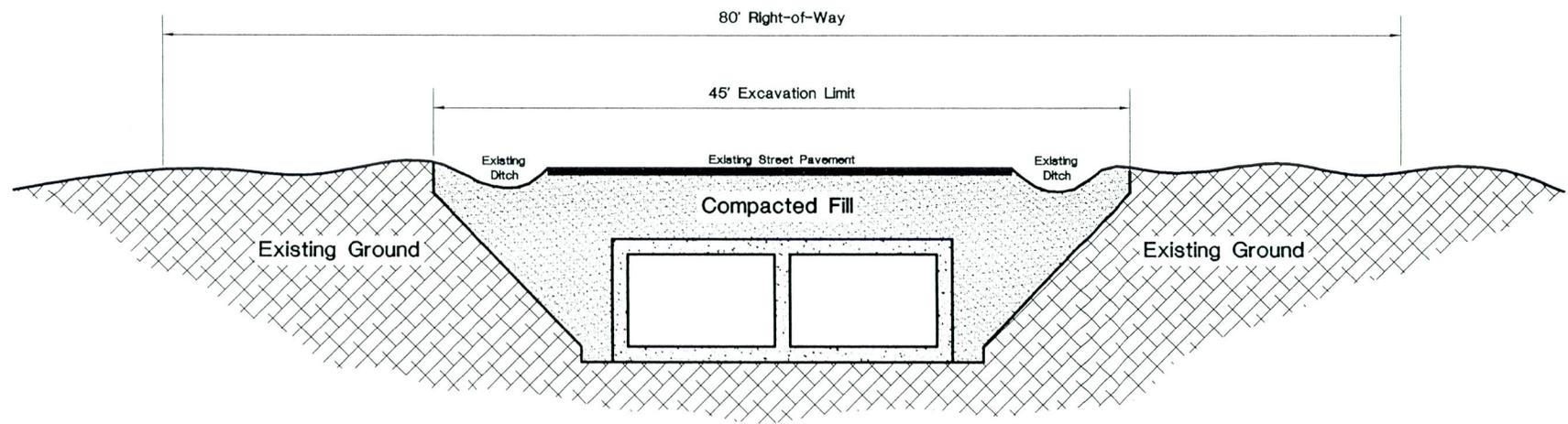
Cherokee Wash has existing dip sections at the following locations: Caballo Lane, Morning Glory Road, 59th Place, 58th Place, Mockingbird Lane, 53rd Place, Desert Jewel Drive, Arroyo Lane, Crestview Lane, and Desert Park Lane. All dip sections will be replaced by culverts to the level of the capacity of the channel. Existing four 24" x 36" arch corrugated metal pipes at 56th Street will be replaced with a box culvert and an overflow back to the existing channel. Road Runner Road has existing two 36" coated corrugated metal pipe with mitered ends which will remain.

Doubletree Ranch Road has existing three 36" corrugated metal pipes at Sanna Drive, a dip crossing at 56th Street, a double 24" culvert at 52nd Street, various size culverts under driveway. There is an existing double 10' x 2' concrete box culvert at 47th Place. These culverts will all be replaced by a storm drain using concrete box culverts.

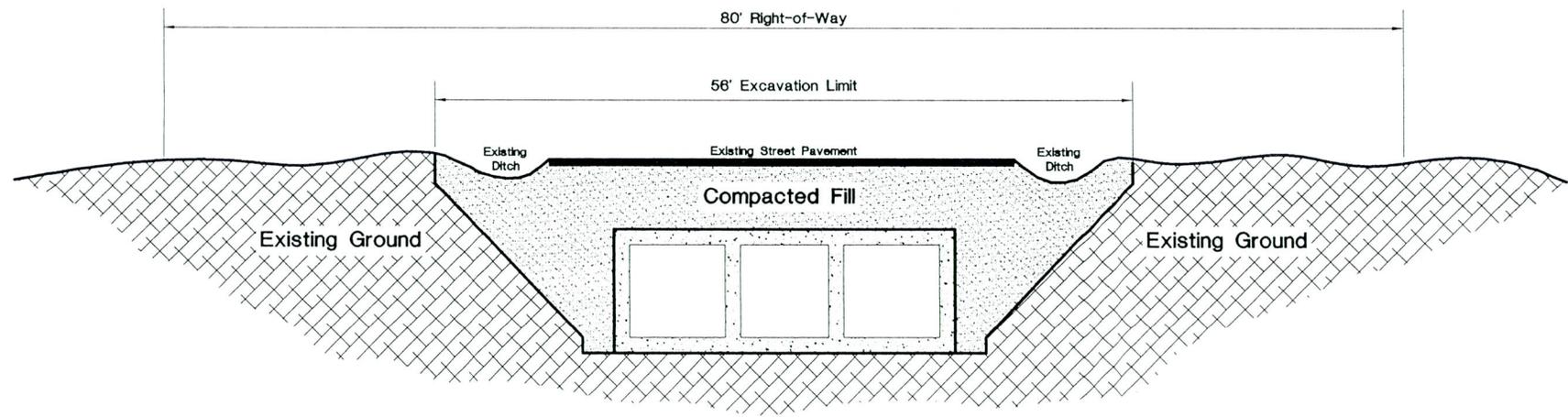
### 5.4 STORM DRAINS

The storm drain concrete box culvert size was determined by using a computer program called StormCAD. The size, slope and depth was adjusted so that the hydraulic grade line was a minimum of two feet below the surface of the existing ground. This should allow for the anticipated catch basin and connector pipe head losses.

ALTERNATIVE STORM DRAIN CAPACITY CROSS SECTIONS  
FOR DOUBLETREE RANCH ROAD FROM 52nd TO 56th STREET  
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY PROJECT NO. FCD 94-28



Alternative 1  
100-Year Storm Capacity  
Double Barrel Storm Drain



Alternative 2  
100-Year Storm Capacity  
Triple Barrel Storm Drain

FIGURE 10

An output informative message means there is a possible problem which should be investigated. The program was able to proceed with computations, but the results may sometimes be improved by revising the input data to eliminate the condition leading to the informative message.

“Critical Depth assumed upstream” is an assumption that should be verified by inspection of the storm drain properties. It should be checked that “n” values are reasonable. Another possibility checked is that there is a reduction in area compared to the downstream section. Another possibility is a change in invert elevations.

When flow passes rapidly from supercritical to subcritical depth, a hydraulic jump occurs. When the downstream depth is greater than the normal depth, a hydraulic jump will occur and in some cases of a hydraulic jump, the hydraulic grade at the downstream end of the pipe will exceed the hydraulic grade at the upstream end. The primary concerns associated with a hydraulic jump are whether the pipe can withstand the forces and how will it affect the hydraulic conditions. High energy losses, which make them good energy dissipators, and erosive forces are associated with jumps.

StormCAD does not perform any specific force analysis that seeks to precisely locate the hydraulic jump nor does StormCAD identify the occurrence of jumps that might happen as flows leave a steep pipe and enter a mild pipe. Rather StormCAD performs analyses sufficient to compute energy grades at junctions. The occurrence of hydraulic jumps typically does not affect these elevations when analyzed using conventional methods.

Special improved inlets will need to be designed to allow the required flow into the culverts. It will be necessary to design special transition structures where different sized culverts come together. Attention needs to be given to the location of existing utilities and to disturb as few as possible.

The outlet into Indian Bend Wash has a positive outfall where no standing water will accumulate. This requires an energy dissipator that will work on a flat slope. Individual dissipator designs have been qualified as to their area of application. The attributes delineated include: Froude number range for best performance; discharge velocity, maintenance, operational or location problems; maximum size; and limiting characteristics such as culvert slope or shape. The dissipator selection should be governed by comparing the efficiency, cost, channel compatibility, and anticipated scour for all the alternatives. A concrete impact basin and a rip rap basin were analyzed to get a comparison to include in the cost estimate.

Child resistant trash rack (safety grates) will prevent children from entering the culverts and also collect debris before it can clog up the inside of the culverts. Floating material, suspended sediment, and bed loads will be washed through the culverts if a velocity greater than 2.5 feet per second is maintained. The outlet will also have a child resistant grate to prevent children entering the culvert. Inlet wing walls will direct the water into the mouth of the storm drain culverts.

The manhole loss coefficient was selected per culvert situation of direction, size, etc. Manhole loss coefficients used throughout the model will need to be revised in the construction design depending upon the complexity of the flows through the structure (direction, expansion, contraction, etc.).



## 6.0 ALTERNATIVE EVALUATIONS

Evaluation of the alternatives consisted of qualitative and quantitative comparisons. Some specific items were given greater consideration in the analysis. Listed below are those items which were primary considerations in the alternatives evaluation, followed by items that were considered secondary.

### Primary Considerations:

1. Maximize capacity.
2. Minimize cost.
3. Minimize right-of-way acquisition.

### Secondary Considerations:

1. Minimize maintenance costs.
2. Provide safety at all box culvert inlets.
3. Minimize channel excavation for Cherokee Wash.
4. Do not exceed the maximum velocity for a given lining for Cherokee Wash.
5. Provide access in and out of Cherokee Wash channel.
6. Enhance visual appeal and environmental impacts.

A summary of the alternatives evaluation follows:

### 6.1 NO ACTION ALTERNATIVE

The No Action Alternative involves no planning along the corridors. There is no advantage to this alternative because it does not provide any logical solution to protect the residences in these corridors from flooding.

### 6.2 DOUBLETREE CORRIDOR ALTERNATIVES (See Figure 11)

#### 6.2.1 ALTERNATIVE 1

This alternative involves the construction of detention basins along with an open channel down the side of Doubletree Ranch Road.

#### Advantages:

- Low channel construction cost.
- Short construction time.
- Aesthetically pleasing, natural looking channel banks.
- Construction outside of roadway.
- Not labor intensive.

**SUMMARY OF CONSIDERED ALTERNATIVES**  
**DOUBLETREE RANCH ROAD REGIONAL DRAINAGE STUDY**  
**FLOOD CONTROL DISTRICT OF MARICOPA COUNTY PROJECT NO. FCD 94-28**

ALTERNATIVES	REMARKS
Open Channel with Detention Basins.	<ul style="list-style-type: none"> <li>• Least Cost Effective</li> <li>• Unsafe</li> <li>• High Maintenance</li> </ul>
Open Channel without Detention Basins.	<ul style="list-style-type: none"> <li>• Unsafe</li> <li>• Lack of Capacity</li> <li>• High Maintenance</li> </ul>
Storm Drain with Detention Basins in the Mountain Preserve.	<ul style="list-style-type: none"> <li>• Least Cost Effective</li> <li>• Lack of Capacity</li> </ul>
Storm Drain with Detention Basins in Residential Locations.	<ul style="list-style-type: none"> <li>• Least Cost Effective</li> </ul>
Storm Drain without Detention Basins.	<p><u>Recommended</u></p> <ul style="list-style-type: none"> <li>• Most Cost Effective</li> <li>• Safest</li> <li>• Sufficient Capacity</li> <li>• Least Maintenance</li> <li>• Least Visual Impact</li> </ul>

FIGURE 11

Disadvantages:

- Least cost effective (high detention basin cost due to land acquisition).
- Unsafe (vehicular and pedestrian).
- High Maintenance (vegetation growth through bank lining would require maintenance).
- Insufficient capacity in existing right-of-way.
- Requires culverts under driveways and streets.
- Might require grade control structures to lower velocity.
- Requires extensive excavation.

6.2.2 ALTERNATIVE 2

This alternative involves the use of open channels without detention basins.

Advantages:

- Low channel construction cost.
- Short construction time.
- Aesthetically pleasing, natural looking channel banks.
- Construction outside of roadway.
- Not labor intensive.
- Cost effective.

Disadvantages:

- Unsafe (vehicular and pedestrian).
- High Maintenance (vegetation growth through bank lining would require maintenance).
- Insufficient capacity in existing right-of-way.
- Requires culverts under driveways and streets.
- Might require grade control structures to lower velocity.
- Some bank linings might not be durable.
- Requires extensive excavation.

6.2.3 ALTERNATIVE 3

This alternative uses detention basins in the Phoenix Mountain Preserve with a storm drain system.

Advantages:

- Vacant government owned property can be utilized for basins.
- The basins are in the flow path of the existing channels.

Disadvantages:

- Storage capacity far smaller than needed.
- The Phoenix Mountain Preserve is to remain a natural sensitive area, and can't be disturbed.
- Political considerations used in evaluation.

#### 6.2.4 ALTERNATIVE 4

This alternative involves using detention basins located on vacant parcels within residential subdivisions with the use of a storm drain down Doubletree Ranch Road.

Advantages:

- Safer for vehicles and pedestrians.
- Aesthetically pleasing.
- Low maintenance.

Disadvantages:

- Least cost effective (high land acquisition cost for detention basin).
- Long construction time.
- Labor intensive.

#### 6.2.5 ALTERNATIVE 5

This alternative utilizes the use of a storm drain exclusively without the use of detention basins.

Advantages:

- Most cost effective.
- Safest (vehicular and pedestrian).
- Sufficient capacity to convey 100-year storm capacity.
- Least Maintenance.
- Least Visual Impact.

Disadvantages:

- Inconvenience to the community during construction.

### 6.3 CHEROKEE WASH CORRIDOR ALTERNATIVES (See Figure 12)

#### 6.3.1 ALTERNATIVE 1

This alternative involves the use of detention basins with excavated dirt (natural) channel.

**CHEROKEE WASH ALTERNATIVES**  
**DOUBLETREE RANCH ROAD REGIONAL DRAINAGE STUDY**  
**FLOOD CONTROL DISTRICT OF MARICOPA COUNTY PROJECT NO. FCD 94-28**

ALTERNATIVES	MAXIMUM CAPACITY WITHIN EASEMENT	REMARKS
Excavated Dirt Channel with Detention Basins	28-46 Year Storm	- \$ 3.1-5.9 Million - High Maintenance
Rock Lined Channel with Detention Basins	78 Year Storm	- \$ 7.5 Million - Medium Maintenance
Excavated Dirt Channel without Detention Basins	8-17 Year Storm	- \$ 1.2-3.0 Million - High Maintenance
Rock Lined Channel without Detention Basins	23 Year Storm	- \$ 5.5 Million - Medium Maintenance
Concrete Channel without Detention Basins	100 Year Storm	- \$ 7.4 Million - Least Safe - Minimum Maintenance - Negative Visual Impact

FIGURE 12

Advantages:

- Acceptable to residents.
- Low channel construction cost.
- Short construction time.
- Aesthetically pleasing, natural looking channel banks.

Disadvantages:

- High Maintenance.
- Does not provide desired capacity.
- High cost of property for detention basins.
- Requires grade control structures to lower velocity.
- Bank lining not durable.

### 6.3.2 ALTERNATIVE 2

This alternative uses detention basins with a rock lined channel.

Advantages:

- Acceptable to residents.
- High channel construction cost.
- Moderately aesthetically pleasing.

Disadvantages:

- Does not provide desired capacity.
- High cost of property for detention basins.
- Requires grade control structures to lower velocity.
- Medium maintenance.

### 6.3.3 ALTERNATIVE 3

Alternative 3 consists of a dirt (natural) channel without detention basins.

Advantages:

- Minimum channel construction cost.
- Short construction time.
- Aesthetically pleasing, natural looking channel banks.
- Cost effective.

Disadvantages:

- High Maintenance (vegetation growth through bank lining will require intense maintenance).
- Does not provide desired capacity.
- Might require grade control structures to lower velocity.
- Some bank linings might not be durable.

6.3.4 ALTERNATIVE 4

This alternative consists of a rock-lined channel without detention basins.

Advantages:

- Moderate channel construction cost.
- Moderate construction time.
- Moderately aesthetically pleasing, natural looking channel banks.
- Cost effective.

Disadvantages:

- High Maintenance (vegetation growth through bank lining will require intense maintenance).
- Does not provide desired capacity.
- Might require grade control structures to lower velocity.
- Some bank linings might not be durable.

6.3.5 ALTERNATIVE 5

This alternative consist of a concrete channel without detention basins.

Advantages:

- Meets 100-year capacity requirement.
- Minimum maintenance.
- Bank linings are durable.

Disadvantages:

- Least safe.
- Highest construction cost.
- Most negative visual impact.

6.3.6 ALTERNATIVE 6

This alternative was developed after the others were evaluated to provide a hybrid solution. It consists of diverting the 10-year 6-hour stormwater from Cherokee Wash into the Doubletree storm drain system

at 52nd Street and 56th Street. From 52nd Street to Indian Bend Wash, a gabion or wire tied rock rip rap will be used to maximize the channel capacity within the existing right-of-way.

Advantages:

- Improved capacity.
- Moderate channel construction/cleaning cost.
- Aesthetically pleasing, natural looking channel.

Disadvantages:

- Higher cost and longer construction time for Doubletree Storm Drain.

The preferred alternatives are Alternative 5 for the Doubletree Corridor and Alternative 6 for the Cherokee Wash Corridor.



## 7.0 ENVIRONMENTAL CONSIDERATIONS

As part of the alternatives development process, potential environmental impacts were identified and are described in the following sections.

### 7.1 LAND USE

Coordination with the City of Phoenix and the Town of Paradise Valley indicate that the vacant privately owned lands are zoned for residential use. The Phoenix Mountain Preserve is in government ownership and will never be developed.

The Doubletree Drainage System for the most part will be within the existing road right-of-way. Culvert inlets will also be installed within the right-of-way. The exceptions to this could be the culvert inlet at the top of Doubletree Corridor west of Tatum Boulevard, and the culvert inlets on Cherokee Wash. Existing land along the Cherokee Wash Corridor is in private residential ownership and the top portion is in the Paradise Valley Country Club Golf Course. These residential owners will be notified of construction on their properties as part of the design process before temporary construction easements are obtained. Proposed improvements along Cherokee Wash should not adversely affect existing or future land use.

The outlet into Indian Bend Wash by easement is part of the Maricopa County Flood Control Channel. Approval from the Marriott Camelback Golf Course will have to be obtained to install an energy dissipator.

### 7.2 HAZARDOUS MATERIALS

An environmental site assessment of the project area is being conducted under separate contract by the District.

There appears to be sporadic surface dumping throughout the entire length of Cherokee Wash and along Doubletree Ranch Road. Other than these isolated locations, there were no observations or evidence to suggest the potential presence of hazardous waste substances within the project area.

### 7.3 CULTURAL RESOURCES

Archeological investigations are being conducted under separate contract with the District.

### 7.4 FLOOD PLAIN CONSIDERATIONS

The Federal Emergency Management Agency (F.E.M.A.) has published Flood Insurance Rate Maps (FIRM) for Maricopa County and the City of Phoenix and Town of Paradise Valley (see Figures 13 and 14).

**FIRM**  
FLOOD INSURANCE RATE MAP

MARICOPA COUNTY,  
ARIZONA AND  
INCORPORATED AREAS

PANEL 1680 OF 4350

CONTAINS

COMMUNITY	NUMBER	PANEL	SUFFIX
PARADISE VALLEY, TOWN OF	040049	1680	
PHOENIX, CITY OF	040051	1680	
SCOTTSDALE, CITY OF	045012	1680	

MAP NUMBER  
04013C1680 E

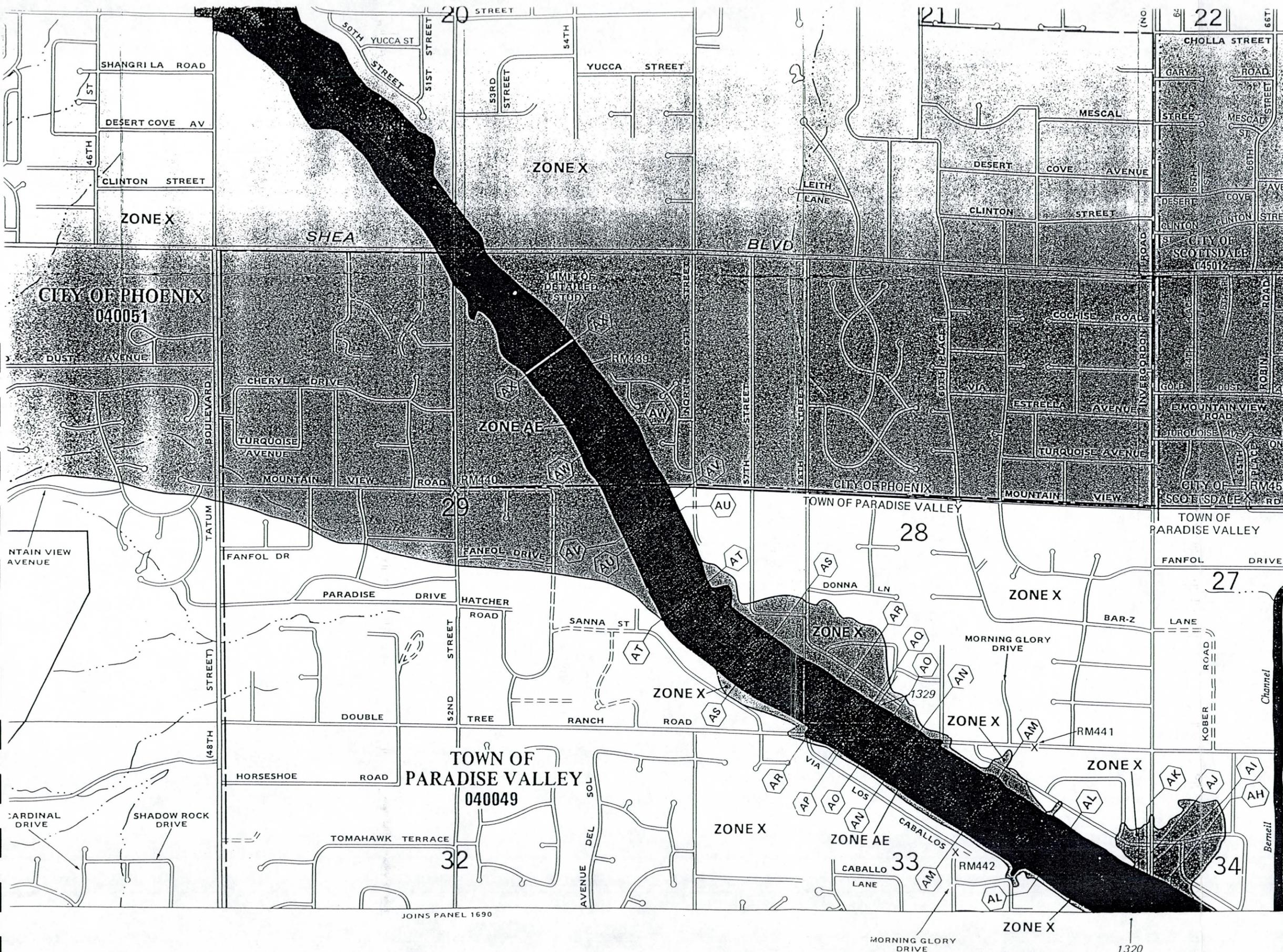
MAP REVISED:  
SEPTEMBER 29, 1989



Federal Emergency Management Agency

**LEGEND**

- SPECIAL FLOOD HAZARD AREAS INUNDATED BY 100-YEAR FLOOD
- ZONE A** No base flood elevations determined.
- ZONE AE** Base flood elevations determined.
- ZONE AH** Flood depths of 1 to 3 feet (usually areas of ponding); base flood elevations determined.
- ZONE A0** Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
- ZONE A99** To be protected from 100-year flood by Federal flood protection system under construction; no base elevations determined.
- ZONE V** Coastal flood with velocity hazard (wave action); no base flood elevations determined.
- ZONE VE** Coastal flood with velocity hazard (wave action); base flood elevations determined.
- FLOODWAY AREAS IN ZONE AE
- OTHER FLOOD AREAS
- ZONE X** Areas of 500-year flood; areas of 100-year flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 100-year flood.
- OTHER AREAS
- ZONE X** Areas determined to be outside 500-year flood plain.
- ZONE D** Areas in which flood hazards are undetermined.
- Flood Boundary
- Floodway Boundary
- Zone D Boundary
- Boundary Dividing Special Flood Hazard Zones, and Boundary Dividing Areas of Different Coastal Base Flood Elevations Within Special Flood Hazard Zones.
- 513 Base Flood Elevation Line; Elevation in Feet\*
- Cross Section Line
- Base Flood Elevation in Feet Where Uniform Within Zone\*
- Elevation Reference Mark



**FIGURE 13**

EXPLANATION OF ZONE DESIGNATIONS

ZONE	EXPLANATION
A	Areas of 100-year flood; base flood elevations and flood hazard factors not determined.
A0	Areas of 100-year shallow flooding where depths are between one (1) and three (3) feet; average depths of inundation are shown, but no flood hazard factors are determined.
AH	Areas of 100-year shallow flooding where depths are between one (1) and three (3) feet; base flood elevations are shown, but no flood hazard factors are determined.
A1-A30	Areas of 100-year flood; base flood elevations and flood hazard factors determined.

A99	Areas of 100-year flood to be protected by flood protection system under construction; base flood elevations and flood hazard factors not determined.
B	Areas between limits of the 100-year flood and 500-year flood; or certain areas subject to 100-year flooding with average depths less than one (1) foot or where the contributing drainage area is less than one square mile; or areas protected by levees from the base flood. (Medium shading)
C	Areas of minimal flooding. (No shading)
D	Areas of undetermined, but possible, flood hazards.
V	Areas of 100-year coastal flood with velocity (wave action); base flood elevations and flood hazard factors not determined.
V1-V30	Areas of 100-year coastal flood with velocity (wave action); base flood elevations and flood hazard factors determined.

CITY OF PHOENIX  
040051

JOINS PANEL 1680

ZONE B  
ZONE C  
ZONE A5  
1320

Bernell Channel

ZONE A  
ZONE B

LIMIT OF  
DETAILED STUDY

PROFILE  
BASE LINE

NATIONAL FLOOD INSURANCE PROGRAM

**FIRM**  
FLOOD INSURANCE RATE MAP

MARICOPA COUNTY,  
ARIZONA AND  
INCORPORATED AREAS

PANEL 1690 OF 4350

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
MARICOPA COUNTY, UNINCORPORATED AREAS	040037	1690	D
PARADISE VALLEY, TOWN OF	040049	1690	D
PHOENIX, CITY OF	040051	1690	D
SCOTTSDALE, CITY OF	045012	1690	D

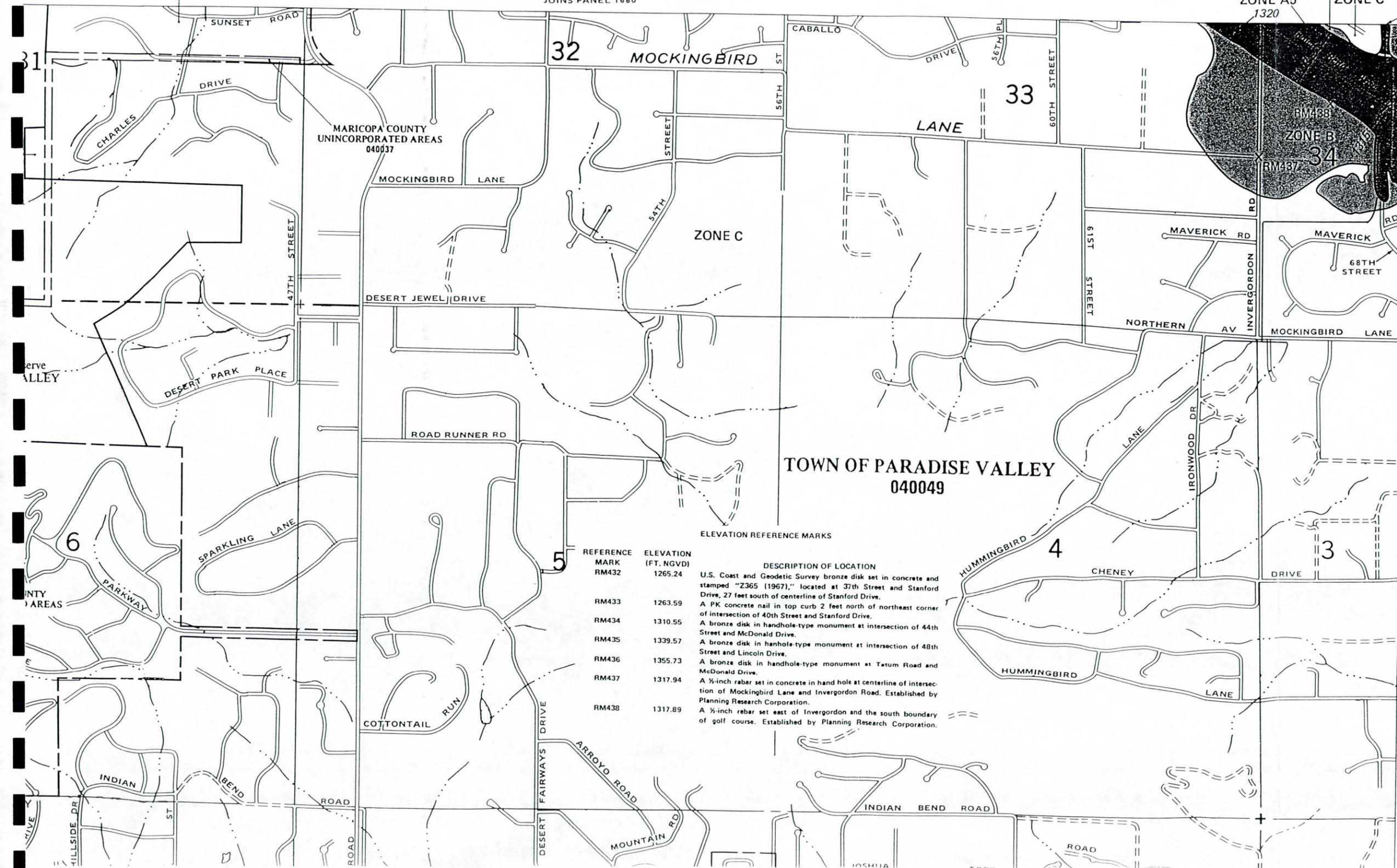
MAP NUMBER  
04013C1690 D

EFFECTIVE DATE:  
APRIL 15, 1988



Federal Emergency Management Agency

FIGURE 14



TOWN OF PARADISE VALLEY  
040049

ELEVATION REFERENCE MARKS

REFERENCE MARK	ELEVATION (FT. NGVD)	DESCRIPTION OF LOCATION
RM432	1265.24	U.S. Coast and Geodetic Survey bronze disk set in concrete and stamped "Z365 (1967)," located at 37th Street and Stanford Drive, 27 feet south of centerline of Stanford Drive.
RM433	1263.59	A PK concrete nail in top curb 2 feet north of northeast corner of intersection of 40th Street and Stanford Drive.
RM434	1310.55	A bronze disk in handhole-type monument at intersection of 44th Street and McDonald Drive.
RM435	1339.57	A bronze disk in handhole-type monument at intersection of 48th Street and Lincoln Drive.
RM436	1355.73	A bronze disk in handhole-type monument at Tetum Road and McDonald Drive.
RM437	1317.94	A 1/2-inch rebar set in concrete in hand hole at centerline of intersection of Mockingbird Lane and Invergordon Road. Established by Planning Research Corporation.
RM438	1317.89	A 1/2-inch rebar set east of Invergordon and the south boundary of golf course. Established by Planning Research Corporation.

This project is in Zone "B" Map Number 04013C1690D effective date April 15, 1988 south of Mockingbird Lane and Zone "X" Map Number 04013C1680E map revised September 29, 1989 for area north of Mockingbird Lane. These are areas between the limits of the 100-year flood and 500-year flood; or certain area subject to 100-year flooding with average depths less than one (1) foot or where the contributing drainage area is less than one square mile; or areas protected by levees from the base flood.

Indian Bend Wash is classified in Zone "AE" which are areas where the base flood elevation has been determined.

The District completed a delineation of the waters of the United States in May 1994 and the subsequent delineation showed that the U.S. Army Corps of Engineers has no jurisdictional authority over Cherokee Wash and Doubletree Ranch Road Wash.

Cherokee Wash and Doubletree Ranch Road Wash are ephemeral streams that flow only when it rains.

#### 7.5 THREATENED AND ENDANGERED SPECIES

Threatened and endangered species investigations are being conducted under separate contract with the District.

#### 7.6 VEGETATION

Vegetation types will be determined along the banks of the wash and the channel bottom under separate contract with the District.

Native species should be utilized for aesthetic treatments and revegetation.

#### 7.7 WATER QUALITY

Improvements within Cherokee Wash will have the potential for temporary effects upon the water quality of the wash. The actual extent of these effects will depend upon the time of year in which construction occurs, as the wash is an intermittent stream that is dry for most of the year. A National Pollutant Discharge Elimination System (NPDES) permit will be required from the Environmental Protection Agency in order to construct any improvements in or adjacent to existing streams and washes. All potential impacts will be minimized by adhering to FCD's Drainage Design Manual for Maricopa County, Arizona, Volume III, Erosion Control.

Cherokee Wash and Doubletree Ranch Road Wash are not designated as wild and scenic rivers and do not require special consideration as required by the Wild and Scenic Rivers Act (16 USC 1271-1287).

7.8 CONSTRUCTION IMPACTS

Temporary air and noise impacts will occur during construction of improvements along Doubletree Corridor and Cherokee Wash. The construction contractor will be required to control fugitive dust with water applications and comply with City, Town, and County regulations to minimize air and noise impacts. To control erosion, areas disturbed by construction will be either revegetated with indigenous plant species (as listed under vegetation earlier in this section) or bank protection will be constructed.



## 8.0 COST ESTIMATES

Cost estimates were prepared for all channel and storm drain alternatives. Unit prices were based on recent District and Arizona Department of Transportation bid results with adjustments made to reflect the difficulty of the work anticipated. The costs are intended to provide estimates and are relative subject to design specifications and the scarcity of either material or labor (see Tables 2 and 3).

The cost data are most useful in three areas:

1. Assessing relative cost of different levels of stormwater control practices (see appendices).
2. Providing general guidelines to local governments in the estimation of improvement costs.

The optimum combination of practices should be the objective, in other words, the greatest level of protection effectiveness at the least cost.

