MASTER DRAINAGE REPORT
FOR PROPOSED PARADISE RIDGE DEVELOPMENT
WITHIN STATE LANDS (2230 ACRES)
WEST OF SCOTTSDALE ROAD, BETWEEN
PINNACLE PEAK ROAD AND CAP CANAL
(ASLD PLANNING PERMIT NO. 47-97397)

NOVEMBER 15, 1993

REVISED MARCH 15, 1994

PREPARED FOR:
LANDMARK LAND COMPANY OF ARIZONA
8630 VIA DE VENTURA
SUITE 220
SCOTTSDALE, ARIZONA 85255

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A-N WEST NO. 7229-03

The contents of this report reflect the views of the author, who is responsible for the facts and accuracy of the data presented herein. The contents have not been approved by the Land Department and do not necessarily reflect the official views or policies of the Arizona State Land Department.

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LETTER OF TRANSMITTAL

TO:
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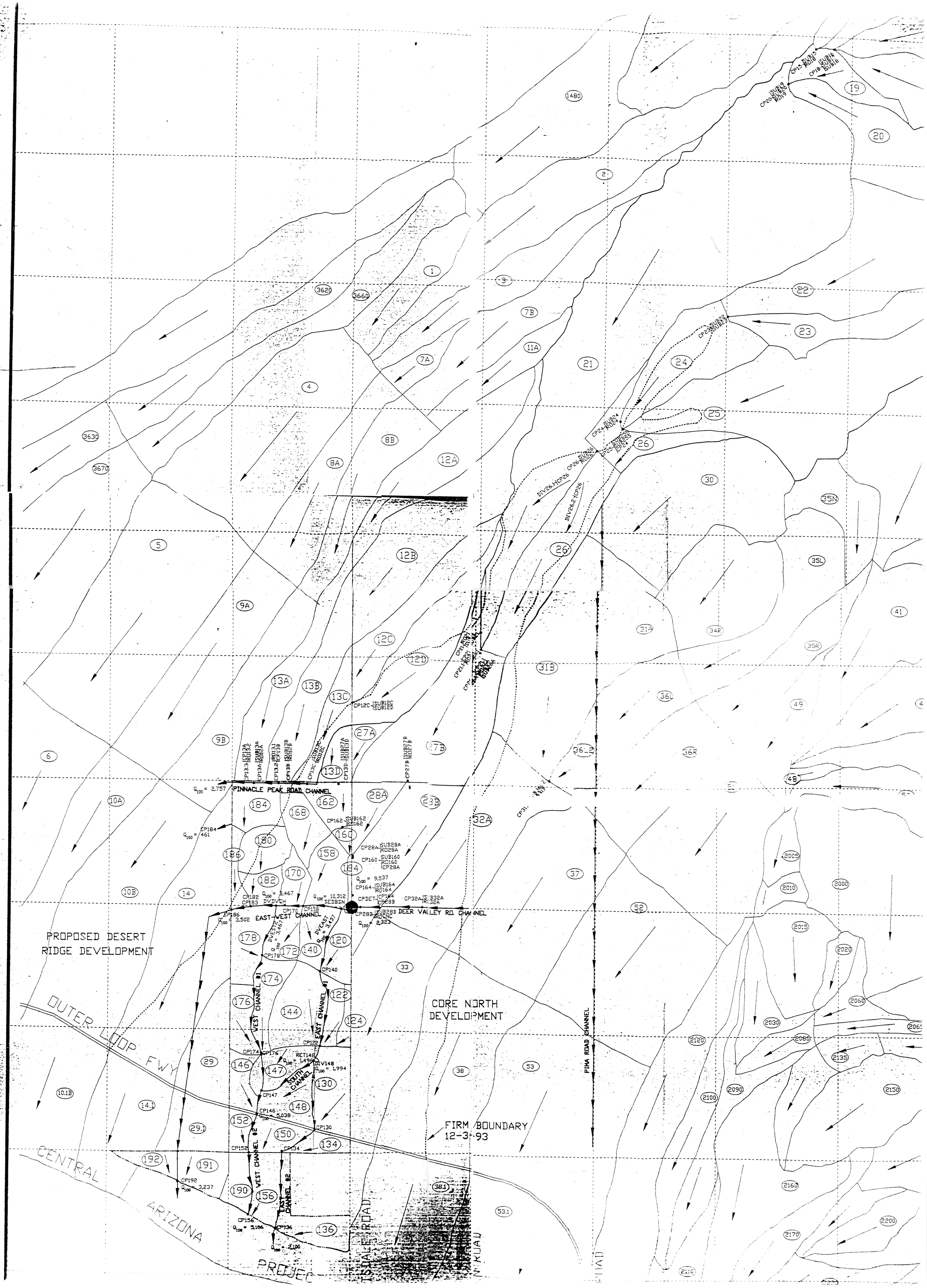
PINNACLE PEAK ROAD CHANNEL
EAST-WEST CHANNEL
DEER VALLEY RD. CHANNEL
PROPOSED DESERT RIDGE DEVELOPMENT
CORE NORTH DEVELOPMENT
OUTER LOOP FWY
CENTRAL ARIZONA PROJECT
FIRM BOUNDARY 12-3-93
PIMA ROAD CHANNEL
WEST CHANNEL #1
EAST CHANNEL #1
WEST CHANNEL #2
EAST CHANNEL #2
SOUTH CHANNEL
Q_{100} = 2,757
Q_{100} = 461
Q_{100} = 3,467
Q_{100} = 10,312
Q_{100} = 9,537
Q_{100} = 3,502
Q_{100} = 2,323
Q_{100} = 3,237
Q_{100} = 3,186
Q_{100} = 1,994
Q_{100} = 5,038

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EXECUTIVE SUMMARY

Landmark Land Company currently holds a planning permit for approximately 2,230 acres of Arizona Trust Land. The proposed name for the planned development is Paradise Ridge.

This drainage report was prepared to identify drainage problems, constraints to development and a drainage solution coordinated with the site plan and adjacent existing and proposed drainage facilities.

The majority of the site has been identified by FEMA, in the Flood Insurance Study, as being in a Special Flood Hazard Zone 'AO'. This Special Flood Hazard Zone 'AO' is associated with alluvial fan flooding originating from an approximate 16.1 square mile drainage area to the northeast in the City of Scottsdale.

Regional drainage studies have been prepared for both the City of Phoenix and Scottsdale to evaluate solutions to this potential alluvial fan flooding problem. Both studies have proposed a channel/levee system to intercept and convey flow from the fan apex in the City of Scottsdale to the CAP Canal south of the study site in the City of Phoenix. The channel/levee system proposed in these studies, crosses the study site from Scottsdale Road (south of Pinnacle Peak Road) to the CAP Canal.

Development of the study site with the FEMA Special Flood Hazard Zone 'AO' intact will involve elevating building finished floors and arranging streets parallel to the flow direction to accommodate these potential alluvial fan flows, with resultant higher construction costs and lower building density. Flood Insurance may still be required for the buildings. The higher cost of development and associated Flood Insurance premiums raise the

question of whether development within this Special Flood Hazard Zone 'AO' can be competitive with adjacent developments outside the special Flood Hazard Zone 'AO'.

The FEMA Special Flood Hazard Zone 'AO' may be removed by construction of channel/levee system capable of intercepting the total alluvial fan flows and conveying them to the CAP Canal. Upstream, the City of Scottsdale has proposed such a channel and has commissioned a study to evaluate the financing methods and design requirements to incorporate the channel. The City of Scottsdale's proposed channel construction would outlet into the study site.

Interim meetings and coordination with the City of Scottsdale an adjacent developments in Scottsdale have been made to develop an alignment and schedule for channel improvements in Scottsdale. This coordination has resulted in preliminary agreements to construct sufficient channel improvements on Rawhide Wash within 2 years time to ensure that 100-year discharges are conveyed across Scottsdale Road at a point 2,500± feet south of Pinnacle Peak Road. In addition, one other offsite discharge inflow point along Scottsdale Road was agreed to involve a channel entering the site at the City of Scottsdale's (COS) Deer Valley Road alignment.

This drainage report proposes a drainage system plan to intercept and convey these alluvial fan flows through the site with the goal of removing the Special Flood Hazard Zone 'AO'. The proposed ultimate drainage system involves intercepting the Rawhide Wash Channel on the west side of Scottsdale Road, approximately 2500 feet south of Pinnacle Peak Road, and continuing the channel south along the west side of Scottsdale Road to the COS's Deer Valley Road alignment.

This reach of channel will convey 100-year flows at higher velocities (14± fps) capable of conveying sediment. At the COS's

Deer Valley Road alignment, the Scottsdale Road channel will be passed through a sediment basin to reduce velocities and remove the major sediment loan (gravels and large sands). Downstream of the sediment basin, channels are designed at a slower, relatively non-erosive velocity to minimize maintenance and erosion protection costs.

At the sediment basin the 100-year discharge of 10,300 cfs will be split such that approximately 3,400 cfs will go south in the East Channel at the first of three flow splits. The East Channel continues south within the study site to a point of intersection with the proposed Ridge Circle Alignment to the second flow split where approximately 1,500 cfs is split out and channelled to intersect with the West Channel. The balance, approximately 2,000 cfs continues south to the ultimate outlet, the CAP Canal Dike 2 detention basin.

The remaining 6,900 cfs of the 100-year flow continues west in the East/West Channel to the third flow split. At this flow split 3,450 cfs is split south in the West Channel. The West Channel continues south within the study site combining with the discharge split from the East Channel south of Deer Valley Drive for a total of approximately 5000 cfs that continues south to the ultimate outlet, the CAP Canal Dike 2 detention basin.

At Split No. 3, 3,450 cfs or 1/3 of the 100-year peak discharge from the sediment basin continues west into the Desert Ridge Development.

Along the north edge of the study site, a channel is proposed along the north side of Pinnacle Peak Road west of Scottsdale Road to 64th Street. This proposed channel is located on State Land or within the setback for an electric substation. The channel is proposed to enter the Desert Ridge Development at 64th Street or further west as dictated by Desert Ridge's ultimate drainage master

plan. The 100-year peak discharge at 64th Street is 2,800 cfs for a 3.2 square mile drainage area.

It is expected that most onsite drainage from Paradise Ridge can be drained to these major channels by streets, roadside swales, pipes, or golf corridors. One exception to this, involves approximately 106 acres in the northwest corner. A peak 100-year discharge into Desert Ridge of 460 cfs is proposed at 64th Street, 1/2 mile south of Pinnacle Peak Road.

The proposed system attempts to incorporate the proposed regional drainage master plans and adjacent development master drainage plans. The proposed system design will require continued coordination with the Cities of Phoenix and Scottsdale, the Arizona State Land Department, Arizona Department of Transportation and adjacent land owners.

NOTE: Subsequent to this report on December 3, 1993, FEMA issued a revised FIRM that delineated the study area as a zone 'AO', depth one foot, velocity 2-4 fps.

1.0 INTRODUCTION

1.1 INTRODUCTION:

Landmark Land Company of Arizona (LMLAZ) currently holds a planning permit (No. 47-97397) for approximately 2230 acres of State Trust Land in north Phoenix (See Figure 1). The proposed name for the project is Paradise Ridge Development.

A-N West has been retained to prepare both a preliminary and master drainage study to be submitted as elements of the planning process. The purpose of the preliminary study was to identify and characterize the current drainage conditions affecting the site. The preliminary study also developed preliminary onsite and offsite hydrology, channel designs and alignments to be used for the planning of both the drainage infrastructure and the overall site. The preliminary drainage study (Reference 28) was dated April 2, 1993.

This master drainage study scope of work involved; a) refining the onsite and offsite hydrology and hydraulic channel design based on the proposed site planning and coordination with offsite drainage facilities, b) identifying needed drainage infrastructure and land area requirements to provide transportation access, remove floodplain impacts and provide for onsite and offsite drainage.

Most of Sections 1-3 and Figures 1-9 of the Preliminary Report were retained in the Master Drainage Report. The remaining report sections, figures, and appendices were added in developing this Master Drainage Report.

1.2 PROJECT DESCRIPTION:

The proposed project, which is comprised of approximately 2230 acres of Trust land, is located within the corporate limits of the City of Phoenix, Arizona (See Figure 1). The site is located within sections 15, 22, 27, and portions of 33, and 34 in T4N, R4E of the Gila and Salt River Base and Median, Maricopa County. The project is bounded on the north by Pinnacle Peak Road, on the east by Scottsdale Road, on the south by the Central Arizona Project Canal and on the majority of the west by 64th Street with a portion of the site extending near 56th Street, south of Union Hills Road.

The development plan for the project site is in the planning process and land uses types and their proportions will be determined as the planning process moves forward.

1.3 SITE DESCRIPTION:

The majority of the site is currently natural desert. There is a 365± foot wide power line easement extending across the northeast corner of Section 15. The easement is currently occupied by Salt River Project (SRP), Arizona Public Service (APS) and Western Area Power Administration (WAPA).

The proposed Outer Loop Freeway is planned to cross the southern half of Section 27 of the project site (See Figure 1).

Along the southern boundary of the project is the Central Arizona Project Canal (CAP). On the north side of the CAP are large retention basins which were designed to store runoff from the maximum probable flood occurring from the drainage watershed to the northeast. The watershed drainage boundaries to these retention basins and the storm runoff volumes were estimated by the Bureau of Reclamation based on undeveloped conditions that existed when the CAP was designed.

The site slopes from north northeast to south southwest at approximately 1.5 percent slope as a tilted plane surface. There are no significant ridges or valleys over the site. The site is crossed perpendicular to the contour lines by numerous branded small washes which join together and split apart throughout the site. These washes vary in depth from 0.5 to 4 feet deep.

The site vegetative cover consists of a light to moderate growth of native desert grasses, bushes and trees and is typical of Sonoran Desert in the north Phoenix/Scottsdale Area, including but not limited to; Palo Verde, Ironwood, Creosote and cacti.

2.0 EXISTING HYDROLOGY AND FLOODPLAINS

2.1 EXISTING HYDROLOGY:

The watershed area contributing storm runoff to the study site has been studied several times for; a) Arizona Department of Transportation, Outer Loop Freeway by Simons and Li, 1987 (Reference 1); b) City of Scottsdale, General Drainage Plan for North Scottsdale by Water Resources Associates

1988-1989 (Reference 2), c) City of Phoenix, Concept Drainage Study, Paradise Valley Fan Terrace by Water Resources Associates, February, 1990, and; d) City of Scottsdale, Final Report, Upper Indian Bend Wash, Regional Drainage and Flood Control Plan by Water Resources Associates, July, 1992 (Reference 4).

Other less comprehensive hydrology studies have been conducted for proposed developments in the vicinity of the study site of which a number of these studies, but not all, are noted in the References Section of this report.

All of the four specific reports discussed above were prepared by the same author.

The latest report, the Upper Indian Bend Wash Report has been reviewed by numerous agencies that have jurisdiction or interests in the area including the City of Scottsdale, City of Phoenix, Arizona State Land Department, ADOT, Flood Control District of Maricopa County, Bureau of Reclamation, Arizona Department of Water Resources and Corps of Engineers. The following revisions to the UIBW hydrology were recommended by the above agencies for incorporation into the hydrology HEC-1 computer models.

1. Change the storm duration from 24-hour to 6-hour.
2. Change the rainfall distribution from the SCS Type II A to the HEC-1 models hypothetical distribution option (PH record).
3. Route channelized flows by Modified-Puls method versus Kinematic wave method.
4. Change Antecedent Moisture Condition from 2 (average moisture condition) to 1 (dry moisture condition) for modelling of 2-year frequency storm event only.

The Federal Emergency Management Agency (FEMA) has also reviewed and approved this revised hydrology for use in the ongoing flood insurance study of alluvial fans in the area (Reference 17).

The Arizona Department of Transportation (ADOT) has indicated that where detention basins are to be designed along the Outer Loop Freeway, these facilities will need to be designed for the 100-year 24-hour storm event. The 100-year 24-hour storm event would generate more storm runoff volume than

the 6-hour event which would be ADOT's concern for regional detention basin design.

It is A-N West's understanding that the above agencies, including the Arizona State Land Department and FEMA, approve of the U.I.B.W. report's results (with revisions), specifically regarding the general methodology and analysis of existing conditions. As such, A-N West has chosen this revised U.I.B.W. report's hydrology data for use in the study site.

The U.I.B.W. report utilized the U.S. Army Corps of Engineers HEC-1 computer hydrology model to compute peak discharges over the study area. Figure 2 shows the existing condition drainage subareas and HEC-1 model schematic from the U.I.B.W. report impacting the study site. The drainage subarea boundaries contributing drainage to the study site are not well defined in the lower reaches of the watershed. The drainage patterns in the lower watershed involve numerous parallel and intermittently braided washes. These washes are typically of small bankfull capacity (i.e. less than 10-year storm event). For larger storm events, such as the 100-year event, shallow sheet flow occurs over a wide area, between these washes. As such, the 100-year peak discharges computed and shown on Figure 2 are not concentrated at one point but represent a wide area of shallow flow including small washes flowing bankfull.

The Federal Emergency Management Agency has prepared Preliminary Floodplain Mapping of alluvial fan areas in the watershed of the study site which also encompass the majority of the study site. The alluvial fan floodplains are discussed further in the next section. The preliminary FEMA alluvial fan flood delineation is based on hydrology from the revised U.I.B.W. report discussed earlier.

The following Table 1, presents the approximate 100-year 6-hour peak discharges entering the study site from the July, 1992 U.I.B.W. report revised hydrology.

A-N West modified the baseline hydrology HEC-1 model from the U.I.B.W. report (File: F3.24I) to include the above revisions as well as revisions to drainage areas to achieve peak discharges along the border of the study site. The HEC-1 model input/output for this model (File: F3-24ILL) is not included in the Appendix A. See Figure 2 for location of Table 1 discharges.

TABLE 1

SUMMARY OF EXISTING FLOW PATTERN PEAK DISCHARGES

Location (See Figure 2)	Drainage Area (sq. mi.)	HEC-1 Model I.D.	100-Year 6-Hour Peak Discharge (cfs)
Along Pinnacle Peak Road (64th Street to 1000 ft. West of Scottsdale Road)	2.2	C013.1	2200
Along Scottsdale Road (1600 Ft. North of Pinnacle Peak Road to 1600 ft.South of Deer Valley Road)	16.1	C028.1	10400
Along Scottsdale Road (1600 Feet South of Deer Valley Road to 2500 ft. South of Union Hills Road)	7.1	C033.1	4324

2.2 FLOODPLAINS:

The currently effective Flood Insurance Rate Maps (Reference 16) show the study site to be totally in a Flood Hazard Zone 'X' (formerly referred to as 'B'). Zone 'X' is the flood insurance rate zone that corresponds to areas outside the 100-year floodplain, and areas of 100-year sheet flow flooding where average depths are less than 1 foot, areas of 100-year stream flooding where the contributing drainage area is less than 1 square mile, or areas protected by 100-year flood by levees. No Base Flood Elevations or depths are shown within this zone (Reference 18).

On February 14, 1989, FEMA published preliminary Flood Insurance Rate maps (FIRM's) for the study area. These are now commonly known as Alluvial Fans Nos. 1-6. Fans No. 4 through 6 begin within the City of Scottsdale and extend downstream into the City of Phoenix.

The FEMA classification of these floodplains as alluvial fan flows assumed that flows could shift within the designated floodplain limits as relatively concentrated flow with associated high depths and velocities. The February 14, 1989 draft FIRM mapping showed the majority of the study site in the alluvial fan floodplain with estimated flow depths and velocities of 2 feet and 6 to 7 fps, respectively.

FEMA designated these alluvial fan areas a Special Flood Hazard Zone 'AO' which did not define depth of flow. Floodproofing individual developments in this Special Flood Hazard Zone would be difficult as each development would need to show it could convey the potential concentrated flow of up to approximately 10,000 cfs, around or through the development.

The Cities of Phoenix and Scottsdale and the Flood Control District of Maricopa County have protested and appealed the alluvial fan designations since they were first proposed. It is A-N West's understanding that the Cities appeal argued that these were not true alluvial fans, on which concentrated flows would shift within the floodplain limits. The Cities argued these were shallow flooding areas with an approximate but definable flow distribution and average flow depth. The Cities proposed a Special Flood Hazard Zone AO1-3, which would involve average shallow flooding of 1 to 3 feet deep with a depth defined on the FIRM maps. This Special Flood Hazard Zone would allow development floodproofing by; elevating buildings above the average flow depth and providing conveyance through the development for the approximate storm runoff discharge distribution entering the development.

The alluvial fan FIRM's have been revised several times and on January 4, 1993, FEMA published their latest "draft" final FIRMs. This January 4, 1993 draft map is also under appeal by the Cities of Phoenix and Scottsdale and FCDMC. Figure 3, Preliminary Floodplain Map shows the impact of this alluvial fan on the study site. The majority of the study site is within a designated special flood hazard Zone A with a note that this flooding originates from Basin 4 or Alluvial Fan Apex No. 4. The Zone A represents areas inundated by a 100-year flood with no base flood elevation determined. The 100-year discharge from Basin 4 is estimated at approximately 10,000 cfs. In order to remove this flood hazard designation, from the study area, a drainage system would need to be built, capable of adequately intercepting and conveying to the CAP dikes, the total 100-year discharge, upstream of the study area.

3.0 PROPOSED REGIONAL HYDROLOGY AND DRAINAGE FACILITIES

3.1 U.I.B.W. REPORT AND RAWHIDE/PINNACLE PEAK WASH ALIGNMENT REPORT:

U.I.B.W. Report. In addition to analyzing existing condition hydrology, a goal of the Upper Indian Bend Wash Study (Reference 4) prepared for the City of Scottsdale was to evaluate possible drainage solutions to mitigate the area wide alluvial fan floodplain hazards. As part of the U.I.B.W. report, a proposed master drainage plan of channels was recommended to intercept the 100-year discharges at the alluvial fan apexes and convey the flows to the CAP dikes. Figure 4 of this report shows the proposed drainage area map, channel alignments and HEC-1 model schematic from the U.I.B.W. Report.

As shown on Figure 4, the U.I.B.W. report proposed a channel referred to as Rawhide Wash Channel, which would intercept the basin (i.e. fan) No. 4 upstream of the Happy Valley Road and Hayden Road intersection and convey the 100-year flows to the CAP Dike No. 2 near 64th Street. The proposed Rawhide Wash Channel entered the study site on Scottsdale Road approximately 1200 feet south of Pinnacle Peak Road.

A second channel referred to as Scottsdale Road Channel was proposed to parallel Scottsdale Road on either, the east or west side, from the Rawhide Wash Channel, north to Jomax Road. It is noted that the Scottsdale Road Channel was proposed to intercept local upstream drainage and would not be necessary to eliminate the alluvial fan flooding hazard, if the Rawhide Channel intercepts the fan apex.

A third channel referred to as the Deer Valley Channel was proposed to parallel COS Deer Valley Road alignment, from Hayden to Scottsdale Road then turn south along the east side of Scottsdale Road. The proposed Deer Valley Channel would cross Scottsdale Road near the COS Beardsley Road intersection alignment. Per the U.I.B.W. Report, the Deer Valley Road Channel would also intercept and convey only local upstream drainage. It would not be necessary to eliminate the alluvial fan flooding, provided Rawhide Wash is completed upstream to the Fan No. 4 Apex. The proposed Deer Valley Road Channel represents the incorporation of the proposed Master Drainage plan for the Arizona State Land Department's Core North Development (Reference 5).

The following Table 2 presents the approximate 100-year 6-hour storm peak discharges entering the study area for the above described proposed channel system from the U.I.B.W. report. A-N West modified the hydrology from the U.I.B.W. report HEC-1 model (File: MP3.24I) to reflect the 6-hour duration storm, normal depth routing and hypothetical rainfall distribution. The revised HEC-1 hydrology input/output (File: MP3.24ILL) were not included in this report.

TABLE 2
SUMMARY OF PROPOSED CHANNEL DISCHARGES
FROM U.I.B.W. REPORT

Location (See Figure 4)	Drainage Area (sq. mi.)	HEC-1 Model I.D.	100-Year 6-Hour Peak Discharge (cfs)
Scottsdale Road Channel At Pinnacle Peak Road	3.0	4B1	2310
Rawhide Wash Channel at Pinnacle Peak Road (Upstream of Confluence with Scottsdale Road Channel)	15.4	28A2	10133
Rawhide Wash Channel at Scottsdale Road Channel (Downstream of Confluence)	18.4	4B3	11520
Deer Valley Road Channel at Scottsdale Road	2.03	CNC6	1924

Rawhide/Pinnacle Peak Wash Alignment Report. The City of Scottsdale utilized the Upper Indian Bend Wash Study results to further refine channel concepts and alignments within the City of Scottsdale, which would specifically intercept and convey storm runoff through the City of Scottsdale from the fan apexes to the CAP dikes.

The City of Scottsdale recognized that eliminating the alluvial fan flooding problem could not be efficiently addressed by individual developers and that a coordinated regional effort was needed. The City assembled a committee of City staff and prepared two reports, "Rawhide/Pinnacle Peak Wash" (Reference 10) and "Reata Pass/Beardsley Wash (Reference 11) Alignment Study Reports". These reports will form the concept design for a more detailed design and

financing plan study to be conducted by a consultant for the City of Scottsdale. This study will be initiated in May, 1993, with the goal of developing a more detailed preliminary design and financing plan to implement the channel system.

The recommended alignment for Rawhide Wash from the Alignment Study (Reference 10) is shown on Figure 5. The recommended conceptual regional storm water management plan proposed in the alignment reports (Reference 10 and 11) is shown on Figure 6.

3.2 ARIZONA STATE LANDS - CORE NORTH DRAINAGE MASTER PLAN:

The Core North Development Master Drainage Plan (Reference 5) was prepared in November, 1989 for Core North, Inc. These Arizona State Lands are bounded by Scottsdale Road, Deer Valley Road, Pima Road and the Outer Loop. A schematic of this system obtained from the U.I.B.W. Report is shown on Figure 7. The Core North Master Drainage Plan attempted to integrate the proposed alluvial fan channelization plan developed by the City of Scottsdale (Reference 10 and 11).

The proposed channels shown on Figure 7 were sized for storm runoff discharges for 2 cases; Case 1) the alluvial fans are intercepted by the regional channel system (Reference 10 and 11) and the channels intercept local offsite flow and; Case 2) the regional channel system is not in place and the Core North Channels are upsized to convey the alluvial fan flows and local offsite flow.

For Case 1 above, the local offsite drainage area impacting the Deer Valley Channel from Scottsdale Road to Hayden Road was adjusted and re-computed in the HEC-1 model from the U.I.B.W. report. A 100-year 24-hour storm discharge of 2100 cfs was computed. For Case 2, the estimated alluvial fan flow of 10,000 cfs was utilized for preliminary design.

3.3 ARIZONA STATE LANDS - DESERT RIDGE DRAINAGE CONCEPT PLAN:

The Desert Ridge Development Drainage Concept Plan (Reference 7 and 9) was prepared in February, 1990, for Northeast Phoenix Partners. These Arizona State Lands are bounded generally by 64th Street, Union Hills Road, CAP Canal, 32nd Street and Pinnacle Peak Road. The proposed concept drainage plan for this development involved a series of shallow, wide drainage swales to intercept offsite drainage from the north and east and convey it to the

CAP canal dikes. The Drainage Concept Plan is shown on Figure 8. This report did not address the alluvial fan impacts to Desert Ridge Development.

3.4 ADOT OUTER LOOP FREEWAY DRAINAGE CONCEPT PLAN:

The Outer Loop Freeway Drainage Concept Report Plan (Reference 13) Printed, May, 1988, shows a pass-through drainage concept for conveying offsite drainage across the Outer Loop Highway between Tatum Boulevard and Scottsdale Road. It is A-N West's understanding based on past experience with ADOT, that ADOT would be willing to revise this pass-through concept, if a more concentrated interceptor/conveyance channel was planned and approved upstream and downstream of the Highway. There are cost efficiencies to ADOT to provide fewer, larger drainage structures across the Outer Loop. The feasibility of this revision is dependent on obtaining an approved master planned channel system crossing the Outer Loop, before ADOT constructs these facilities.

In discussions with the Outer Loop Management consultant for ADOT, the Outer Loop section from 56th Street to Scottsdale Road does not have a definite construction schedule and is not currently in the 5-year plan for construction.

3.5 PARADISE VALLEY FAN TERRACE CONCEPT DRAINAGE STUDY:

The Paradise Valley Fan Terrace (PVFT) Concept Drainage Study (Reference 3) was prepared for the City of Phoenix in February, 1990. This study evaluated drainage solutions to drainage problems in the City of Phoenix, north of the CAP Canal and east of Cave Creek Wash. Among the structural flood control measures evaluated was a system of channels as shown on Figure 9.

The later Master Drainage Plan, U.I.B.W. Report July, 1992 (Reference 4) and the Desert Ridge Concept Drainage Plan (Reference 7 and 9) deviate from the channel system proposed in PVFT report at the study site. The U.I.B.W. report and Desert Ridge report drainage plans propose drainage channels that follow the natural flow paths to the CAP canal.

4.0 PROPOSED DRAINAGE FACILITIES

4.1 EXISTING DRAINAGE PROBLEMS AND CONSTRAINTS TO DEVELOPMENT:

As noted in Section 2.2, the study site is currently in a Zone 'AO' (formerly referred to as Zone X) based on currently effective Flood Insurance Rate Maps (Reference 16). This flood hazard zone corresponds to 100-year sheet flow flooding where average depths are 1 foot deep and velocities vary from 2 - 4 fps. Flood Insurance is required for this zone.

The special flood hazard Zone AO may be eliminated through the construction of a flood control levee/channel system capable of adequately intercepting the total alluvial fan 100-year discharge at the fan apex and conveying the flows to the CAP dikes.

Such a system has been proposed and conceptually designed as discussed, earlier in this report. The alignment through the study site is only critical in that the upstream connection at Scottsdale Road should be located approximately 1,000 to 1,200 feet south of Pinnacle Peak Road to connect to the upstream facility. Within the study site, the channel alignment can vary, so long as it connects to the CAP Dike 2.

A levee/channel system may also be considered adequate to remove the flood hazard on the study site downstream of the system if it intercepts the entire upstream floodplain width.

Without the removal of the Special Flood Hazard Zone **'AO'** building finished floors will need to be elevated at least 2 feet above highest existing grade within the building footprint. No basements, split level or sunken living room floor elevations will be allowed below this elevation requirement. Federal Flood Insurance may still be required even with these elevated finished floors within the SFH Zone AO limits. The majority of streets would need to be laid out parallel to natural flow directions to provide a conveyance system for possible alluvial fan flow. This will result in higher building costs, lower development density and a development master plan orientated toward maintaining parallel flowpaths for flow.

The implementation phasing of the proposed upstream drainage facilities in the City of Scottsdale have an impact on the design and effectiveness of drainage facilities in the study site. Likewise, the design of these

upstream facilities require a coordinated outlet drainage system through the study site to the CAP Dike No. 2. Also, FEMA will not recognize a channel system as adequate to intercept the alluvial fan flows, if flows could meander around the partially complete system. Hence, to remove the Special Flood Hazard Zone, the drainage system will need to be complete and capable of intercepting the upstream flows within the alluvial fan floodplain limits.