The basis of the quantity estimates and unit prices are as follows:

- Clearing and Grubbing----Construction area quantities were computed based on maximum area needed for development. A price of \$1,850/acre was used.
- Channel Excavation----Quantities were provided by using a typical cross section of the channel and projecting down the whole reach. A price of \$6.00/cubic yard was used.
- Dumped Rip Rap----Quantities were based on a 24-inch thick rip rap blanket with a two foot toe down. The unit price includes the rip rap and a non-woven filter fabric. A price of \$35.00/cubic yard was used.
- Concrete Construction----Quantities were based on ADOT summaries of box culverts with the cement and reinforcing steel quantified separately. A price of \$300/cubic yard for cement poured in place and a price of \$.50/pound for steel was used.
- Dirt (Granite)---Quantities were based on a six inch thick blanket with no filter fabric to protect it. A price of \$12.00/cubic yard was used.
- Land Cost----Quantities for detention basin and drainage easement were determined by aerial photographs. From a known piece of property, a price of \$125,000/acre was used.
- Culvert Excavation----Quantities were provided by using ADOT (B-19.50, C-13.15) typical cross section of the trench with 1.5:1 side slopes. A price of \$6.00/cubic yard was used.
- Structural Backfill----Quantities were provided by using ADOT (B-19.50) typical cross section of straight walls two feet from the edge of box wall. A price of \$18.00/cubic yard was used.
- Road Removal----Quantities were computed based on the area needed for trench excavation. A price of \$2.50/square yard was used.
- Road Replacement----Quantities were based on trench width for excavation and a four inch AC and ten inch ABC by City of Phoenix cost estimate. Curb and gutter was not included in this price. A price of \$14.00/square yard was used.

- Pipe Culverts----Costs were based on a reinforced concrete pipe, size and linear feet of pipe by using ADOT construction cost.
- End Sections----Costs were based on reinforced concrete end sections, and the size of the pipe culvert from ADOT construction cost.
- Energy Dissipator----No specific type of energy dissipator is identified at this time. Cost for this item was estimated as a lump sum of \$195,000 (see Cost Analysis in Appendices).
- Grade Control Structures----No specific type of grade control structure has been identified at this time; cost for this item was estimated as a lump sum of \$15,000 each depending on the frequency of the storm design. Four grade control structures were estimated in Cherokee Wash.
- Tatum Crossing----Extra construction costs were estimated due to the complexity of traffic control of Tatum Boulevard and depending on the frequency of the storm design. A price of \$100,000 was used.
- Headwalls----Costs were based on ADOT construction cost for pipe culverts over 48 inch diameter and for box culverts the quantities were based on concrete and reinforcing steel quantities (see Concrete).
- Junction Boxes----Costs were based on size and complexity of the box based on ADOT construction cost. A price of \$25,000/box was used.
- Manholes----Costs were based on ADOT detail C-18.10-40 construction cost. A price of \$5,500/manhole was used.
- Inlets----Costs were based on ADOT catch basin construction cost. A price of \$2,000/catch basin was used.
- Grader Ditch Channels----Costs were based on ADOT construction cost. A price of \$5.00/linear foot was used.
- Detention Basins
  - ◆ Structural Fill----See Backfill. Side slopes of 4:1 was used.
  - ◆ Environmental Impact Mitigation---Cost for this work includes erosion control, protection against water/soil contamination, revegetation of channel were necessary and removal of construction waste. Cost for this item was estimated as 2 percent of the construction cost.
  - ◆ Fence----Quantities were based on a six foot high chain link fence. A price of \$9.00/linear foot was used.
  - ◆ Outlet Weir----No specific overflow weir has been designated; cost was estimated as a lump sum. It is anticipated that they will be constructed out of concrete and steel with an energy dissipator at the bottom. Variable prices were used depending upon the size of the basin.
- Utility Relocation----Cost for this item is estimated per utility relocation.
- Engineering Design----Cost for this item is estimated as ten percent of the construction cost. It includes all civil, geotechnical, surveying, landscape, and structural engineering.
- Construction Administration----Cost for this item is estimated as ten percent of construction cost. It includes inspection, survey and testing.
- Contingency----Cost for this item is estimated as 12 percent of both land and construction cost.

## TABLE 2

### DOUBLETREE RANCH ROAD

PROJECT NO. 2878

### DOUBLETREE RANCH ROAD STORM DRAIN PRELIMINARY COST ESTIMATE SUMMARY ALTERNATIVE NO. 5

DOUBLETREE STORM DRAIN SYSTEM Including CHEROKEE WASH DIVERSION at 52nd and 56th Streets

ALTERNATIVES	LAND/ EASEMENT ACQUISITION	STORM DRAIN CONST.	DETENTION BASIN CONST.	SUB TOTAL CONST.	UTILITY RELOCATION	ENGINEERING DESIGN	CONSTRUCTION ADMIN.	CONTINGENCY	TOTAL PROJECT COST
	(\$)	(\$)	(\$)	(\$)	(\$)	(\$)	(\$)	(\$)	(\$)
NO DETENTION BASINS 100-Year	328,496	15,583,269	-0-	15,583,269	393,280	1,558,327	1,558,327	1,909,412	\$21,331,111

## TABLE 3

### DOUBLETREE RANCH ROAD PROJECT NO. 2878

### CHEROKEE WASH DRAINAGE CORRIDOR PRELIMINARY COST ESTIMATE SUMMARY ALTERNATIVE NO. 6

TRAPEZOIDAL CHANNEL GABIONS from Indian Bend Wash to Paradise Valley Country Club  
CULVERT DESIGN to CHANNEL CAPACITY

ALTERNATIVES	LAND/ EASEMENT ACQUISITION	CHANNEL CONSTRUCTION	CULVERT CONST.	UTILITY RELOCATION	ENGINEERING DESIGN	CONSTRUCTION ADMIN.	CONTINGENCY	TOTAL PROJECT COST
	(\$)	(\$)	(\$)	(\$)	Includes: Civil Geotechnical Landscape Structural Survey  10% of Construction (\$)	Includes: Inspection Survey Testing  10% of Construction (\$)	12% of Land Acquisition & Construction (\$)	(\$)
NO DETENTION BASINS	414,514	1,842,742	624,328	62,740	246,707	246,707	345,790	\$ 3,783,528

WSS 12/17/96  
Ckd:



## 9.0 PUBLIC INVOLVEMENT PROGRAM

### 9.1 TOWN OF PARADISE VALLEY PUBLIC MEETING PROGRAM

In January of 1994, Hook Engineering was contracted by the Town of Paradise Valley to do a study entitled "Doubletree Ranch Road Drainage and Street Improvement Project." The initial public involvement phase of this project was intended to listen to residents' concerns and build consensus among them regarding project parameters. The first public meeting was held on January 19, 1994 at the Cherokee Elementary School in the Town of Paradise Valley with approximately 180 people in attendance. Both verbal and written comments were received. After the first public meeting, many citizens indicated their desire to be included in a neighborhood meeting. Four neighborhood meetings were held at Town Hall because of the large anticipated attendance on February 16, 17, 22, 23, 1994. Sixteen residents requested individual meetings and Hook Engineering scheduled these meetings with the residents and representatives from the District. **It became clear that the project parameters needed to expand to address regional drainage issues,** and coordination with the District became more extensive than originally anticipated. On March 23, 1994, a final public meeting was held at Cherokee Elementary School to present the proposed District project schedule and parameters to the citizens. Following these meetings, the District went through the process of selecting a consulting engineering firm to perform a feasibility study of the flooding and drainage problems in the Doubletree Ranch Road Regional Drainage area.

The following agencies were contacted during project development and invited to participate in a project scoping session:

- City of Phoenix
- Town of Paradise Valley

### 9.2 FLOOD CONTROL DISTRICT PUBLIC INVOLVEMENT PROGRAM

After the Notice to Proceed was given on December 8, 1994 by the District, Hook Engineering set up a meeting with the Town of Paradise Valley on January 4, 1995, to brief them on the public involvement meeting to be held on January 11, 1995. Presented at this briefing was a summary of study activities, review of the public meeting agenda and study schedule, review of aesthetic advisory committee guidelines, and review of overall project status.

At the public involvement meeting held on January 11, 1995 at the Cherokee Elementary School in the Town of Paradise Valley, a formal presentation was given which included a summary of the District's program for completion of the study, design and construction of the project. The study schedule and details of the technical process to be followed during the study were explained. An overview of the public involvement process and responsibilities of the aesthetics advisory committee were also explained.

In August of 1995 a mailing list of approximately 2,000 addresses was created and a questionnaire was mailed out on the 28th of the month. The questionnaire responses were evaluated and presented in an exhibit in the following public involvement meetings (see Figure 15).

On Wednesday, September 20, 1995, a progress meeting was held with the Town of Paradise Valley to present and discuss the progress of the Doubletree Ranch Road Regional Drainage Study. The staff was shown where the proposed detention basins were located. The criteria for locating of the detention basins included placing them on vacant property, in the path of the existing channel and that no pumps or diversions were to be utilized. It was felt that Phoenix Mountain Preserve property should not be used for detention basins due to the District's past experiences with other projects. The Town of Paradise Valley determined that a meeting should take place to discuss this issue from a political point of view with the City of Phoenix.

On Friday, October 20, 1995, Mayor Joan Horne and staff of Town of Paradise Valley met with Mayor Skip Rimsza and staff of City of Phoenix and discussed the possibility of detention basins in the Phoenix Mountain Preserve. It was concluded that the City and Town staffs would work together to evaluate different alternatives and combinations to see if it would be practical for detention basins to be built in the Phoenix Mountain Preserve. The study was to address the costs versus the benefits of detention basins in the preserve taking into account that the purpose of the Preserve is desert wildlife preservation. Approval for any basin sites would need to be obtained from the Phoenix Park Board and Citizens of the Phoenix Mountain Preserve.

On Thursday, November 16, 1995 a progress meeting update was held to discuss the status of the Doubletree drainage study at the Town of Paradise Valley. A summary of the Doubletree Corridor storm drain alternative concepts was presented. It was determined that the detention basins along Doubletree Ranch Road were not cost effective because land costs were higher to construct detention basins than a 100-year capacity storm drain system down Doubletree Ranch Road. At this time, the Doubletree Drainage System was designed to accept 400 cubic feet per second at 56th Street from Cherokee Wash. The Phoenix Mountain Preserve basins were ruled out because they would not detain enough stormwater to make a significant difference. From the alternative concepts, the town expressed a desire for the project direction to be a 100-year capacity storm drain constructed in Doubletree Ranch Road, and the District directed us to proceed with this preferred alternative.

Another progress meeting was held on Thursday, December 14, 1995 at the Town of Paradise Valley to present findings on the Cherokee Wash Corridor alternatives solutions and a summary of the costs. The alternatives were reviewed, which included lining the channels with granite, rock or concrete. To increase capacity, detention basins could be added upstream on vacant property. The alternatives were rated from a technical basis on capacity, cost, and maintenance. The consensus was that construction should stay within the existing drainage easements, detention basins would not be built as part of this

QUESTIONNAIRE RESPONSE SUMMARY  
DOUBLETREE RANCH ROAD REGIONAL DRAINAGE STUDY  
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY PROJECT NO. FCD 94-28

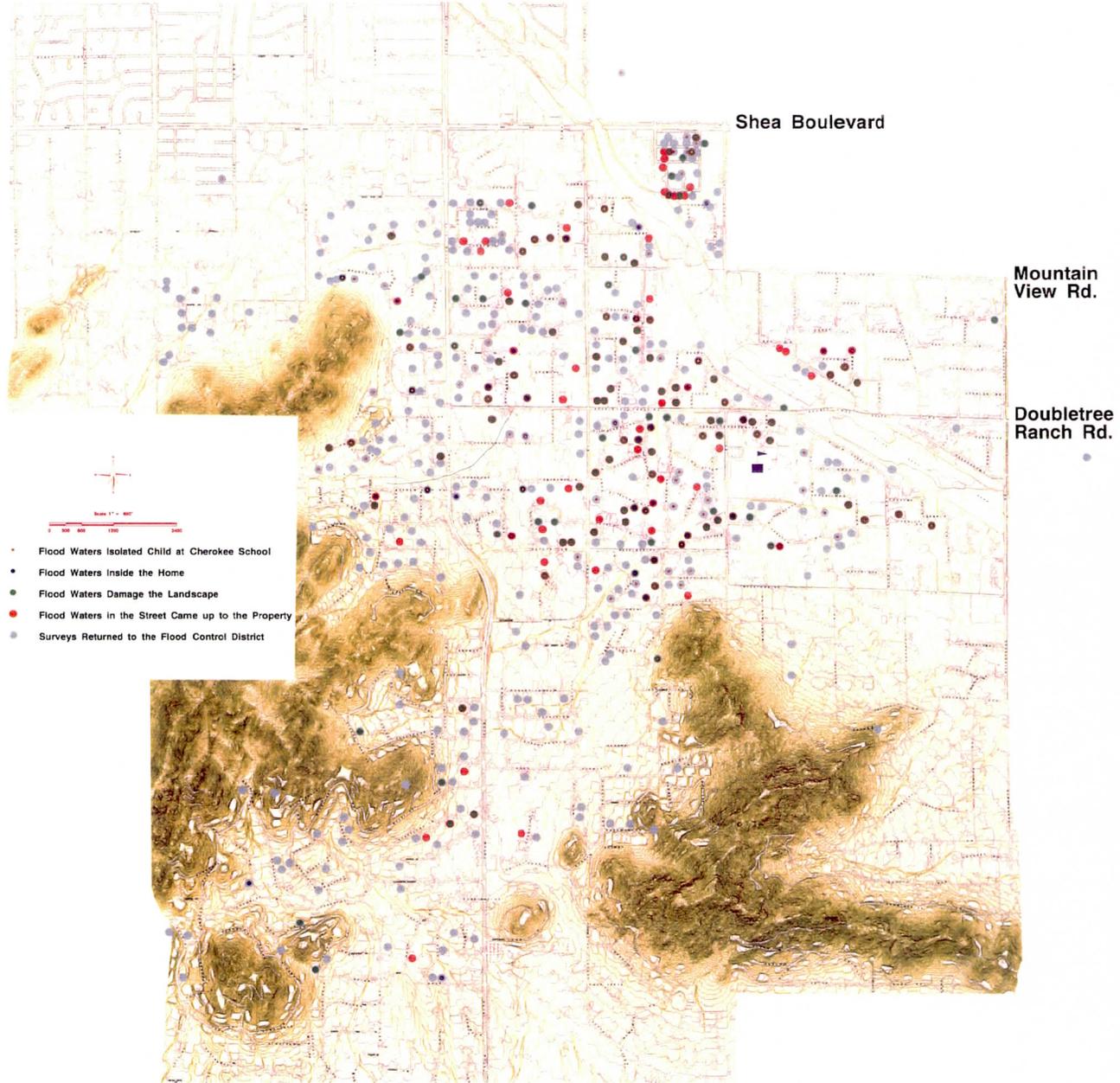


FIGURE 15

project, and that a concrete channel is not really compatible with the neighborhood. Rock or dirt would be the choice for the lining of the channel but it will be necessary to continue a dialog with the residents and the District to determine more specifically what the treatment should be. After this meeting, the District directed us to proceed with the development of a sixth alternative for Cherokee Wash which would include bleeding 10-year capacity off Cherokee Wash into the Doubletree Corridor storm drain system at 52nd Street and 56th Street. Ultimately, this alternative evolved to limit channel improvements form 52nd Street and Indian Bend Wash.

A public information meeting was to be held on Tuesday, January 9, 1996 at the Cherokee School in the Town of Paradise Valley for the Doubletree Ranch Road Corridor but due to a delay in the notification mailing only those who knew about it responded, chiefly the Town Council.

Another date was set for the public information meeting for the Cherokee Wash Corridor on Wednesday, January 17, 1996. Because of the poor turnout at the first public meeting, it was decided to combine both corridors into this one date. An open house format was used to inform the public of the most beneficial alternatives to seek input regarding their concerns and requests and ultimately their preference regarding which alternative should be constructed. C-Vision has provided computer enhanced photographs depicting how the area will appear after construction is completed and vegetation has been established (see Figures 16 and 17). The photographs enabled residents to visualize the benefits of proposed improvements. The meeting was attended by 79 citizens. Written comments and rankings were received from 42 citizens (see Figures 18 and 19). A copy of the compiled results is included for your review.

### 9.3 TOWN COUNCIL MEETING

On Thursday, March 14, 1996 at the Town Council Meeting in the Town of Paradise Valley, Greg Rodzenko of the District, presented the preferred alternatives for the Doubletree Corridor and Cherokee Wash Corridor. After the input from concerned citizens, the Town Council took a vote and passed a resolution authorizing the District to proceed to the design phase.



Existing View Looking NorthEast Toward Tatum Boulevard



Simulation of Completed Project

**Double Tree Ranch Road Wash**  
Town of Paradise Valley / Flood Control District





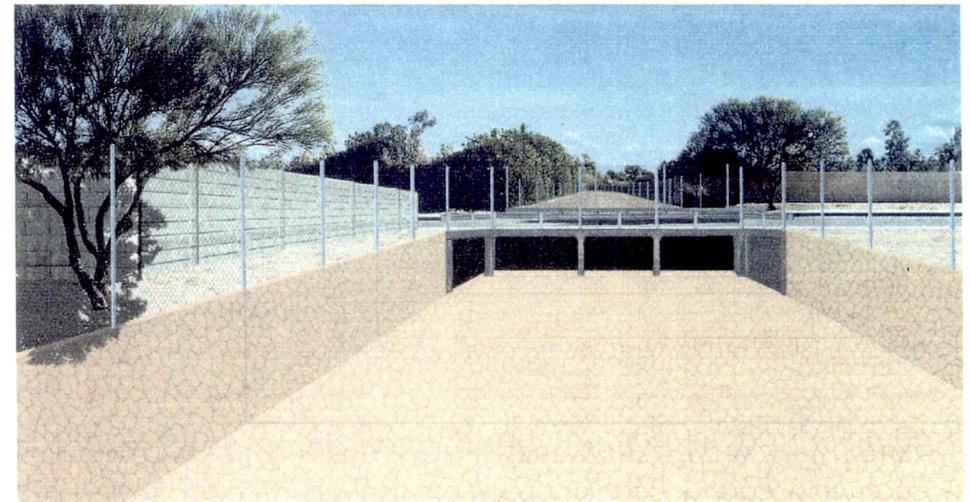
Existing View



Excavated Dirt Channel



Rock Lined Channel



Concrete Channel



Maricopa County  
Flood Control District

# Proposed Cherokee Wash Alternatives

FIGURE  
17



# Hook Engineering, Inc.

---

---

## MEMO

---

---

*Date:* January 22, 1996

*To:* Bert Miller, Flood Control District of Maricopa County

*From:* Susan McManus

*Subject:* Summary of Comments Received at the Doubletree Ranch Road Drainage Project Open House, January 17, 1996

---

Seventy-nine attendees signed the attendance register at the Open House Wednesday evening.

We received 29 comment forms for Area A (Doubletree Ranch Road Drainage Corridor).

- 25 Preferred the "100-year" storm drain
- 1 Preferred the "10-year" storm drain
- 1 Wrote in that a "50-year" storm drain would be ideal
- 2 Did not express a preference.

We received 13 comment forms for Area B (Cherokee Wash Drainage Corridor).

We asked the respondents to rank the five alternatives in order of preference. By assigning 5 points to each "1st preference" response, 4 points to each "2nd preference" response, 3 points to each "3rd preference" response, 2 points to each "4th preference response, and 1 point to each "5th preference" response, we have come up with the following scores for each alternative.

**FIGURE 18**

Alternative	Score	# of 1st Rankings
Excavated Dirt Channel with Detention Basins	37	5
Rock Lined Channel with Detention Basins	37	3
Excavated Dirt Channel without Detention Basins	18	1
Rock Lined Channel without Detention Basins	34	3
Concrete Channel without Detention Basins	18	* 0

\* The concrete channel also received several emphatic comments like "NO WAY" and "UNACCEPTABLE".

We asked if the respondents favored the use of Detention Basins. The results were:

Yes . . . . . 6  
 No . . . . . 4

We asked which type of channel treatment the respondents favored. The results were:

Dirt/Decomposed Granite . . . . . 5  
 Rock . . . . . 6  
 Concrete . . . . . 0

One respondent wrote in "Clean existing channel".

Other written comments included four references to the crossing at 56th Street needing immediate attention and two references to building box culverts where dip sections currently exist.



## 10.0 DISCUSSION

Essentially, the objective of this report is to develop a conceptual plan to be used for preparation of construction plans for the storm drain trunk line and channel improvements to control flooding. The District and the Town of Paradise Valley can now use the results of this report to proceed with the preferred alternatives.

In the Doubletree Corridor, detention basins were determined not to be cost effective because of land cost in the Town of Paradise Valley. A storm drain system using concrete box culverts was conceptually designed for the 100-year 6-hour storm event. The storm drain conveyance system was designed to contain flooding with little disruption and inconvenience. Safety for pedestrians and vehicular traffic will be greatly improved. The culverts were designed so the hydraulic gradient would be at least two feet below existing ground. The Doubletree Ranch Road storm drain system was analyzed with both the 100-year and 10-year inlet discharges and tailwater depths at Indian Bend Wash. By the time the hydraulic gradient is to Junction 3 (J3), the water surface elevation is approximately back to normal. None of the lateral trunk lines were affected by the difference in tailwater elevations. Special improved inlets might be needed to increase the hydraulic inlet efficiency. Concrete box culverts are an efficient way to hydraulically transport storm runoff. Right-of-way requirements are kept to a minimum.

The Doubletree storm drain system is designed to pick up six main wash areas: Doubletree Ranch Road Wash west of Tatum Boulevard; ~~Berneil Wash at 52nd Street~~; Butler Wash at Tatum Boulevard; the wash at approximately 54th Street and Doubletree Ranch Road; and Cherokee Wash at 52nd Street and 56th Street. There is a lateral designed for the west side of Tatum Boulevard to pick up storm runoff from an existing culvert at Tomahawk Drive. The rest of the sub-basin storm runoff will be picked up as local water in catch basins along the storm drain system where local drainage patterns dictate. The 10-year 6-hour storm event of Cherokee Wash will be diverted at 52nd Street and 56th Street because the natural channel cannot handle the 100-year storm capacity within the existing drainage easement banks. Diverting stormwater from Cherokee Wash will provide enhanced flooding protection to the areas down stream of the diversions but it will provide less than the 50-year storm protection.

Indian Bend Wash storm runoff peaks at this location after the stormwater from Doubletree Ranch Road and Cherokee Wash peak. An energy dissipator is required at the outlet in Indian Bend Wash because of the velocities generated in the box culvert. The outlet elevation was set so that there would be a positive slope down Indian Bend Wash and no ponding water in the culvert.

Table 2 summarizes the construction cost for the Doubletree storm drain system including extensions to pick up water from Cherokee Wash. Table 3 summarizes the construction cost for the Cherokee Wash Corridor.

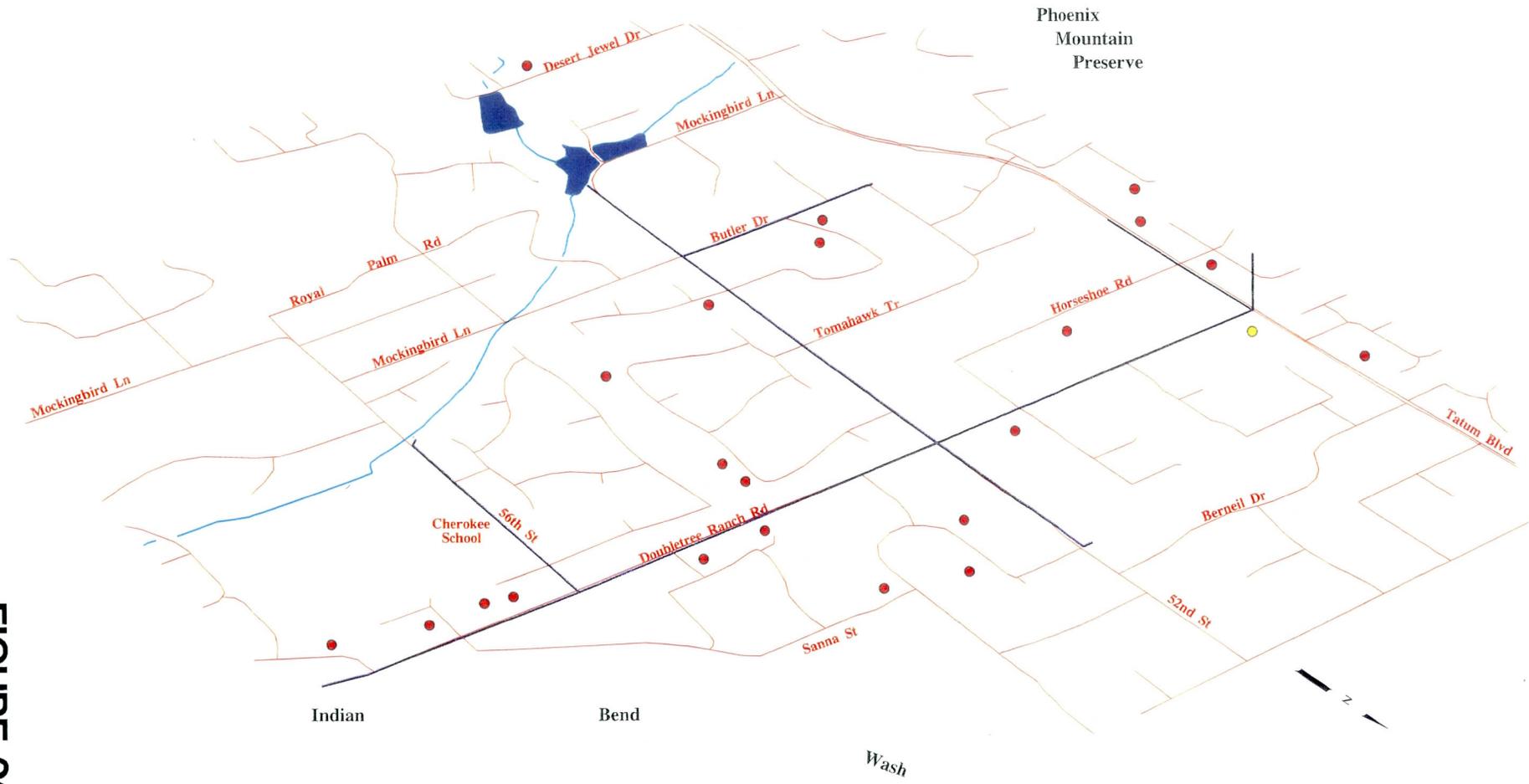
Drainage easements where not already existing, will be required to stop encroachment upon Cherokee Wash. Removal by the homeowners of existing trash and debris that has

accumulated over the years of development will greatly improve the flow characteristic of Cherokee Wash.

The proposed drainage structures have been conceptually designed and will improve control of stormwater in both the Doubletree and Cherokee Wash Corridors (see Figure 20). A sediment transport study is under contract by the District for Cherokee Wash. Once the sediment report has been completed and accepted, the grades and any structures that have been recommended can be used to further define the frequency protection of the ultimate channel capacity improvement of Cherokee Wash.

Kaminski-Hubbard Engineering's report entitled "Final Drainage Report for Tatum Boulevard, Cadia Del-Sol to Shea Boulevard," dated January 22, 1993 makes a recommendation to address street runoff on Tatum Boulevard for the City of Phoenix. Following the recommendation, the plans have included a 30" line along Tatum Boulevard south of Doubletree Ranch Road to collect runoff from an existing wash and culvert by Tomahawk Trail. Catch basins can be added to this extension during the design phase of this project. Construction of the storm drain system from Hatcher Wash north to approximately Mountain View Road should be postponed until Hatcher Wash between Tatum Boulevard and 52nd Street has been designed and constructed to handle the flows.

FIGURE 20



# Doubletree Public Input

**Legend**

- Cherokee Wash Improvements
- Doubletree Improvements
- Streets
- Basins
- 10 Year Storm Event
- 100 Year Storm Event





## 11.0 REFERENCES

1. City of Phoenix, Arizona, The Floodplain Management Section of the Street Transportation Department, The Local Flooding Mitigation Program, Volume I and II, March 1992.
2. Federal Emergency Management Agency, Flood Insurance Study For Maricopa County, Arizona, Arizona And Incorporated Area. Revised September 29, 1992.
3. Flood Control District of Maricopa County, Drainage Design Manual For Maricopa County, Arizona, Volume II, Hydraulics. November, 1991.
4. King, Horace W. and Brater, Ernest F., Handbook of Hydraulics, Sixth Edition, McGraw-Hill Book Company, 1963.
5. U.S. Department of Transportation, Federal Highway Administration, Hydraulic Design of Highway Culverts, HDS No. 5, September 1985.
6. U. S. Army Corps of Engineers, The Hydrologic Engineering Center, Simulation of Flood Control and Conservation Systems, April 1982.
7. Dodson and Associates, Inc., Computer Program, Hydrocalc Hydraulics, 1989.
8. Thomson and Hjalmarson, U.S. Geological Survey, Estimated Manning's Roughness Coefficients for Stream Channels and Floodplains in Maricopa County, Arizona, 1991.
9. Chow, Ven Te, Open Channel Hydraulics, McGraw-Hill Book Company, Inc., New York, NY, 1959.
10. Haestad Methods, Computer Program, StormCAD for Windows, Version 1.0, 1995.