4.2 DETENTION REQUIREMENTS:

The City of Phoenix Subdivision Drainage Design Manual (Reference 14) indicates that detention for runoff from the 100-year 2-hour storm for proposed development is required. Table 3 below summarizes an estimated detention volume and land area, of 216 acre feet and 86 acres required, respectively, based on an assumed land use mix obtained from the Phoenix General Plan, Peripheral Areas C and D (Reference 15). A 100-year 2-hour rainfall precipitation of 2.82-inches was utilized with a hydrologic soil group, Type B (Reference 4).

The U.I.B.W. Report analysis indicates that the CAP Dike 2 detention area is adequate to detain the upstream developed condition watershed. The U.I.B.W. Report hydrology is based on developed conditions without detention. The study site development will outlet directly into the CAP Dike 2. The City of Phoenix storm drain manual will be utilized to provide sufficient on-site local detention requirements.

TABLE - 3
100-YEAR 2-HOUR STORM
DETENTION REQUIREMENTS FOR
ASSUMED MIXED LAND USE DEVELOPMENT

Estimated Land Use/Zoning From C.O.P. General Plan (Ref. 15)	Acres (Ac)	CN (1)	100-yr. 2-hr. Runoff (In.)	Detention Volume (Ac. Ft.)	Area (2) (Ac)
Residential	1425	81.5	1.15	136.6	54.6
Commercial	233	92	2.0	37.2	14.9
Open Space	533	77	0.95	42.2	16.9
Outer Loop	49	N/A	--	--	--
TOTAL	2230			216.0	86.4

Notes: (1) Curve Numbers (CN) from City of Phoenix Subdivision Drainage Manual.
(2) Area Based on 2.5 Foot Assumed Average Depth.

4.3 PROPOSED DRAINAGE SYSTEM GOALS:

The design of the proposed drainage system attempted to integrate adjacent proposed regional drainage systems and address constraints posed by the floodplain designation over most of the site. The general goals of the drainage systems are to:

a) Remove the study site from the Alluvial Fan Special Flood Hazard Zone 'AO' 100-year floodplain.
b) Incorporate the proposed upstream flood control facilities.
c) Intercept and convey onsite and offsite drainage, through the project to the CAP Canal Dike 2 detention basin or adjacent downstream drainage facilities.

4.4 COORDINATION WITH PROPOSED ADJACENT DEVELOPMENT AND CITY OF SCOTTSDALE DRAINAGE FACILITIES:

4.4.1 Proposed Stardust Development Project. In April of 1993, Stardust Development approached the Arizona State Land Department to develop a 40 acre parcel of state land located in the S.W. 1/4 of the N.W. 1/4 of Section 11, as shown on Figure 10. This proposed development was also in the Rawhide Wash 100-year floodplain of the alluvial fan basin 4. The Stardust Development proposed to construct a floodwall along the west bank of Rawhide Wash from this 40 acre parcel upstream to a point, where flows were contained in Rawhide Wash as shown on Figure 10.

Two reports were prepared in support of the proposed development of this 40 acre parcel on state land. The first report was entitled, Hydrology Study Report for Rawhide Wash Floodwall, August, 1993 (Reference 20). This report computed a peak 100-year 6-hour developed condition discharge for Rawhide Wash at the development of 9430 cfs (Drainage Area 14.24 sq. mi. and Concentration Point 27.1). This report utilized the basic hydrology methodology from the Upper Indian Bend Wash Report (Reference 4), but with the following modifications; 100-year 6-hour precipitation storm, hypothetical rainfall distribution, normal depth channel routing.

The second report was entitled, Impact Analysis Study for Rawhide Wash Floodwall, September, 1993 (Reference 21). This report summarized a hydraulic analysis of Rawhide Wash from Pinnacle Peak Road to Jomax Road using new 2 foot contour internal mapping. This hydraulic analysis utilized the HEC-2 model to estimate 100-year storm breakout flows from Rawhide Wash

to the west and east, over this reach. It was estimated that 2343 cfs broke out to the west, from 2300 feet north of Happy Valley Road to Happy Valley Road and 1365 cfs between Happy Valley Road and the north edge of Los Portonnes development for a total of 3708 cfs breakout to the west.

It was also estimated that 2704 cfs of the total 100-year discharge of 9430 cfs broke out to the east from Rawhide Wash between Happy Valley Road and the north edge of the Los Portonnes development.

This report (Reference 21) proposed a floodwater retaining wall and limited channel improvements along the west bank of Rawhide Wash from the north edge of the Los Portonnes development to a point approximately 2300 feet north of the Happy Valley Road as shown on Figure 10. This floodwall and channelization would prevent breakout flows to the west from impacting the proposed 40 acre development parcel and maintain water surface elevations at existing levels over this reach.

The City of Scottsdale was concerned that the proposed floodwall and limited channel improvements would concentrate flows downstream and possibly increase breakout flows to the east, thereby aggravating flooding problems in these areas.

4.4.2 Proposed Improvements by City of Scottsdale

In September of 1993 the City of Scottsdale (COS) presented an interim drainage solution for the Rawhide Wash which was neither approved by the City of Phoenix (COP) or the Arizona State Land Department (ASLD), nor recommended by the Planning Permittee, LMLAZ. In a subsequent meeting held February 9, 1994, the COS stated that the interim improvements were no longer being considered and that they would continue pursuing a permanent drainage solution for the Rawhide Wash based on the Rawhide/Pinnacle Peak Wash Alignment Report (see pages 8 and 9 of this report).

The permanent drainage solution involves the theory of consolidation and conveyance of storm water into a major drainage channel and through the Rawhide Wash drainage area (see figure 5). To date this recommendation has not been approved by the COP or ASLD as the most viable drainage solution for the Rawhide Wash.

In December of 1993 a proposal was presented regarding storm water detention (detention basin) at the apex of the Rawhide Wash within the City of Scottsdale. Subsequent meetings and discussions were held in January and February 1994. On March 4, 1994 the ASLD, COP, and COS all agreed that a detention basin may be the best solution for the Rawhide Wash. A committee was formed to study the detention basin and to ultimately reach a decision regarding it.

Discussions are continuing regarding a final drainage solution for the Rawhide Wash as of the filing date of this report.

4.4.3 Proposed Core North Drainage Facilities

The Core North Development is located east of Scottsdale Road and south of the COS Deer Valley Road alignment on State Land. As shown on Figure 7 and discussed in this report, Section 3.2, the original drainage master plan for Core North proposed a drainage channel along the south side of the COS Deer Valley Road alignment, starting just west of Hayden Road and proceeding west to Scottsdale Road. At Scottsdale Road the channel was proposed to proceed south along the east side of Scottsdale Road and cross Scottsdale Road approximately 1000 feet north of the COS Beardsley Road alignment.

This channel was proposed to intercept and convey offsite flows around and the site for two possible drainage area scenarios, 1) without any upstream Rawhide Wash channel improvements, the channel could conceivably, by FEMA criteria, need to intercept the total 100-year discharge of approximately 10,000 cfs for the Rawhide Wash watershed, and 2) with Rawhide Wash channel improvements in place as discussed in Sections 4.4.1 and 4.4.2 above, the local drainage area is greatly reduced and the 100-year peak discharge intercepted by the channel along the COS Deer Valley Road alignment is approximately 1900 cfs.

Based on the proposed drainage facility improvements discussed in Sections 4.4.1 and 4.4.2, the peak discharge from the drainage area scenario number 2 will result.

Based on meetings and coordination between representations of LMLAZ, Core North Development and State Land Department, it was also agreed that the proposed Core North channel along Deer Valley Road alignment would be brought straight across Scottsdale Road, thereby eliminating the segment of channel proposed to extend south from the COS Deer Valley Road alignment along Scottsdale Road.

It was further agreed that no onsite drainage from Core North south of the COS Deer Valley Road alignment would be conveyed west across Scottsdale Road. (See "Note B" on page 24)

The Core North Master Drainage Plan (CNMDP) indicates the location of a detention facility at the Deer Valley alignment channel east of Scottsdale Road. The Detention Basin/Park area on the CNMDP encompasses 5 to 6 acres and it is anticipated to detain 50 to 80 acre feet of runoff prior to discharging the flow to the Scottsdale Road Channel.

4.4.4 Proposed Desert Ridge Development Drainage Facilities.

4.4.4.1 Proposed Rawhide Wash Channel: The Desert Ridge Development is located on State Land west of 64th Street, between Pinnacle Peak road and the Union Hills Road alignment. The original Desert Ridge Development Master Drainage Plan developed in February, 1990 and shown on Figure 9 and did not incorporate the impacts of the proposed FEMA alluvial fan floodplain for Rawhide Wash. As shown on Figure 10, this floodplain delineation impacts from 1/2 mile south of Pinnacle Peak Road, south to the Union Hills Road alignment.

By FEMA criteria, the peak 100-year discharge of approximately 10,000 cfs could enter the Desert Ride Development, anywhere within this floodplain delineation.

Since the Desert Ridge Development is impacted by the existing Rawhide Wash floodplain, it was considered appropriate that the Desert Ridge Development also participate in the proposed drainage solution. The ultimate drainage solution involves conveying the Rawhide Wash 100-year discharges to the CAP Canal Dike 2 detention basin. The Dike 2 detention basin extends from Tatum Boulevard (48th Street) to Scottsdale Road. It is proposed that approximately 1/3 of the Rawhide Wash 100-year discharge entering the proposed sediment basin at Scottsdale Road and the COS Deer Valley alignment (see Figure 10) be conveyed west into the Desert Ridge development at 64th Street.

4.4.4.2 Proposed Possible Alternative Pinnacle Peak Road Channel: In the Preliminary Report, (Reference 28) as shown on Figure 2, an offset drainage area of 2.2 square miles and total peak 100-year 6-hour discharge of 2211 cfs (concentration point C013.1) was estimated to cross Pinnacle Peak Road between Scottsdale Road and 64th Street. This preliminary report analysis assumed that a proposed channel along Scottsdale Road would be in place from 3300 feet north of Pinnacle Peak Road to a point south of Pinnacle Peak Road, coinciding with the Rawhide Wash Channel. The Scottsdale Road channel was proposed to intercept the Rawhide Wash Flood plain at the time of the preliminary drainage report.

The Scottsdale Road channel will not be necessary to intercept the floodplain with the proposed improvements discussed in Section 4.4.1 and 4.4.2. Without the Scottsdale Road channel, additional local offsite flow can contribute to Pinnacle Peak Road.

For this master drainage report, a total offsite drainage area of approximately 3.2 square miles has been estimated to contribute to Pinnacle Peak Road between Scottsdale Road and 64th Street as shown on Figure 11 (subareas 12A-D and 13A-D). The increase in total contributing drainage areas from 2.2 to 3.2 square miles from the preliminary report to this final report is the result of; (a) subarea 12D with a drainage area of 0.55 square miles now contributes without the Scottsdale Road channel, and (b) a more detailed evaluation of drainage areas suggests more drainage area contributing.

The proposed Pinnacle Peak Road channel was proposed in the Preliminary Drainage Report and continues to be proposed as one of the alternative solutions in this Master Drainage Report. As proposed the Pinnacle Peak Road channel will be located north of Pinnacle Peak Road. From Scottsdale to 1750 ± feet west of Scottsdale Road, offsite drainage is anticipated to be conveyed in a roadside swale within road right-of-way. From 1750 feet west of Scottsdale Road to 64th Street the channel would be located

adjacent to the road on the north side. At 64th Street the flow would be conveyed south across the road into the Desert Ridge Development. The peak 100-year, 6-hour discharge at 64th Street is computed to be 2,800 cfs for the 3.2 square mile total drainage area. (See "Note A" on page 23)

4.4.4.3 Proposed Onsite Flow From Paradise Ridge to Desert Ridge Developments. An onsite subarea of approximately 106 acres in the northwest corner of the Paradise Ridge development is proposed to cross 64th Street into Desert Ridge, 1/2 mile south of Pinnacle Peak Road. This onsite subarea is west of the proposed Ridge Road and Paradise Parkway. The peak 100-year 6-hour developed condition discharge is estimated as 470 cfs.

A portion of onsite flow north of the Deer Valley Road alignment will also cross 64th Street at the Deer Valley Road alignment as part of the Rawhide Wash flows.

No onsite flow south of the Deer Valley Road alignment is proposed to cross 64th Street into Desert Ridge development. The onsite flow south of the Deer Valley alignment is expected to be conveyed by streets and roadside ditches to the major onsite channels, which will convey onsite and Rawhide Wash flows to the Dike 2 basin.

4.5 PROPOSED DESIGN HYDROLOGY

4.5.1 General.

Proposed design discharges for the drainage systems were generated from modifications to the U.I.B.W. report hydrology models for Rawhide Wash and new hydrologic analysis by A-N West for onsite drainage discharges and the offsite drainage contributing to Pinnacle Peak Road. The Corps of Engineers HEC-1 model (Reference 19) was used to compute peak discharges.

Figures 10 and 11 show drainage area boundaries and HEC-1 model I.D. No.s for the offsite drainage impacting Pinnacle Peak Road and the Deer Valley Road alignment channel. Curve numbers percent impervious values and kinematic wave methodology from the U.I.B.W. Report were used to generate hydrographs.

A-N West modified the U.I.B.W. proposed hydrology model (File: MP3.24I) to reflect the following changes; which were utilized to develop the Rawhide Wash floodplain hydrology for FEMA.

The final Paradise Ridge Master Drainage Plan 100 year - 6 hour HEC-1 model (PRMDP1.OUT) has been updated and included with this report. A drainage basin map with the HEC-1 sub-basins, confluence points, and routing designation numbers has also been included. The HEC-1 model includes some re-naming/re-numbering to coordinate computer model with drainage basin map for clarification.

a) 6-hour duration storm
b) Hypothetical rainfall distribution
c) Normal depth routing of hydrographs
d) Add Deer Valley Road Alignment Channel flow to Scottsdale Road Channel.

4.5.2 Precipitation Values.

It was considered necessary to generate 10-year peak discharges to evaluate scour and sediment transport as the 10-year storm is considered the dominant or long-term storm frequency associated with sediment transport and channel stability. The 2-year discharges were also desired to evaluate flow distributions for this frequent storm event.

The Hydrologic Design Manual prepared by the FCDMC (Reference 22) was used to estimate precipitation values for the 2,10, and 100-year storm return interval or frequency for the several durations needed for the HEC-1 model PH record. These precipitation values are shown below and were calculated for a drainage centroid located at the intersection of Pinnacle Peak Road and Scottsdale Roads. Also, shown are the 100-year 6-hour precipitation values from the Basin 4 alluvial fan hydrology prepared for FEMA.

PRECIPITATION VALUES (INCHES)

Storm Return Period or Frequency (Years)	Duration 5 Min	15 Min	1 Hr.	2 Hr.	3 Hr.	6 Hr.	12 Hr.	24 Hr.
At Pinnacle Peak and Scottsdale Roads								
2	0.34	0.62	1.00	1.12	1.20	1.35		
10	0.55	1.00	1.62	1.81	1.94	2.18		
100	0.85	1.55	2.50	2.77	2.96	3.30		
From FEMA Rawhide Wash (Basin 4) Floodplain Hydrology								
100	0.77	1.51	2.65	3.00	3.23	3.66	4.00	4.52

It is proposed that for computing 100-year peak discharges that the FEMA precipitation values will be utilized for the Rawhide Wash and Deer Valley Road channel drainage areas to the proposed sediment basin.

Downstream of the sediment basin, 100-year peak onsite discharges and Pinnacle Peak Road channel discharges will be computed using the precipitation values computed for the Pinnacle Peak/Scottsdale Road drainage centroid.

It is proposed that 2 and 10-year discharges for the entire watershed will be computed using the values shown in the table.

4.5.3 Area Reduction of Precipitation Values.

The total drainage area for the Rawhide Wash and Deer Valley Road alignment channels as they enter the proposed sediment basin is approximately 18 square miles. The area reduction option of the HEC-1 model PH record (Field 2) was utilized to reduce the point precipitation values for the drainage areas upstream of the proposed sediment basin based on an 18 square mile watershed.

Downstream of the proposed sediment basin this precipitation reduction was not used to allow for computation of peak discharges for onsite drainage areas.

For the Pinnacle Peak Road channel the precipitation area reduction option was utilized for the 3.2 square mile total watershed for this channel at 64th Street.

4.5.4 Flow Splits.

Flow splits were modelled in the HEC-1 hydrologic model within the proposed Paradise Ridge Developments.

Split 1: Referring to Figure 10A and 10B, the first flow split was modeled as flow exited the sediment basin. The sediment basin is proposed to remove bed load (gravels and large sand) from the higher velocity channel along Scottsdale Road. The basin will pond water in the basin and cause the sediment to drop out. The ponded water in the sediment basin will then outlet via two sets of box culverts into either the East Channel or East/West Channel Segment 1. The 100-year, 6-hour inflow to the proposed sediment basin is approximately 10,300 cfs. The East Channel was designed to accept approximately 3,400 cfs from the sediment basin, while the remaining approximately 6,900 cfs was proposed to continue into the East/West Channel Segment 1.

Split 2: The East Channel segment No. 1 will convey flow south through the project to the north leg of Ridge Circle Road. At Ridge Circle Road, the second flow split will occur. Two sets of culverts, which will also facilitate as the Ridge Circle Road crossing, will split flow west and south. The 100 year - 6 hour inflow to this split including onsite flow, is approximately 3,450 cfs. One set of culverts will convey approximately 1,480 cfs to the west channel (via the south channel) and the remaining flows of approximately 1,980 cfs will continue to be conveyed in segment #2 of the east channel to the projects south boundary.

Split 3: The East/West Channel Segment 1 will convey flow west from the split 1 to split 3. Split 3 is proposed to involve a grade control structure in the East/West Channel Segment 2. The 100-year, 6-hour inflow, including onsite flow is approximately 6,900 cfs. The grade control structure will split approximately 3,450 cfs south into the west channel. The remaining approximately 3,450 cfs will continue west in East/West Channel Segment 3, across 64th Street and into the Desert Ridge Development.

Table 4
Summary of Design Discharges for Major Drainage Facilities

LOCATION/DESCRIPTION	DRAINAGE AREA	HEC-1 MODEL I.D.	100 YEAR PEAK DISCH.	10 YEAR PEAK DISCH.	2 YEAR PEAK DISCH.	REMARKS
Proposed Rawhide Wash Channel at Scottsdale Road 2600 ft South of Pinnacle Peak Road	14.98	CP28A	9485	3523	1201	
Scottsdale Road channel at sediment basin	15.28	CP164	9,537	3,543	1,193	Not including flow from Deer Valley Road Channel
Deer Valley Road Channel at sediment basin	2.63	CP28B	2,323	755	317	Flow from Core North including subbasin 28B
Sediment basin including Deer Valley & Scottsdale Road Channels	17.92	SEDBSN	10,312	3,802	1,285	Total in flow to sediment basin
East Channel Segment #1 Downstream of sediment basin	N/A	DVEAST	3,437	1,267	428	Diversion to East Channel out of sediment basin
South Channel diversion from East Channel to West Channel	N/A	RET148	1,496	551	175	Diversion from East Channel to West Channel @ Ridge Circle Road
East channel Segment #2 downstream of diversion to West Channel	N/A	DIV148	1,994	735	233	After flow diverted to West Channel
East Channel Segment #2 at south boundary of project	N/A	CP136	2,100	780	242	Includes developed condition onsite flow to south boundary
East/West Channel at diversion to West Channel	N/A	CP170	6,934	2,556	843	Prior to diversion to West Channel

West Channel Segment #1 downstream of diversion from East/West Channel	N/A	DWEST2	3,467	1,278	422	West Channel Segment #1
West channel Segment #2 downstream of confluence with South Channel	N/A	CP146	5,038	1,857	579	Includes flow in West channel and flow diverted from East Channel
West Channel Segment #2 at South Boundary of project	N/A	CP156	5,106	1,886	582	Includes developed condition onsite flow to South boundary
East/West Channel west of diversion to West Channel	N/A	DVDVCH	3,467	1,278	422	
East/West Channel at western boundary of project	N/A	CP186	3,502	1,291	425	Flow to Desert Ridge
Pinnacle Peak Road Channel at northwest corner of project	N/A	CP13.3	2,757	1,313	534	Includes all flow from Pinnacle Peak Road Channel flow to Desert Ridge
Subbasin 184	N/A	SUB184	461	197	86	Includes flow from Subbasin 184 to Desert Ridge
Routed flow from East/West Channel through Desert Ridge Channel North boundary of Paradise Ridge South	N/A	RO191	3,216	1,135	323	Not including Desert Ridge onsite runoff
Flow from Desert Ridge Channel routed through Paradise Ridge	N/A	CP192	3,237	1,143	326	Flow at South Boundary of Paradise Ridge

Note: Peak discharge flows in table represent HEC-1 modeling output data.

4.5.5 Sediment Basin Routing.

The storage routing option of the HEC-1 model was utilized to model the proposed sediment basin storage routing. The sediment basin is proposed primarily to trap bed load (gravels and large sands) from the high velocity channel along Scottsdale Road. It will also cause energy dissipation and effective transition from supercritical upstream flows to subcritical downstream flows. A two foot depth of basin designed to store the approximate 100-year 6-hour storm design sediment volume of 10.0 acre feet was not modeled as effective storage.

4.5.6 Results.

The proposed summary of design discharges for the major drainage facilities are presented in Table 4. Figure 10A and 10B provide a schematic of the proposed channel system to utilize with Table 4 in locating peak discharges. Table 4 provides the 2, 10, and 100-year, 6-hour storm discharges.

Appendix A contains the HEC-1 model input-output for the 100 year storm.

4.6 PROPOSED DRAINAGE SYSTEM DESIGN

4.6.1 Overview

Section 4.4 of this report summarizes coordination with proposed adjacent developments and the City of Scottsdale drainage faiclities. The proposed drainage system for Paradise Ridge Development provides a 100-year capacity channel system to intercept the adjacent drainage facilities and provide for drainage to the ultimate outlet, the CAP Canal Dike 2 Detention Basin.

Figures 10A and 10B shows the existing and proposed drainage facilities within and adjacent to the proposed Paradise Ridge Development. Section 4.5 and Table 4 of this report summarizes the proposed 100-year storm design discharges. Tables 5 and 6 summarize the hydraulic parameters for the 100 and 10-year, 6-hour design discharges, respectively.

As shown on Figure 10A and 10B upstream of the Paradise Ridge Development, channel improvements are proposed to contain the Rawhide Wash 100-year floodplain and convey this flow across Scottsdale Road at the overhead power line easement.

The Rawhide Wash channel flows entering Paradise Ridge are anticipated to be of high velocity (13-14 fps) and capable of conveying sediment.

The proposed Scottsdale Road channel between the electric easement and the proposed sediment basin will maintain these high velocities and sediment transport capacities. Grade control structures are proposed to control vertical channel bed movement. Heavy transplanted desert vegetation on the channel sideslopes is proposed to mitigate lateral erosion potential. This will mimic existing tree-lined desert washes. A vertical articulated concrete cutoff wall is proposed as a passive lateral scour barrier backup in case of localized failure of the vegetation as a bank protection.

At the sediment basin, a transition from high velocity, sediment laden flow to slow velocity flows is proposed. The sediment basin will serve several functions. It will trap sediment (gravels and heavy sands) thereby minimizing maintenance problems downstream. It will facilitate as one of the split flow structures to divert flow to the East Channel and East/West Channel Segment 1. It will also ensure energy dissipation of the upstream channel flow.

Downstream of the sediment basin, the channel design philosophy was to utilize road crossings as much as possible as grade control structures, to reduce the channel slope and flow velocity. Some grade control structures will also be proposed to supplement the road crossings in reducing the channel slope. This will allow for minimal artificial bank protection along the remaining channel bank and invert.

NOTE:

A. Prior to any development within Paradise Ridge if there is no flood control solution on the Rawhide Wash within the City of Scottsdale, or any channel along Scottsdale Road north of Pinnacle Peak Road, a berm and channel will be constructed to collect and convey the 100-year flood discharge. The berm and channel will begin at the west intersection point of the FEMA FIRM line, Pinnacle Peak Road and the alignment of Ridge Road, head east along the utility easement along the north boundary of Paradise Ridge (south of Pinnacle Peak Road), and intersect with the utility easement along the northeast boundary of Paradise Ridge, then continue southeast along the south side of the utility easement to an intersection point with the proposed channel on the west side of Scottsdale Road (see Figures 10A and 10B).

B. Furthermore, if no flood control structures are constructed within Core North along the COS Deer Valley Road alignment, a series of pass-through drainage systems are proposed along Scottsdale Road to discharge into the proposed East Channel in Paradise Ridge.

Without limiting the generality of the foregoing, it is not intended that Core North be relieved of constructing the flood control structures and provisions for detention along the COS Deer Valley Road Alignment as described in Section 4.4.3 when development occurs in Core north.

4.6.2 Channel Surface Treatment and Roughness Coefficient.

The general channel design was based on a channel surface roughness coefficient or Manning's 'n' value of 0.035. This roughness coefficient was based on the assumption that the excavated channels will be revegetated with native desert trees, brush and shrubs or in areas of golf or parks, grass turf.

The average 100-year flow depth ranges from 2 to 3.5 feet in most channels downstream of the sediment basin, with a depth of approximately 5.0 feet in the Scottsdale Road Channel reach and East/West Channel Segment 1.
Revegetation of desert trees, shrubs, and brush of similar mix and density as currently exists on the study area along washes is considered within the assumed Manning's roughness coefficient of 0.035. It is recommended that more brush and other lowlying vegetation be encouraged along each side of the channel at the toe of slope. This will mitigate lateral erosion by reducing velocities on the sideslopes. The recommendation for heavier density vegetation will also apply to the outside of bends at curves in the channel for the same reasons.

Selected areas of rock rip-rap bank and invert protection are proposed at; a) the inlet and outlet transitions of road crossing culverts and grade control structures, b) the outside of the Scottsdale Road channel curve at the overhead electric line easements.

4.6.3 Soils Description, Sediment Basin Sizing, Equilibrium Slope, and Allowable Velocity Analysis.

Appendix B contains a more detailed discussion of the general soils within the study area and the basis for sizing of the sediment basin. It also contains an equilibrium slope analysis for the proposed high velocity, Scottsdale Road channel which is expected to transport sediment to the sediment basin. For, the channels downstream of the sediment basin, an allowable velocity analysis was performed. These analysis were performed for the 10-year discharge which was considered the dominant discharge which would dictate long term erosional, sediment deposition trends.

4.6.4 Road Crossing Culverts.

Reinforced Concrete Box (RCB) culverts are proposed at road crossings of the proposed channels shown on Figure 10A and 10B. These culverts are proposed to be sized to convey the 100-year, 6-hour peak discharges. The size of the road crossing culverts were generally reduced by increasing the potential ponding depth at the culvert inlet and providing a sloped inlet transition to the upstream channel. The inlet transition also acts as a grade control structure to reduce channel slopes, velocities and erosion potential.

The box culverts were sized using the Hydraulic Design of Highway Culverts Manual (Reference 23). Because of the sloped inlet transitions, the box culvert crossing designs were controlled by ponding depth at the inlet.

The outlet velocities from the box culverts velocities ranged from 14 to 17 fps based on super critical flow analysis by the HEC-2 hydraulic backwater model (Reference 24). Rock rip-rap lined basins at the outlet of box culverts are proposed to reduce these high velocities and provide a transition to the downstream channels. Procedures from (Reference 25) were used to size the basins which are proposed to involve a rip-rapped basin extending 60 feet downstream of the culvert. The basin typically will slope down approximately 4 feet below culvert invert at 2(H):1(V) slope, extend 24 feet level and slope back up to culvert invert elevation at 2(H):1(V) slope followed by 20 feet of level rip-rap. Rip-rap thickness of 2.5 feet is proposed.

The following Table 7, summarizes the proposed road crossing locations, sizes, design discharges and inlet ponding depths.

Table 7
Summary of Proposed Box Culverts

Location/Description	Design Discharge cfs	Culvert Size Note 1
East Channel		
At Sediment Basin	3500	4-10'(S) x 9'(R) x 40'
At Ridge Run Street	3500	4-10' x 9' x 50'
At Paradise Parkway	3500	4-10' x 9' x 90'
At Deer Valley Road	3500	4-10' x 9' x 100'
Split No. 2	3500	4-10' x 9' x 60'
At Ridge Circle S.	2000	2-10' x 9' x 60'
At Outer Loop	2000	By ADOT
At Union Hills N.	2000	2-10' x 8' x 100'
At Sports Village Way S.	2000	2-12' x 8' x 100'
East/West Channel		
Ridge Road	7000	6-12' x 8' x 60'
At Paradise Parkway	3500	5-10' x 8' x 60'
At 64th Street	3500	5-10' x 8' x 60'
West Channel		
At Paradise Parkway	3500	4-10' x 9' x 60'
At Sunset	3500	4-10' x 9' x 60'
At Deer Valley Road	3500	4-10' x 9' x 100'
At Ridge Circle N.	3500	4-10' x 9' x 60'
At Ridge Circle S.	5000	6-10' x 8' x 60'
At Outer Loop	5000	By ADOT
At Union Hills	5000	6-10' x 8' x 100'
At Sports Village Way	5000	6-10' x 8' x 100'
Pinnacle Peak Road Channel		
At Pinnacle Pk Rd/64th St.	2900	4-10' x 6' x 100'
64th Street		
1/2 Mile S. of Pinnacle Pk.	460	1-8' x 6' x 60'

Notes:
1: Approximate HEC-1 model peak flows at specific concentration points.
2: 2-8' (S) x ' (R) x 40' - 2 Barrel - 8' span x 8' rise x 40' long box culvert.

4.6.5 Grade Control Structures

Several grade control structures are proposed to supplement the road crossing culverts in reducing channel slope and erosion potential. There general locations are noted on Table 5.

Along the proposed Scottsdale Road channel, between the overhead electric easement and the sediment basin, two grade control structures of 3 foot elevation difference each are proposed. One grade control is proposed at the channel entrance to the sediment basin to provide a stable vertical and horizontal control at this transition and the second grade control is proposed midway between the sediment basin and the proposed Scottsdale Road bridge crossing at the electric line easement. These grade control structures are not proposed to dissipate energy, but only to provide a vertical and horizontal stabilization of the channel. The flow in this channel is proposed to be supercritical and hence dissipation is not proposed until flow enters the sediment basin.

Other grade control structures downstream of the sediment basin were proposed to dissipate flow within the structure. These channels are designed for relatively non-erosive slow velocities (less than 8.0 fps for 100-year storm). Therefore, the higher velocities produced at the grade control structure elevation change were dissipated within an armored depressed basin below. Procedures from the HEC-14 manual (Reference 25) were used to size the basins, which force the hydraulic jump, energy and velocity dissipation within the basin.

The grade control structures are proposed to be constructed of 18-inch thick soil-cement and loose rock rip-rap, however, other materials may be used in final design. The grade control structure size is proposed to be of bottom width approximately equal to the adjacent channel width.

4.6.6 Onsite Drainage

Onsite drainage discharges were computed for all of the study area. A 38 percent impervious factor was applied to all areas, except the golf corridors and the commercial land use areas, which were modelled with 0 and 90 percent impervious factor, respectively.

The onsite drainage areas were generally assumed to drain to the major channels. Referring to Figure 10A and 10B, the commercial area north of the electric easement was assumed to drain south and east to the proposed Scottsdale Road channel at the intersection with the electric easement. Drainage of this commercial area was expected to occur by one or more of a number of methods including 1) a ditch within the electric easement, 2) pavement or streets; or 3) storm drains. Other onsite areas north of the Deer Valley Road alignment were anticipated to drain by ditches in golf corridors, street right-of-ways or streets, to the East/West channel. An exception to this involves the onsite subarea 184, shown on figure 10A in the northwest corner of the property. This approximately 106 acre parcel north of Paradise Parkway and west of Ridge Road is proposed to drain across 64th Street, 1/2 mile south of Pinnacle Peak Road into Desert Ridge.

Below the Deer Valley alignment, it was expected that onsite drainage could be conveyed within road right-of-ways, streets and golf corridors to the channels. This included the area between West Channel and 64th Street. Downstream of the Union Hills alignment, a good portion of onsite flow would flow directly to the CAP Dike 2 detention basin.

5.0 CONCLUSIONS

Local, State, and Federal regulations require the identification of 100-year floodplains within proposed developments and that finished floor elevations of buildings be elevated (1) foot above the 100-year flood elevations.

The Federal Emergency Management Agency (FEMA) has identified a Special Flood Hazard Zone 'AO' over the majority of the study site as part of a preliminary Flood Insurance Study currently being performed.

The 100-year discharge is estimated to be 9,500 cfs for the alluvial fan flows from Rawhide Wash entering the study site near Pinnacle Peak Road. FEMA considers the flow distribution within alluvial fans unstable and therefore, having the potential for relatively concentrated flows to shift anywhere within the delineated floodplains. Therefore, provisions for elevating finished floors and providing conveyance through a proposed development would need to consider concentrated flows entering the site at any place within the floodplain limits. This would require additional construction costs for building pads and possible scour protection, lighter building density to accommodate concentrated flows between buildings and the arrangement of the development to create continuous parallel street or, conveyance corridors for flow.

It would also be difficult and expensive to demonstrate emergency access throughout the site.

The proposed drainage system involves intercepting the flow and diverting portions of the total 100-year discharge into several channels which convey it to the CAP Canal Dike 2 detention basin. A portion of the 100-year flow will also be delivered to the Desert Ridge Development, which potentially occurs in the existing condition.

If constructed to FEMA standards the proposed system would allow removal of the Special Flood Hazard Zone **AO** floodplain designation impacting the study site.

Street box culvert crossings of 100-year discharge capacity are proposed at crossing of channels to maintain access within the site and to adjacent major streets during flood events.

Coordination has been performed with adjacent existing and proposed drainage facilities to maintain a continuous 100-year storm capacity drainage system from the alluvial fan apex to the ultimate outlet at the CAP Canal Dike 2 detention basin.

The proposed drainage system will require continued coordination with the Cities of Phoenix and Scottsdale, the Arizona Department of Transportation, Arizona State Land Department and adjacent private land owners, regarding design and cost-sharing issues.

6.0 REFERENCES

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10. "Rawhide/Pinnacle Peak Wash Alignment Study" by City of Scottsdale Alluvial Fan Task Force, September, 1992.

11. "Reata Pass/Beardsley Wash Alignment Study" by City of Scottsdale Alluvial Fan Task Force, September, 1992.

12. Flood Insurance Rate Maps (FIRM's), Maricopa County, Arizona and Incorporated Areas; Panels 1230, 1235F, 1240G, and 1245 of 4350, Federal Emergency Management Agency, Dated: January 4, 1993 (Preliminary).

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16. **Flood Insurance Rate Maps (FIRM's), Maricopa County, Arizona and Incorporated Areas; Panels 1230, 1235, 1240D and 1245D of 4350, Federal Emergency Management Agency (FEMA) Effective Date: April 15, 1988 and December 3, 1993.**

17. Letter from Federal Emergency Management Agency to City of Scottsdale, Arizona, Dated: January 4, 1993.

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22. Hydrologic Design Manual for Maricopa County, Arizona. Prepared by the Flood Control District of Maricopa County, Hydrology Division, Special Projects Branch, September 1, 1990.

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24. Water Surface Profile Hydraulic Backwater HEC-2 Computer Model, May, 1991, Version 4.6.2, U.S. Army Corps of Engineers, Hydrologic Engineering Center, 609 Second Street, Davis, California 95619.

25. Hydraulic Design of Energy Dissipaters for Culverts and Channels, Hydraulic Engineering Circular No. 14 (HEC-14) Federal Highway Administration, Hydraulics Branch, Bridge Division, December, 1975.

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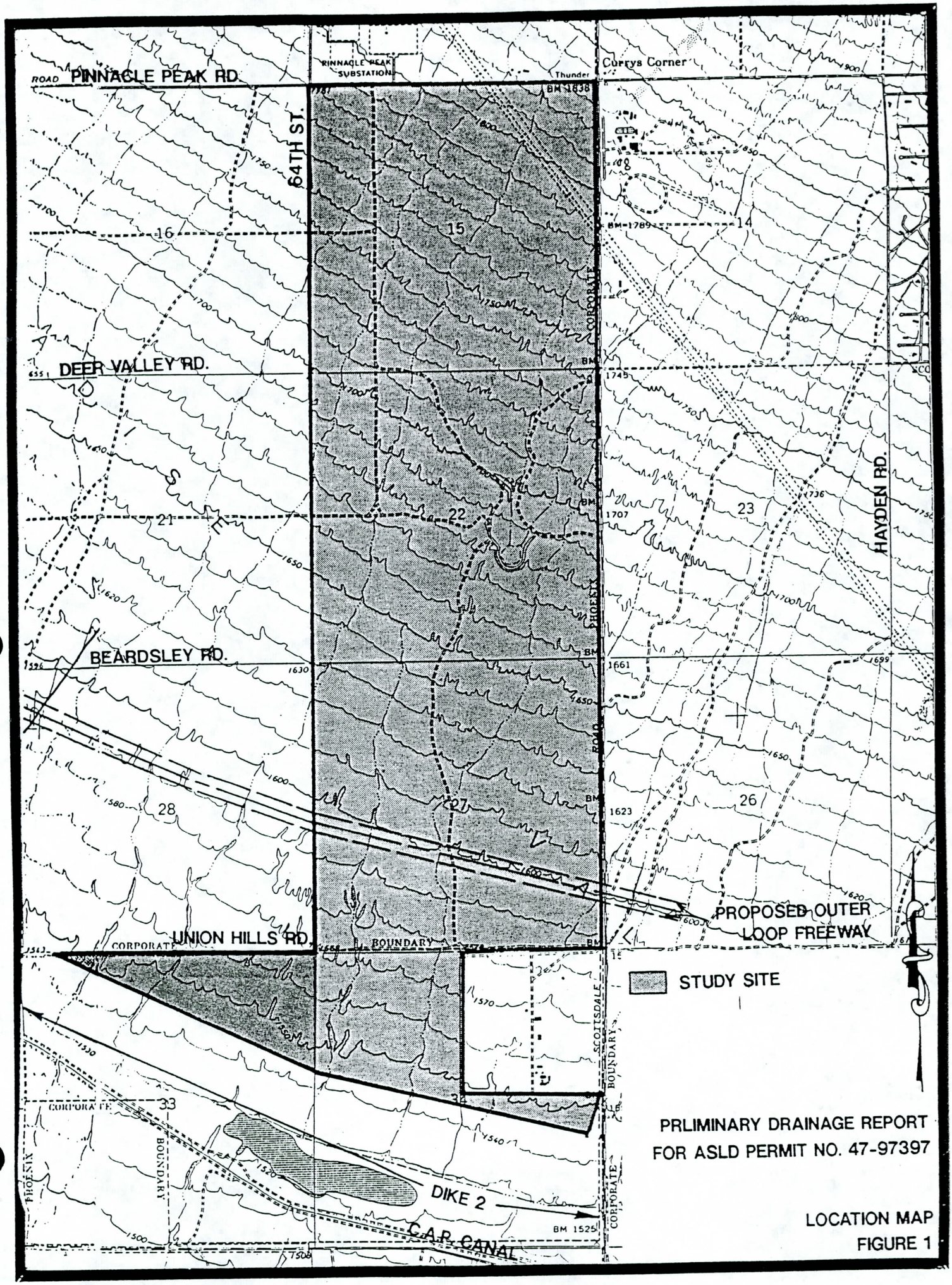
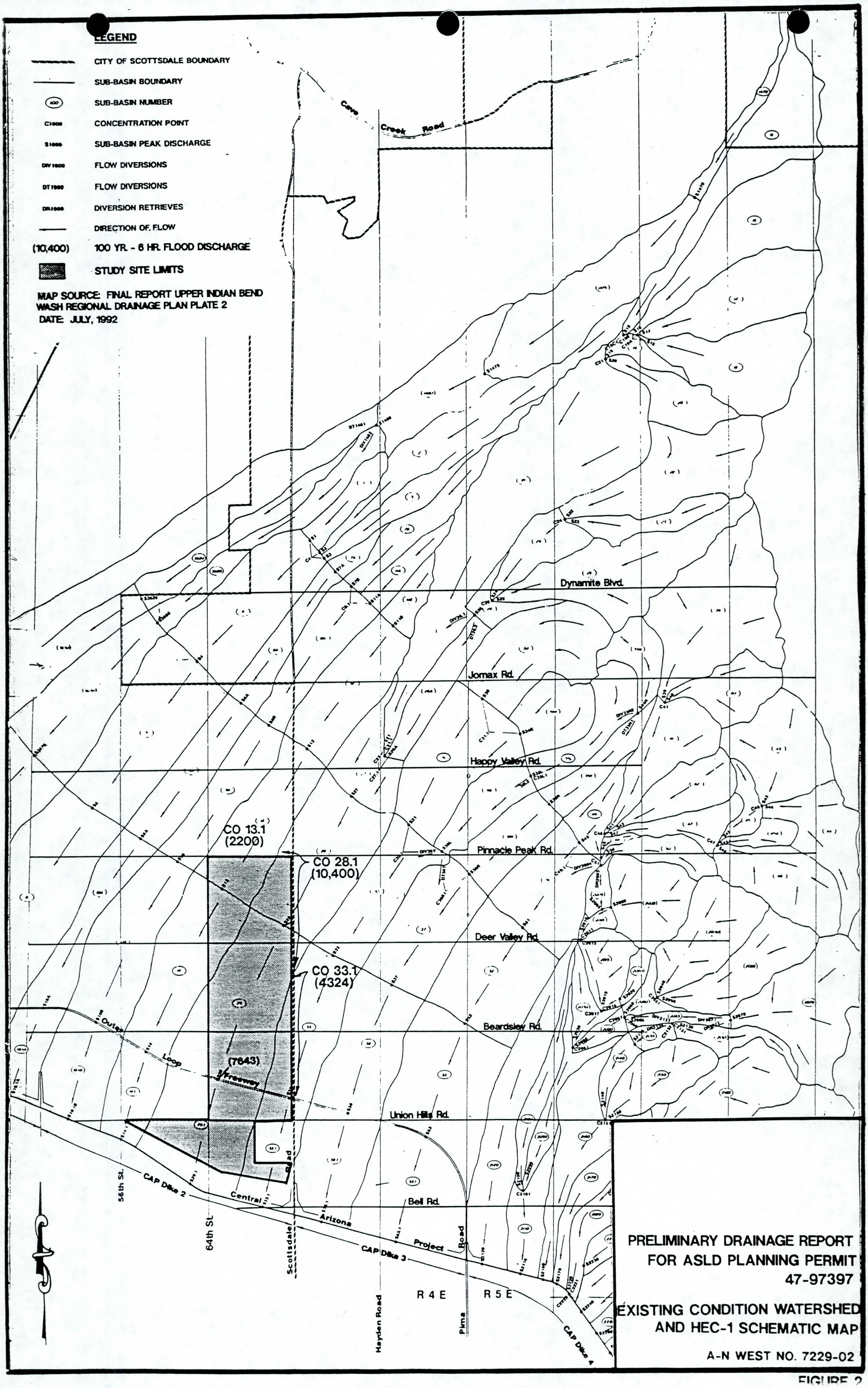
27. Open Channel Hydraulics, by Richard H. French McGraw Hill Co., Copyright, 1985.



PRLIMINARY DRAINAGE REPORT
FOR ASLD PERMIT NO. 47-97397

LOCATION MAP
FIGURE 1

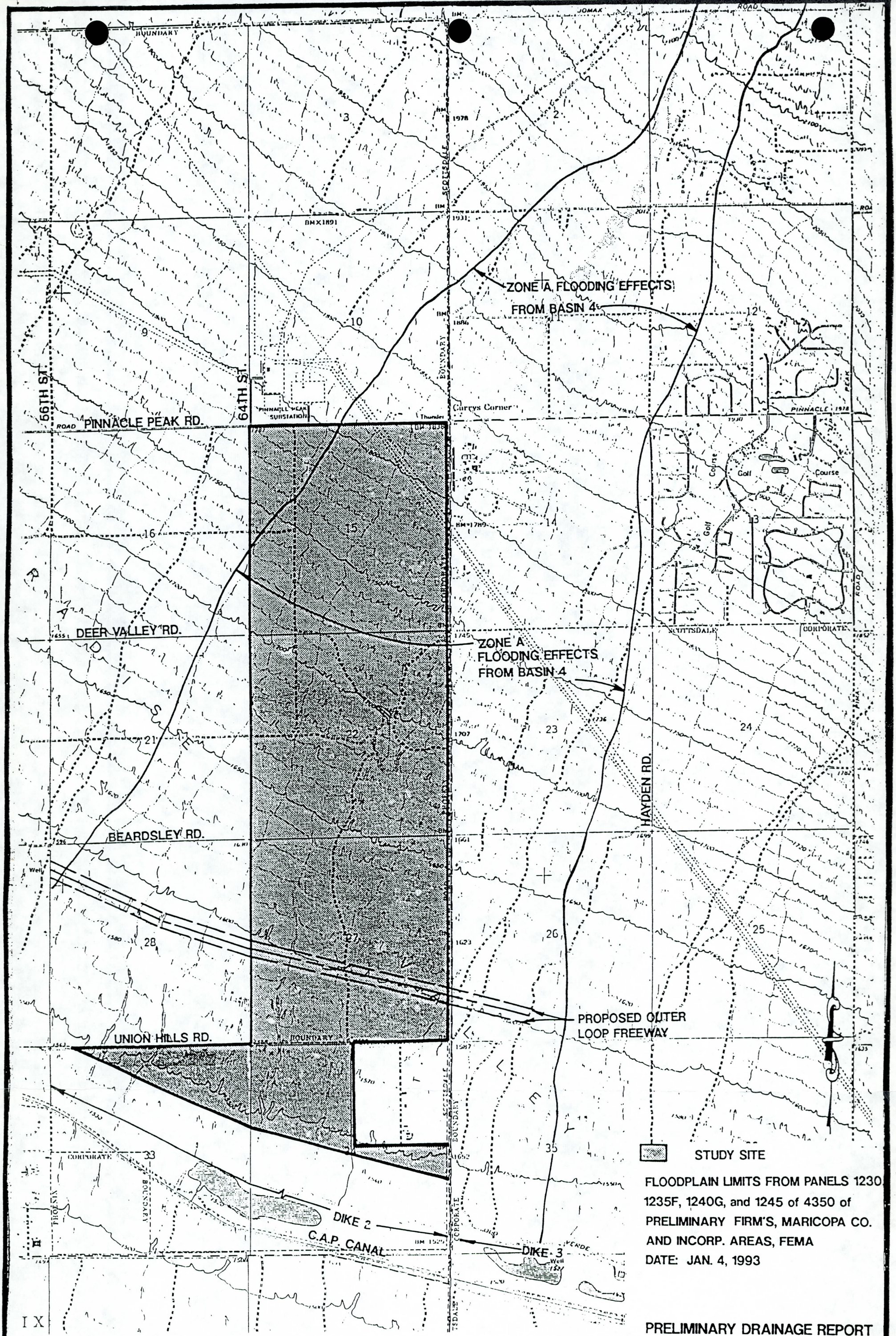


PRELIMINARY DRAINAGE REPORT
FOR ASLD PLANNING PERMIT
47-97397

EXISTING CONDITION WATERSHED
AND HEC-1 SCHEMATIC MAP

A-N WEST NO. 7229-02

FIGURE 2



PRELIMINARY DRAINAGE REPORT
FOR ASLD PERMIT 47-97397

PRELIMINARY FLOODPLAIN MAP

A-N WEST NO. 7229-02

FIGURE 3

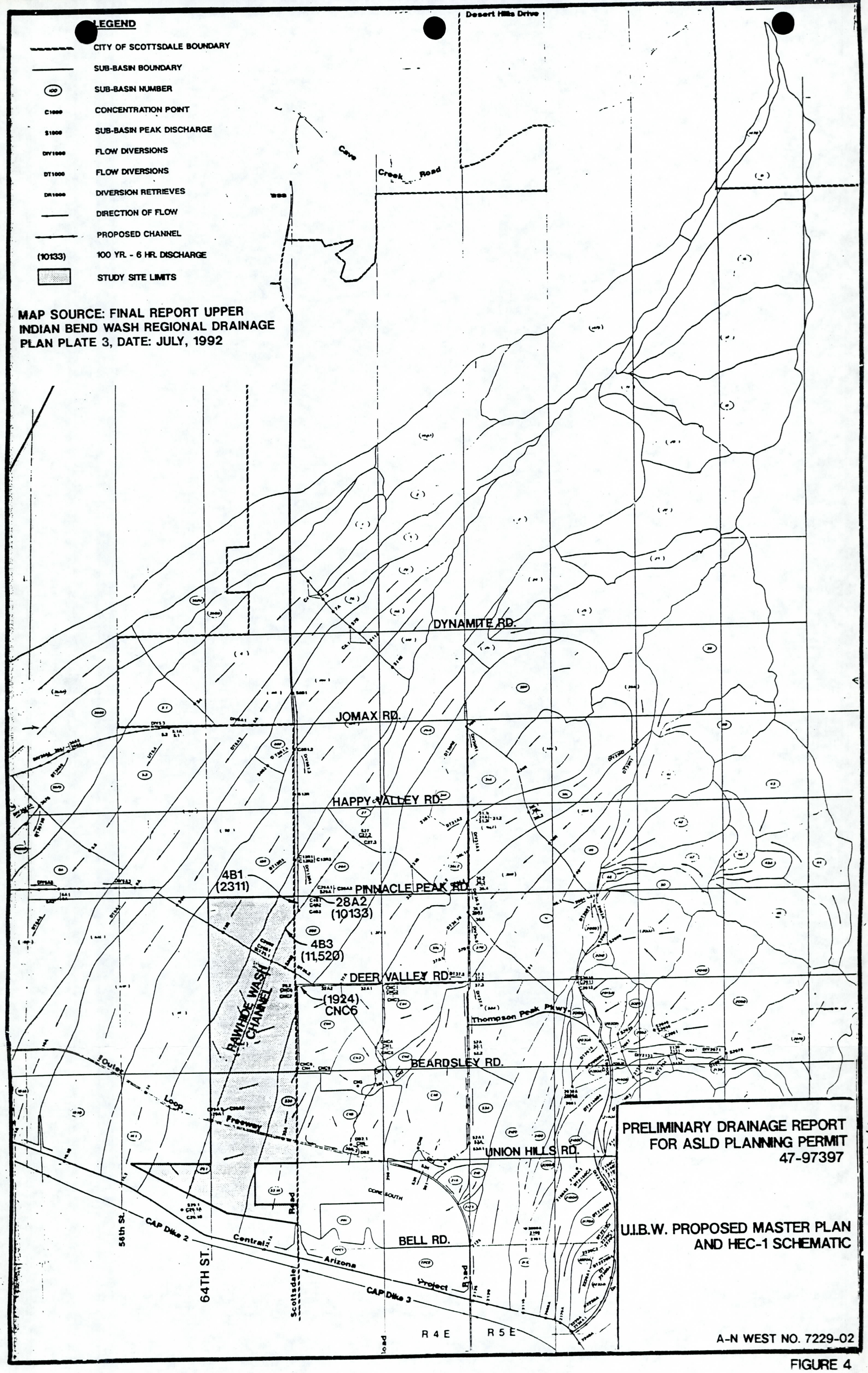

LEGEND
CITY OF SCOTTSDALE BOUNDARY
SUB-BASIN BOUNDARY
SUB-BASIN NUMBER
CONCENTRATION POINT
SUB-BASIN PEAK DISCHARGE
FLOW DIVERSIONS
FLOW DIVERSIONS
DIVERSION RETRIEVES
DIRECTION OF FLOW
PROPOSED CHANNEL
(10133) 100 YR. - 6 HR. DISCHARGE
STUDY SITE LIMITS
MAP SOURCE: FINAL REPORT UPPER INDIAN BEND WASH REGIONAL DRAINAGE PLAN PLATE 3, DATE: JULY, 1992
Desert Hills Drive
Cave Creek Road
DYNAMITE RD.
JOMAX RD.
HAPPY VALLEY RD.
PINNACLE PEAK RD.
DEER VALLEY RD.
BEARDSLEY RD.
UNION HILLS RD.
BELL RD.
4B1 (2311)
28A2 (10133)
4B3 (11,520)
(1924) CNC6
RAWHIDE WASH CHANNEL
Thompson Peak Pkwy.
Outer Loop Freeway
CAP Dike 2
CAP Dike 3
Central Arizona Project
56th St.
64TH ST.
Scottsdale Road
CORE SOUTH
R 4 E
R 5 E
PRELIMINARY DRAINAGE REPORT FOR ASLD PLANNING PERMIT 47-97397
U.I.B.W. PROPOSED MASTER PLAN AND HEC-1 SCHEMATIC
A-N WEST NO. 7229-02

FIGURE 4

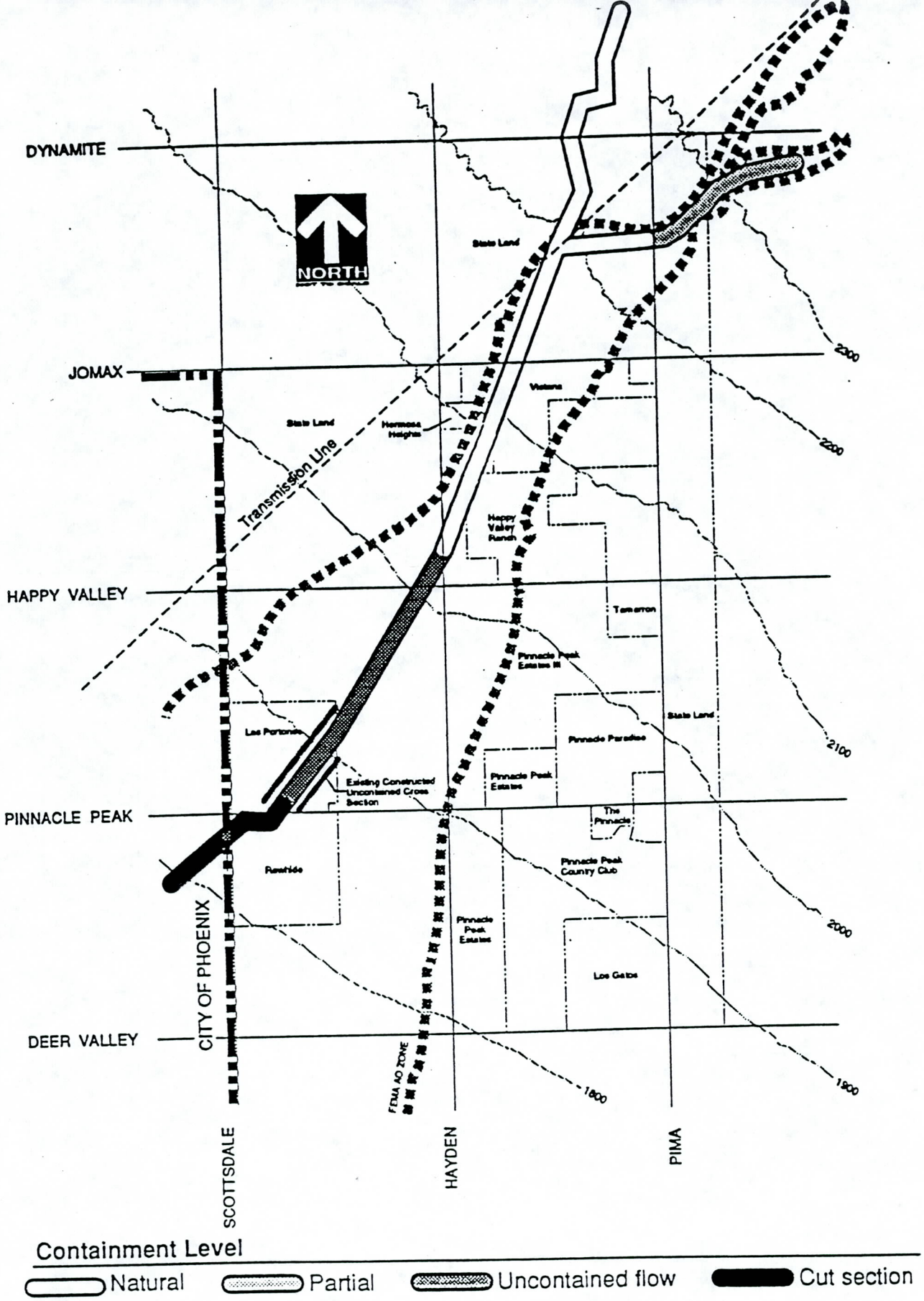
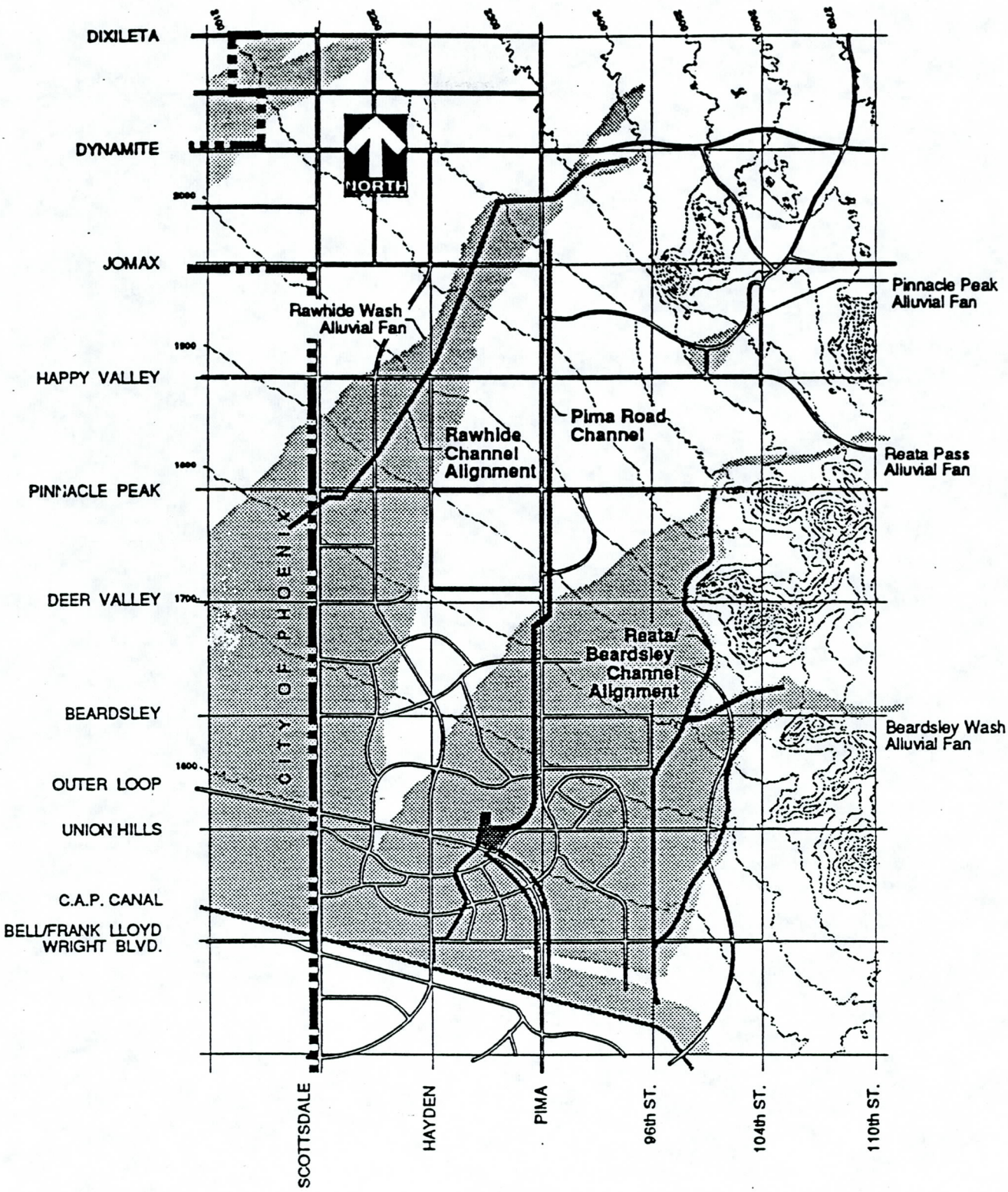


Figure #5:
Recommended Alignment-Rawhide Wash

Note: The purpose of these figures is completely illustrative only. For more detailed information, contact the City of Scottsdale.

EXHIBIT SOURCE: FROM REFERENCE 10 OF
A-N WEST REPORT (2/93) A-N W NO. 7229-02



Legend

Flood Zones

Figure #7:
Recommended Conceptual Regional Stormwater Management Plan

Note: The purpose of these figures is completely illustrative only. For more detailed information, consult the Upper Indian Bend Wash Regional Drainage & Flood Control Plan, July 1992.