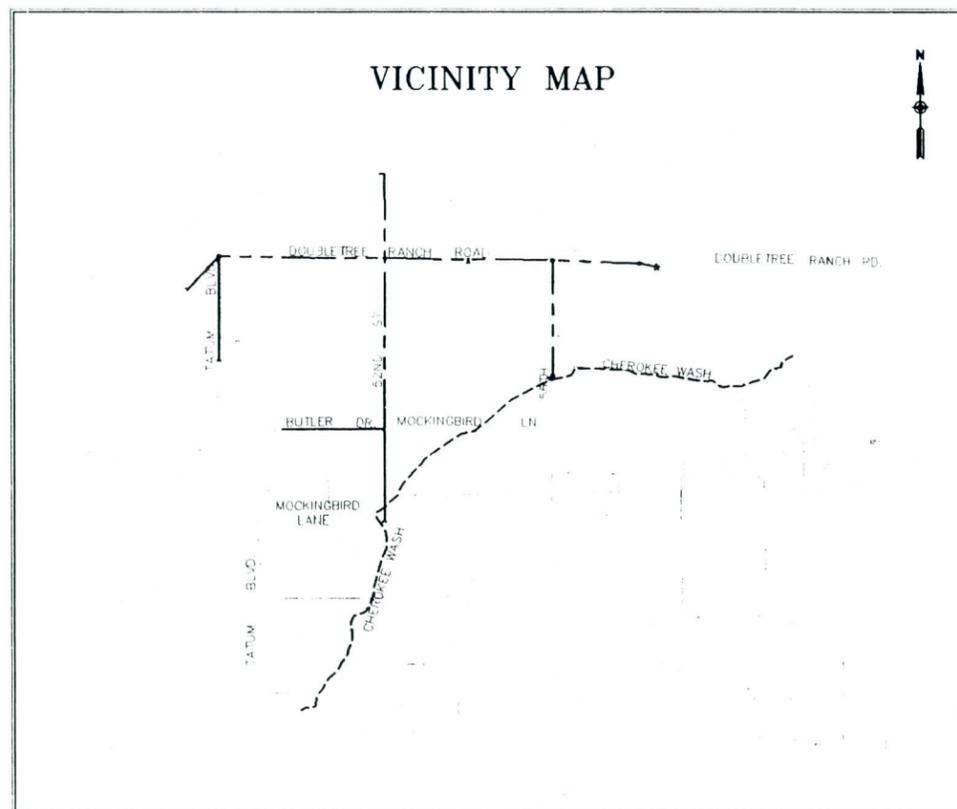
# FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

## CONCEPTUAL STORM WATER PLANS

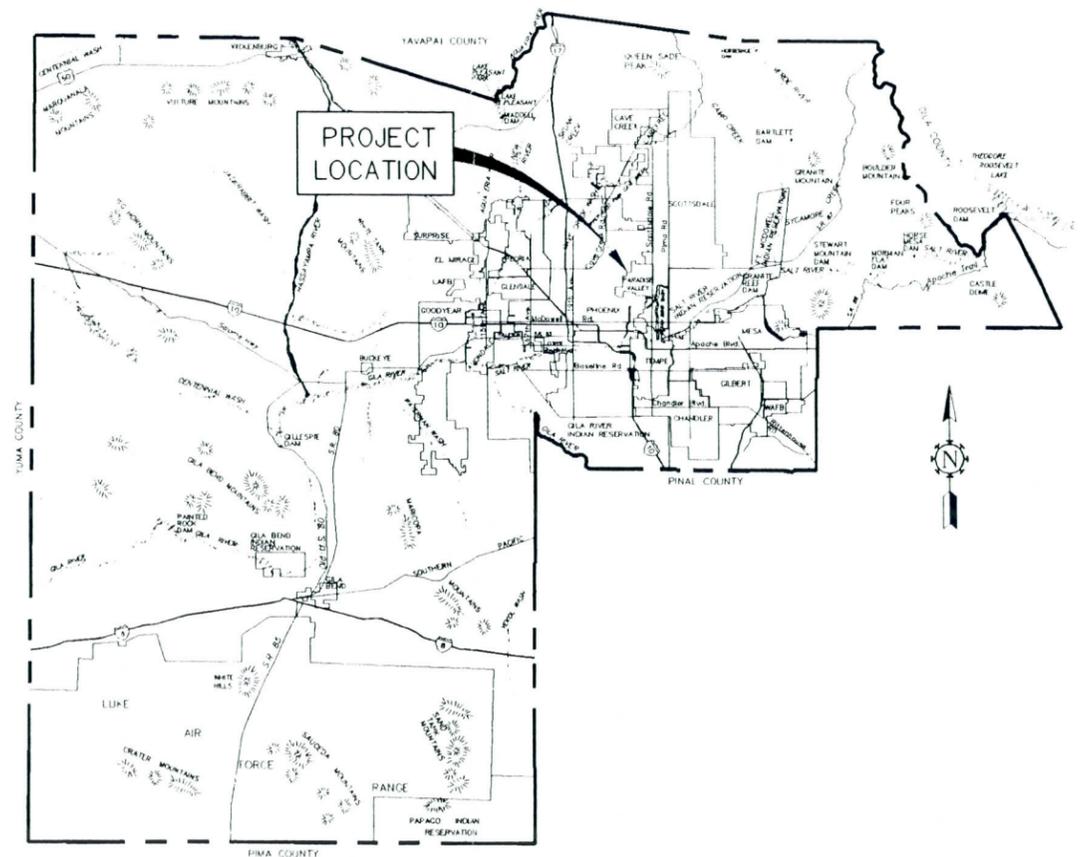
FOR

## DOUBLETREE RANCH ROAD REGIONAL DRAINAGE STUDY

DOUBLETREE RANCH ROAD CORRIDOR  
CHEROKEE WASH CORRIDOR



2801 WEST DURANGO  
PHOENIX, AZ 85009



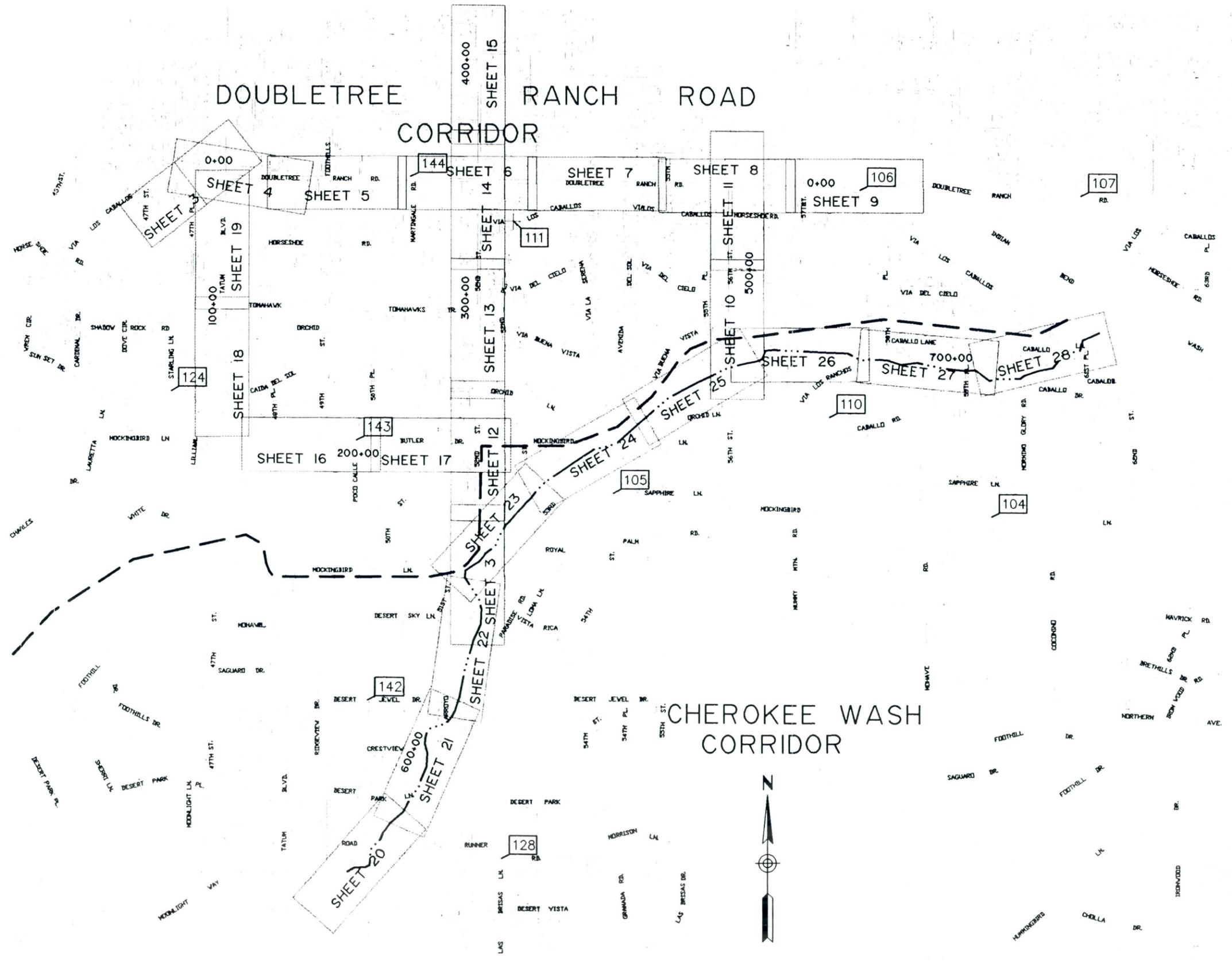
MARICOPA COUNTY  
NOT TO SCALE

F.C.D. CONTRACT NO. 94-28

<b>HOO K ENGINEERING, INC.</b> <small>3511 E. INDIAN SCHOOL ROAD PHOENIX, ARIZONA 85018                  Tel: (602) 956-3200 Fax: (602) 955-5443</small>			
DESIGN	BY	DATE	FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
	W.S.S.	12/96	
DESIGN CHK	D.L.S.	12/96	RECOMMENDED BY
PLANS	W.S.S.	12/96	APPROVED BY
PLANS CHK	D.L.S.	12/96	DATE
SUBMITTED BY			DATE
			CHIEF ENGINEER AND GENERAL MANAGER
			SHEET 1 OF 28

# FLOOD CONTROL DISTRICT OF MARICOPA COUNTY LOCATION MAP

F.C.D. CONTRACT NO. 94-28



### BENCHMARK CONTROLS

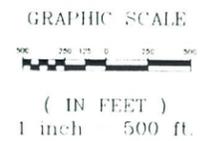
POINT	NORTH	EAST	ELEVATION	DESCRIPTION
104	930848.675	689333.017	1336.31	FOUND ADOT ACP ON MORNINGBIRD, 77.150 FEET WEST OF MORNING GLORY FOUND MONUMENT MARKED WITH "Y" PANEL
105	93072.564	685409.934	1364.30	FOUND RR SPIKE AT THE INTERSECTION OF 54TH STREET AND SAPPHIRE. MONUMENT IS 0.2 BELOW PAVEMENT MARKED WITH A "CIRCLE" PANEL
106	93480.142	687960.855	1350.54	FOUND TOWN OF PARADISE VALLEY BC (FLUSH) AT DOUBLETREE AND VIA LOS CABALLOS (WEST SIDE OF INDIAN BEND WASH). MARKED WITH "CIRCLE" PANEL
107	93427.358	690237.582	1329.86	SET PK NAIL (FLUSH) IN ASPHALT SIDEWALK AT THE NORTHWEST CORNER OF DOUBLETREE ROAD AND MORNING GLORY MARKED WITH A "CIRCLE" PANEL
110	93857.140	687646.867	1341.19	FOUND MARICOPA COUNTY HIGHWAY DEPT. BC (FLUSH) AT CABALLO AND AN UN NAMED CUL-DE-SAC TO THE SOUTH. POINT IS APPROXIMATELY MIDWAY BETWEEN VIA LOS RANCHOS AND 58TH PLACE MARKED WITH A "CIRCLE" PANEL
111	933848.352	684374.410	1352.25	FOUND MARICOPA COUNTY HIGHWAY DEPT. BC (FLUSH) AT THE INTERSECTION OF VIA LOS CABALLOS AND 52ND PLACE MARKED WITH A "CIRCLE" PANEL
124	93205.449	680869.170	1442.27	FOUND CITY OF PHOENIX BC AT THE INTERSECTION OF SUNSET AND STARLING MARKED WITH A "CIRCLE" PANEL
128	927345.784	684758.375	1436.99	FOUND BC (FLUSH) AT THE INTERSECTION OF ROADRUNNER AND LAS BRISAS LANE MARKED WITH A "CIRCLE" PANEL
142	928956.159	687931.267	1417.35	SET PK NAIL (FLUSH) ON THE NORTH EDGE OF ASPHALT ON DESERT JEWEL APPROXIMATELY 900' EAST OF TATUM MARKED WITH "CIRCLE" PANEL
143	93605.340	682775.575	1384.72	FOUND PK NAIL (FLUSH) AT THE INTERSECTION OF BUTLER AND FOOD CALLE MARKED WITH A "Y" PANEL
144	934300.954	683123.934	1362.10	SET PK NAIL (FLUSH) ON THE ASPHALT BIKE PATH ON THE NORTH SIDE OF DOUBLETREE AT MARTINGALE MARKED WITH A "CIRCLE" PANEL

### LEGEND

- CORRIDOR LINE
- CHEROKEE WASH CENTER LINE
- SHEET NO.

 SHEET NUMBERS
- 110

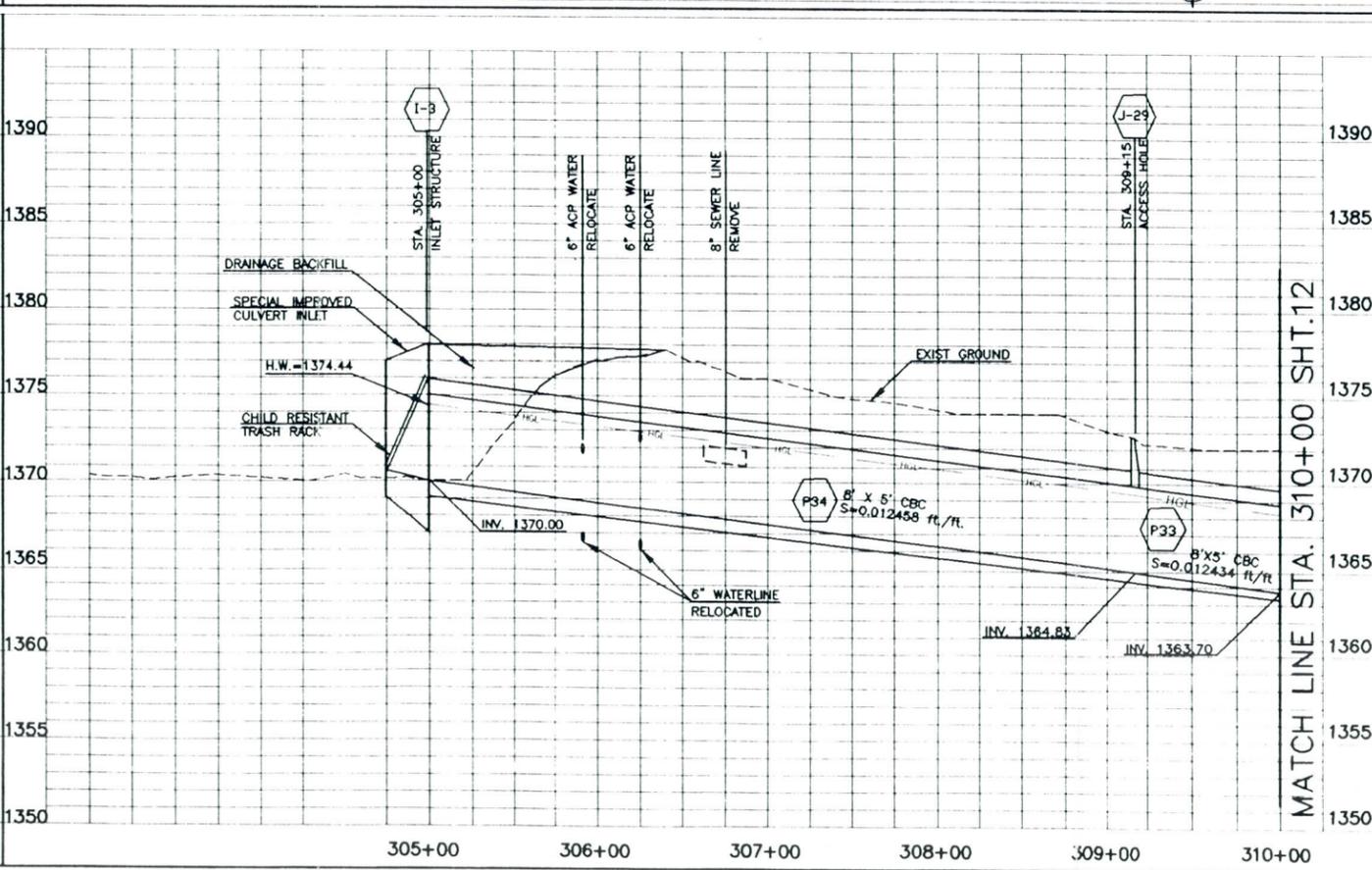
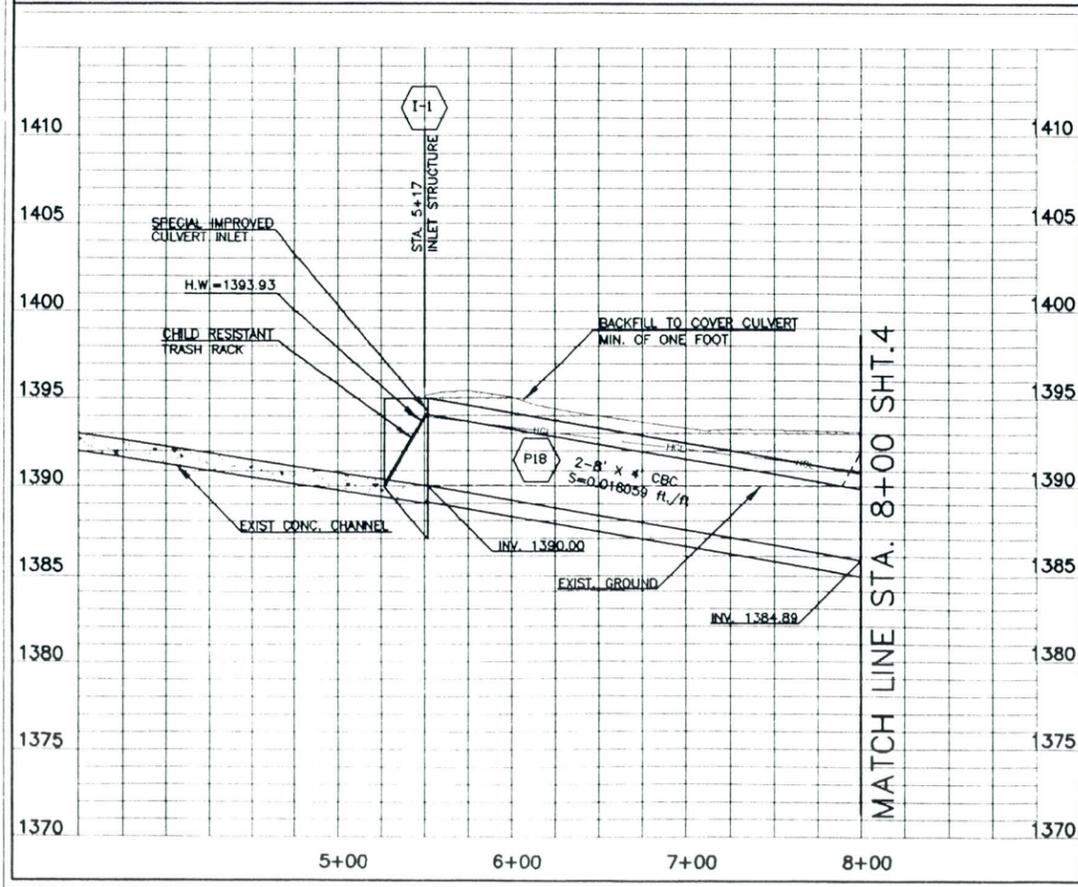
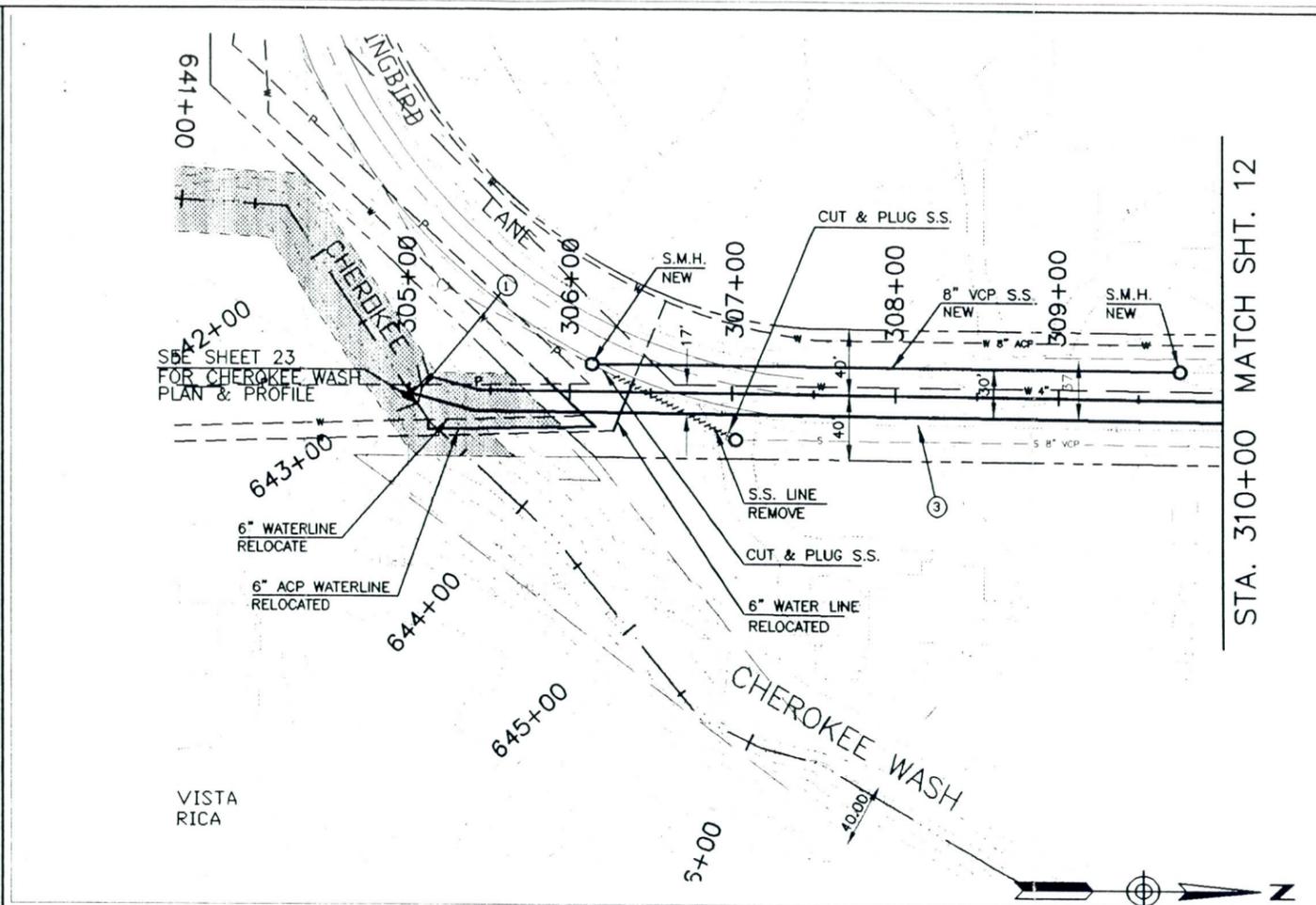
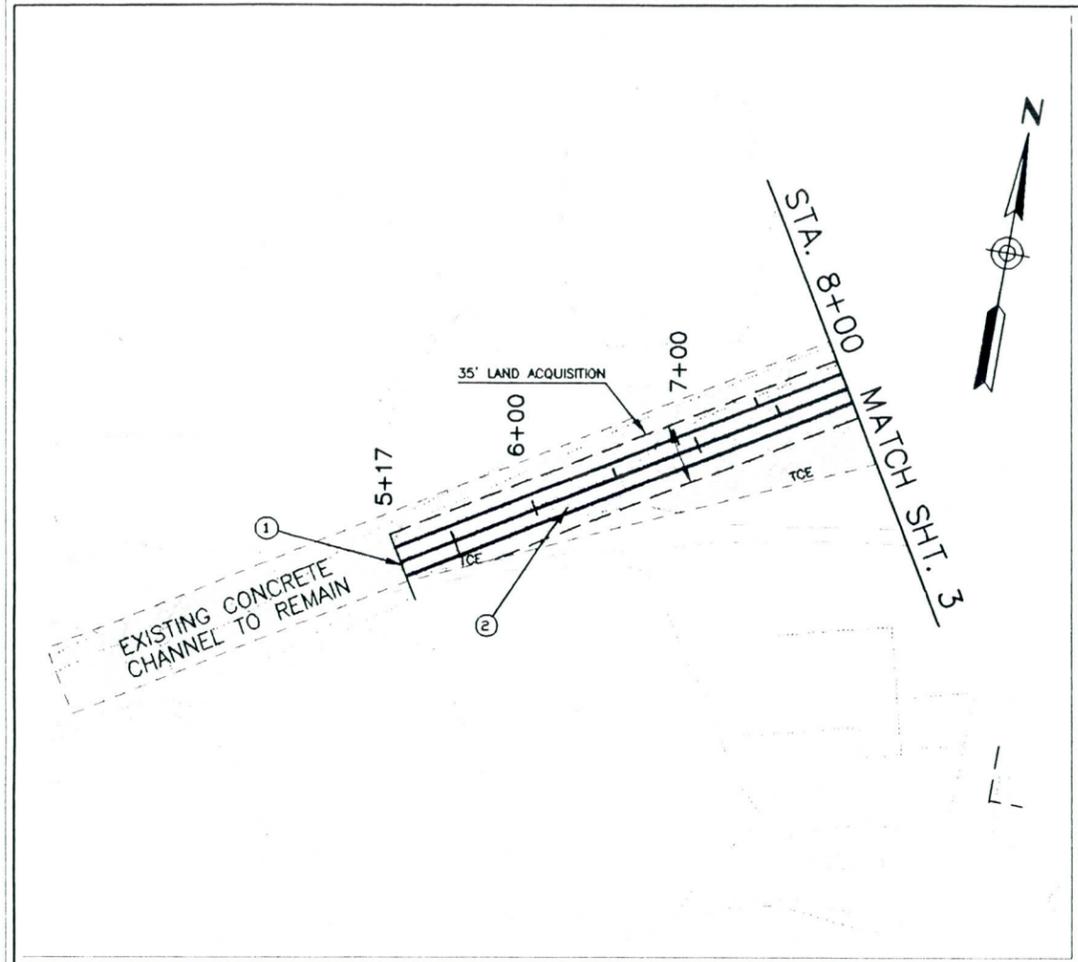
 BENCHMARK CONTROL POINT
- 0+00 STATIONING



**HOOK ENGINEERING, INC.**  
1311 E. INDIAN SCHOOL ROAD, PHOENIX, ARIZONA 85016  
TEL: (602) 956-3200 FAX: (602) 955-5443

DESIGN	BY	DATE	FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
DESIGN CHG	W.S.S.	12/96	
PLANS	BY	DATE	PERFORMED BY: _____ DATE: _____
PLANS CHG	W.S.S.	12/96	
SUBMITTED BY	DATE	APPROVED BY	DATE
		CHIEF ENGINEER AND GENERAL MANAGER	

SHEET **2** OF **28**



COUNTY	STATE	PROJECT NO.	SHEET	TOTAL SHEETS	AS BUILT
MARICOPA	AZ.	2878	3	28	

- ① SPECIAL IMPROVED CULVERT INLET W/ CHILD RESISTANT TRASH RACK
- ② 2-8' x 4' CBC
- ③ 8' x 5' CBC

**LEGEND**

- EXISTING DRAINAGE EASEMENT
- REQUIRED DRAINAGE EASEMENT
- CABLE TV
- GAS LINE
- TELEPHONE
- OVERHEAD POWER
- SANITARY SEWER
- UNDERGROUND POWER
- WATER LINE
- PROPERTY LINE
- CENTER LINE
- CENTER LINE OF WASH
- HYDRAULIC GRADE LINE
- MANHOLE
- ACCESS HOLE
- REPORT SCHEMATIC NO.

SCALE  
 HORIZ 1"=50'  
 VERT 1"=5'

GRAPHIC SCALE  
 ( IN FEET )  
 1 inch = 60 ft

NO.	REVISION	BY	DATE

**FLOOD CONTROL DISTRICT OF MARICOPA COUNTY**  
**DOUBLETREE RANCH ROAD REGIONAL STUDY**

DESIGN	NAME	DATE
	W.S.S.	12/98
DRAWN	D.E.B.	12/98
CHECKED	D.L.S.	12/98

**HOOK ENGINEERING, INC.**  
 1101 N. 10TH AVENUE, SUITE 100, DENVER, CO 80202  
 TEL: 303.733.1100 FAX: 303.733.1101

COUNTY	STATE	PROJECT NO.	SHEET	TOTAL SHEETS	AS BUILT
MARICOPA	AZ.	2878	8	28	

- ① 2-8" x 4' CBC
- ② 8" x 6' CBC
- ③ TRANSITION STRUCTURE WITH ACCESS HOLE
- ④ INLET EQUALIZATION PER DETAIL ON SHEET 12

**LEGEND**

- EXISTING DRAINAGE EASEMENT
- REQUIRED DRAINAGE EASEMENT
- CABLE TV
- GAS LINE
- TELEPHONE
- OVERHEAD POWER
- SANITARY SEWER
- UNDERGROUND POWER
- WATER LINE
- PROPERTY LINE
- CENTER LINE
- CENTER LINE OF WASH
- HYDRAULIC GRADE LINE
- MANHOLE
- ACCESS HOLE
- REPORT SCHEMATIC NO.

SCALE  
 HORIZ 1"=50'  
 VERT 1"=5'

GRAPHIC SCALE  
 ( IN FEET )  
 1 inch = 50 ft

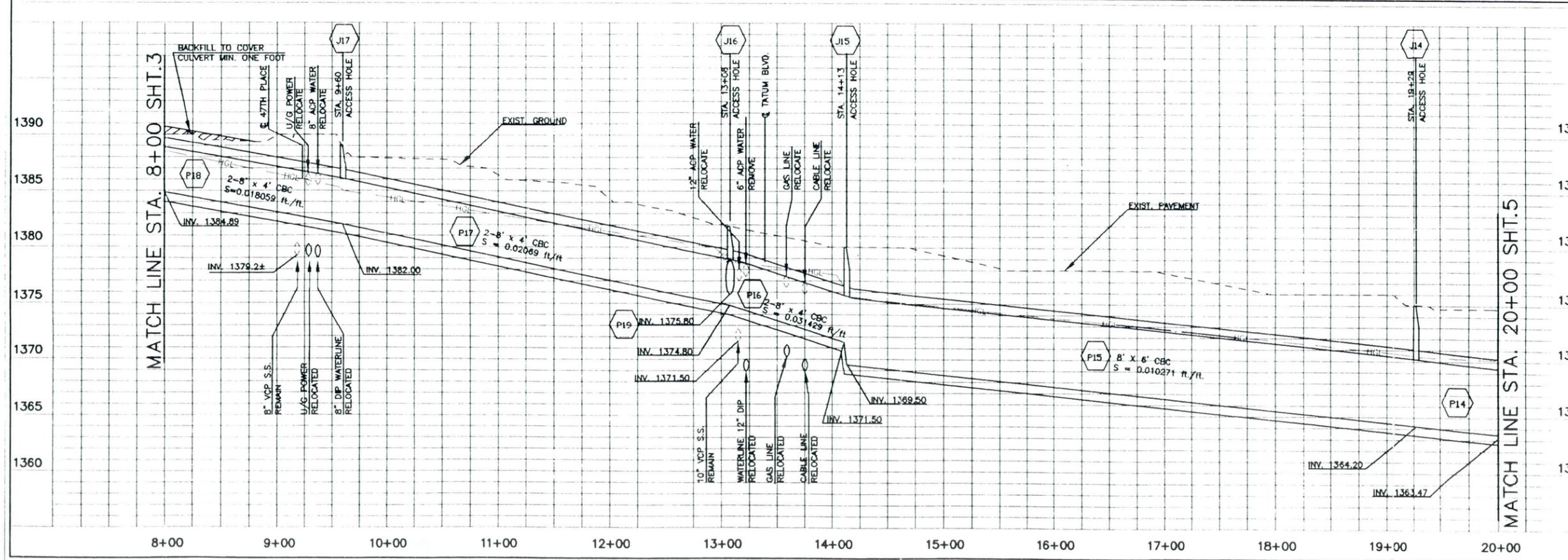
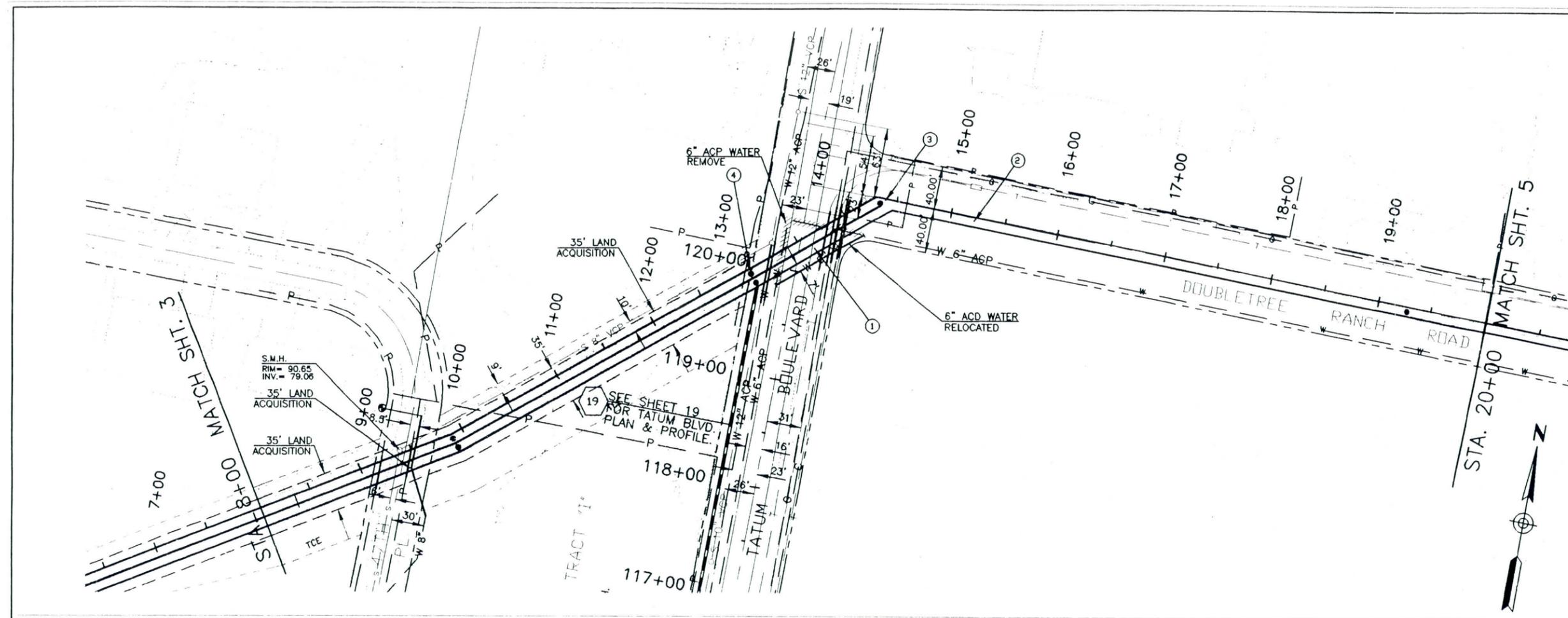
NO.	REVISION	BY	DATE

**FLOOD CONTROL DISTRICT OF MARICOPA COUNTY**

**DOUBLETREE RANCH ROAD REGIONAL STUDY**

DESIGN	NAME	DATE
DESIGN	W.S.S.	12/96
DRAWN	D.E.B.	12/96
CHECKED	D.L.S.	12/96

HOOK ENGINEERING, INC  
 1111 N. 10TH AVENUE, SUITE 100, PHOENIX, ARIZONA 85007  
 TEL: 602-998-8888 FAX: 602-998-8889



COUNTY	STATE	PROJECT NO.	SHEET	TOTAL SHEETS	AS BUILT
MARICOPA	AZ.	2878	5	28	

① 8' X 6' CBC

**LEGEND**

- EXISTING DRAINAGE EASEMENT
- REQUIRED DRAINAGE EASEMENT
- CABLE TV
- GAS LINE
- TELEPHONE
- OVERHEAD POWER
- SANITARY SEWER
- UNDERGROUND POWER
- WATER LINE
- PROPERTY LINE
- CENTER LINE
- CENTER LINE OF WASH
- HYDRAULIC GRADE LINE
- MANHOLE
- ACCESS HOLE
- REPORT SCHEMATIC NO.