EXHIBIT SOURCE: FROM REFERENCE 10 OF
A-N WEST REPORT (2/93) A-N W NO. 7229-02

FIGURE 6

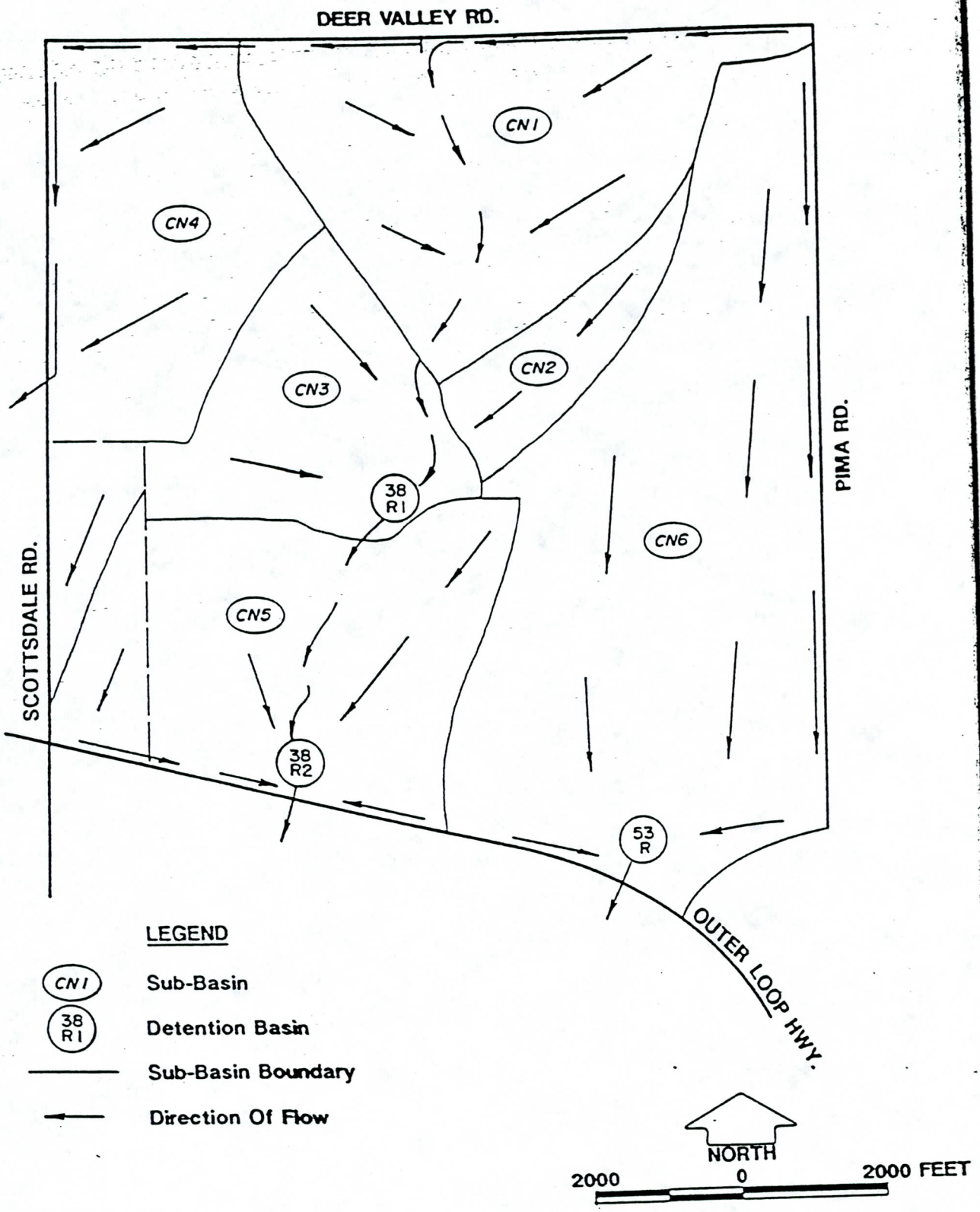


EXHIBIT SOURCE: FROM REFERENCE 4 OF
A-N WEST REPORT (2/93) A-N W NO. 7229-02

Water Resources Associates, Inc. Hydrologists • Hydrogeologists • Engineers • Forensic Hydrologists	SCHEMATIC OF CORE NORTH DRAINAGE SYSTEM	FIGURE 4.7
PROJECT NO. AC02670 DRAWN BY KMA DATE 8/31/90 CHECKED BY JJH		

FIGURE 7

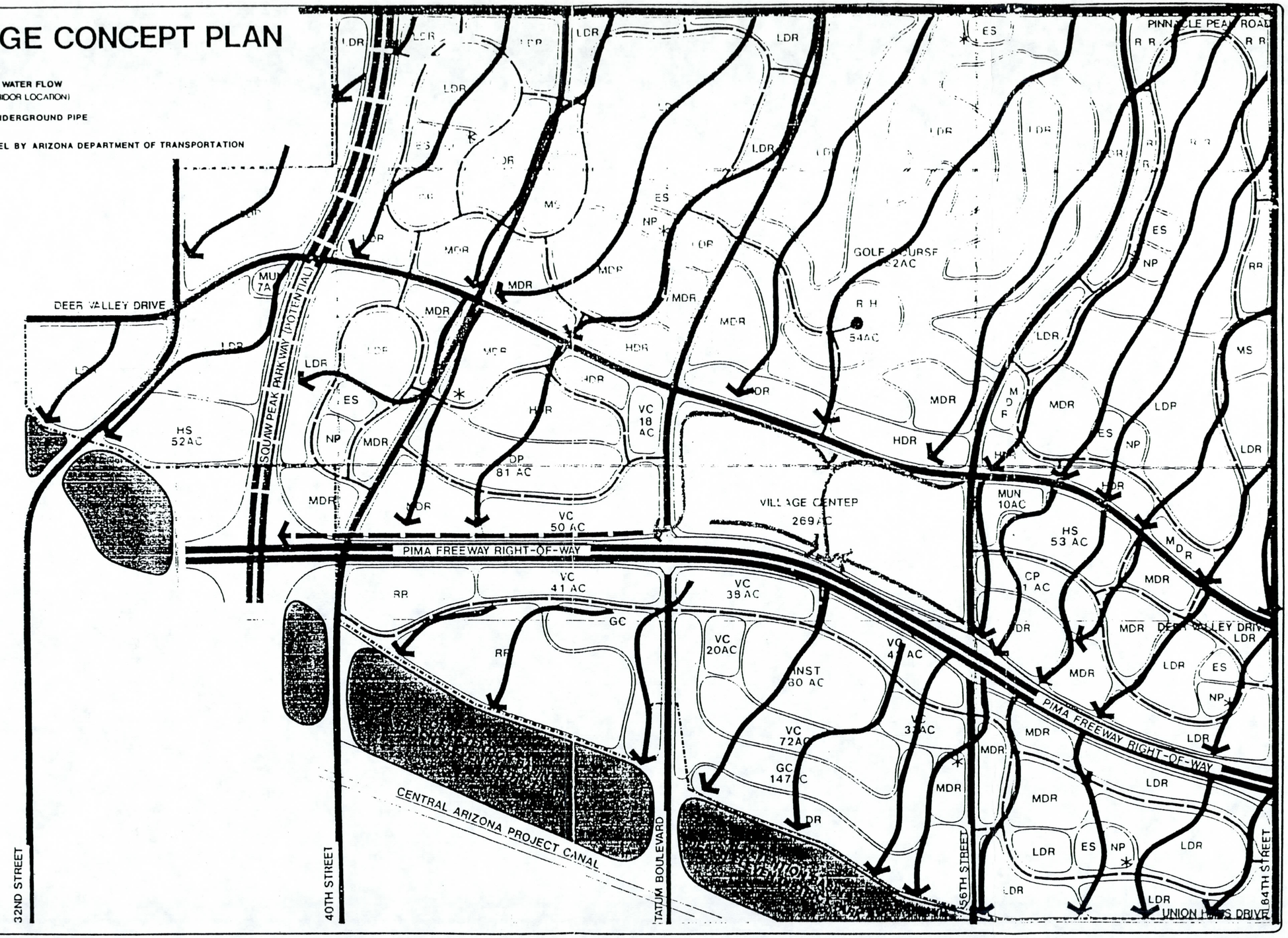
DRAINAGE CONCEPT PLAN

DIRECTION OF WATER FLOW (GENERAL CORRIDOR LOCATION)

PROBABLE UNDERGROUND PIPE

OPEN CHANNEL BY ARIZONA DEPARTMENT OF TRANSPORTATION

18 JULY 1990



DESERT RIDGE

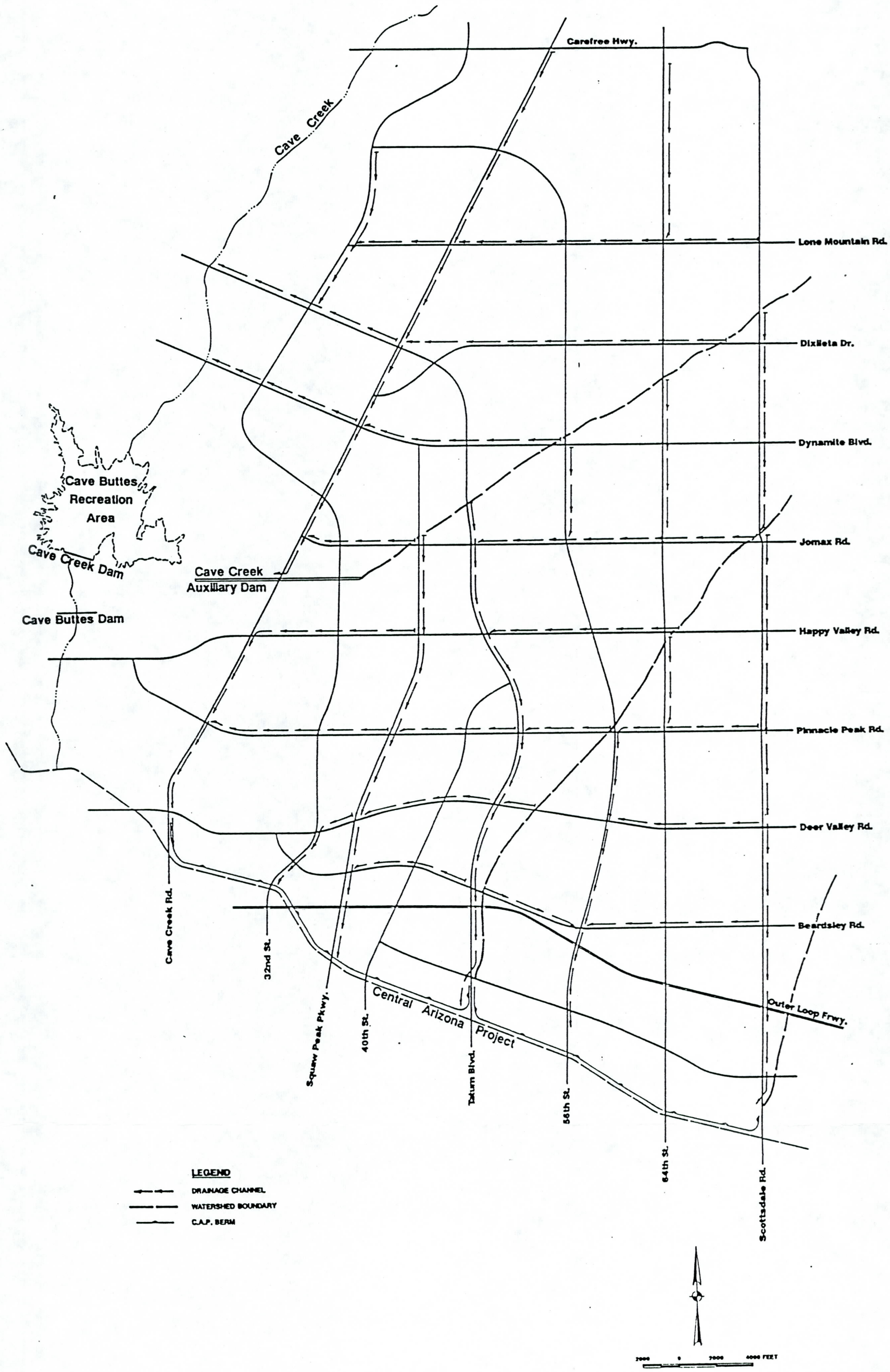
NORTHEAST PHOENIX PARTNERS

EXHIBIT SOURCE: FROM REFERENCE 9 OF A-N WEST REPORT (2/93) A-N W NO. 7229-02

22

BRW
Barton Myers Associates
Mountain West Research
THK Associates Inc
Gammage & Burnham
Robert Trent Jones II

FIGURE 8



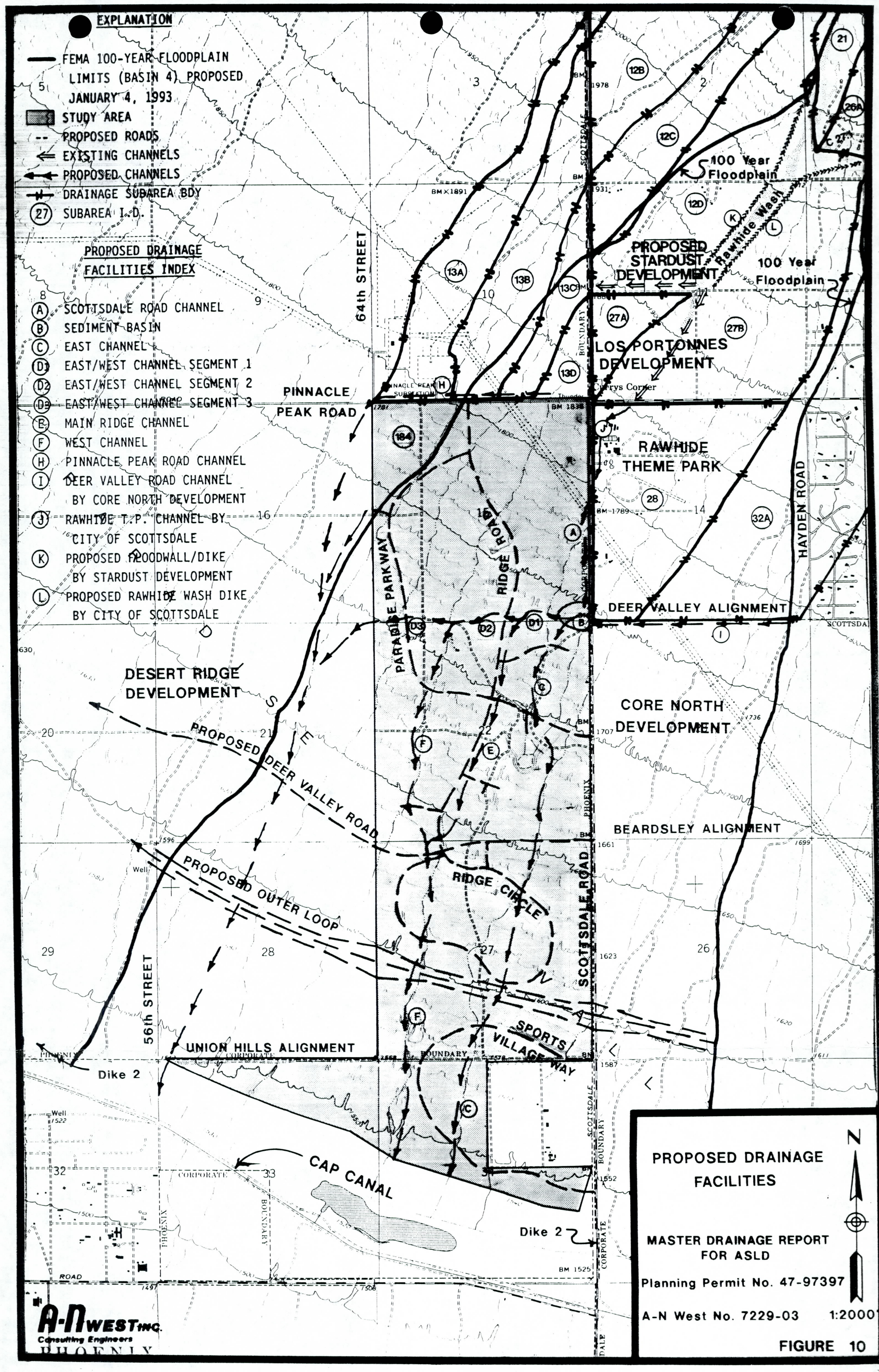
Water Resources Associates, Inc.
Hydrologists • Hydrogeologists • Engineers • Forensic Hydrologists

SCHEMATIC DIAGRAM FOR AREA-WIDE CHANNEL SYSTEM

PLATE 3

EXHIBIT SOURCE: FROM REFERENCE 3 OF A-N WEST REPORT (2/93) A-N W NO. 7229-02

FIGURE 9



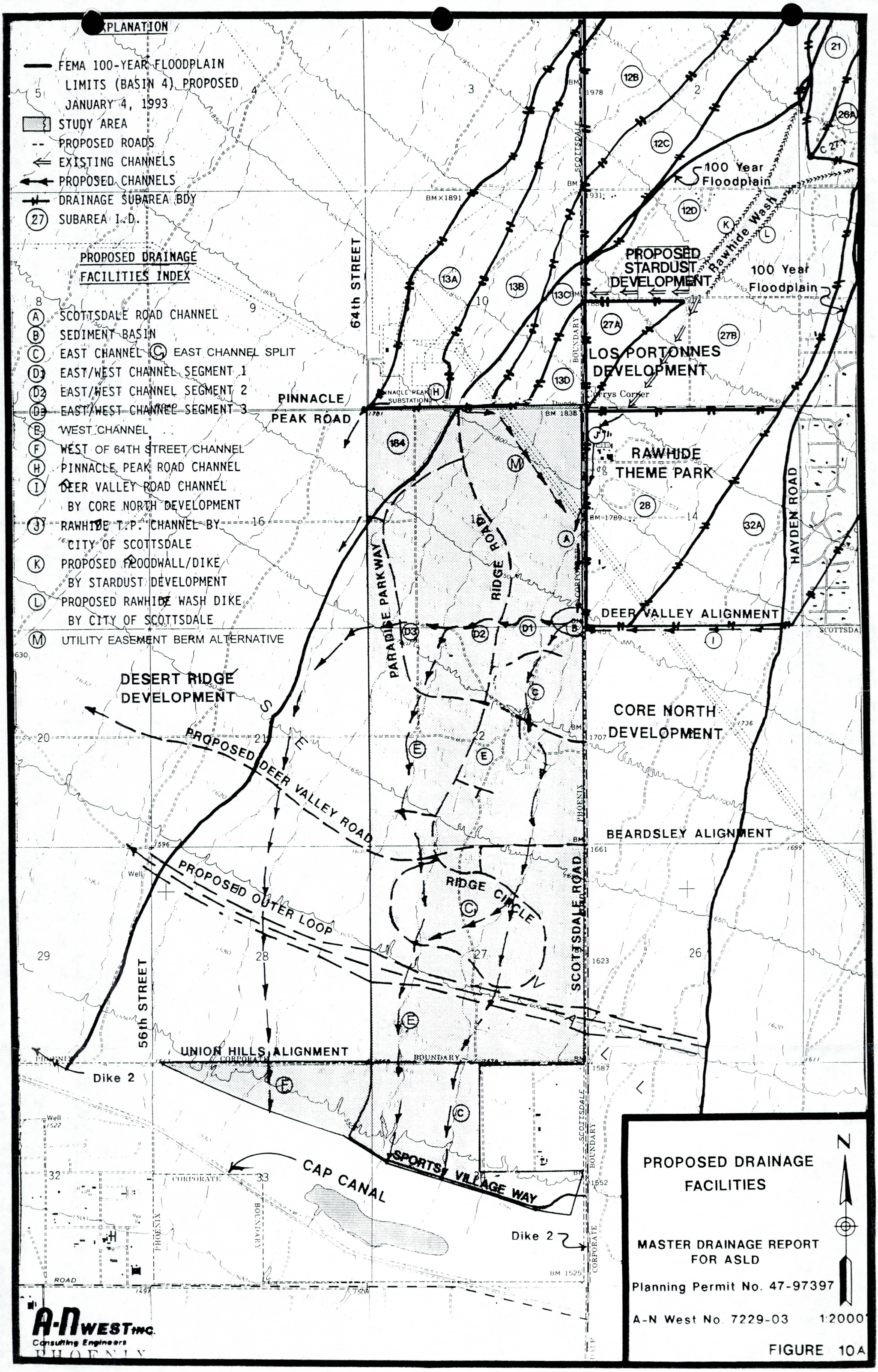
PROPOSED DRAINAGE FACILITIES

MASTER DRAINAGE REPORT FOR ASLD

Planning Permit No. 47-97397

A-N West No. 7229-03 1:2000

FIGURE 10


EXPLANATION
FEMA 100-YEAR FLOODPLAIN LIMITS (BASIN 4) PROPOSED JANUARY 4, 1993
STUDY AREA
PROPOSED ROADS
EXISTING CHANNELS
PROPOSED CHANNELS
DRAINAGE SUBAREA BDY
SUBAREA I.D.
PROPOSED DRAINAGE FACILITIES INDEX
A SCOTTSDALE ROAD CHANNEL
B SEDIMENT BASIN
C EAST CHANNEL
G EAST CHANNEL SPLIT
D1 EAST/WEST CHANNEL SEGMENT 1
D2 EAST/WEST CHANNEL SEGMENT 2
D3 EAST/WEST CHANNEL SEGMENT 3
E WEST CHANNEL
F WEST OF 64TH STREET CHANNEL
H PINNACLE PEAK ROAD CHANNEL
I DEER VALLEY ROAD CHANNEL BY CORE NORTH DEVELOPMENT
J RAWHIDE T.P. CHANNEL BY CITY OF SCOTTSDALE
K PROPOSED FLOODWALL/DIKE BY STARDUST DEVELOPMENT
L PROPOSED RAWHIDE WASH DIKE BY CITY OF SCOTTSDALE
M UTILITY EASEMENT BERM ALTERNATIVE
100 Year Floodplain
PROPOSED STARDUST DEVELOPMENT
Rawhide Wash
LOS PORTONNES DEVELOPMENT
64th STREET
PINNACLE PEAK ROAD
RAWHIDE THEME PARK
HAYDEN ROAD
PARADISE PARKWAY
RIDGE ROAD
DEER VALLEY ALIGNMENT
DESERT RIDGE DEVELOPMENT
CORE NORTH DEVELOPMENT
PROPOSED DEER VALLEY ROAD
BEARDSLEY ALIGNMENT
PROPOSED OUTER LOOP
RIDGE CIRCLE
SCOTTSDALE ROAD
56th STREET
UNION HILLS ALIGNMENT
Dike 2
CAP CANAL
SPORTS VILLAGE WAY
A-N WEST INC.
Consulting Engineers
PROPOSED DRAINAGE FACILITIES
MASTER DRAINAGE REPORT FOR ASLD
Planning Permit No. 47-97397
A-N West No. 7229-03
1:2000
FIGURE 10A

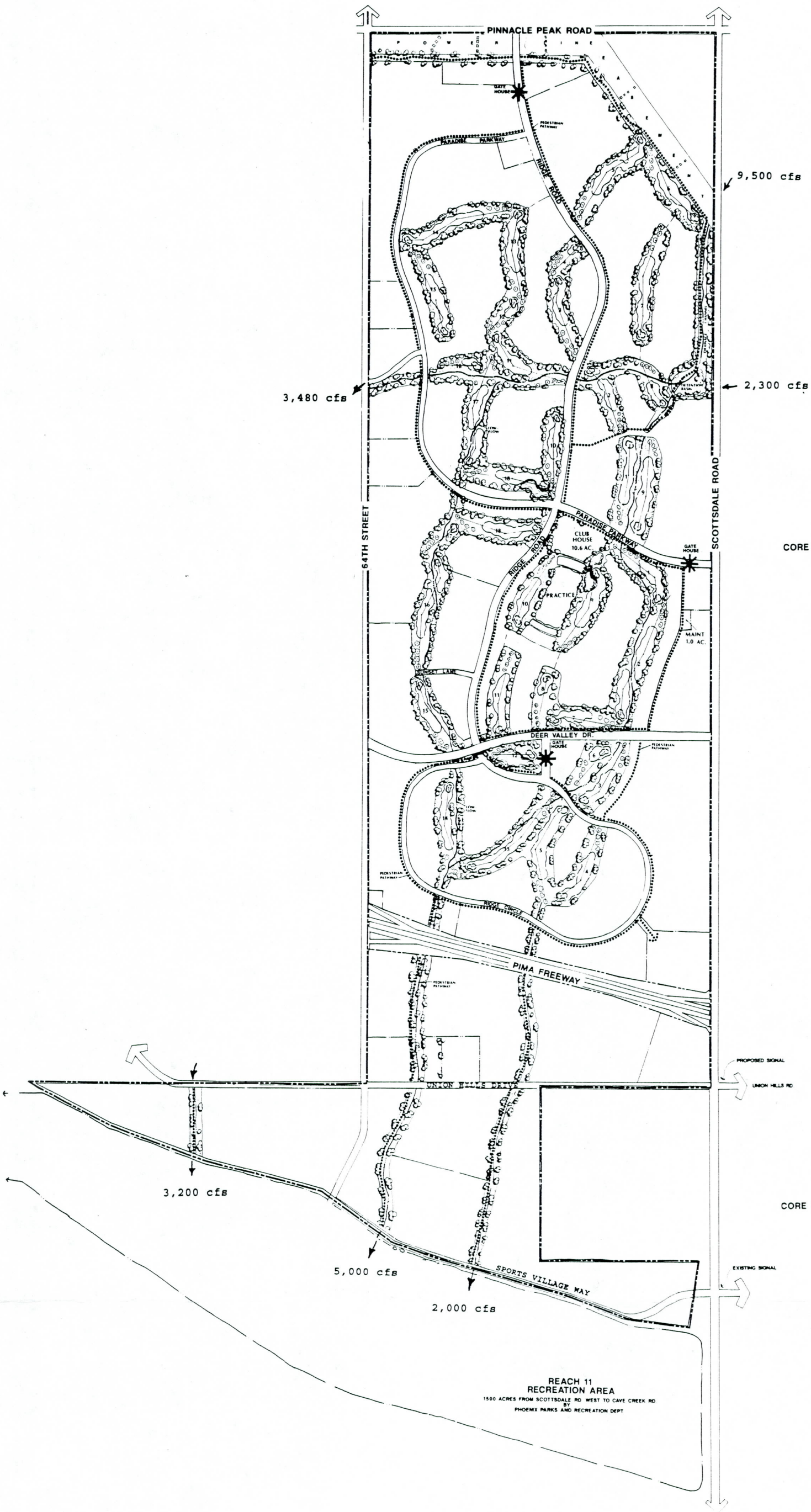
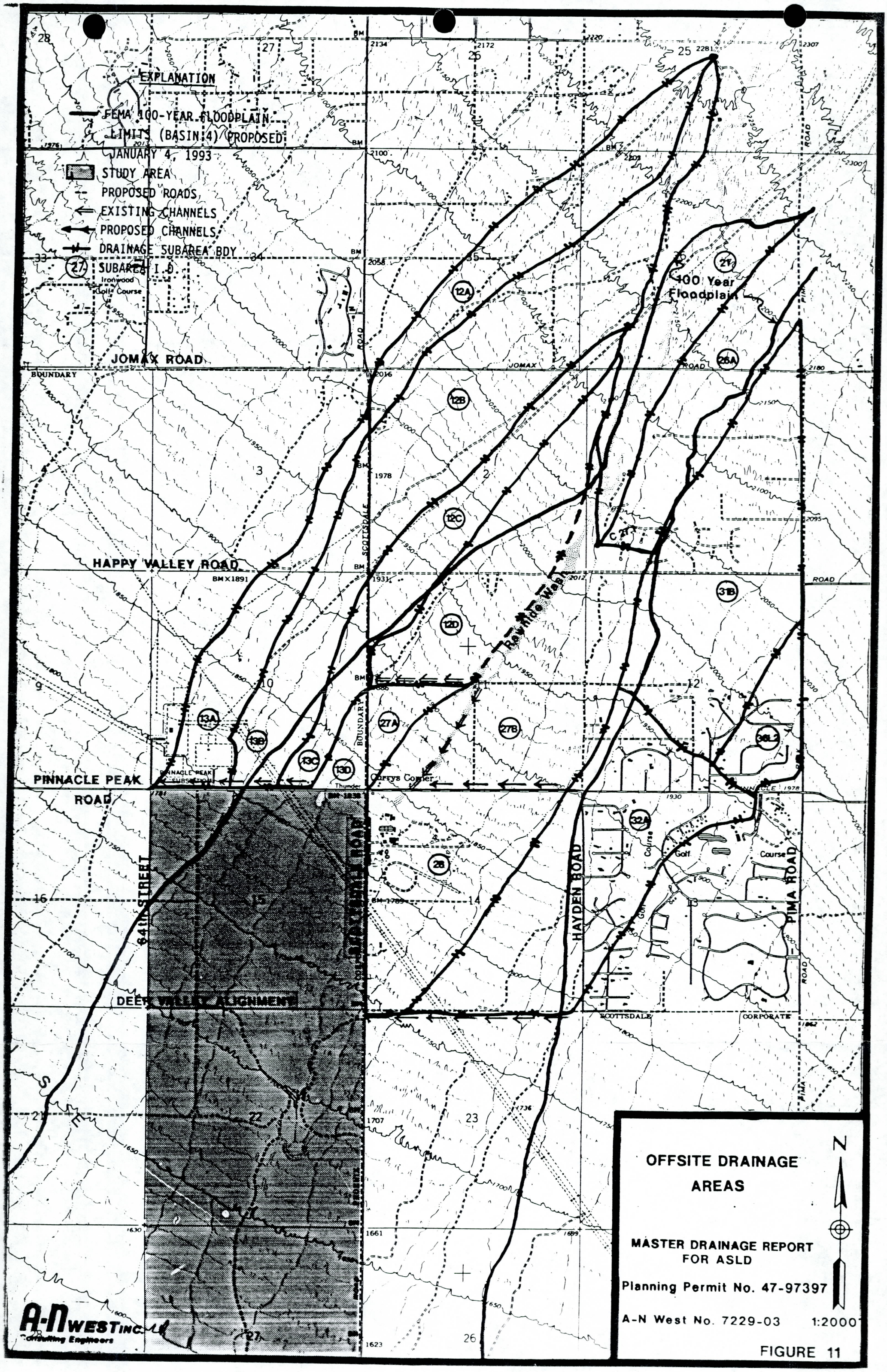

PINNACLE PEAK ROAD
POWERLINE EASEMENT
GATE HOUSE
PEDESTRIAN PATHWAY
PARADISE PARKWAY
RIDGE ROAD
9,500 cfs
3,480 cfs
2,300 cfs
64TH STREET
SCOTTSDALE ROAD
CORE NORTH
CLUB HOUSE 10.6 AC
PRACTICE
MAINT 1.0 AC.
SUNSET LANE
DEER VALLEY DR.
LOW FLOW
RIDGE CIRCLE
PIMA FREEWAY
UNION HILLS DRIVE
PROPOSED SIGNAL
UNION HILLS RD
CORE SOUTH
3,200 cfs
5,000 cfs
2,000 cfs
SPORTS VILLAGE WAY
EXISTING SIGNAL
REACH 11
RECREATION AREA
1500 ACRES FROM SCOTTSDALE RD WEST TO CAVE CREEK RD
BY
PHOENIX PARKS AND RECREATION DEPT
Paradise Ridge
2-17-94
PROPOSED MASTER
DRAINAGE PLAN
VSA
NORTH

FIGURE 10B



OFFSITE DRAINAGE AREAS

MASTER DRAINAGE REPORT FOR ASLD

Planning Permit No. 47-97397

A-N West No. 7229-03 1:2000

FIGURE 11

TABLE 5

SUMMARY OF CHANNEL DESIGN PARAMETERS

100 YEAR 6-HOUR STORM

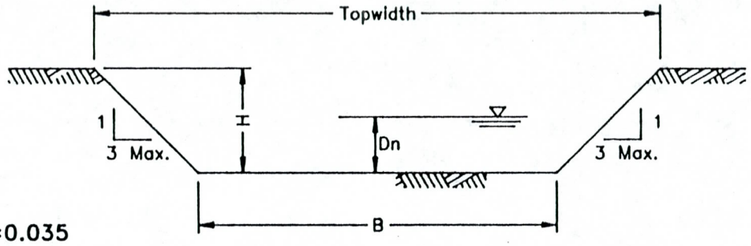
n = 0.035 z = 3:1

DESCRIPTION	REACH LENGTH	Q100 DESIGN (cfs)	B (ft)	Dn (ft)	SLOPE (ft/ft)	Hmax (ft)	VELOCITY (fps)	TOP WIDTH (ft)	FROUDE NO.	REMARKS
SCOTTSDALE ROAD CHANNEL	2,800	9,500	110	5	0.018	10	15.3	170	1.17	See note
EAST-WEST CHANNEL, SEGMENT 1										Grade control structure, 4.5' at
Sediment basin to West channel	2,950	6,900	230	3.7	0.006	8	7.7	300	0.71	split #1 and 4.5' at Ridge Road
										existing slope = 0.009
EAST-WEST CHANNEL, SEGMENT 2										
West channel to development										
boundary	1,900	3,500	140	3	0.008	8	7.6	200	0.73	2' grade control structure
										existing slope = 0.009
EAST CHANNEL, SEGMENT 1										
Sediment basin to diversion point										grade control structures, 30'
with south channel	6,100	3,500	150	2.8	0.009	8	7.7	200	0.76	over 6 locations
										existing slope = 0.014
EAST CHANNEL, SEGMENT 2										
From diversion point to South channel										grade control structures, 22'
to southern development boundary	7,500	2,100	100	2.7	0.009	8	7.3	150	0.82	over 4 locations
										existing slope = 0.012
WEST CHANNEL, SEGMENT 1										
From East-West channel to confluence										grade control structures, 43'
point with South channel	8,600	3,500	150	2.8	0.009	8	7.7	200	0.76	over 6 locations
										exisiting slope = 0.014
WEST CHANNEL, SEGEMNT 2										
From confluence point with South										
channel tosouthern development										grade control structures, 22'
boundary	3,700	5,000	150	4	0.006	8	7.8	200	0.66	over 4 locations
										existing slope = 0.012
SOUTH CHANNEL										
From East channel to West channel	3,200	1,500	100	2.1	0.009	5	6.4	150	0.72	exisitng slope = 0.009
PINNACLE PEAK ROAD CHANNEL										
Segment 1 0 to 850 ft	850	1,000	50	2.5	0.01	4.5	7.1	75	0.85	Scottsdale Road
Segment 2 850 to 2550 ft	1,700	2,000	110	2.4	0.01	4.5	7.2	140	0.85	
Segment 3 2550 to 3450 ft	900	2,800	140	2.5	0.01	4.5	7.6	165	0.86	

A-N WEST INC.
Consulting Engineers

TABLE 5
SUMMARY OF CHANNEL DESIGN PARAMETERS
100 – YEAR STORM

ASLD PLANNING PERMIT NO. 47-97397
DATE: 11/10/93
ANW NO. 7229-03



MANNING'S 'n'=0.035

Description (See Figure 10)	Reach Length (ft)	Q_{100} Design (CFS)	B (FT)	Dn (FT)	Slope (FT/FT)	H Max. (FT)	Vel (FPS)	Topwidth Design (FT)	Fr No.	Remarks
SCOTTSDALE ROAD CHANNEL Electric Line Easement to Sediment Basin	2550	9462	110	5.0	0.018	10	15.3	170	1.28	Additional 15 Foot Each Side of Topwidth Reserved for Maintenance Access and Concrete Lateral Scour Cutoff Wall. 3 Foot Elev. Diff. Grade Controls at 1280 Foot Spacing. Scour Mitigated by Sediment Load in Flow. Q100 Increases to 10258 in Basin From Deer Valley Road Channel to East
EAST CHANNEL Sediment Basin to Grade Control South of Paradise Parkway	3395	1652	100	2.3	0.0092	8	6.8	150	0.81	6 Foot Grade Control Structure South of Paradise Parkway
Grade Control South of Paradise Parkway to Deer Valley Road along Golf	1970	1720	100	2.2	0.0111	8	7.3	150	0.89	
Deer Valley Road to South Boundary	8350	1727	100	2.4	0.0092	8	6.9	150	0.82	
EAST/WEST CHANNEL SEGMENT 1 Sediment Basin to Diversion at Ridge Rd.	1350	8643	230	5.0	0.0034	13	7.0	310	0.56	Flow Splits at Diversion to East/West Channel, Segment 2 and Ridge Road Channel.
RIDGE ROAD CHANNEL Diversion to Ridge Run Street	675	3529	155	3.2	0.006	8	6.8	200	0.69	
Ridge Run Street to Paradise Parkway	835	3530	170	2.7	0.0089	7.5	7.5	215	0.82	
Paradise Parkway to Driving Range Grade Control	710	3530	170	2.7	0.0089	7.5	7.5	215	0.82	6 Foot Grade Control Structure Proposed at N. End of Driving Range
Along Driving Range	900	3530	240	2.0	0.011	10	7.0	300	0.88	
South End of Driving Range to Range Road	300	3530	155	3.2	0.006	6	6.8	200	0.69	
Range Road to Ridge Road Along Golf	1520	3530	170	2.7	0.0089	5	7.5	200	0.82	
Ridge Road to Deer Valley Road	530	3537	155	3.2	0.006	8	6.8	200	0.69	
EAST/WEST CHANNEL SEGMENT 2 Diversion at Ridge Road to Junction of West and East/West Channel (Segment 3)	1110	5157	210	3.4	0.0055	12	6.9	280	0.67	4 Foot Grade Control Structure Proposed to Split Flow to West and East/West Channel Segment 3
WEST CHANNEL Junction East/West Channel Segment 2 to Paradise Parkway	1670	1717	100	2.4	0.0092	8	6.9	150	0.81	
Paradise Parkway to Road N. of Deer Valley Road	2820	1750	100	2.2	0.0122	8	7.5	150	0.93	
Road to Junction w/Ridge Road Channel	1170	1768	100	2.4	0.0092	8	7.0	150	0.82	
Along Golf From Deer Valley Road to S. Crossing of Ridge Circle St.	1760	5315	230	3.0	0.0074	8	7.4	275	0.77	
Ridge Circle St. to Outer Loop	550	5330	200	3.6	0.0055	8	7.1	250	0.68	
Outer Loop to South Boundary	4400	5345	200	3.6	0.0055	8	7.1	250	0.68	(2) 4 Foot and (1) 6 Foot Grade Control Structures in this Reach
EAST/WEST CHANNEL SEGMENT 3 Junction West Channel to 64th St.	2050	3476	140	3.4	0.0055	9	6.8	195	0.67	
PINNACLE PEAK ROAD CHANNEL 1750 to 2600 Feet ①	850	1135	50	2.7	0.010	4.5	7.4	75	0.85	① Distance West of Scottsdale Road
2600 to 4300 Feet ①	1700	2214	110	2.5	0.010	4.5	7.5	140	0.86	
4300 to 5200 ①	900	2850	140	2.5	0.010	4.5	7.6	165	0.86	

TABLE 6

SUMMARY OF CHANNEL DESIGN PARAMETERS

n=0.035 z=3:1

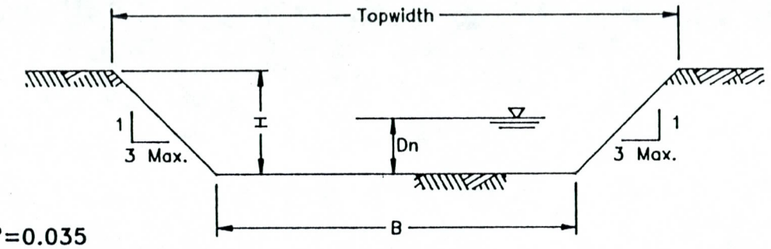
10 YEAR 6-HOUR STORM

DESCRIPTION	REACH LENGTH	Q10 DESIGN (cfs)	B (ft)	Dn (ft)	SLOPE (ft?ft)	Hmax (ft)	VELOCITY (fps)	TOP WIDTH (ft)	FROUDE NO.	REMARKS
SCOTTSDALE ROAD CHANNEL	2,800	3,500	110	2.8	0.018	10	10.7	170	1.28	See note
EAST-WEST CHANNEL, SEGMENT 1										Grade control structure, 4.5' at
Sediment basin to West channel	2,950	2,500	230	2.1	0.006	8	5.2	300	0.71	split #1 and 4.5' at Ridge Road
										existing slope = 0.009
EAST-WEST CHANNEL, SEGMENT 2										
West channel to development										
boundary	1,900	1,300	140	1.7	0.008	8	5.2	200	0.79	2' grade control structure
										existing slope = 0.009
EAST CHANNEL, SEGMENT 1										
Sediment basin to diversion point										grade control structures, 30'
with south channel	6,100	1,300	150	1.6	0.009	8	5.3	200	0.83	over 6 locations
										existing slope = 0.014
EAST CHANNEL, SEGMENT 2										
From diversion point to South channel										grade control structures, 22'
to southern development boundary	7,500	800	100	1.5	0.009	8	5	150	0.82	over 4 locations
										existing slope = 0.012
WEST CHANNEL, SEGMENT 1										
From East-West channel to confluence										grade control structures, 43'
point with South channel	8,600	1,300	150	1.6	0.009	8	5.3	200	0.83	over 6 locations
										exisiting slope = 0.014
WEST CHANNEL, SEGEMNT 2										
From confluence point with South										
channel tosouthern development										grade control structures, 22'
boundary	3,700	1,900	150	2.2	0.006	8	5.4	200	0.72	over 4 locations
										existing slope = 0.012
SOUTH CHANNEL										
From East channel to West channel	3,200	500	100	1.2	0.009	5	4.4	150	0.79	exisitng slope = 0.009
PINNACLE PEAK ROAD CHANNEL										
Segment 1 0 to 850 ft	850	500	50	1.6	0.01	4.5	5.6	75	0.8	Scottsdale Road
Segment 2 850 to 2550 ft	1,700	1,000	110	1.6	0.01	4.5	5.6	140	0.8	
Segment 3 2550 to 3450 ft	900	1,300	140	1.6	0.01	4.5	5.7	165	0.8	

A-N WEST INC.
Consulting Engineers

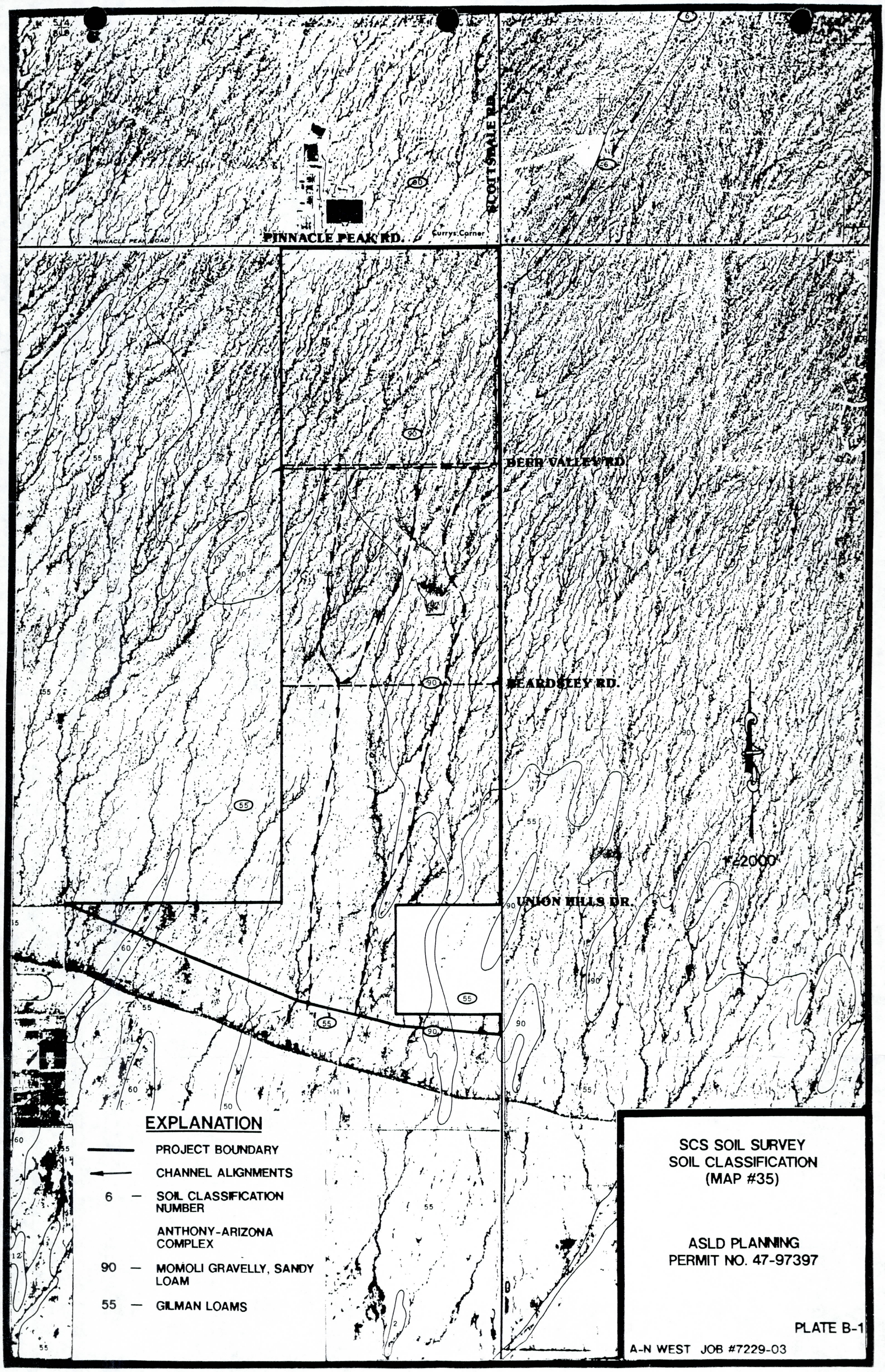
TABLE 6
SUMMARY OF CHANNEL DESIGN PARAMETERS
10 – YEAR STORM

ASLD PLANNING PERMIT NO. 47-97397
DATE: 11/10/93
ANW NO. 7229-03



MANNING'S 'n'=0.035

Description (See Figure 10)	Reach Length (ft)	Q_{100} Design (CFS)	B (FT)	Dn (FT)	Slope (FT/FT)	H Max. (FT)	Vel (FPS)	Topwidth Design (FT)	Fr No.	Remarks
SCOTTSDALE ROAD CHANNEL Electric Line Easement to Sediment Basin	2550	3516	110	2.8	0.018	10	10.7	170	1.17	Additional 15 Foot Each Side of Topwidth Reserved for Maintenance Access and Concrete Lateral Scour Cutoff Wall. 3 Foot Elev. Diff. Grade Controls at 1280 Foot Spacing. Scour Mitigated by Sediment Load in Flow. Q100 Increases to 10258 in Basin From Deer Valley Road Channel to East
EAST CHANNEL Sediment Basin to Grade Control South of Paradise Parkway	3395	746	100	1.4	0.0092	8	5.0	150	0.75	o Foot Grade Control Structure South of Paradise Parkway
Grade Control South of Paradise Parkway to Deer Valley Road along Golf	1970	750	100	1.4	0.0111	8	5.3	150	0.82	
Deer Valley Road to South Boundary	8350	765	100	1.5	0.0092	8	5.1	150	0.76	
EAST/WEST CHANNEL SEGMENT 1 Sediment Basin to Diversion at Ridge Rd.	1350	3046	230	2.7	0.0034	13	4.7	310	0.51	Flow Splits at Diversion to East/West Channel, Segment 2 and Ridge Road Channel.
RIDGE ROAD CHANNEL Diversion to Ridge Run Street	675	1245	155	1.7	0.006	8	4.6	200	0.60	
Ridge Run Street to Paradise Parkway	835	1245	170	1.4	0.0089	7.5	5.0	215	0.74	
Paradise Parkway to Driving Range Grade Control	710	1245	170	1.4	0.0089	7.5	5.0	215	0.74	6 Foot Grade Control Structure Proposed at N. End of Driving Range
Along Driving Range	900	1245	240	1.1	0.011	10	4.7	300	0.79	
South End of Driving Range to Range Road	300	1245	155	1.7	0.006	6	4.6	200	0.63	
Range Road to Ridge Road Along Golf	1520	1245	170	1.4	0.0089	5	5.0	200	0.74	
Ridge Road to Deer Valley Road	530	1249	155	1.7	0.006	8	4.6	200	0.63	
EAST/WEST CHANNEL SEGMENT 2 Diversion at Ridge Road to Junction of West and East/West Channel (Segment 3)	1110	1821	210	1.8	0.0055	12	4.6	280	0.61	4 Foot Grade Control Structure Proposed to Split Flow to West and East/West Channel Segment 3
WEST CHANNEL Junction East/West Channel Segment 2 to Paradise Parkway	1670	607	100	1.3	0.0092	8	4.6	150	0.74	
Paradise Parkway to Road N. of Deer Valley Road	2820	620	100	1.2	0.0122	8	5.1	150	0.84	
Road to Junction w/Ridge Road Channel	1170	627	100	1.3	0.0092	8	5.1	150	0.74	
Along Golf From Deer Valley Road to S. Crossing of Ridge Circle St.	1760	1882	230	1.6	0.0074	8	5.0	275	0.69	
Ridge Circle St. to Outer Loop	550	1885	200	1.9	0.0055	8	4.8	250	0.61	
Outer Loop to South Boundary	4400	1890	200	1.9	0.0055	8	4.8	250	0.61	(2) 4 Foot and (1) 6 Foot Grade Control Structures in this Reach
EAST/WEST CHANNEL SEGMENT 3 Junction West Channel to 64th St.	2050	1229	140	1.8	0.0055	9	4.6	195	0.61	
PINNACLE PEAK ROAD CHANNEL 1750 to 2600 Feet ①	850	508	50	1.7	0.010	4.5	5.5	75	0.89	① Distance West of Scottsdale Road
2600 to 4300 Feet ①	1700	1007	110	1.6	0.010	4.5	5.6	140	0.80	
4300 to 5200 ①	900	1301	140	1.6	0.010	4.5	5.7	165	0.80	


PINNACLE PEAK ROAD
PINNACLE PEAK RD.
Currys Corner
SCOTTSDALE RD.
BEEB VALLEY RD.
BEARDSLEY RD.
UNION HILLS DR.
2000'
EXPLANATION
PROJECT BOUNDARY
CHANNEL ALIGNMENTS
6 — SOIL CLASSIFICATION NUMBER
ANTHONY-ARIZONA COMPLEX
90 — MOMOLI GRAVELLY, SANDY LOAM
55 — GILMAN LOAMS
SCS SOIL SURVEY
SOIL CLASSIFICATION
(MAP #35)
ASLD PLANNING
PERMIT NO. 47-97397
PLATE B-1
A-N WEST JOB #7229-03

10-21

Type of Material: Anthony-Arizo Complex (SCS Soil Survey Map No. 6)

Job No.: ASLD Planning Permit No. 47-97397

Source of Material: Rawhide Wash - From Approximately Pinnacle Peak Road - Upstream

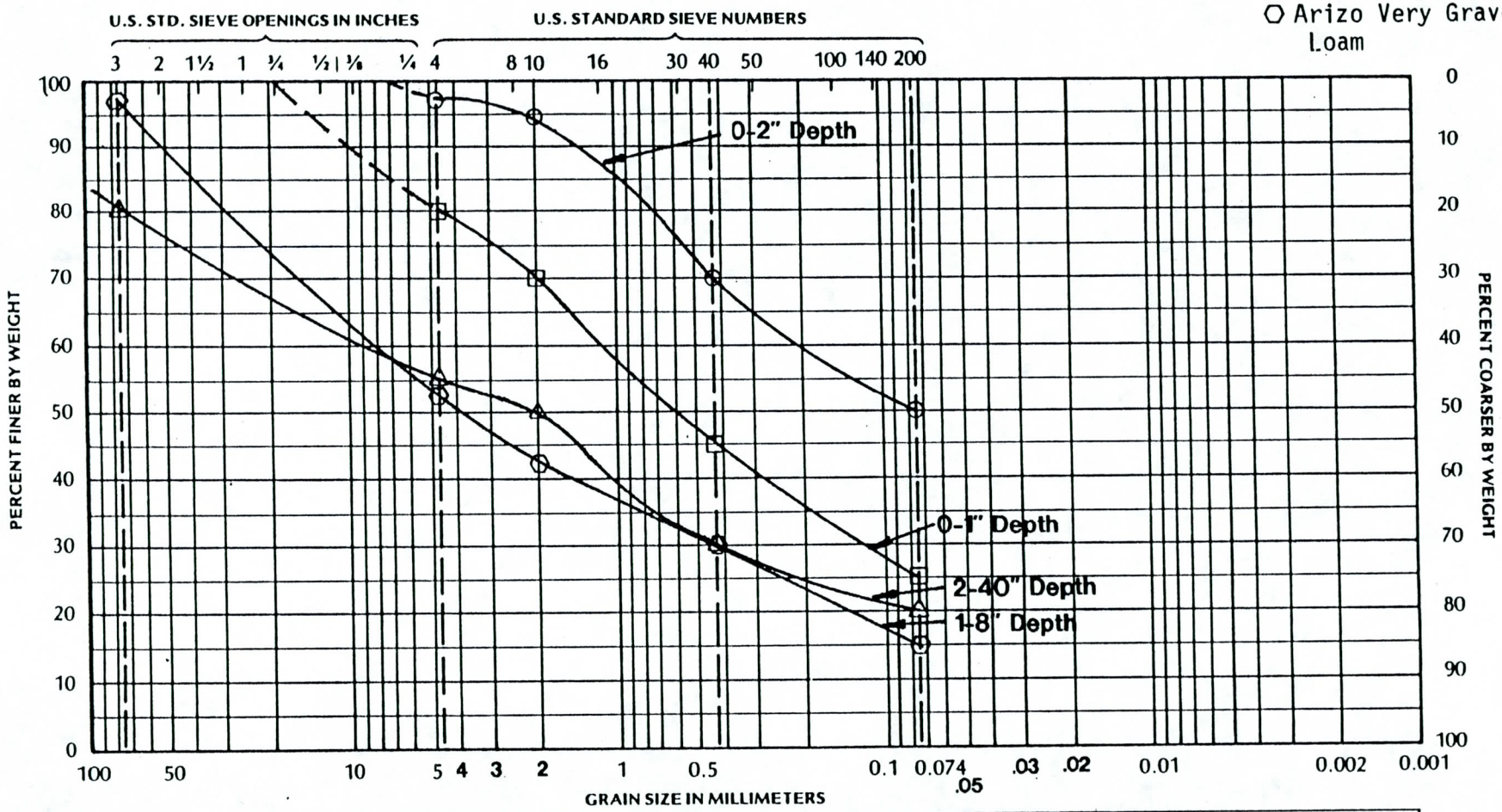
Lab/Inv. No.:

Test Procedure: Source; SCS Soil Survey

Tested/Calc. By: Date:

Reviewed By: Date:

○ Anthony Sandy Loam
△ Anthony Very Gravelly Sandy Loam
□ Arizo Gravelly, Sandy Loam
⬡ Arizo Very Gravelly, Sandy Loam



Unified	Gravel	Coarse Sand	Medium Sand	Fine Sand	Silt or Clay	
AASHTO	Gravel		Coarse Sand	Fine Sand	Silt	Clay

Particle Size, Percent Passing								Atterberg Limits	
2"	1"	½"	#10	#30	#100	0.05 mm		Liquid Limit	P.I.
1½"	¾"	#4	#16	#50	#200	0.002 mm		Plastic Limit	Sp. Gr.

PARTICLE SIZE DISTRIBUTION CHART

PLATE B-2

10-21

ASLD Planning Permit

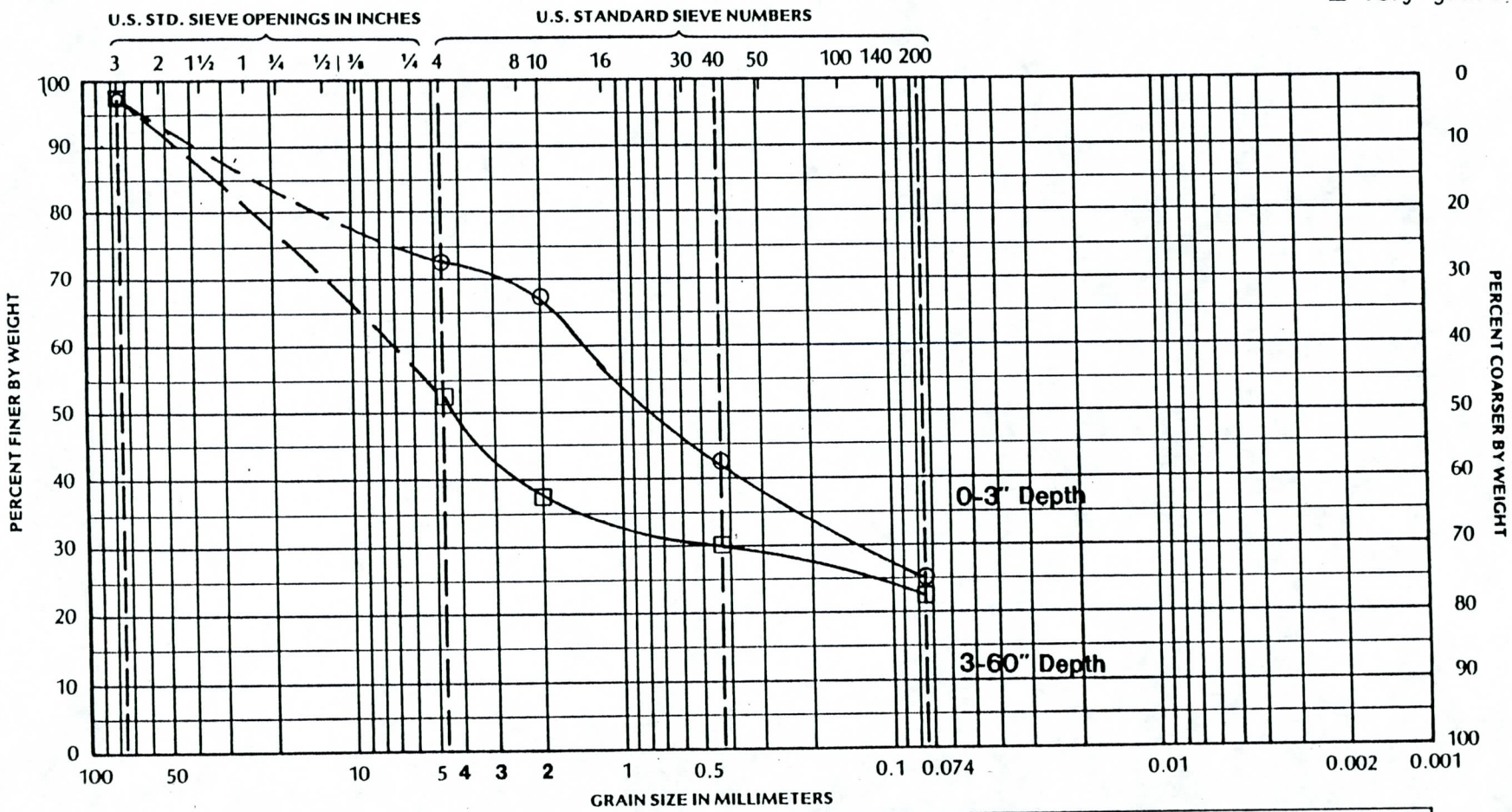
Type of Material Momoli Complex (SCS Soil Survey Map #90) Job No No. 47-97397

Source of Material Eastern and Northern Portions of ASLD Planning Site Lab/Inv. No.

Test Procedure Tested/Calc. By Date

Reviewed By Date

○ Gravelly sandy loam
□ Very gravelly loam



Unified	Gravel	Coarse Sand	Medium Sand	Fine Sand	Silt or Clay	
AASHTO	Gravel		Coarse Sand	Fine Sand	Silt	Clay

Particle Size, Percent Passing								Atterberg Limits	
2"	1"	½"	#10	#30	#100	0.05 mm		Liquid Limit	P.I.
1½"	¾"	#4	#16	#50	#200	0.002 mm		Plastic Limit	Sp. Gr.

PARTICLE SIZE DISTRIBUTION CHART

PLATE B-3

10-21

Type of Material Gilman Complex (SCS Soil Survey Map #55)

Job No. ASLD Planning Permit No. 47-97397

Source of Material Western and Southern Portions of ASLD Planning Site

Lab/Inv. No.