SCALE  
 HORIZ 1"=50'  
 VERT 1"=5'

GRAPHIC SCALE  
 ( IN FEET )  
 1 inch = 50 ft

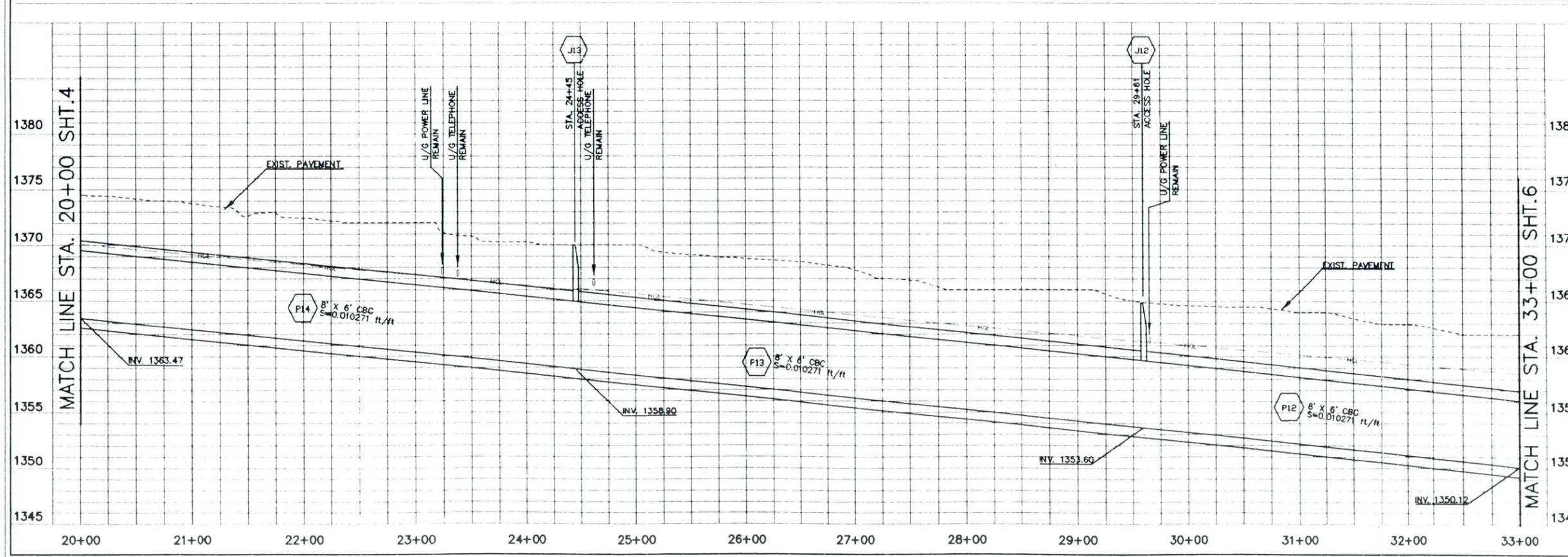
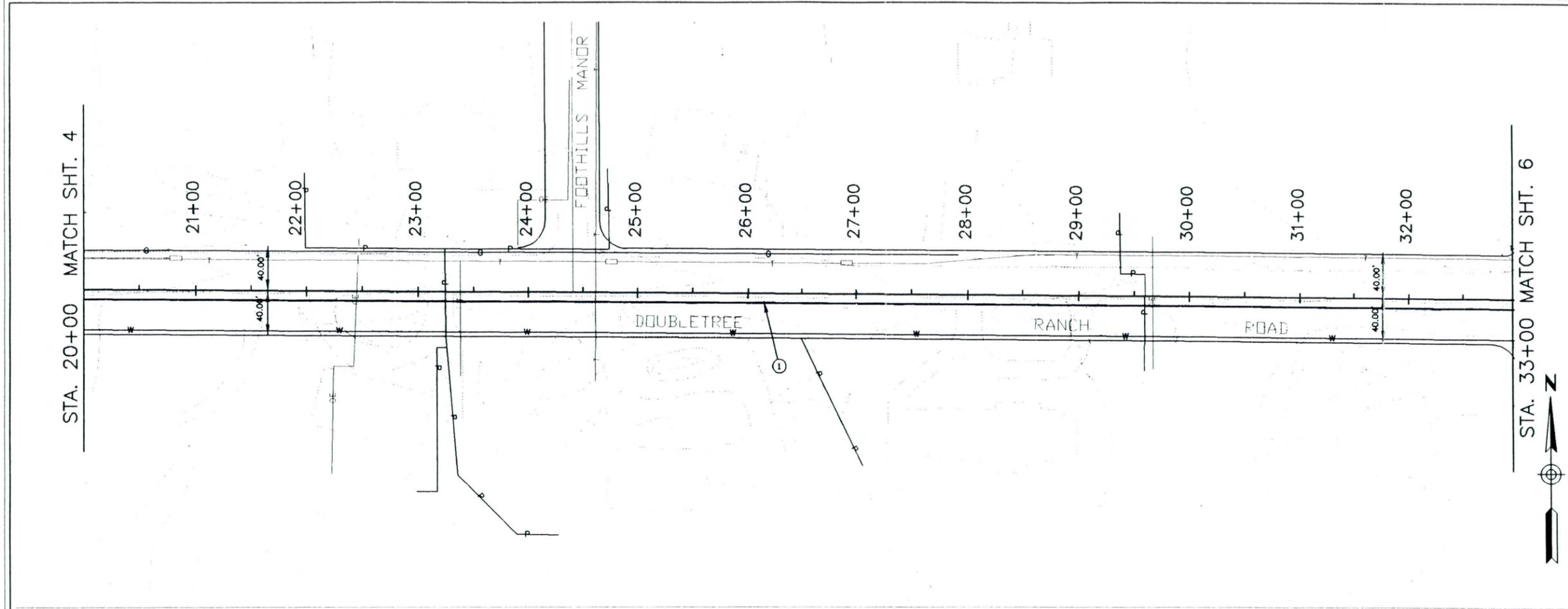
NO.	REVISION	BY	DATE

**FLOOD CONTROL DISTRICT OF MARICOPA COUNTY**

**DOUBLETREE RANCH ROAD REGIONAL STUDY**

	NAME	DATE
DESIGN	W.S.S.	12/96
DRAWN	P.E.B.	12/96
CHECKED	D.L.S.	12/96

**HOOK ENGINEERING, INC.**  
 1101 N. 10TH AVENUE, SUITE 200, PHOENIX, ARIZONA 85015  
 P.O. BOX 1000, TOLSON, ARIZONA 85622



COUNTY	STATE	PROJECT NO.	SHEET	TOTAL SHEETS	AS BUILT
MARICOPA	AZ.	2878	6	28	

- ① JUNCTION STRUCTURE
- ② 8' x 6' CBC
- ③ 3-10' x 6' CBC

**LEGEND**

- EXISTING DRAINAGE EASEMENT
- REQUIRED DRAINAGE EASEMENT
- CABLE TV
- GAS LINE
- TELEPHONE
- OVERHEAD POWER
- SANITARY SEWER
- UNDERGROUND POWER
- WATER LINE
- PROPERTY LINE
- CENTER LINE
- CENTER LINE OF WASH
- HYDRAULIC GRADE LINE
- MANHOLE
- ACCESS HOLE
- REPORT SCHEMATIC NO.

**SCALE**  
 HORIZ 1"=50'  
 VERT 1"=5'

**GRAPHIC SCALE**  
 ( IN FEET )  
 1 inch = 50 ft.

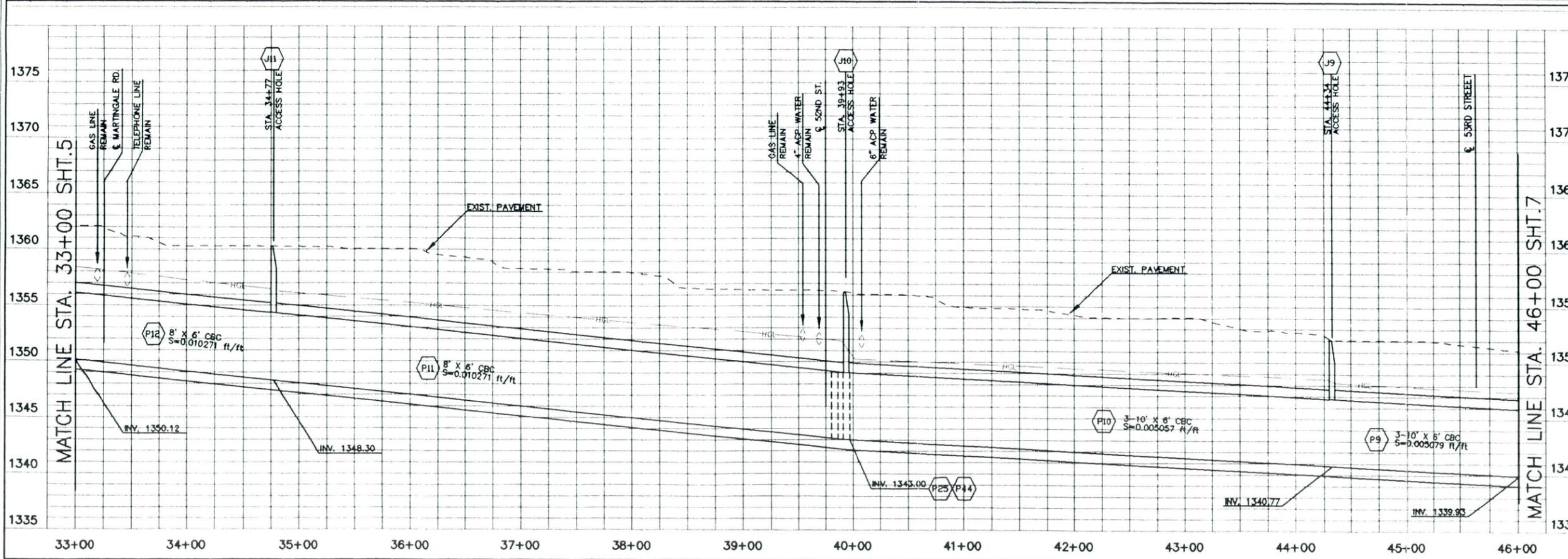
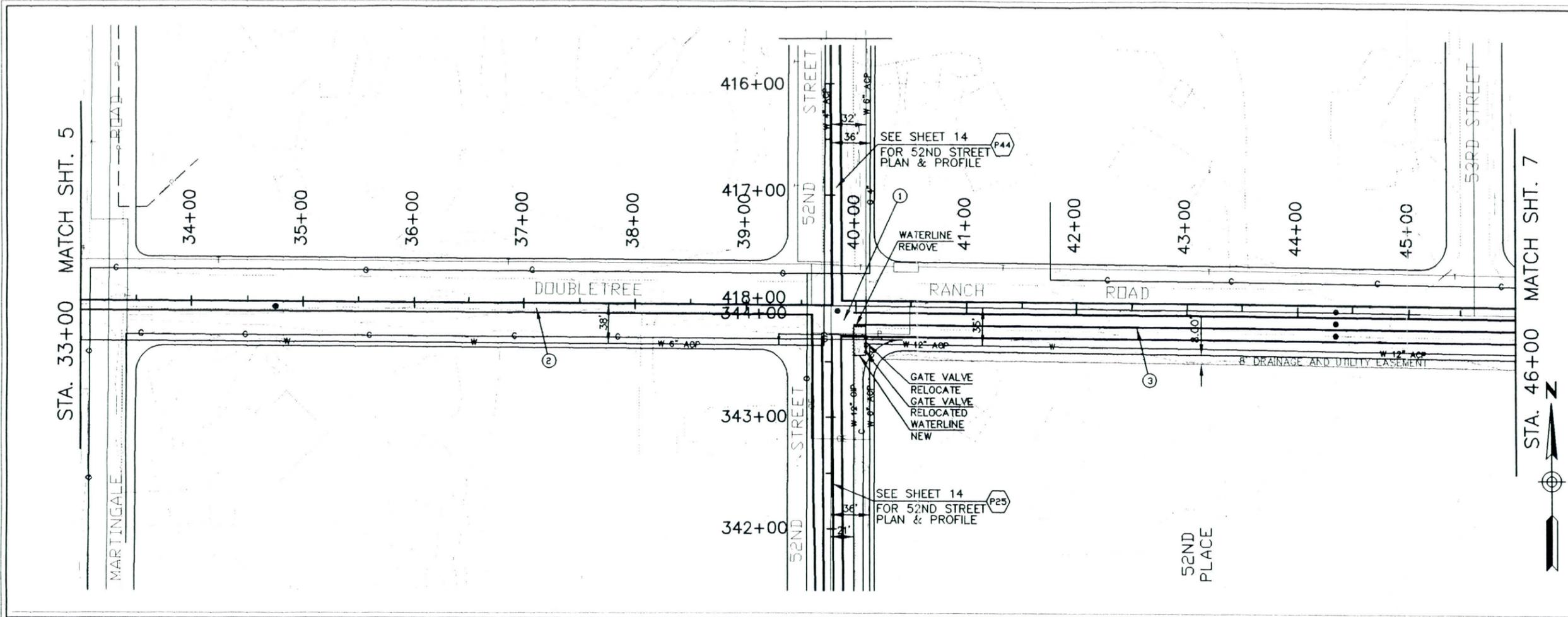
**263-1100**  
**1-800-STAKE-IT**  
(PHONE MARICOPA COUNTY)

NO.	REVISION	BY	DATE

**FLOOD CONTROL DISTRICT OF MARICOPA COUNTY**  
**DOUBLETREE RANCH ROAD REGIONAL STUDY**

DESIGN	NAME	DATE
DRAWN	W.S.S.	12/96
CHECKED	D.E.B.	12/96
	D.L.S.	12/96

**HOOK ENGINEERING, INC.**  
1111 N. GARDEN AVENUE, SUITE 100, PHOENIX, ARIZONA 85012



COUNTY	STATE	PROJECT NO.	SHEET	TOTAL SHEETS	AS BUILT
MARICOPA	AZ.	2878	7	28	

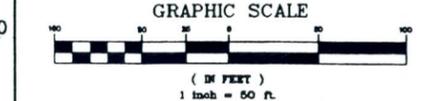
- ① 3-10" X 6' CBC
- ② LOCAL RUNOFF WITH INLET STRUCTURES
- ③ INLET EQUALIZATION PER DETAIL ON SHEET 12

**LEGEND**

- EXISTING DRAINAGE EASEMENT
- REQUIRED DRAINAGE EASEMENT
- CABLE TV
- GAS LINE
- TELEPHONE
- OVERHEAD POWER
- SANITARY SEWER
- UNDERGROUND POWER
- WATER LINE
- PROPERTY LINE
- CENTER LINE
- CENTER LINE OF WASH
- HYDRAULIC GRADE LINE
- MANHOLE
- ACCESS HOLE
- REPORT SCHEMATIC NO.

SCALE  
 HORIZ 1"=50'  
 VERT 1"=5'

CALL THE NUMBER BEFORE YOU DIG  
**283-1100**  
**1-800-STAKE-IT**  
(OUTSIDE MARICOPA COUNTY)



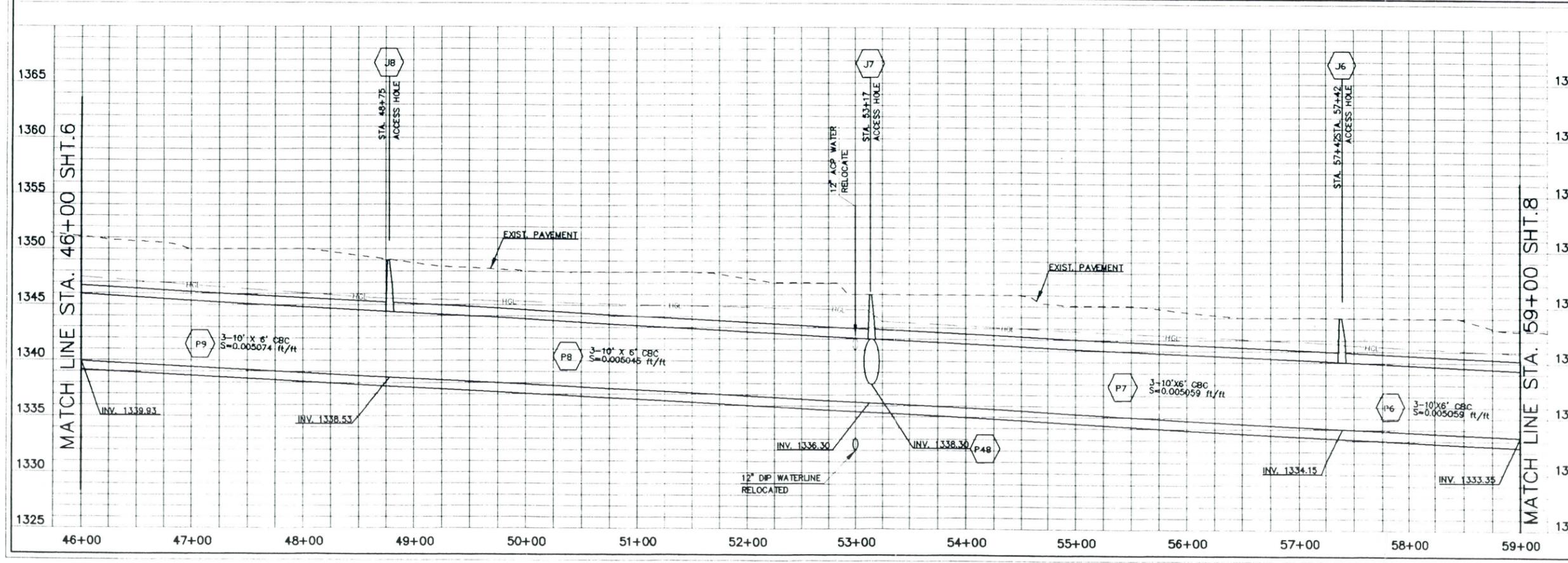
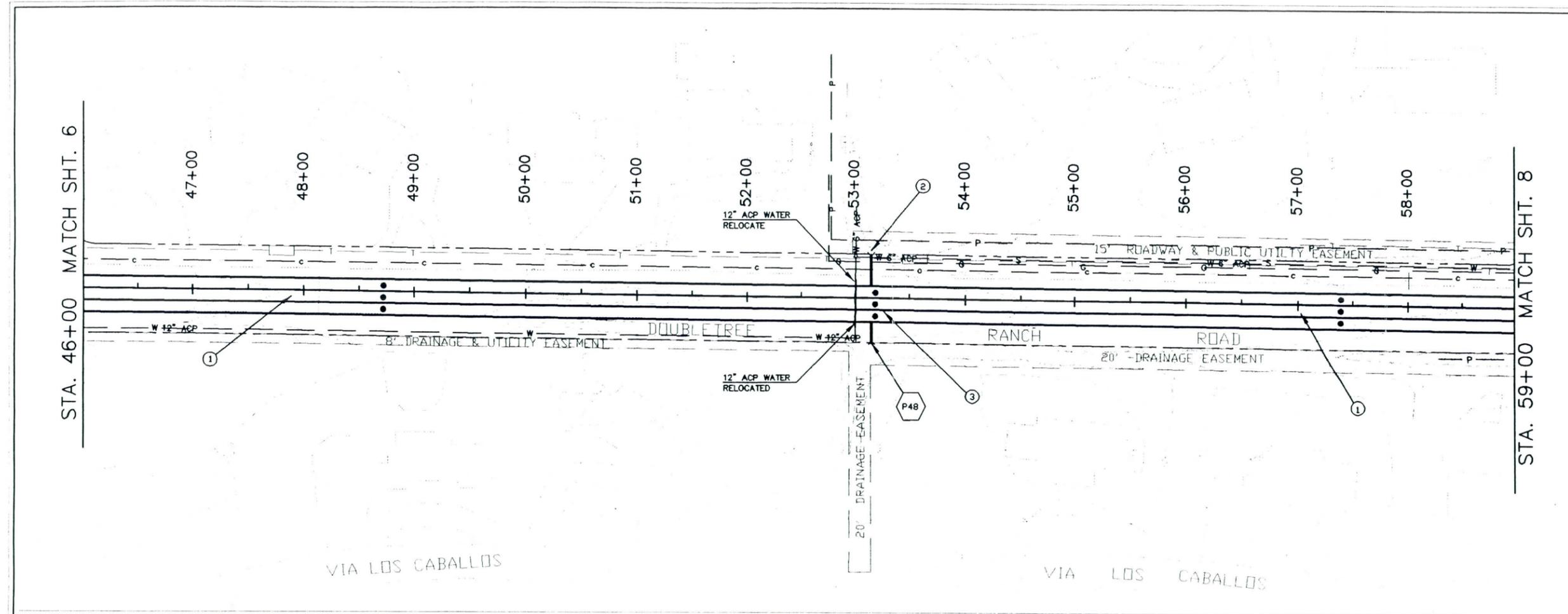
NO.	REVISION	BY	DATE

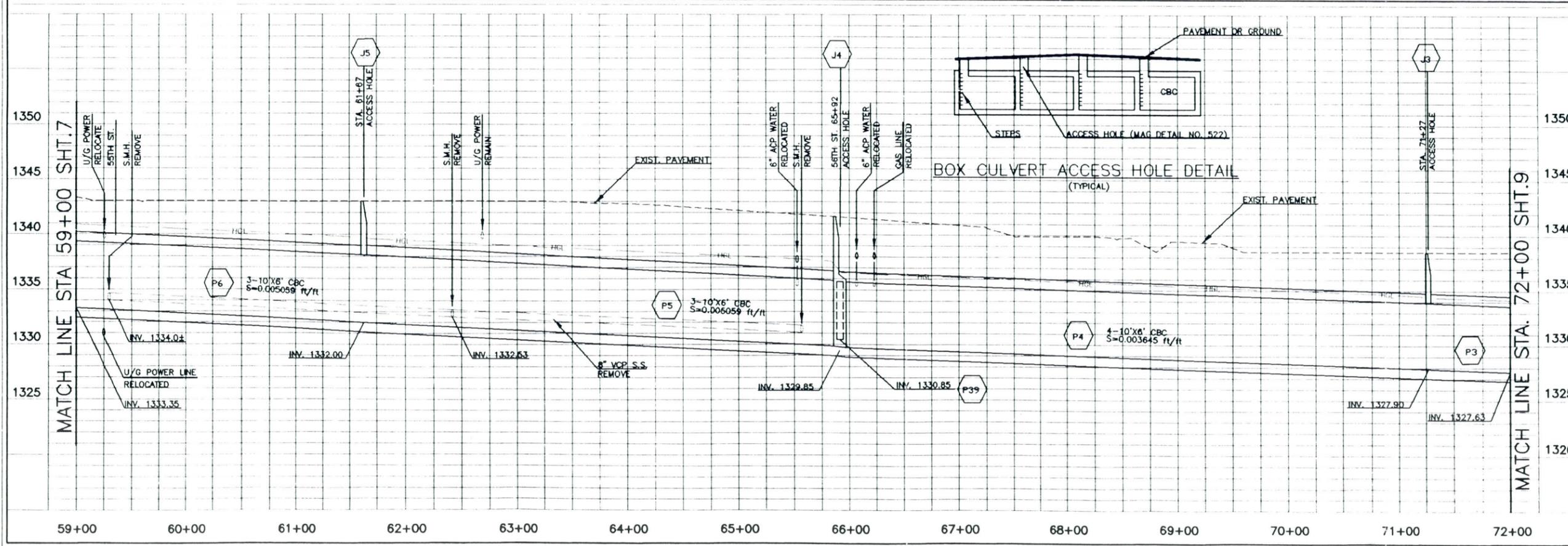
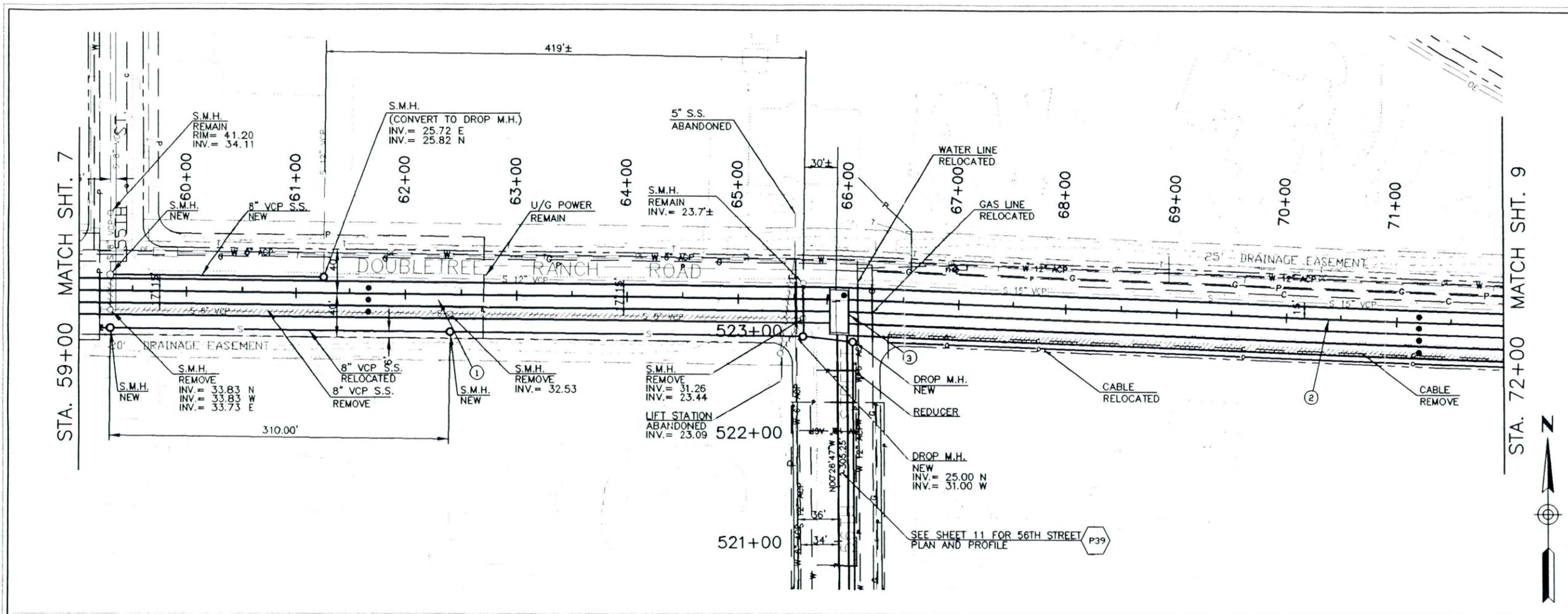
**FLOOD CONTROL DISTRICT OF MARICOPA COUNTY**

**DOUBLETREE RANCH ROAD REGIONAL STUDY**

	NAME	DATE
DESIGN	W.S.S.	12/96
DRAWN	D.E.B.	12/96
CHECKED	D.L.S.	12/96

**HOOK ENGINEERING, INC.**  
1111 E. WASHINGTON ROAD, PHOENIX, ARIZONA 85014  
 (602) 998-8877 FAX (602) 998-8878





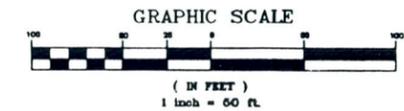
COUNTY	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
MARICOPA	AZ.	2878	8	28	

- ① 3-10" x 6" CBC
- ② 4-10" x 6" CBC
- ③ JUNCTION STRUCTURE

**LEGEND**

- EXISTING DRAINAGE EASEMENT
- REQUIRED DRAINAGE EASEMENT
- CABLE TV
- GAS LINE
- TELEPHONE
- OVERHEAD POWER
- SANITARY SEWER
- UNDERGROUND POWER
- WATER LINE
- PROPERTY LINE
- CENTER LINE
- CENTER LINE OF WASH
- HYDRAULIC GRADE LINE
- MANHOLE
- ACCESS HOLE
- REPORT SCHEMATIC NO.

SCALE  
 HORIZ 1"=50'  
 VERT 1"=5'



NO.	REVISION	BY	DATE

**FLOOD CONTROL DISTRICT OF MARICOPA COUNTY**  
**DOUBLETREE RANCH ROAD REGIONAL STUDY**

DESIGN	NAME	DATE
	W.S.S.	12/96
DRAWN	D.E.B.	12/96
CHECKED	D.L.S.	12/96

**HOOK ENGINEERING, INC.**  
 1001 N. GILBERT ST. SUITE 100, GILBERT, AZ 85133  
 TEL: 480-837-1000 FAX: 480-837-1001

COUNTY	STATE	PROJECT NO.	SHEET	TOTAL SHEETS	AS BUILT
MARICOPA	AZ.	2878	9	28	

- ① 4-10' X 6' CBC
- ② ENERGY DISSIPATOR

**LEGEND**

- EXISTING DRAINAGE EASEMENT
- REQUIRED DRAINAGE EASEMENT
- CABLE TV
- GAS LINE
- TELEPHONE
- OVERHEAD POWER
- SANITARY SEWER
- UNDERGROUND POWER
- WATER LINE
- PROPERTY LINE
- CENTER LINE
- CENTER LINE OF WASH
- HYDRAULIC GRADE LINE
- MANHOLE
- ACCESS HOLE
- REPORT SCHEMATIC NO.

**SCALE**  
 HORIZ 1"=50'  
 VERT 1"=5'

**GRAPHIC SCALE**  
 ( IN FEET )  
 1 inch = 60 ft.

CALL THE WORKING SHEET BEFORE YOU BUY  
**263-1100**  
**1-800-STAKE-IT**  
(EXCLUSIVE MARICOPA COUNTY)

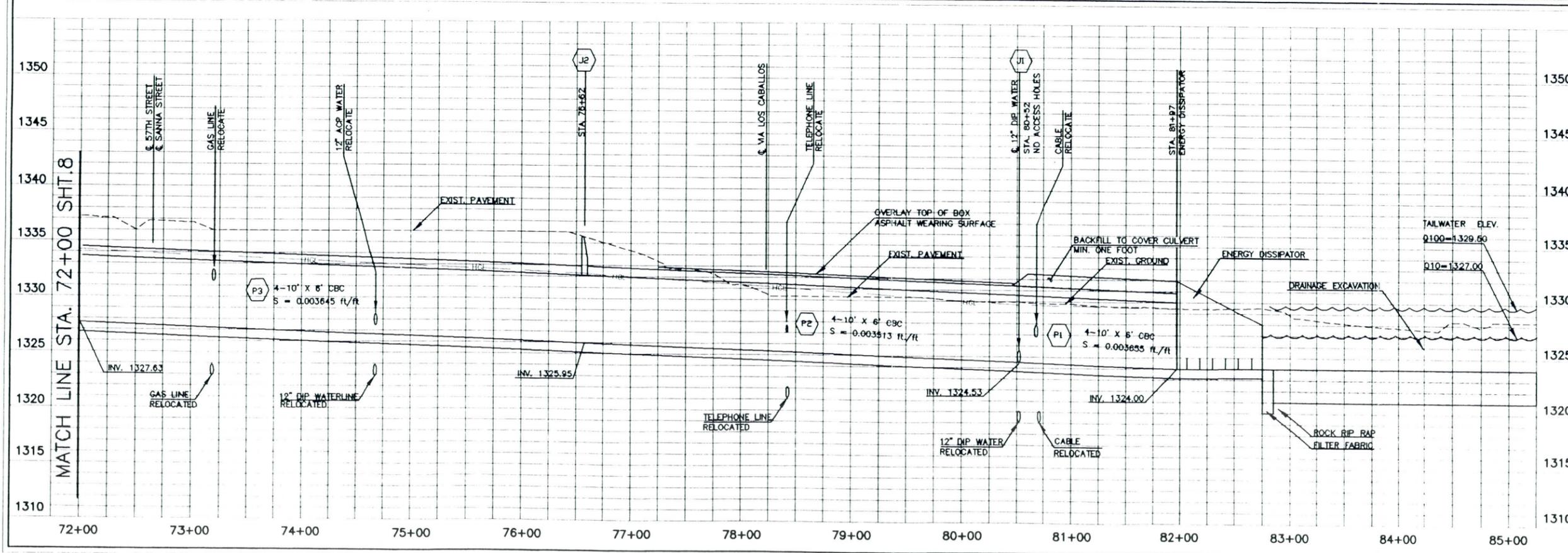
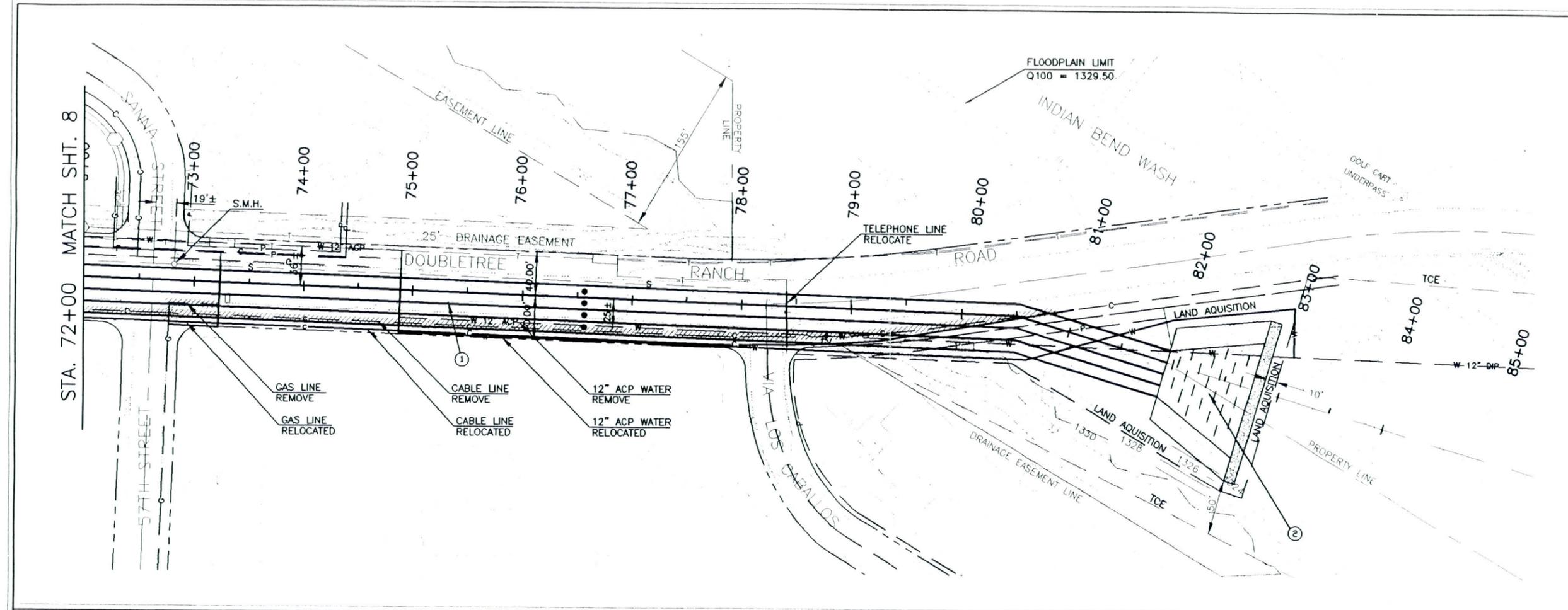
NO.	REVISION	BY	DATE

**FLOOD CONTROL DISTRICT OF MARICOPA COUNTY**

**DOUBLETREE RANCH ROAD REGIONAL STUDY**

DESIGN	NAME	DATE
DRAWN	W.S.S.	12/96
CHECKED	D.E.B.	12/96
	D.L.S.	12/96

**HOOK ENGINEERING, INC.**  
1100 N. 10TH AVENUE, SUITE 100, PHOENIX, AZ 85001



COUNTY	STATE	PROJECT NO.	SHEET	TOTAL SHEETS	AS BUILT
MARICOPA	AZ.	2878	10	28	

- ① 8' x 5' CBC
- ② SPECIAL IMPROVED CULVERT INLET W/ CHILD RESISTANT TRASH RACK
- ③ LOCAL RUNOFF
- ④ 2 - 10' x 5' CBC

**LEGEND**

- EXISTING DRAINAGE EASEMENT
- REQUIRED DRAINAGE EASEMENT
- CABLE TV
- GAS LINE
- TELEPHONE
- OVERHEAD POWER
- SANITARY SEWER
- UNDERGROUND POWER
- WATER LINE
- PROPERTY LINE
- CENTER LINE
- CENTER LINE OF WASH
- HYDRAULIC GRADE LINE
- MANHOLE
- ACCESS HOLE
- REPORT SCHEMATIC NO.