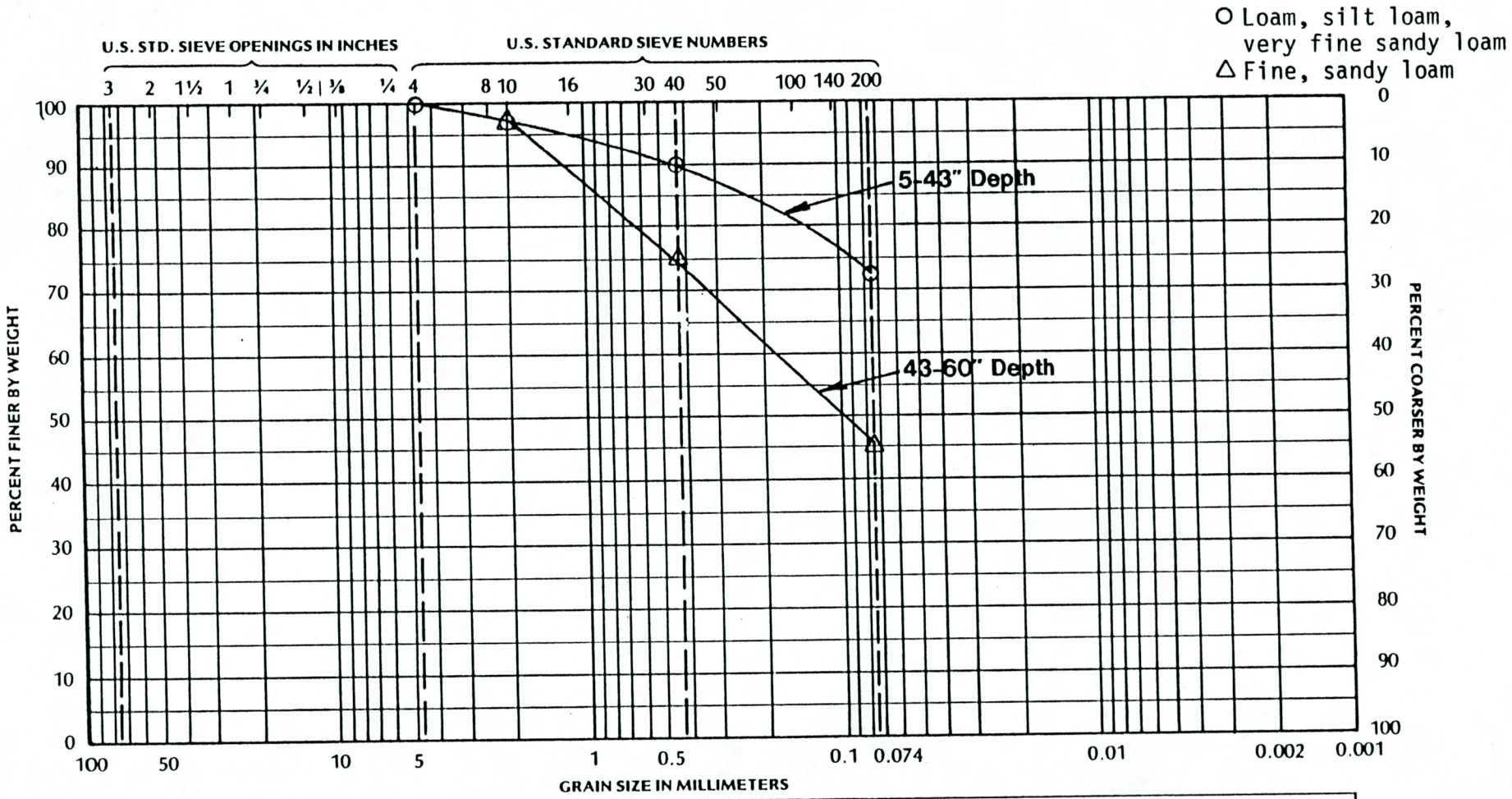
Test Procedure Source: SCS Soil Survey

Tested/Calc. By

Date

Reviewed By

Date

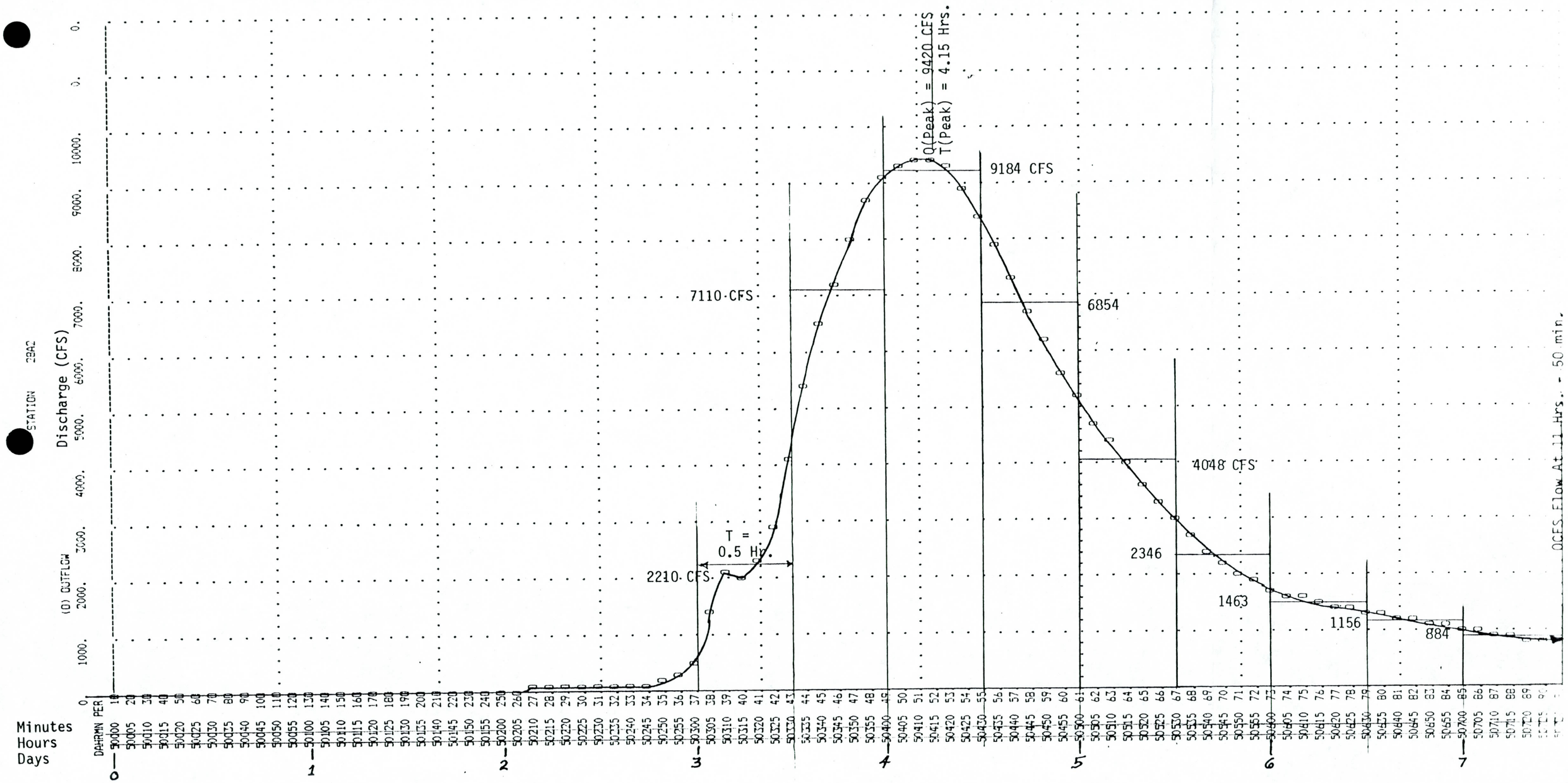


PARTICLE SIZE DISTRIBUTION CHART

Unified	Gravel	Coarse Sand	Medium Sand	Fine Sand	Silt or Clay	
AASHTO	Gravel		Coarse Sand	Fine Sand	Silt	Clay

Particle Size, Percent Passing								Atterberg Limits	
2"	1"	½"	#10	#30	#100	0.05 mm		Liquid Limit	P.I.
1½"	¾"	#4	#16	#50	#200	0.002 mm		Plastic Limit	Sp. Gr.

PLATE B-4

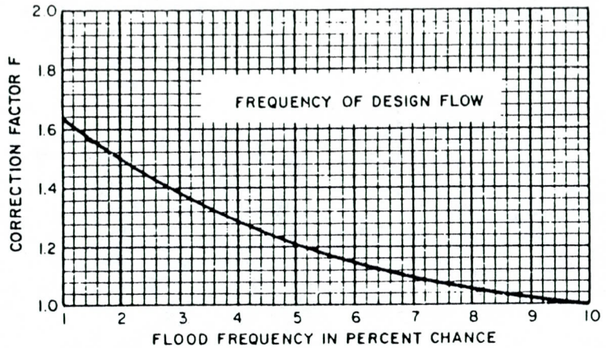


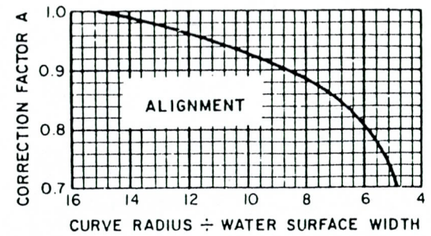
NOTES

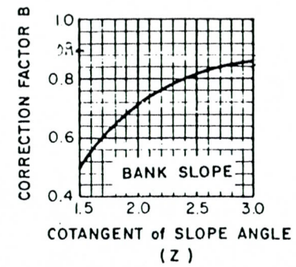
1. Drainage Area = 15.44 Sq. Miles at Pinnacle Peak Road
2. Peak Discharge Based on Aerial Reduction Drainage Area = 19.5 Sq. Miles at Junction with Deer Valley Road Channel
3. Average Discharges for 1/2 Hour Time Increments Superimposed on Hydrograph.

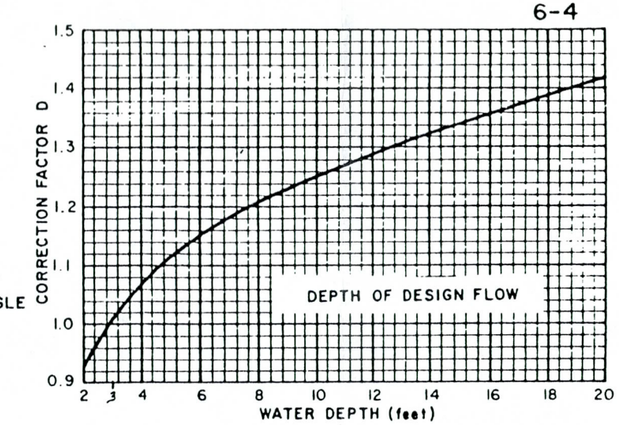
A-N West No. 7229-03
ASLD Planning Permit
No. 47-97-397

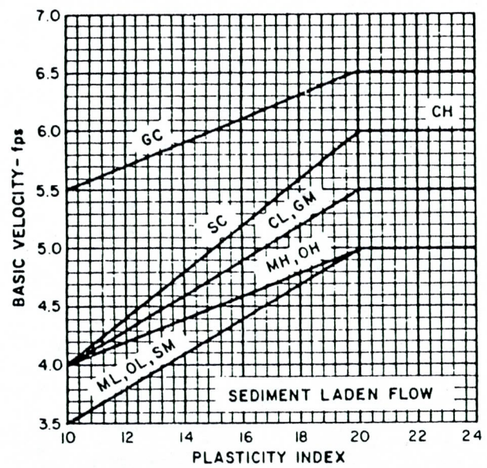
Rawhide Wash 100-Year - 6 Hour Storm Hydrograph at Pinnacle Peak Road



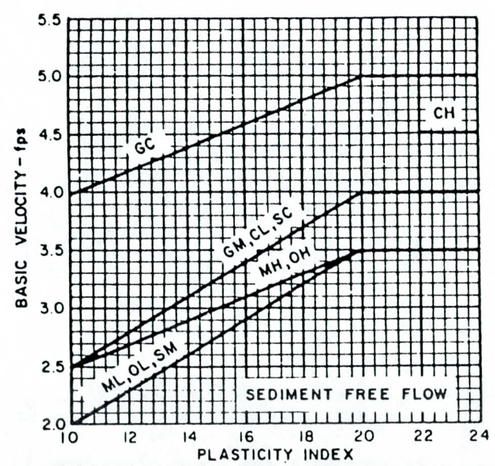




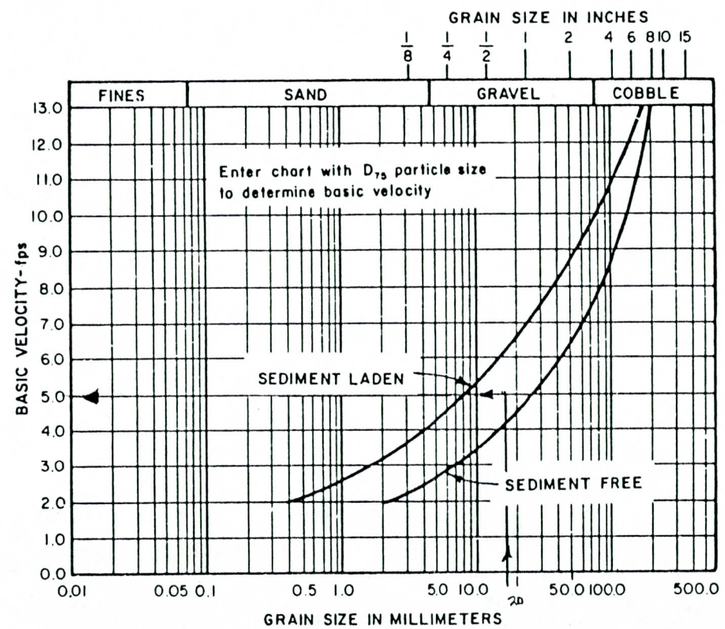




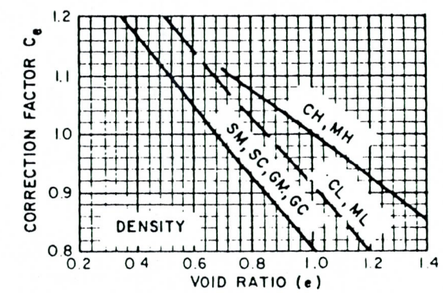
BASIC VELOCITIES FOR COHERENT EARTH MATERIALS (v_b)



BASIC VELOCITIES FOR COHERENT EARTH MATERIALS (v_b)



BASIC VELOCITY FOR DISCRETE PARTICLES OF EARTH MATERIALS (v_b)



NOTES:

1. In no case should the allowable velocity be exceeded when the 10% chance discharge occurs, regardless of the design flow frequency.

A = Alignment Factor
D = Depth Factor
B = Bank Slope Factor

SOURCE: SCS TR-25, OCT.,1977
DESIGN OF OPEN CHANNELS

ALLOWABLE VELOCITIES FOR UNPROTECTED EARTH CHANNELS	
CHANNEL BOUNDARY MATERIALS	ALLOWABLE VELOCITY
DISCRETE PARTICLES	
Sediment Laden Flow	
$D_{75} > 0.4$ mm	Basic velocity chart value x D x A x B
$D_{75} < 0.4$ mm	2.0 fps
Sediment Free Flow	
$D_{75} > 2.0$ mm	Basic velocity chart value x D x A x B
$D_{75} < 2.0$ mm	2.0 fps
COHERENT EARTH MATERIALS	
PI > 10	Basic velocity chart value x D x A x F x C_e
PI < 10	2.0 fps

FIGURE 6-2

ALLOWABLE VELOCITIES
FOR UNPROTECTED EARTH CHANNELS

Revised -

PLATE B-6

247-927 O - 18 (Face blank p. 152)

TABLE 7.11 Permissible velocities for channels lined with grass (Coyle, 1975)

Cover	Slope range,† %	Permissible velocity* Erosion-reresistant soils, ft/s	Easily eroded soils, ft/s
Bermuda grass	0–5	8	6
	5–10	7	5
	Over–10	6	4
Bahia			
Buffalo grass			
Kentucky bluegrass	0–5	7	5
Smooth brome	5–10	6	4
Blue grama	Over–10	5	3
Tall fescue			
Grass mixtures	0–5†	5	4
Reed canary grass	5–10	4	3
Lespedeza sericea			
Weeping lovegrass			
Yellow bluestem			
Redtop	0–5‡	3.5	2.5
Alfalfa			
Red fescue			
Common *Lespedeza*§,¶			
Sudan grass§	0–5	3.5	2.5

*Use velocities exceeding 5 ft/s only where good covers and proper maintenance can be obtained.

†Do not use on slopes steeper than 10% except for vegetated side slopes in combination with a stone, concrete, or highly resistant vegetative center section.

‡Do not use on slopes steeper than 5% except for vegetated side slopes in combination with a stone, concrete, or highly resistant vegetative center section.

§Annuals—use on mild slopes or as temporary protection until permanent covers are established.

¶Use on slopes steeper than 5% is not recommended.

SOURCE:OPEN CHANNEL HYDRAULICS BY RICHARD FRENCH

TABLE 7.5 Maximum permissible velocities as recommended by Fortier and Scobey (1926) for straight channels of small slope and after aging

Material (1)	n^2 (2)	Clear water $\bar{u}$, ft/s (3)	Clear water τ_o, lb/ft^2 (4)	Clear water $\bar{u}$, m/s (5)	Clear water τ_o, N/m^2 (6)	Water transporting colloidal silts $\bar{u}$, ft/s (7)	Water transporting colloidal silts τ_o, lb/ft^2 (8)	Water transporting colloidal silts $\bar{u}$, m/s (9)	Water transporting colloidal silts τ_o, N/m^2 (10)
Fine sand, noncolloidal	0.020	1.50	0.027	0.457	1.29	2.50	0.075	0.762	3.59
Sandy loam, noncolloidal	0.020	1.75	0.037	0.533	1.77	2.50	0.075	0.762	3.59
Silt loam, noncolloidal	0.020	2.00	0.048	0.610	2.30	3.00	0.11	0.914	5.27
Alluvial silts, noncolloidal	0.020	2.00	0.048	0.610	2.30	3.50	0.15	1.07	7.18
Ordinary firm loam	0.020	2.50	0.075	0.762	3.59	3.50	0.15	1.07	7.18
Volcanic ash	0.020	2.50	0.075	0.762	3.59	3.50	0.15	1.07	7.18
Stiff clay, very colloidal	0.025	3.75	0.26	1.14	12.4	5.00	0.46	1.52	22.0
Alluvial silts, colloidal	0.025	3.75	0.26	1.14	12.4	5.00	0.46	1.52	22.0
Shales and hardpans	0.025	6.00	0.67	1.83	32.1	6.00	0.67	1.83	32.1
Fine gravel	0.020	2.50	0.075	0.762	3.59	5.00	0.32	1.52	15.3
Graded loam to cobbles when noncolloidal	0.030	3.75	0.38	1.14	18.2	5.00	0.66	1.52	31.6
Graded silts to cobbles when colloidal	0.030	4.00	0.43	1.22	20.6	5.50	0.80	1.68	38.3
Coarse gravel noncolloidal	0.025	4.00	0.30	1.22	14.4	6.00	0.67	1.83	32.1
Cobbles and shingles	0.035	5.00	0.91	1.52	43.6	5.50	1.10	1.68	52.7

NOTES:

1. The Gilman Loam (Soil I.D. 55) found in the southern and western areas of the study area is estimated as a sandy loam, non-colloidal, as shown above. The average permissible velocity $\bar{u}$ = 2.5 fps for water transporting colloidal silts for this soil.
2. The Momoli gravelly loam (Soil I.D. 90) found in the northern and eastern areas of the study area is estimated as a fine gravel as shown above. The average permissible velocity $\bar{u}$ = 5.0 fps for water transporting colloidal silts for this soil.

SOURCE: OPEN CHANNEL HYDRAULICS BY RICHARD FRENCH

PLATE B-8

HEC-1 INPUT

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LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

   1          ID        FILE:PRMDP1.OUT   DATE 03-10-1994   BY P.A.C.E, INC.
   2          ID        TAKEN FROM FILE MP324IL8.DAT DATED 09/28/93 BY A-N WEST, INC.
   3          ID ******************************************************************************
   4          ID
   5          ID            P.A.C.E. MODIFICATIONS FOR PARADISE RIDGE MASTER DRAINAGE PLAN
   6          ID
   7          ID                    1. Model used was MP324IL8.DAT by A-N WEST dated 09/28/93
   8          ID                    2. Onsite subbasin modifications
   9          ID                    3. Modified flow diversions
  10          ID                    4. Eliminate Ridge Road Channel
  11          ID                    5. South channel connecting East and West channels was put in
  12          ID                       going thru what used to be subbasin 148
  13          ID                    6. Subbasins 27A, 12d, 13d drain into Scottsdale Road Channel
  14          ID                    7. Several modifications south of Union Hills Road including
  15          ID                       the addition of new drainage basins, changes in existing
  16          ID                       basins and routing of Pinnacle Peak Road Channel through
  17          ID                       subbasins 191 and 192
  18          ID
  19          ID ******************************************************************************
  20          ID
  21          ID        *****
  22          ID        THIS FILE MP324IL8.DAT COMBINES MP324IL7.DAT AND LANDM3.DAT TO
  23          ID        INCORPORATE PINN. PEAK RD. CHANNEL FLOWS IN ONE MODEL AND COMBINE
  24          ID        PINN. PEAK RD CHANN. FLOWS WITH EAST/WEST CHANN. SEGMENT 3 FLOWS
  25          ID        WITHIN DESERT RIDGE DEVELOPMENT.
  26          ID        *****
  27          ID        CAUTION !!! THREE (PH) RECORDS LOCATED AT BEGINING OF DECK, AT SUB120
  28          ID        (AFTER SEDBSN),AND AT SUB12D. CHANGE ALL TO MODEL OTHER STORM EVENTS.
  29          ID        *****
  30          ID        THIS FILE COPIED FROM MP324IL2.DAT ON 11/08/93 TO MODEL
  31          ID        DRAINAGE AREA INTERCEPTED BY PINN. PEAK RD.,WEST OF SCOTTSDALE RD.,
  32          ID        AND TO REVISE SUBAREAS IMMEDIADATELY NORTH AND SOUTH OF PINN. PEAK
  33          ID        RD. AND EAST OF SCOTTSDALE RD.
  34          ID        SUB27A AND SUB 27B WERE REVISED TO INCLUDE THE AREA N. OF PINN. PEAK
  35          ID        RD. AND EAST OF SCOTTSDALE RD. THAT WERE EXPECTED TP DRAIN TO
  36          ID        RAWHIDE WASH CHANN. THIS EXCLUDED AREA N. OF LOS PORTONNES DEV. AND
  37          ID        WEST OF RAWHIDE WASH CHANN.
  38          ID        ALSO SUB28 SOUTH OF SCOTTSDALE RD., BETWEEN PINN. PEAK RD. AND DEER
  39          ID        VALLEY RD. WAS ADJUSTED.
  40          ID        ******
  41          ID        THIS FILE;MP324IL2.DAT WAS REVISED  10\25\93 TO ADJUST FLOW SPLIT
  42          ID        AT DVWEST\DVMAIN2.
  43          ID        ******
  44          ID        THIS FILE NO.MP324IL1.DAT WAS COPIED FROM FILE :MP3.24I AS
  45          ID        OBTAINED ON MAR.3,1993 FROM CITY OF SCOTTSDALE
  46          ID        MODIFICATIONS WERE MADE FOR LANDMARK LAND CO.'S PLANNING OF STATE
  47          ID        LAND AT S.E. CORNER OF SCOTTSDALE RD. AND PINNACLE PEAK RD.
  48          ID        THESE MODIFICATIONS INCLUDED CHANGING TO 6-HR. STORM AND HYPOTHETICAL
  49          ID        RAINFALL DISTRIBUTION AND USING NORMAL DEPTH ROUTING METHOD,IN ADDITION
  50          ID        TO ADJUSTING DRAINAGE AREAS TO OBTAIN THE D.A. ENTERING THE LANDMARK
  51          ID        PROPERTY AND RECONFIGURING D.A.'S TO MODEL INTERCEPTION OF THE
  52          ID        DEER VALLEY CHANNEL BY THE SCOTTSDALE RD. CHANNEL
  53          ID
  54          ID        THE FILE:FAN4.GI WAS USED TO OBTAIN COMMON ROUTING REACH DATA, AND
  55          ID        RAINFALL AMTS.
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LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

  56          ID        FILE:FAN4.6I REPRESENTS THE REVISIONS MADE AND ACCEPTED BY FEMA FOR
  57          ID        THE ONGOING FIS OF THE AREA.
  58          ID
  59          ID        UPPER INDIAN BEND WASH REGIONAL FLOOD CONTROL & DRAINAGE PLAN
  60          ID
  61          ID
  62          ID        MODEL MP3.24I -- SUB-BASIN SERIES 7B TO 53.1
  63          ID
  64          ID        THIS IS AN INTEGRATED MASTER PLAN MODEL WITH A NORTH-SOUTH INTERCEPTOR
  65          ID        CHANNEL IN-PLACE ALONG PIMA ROAD FROM POINT 3A TO 3K TO 3L.
  66          ID        ALL CORE NORTH-CORE SOUTH CHANNELS & DETENTION BASINS ARE IN-PLACE.
  67          ID        THE RAWHIDE WASH CHANNEL IS IN-PLACE ALONG ALIGNMENT 4A-4B-4D.
  68          ID        A NORTH-SOUTH INTERCEPTOR CHANNEL IS IN-PLACE ALONG SCOTTSDALE ROAD FROM
  69          ID        POINT 4C TO 4B.
  70          ID
  71          ID        DETENTION BASIN 53R HAS BEEN RECONFIGURED TO REFLECT NEW VOLUMES
  72          ID        & OUTLET DESIGN FROM STANLEY CONSULTANTS (8/10/90)
  73          ID        OUTLET DESIGN WAS SUBSEQUENTLY MODIFIED BY RLW
  74          ID
  75          ID        SUB 33A & CN5 MODIFIED TO REFLECT DRAINAGE SPLIT ON CORRIGAN-MARLEY
  76          ID
  77          ID        FUTURE CONDITION LAND-USE
  78          ID
  79          ID        LOW-FLOW CULVERT DIVERTS ARE SET AT ZERO
  80          ID
  81          ID        100% OF REATA PASS FAN IS DIVERTED WEST TO PIMA ROAD.
  82          ID
  83          ID        RESERVOIR ROUTING OPERATIONS ARE IN-PLACE FOR CAP DIKES 2 & 3.
  84          ID
  85          ID        THIS MODEL REFLECTS ALL D.A. ADJUSTMENTS MADE TO MODEL F3.24I AND FLOW
  86          ID        DIVERSIONS NEAR RAWHIDE WASH APEX & PINNACLE PEAK.
  87          ID        THE TPC GOLF COURSE AND ADJACENT RESIDENTIAL AREAS HAVE BEEN ADDED TO
  88          ID        THE CORE SOUTH AREA.
  89          ID
  90          ID        100-YR, 24-HR STORM, USING SCS TYPE IIA RAINFALL DISTRIBUTION
  91          ID        RAINFALL FROM NOAA ATLAS, USING 25 SQ MI AREAL REDUCTION FACTOR (.968)
  92          ID
  93          ID        FUTURE LAND-USE DENSITIES FROM OCT 1987 GENERAL PLAN, BRW PLANS, AND
  94          ID        THE TONTO FOOTHILLS PLAN,    ALL SCOTTSDALE RESIDENTIAL AREAS HAVE THE
  95          ID        PERCENT OF IMPERVIOUS COVER ADJUSTED FOR NAOS REQUIREMENTS.
              *DIAGRAM
  96          IT       5 05MAR93       0     150
  97          IO       5       0                                                    ***************
              *       *****************
              *       *****************  BEGIN DRAINAGE AREA FOR CAP DIKE NO.2        ***************
              *       *****************

  98          KK   SUB16
  99          KM        RUNOFF FROM SUB-BASIN 16
 100          BA  1.4570
 101          PH              16    0.77    1.51    2.65    3.00    3.23    3.60
 102          LS              63     9.8
 103          UK     217   .0581     .20     100
 104          RK   14800   .0216    .045            TRAP      25       3
```

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LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 105          KK   SUB17
 106          KM        RUNOFF FROM SUB-BASIN 17
 107          BA  1.1851
 108          LS              83      9.8
 109          UK     285   .0421      .20      100
 110          RK   12200   .0254     .045              TRAP       25        3

 111          KK   SUB18
 112          KM        RUNOFF FROM SUB-BASIN 18
 113          BA  1.2041
 114          LS              83      6.5
 115          UK     285   .0421      .20      100
 116          RK   10840   .0259     .045              TRAP       25        3

 117          KK    CP18
 118          KM        COMBINE HYDROGRAPHS SUB16, SUB17, & SUB18
 119          HC       3

 120          KK    RO18
 121          KM        ROUTE CP18 TO CP15
 122          RS       1    FLOW      -1
 123          RC    .055     .04    .055    1100    .0155
 124          RX       0       1     126     132      167      173      298      299
 125          RY      10       8       3       0        0        3        8       10

 126          KK   SUB15
 127          KM        RUNOFF FROM SUB-BASIN 15
 128          BA  1.3702
 129          LS              82      5.4
 130          UK     217   .0581      .20      100
 131          RK   21200   .0236     .045              TRAP       25        3

 132          KK    CP15
 133          KM        COMBINE HYDROGRAPHS SUB15 & RO18
 134          HC       2

 135          KK    RO19
 136          KM        ROUTE CP15 TO CP20
 137          RS       1    FLOW      -1
 138          RC    .055     .04    .055    1800    .020
 139          RX       0       1     151     166      210      231      381      382
 140          RY      10       9       3       0        0        3        9       10

 141          KK   SUB19
 142          KM        RUNOFF FROM SUB-BASIN 19
 143          BA   .1872
 144          LS              84      7.2
 145          UK     275   .0800      .20      100
 146          RK    3730   .0352     .045     .100    TRAP       15        3
 147          RK    1800   .0200     .045             TRAP       50       30
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LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 148          KK   SUB20
 149          KM        RUNOFF FROM SUB-BASIN 20
 150          BA   .5698
 151          LS              84      3.6
 152          UK    300   .0750     .20     100
 153          RK   9640   .0197    .045             TRAP      15       3

 154          KK    CP20
 155          KM        COMBINE HYDROGRAPHS SUB19 , SUB20 AND RO19
 156          HC       3

 157          KK    RO21
 158          KM        ROUTE CP20 TO CP21
 159          RS      13    FLOW      -1
 160          RC    .055     .04    .055   27600   .0196
 161          RX       0       1     201     211     261     271     471     472
 162          RY      10       4       2       0       0       2       4      10

 163          KK   SUB21
 164          KM        RUNOFF FROM SUB-BASIN 21
 165          BA  3.6659
 166          LS              80      6.4
 167          UK    297   .0558     .20     100
 168          RK  27600   .0196    .045             TRAP      50      30

 169          KK    CP21
 170          KM        COMBINE SUB21 AND RO21
 171          HC       2

 172          KK   SUB22
 173          KM        RUNOFF FROM SUB-BASIN 22
 174          BA  1.3800
 175          LS              84      5.1
 176          UK    225   .0590     .20     100
 177          RK  13000   .0238    .045             TRAP      25       3

 178          KK   SUB23
 179          KM        RUNOFF FROM SUB-BASIN 23
 180          BA   .3945
 181          LS              84      6.3
 182          UK    225   .0590     .20     100
 183          RK  10200   .0304    .045             TRAP      20       3

 184          KK    CP23
 185          KM        COMBINE HYDROGRAPHS SUB22 & SUB23
 186          HC       2

 187          KK    RO24
 188          KM        ROUTE CP23 TO CP24
 189          RS       3    FLOW      -1
 190          RC    .055     .04    .055    6800   .0257
 191          RX       0       1     101     107     122     128     228     229
 192          RY      10       8       3       0       0       3       8      10
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HEC-1 INPUT

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LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 193          KK   SUB24
 194          KM        RUNOFF FROM SUB-BASIN 24
 195          BA   .4907
 196          LS              77      6.8
 197          UK     295   .0438      .20      100
 198          RK    6800   .0257     .045              TRAP      15       3

 199          KK    CP24
 200          KM        COMBINE SUB24 AND RO24
 201          HC       2

 202          KK  SUB25N
 203          KM        RUNOFF FROM SUB25N - APEX FAN4B
 204          BA   .7834
 205          LS              84       9
 206          UK     295   .0438      .20      100
 207          RK   16700   .0302     .045              TRAP      25       3

 208          KK  SUB25S
 209          KM        RUNOFF FROM SUB 25S - APEX FAN4A
 210          BA   .6256
 211          LS              86       9
 212          UK     295   .0438      .20      100
 213          RK    6900   .0278     .045              TRAP      25       3

 214          KK    CP25
 215          KM        COMBINE HYDROGRAPHS CP24,SUB25N AND SUB25S
 216          HC       3

 217          KK    RO26
 218          KM        ROUTE CP25 TO CP26
 219          RS       1    FLOW      -1
 220          RC    .055     .04     .055     1400    .0217
 221          RX       0       1      201      211      261      271      471      472
 222          RY      10       4        2        0        0        2        4       10

 223          KK   SUB26
 224          KM        RUNOFF FROM SUB-BASIN 26
 225          BA   .2231
 226          LS              78      6.9
 227          UK     200   .0250      .20      100
 228          RK    1400   .0217     .045              TRAP      60       7

 229          KK    CP26
 230          KM        COMBINE SUB26 AND RO26
 231          HC       2

 232          KK    26.1      DIV
 233          KM        DIVERT FLOW FROM CP26 TO SUB 26A
 234          DT    26.2
 235          DI       0     500     1000    10000
 236          DQ       0     250      500     5000
```

HEC-1 INPUT

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LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 237          KK  RO26.1
 238          KM        ROUTE DIV26.1 TO SUB21 OUTLET  (CP21.1)
 239          RS       5    FLOW      -1
 240          RC    .055     .04    .055   10600   .0263
 241          RX       0       1     201     211     261     271     471     472
 242          RY      10       4       2       0       0       2       4      10

 243          KK  CP21.1
 244          KM        COMBINE CP21 AND RO26.1
 245          HC       2

 246          KK    26.2     RET
 247          KM        RETRIEVE DIVERTED FLOW FROM CP 26
 248          OR    26.2

 249          KK   RO26A
 250          KM        ROUTE DIV26.2 TO SUB26A OUTLET (CP26A)
 251          RS       5    FLOW      -1
 252          RC    .055     .04    .055   10600   .0263
 253          RX       0       1     201     211     261     271     471     472
 254          RY      10       4       2       0       0       2       4      10

 255          KK  SUB26A
 256          KM        RUNOFF FROM SUB 26A
 257          BA   .5251
 258          LS              74    14.5
 259          UK     200   .0250     .20     100
 260          RK   10000   .0263    .045             TRAP      35      10

 261          KK   CP26A
 262          KM        COMBINE CP21.1 & SUB 26A  AND RO26A
 263          HC       3

 264          KK   RO27B
 265          KM        ROUTE CP26A TO CP27B
 266          RS       3    FLOW      -1
 267          RC    .035    .035    .035    .6600   .0227
 268          RX       0       8       9      21     171     183     184     192
 269          RY      10       6       6       0       0       6       6      10

 270          KK  SUB27B
 271          KM        RUNOFF FROM SUB-BASIN 27B
 272          BA    .766
 273          LS              73    35.0
 274          UK     100   .0213     .10     100
 275          RK    7000    .022    .035             TRAP      30     100

 276          KK   CP27B
 277          KM        COMBINE SUB27B & RO27B
 278          HC       2
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HEC-1 INPUT

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LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 279          KK   R028A
 280          KM          ROUTE CP27B TO
 281          KM          PARADISE RIDGE DEVELOPMENT BOUNDARY (CP28A)
 282          RS       1    FLOW      -1
 283          RC    .035    .035    .035    4000    .0227
 284          RX       0      12      22      40      150     108     178     190
 285          RY      10       6       6       0        0       6       6      10

 286          KK  SUB28A
 287          KM          SUBBASIN 28A
 288          BA   0.086
 289          LS               74      38
 290          UK    1000     .01     .15     100
 291          RK    7500    .015     .03             TRAP      25       4

 292          KK   CP28A
 293          KM        COMBINE SUB28A AND R028A
 294          HC       2

 295          KK  SUB27A
 296          KM        SUBBASIN 27A
 297          BA    .085
 298          LS               74      38
 299          UK     100   .0213     .10     100
 300          RK    2200    .022    .025             TRAP      30      10

 301          KK  SUB13D
 302          KM        COMPUTE HYDROGRAPH
 303          BA    .073
 304          LS               74    38.0
 305          UK     100    .030     .10     100
 306          RK    2200    .022    .045             TRAP      30     100

 307          KK   CP13D
 308          KM        COMBINE SUBBASINS 13D & 27A
 309          HC       2

 310          KK   R0162
 311          KM        ROUTE CP13D THROUGH SUBBASIN 162 TO CP162
 312          RS       1    FLOW      -1
 313          RC    .035    .035    .035    2000     .01
 314          RX       0       1       2      17      52      67      68      68
 315          RY       6       5       5       0       0       5       5       6

 316          KK  SUB162
 317          KM        RUNOFF FROM SUB162 A COMMERCIAL SITE
 318          BA    .070
 319          LS               74      90
 320          UK     100     .01      .1     100
 321          RK     600    .018     .02    .013    TRAP      40      10
 322          RK    1000     .01    .035     1.0    TRAP      20       3
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LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 323          KK   CP162
 324          KM        COMBINE RO162 & SUB162
 325          HC       2

 326          KK   RO160
 327          KM        ROUTE CP162 TO CP160
 328          RS       1    FLOW      -1
 329          RC    .035    .035    .035    1200    .018
 330          RX       0      12      22      40     150     168     178     190
 331          RY      10       6       6       0       0       6       6      10

 332          KK  SUB160
 333          KM        RUNOFF FROM SUB160, A COMMERCIAL SITE
 334          BA    .026
 335          LS              74      90
 336          UK     100    .018     .02     100
 337          RK     600    .018     .02    .013    TRAP      40      10
 338          RK    1000     .01    .035     1.0    TRAP      20       3

 339          KK   CP160
 340          KM        COMBINE SUB 160 AND RO160 AND CP28A
 341          HC       3

 342          KK   RO164
 343          KM        ROUTE CP160 DOWN SCOTTSDALE ROAD CHANNEL TO CPDET
 344          RS       1    FLOW      -1
 345          RC    .035    .035    .035    2800    .018
 346          RX       0      12      22      40     150     168     178     190
 347          RY      10       6       6       0       0       6       6      10

 348          KK  SUB164
 349          KM        RUNOFF FROM 164
 350          BA    .044
 351          LS              74
 352          UK     100     .01      .3     100
 353          RK    2800   .0133    .035     1.0    TRAP     110       3

 354          KK   CP164
 355          KM             COMBINE SUBBASIN 164 AND RO164
 356          HC       2

 357          KK  SUB28B
 358          KM        RUNOFF FROM SUB 28B
 359          BA   0.508
 360          LS              74    53.6
 361          UK     100   .0213     .10     100
 362          RK    7000    .022    .035            TRAP      30     100

 363          KK  SUB31B
 364          KM        RUNOFF FROM SUB-BASIN 31B
 365          BA   .9898
 366          LS              74    13.8
 367          UK     102   .0213     .10     100
 368          RK    8800   .0228    .045            TRAP      50     130
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LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 369          KK  SU36L2
 370          KM        RUNOFF FROM SUB 36L2
 371          BA   .1736
 372          LS              74    18.4
 373          UK     110   .0213     .10     100
 374          RK    3000   .0269    .045             TRAP      50     130

 375          KK   CP31B
 376          KM        COMBINE SUB31B AND SUB36L2
 377          HC       2

 378          KK   RO32A
 379          KM        ROUTE CP31B TO CP32A
 380          RS       4    FLOW      -1
 381          RC    .055     .04    .055    8000   .0214
 382          RX       0       1     201     211     261     271     471     472
 383          RY      10       4       2       0       0       2       4      10

 384          KK  SUB32A
 385          KM        RUNOFF FROM SUB-BASIN 32A
 386          BA   .8745
 387          LS              74    20.0
 388          UK      67   .0213     .10     100
 389          RK    8000   .0214    .045             TRAP      50     130

 390          KK   CP32A
 391          KM        COMBINE SUB32A AND RO32A
 392          HC       2

 393          KK   ROCNC
 394          KM    CORE NORTH CHANN.-ROUTE CP32A TO THE INTXN OF SCOTTSDALE AND DEER VALLEY RDS
 395          KM    (CP28B)
 396          RS       1    FLOW      -1
 397          RC    .035    .035    .035    2650   .0125
 398          RX       0       8       9      21      71      83      84      92
 399          RY      10       6       6       0       0       6       6      10

 400          KK   CP28B
 401          KM        COMBINE SUB28B AND ROCNC AT SCOTTSDALE AND DEER VALL RDS.
 402          HC       2

 403          KK   CPDET
 404          KM        COMBINE CP164 & CP28B AT DEER VALLEY RD. AND SCOTTSDALE RD
 405          KM        INFLOW TO SEDIMENT BASIN
 406          HC       2

 407          KK  SEDBSN
 408          KM        ROUTE CPDET THROUGH PROPOSED SEDIMENT BASIN AT SCOTSDALE & DEER VALL.RD
 409          RS       1    STOR       0
 410          SV       0    0.00   11.28   16.65   22.17   27.84   33.64   52.03   65.04   78.04
 411          SQ       0     400    1050    2000    3300    4700    7950   10930   13480   15400
 412          SE  1730.8    1732    1733    1734    1735    1736    1738    1740    1742    1744
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HEC-1 INPUT

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LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 413          KK  DVEAST
 414          KM        DIVERT FLOW INTO EAST CHANNEL & EAST-WEST CHANNEL FROM SEDIMENT BASIN
 415          KM        THROUGH TWO SETS OF BOX CULVERTS EXITING THE SEDIMENT BASIN.
 416          KM        INITIAL FLOWS FROM BASIN WILL GO TO MAIN CHANNEL.
 417          DT  DVMAIN
 418          DI       0     300     900    1500    3000    4500    6000    7500    9000   12000
 419          DQ       0     200     600    1000    2000    3000    4000    5000    6000    8000

 420          KK  ROEAST
 421          KM        ROUTE DVEAST ALONG EAST CHANN. TO CP140
 422          RS       1    FLOW      -1
 423          RC    .035    .035    .035    2300    .009
 424          RX       0      .5       1      25     175     199   199.5     200
 425          RY       8       8       8       0       0       8       8       8

 426          KK  SUB120
 427          KM        RUNOFF FROM SUB 120
 428          BA    .126
 429          PH                     .85    1.55    2.50    2.77    2.90    3.30
 430          LS              74    27.1
 431          UK     100     .01     .15     100
 432          RK    1000    .005     .02    .016    TRAP      40      10
 433          RK    2000   .0003    .035            TRAP     100       3

 434          KK  SUB140
 435          BA    .061
 436          LS              74    21.4
 437          UK     100     .01     .15     100
 438          RK     600    .006     .02    .015    TRAP      40      10
 439          RK    1600   .0055    .035     1.0    TRAP     150       3

 440          KK   CP140
 441          KM        COMBINE SUB120, SUB140 AND ROEAST
 442          HC       3

 443          KK   RO122
 444          KM        ROUTE CP140 ALONG EAST CHANNEL  TO CP122
 445          RS       1    FLOW      -1
 446          RC    .035    .035    .035    3000    .009
 447          RX       0      .5       1      25     175     199   199.5     200
 448          RY       8       8       8       0       0       8       8       8

 449          KK  SUB122
 450          KM        RUNOFF FROM SUB122
 451          BA    .071
 452          LS              74      14
 453          UK     100     .01     .15     100
 454          RK     600    .013     .02   .0142    TRAP      40      10
 455          RK    2000   .0003    .035     1.0    TRAP     100       3
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LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 456          KK  SUB124
 457          KM        RUNOFF FROM SUB124 A COMMERCIAL SITE
 458          BA    .064
 459          LS              74      90
 460          UK     100     .01      .1     100
 461          RK    1500    .013     .02    .021    TRAP      40      10
 462          RK    2000   .0003    .035     1.0    TRAP     100       3

 463          KK  SUB144
 464          KM        RUNOFF FROM SUB144
 465          BA    .204
 466          LS              74    17.6
 467          UK     100     .01     .15     100
 468          RK    1500    .012     .03    .034    TRAP      40      10
 469          RK    1600    .005     .03     1.0    TRAP      40      10

 470          KK   CP122
 471          KM        COMBINE SUB124, SUB144, SUB122 & RO122 AT BEARDSLEY RD AND EAST CHNL
 472          HC       4

 473          KK  RO130D
 474          KM        ROUTE CP122 ALONG EAST CHANNEL  TO DIVERSION POINT, DIV148
 475          RS       1    FLOW      -1
 476          RC    .035    .035    .035     800    .009
 477          RX       0      .5       1      25     175     199   199.5     200
 478          RY       8       8       8       0       0       8       8       8

 479          KK  DIV148
 480          KM        DIVERT FLOW INTO CH148 CHANNEL TOWARDS THE WEST CHANNEL
 481          DT   DV148
 482          DI       0     350    1050    1750    3500    5250    7125    8750    9000   12000
 483          DQ       0     150     450     750    1500    2250    3000    3750    4500    6000

 484          KK   RO130
 485          KM        ROUTE DIV148 ALONG EAST CHANNEL TO OUTER LOOP CP130
 486          RS       2    FLOW      -1
 487          RC    .035    .035    .035    3500    .009
 488          RX       0      .5       1      25     125     149   149.5     150
 489          RY       8       8       8       0       0       8       8       8

 490          KK  SUB130
 491          KM        RUNOFF FROM SUB130
 492          BA    .275
 493          LS              74    46.0
 494          UK     100     .01     .15     100
 495          RK    1600   .0003     .02    .023    TRAP      40      10
 496          RK    3400   .0003    .035     1.0    TRAP     100       3

 497          KK   CP130
 498          KM        COMBINE SUB130 AND RO130 AT OUTER LOOP ON EAST CHANNEL
 499          HC       2
```

HEC-1 INPUT

```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 500          KK   RO134
 501          KM        ROUTE CP130 ALONG EAST CHANNEL TO CP134
 502          RS       1    FLOW      -1
 503          RC    .035    .035    .035    2000    .009
 504          RX       0      .5       1      25     125     149   149.5     150
 505          RY       8       8       8       0       0       8       8       8

 506          KK  SUB134
 507          BA    .180
 508          LS              74    54.5
 509          UK     600     .01     .15     100
 510          RK     000     .01     .02    .019    TRAP      40      10
 511          RK    2000   .0025    .035     1.0    TRAP      12       3

 512          KK   CP134
 513          KM        COMBINE SUB134 AND RO134
 514          HC       2

 515          KK   RO136
 516          KM        ROUTE CP134 ALONG EAST CHANNEL  TO CP136
 517          RS       1    FLOW      -1
 518          RC    .035    .035    .035    2000    .009
 519          RX       0      .5       1      25     125     149   149.5     150
 520          RY       8       8       8       0       0       8       8       8

 521          KK  SUB136
 522          KM        RUNOFF FROM SUB136
 523          BA    .155
 524          LS              74      38
 525          UK     400     .01     .15     100
 526          RK     000   .0007     .02    .026    TRAP      40      10
 527          RK    3000   .0063    .035     1.0    TRAP     100       3

 528          KK   CP136
 529          KM        COMBINE SUB136 AND RO136 AT SOUTH PROPERTY BOUNDARY ON EAST CHANNEL
 530          HC       2

 531          KK  DVMAIN
 532          KM        RETRIEVE DVMAIN (FLOW IN EAST-WEST CHANNEL FROM SEDIMENT BASIN)
 533          DR  DVMAIN

 534          KK  ROMAIN
 535          KM        ROUTE DVMAIN ALONG EAST-WEST CHANNEL TO CP158
 536          RS       1    FLOW      -1
 537          RC    .035    .035    .035    1350    .006
 538          RX       0       0      20      44     274     304     305     306
 539          RY       8       8       8       0       0       8      10      10

 540          KK  SUB158
 541          KM        RUNOFF FROM SUB158
 542          BA    .182
 543          LS              74    23.5
 544          UK     100     .01     .15     100
 545          RK     000    .004     .03    .013    TRAP      40      10
```

HEC-1 INPUT

```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

546           RK    2400    .015     .03     1.0    TRAP      40      10

547           KK   CP158
548           KM        COMBINE ROMAIN, AND SUB158
549           HC       2

550           KK  ROWEST
551           KM        ROUTE CP158  ALONG EAST-WEST CHANNEL TO CP170
552           RS       1    FLOW      -1
553           RC    .035    .035    .035    1600    .006
554           RX       0       6      20      44     274     304     305     306
555           RY       8       8       8       0       0       8      10      10

556           KK  SUB168
557           KM        SUBAREA 168
558           BA    .142
559           LS              74      38
560           UK     100     .01     .15     100
561           RK    1000     .01     .02     .02    TRAP      40      10
562           RK    2400    .013    .035     1.0    TRAP      20       3

563           KK   RO170
564           KM        ROUTE SUB168 TO (CP170) WEST CHANNEL
565           RS       1    FLOW      -1
566           RC    .035    .035    .035    3200   0.015
567           RX       0       2      10      12      32      34      44      46
568           RY       4     2.5       2       0       0       2     2.5       4

569           KK  SUB170
570           KM        SUBBASIN 170
571           BA    .138
572           LS              74    20.3
573           UK     100     .01     .15     100
574           RK     800    .006     .02    .009    TRAP      40      10
575           RK    2600    .016    .035     1.0    TRAP      20       3

576           KK   CP170
577           KM        COMBINE ROWEST,SUB170 AND RO170
578           HC       3

579           KK  DWEST2
580           KM        DIVERT 1/2 OF THE CO171 FLOW SOUTH IN WEST CHANNEL
581           KM        THE REMAINDER WILL BE DIVERTED INTO EAST-WEST CHANNEL
582           DT  DVDVCH
583           DI       0    1000    2000    4000    6000    8000
584           DQ       0     500    1000    2000    3000    4000

585           KK  RWEST2
586           KM        ROUTE DWEST2 ALONG WEST CHANNEL TO CP178
587           RS       1    FLOW      -1
588           RC    .035    .035    .035    1600    .009
589           RX       0       1       2      26     176     200     201     202
590           RY       8       8       8       0       0       8       8       8
```

HEC-1 INPUT

```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

591           KK  SUB172
592           KM        RUNOFF FROM SUB172
593           BA    .097
594           LS              74     19.9
595           UK     100     .01      .15     100
596           RK    1000    .008      .02    .019    TRAP      40       10
597           RK    1400   .0072     .036     1.0    TRAP      80        3

598           KK  SUB178
599           KM        RUNOFF FROM SUB178
600           BA    .121
601           LS              74       38
602           UK     100     .01      .15     100
603           RK    1200   .0067      .02    .015    TRAP      40       10
604           RK    2400    .014      .03     1.0    TRAP      40        3

605           KK   CP178
606           KM        COMBINE SUB172,SUB178 AND RWEST2
607           HC       3

608           KK   RO174
609           KM        ROUTE CP178 TO CP174
610           RS       2    FLOW      -1
611           RC    .035    .035     .035    3800    .009
612           RX       0       1        2      26     176     200      201      202
613           RY       8       8        8       0       0       8        8        8

614           KK  SUB174
615           KM        RUNOFF FROM SUB174
616           BA    .178
617           LS              74     21.5
618           UK     100     .01      .15     100
619           RK    1000    .008      .02    .013    TRAP      40       10
620           RK    4800   .0072     .035     1.0    TRAP      80        3

621           KK   CP174
622           KM        COMBINE SUB174 AND RO174
623           HC       2

624           KK  SUB176
625           KM        RUNOFF FROM SUB176
626           BA    .090
627           LS              74       38
628           UK     100     .01      .15     100
629           RK     650    .006      .02     .01    TRAP      40       10
630           RK    3500     .01     .030     1.0    TRAP      40        3

631           KK   CP176
632           KM        COMBINE CP174 AND SUB176
633           HC       2
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HEC-1 INPUT

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LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 634          KK   R0146
 635          KM        ROUTE CP176 ALONG MAIN CHANNEL  TO OUTER LOOP (CP146)
 636          RS       2    FLOW      -1
 637          RC    .035    .035    .035    3200    .009
 638          RX       0       1       2      26     176     200     201     202
 639          RY       8       8       8       0       0       8       8       8

 640          KK  SUB146
 641          KM        RUNOFF FROM SUB146
 642          BA    .070
 643          LS              74      38
 644          UK     100     .01     .15     100
 645          RK    2200    .012     .03    .006    TRAP      40      10
 646          RK     900   .0055     .03     1.0    TRAP      40      10

 647          KK  SUB148
 648          KM        RUNOFF FROM SUB148
 649          BA    .155
 650          LS              74    29.1
 651          UK     100     .01      .1     100
 652          RK    1500    .012     .03    .006    TRAP      40      10
 653          RK    1500   .0033     .03     1.0    TRAP      40      10

 654          KK  RET148
 655          KM        RETRIEVE OV148
 656          OR   OV148

 657          KK   R0147
 658          KM        ROUTE RET148 THROUGH SUB147 TO WEST CHANNEL (CP147)
 659          RS       1    FLOW      -1
 660          RC    .035    .035    .035    3200    .009
 661          RX       0       1       2      26     126     150     151     152
 662          RY       8       8       8       0       0       8       8       8

 663          KK  SUB147
 664          KM        RUNOFF FROM SUB147
 665          BA    .110
 666          LS              74    29.1
 667          UK     100     .01      .1     100
 668          RK    1500    .012     .03    .006    TRAP      40      10
 669          RK    1500   .0033     .03     1.0    TRAP      40      10

 670          KK   CP147
 671          KM        COMBINE SUB 147 AND R0147 (FLOW RETREIVED FROM RET148)
 672          HC       2

 673          KK   R0148
 674          KM             ROUTE CP147 THROUGHH SUBBASINS 146 & 148 TO CP146
 675          RS       2    FLOW      -1
 676          RC    .035    .035    .035     800   .0055
 677          RX       0       1       2      26     236     260     261     262
 678          RY       8       8       8       0       0       8       8       8
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LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 679          KK   CP146
 680          KM        COMBINE SUB 146, SUB148 RO146 AND RO148
 681          HC       4

 682          KK   RO152
 683          KM        ROUTE CP146 ALONG MAIN CHANNEL FROM OUTER LOOP TO DOWNSTREAM RD (CP152)
 684          RS       1    FLOW      -1
 685          RC    .035    .035     .035    1600     .006
 686          RX       0       1        2      26      176      200      201      202
 687          RY       8       8        8       0        0        8        8        8

 688          KK  SUB150
 689          KM        RUNOFF FROM SUB150
 690          BA    .137
 691          LS              74       38
 692          UK     600     .01      .15     100
 693          RK     300   .0028      .02    .024     TRAP      40       10
 694          RK    2300   .0055     .035     1.0     TRAP     210        3

 695          KK  SUB152
 696          KM        RUNOFF FROM SUB152
 697          BA    .079
 698          LS              74       38
 699          UK     400     .01      .15     100
 700          RK     800    .010      .03   .0135     TRAP      40       10
 701          RK    2000    .005      .03     1.0     TRAP      40       10

 702          KK   CP152
 703          KM        COMBINE RO152, SUB150, AND SUB152
 704          HC       3

 705          KK   RO156
 706          KM        ROUTE CP152 ALONG MAIN CHANNEL TO DOWNSTREAM RD. (CP156)
 707          RS       1    FLOW      -1
 708          RC    .035    .035     .035    2100     .006
 709          RX       0       1        2      26      176      200      201      202
 710          RY       8       8        8       0        0        8        8        8

 711          KK  SUB156
 712          KM        RUNOFF FROM SUB156
 713          BA    .141
 714          LS              74       38
 715          UK     500     .01      .15     100
 716          RK     500    .006      .02    .008     TRAP      40       10
 717          RK    2500   .0055     .035     1.0     TRAP     210        3

 718          KK  SUB190
 719          KM            RUNOFF SUBBASIN 190
 720          BA    .053
 721          LS              74       38
 722          UK     200     .01      .15     100
 723          RK    2200   .0055     .034       1     TRAP     210        3
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LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 724          KK   CP156
 725          KM        COMBINE SUB156, SUB190 AND RO156
 726          HC       3

 727          KK  DVDVCH
 728          KM        RETRIEVE DVDVCH (FLOW SPLIT TO WEST IN CHANNEL TO 64TH ST. ALONG
 729          KM        DEER VALLEY RD. ALIGN.)
 730          DR  DVDVCH

 731          KK  RODVCH
 732          KM        ROUTE DVDVCH ALONG 64TH ST CHANNEL TO CP163
 733          RS       1    FLOW      -1
 734          RC    .035    .035    .035    1100    .008
 735          RX       0       1       2      26     166     190     191     192
 736          RY       8       8       8       0       0       8       8       8

 737          KK  SUB180
 738          KM        RUNOFF FROM SUB180
 739          BA    .090
 740          LS              74    30.0
 741          UK     100     .01     .15     100
 742          RK    1000    .015     .02    .014    TRAP      40      10
 743          RK    1900    .012    .030     1.0    TRAP      40       3

 744          KK   RO182
 745          KM        ROUTE SUB 180 TO 64TH ST. CHANNEL (CP182)
 746          RS       1    FLOW      -1
 747          RC    .035    .035    .035    2200    .011
 748          RX       0       2      10      12      32      34      44      46
 749          RY       4     2.5       2       0       0       2     2.5       4

 750          KK  SUB182
 751          KM        RUNOFF FROM SUB182
 752          BA    .100
 753          LS              74    25.8
 754          UK     100     .01     .15     100
 755          RK    1200    .015     .02    .014    TRAP      40      10
 756          RK    1800    .011    .030     1.0    TRAP      40       3

 757          KK   CP182
 758          KM        COMBINE RO182 AND SUB182
 759          HC       2

 760          KK   CP183
 761          KM        COMBINE RODVCH, AND CP182
 762          HC       2

 763          KK   RO186
 764          KM        ROUTE DVDVCH ALONG 64TH ST CHANNEL TO CP183
 765          RS       1    FLOW      -1
 766          RC    .035    .035    .035     800    .008
 767          RX       0       1       2      26     166     190     191     192
 768          RY       8       8       8       0       0       8       8       8
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HEC-1 INPUT

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LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 769          KK  SUB186
 770          KM        RUNOFF FROM SUB186
 771          BA    .065
 772          LS                 74      38
 773          UK     100      .01     .15     100
 774          RK     500     .006     .02   .0072    TRAP      40      10
 775          RK    2500     .014    .030     1.0    TRAP      40       3

 776          KK   CP186
 777          KM        COMBINE SUB186 AND CP183
 778          HC       2

 779          KK   R0191
 780          KM             ROUTE CP186 TO NORTH END OF SUBBASINS 191 AND 192
 781          RS       1    FLOW      -1
 782          RC    .035    .035    .035   11000   .0063
 783          RX       0       1       2      26     166     190     191     192
 784          RY       8       8       8       0       0       8       8       8

 785          KK   R0192
 786          KM             ROUTE R0191 TO CP192
 787          RS       1    FLOW      -1
 788          RC    .035    .035    .035    1400   .0063
 789          RX       0       1       2      26     166     190     191     192
 790          RY       8       8       8       0       0       8       8       8

 791          KK  SUB191
 792          KM             RUNOFF SUBBASIN 191
 793          BA    .132
 794          LS                 74      38
 795          UK     400      .01     .15     100
 796          RK    2600     .013    .035       1    TRAP      20       3

 797          KK  SUB192
 798          KM             RUNOFF SUBBASIN 192
 799          BA    .063
 800          LS                 74      38
 801          UK     400      .01     .15     100
 802          RK    2400     .013    .035       1    TRAP      20       3

 803          KK   CP192
 804          KM             COMBINE SUBBASINS 191 192 AND R0192
 805          HC       3

 806          KK  SUB12d
 807          KM             SUBBASIN 12D
 808          BA    .552
 809          LS                 74    30.1
 810          UK     100      .03     .10     100
 811          RK    9000     .025    .045             TRAP      30     100
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HEC-1 INPUT

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LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 812          KK  SUB12C
 813          KM        COMPUTE HYDROGRAGH
 814          BA    .354
 815          PH                     .85    1.55     2.5    2.77    2.90     3.3
 816          LS                 74   30.1
 817          UK    100    .030     .10     100
 818          RK   8700    .023    .045            TRAP      30     100

 819          KK   CP12C
 820          KM             COMBINE SUBBASINS 12C 12D
 821          HC       2

 822          KK   RO12C
 823          KM        ROUTE CP12C TO CP13C (PINN. PEAK RD)
 824          RS       2    FLOW      -1
 825          RC    .045     .04    .045    5000     .02
 826          RX       0       2     100     110     140     150     250     252
 827          RY       4     2.5       2       0       0       2     2.5       4

 828          KK  SUB13C
 829          KM        COMPUTE HYDROGRAPH
 830          BA    .120
 831          LS                 74    38.0
 832          UK    100    .030     .10     100
 833          RK   4200    .020    .045            TRAP      30     100

 834          KK   CP13C
 835          KM        COMBINE RO12C AND SUB13C
 836          HC       2

 837          KK  RO13.1
 838          KM        ROUTE CP13.1 ALONG PINN. PEAK RD. WEST  TO CP13.2
 839          RS       1    FLOW      -1
 840          RC    .035    .035    .035     850     .01
 841          RX       0       1       2      17      67      82      83      83
 842          RY       6       5       5       0       0       5       5       6

 843          KK  SUB12B
 844          KM        COMPUTE HYDROGRAPH
 845          BA   0.914
 846          LS                 74    30.1
 847          UK    100    .030     .10     100
 848          RK  13700    .024    .045            TRAP      40     100

 849          KK   RO12B
 850          KM        ROUTE SUB12B TO CP13B (TO PINNACLE PEAK ROAD)
 851          RS       4    FLOW      -1
 852          RC    .045     .04    .045    7500     .02
 853          RX       0       2     100     110     140     150     250     252
 854          RY       4     2.5       2       0       0       2     2.5       4
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HEC-1 INPUT

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LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

855           KK  SUB13B
856           KM        COMPUTE HYDROGRAPH
857           BA    .383
858           LS                 74     38.0
859           UK     100     .030      .10      100
860           RK    7200     .020     .045              TRAP      30      100

861           KK   CP13B
862           KM         COMBINE RO12B AND SUB13B
863           HC       2

864           KK  CP13.2
865           KM        COMBINE CP13.1 AND CP13B
866           HC       2

867           KK  RO13.2
868           KM        ROUTE CP13.2 ALONG PINN. PEAK RD IN PROPOSED CHANNEL TO CP13.2
869           RS       1    FLOW      -1
870           RC    .035    .035    .035    1700     .01
871           RX       0       1       2      17     127     142     143     144
872           RY       6       5       5       0       0       5       5       6

873           KK  SUB12A
874           KM        COMPUTE HYDROGRAPH
875           BA    .471
876           LS                 74     30.1
877           UK     100     .03      .10      100
878           RK   11000    .024     .045              TRAP      30      100-

879           KK   RO12A
880           KM        ROUTE SUB12A TO CP13A (PINNACLE PEAK ROAD)
881           RS       5    FLOW      -1
882           RC    .045     .04    .045   10000     .02
883           RX       0       2     100     110     140     150     250     252
884           RY       4     2.5       2       0       0       2     2.5       4

885           KK  SUB13A
886           KM        COMPUTE HYDROGRAPH
887           BA    .303
888           LS                 74      38
889           UK     100     .030      .10      100
890           RK   10000     .020     .045              TRAP      30      100

891           KK   CP13A
892           KM        COMBINE RO12A AND SUB13A
893           HC       2

894           KK  CP13.3
895           KM        COMBINE CP13A AND RO13.2 AT PINN. PEAK RD. NEAR 64 TH ST.
896           HC       2
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HEC-1 INPUT

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LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 897          KK  R013.3
 898          KM        ROUTE CP13.3 ALONG PINN. PEAK RD. WEST  TO DEVELOPMENT BOUNDARY
 899          RS      1    FLOW      -1
 900          RC   .035    .035    .035     900     .01
 901          RX      0       1       2      17     157     152     153     153
 902          RY      6       5       5       0       0       5       5       6

 903          KK  SUB184
 904          KM        RUNOFF FROM SUB184. ONSITE FLOW NORTH OF PROP. PARADISE PARKWAY , WEST
 905          KM        OF RIDGE RD.
 906          BA   .160
 907          LS              74      38
 908          UK    100     .01     .15     100
 909          RK    800     .01     .02    .009    TRAP      40      10
 910          RK   2000    .016     .03     1.0    TRAP      40       3

 911          KK   R0184
 912          KM        ROUTE SUB184 TO PARADISE RIDGE BOUNDARY
 913          RS      1    FLOW      -1
 914          RC   .035    .035    .035     600    .006
 915          RX      0       1       2      17      42      57      58      59
 916          RY      5       5       5       0       0       5       5       5
 917          ZZ
```

SCHEMATIC DIAGRAM OF STREAM NETWORK