**SCALE**  
 HORIZ 1"=50'  
 VERT 1"=5'

**GRAPHIC SCALE**  
 ( IN FEET )  
 1 inch = 60 ft.

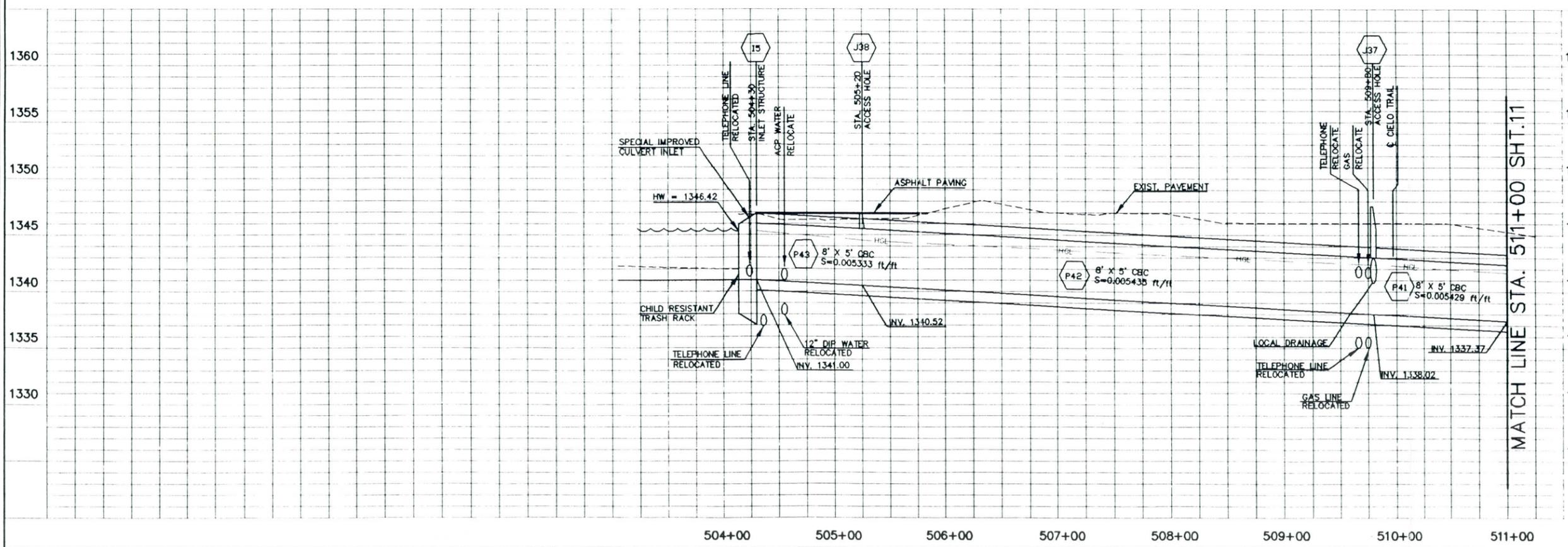
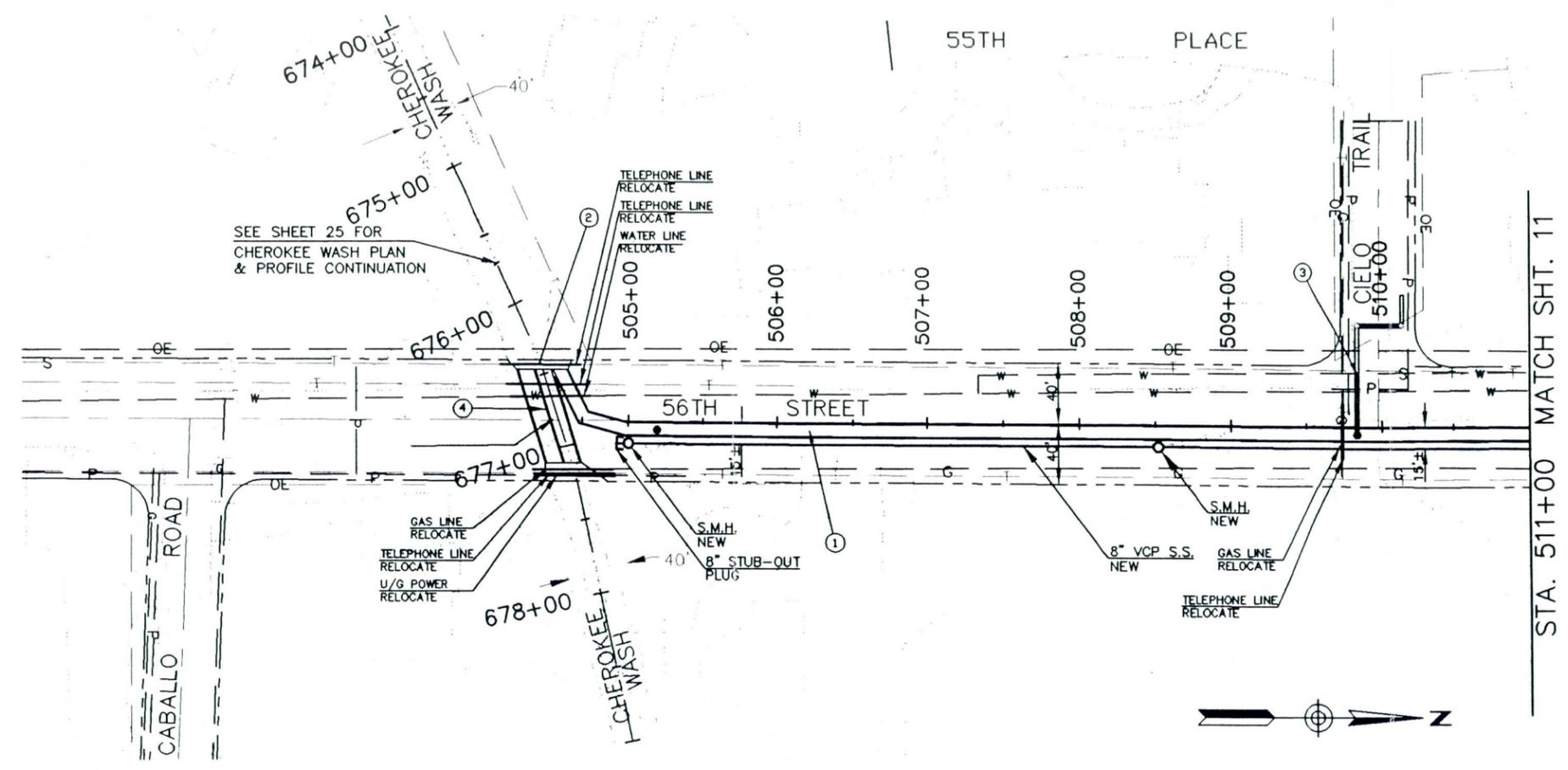
NO.	REVISION	BY	DATE

**FLOOD CONTROL DISTRICT OF MARICOPA COUNTY**

**DOUBLETREE RANCH ROAD REGIONAL STUDY**

	NAME	DATE
DESIGN	W.S.S.	12/96
DRAWN	D.E.B.	12/96
CHECKED	D.L.S.	12/96

**HOOK ENGINEERING, INC.**  
 1111 E. 10TH AVENUE, SUITE 200, DENVER, COLORADO 80202  
 TEL: 303.733.8800 FAX: 303.733.8801



COUNTY	STATE	PROJECT NO.	SHEET	TOTAL SHEETS	AS BUILT
MARICOPA	AZ.	2878	11	28	

- ① JUNCTION STRUCTURE WITH ACCESS HOLE
- ② LOCAL DRAINAGE
- ③ 8' X 5' CBC

**LEGEND**

- EXISTING DRAINAGE EASEMENT
- REQUIRED DRAINAGE EASEMENT
- CABLE TV
- GAS LINE
- TELEPHONE
- OVERHEAD POWER
- SANITARY SEWER
- UNDERGROUND POWER
- WATER LINE
- PROPERTY LINE
- CENTER LINE
- CENTER LINE OF WASH
- HYDRAULIC GRADE LINE
- MANHOLE
- ACCESS HOLE
- REPORT SCHEMATIC NO.

SCALE  
 HORIZ 1"=50'  
 VERT 1"=5'

GRAPHIC SCALE  
 ( IN FEET )  
 1 inch = 50 ft.

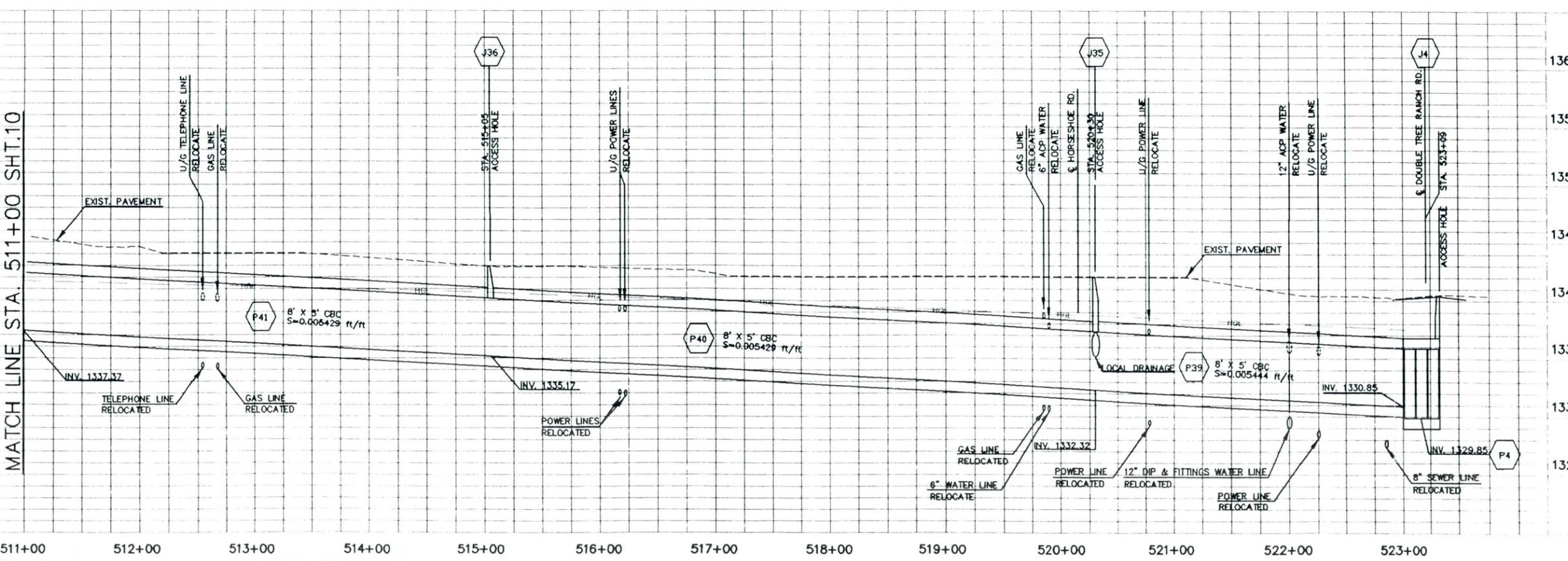
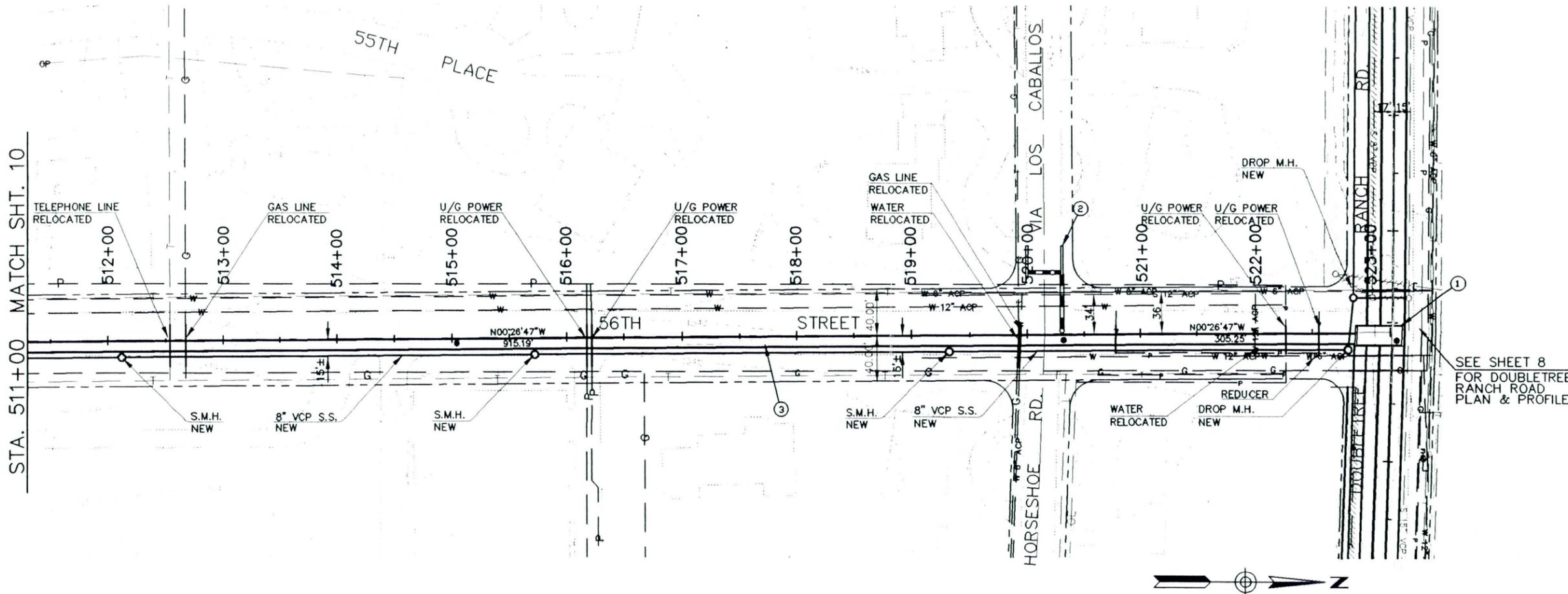
NO.	REVISION	BY	DATE

**FLOOD CONTROL DISTRICT OF MARICOPA COUNTY**

**DOUBLETREE RANCH ROAD REGIONAL STUDY**

	NAME	DATE
DESIGN	W.S.S.	12/96
DRAWN	D.F.B.	12/96
CHECKED	D.L.S.	12/96

**HOOK ENGINEERING, INC.**  
 1101 N. 10TH AVENUE, SUITE 100, PHOENIX, ARIZONA 85015  
 TEL: (602) 998-1000 FAX: (602) 998-1001



COUNTY	STATE	PROJECT NO.	SHEET	TOTAL SHEETS	AS BUILT
MARICOPA	AZ.	2878	12	28	

- ① JUNCTION STRUCTURE
- ② LOCAL DRAINAGE
- ③ 2-8" X 5' CBC
- ④ 8" X 5' CBC
- ⑤ 48" RCP
- ⑥ 60" RCP
- ⑦ INLET EQUALIZATION PER DETAIL BELOW

**LEGEND**

- EXISTING DRAINAGE EASEMENT
- REQUIRED DRAINAGE EASEMENT
- CABLE TV
- GAS LINE
- TELEPHONE
- OVERHEAD POWER
- SANITARY SEWER
- UNDERGROUND POWER
- WATER LINE
- PROPERTY LINE
- CENTER LINE
- CENTER LINE OF WASH
- HYDRAULIC GRADE LINE
- MANHOLE
- ACCESS HOLE
- REPORT SCHEMATIC NO.

- SCALE
- HORIZ 1"=50'
- VERT 1"=5'

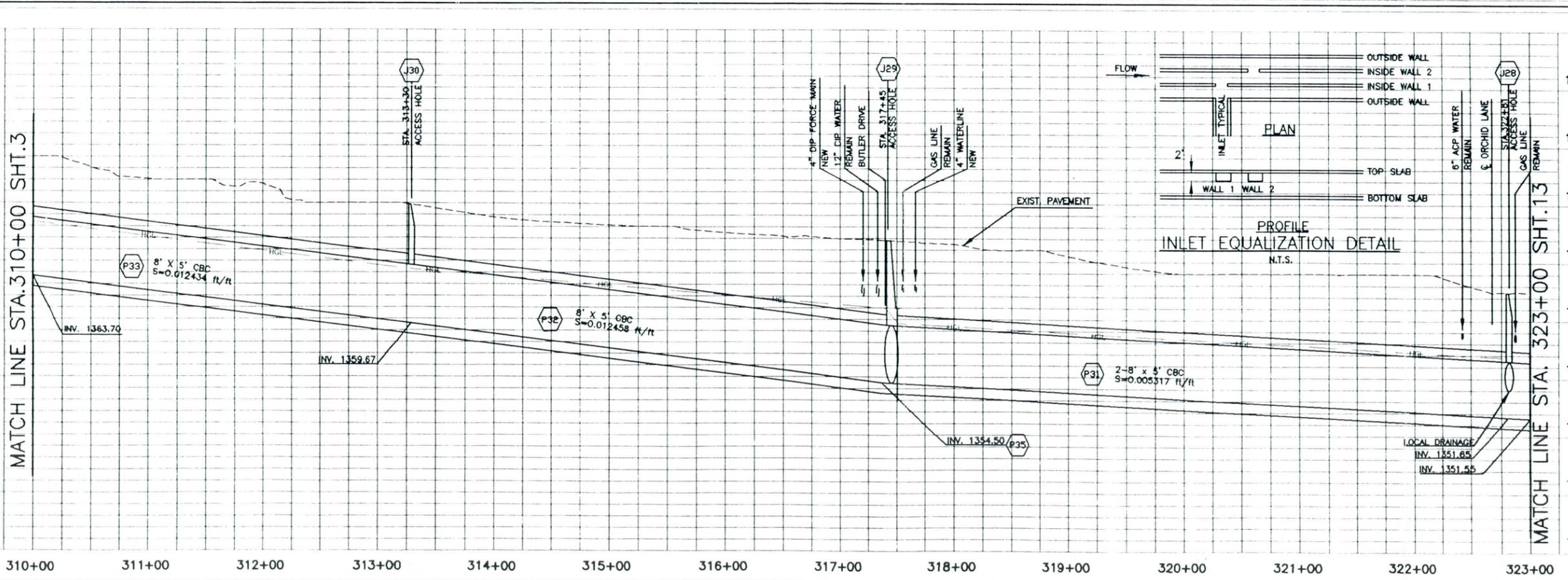
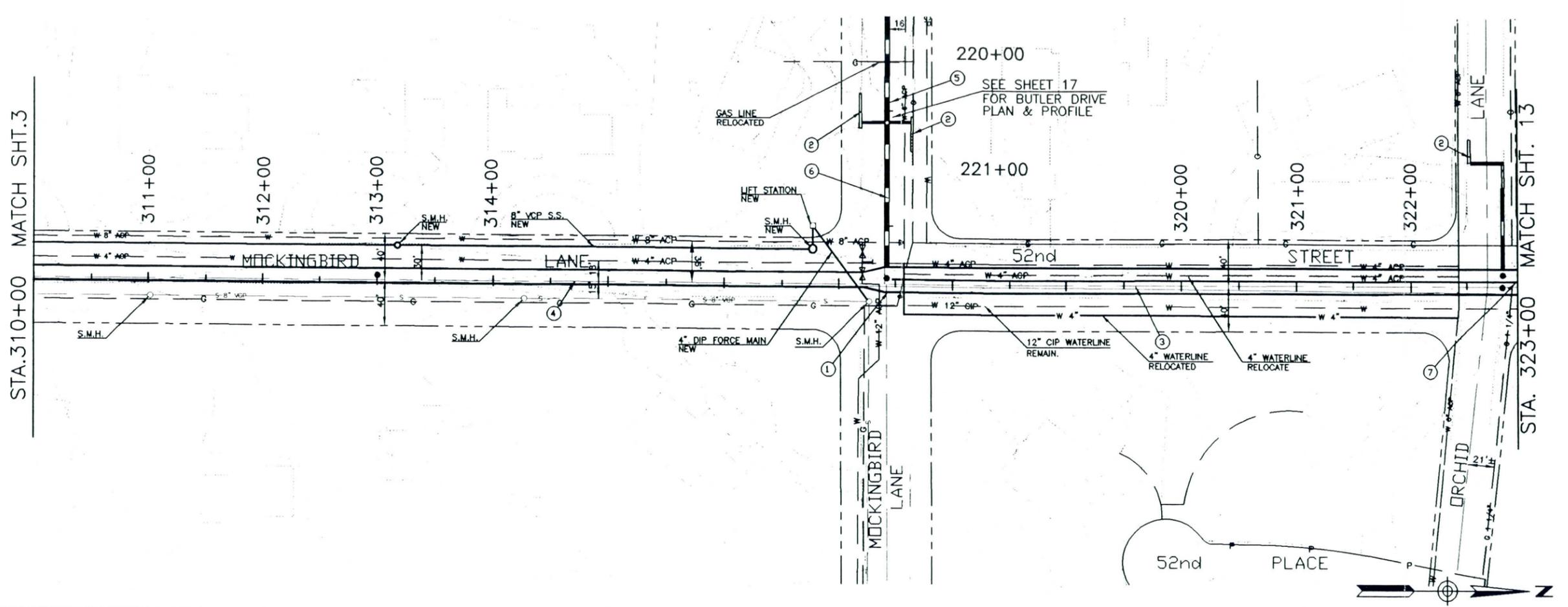
GRAPHIC SCALE  
1 inch = 50 ft

CALL FOR REVISIONS BEFORE YOU CUT  
283-1100  
1-800-STAKE-IT  
DESIGN: W.S.S. DATE: 12/96  
DRAWN: D.E.B. DATE: 12/96  
CHECKED: D.L.S. DATE: 12/96

NO.	REVISION	BY	DATE

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY  
DOUBLETREE RANCH ROAD REGIONAL STUDY

HOOK ENGINEERING, INC.  
1111 E. NEW HAVEN DR., PHOENIX, ARIZONA 85014  
TEL: 602-998-7000 FAX: 602-998-7001



COUNTY	STATE	PROJECT NO.	SHEET	TOTAL SHEETS	AS BUILT
MARICOPA	AZ.	2878	13	28	

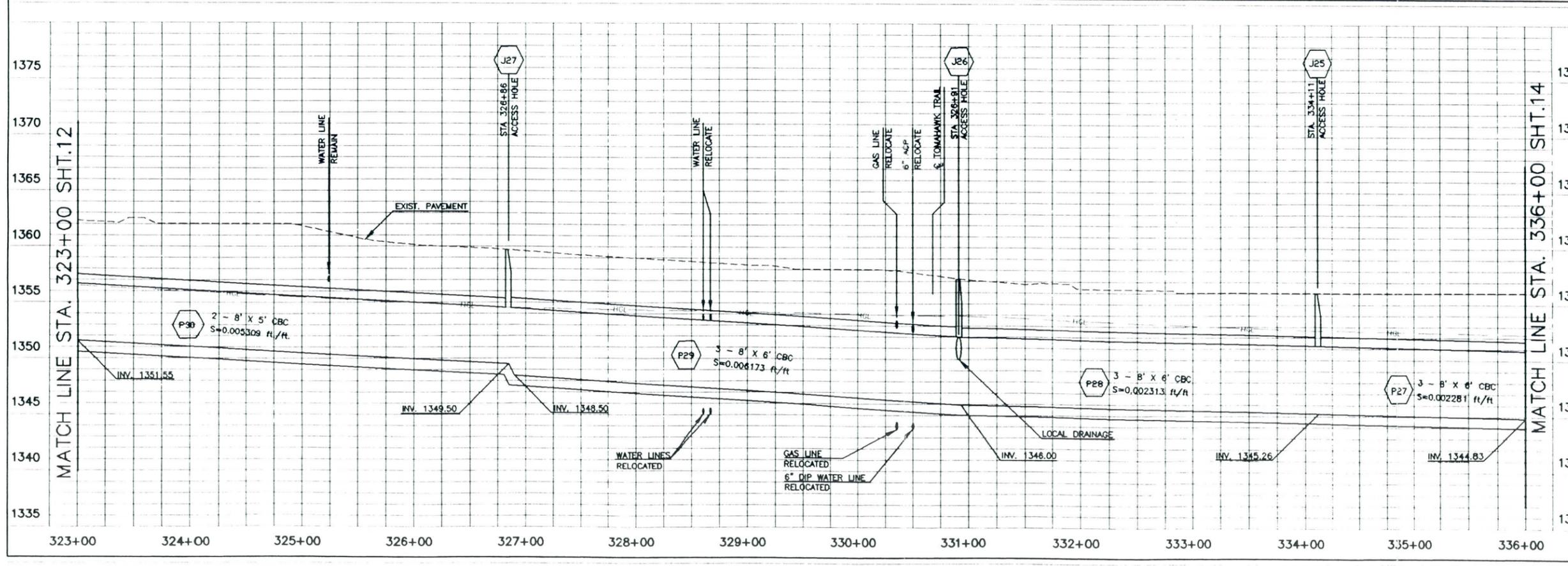
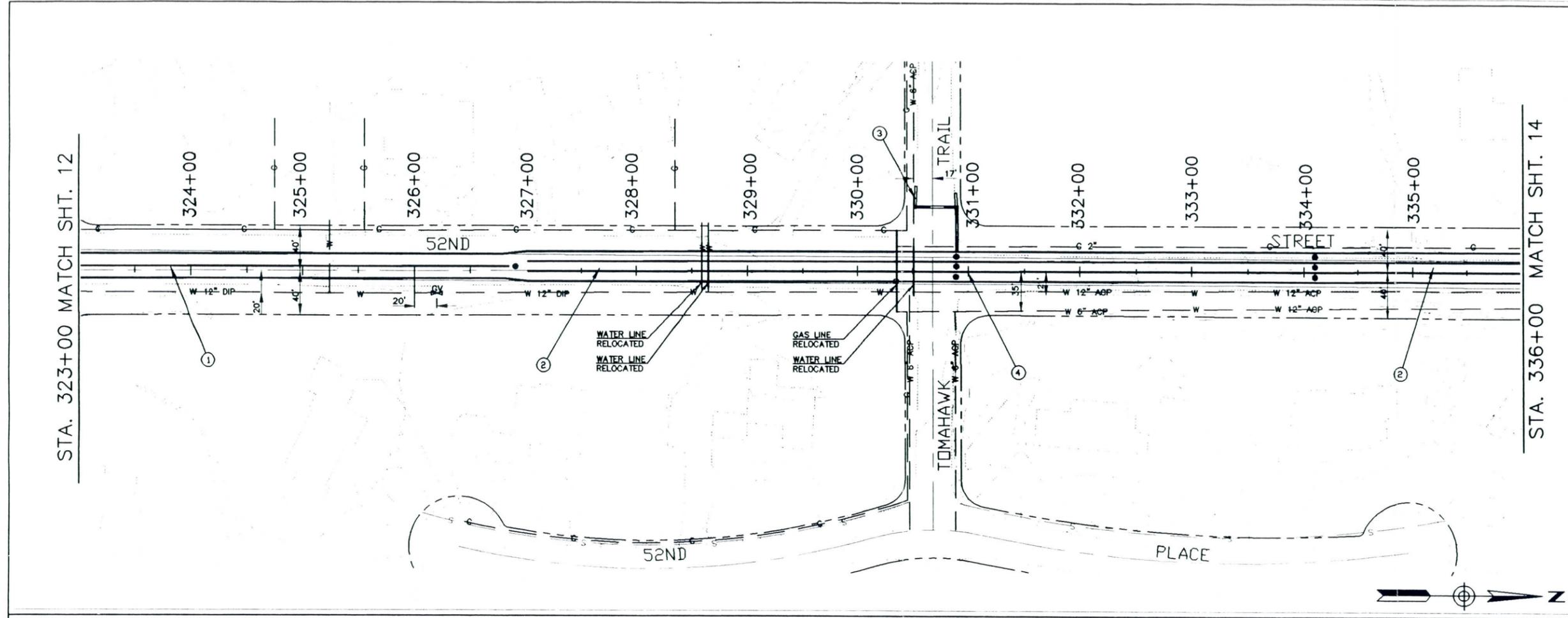
- ① 2-8' X 5' CBC
- ② 3-8' X 6' CBC
- ③ LOCAL DRAINAGE
- ④ INLET EQUALIZATION PER DETAIL ON SHEET 12

**LEGEND**

	EXISTING DRAINAGE EASEMENT
	REQUIRED DRAINAGE EASEMENT
	CABLE TV
	GAS LINE
	TELEPHONE
	OVERHEAD POWER
	SANITARY SEWER
	UNDERGROUND POWER
	WATER LINE
	PROPERTY LINE
	CENTER LINE
	CENTER LINE OF WASH
	HYDRAULIC GRADE LINE
	MANHOLE
	ACCESS HOLE
	REPORT SCHEMATIC NO.

SCALE  
 HORIZ 1"=50'  
 VERT 1"=5'

GRAPHIC SCALE  
 ( IN FEET )  
 1 inch = 50 ft.



NO.	REVISION	BY	DATE

**FLOOD CONTROL DISTRICT OF MARICOPA COUNTY**

**DOUBLETREE RANCH ROAD REGIONAL STUDY**

DESIGN	NAME	DATE
DRAWN	W.S.S.	12/96
CHECKED	D.E.B.	12/96
	D.L.S.	12/96

**HOOK ENGINEERING, INC.**  
1101 N. 10TH AVENUE, SUITE 200, PHOENIX, AZ 85007

SHEET 13 OF 28

COUNTY	STATE	PROJECT NO.	SHEET	TOTAL SHEETS	AS BUILT
MARICOPA	AZ.	2878	14	28	

- ① JUNCTION STRUCTURE
- ② 10' X 6' CBC
- ③ 3 - 8' X 6' CBC
- ④ LOCAL DRAINAGE
- ⑤ INLET EQUALIZATION PER DETAIL ON SHEET 12

**LEGEND**

EXISTING DRAINAGE EASEMENT

REQUIRED DRAINAGE EASEMENT

CABLE TV

GAS LINE

TELEPHONE

OVERHEAD POWER

SANITARY SEWER

UNDERGROUND POWER

WATER LINE

PROPERTY LINE

CENTER LINE

CENTER LINE OF WASH

HYDRAULIC GRADE LINE

MANHOLE

ACCESS HOLE

REPORT SCHEMATIC NO.

SCALE

HORIZ 1"=50'

VERT 1"=5'

GRAPHIC SCALE

( IN FEET )

1 inch = 60 ft.

CALL THE NUMBER BEYOND BEFORE YOU GO

283-1100

1-800-STAKE-IT

(MARICOPA COUNTY)

NO.	REVISION	BY	DATE

**FLOOD CONTROL DISTRICT OF MARICOPA COUNTY**

**DOUBLETREE RANCH ROAD REGIONAL STUDY**

NAME	DATE
DESIGN W.S.S.	12/96
DRAWN D.F.B.	12/96
CHECKED D.L.S.	12/96

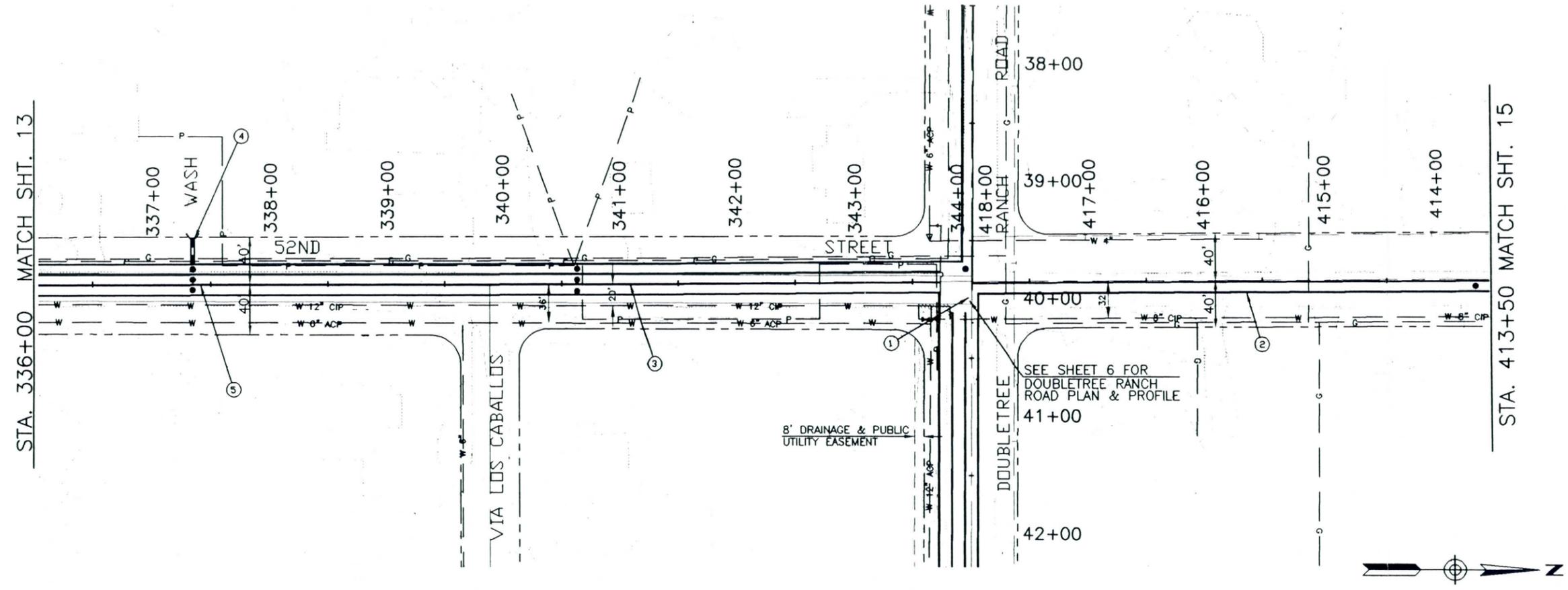
**HOOK ENGINEERING, INC.**

1111 E. HANCOCK ROAD, PHOENIX, ARIZONA 85024

TEL: 260-8800 FAX: 260-8801

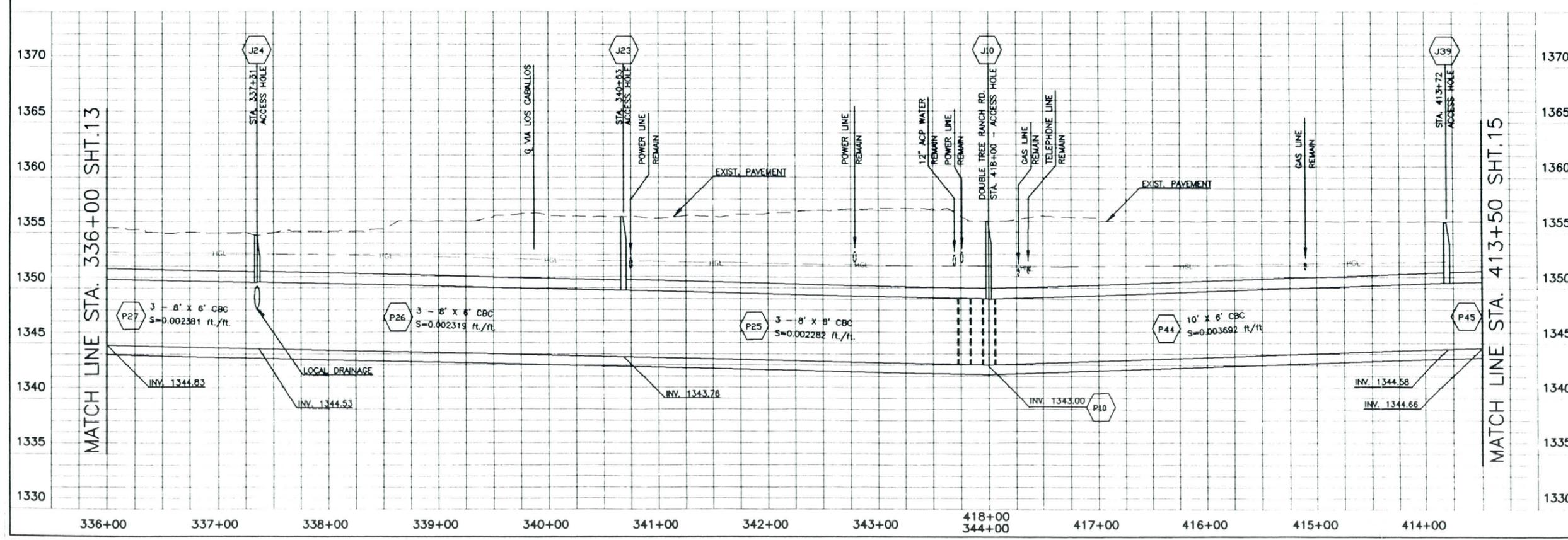
STA. 336+00 MATCH SHT. 13

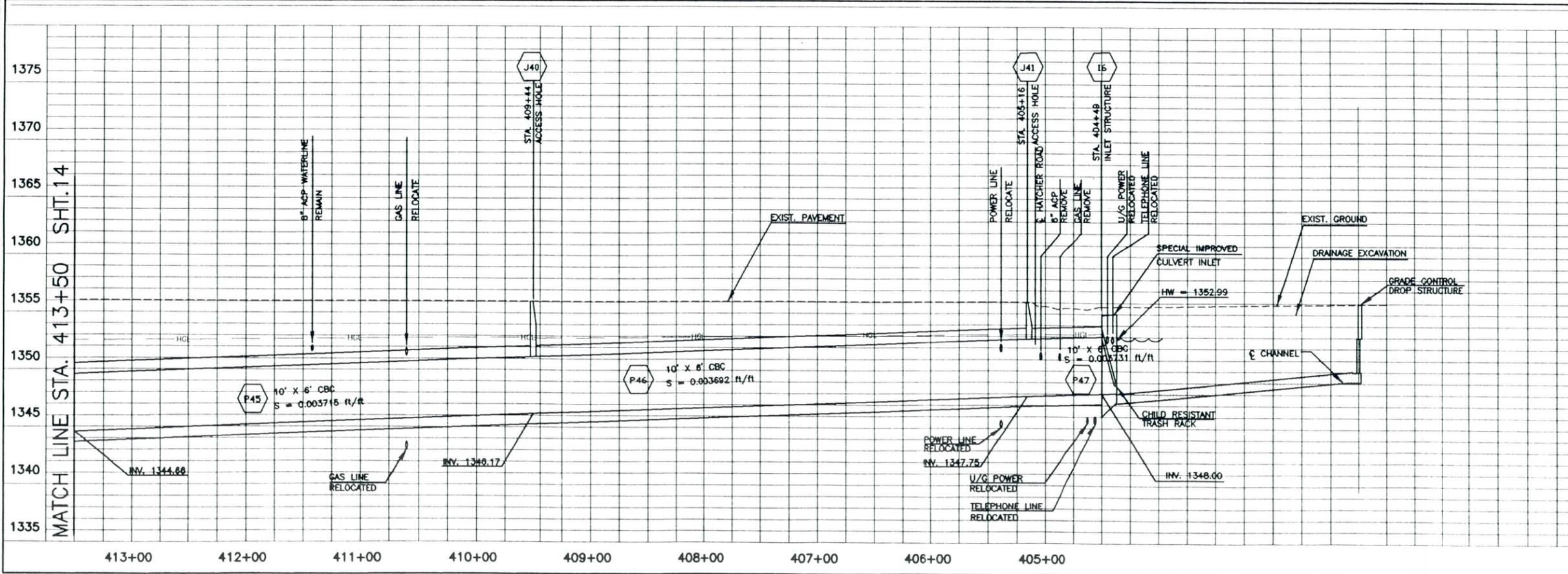
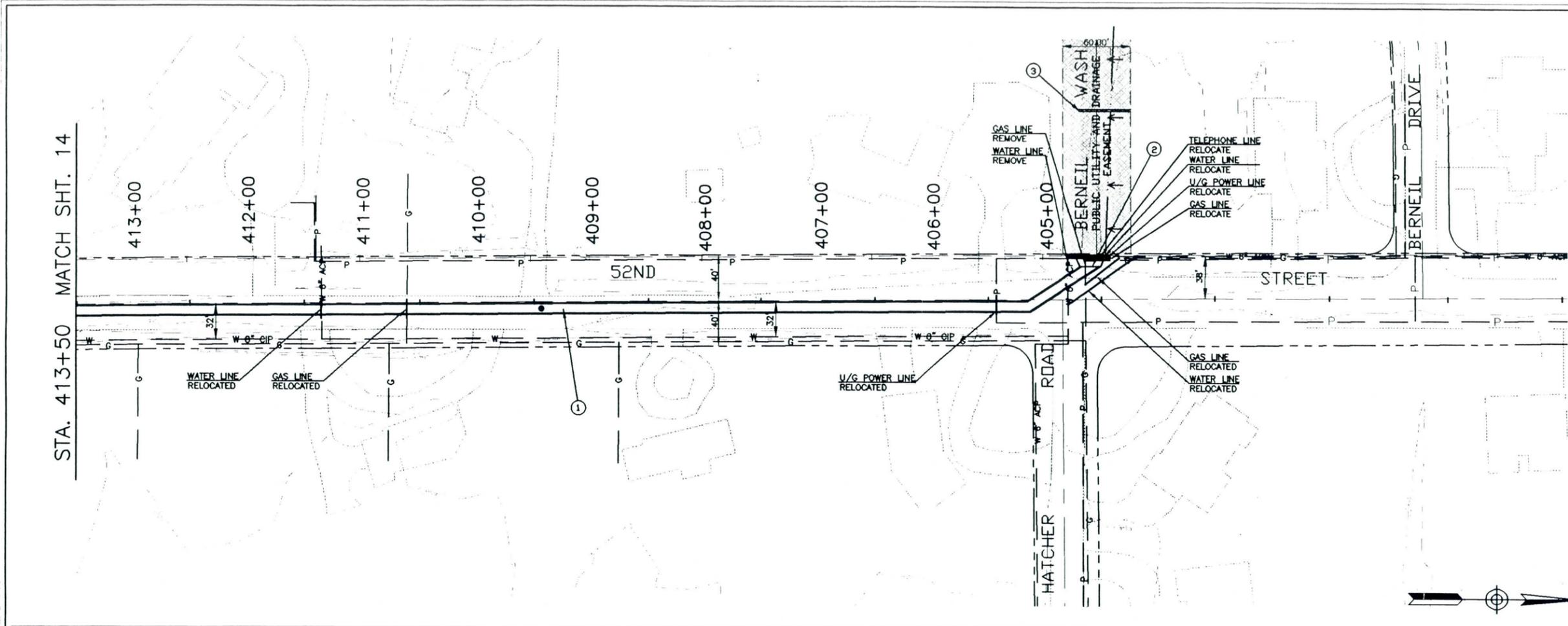
STA. 413+50 MATCH SHT. 15



MATCH LINE STA. 336+00 SHT. 13

MATCH LINE STA. 413+50 SHT. 15





COUNTY	STATE	PROJECT NO.	SHEET	TOTAL SHEETS	AS BUILT
MARICOPA	AZ.	2878	15	28	

- ① 10' X 6' CBC
- ② SPECIAL IMPROVED CULVERT INLET W/ CHILD RESISTANT TRASH RACK
- ③ GRADE CONTROL DROP STRUCTURE

**LEGEND**

- EXISTING DRAINAGE EASEMENT
- REQUIRED DRAINAGE EASEMENT
- CABLE TV
- GAS LINE
- TELEPHONE
- OVERHEAD POWER
- SANITARY SEWER
- UNDERGROUND POWER
- WATER LINE
- PROPERTY LINE
- CENTER LINE
- CENTER LINE OF WASH
- HYDRAULIC GRADE LINE
- MANHOLE
- ACCESS HOLE
- REPORT SCHEMATIC NO.

**SCALE**  
 HORIZ 1"=50'  
 VERT 1"=5'

**GRAPHIC SCALE**  
 ( IN FEET )  
 1 inch = 60 ft.

CALL THE NUMBER ON THESE SIGNS BEFORE YOU DIG  
**263-1100**  
**1-800-STAKE-IT**  
(PUBLIC MARICOPA COUNTY)

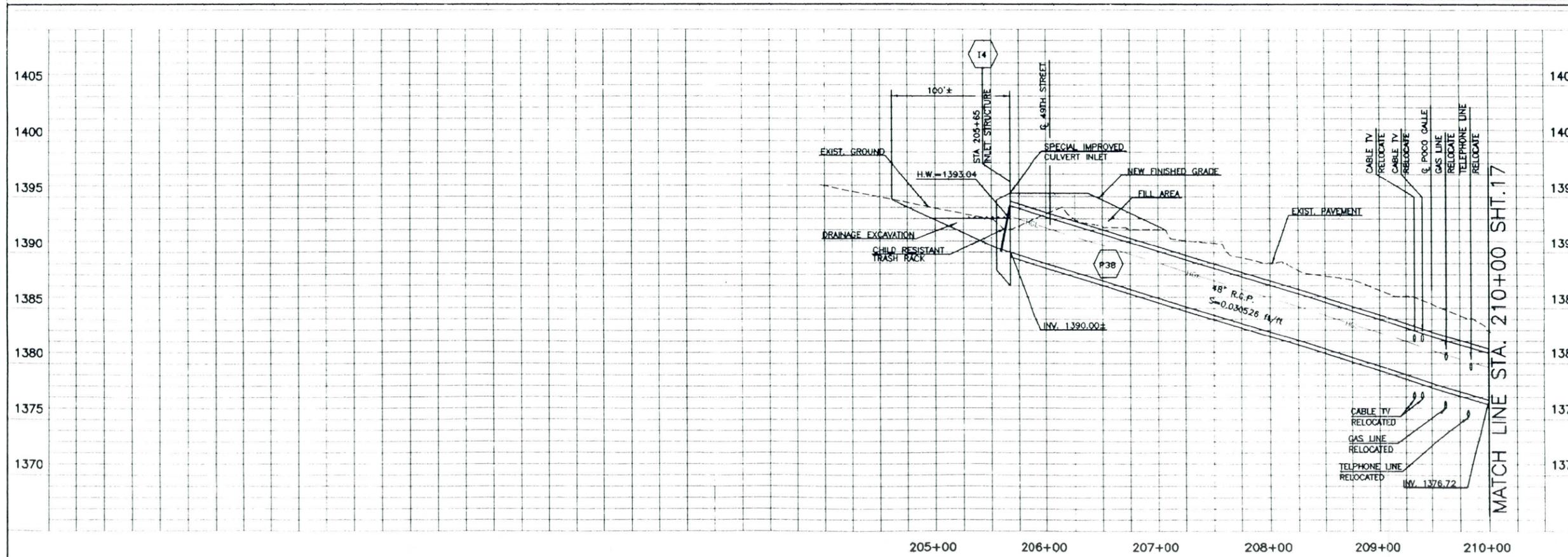
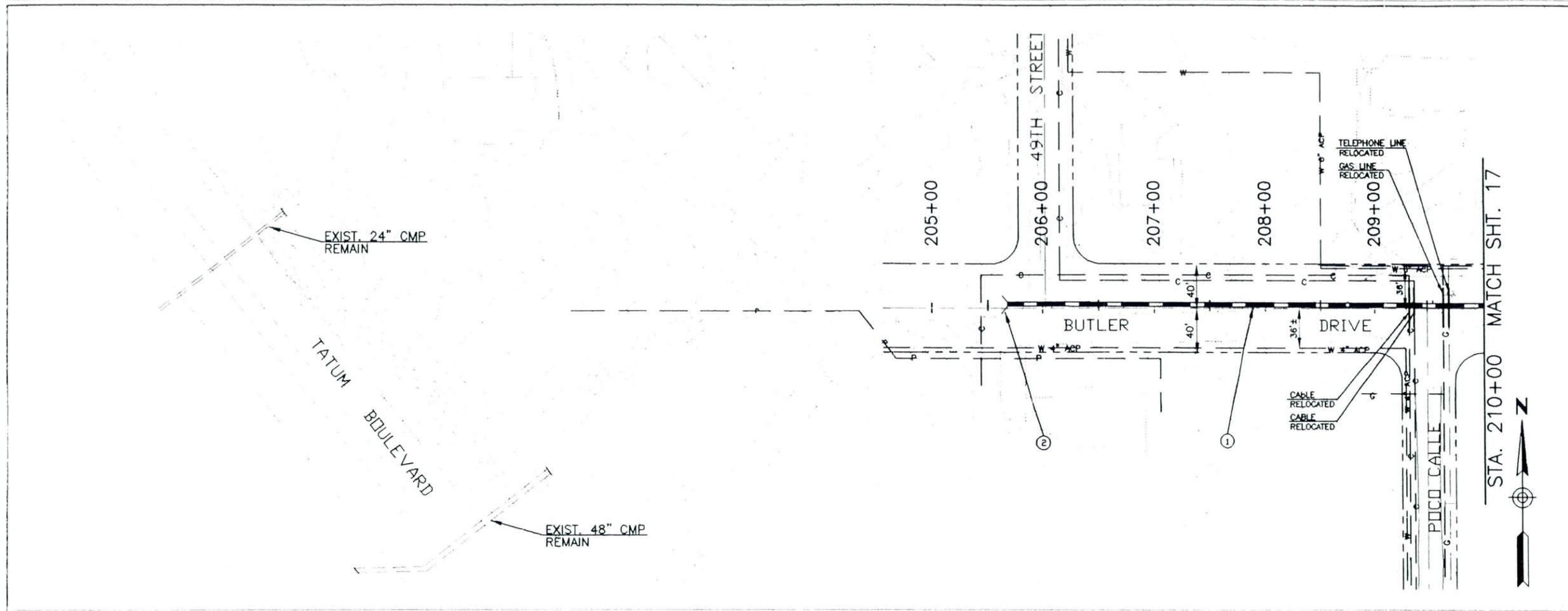
NO.	REVISION	BY	DATE

**FLOOD CONTROL DISTRICT OF MARICOPA COUNTY**

**DOUBLETREE RANCH ROAD REGIONAL STUDY**

DESIGN	NAME	DATE
DRAWN	W.S.S.	12/96
CHECKED	D.E.B.	12/96
	D.L.S.	12/96

**HOOK ENGINEERING, INC.**  
1111 E. WASHINGTON AVENUE, SUITE 100, PHOENIX, ARIZONA 85014  
 TEL: 602-998-8888 FAX: 602-998-8889



COUNTY	STATE	PROJECT NO.	SHEET	TOTAL SHEETS	AS BUILT
MARICOPA	AZ.	2878	16	28	

- ① 48" RCP
- ② INLET PIPE WITH INLET STRUCTURE

**LEGEND**

- EXISTING DRAINAGE EASEMENT
- REQUIRED DRAINAGE EASEMENT
- CABLE TV
- GAS LINE
- TELEPHONE
- OVERHEAD POWER
- SANITARY SEWER
- UNDERGROUND POWER
- WATER LINE
- PROPERTY LINE
- CENTER LINE
- CENTER LINE OF WASH
- HYDRAULIC GRADE LINE
- MANHOLE
- ACCESS HOLE
- REPORT SCHEMATIC NO.

**SCALE**  
 HORIZ 1"=50'  
 VERT 1"=5'

**GRAPHIC SCALE**  
 ( IN FEET )  
 1 inch = 50 ft.

NO.	REVISION	BY	DATE

**FLOOD CONTROL DISTRICT OF MARICOPA COUNTY**  
**DOUBLETREE RANCH ROAD REGIONAL STUDY**

DESIGN	NAME	DATE
DRAWN	W.S.S.	12/96
CHECKED	D.L.S.	12/96

**HOOK ENGINEERING, INC.**  
1111 N. CENTRAL AVENUE, SUITE 100, PHOENIX, ARIZONA 85004  
 TEL: 602.254.8800 FAX: 602.254.8801

COUNTY	STATE	PROJECT NO.	SHEET	TOTAL SHEETS	AS BUILT
MARICOPA	AZ	2878	17	28	

- ① 48" RCP
- ② 60" RCP
- ③ LOCAL DRAINAGE

**LEGEND**

- EXISTING DRAINAGE EASEMENT
- REQUIRED DRAINAGE EASEMENT
- CABLE TV
- GAS LINE
- TELEPHONE
- OVERHEAD POWER
- SANITARY SEWER
- UNDERGROUND POWER
- WATER LINE
- PROPERTY LINE
- CENTER LINE
- CENTER LINE OF WASH
- HYDRAULIC GRADE LINE
- MANHOLE
- ACCESS HOLE
- REPORT SCHEMATIC NO.

**SCALE**  
 HORIZ 1"=50'  
 VERT 1"=5'

**GRAPHIC SCALE**  
 (IN FEET)  
 1 inch = 50 ft

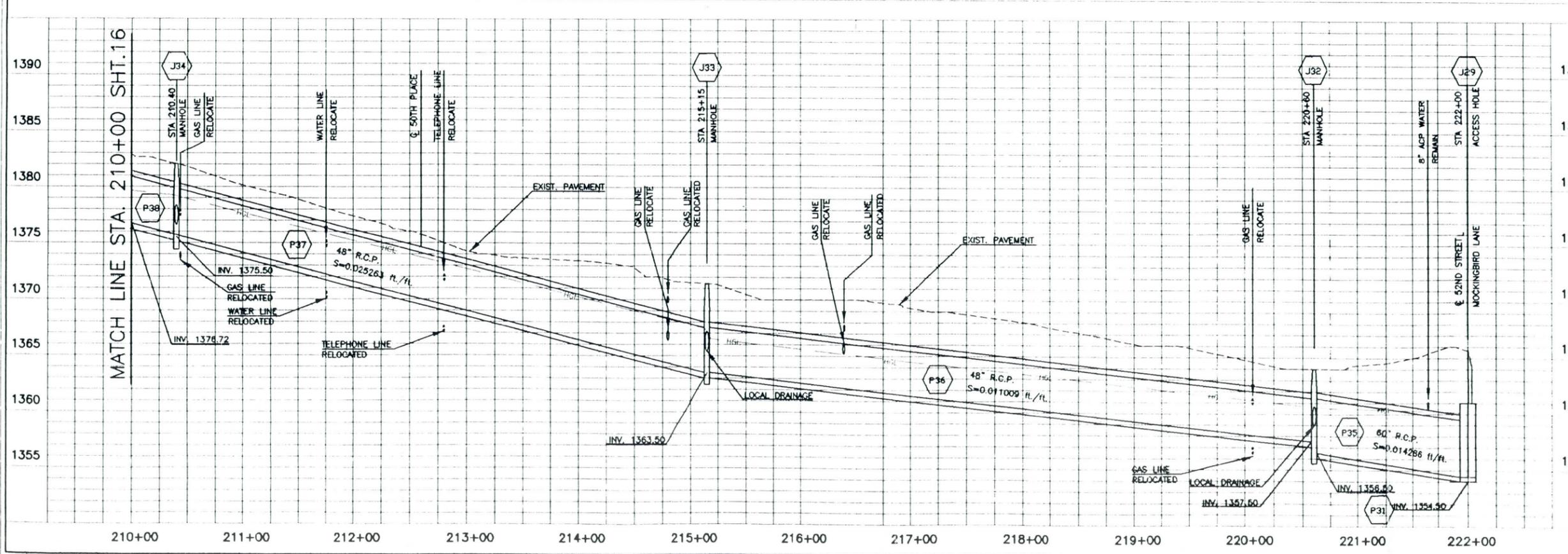
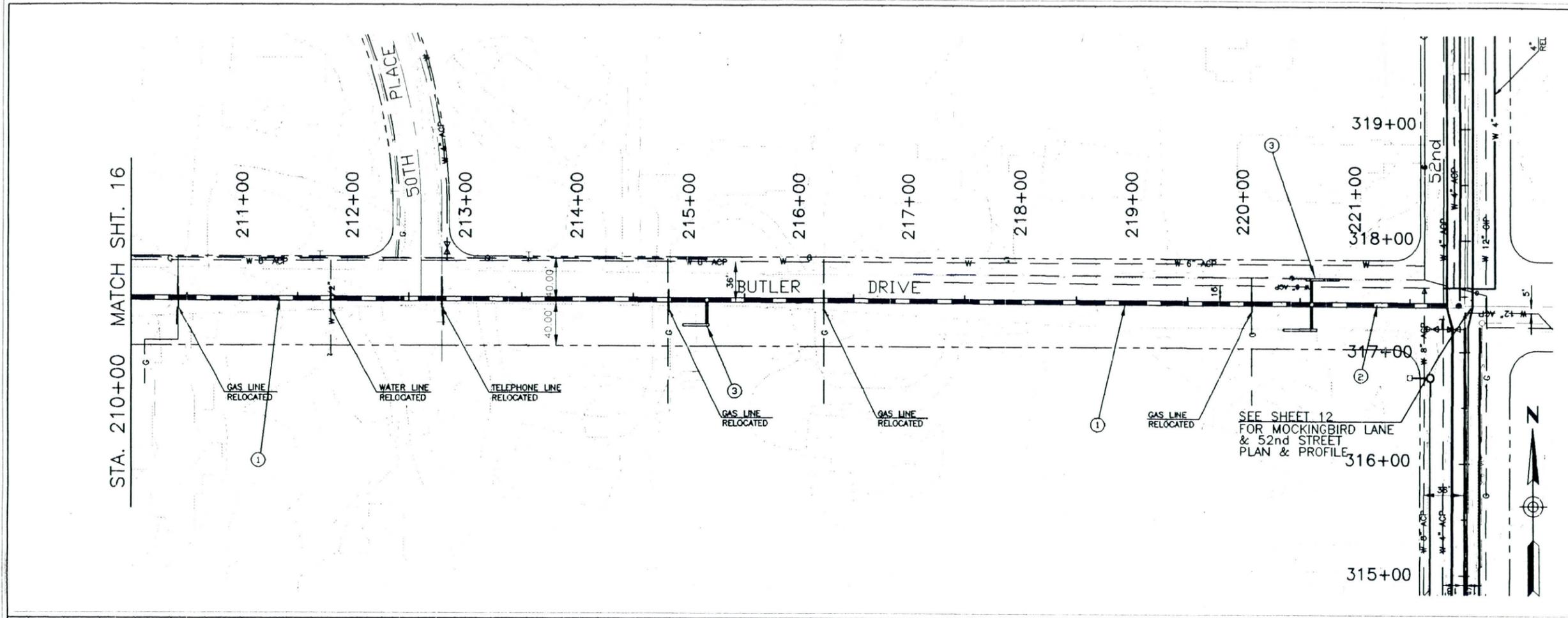
CALL THE WORKING DRAWING YOU SEE  
**203-1100**  
**1-800-STAKE-IT**  
(DRINK MARICOPA COBBLER)

NO.	REVISION	BY	DATE

**FLOOD CONTROL DISTRICT OF MARICOPA COUNTY**  
**DOUBLETREE RANCH ROAD REGIONAL STUDY**

DESIGN	NAME	DATE
	W.S.S.	12/96
DRAWN	D.E.B.	12/96
CHECKED	D.L.S.	12/96

**HOK ENGINEERING, INC.**  
1100 N. CENTRAL AVENUE, SUITE 1000, PHOENIX, ARIZONA 85004  
 TEL: 602-254-2000 FAX: 602-254-2001



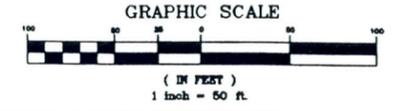
COUNTY	STATE	PROJECT NO.	SHEET	TOTAL SHEETS	AS BUILT
MARICOPA	AZ.	2878	18	28	

- ① 30" RCP
- ② CULVERT INLET WITH TRASH RACK
- ③ TEMPORARY CONSTRUCTION EASEMENT

**LEGEND**

- EXISTING DRAINAGE EASEMENT
- REQUIRED DRAINAGE EASEMENT
- CABLE TV
- GAS LINE
- TELEPHONE
- OVERHEAD POWER
- SANITARY SEWER
- UNDERGROUND POWER
- WATER LINE
- PROPERTY LINE
- CENTER LINE
- CENTER LINE OF WATER
- HYDRAULIC GRADE LINE
- MANHOLE
- ACCESS HOLE
- PERMIT SCHEMATIC

**SCALE**  
 HORIZ 1"=50'  
 VERT 1"=5'



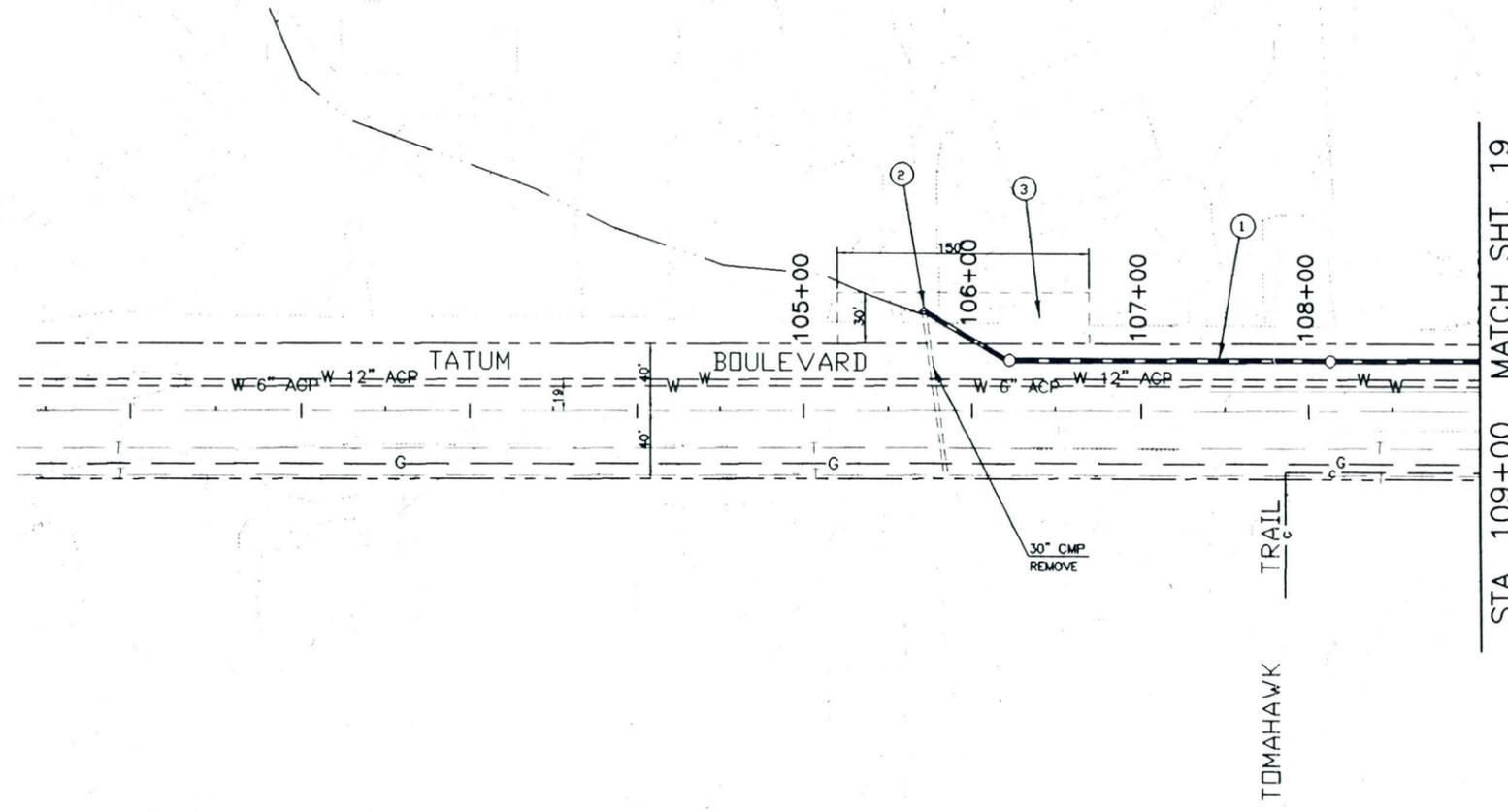
NO.	REVISION	BY	DATE

**FLOOD CONTROL DISTRICT OF MARICOPA COUNTY**

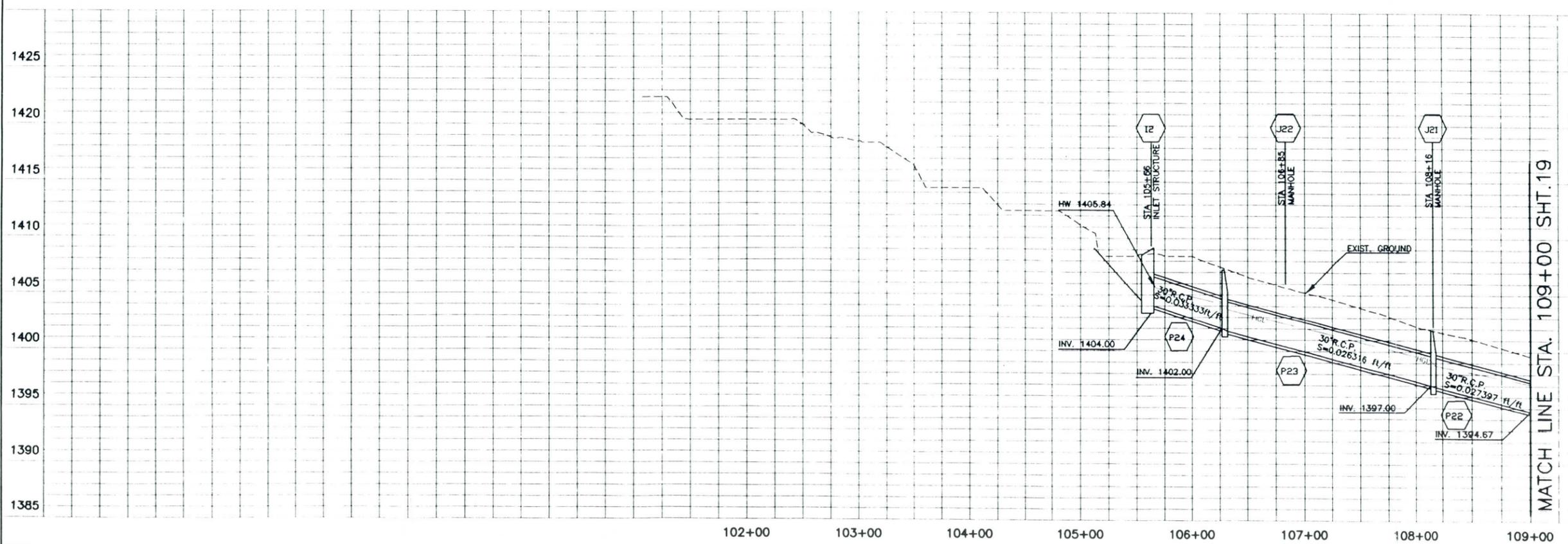
**DOUBLETREE RANCH ROAD REGIONAL STUDY**

	NAME	DATE
DESIGN	W.S.S.	12/95
DRAWN	D.F.B.	12/96
CHECKED	D.L.S.	12/96

**HOOK ENGINEERING, INC.**  
 1111 E. HOOD ROAD, SUITE 100, PHOENIX, ARIZONA 85042  
 (602) 998-1000 FAX (602) 998-1001



STA. 109+00 MATCH SHT. 19



MATCH LINE STA. 109+00 SHT. 19

COUNTY	STATE	PROJECT NO.	SHEET	TOTAL SHEETS	AS BUILT
MARICOPA	AZ.	2878	19	28	

- ① 2'-8" x 4' CBC
- ② 36" RCP
- ③ 8' x 6' CBC
- ④ 30" RCP
- ⑤ TRANSITION STRUCTURE

**LEGEND**

- EXISTING DRAINAGE EASEMENT
- REQUIRED DRAINAGE EASEMENT
- CABLE TV
- GAS LINE
- TELEPHONE
- OVERHEAD POWER
- SANITARY SEWER
- UNDERGROUND POWER
- WATER LINE
- PROPERTY LINE
- CENTER LINE
- CENTER LINE OF WASH
- HYDRAULIC GRADE LINE
- MANHOLE
- ACCESS HOLE
- REPORT SCHEMATIC NO.

**SCALE**  
 HORIZ 1"=50'  
 VERT 1"=5'

**GRAPHIC SCALE**  
 ( IN FEET )  
 1 inch = 60 ft.

CALL THE WORKING SHEET BEFORE YOU BUY  
 263-1100  
 1-800-STAKE-IT  
 (SOURCE: MARICOPA COUNTY)

NO.	REVISION	BY	DATE

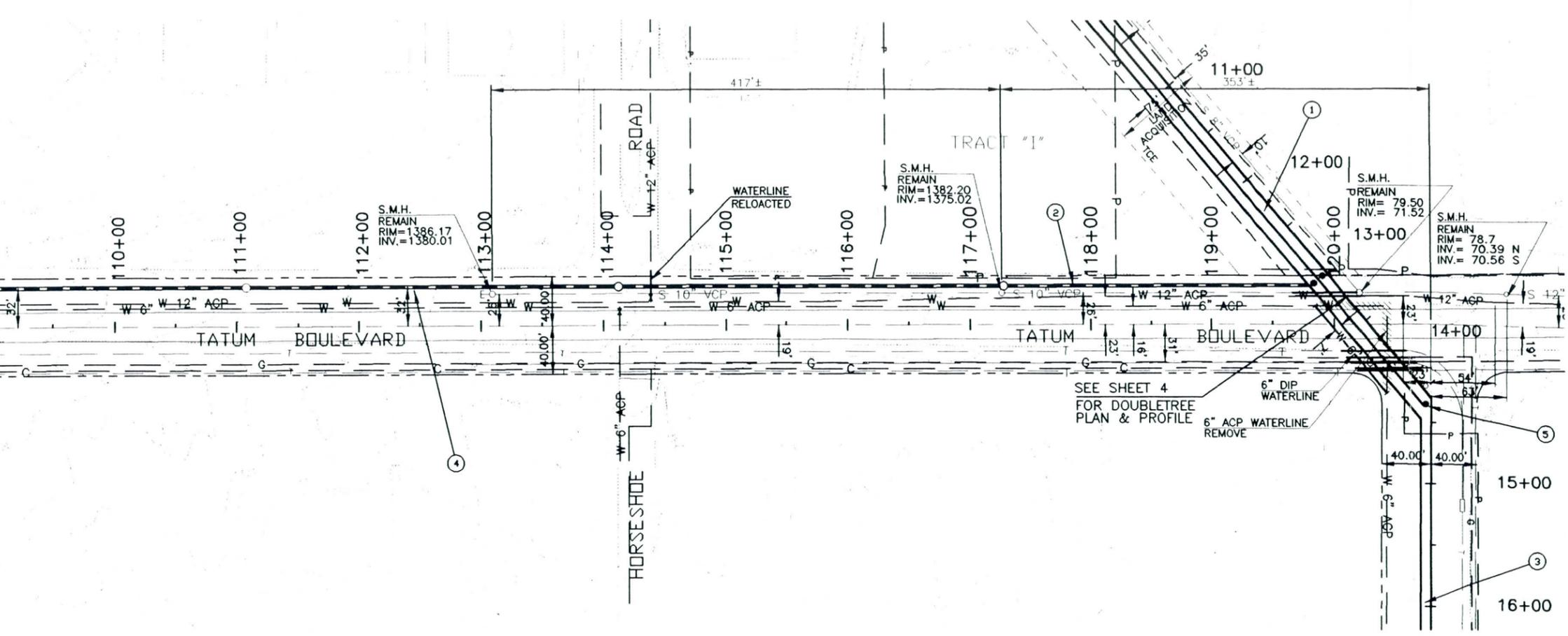
**FLOOD CONTROL DISTRICT OF MARICOPA COUNTY**

**DOUBLETREE RANCH ROAD REGIONAL STUDY**

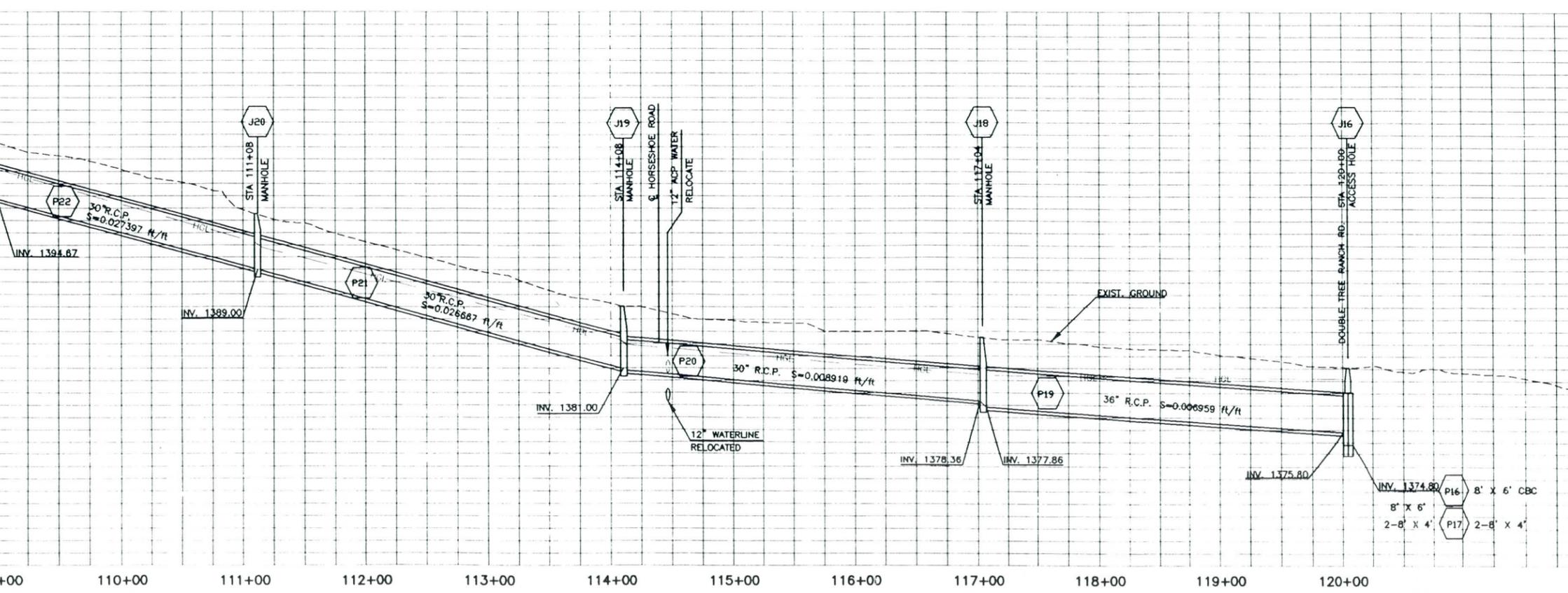
DESIGN	NAME	DATE
	W.S.S.	12/96
DRAWN	D.E.B.	12/96
CHECKED	D.L.S.	12/96

**HOOK ENGINEERING, INC.**  
1111 N. 10TH AVENUE, SUITE 100, PHOENIX, ARIZONA 85007  
 PH: 260-8888 FAX: 260-8889

STA. 109+00 MATCH SHT.18



MATCH LINE STA. 109+00 SHT.18



109+00 110+00 111+00 112+00 113+00 114+00 115+00 116+00 117+00 118+00 119+00 120+00

COUNTY	STATE	PROJECT NO.	SHEET	TOTAL SHEETS	AS BUILT
MARICOPA	AZ.	2878	20	28	

### DRAINAGE EASEMENT

- (X) M.C.A.P.N. 169-07-52
- (Y) M.C.A.P.N. 169-07-53
- (Z) M.C.A.P.N. 169-07-58
- (M) M.C.A.P.N. 169-07-4A
- (AB) M.C.A.P.N. 169-07-27
- (AC) M.C.A.P.N. 169-07-28
- (AD) M.C.R. BK.70 PG.47

### LEGEND

- EXISTING DRAINAGE EASEMENT
- REQUIRED DRAINAGE EASEMENT
- CABLE TV
- GAS LINE
- TELEPHONE
- OVERHEAD POWER
- SANITARY SEWER
- UNDERGROUND POWER
- WATER LINE
- PROPERTY LINE
- CENTER LINE
- CENTER LINE OF WASH
- HYDRAULIC GRADE LINE
- MANHOLE
- ACCESS HOLE
- REPORT SCHEMATIC NO

SCALE  
 HORIZ 1"=50'  
 VERT 1"=5'

GRAPHIC SCALE  
 ( IN FEET )  
 1 inch = 50 ft.

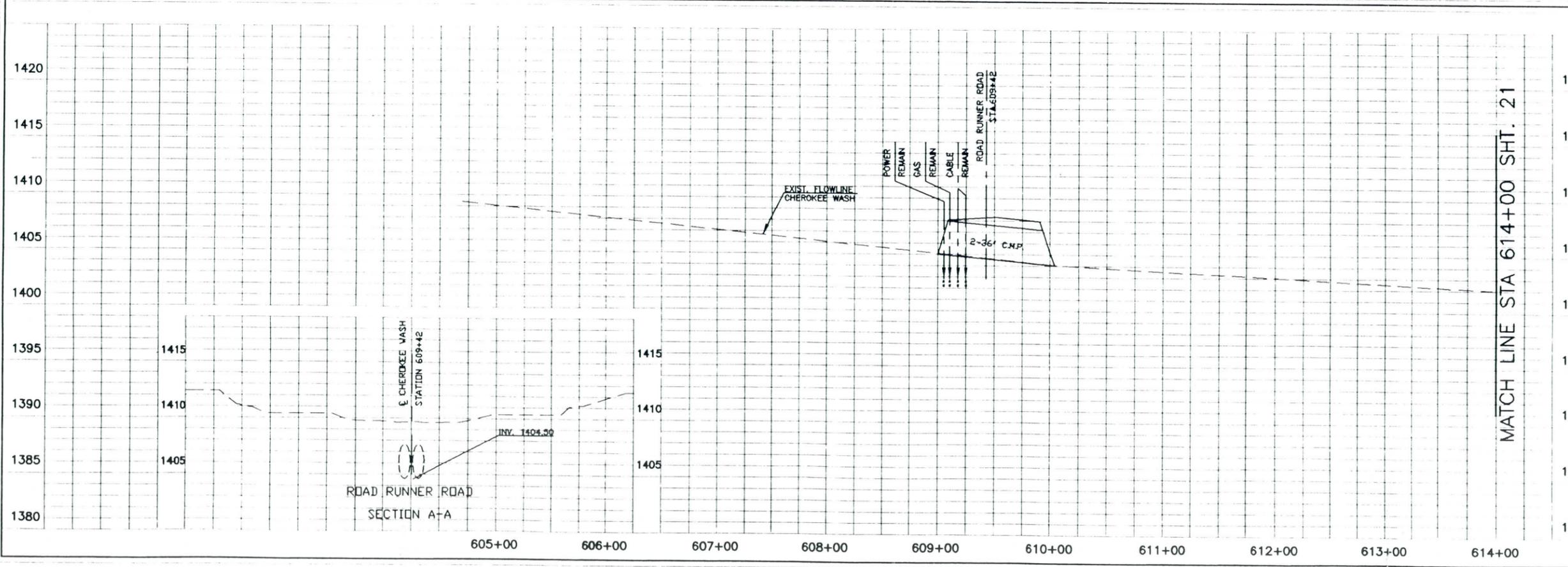
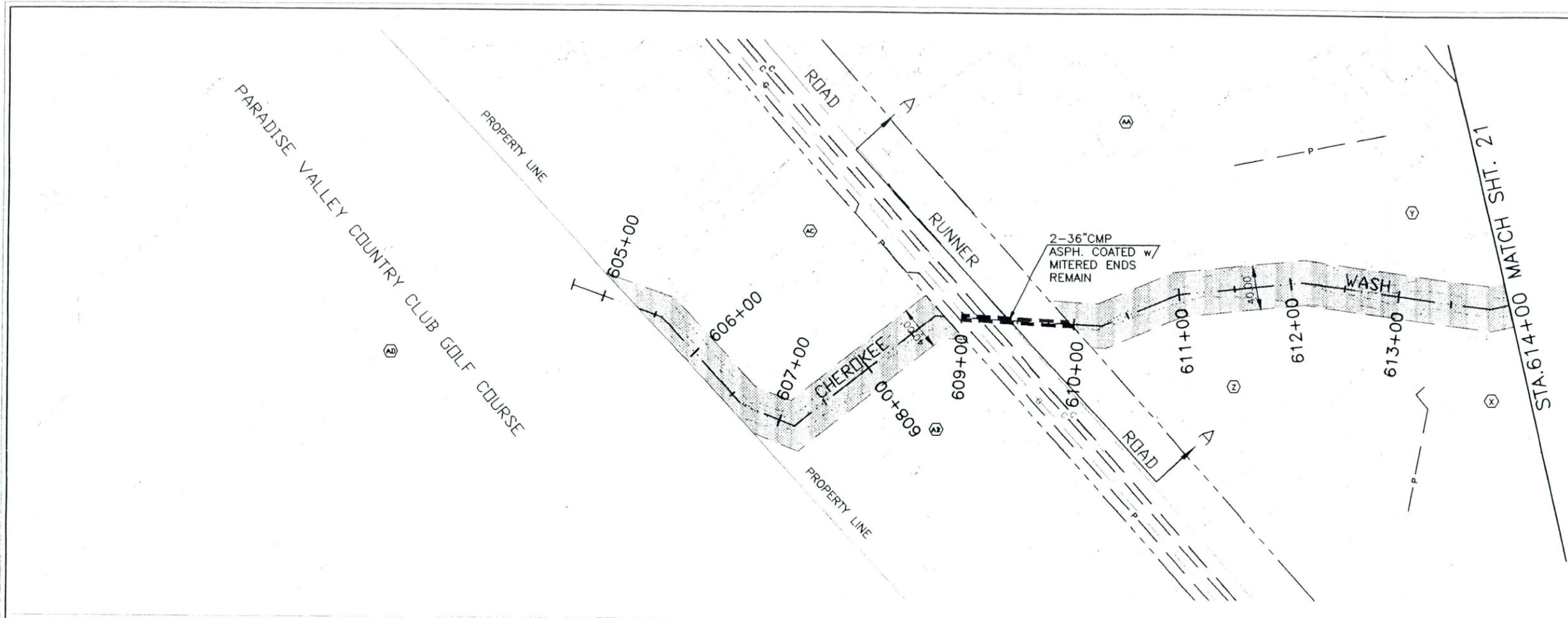
CALL FOR WORKING DRAWINGS BEFORE YOU BUY  
**263-1100**  
**1-800-STAKE-IT**  
(SOURCE: MARICOPA COUNTY)

NO.	REVISION	BY	DATE

### FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

#### DOUBLETREE RANCH ROAD REGIONAL STUDY

	NAME	DATE
DESIGN	W.S.S.	12/96
DRAWN	D.E.B.	12/96
CHECKED	D.L.S.	12/96



COUNTY	STATE	PROJECT NO.	SHEET	TOTAL SHEETS	AS BUILT
MARICOPA	AZ.	2878	21	28	

DRAINAGE EASEMENT					
(N)	M.C.A.P.N. 169-07-71	(U)	M.C.A.P.N. 169-07-66		
(D)	M.C.A.P.N. 169-07-72	(V)	M.C.A.P.N. 169-07-48		
(F)	M.C.A.P.N. 169-07-73	(W)	M.C.A.P.N. 169-07-47		
(G)	M.C.A.P.N. 169-07-70	(X)	M.C.A.P.N. 169-07-52		
(R)	M.C.A.P.N. 169-07-84	(Y)	M.C.A.P.N. 169-07-53		
(S)	M.C.A.P.N. 169-07-83				
(T)	M.C.A.P.N. 169-07-67				

(1) 3-48" RCP

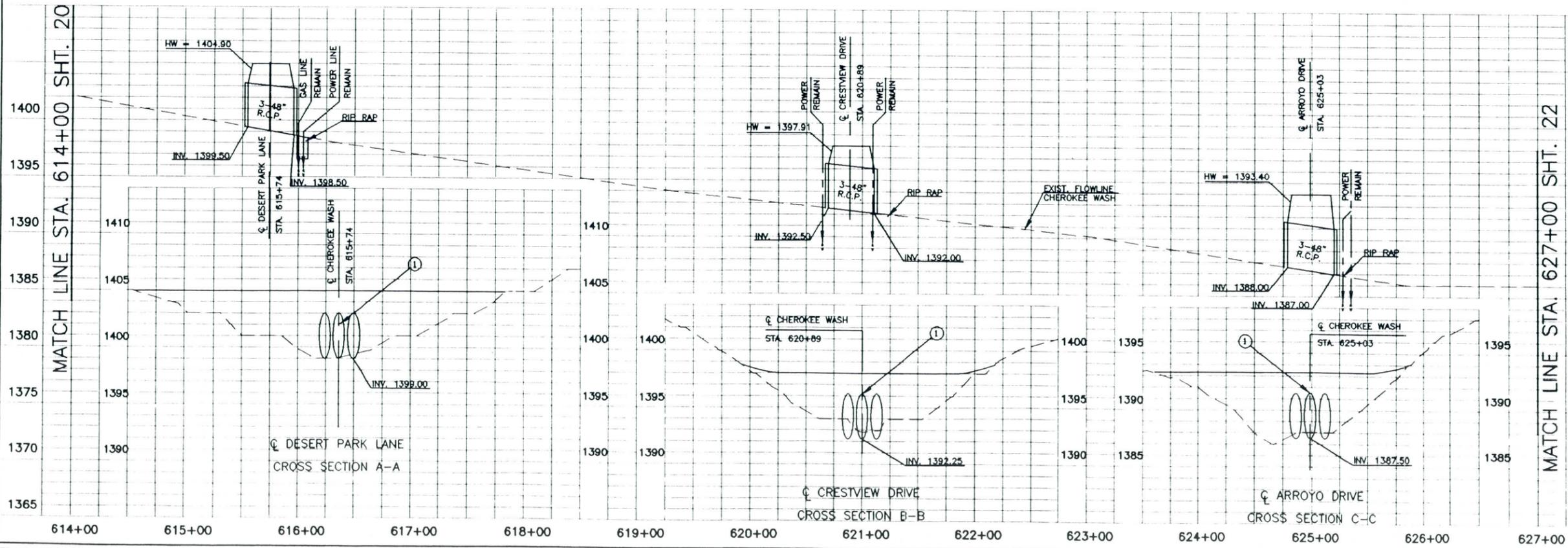
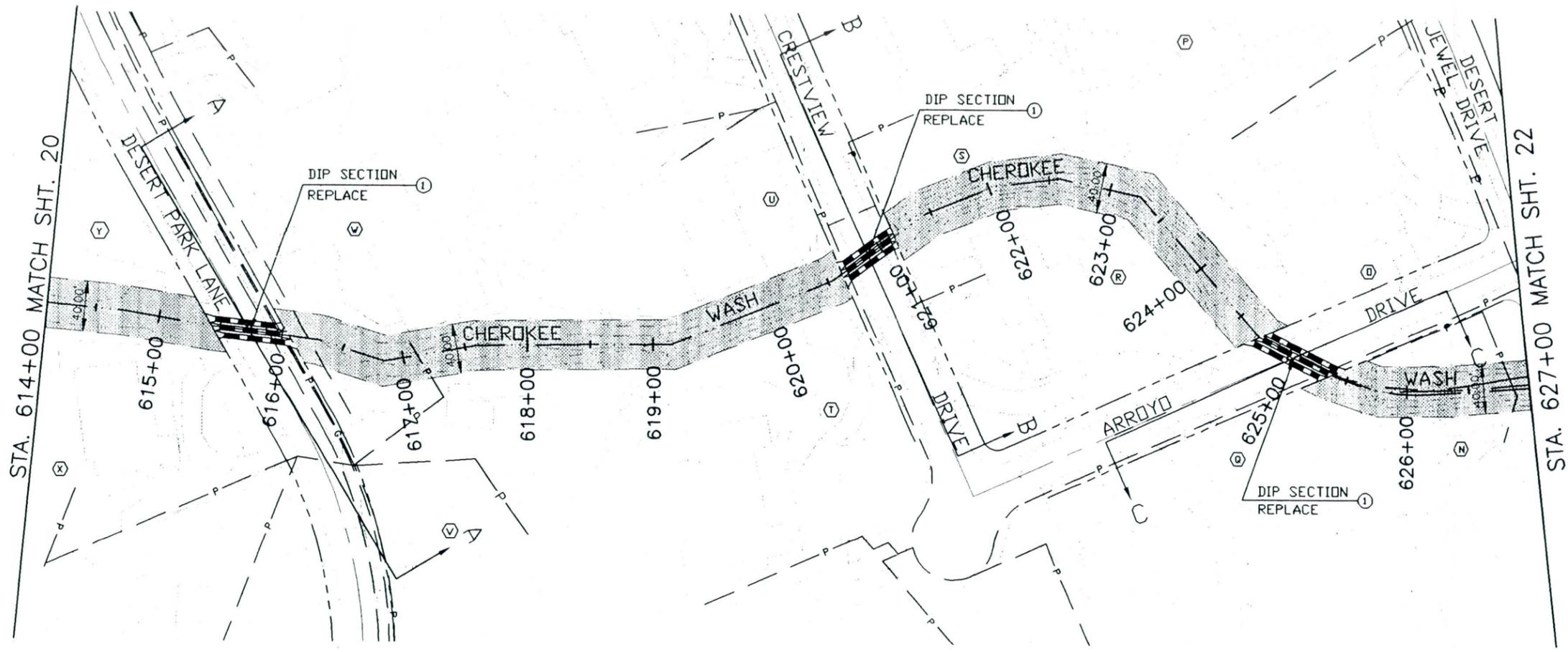
LEGEND	
	EXISTING DRAINAGE EASEMENT
	REQUIRED DRAINAGE EASEMENT
	CABLE TV
	GAS LINE
	TELEPHONE
	OVERHEAD POWER
	SANITARY SEWER
	UNDERGROUND POWER
	WATER LINE
	PROPERTY LINE
	CENTER LINE
	CENTER LINE OF WASH
	HYDRAULIC GRADE LINE
	MANHOLE
	ACCESS HOLE
	REPORT SCHEMATIC NO.

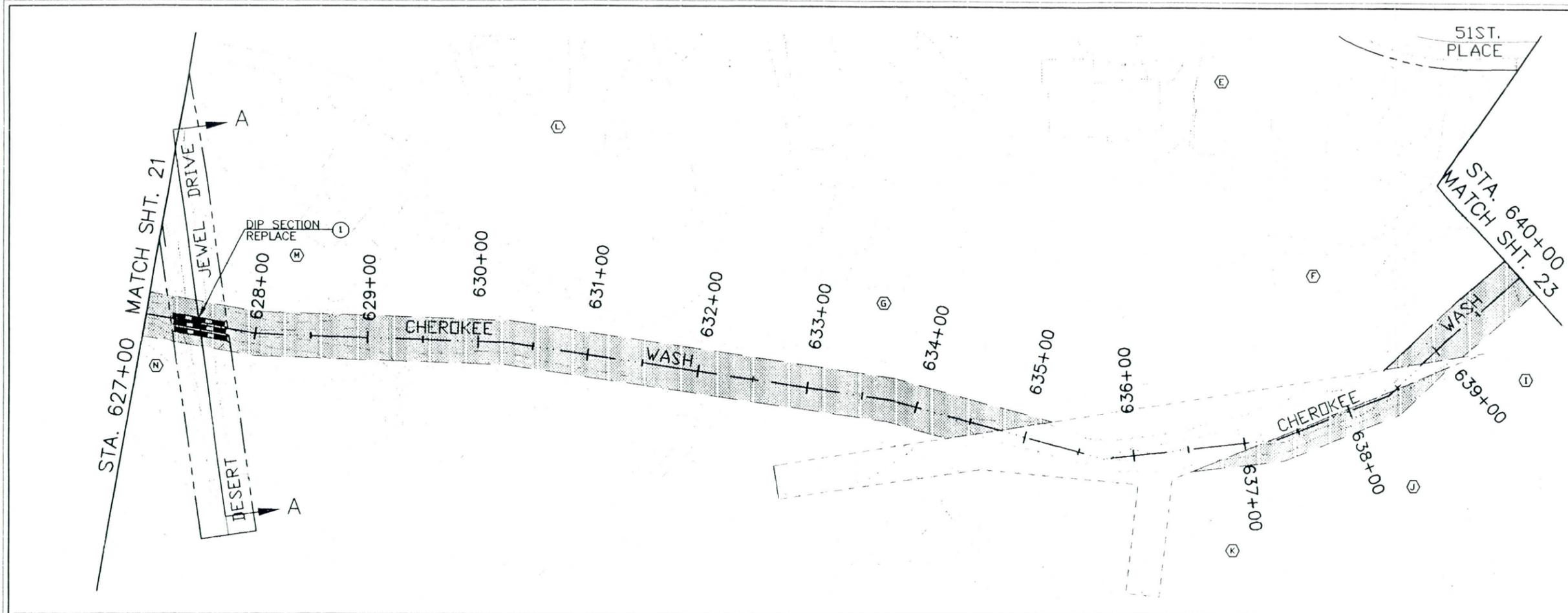
SCALE  
 HORIZ 1"=50'  
 VERT 1"=5'

GRAPHIC SCALE  
 ( IN FEET )  
 1 inch = 50 ft.

CALL FOR LOGS AND BIDS BEFORE YOU BID  
**283-1100**  
**1-800-STAKE-IT**  
(SERVICE THROUGH COUNTY)

NO.	REVISION	BY	DATE
<b>FLOOD CONTROL DISTRICT OF MARICOPA COUNTY</b>			
<b>DOUBLETREE RANCH ROAD REGIONAL STUDY</b>			
DESIGN	NAME	DATE	
DRAWN	W.S.S.	12/96	
CHECKED	D.E.B.	12/96	
	D.L.S.	12/96	
HOOK ENGINEERING, INC. <small>1111 N. 10TH AVENUE, SUITE 100, PHOENIX, ARIZONA 85007</small>			





COUNTY	STATE	PROJECT NO.	SHEET	TOTAL SHEETS	AS BUILT
MARICOPA	AZ.	2878	22	28	

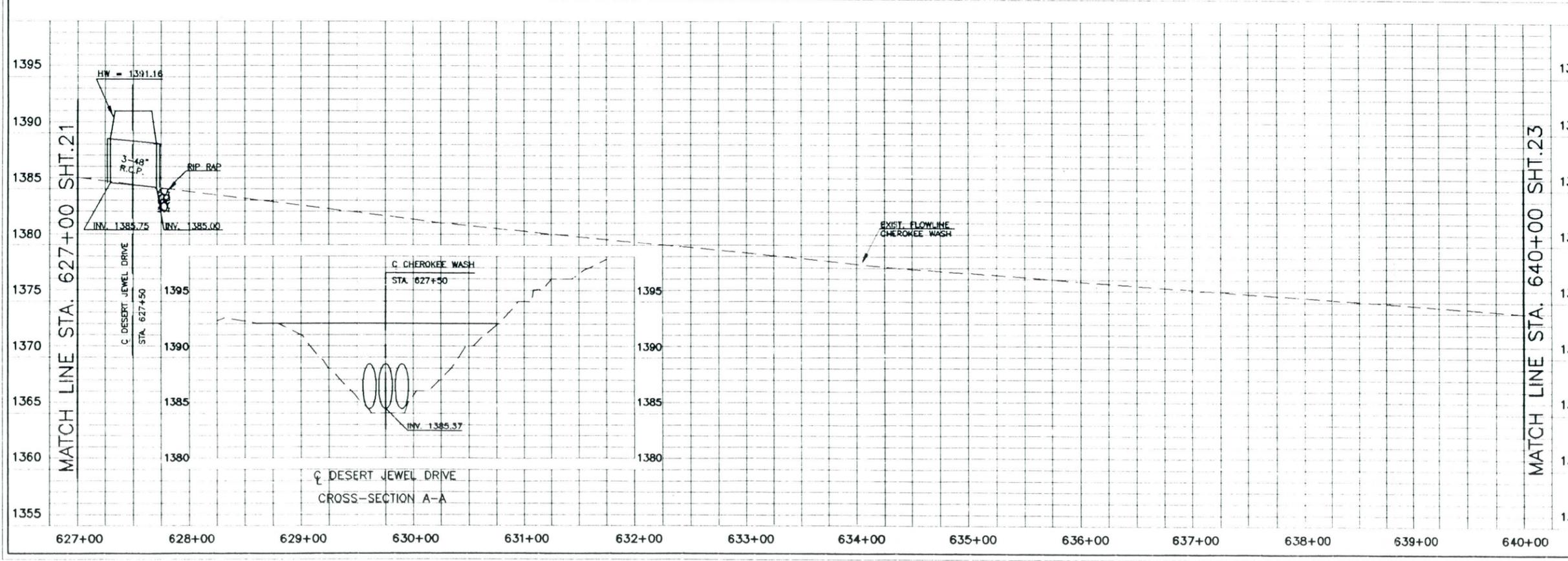
**DRAINAGE EASEMENT**

E	M.C.A.P.N. 168-74-9B	K	M.C.A.P.N. 168-75-005
F	M.C.A.P.N. 168-74-9C	L	M.C.A.P.N. 168-74-4J
G	M.C.A.P.N. 168-74-3E	M	M.C.A.P.N. 168-74-4F
I	M.C.A.P.N. 168-75-003	N	M.C.A.P.N. 169-07-71
J	M.C.A.P.N. 168-75-004		

① 3-48" RCP

**LEGEND**

	EXISTING DRAINAGE EASEMENT
	REQUIRED DRAINAGE EASEMENT
	CABLE TV
	GAS LINE
	TELEPHONE
	OVERHEAD POWER
	SANITARY SEWER
	UNDERGROUND POWER
	WATER LINE
	PROPERTY LINE
	CENTER LINE
	CENTER LINE OF WASH
	HGL
	MANHOLE
	ACCESS HOLE
	REPORT SCHEMATIC NO.



SCALE  
 HORIZ 1"=50'  
 VERT 1"=5'

GRAPHIC SCALE  
 (IN FEET)  
 1 inch = 50 ft

NO.	REVISION	BY	DATE

**FLOOD CONTROL DISTRICT OF MARICOPA COUNTY**

**DOUBLETREE RANCH ROAD REGIONAL STUDY**

DESIGN	NAME	DATE
DRAWN	W.S.S.	12/96
CHECKED	D.F.B.	12/96
	D.L.S.	12/96

HOOK ENGINEERING, INC.  
 1111 N. 10TH AVENUE, SUITE 100, PHOENIX, AZ 85007  
 (602) 263-1100

SHEET 22 OF 28

COUNTY	STATE	PROJECT NO.	SHEET	TOTAL SHEETS	AS BUILT
MARICOPA	AZ.	2878	23	28	

### DRAINAGE EASEMENT

- (C) M.C.A.P.N. 168-66-002
- (D) M.C.A.P.N. 168-74-9A
- (H) M.C.A.P.N. 168-66-14A
- (I) M.C.A.P.N. 168-75-003

### LEGEND

- EXISTING DRAINAGE EASEMENT
- REQUIRED DRAINAGE EASEMENT
- CABLE TV
- GAS LINE
- TELEPHONE
- OVERHEAD POWER
- SANITARY SEWER
- UNDERGROUND POWER
- WATER LINE
- PROPERTY LINE
- CENTER LINE
- CENTER LINE OF WASH
- HYDRAULIC GRADE LINE
- MANHOLE
- ACCESS HOLE
- REPORT SCHEMATIC NO.

**SCALE**  
 HORIZ 1"=50'  
 VERT 1"=5'

**GRAPHIC SCALE**  
 (IN FEET)  
 1 inch = 50 ft.

CALL THE RECORDING DISTRICT BEFORE USING THIS 283-1100 1-800-STAKE-IT (MARICOPA COUNTY)

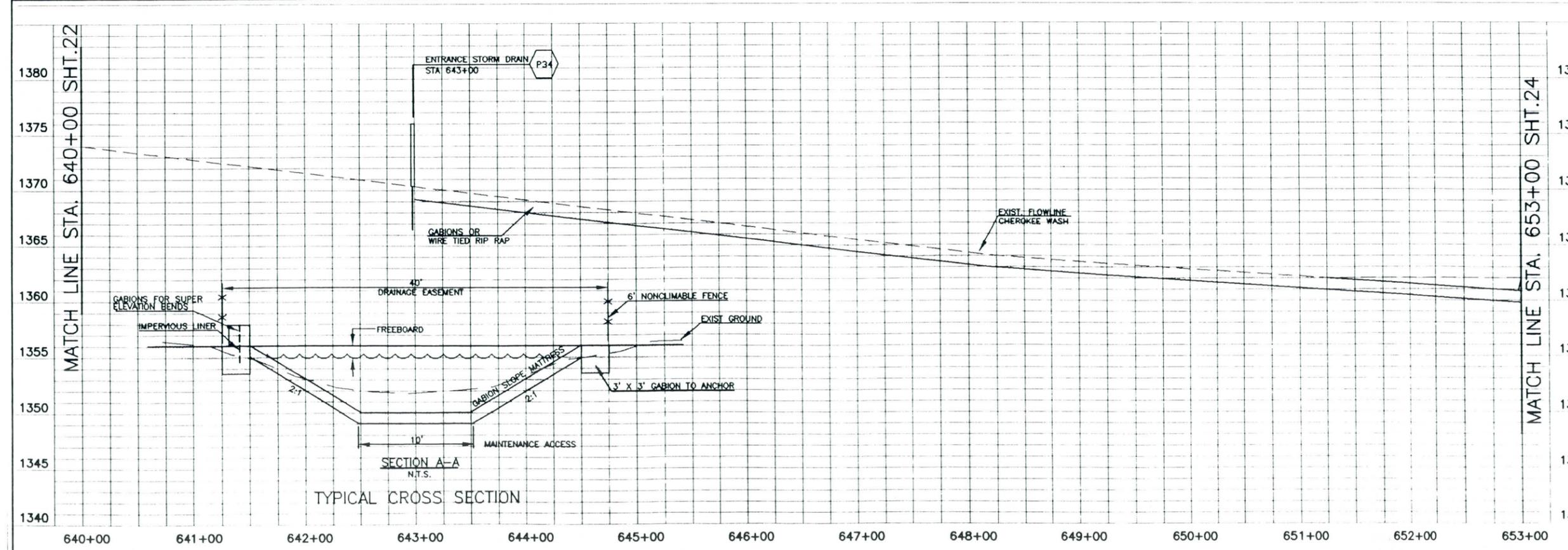
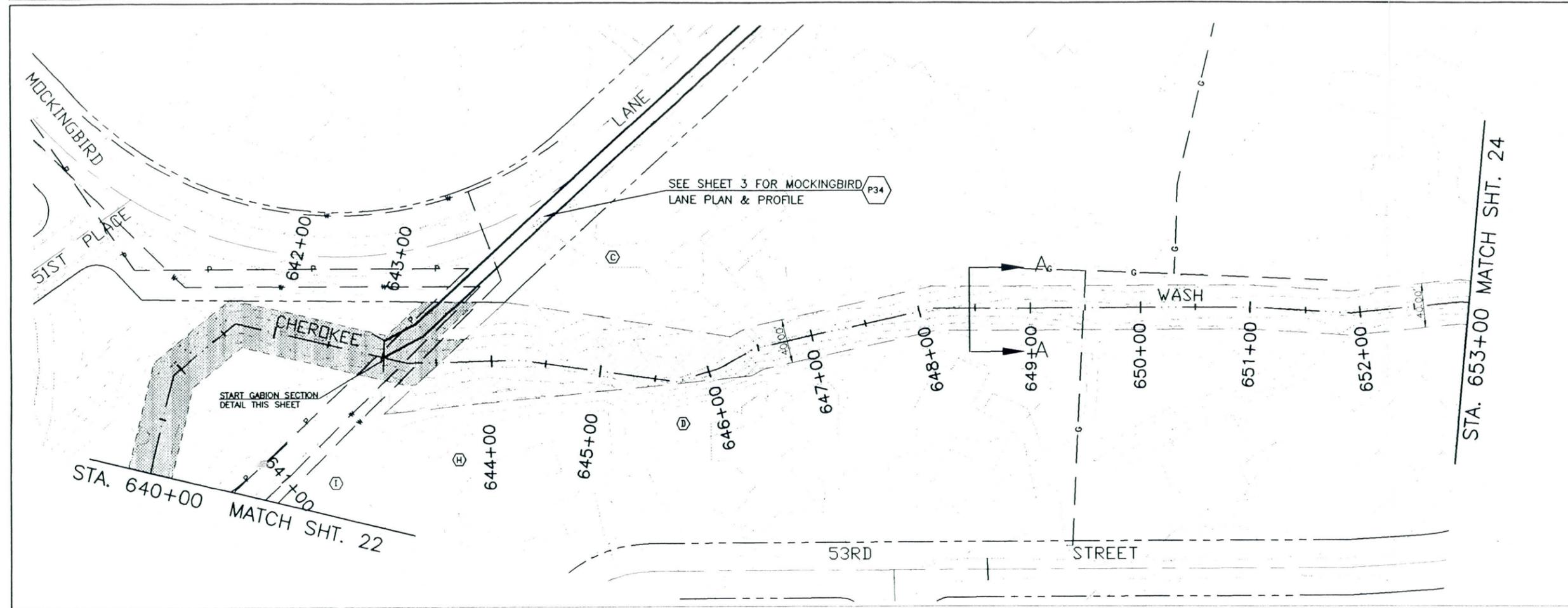
NO.	REVISION	BY	DATE

### FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

### DOUBLETREE RANCH ROAD REGIONAL STUDY

	NAME	DATE
DESIGN	W.S.S.	12/98
DRAWN	D.E.B.	12/96
CHECKED	D.L.S.	12/96

**HOOK ENGINEERING, INC.**  
1100 N. CENTRAL AVENUE, SUITE 100, PHOENIX, ARIZONA 85004  
 TEL: 602-998-8888 FAX: 602-998-8889



COUNTY	STATE	PROJECT NO.	SHEET	TOTAL SHEETS	AS BUILT
MARICOPA	AZ.	2878	24	28	

### DRAINAGE EASEMENT

- (A) M.C.A.P.N. 168-65-040
- (B) M.C.A.P.N. 168-65-041

- (1) 2-10' x 5' CBC
- (2) 3-10' x 3' CBC
- (3) GRADE CONTROL DROP STRUCTURE

### LEGEND

- EXISTING DRAINAGE EASEMENT
- REQUIRED DRAINAGE EASEMENT
- CABLE TV
- GAS LINE
- TELEPHONE
- OVERHEAD POWER
- SANITARY SEWER
- UNDERGROUND POWER
- WATER LINE
- PROPERTY LINE
- CENTER LINE
- CENTER LINE OF WASH
- HYDRAULIC GRADE LINE
- MANHOLE
- ACCESS HOLE
- SCHEMATIC NO.

**SCALE**  
 HORIZ 1"=50'  
 VERT 1"=5'

**GRAPHIC SCALE**  
 ( IN FEET )  
 1 inch = 60 ft.

CALL TWO WORKING DAYS BEFORE YOU BE  
**263-1100**  
**1-800-8TAKE-IT**  
(OUTSIDE MARICOPA COUNTY)

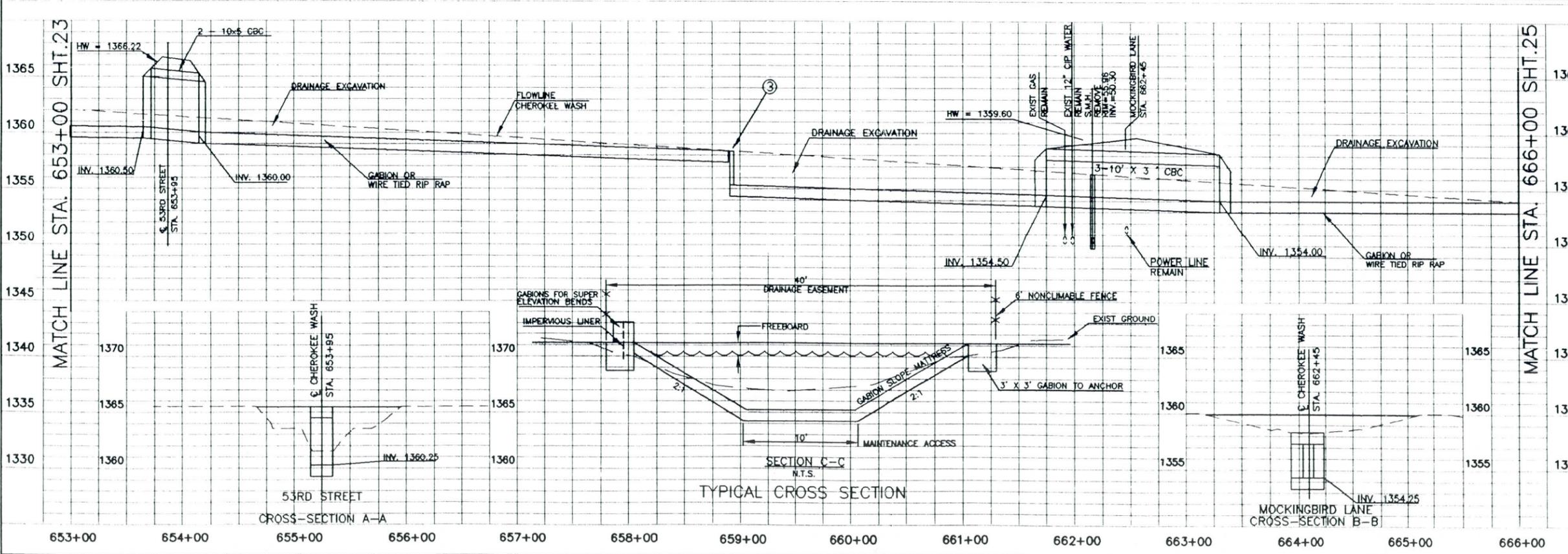
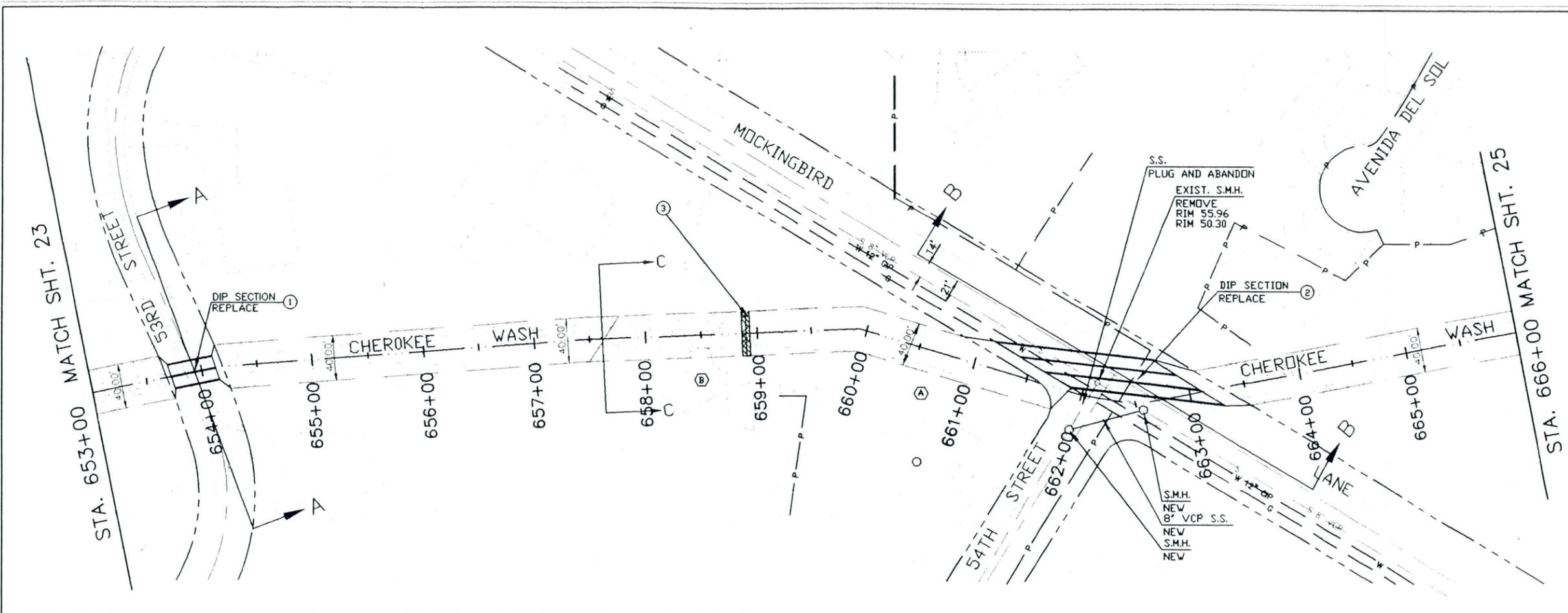
NO.	REVISION	BY	DATE

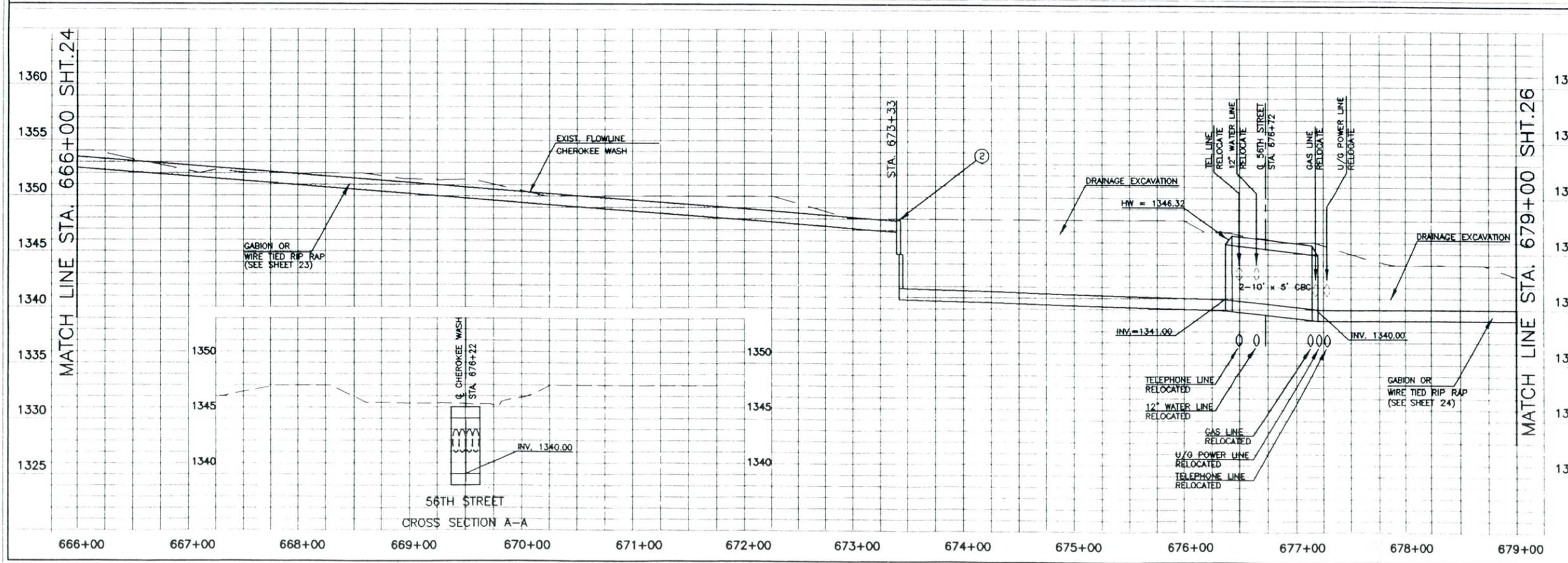
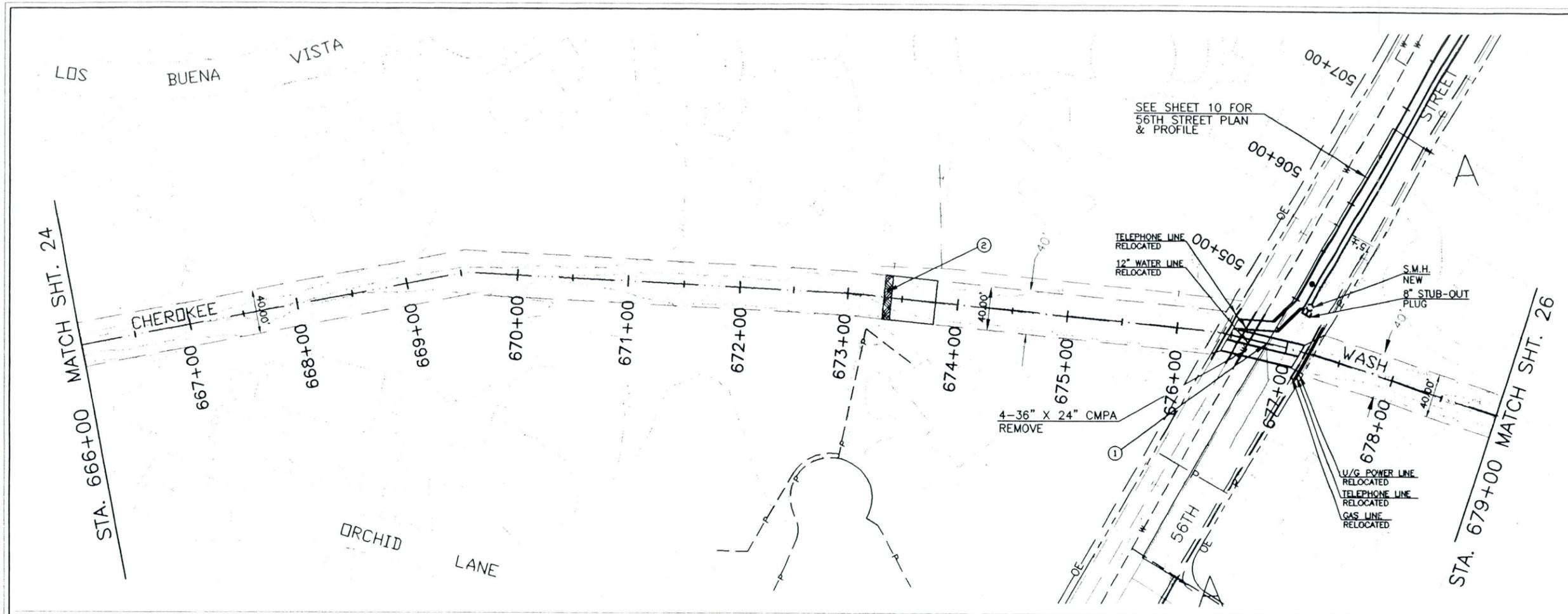
### FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

### DOUBLETREE RANCH ROAD REGIONAL STUDY

DESIGN	NAME	DATE
DRAWN	W.S.S.	12/98
CHECKED	D.E.B.	12/98
	D.L.S.	12/98

**HOOK ENGINEERING, INC.**  
1100 N. 10TH AVENUE, SUITE 100, DENVER, CO 80202





COUNTY	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
MARICOPA	AZ.	2878	25	28	

- ① 2-10' x 5' CBC
- ② GRADE CONTROL DROP STRUCTURE

**LEGEND**

- EXISTING DRAINAGE EASEMENT
- REQUIRED DRAINAGE EASEMENT
- CABLE TV
- GAS LINE
- TELEPHONE
- OVERHEAD POWER
- SANITARY SEWER
- UNDERGROUND POWER
- WATER LINE
- PROPERTY LINE
- CENTER LINE
- CENTER LINE OF WASH
- HYDRAULIC GRADE LINE
- MANHOLE
- ACCESS HOLE
- REPORT SCHEMATIC NO

SCALE  
 HORIZ 1"=50'  
 VERT 1"=5'

GRAPHIC SCALE  
 ( IN FEET )  
 1 inch = 50 ft.

CALL THE ENGINEER BEFORE YOU BUY  
**283-1100**  
**1-800-STAKE-IT**  
(FOR THE MARICOPA COUNTY)

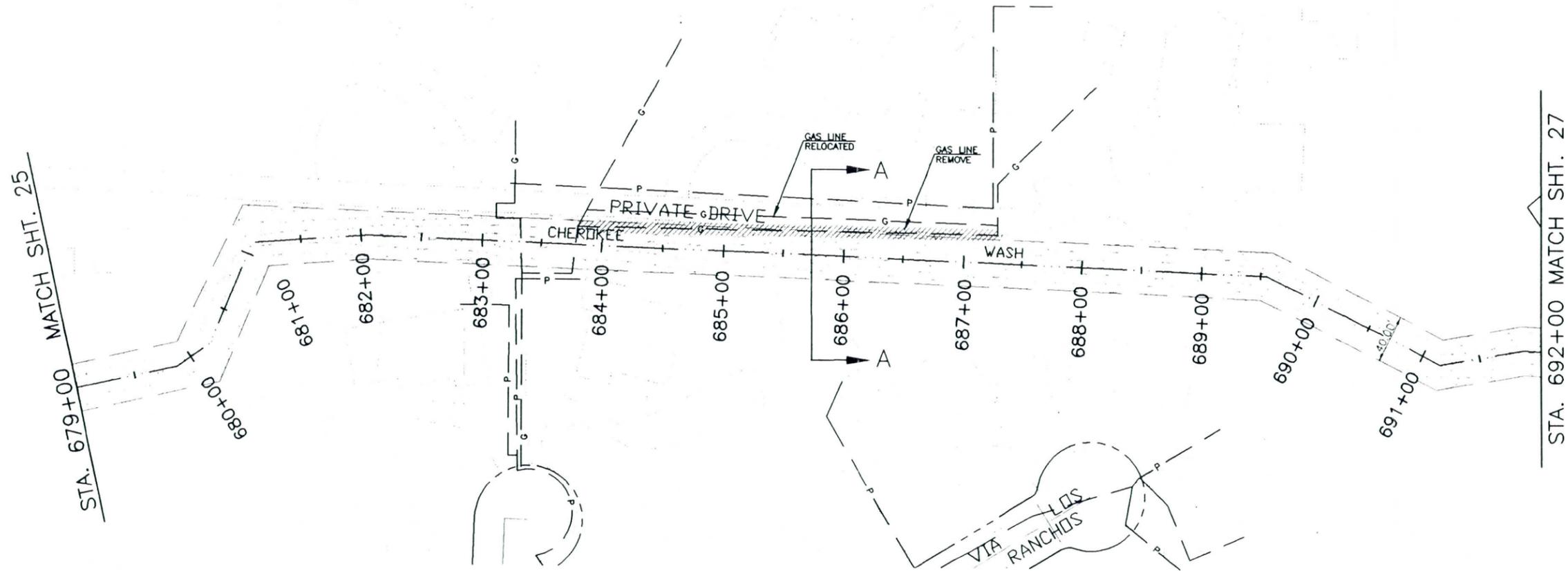
NO.	REVISION	BY	DATE

**FLOOD CONTROL DISTRICT OF MARICOPA COUNTY**  
**DOUBLETREE RANCH ROAD REGIONAL STUDY**

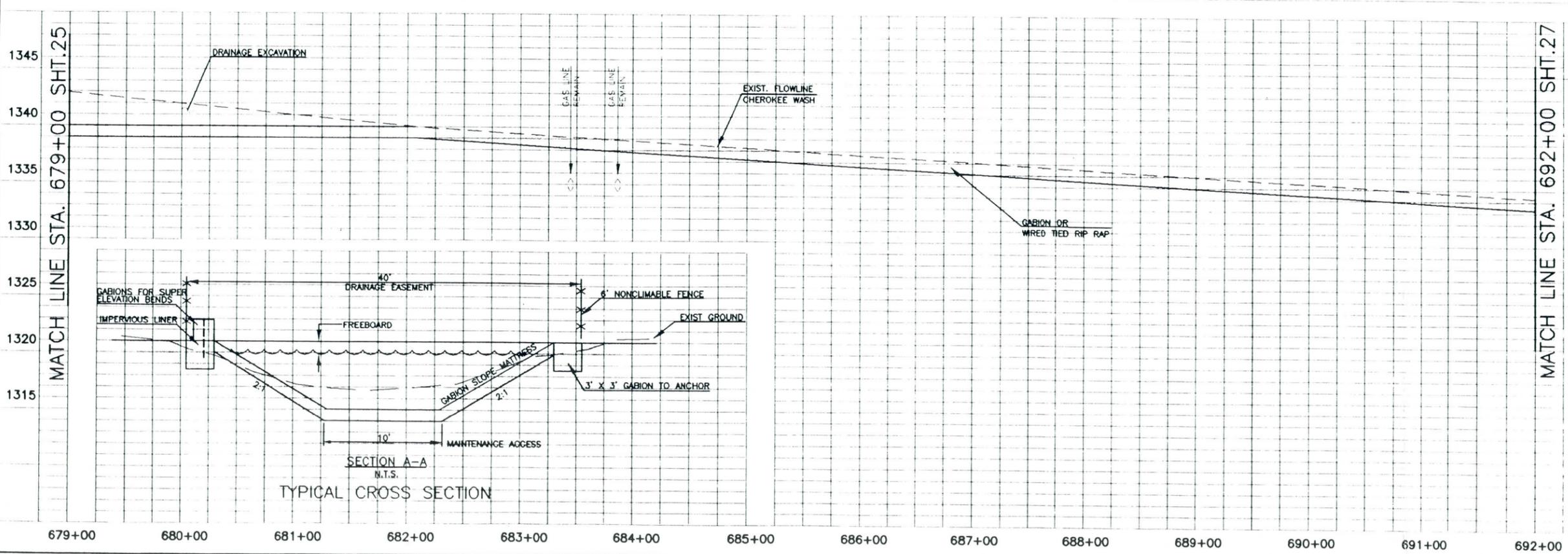
DESIGN	NAME	DATE
DRAWN	W.S.S.	12/96
CHECKED	D.L.S.	12/96

**HOOK ENGINEERING, INC.**  
1101 N. 10TH AVENUE, SUITE 100, PHOENIX, AZ 85007

COUNTY	STATE	PROJECT NO.	SHEET	TOTAL SHEETS	AS BUILT
MARICOPA	AZ.	2878	26	28	



LEGEND	
	EXISTING DRAINAGE EASEMENT
	REQUIRED DRAINAGE EASEMENT
	CABLE TV
	GAS LINE
	TELEPHONE
	OVERHEAD POWER
	SANITARY SEWER
	UNDERGROUND POWER
	WATER LINE
	PROPERTY LINE
	CENTER LINE
	CENTER LINE OF WASH
	HYDRAULIC GRADE LINE
	MANHOLE
	ACCESS HOLE
	REPORT SCHEMATIC NO.



SCALE  
 HORIZ 1"=50'  
 VERT 1"=5'

GRAPHIC SCALE  
 ( IN FEET )  
 1 inch = 50 ft.

NO.	REVISION	BY	DATE

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY  
 DOUBLETREE RANCH ROAD REGIONAL STUDY

	NAME	DATE
DESIGN	W.S.S.	12/96
DRAWN	D.E.B.	12/96
CHECKED	D.L.S.	12/96

HOOK ENGINEERING, INC.  
 10111 N. 28th Ave., Suite 100, Phoenix, AZ 85028  
 (602) 998-8888

COUNTY	STATE	PROJECT NO.	SHEET	TOTAL SHEETS	AS BUILT
MARICOPA	AZ.	2878	27	28	

**DRAINAGE EASEMENT**

- (A) M.C.A.P.N. 168-59-1E
- (B) M.C.A.P.N. 168-59-1C

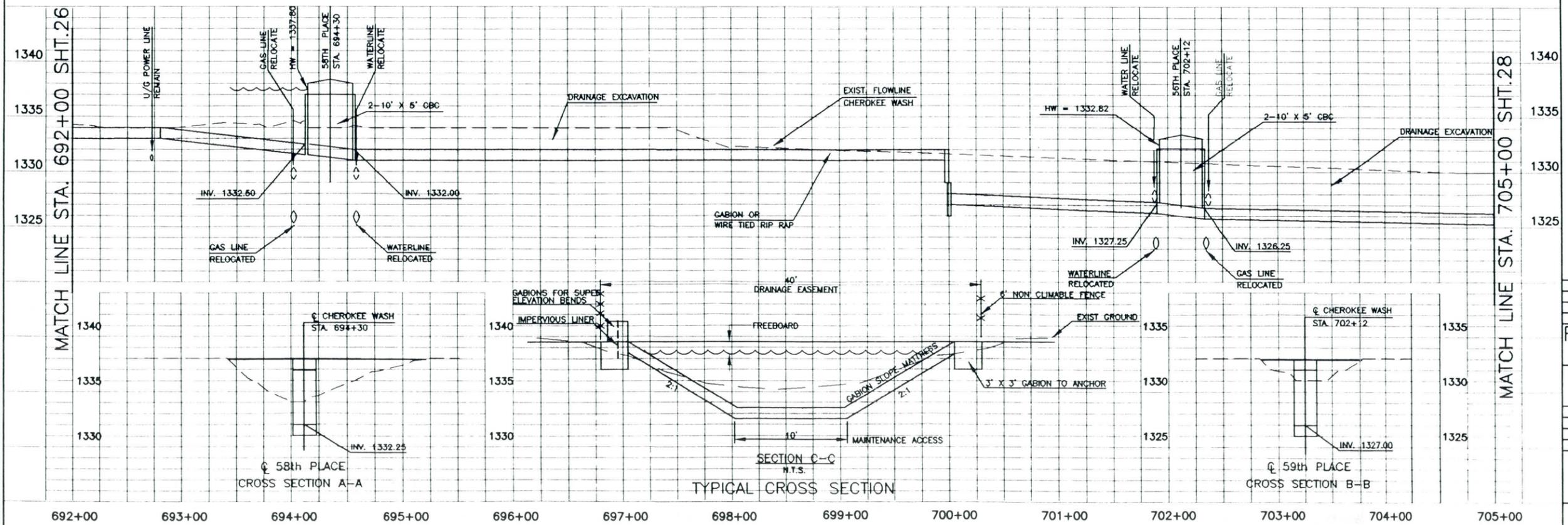
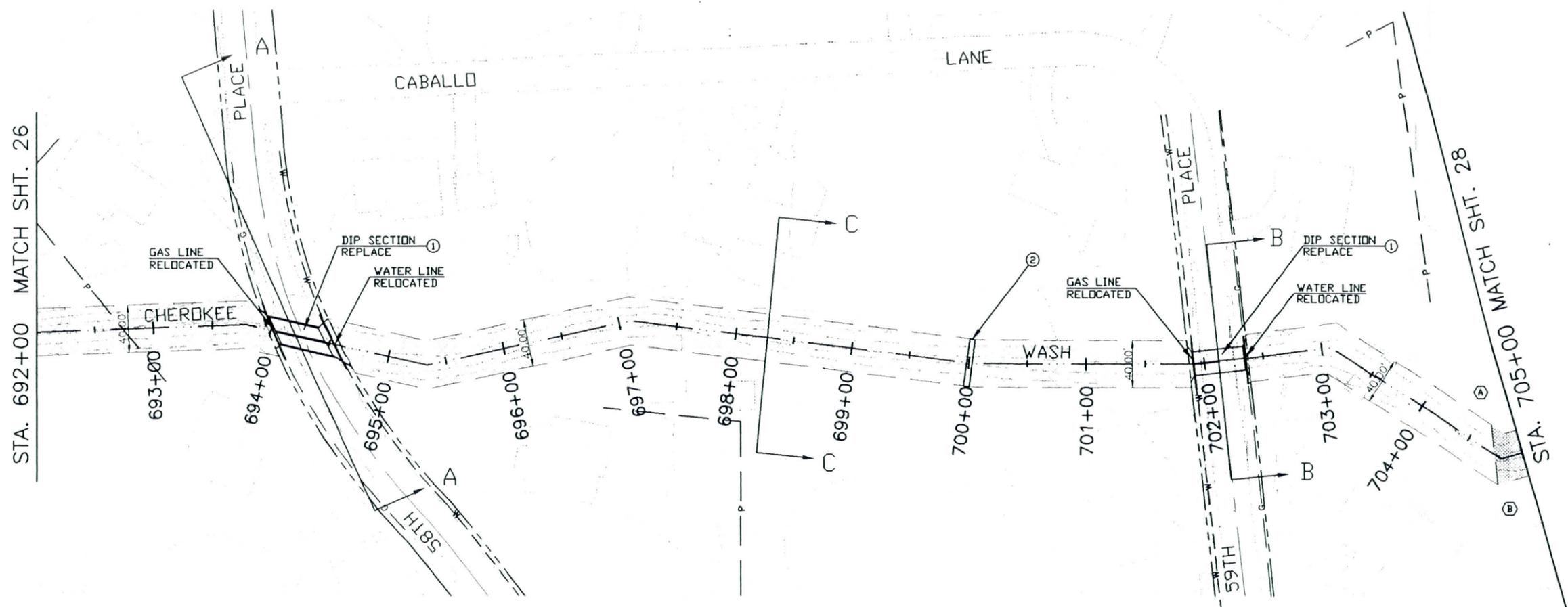
- ① 2 - 10' x 5' CBC
- ② GRADE CONTROL DROP STRUCTURE

**LEGEND**

	EXISTING DRAINAGE EASEMENT
	REQUIRED DRAINAGE EASEMENT
	CABLE TV
	GAS LINE
	TELEPHONE
	OVERHEAD POWER
	SANITARY SEWER
	UNDERGROUND POWER
	WATER LINE
	PROPERTY LINE
	CENTER LINE
	CENTER LINE OF WASH
	HYDRAULIC GRADE LINE
	MANHOLE
	ACCESS HOLE
	REPORT SCHEMATIC NO.

SCALE  
 HORIZ 1"=50'  
 VERT 1"=5'

GRAPHIC SCALE  
 ( IN FEET )  
 1 inch = 50 ft.



NO.	REVISION	BY	DATE

**FLOOD CONTROL DISTRICT OF MARICOPA COUNTY**

**DOUBLETREE RANCH ROAD REGIONAL STUDY**

DESIGN	NAME	DATE
DRAWN	W.S.S.	12/96
CHECKED	D.E.B.	12/96
	D.L.S.	12/96

**HOOK ENGINEERING, INC.**  
1101 N. 10TH AVENUE, SUITE 100, DENVER, CO 80202

SHEET 27 OF 28

COUNTY	STATE	PROJECT NO.	SHEET	TOTAL SHEETS	AS BUILT
MARICOPA	AZ.	2878	28	28	

DRAINAGE EASEMENT

- (A) M.C.A.P.N. 168-59-1E
- (B) M.C.A.P.N. 168-59-1G

- (1) 2-10' x 5' CBC

**LEGEND**

- EXISTING DRAINAGE EASEMENT
- REQUIRED DRAINAGE EASEMENT
- CABLE TV
- GAS LINE
- TELEPHONE
- OVERHEAD POWER
- SANITARY SEWER
- UNDERGROUND POWER
- WATER LINE
- PROPERTY LINE
- CENTER LINE
- CENTER LINE OF WASH
- HYDRAULIC GRADE LINE
- MANHOLE
- ACCESS HOLE
- REPORT SCHEMATIC NO.

SCALE  
 HORIZ 1"=50'  
 VERT 1"=5'

GRAPHIC SCALE  
 ( IN FEET )  
 1 inch = 50 ft.

CALL AND WORKING DAYS BEFORE YOU DIG  
**263-1100**  
**1-800-STAKE-IT**  
(FOR THE MARICOPA COUNTY)

REVISION	BY	DATE

**FLOOD CONTROL DISTRICT OF MARICOPA COUNTY**  
**DOUBLETREE RANCH ROAD REGIONAL STUDY**

DESIGN	NAME	DATE
DRAWN	W.S.S.	12/96
CHECKED	D.E.B.	12/96
	D.L.S.	12/96

**HOOK ENGINEERING, INC.**  
1111 E. HANCOCK ROAD, PHOENIX, ARIZONA 85024