```
INPUT
 LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

 NO.       (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

  98       SUB16
             .
             .
 105         .       SUB17
             .          .
             .          .
 111         .          .       SUB18
             .          .          .
             .          .          .
 117       CP18.......................
             V
             V
 120       RO18
             .
             .
 126         .       SUB15
             .          .
             .          .
 132       CP15............
             V
             V
 135       RO19
             .
             .
 141         .       SUB19
             .          .
             .          .
 148         .          .       SUB20
             .          .          .
             .          .          .
 154       CP20.......................
             V
             V
 157       RO21
             .
             .
 163         .       SUB21
             .          .
             .          .
 169       CP21............
             .
             .
 172         .       SUB22
             .          .
             .          .
 178         .          .       SUB23
             .          .          .
             .          .          .
 184         .       CP23............
             .          V
             .          V
 187         .       RO24
             .          .
             .          .
 193         .          .       SUB24
             .          .          .
             .          .          .
 199         .       CP24............
             .          .
             .          .
 202         .          .       SUB25N
             .          .          .
             .          .          .
 208         .          .          .       SUB25S
             .          .          .          .
             .          .          .          .
 214         .       CP25.......................
             .          V
             .          V
 217         .       RO26
             .          .
             .          .
 223         .          .       SUB26
             .          .          .
             .          .          .
 229         .       CP26............
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                .          .
                .          .
234             .          .-------->   26.2
232             .      26.1
                .        V
                .        V
237             .    R026.1
                .          .
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243         CP21.1..........
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                .
248             .          .<--------   26.2
246             .      26.2
                .        V
                .        V
249             .     R026A
                .          .
                .          .
255             .          .     SUB26A
                .          .          .
                .          .          .
261         CP26A......................
                V
                V
264         R027B
                .
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270             .     SUB27B
                .          .
                .          .
276         CP27B...........
                V
                V
279         R028A
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286             .     SUB28A
                .          .
                .          .
292         CP28A...........
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295             .     SUB27A
                .          .
                .          .
301             .          .     SUB13D
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                .          .          .
307             .     CP13D...........
                .        V
                .        V
310             .     R0162
                .          .
                .          .
316             .          .     SUB162
                .          .          .
                .          .          .
323             .     CP162...........
                .        V
                .        V
326             .     R0160
                .          .
                .          .
332             .          .     SUB160
                .          .          .
                .          .          .
339         CP160......................
                V
                V
342         R0164
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348             .     SUB164
                .          .
                .          .
354         CP164...........
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357             .     SUB28B
                .          .
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363             .          .     SUB31B
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369                                   SU36L2
375                          CP31B............
                                V
                                V
378                          R032A
384                                   SUB32A
390                          CP32A............
                                V
                                V
393                          R0CNC
400                   CP28B............
403            CPDET............
                  V
                  V
407            SEDBSN
417                   -------> DVMAIN
413            DVEAST
                  V
                  V
420            R0EAST
426                   SUB120
434                                SUB140
440            CP140........................
                  V
                  V
443            R0122
449                   SUB122
456                                SUB124
463                                      SUB144
470            CP122.....................................
                  V
                  V
473            R0130D
481                   -------> DV148
479            DIV148
                  V
                  V
484            R0130
490                   SUB130
497            CP130............
                  V
                  V
500            R0134
506                   SUB134
512            CP134............
                  V
                  V
515            R0136
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521             .       SUB130
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                .          .
528         CP130............
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533             .          .<-------  DVMAIN
531             .       DVMAIN
                .          V
                .          V
534             .       ROMAIN
                .          .
                .          .
540             .          .      SUB150
                .          .         .
                .          .         .
547             .      CP150............
                .          V
                .          V
550             .       ROWEST
                .          .
                .          .
556             .          .      SUB160
                .          .         V
                .          .         V
563             .          .      RO170
                .          .         .
                .          .         .
569             .          .         .      SUB170
                .          .         .         .
                .          .         .         .
576             .      CP170........................
                .          .
                .          .
582             .          .------->  DVDVCH
579             .       DWEST2
                .          V
                .          V
585             .       RWEST2
                .          .
                .          .
591             .          .      SUB172
                .          .         .
                .          .         .
598             .          .         .      SUB178
                .          .         .         .
                .          .         .         .
605             .      CP178........................
                .          V
                .          V
608             .      RO174
                .          .
                .          .
614             .          .      SUB174
                .          .         .
                .          .         .
621             .      CP174............
                .          .
                .          .
624             .          .      SUB176
                .          .         .
                .          .         .
631             .      CP176............
                .          V
                .          V
634             .      RO146
                .          .
                .          .
640             .          .      SUB146
                .          .         .
                .          .         .
647             .          .         .      SUB148
                .          .         .         .
                .          .         .         .
650             .          .         .         .          .<-------   DV148
654             .          .         .         .      RET148
                .          .         .         .          V
                .          .         .         .          V
657             .          .         .         .      RO147
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663                                                  SUB147
670                                          CP147............
                                                V
                                                V
673                                          R0148
679   CP146.................................
          V
          V
682   R0152
688                 SUB150
695                           SUB152
702   CP152........................
          V
          V
705   R0156
711                 SUB150
718                           SUB190
724   CP150........................
                            <-------- DVDVCH
730                 DVDVCH
727                     V
                        V
731                 RODVCH
737                           SUB180
                                  V
                                  V
744                           R0182
                                                SUB182
750
757                           CP182............
760                 CP183............
                        V
                        V
763                 R0186
769                           SUB186
776                 CP186............
                        V
                        V
779                 R0191
                        V
                        V
785                 R0192
791                           SUB191
                                                SUB192
797
803                 CP192........................
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806   .   .   .   SUB12D
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      .   .   .     .
812   .   .   .     .       SUB12C
      .   .   .     .         .
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819   .   .   .   CP12C............
      .   .   .     V
      .   .   .     V
822   .   .   .   RO12C
      .   .   .     .
      .   .   .     .
828   .   .   .     .       SUB13C
      .   .   .     .         .
      .   .   .     .         .
834   .   .   .   CP13C............
      .   .   .     V
      .   .   .     V
837   .   .   .   RO13.1
      .   .   .     .
      .   .   .     .
843   .   .   .     .       SUB12B
      .   .   .     .         V
      .   .   .     .         V
849   .   .   .     .       RO12B
      .   .   .     .         .
      .   .   .     .         .
855   .   .   .     .         .       SUB13B
      .   .   .     .         .         .
      .   .   .     .         .         .
861   .   .   .     .       CP13B............
      .   .   .     .         .
      .   .   .     .         .
864   .   .   .   CP13.2............
      .   .   .     V
      .   .   .     V
867   .   .   .   RO13.2
      .   .   .     .
      .   .   .     .
873   .   .   .     .       SUB12A
      .   .   .     .         V
      .   .   .     .         V
879   .   .   .     .       RO12A
      .   .   .     .         .
      .   .   .     .         .
885   .   .   .     .         .       SUB13A
      .   .   .     .         .         .
      .   .   .     .         .         .
891   .   .   .     .       CP13A............
      .   .   .     .         .
      .   .   .     .         .
894   .   .   .   CP13.3............
      .   .   .     V
      .   .   .     V
897   .   .   .   RO13.3
      .   .   .     .
      .   .   .     .
903   .   .   .     .       SUB184
      .   .   .     .         V
      .   .   .     .         V
911   .   .   .     .       RO184
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(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

HEC1 S/N: 1333000003 HMVersion: 6.40 Data File: prmdp1.HC1

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****************************************
*                                      *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *
*          SEPTEMBER 1990              *
*            VERSION 4.0               *
*                                      *
* RUN DATE  03/17/1994  TIME  15:17:41 *
*                                      *
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*                                      *
*   U.S. ARMY CORPS OF ENGINEERS       *
*   HYDROLOGIC ENGINEERING CENTER      *
*         609 SECOND STREET            *
*      DAVIS, CALIFORNIA 95616         *
*          (916) 756-1104              *
*                                      *
****************************************
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FILE:PRMDP1.OUT DATE 03-10-1994 BY P.A.C.E, INC.
TAKEN FROM FILE MP324IL8.DAT DATED 09/28/93 BY A-N WEST, INC.

****

P.A.C.E. MODIFICATIONS FOR PARADISE RIDGE MASTER DRAINAGE PLAN

1. Model used was MP324IL8.DAT by A-N WEST dated 09/28/93
2. Onsite subbasin modifications
3. Modified flow diversions
4. Eliminate Ridge Road Channel
5. South channel connecting East and West channels was put in going thru what used to be subbasin 148
6. Subbasins 27A, 12d, 13d drain into Scottsdale Road Channel
7. Several modifications south of Union Hills Road including the addition of new drainage basins, changes in existing basins and routing of Pinnacle Peak Road Channel through subbasins 191 and 192

****

*****
THIS FILE MP324IL8.DAT COMBINES MP324IL7.DAT AND LANDM3.DAT TO
INCORPORATE PINN. PEAK RD. CHANNEL FLOWS IN ONE MODEL AND COMBINE
PINN. PEAK RD CHANN. FLOWS WITH EAST/WEST CHANN. SEGMENT 3 FLOWS
WITHIN DESERT RIDGE DEVELOPMENT.
*****
CAUTION !!! THREE (PH) RECORDS LOCATED AT BEGINING OF DECK, AT SUB12C
(AFTER SEDBSN),AND AT SUB12D. CHANGE ALL TO MODEL OTHER STORM EVENTS.
*****
THIS FILE COPIED FROM MP324IL2.DAT ON 11/08/93 TO MODEL
DRAINAGE AREA INTERCEPTED BY PINN. PEAK RD.,WEST OF SCOTTSDALE RD.,
AND TO REVISE SUBAREAS IMMEDIADATELY NORTH AND SOUTH OF PINN. PEAK
RD. AND EAST OF SCOTTSDALE RD.
SUB27A AND SUB 27B WERE REVISED TO INCLUDE THE AREA N. OF PINN. PEAK
RD. AND EAST OF SCOTTSDALE RD. THAT WERE EXPECTED TP DRAIN TO
RAWHIDE WASH CHANN. THIS EXCLUDED AREA N. OF LOS PORTONNES DEV. AND
WEST OF RAWHIDE WASH CHANN.
ALSO SUB28 SOUTH OF SCOTTSDALE RD., BETWEEN PINN. PEAK RD. AND DEER
VALLEY RD. WAS ADJUSTED.
******
THIS FILE;MP324IL2.DAT WAS REVISED 10\25\93 TO ADJUST FLOW SPLIT
AT DVWEST\DVMAIN2.
******
THIS FILE NO.MP324IL1.DAT WAS COPIED FROM FILE :MP3.24I AS
OBTAINED ON MAR.3,1993 FROM CITY OF SCOTTSDALE
MODIFICATIONS WERE MADE FOR LANDMARK LAND CO.'S PLANNING OF STATE
LAND AT S.E. CORNER OF SCOTTSDALE RD. AND PINNACLE PEAK RD.
THESE MODIFICATIONS INCLUDED CHANGING TO 6-HR. STORM AND HYPOTHETICAL
RAINFALL DISTRIBUTION AND USING NORMAL DEPTH ROUTING METHOD,IN ADDITION
TO ADJUSTING DRAINAGE AREAS TO OBTAIN THE D.A. ENTERING THE LANDMARK
PROPERTY AND RECONFIGURING D.A.'S TO MODEL INTERCEPTION OF THE
DEER VALLEY CHANNEL BY THE SCOTTSDALE RD. CHANNEL

THE FILE:FAN4.6I WAS USED TO OBTAIN COMMON ROUTING REACH DATA, AND
RAINFALL AMTS.
FILE:FAN4.6I REPRESENTS THE REVISIONS MADE AND ACCEPTED BY FEMA FOR
THE ONGOING FIS OF THE AREA.

UPPER INDIAN BEND WASH REGIONAL FLOOD CONTROL & DRAINAGE PLAN

MODEL MP3.24I -- SUB-BASIN SERIES 7B TO 53.1

THIS IS AN INTEGRATED MASTER PLAN MODEL WITH A NORTH-SOUTH INTERCEPTOR
CHANNEL IN-PLACE ALONG PIMA ROAD FROM POINT 3A TO 3K TO 3L.
ALL CORE NORTH-CORE SOUTH CHANNELS & DETENTION BASINS ARE IN-PLACE.
THE RAWHIDE WASH CHANNEL IS IN-PLACE ALONG ALIGNMENT 4A-4B-4D.
A NORTH-SOUTH INTERCEPTOR CHANNEL IS IN-PLACE ALONG SCOTTSDALE ROAD FROM
POINT 4C TO 4B.

DETENTION BASIN 53R HAS BEEN RECONFIGURED TO REFLECT NEW VOLUMES
& OUTLET DESIGN FROM STANLEY CONSULTANTS (8/10/90)
OUTLET DESIGN WAS SUBSEQUENTLY MODIFIED BY RLW

SUB 33A & CN5 MODIFIED TO REFLECT DRAINAGE SPLIT ON CORRIGAN-MARLEY

FUTURE CONDITION LAND-USE

LOW-FLOW CULVERT DIVERTS ARE SET AT ZERO

100% OF REATA PASS FAN IS DIVERTED WEST TO PIMA ROAD.

RESERVOIR ROUTING OPERATIONS ARE IN-PLACE FOR CAP DIKES 2 & 3.

THIS MODEL REFLECTS ALL D.A. ADJUSTMENTS MADE TO MODEL F3.24I AND FLOW
DIVERSIONS NEAR RAWHIDE WASH APEX & PINNACLE PEAK.
THE TPC GOLF COURSE AND ADJACENT RESIDENTIAL AREAS HAVE BEEN ADDED TO
THE CORE SOUTH AREA.

100-YR, 24-HR STORM, USING SCS TYPE IIA RAINFALL DISTRIBUTION
RAINFALL FROM NOAA ATLAS, USING 25 SQ MI AREAL REDUCTION FACTOR (.968)

FUTURE LAND-USE DENSITIES FROM OCT 1987 GENERAL PLAN, BRW PLANS, AND
THE TONTO FOOTHILLS PLAN, ALL SCOTTSDALE RESIDENTIAL AREAS HAVE THE
PERCENT OF IMPERVIOUS COVER ADJUSTED FOR NAOS REQUIREMENTS.

```
37 IO        OUTPUT CONTROL VARIABLES
                 IPRNT          5  PRINT CONTROL
                 IPLOT          0  PLOT CONTROL
                 QSCAL         0.  HYDROGRAPH PLOT SCALE

   IT        HYDROGRAPH TIME DATA
                  NMIN          5  MINUTES IN COMPUTATION INTERVAL
                 IDATE     5MAR93  STARTING DATE
                 ITIME       0000  STARTING TIME
                    NQ        150  NUMBER OF HYDROGRAPH ORDINATES
               NDDATE     5MAR93  ENDING DATE
               NDTIME       1225  ENDING TIME
                 ICENT         19  CENTURY MARK

          COMPUTATION INTERVAL     .08 HOURS
               TOTAL TIME BASE   12.42 HOURS

     ENGLISH UNITS
          DRAINAGE AREA          SQUARE MILES
          PRECIPITATION DEPTH    INCHES
          LENGTH, ELEVATION      FEET
          FLOW                   CUBIC FEET PER SECOND
          STORAGE VOLUME         ACRE-FEET
          SURFACE AREA           ACRES
          TEMPERATURE            DEGREES FAHRENHEIT

*** FDKRUT - NEWTON RAPHSON FAILEDFIXED POINT ITERATION USED - ITERATION-  1
```

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
HYDROGRAPH AT	SUB16	2476.	3.33	313.	152.	152.	1.46		
HYDROGRAPH AT	SUB17	2016.	3.25	255.	124.	124.	1.19		
HYDROGRAPH AT	SUB18	2250.	3.25	265.	129.	129.	1.26		
3 COMBINED AT	CP18	6700.	3.25	833.	406.	406.	3.91		
ROUTED TO	R018	6752.	3.33	833.	406.	406.	3.91	6.86	3.33
HYDROGRAPH AT	SUB15	1774.	3.42	273.	133.	133.	1.37		
2 COMBINED AT	CP15	8319.	3.33	1106.	539.	539.	5.28		
ROUTED TO	R019	7934.	3.42	1106.	539.	539.	5.28	5.91	3.42
HYDROGRAPH AT	SUB19	416.	3.25	41.	20.	20.	.19		
HYDROGRAPH AT	SUB20	1005.	3.25	121.	59.	59.	.57		
3 COMBINED AT	CP20	9172.	3.33	1269.	618.	618.	6.03		
ROUTED TO	R021	5605.	4.33	1254.	617.	617.	6.03	4.20	4.33
HYDROGRAPH AT	SUB21	2671.	3.92	679.	334.	334.	3.67		
2 COMBINED AT	CP21	7150.	4.33	1924.	950.	950.	9.70		
HYDROGRAPH AT	SUB22	2622.	3.25	299.	145.	145.	1.39		
HYDROGRAPH AT	SUB23	729.	3.25	86.	42.	42.	.39		
2 COMBINED AT	CP23	3351.	3.25	385.	187.	187.	1.78		
ROUTED TO	R024	2733.	3.42	385.	187.	187.	1.78	5.45	3.42
HYDROGRAPH AT	SUB24	647.	3.25	82.	40.	40.	.49		
2 COMBINED AT	CP24	3253.	3.42	467.	227.	227.	2.27		
HYDROGRAPH AT	SUB25N	1177.	3.42	173.	84.	84.	.76		
HYDROGRAPH AT	SUB25S	1326.	3.25	148.	72.	72.	.63		
3 COMBINED AT	CP25	5302.	3.42	787.	384.	384.	3.66		
ROUTED TO	R026	5187.	3.42	787.	383.	383.	3.66	4.01	3.42
HYDROGRAPH AT	SUB26	370.	3.17	39.	19.	19.	.22		
2 COMBINED AT	CP26	5383.	3.42	826.	402.	402.	3.90		
DIVERSION TO	26.2	2692.	3.42	413.	201.	201.	3.90		
HYDROGRAPH AT	26.1	2692.	3.42	413.	201.	201.	3.90		
ROUTED TO	R026.1	2271.	3.83	412.	201.	201.	3.90	2.86	3.83
2 COMBINED AT	CP21.1	8074.	4.25	2336.	1151.	1151.	13.60		
HYDROGRAPH AT	26.2	2692.	3.42	413.	201.	201.	.00		
ROUTED TO	R026A	2271.	3.83	412.	201.	201.	.00	2.86	3.83
HYDROGRAPH AT	SUB26A	563.	3.42	87.	43.	43.	.53		
3 COMBINED AT	CP26A	9357.	4.17	2834.	1395.	1395.	14.13		
ROUTED TO	R027B	9311.	4.25	2827.	1394.	1394.	14.13	3.87	4.25
HYDROGRAPH AT	SUB27B	1259.	3.25	164.	80.	80.	.77		
2 COMBINED AT	CP27B	9452.	4.25	2968.	1474.	1474.	14.89		
ROUTED TO	R028A	9442.	4.25	2963.	1473.	1473.	14.89	4.02	4.25
HYDROGRAPH AT	SUB28A	75.	3.67	18.	9.	9.	.09		
2 COMBINED AT	CP28A	9485.	4.25	2982.	1482.	1482.	14.98		

HYDROGRAPH AT	SUB27A	213.	3.08	19.	9.	9.	.09		
HYDROGRAPH AT	SUB13D	155.	3.17	16.	8.	8.	.07		
2 COMBINED AT	CP13D	349.	3.17	36.	17.	17.	.16		
ROUTED TO	RO162	295.	3.25	36.	17.	17.	.16	1.46	3.25
HYDROGRAPH AT	SUB162	269.	3.08	25.	12.	12.	.07		
2 COMBINED AT	CP162	511.	3.17	60.	29.	29.	.23		
ROUTED TO	RO160	469.	3.25	60.	29.	29.	.23	.81	3.25
HYDROGRAPH AT	SUB160	120.	3.08	9.	4.	4.	.03		
3 COMBINED AT	CP160	9537.	4.25	3039.	1516.	1516.	15.23		
ROUTED TO	RO164	9527.	4.25	3037.	1515.	1515.	15.23	4.97	4.25
HYDROGRAPH AT	SUB164	35.	3.50	6.	3.	3.	.04		
2 COMBINED AT	CP164	9537.	4.25	3043.	1518.	1518.	15.28		
HYDROGRAPH AT	SUB28B	983.	3.25	133.	65.	65.	.51		
HYDROGRAPH AT	SUB31B	976.	3.50	164.	80.	80.	.99		
HYDROGRAPH AT	SU3GL2	273.	3.25	31.	15.	15.	.17		
2 COMBINED AT	CP31B	1104.	3.50	195.	95.	95.	1.16		
ROUTED TO	RO32A	1052.	3.67	194.	95.	95.	1.16	2.12	3.67
HYDROGRAPH AT	SUB32A	970.	3.42	158.	77.	77.	.87		
2 COMBINED AT	CP32A	1881.	3.50	351.	172.	172.	2.04		
ROUTED TO	ROCNC	1831.	3.58	351.	172.	172.	2.04	3.32	3.58
2 COMBINED AT	CP28B	2323.	3.50	480.	237.	237.	2.55		
2 COMBINED AT	CPDET	10343.	4.17	3508.	1755.	1755.	17.82		
ROUTED TO	SEDBSN	10312.	4.25	3505.	1754.	1754.	17.82	1739.59	4.25
DIVERSION TO	DVMAIN	6875.	4.25	2337.	1170.	1170.	17.82		
HYDROGRAPH AT	DVEAST	3437.	4.25	1168.	585.	585.	17.82		
ROUTED TO	ROEAST	3432.	4.25	1166.	584.	584.	17.82	2.80	4.25
HYDROGRAPH AT	SUB120	260.	3.25	23.	11.	11.	.13		
HYDROGRAPH AT	SUB140	99.	3.25	10.	5.	5.	.06		
3 COMBINED AT	CP140	3461.	4.25	1197.	600.	600.	18.01		
ROUTED TO	RO122	3447.	4.33	1194.	599.	599.	18.01	2.81	4.33
HYDROGRAPH AT	SUB122	100.	3.25	11.	5.	5.	.07		
HYDROGRAPH AT	SUB124	235.	3.17	21.	10.	10.	.06		
HYDROGRAPH AT	SUB144	375.	3.25	32.	16.	16.	.20		
4 COMBINED AT	CP122	3491.	4.33	1252.	631.	631.	18.35		
ROUTED TO	RO130D	3490.	4.33	1251.	630.	630.	18.35	2.83	4.33
DIVERSION TO	DV148	1496.	4.33	536.	270.	270.	18.35		
HYDROGRAPH AT	DIV148	1994.	4.33	715.	360.	360.	18.35		
ROUTED TO	RO130	1988.	4.42	712.	359.	359.	18.35	2.56	4.42
HYDROGRAPH AT	SUB13D	615.	3.25	61.	30.	30.	.28		
2 COMBINED AT	CP130	2030.	4.42	768.	389.	389.	18.62		
ROUTED TO	RO134	2025.	4.50	767.	389.	389.	18.62	2.59	4.50
HYDROGRAPH AT	SUB134	238.	3.50	43.	21.	21.	.18		

2 COMBINED AT	CP134	2072.	4.50	808.	410.	410.	18.80		
ROUTED TO	R0136	2070.	4.50	807.	409.	409.	18.80	2.62	4.50
HYDROGRAPH AT	SUB136	220.	3.42	31.	15.	15.	.10		
2 COMBINED AT	CP136	2100.	4.50	837.	425.	425.	18.90		
HYDROGRAPH AT	DVMAIN	6875.	4.25	2337.	1170.	1170.	.00		
ROUTED TO	ROMAIN	6879.	4.25	2335.	1169.	1169.	.00	3.72	4.25
HYDROGRAPH AT	SUB158	359.	3.25	31.	15.	15.	.18		
2 COMBINED AT	CP158	6903.	4.25	2364.	1184.	1184.	.18		
ROUTED TO	ROWEST	6891.	4.25	2361.	1183.	1183.	.18	3.72	4.25
HYDROGRAPH AT	SUB168	377.	3.17	29.	14.	14.	.14		
ROUTED TO	R0170	277.	3.25	29.	14.	14.	.14	1.80	3.25
HYDROGRAPH AT	SUB170	205.	3.25	23.	11.	11.	.14		
3 COMBINED AT	CP170	6934.	4.25	2410.	1209.	1209.	.46		
DIVERSION TO	DVDVCH	3467.	4.25	1205.	604.	604.	.46		
HYDROGRAPH AT	DWEST2	3467.	4.25	1205.	604.	604.	.46		
ROUTED TO	RWEST2	3465.	4.33	1203.	604.	604.	.46	2.81	4.33
HYDROGRAPH AT	SUB172	183.	3.25	16.	8.	8.	.10		
HYDROGRAPH AT	SUB178	276.	3.25	25.	12.	12.	.12		
3 COMBINED AT	CP178	3492.	4.33	1241.	624.	624.	.68		
ROUTED TO	R0174	3482.	4.42	1236.	623.	623.	.68	2.82	4.42
HYDROGRAPH AT	SUB174	233.	3.42	30.	14.	14.	.18		
2 COMBINED AT	CP174	3510.	4.42	1264.	637.	637.	.86		
HYDROGRAPH AT	SUB176	199.	3.25	18.	9.	9.	.09		
2 COMBINED AT	CP176	3521.	4.42	1281.	646.	646.	.95		
ROUTED TO	R0146	3512.	4.50	1277.	645.	645.	.95	2.84	4.50
HYDROGRAPH AT	SUB146	124.	3.33	14.	7.	7.	.07		
HYDROGRAPH AT	SUB148	302.	3.25	29.	14.	14.	.16		
HYDROGRAPH AT	RET148	1496.	4.33	536.	270.	270.	.00		
ROUTED TO	R0147	1485.	4.42	534.	270.	270.	.00	2.16	4.42
HYDROGRAPH AT	SUB147	209.	3.25	20.	10.	10.	.11		
2 COMBINED AT	CP147	1499.	4.42	552.	280.	280.	.11		
ROUTED TO	R0148	1498.	4.50	552.	279.	279.	.11	1.62	4.50
4 COMBINED AT	CP146	5038.	4.50	1866.	945.	945.	1.28		
ROUTED TO	R0152	5036.	4.50	1863.	944.	944.	1.28	3.96	4.50
HYDROGRAPH AT	SUB150	100.	3.50	27.	14.	14.	.14		
HYDROGRAPH AT	SUB152	116.	3.33	16.	8.	8.	.08		
3 COMBINED AT	CP152	5082.	4.50	1905.	965.	965.	1.50		
ROUTED TO	R0156	5069.	4.58	1901.	963.	963.	1.50	3.98	4.58
HYDROGRAPH AT	SUB156	174.	3.50	28.	14.	14.	.14		
HYDROGRAPH AT	SUB190	79.	3.33	11.	5.	5.	.05		
3 COMBINED AT	CP156	5100.	4.58	1937.	982.	982.	1.69		
HYDROGRAPH AT	DVDVCH	3467.	4.25	1205.	604.	604.	.00		
ROUTED TO	RODVCH	3466.	4.33	1204.	604.	604.	.00	3.04	4.33

HYDROGRAPH AT	SUB180	220.	3.17	18.	9.	9.	.10		
ROUTED TO	R0182	173.	3.25	18.	9.	9.	.10	1.49	3.25
HYDROGRAPH AT	SUB182	210.	3.17	18.	9.	9.	.10		
2 COMBINED AT	CP182	368.	3.25	36.	17.	17.	.20		
2 COMBINED AT	CP183	3492.	4.33	1237.	621.	621.	.20		
ROUTED TO	R0186	3494.	4.33	1237.	621.	621.	.20	3.05	4.33
HYDROGRAPH AT	SUB186	154.	3.17	13.	7.	7.	.06		
2 COMBINED AT	CP186	3502.	4.33	1249.	628.	628.	.26		
ROUTED TO	R0191	3216.	4.67	1218.	619.	619.	.26	3.12	4.67
ROUTED TO	R0192	3212.	4.67	1217.	618.	618.	.26	3.11	4.67
HYDROGRAPH AT	SUB191	205.	3.33	27.	13.	13.	.13		
HYDROGRAPH AT	SUB192	98.	3.33	13.	6.	6.	.06		
3 COMBINED AT	CP192	3237.	4.67	1244.	638.	638.	.46		
HYDROGRAPH AT	SUB12d	662.	3.42	103.	50.	50.	.55		
HYDROGRAPH AT	SUB12C	391.	3.50	66.	32.	32.	.35		
2 COMBINED AT	CP12C	1042.	3.42	169.	83.	83.	.91		
ROUTED TO	R012C	922.	3.67	168.	83.	83.	.91	2.43	3.67
HYDROGRAPH AT	SUB13C	198.	3.33	25.	12.	12.	.12		
2 COMBINED AT	CP13C	1000.	3.58	193.	95.	95.	1.03		
ROUTED TO	R013.1	997.	3.67	193.	95.	95.	1.03	2.45	3.67
HYDROGRAPH AT	SUB12B	830.	3.58	170.	83.	83.	.91		
ROUTED TO	R012B	777.	3.92	169.	83.	83.	.91	2.28	3.92
HYDROGRAPH AT	SUB13B	538.	3.42	79.	39.	39.	.38		
2 COMBINED AT	CP13B	1100.	3.50	246.	122.	122.	1.30		
2 COMBINED AT	CP13.2	2002.	3.50	439.	216.	216.	2.32		
ROUTED TO	R013.2	2049.	3.58	439.	216.	216.	2.32	2.39	3.58
HYDROGRAPH AT	SUB12A	456.	3.58	88.	43.	43.	.47		
ROUTED TO	R012A	430.	3.83	87.	43.	43.	.47	1.70	3.83
HYDROGRAPH AT	SUB13A	379.	3.58	74.	36.	36.	.36		
2 COMBINED AT	CP13A	744.	3.67	160.	79.	79.	.83		
2 COMBINED AT	CP13.3	2757.	3.67	599.	296.	296.	3.16		
ROUTED TO	R013.3	2758.	3.67	599.	296.	296.	3.16	2.54	3.67
HYDROGRAPH AT	SUB184	401.	3.17	34.	17.	17.	.17		
ROUTED TO	R0184	404.	3.25	34.	17.	17.	.17	2.43	3.25

SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
(FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)

ISTAQ	ELEMENT	DT (MIN)	PEAK (CFS)	TIME TO PEAK (MIN)	VOLUME (IN)	INTERPOLATED TO COMPUTATION INTERVAL DT (MIN)	PEAK (CFS)	TIME TO PEAK (MIN)	VOLUME (IN)
SUB16	MANE	3.43	2559.96	196.12	2.02	5.00	2476.29	200.00	2.01

CONTINUITY SUMMARY (AC-FT) - INFLOW- .0000E+00 EXCESS- .1578E+03 OUTFLOW- .1567E+03 BASIN STORAGE- .2459E+00 PERCENT ERROR- .5

SUB17	MANE	3.79	2073.05	195.46	2.02	5.00	2016.20	195.00	2.02

CONTINUITY SUMMARY (AC-FT) - INFLOW- .0000E+00 EXCESS- .1283E+03 OUTFLOW- .1274E+03 BASIN STORAGE- .2446E+00 PERCENT ERROR- .6

SUB18	MANE	3.11	2307.49	196.91	1.96	5.00	2250.11	195.00	1.96

CONTINUITY SUMMARY (AC-FT) - INFLOW- .0000E+00 EXCESS- .1332E+03 OUTFLOW- .1323E+03 BASIN STORAGE- .2447E+00 PERCENT ERROR- .5

SUB15	MANE	3.65	1784.91	207.96	1.87	5.00	1773.93	205.00	1.87

CONTINUITY SUMMARY (AC-FT) - INFLOW- .0000E+00 EXCESS- .1378E+03 OUTFLOW- .1368E+03 BASIN STORAGE- .3256E+00 PERCENT ERROR- .5

SUB19	MANE	1.76	424.08	193.66	2.05	5.00	416.34	195.00	2.06

CONTINUITY SUMMARY (AC-FT) - INFLOW- .0000E+00 EXCESS- .2057E+02 OUTFLOW- .2051E+02 BASIN STORAGE- .1818E-01 PERCENT ERROR- .2

SUB20	MANE	3.84	1059.24	196.25	1.99	5.00	1005.08	195.00	1.99

CONTINUITY SUMMARY (AC-FT) - INFLOW- .0000E+00 EXCESS- .6089E+02 OUTFLOW- .6048E+02 BASIN STORAGE- .8075E-01 PERCENT ERROR- .5

SUB21	MANE	3.89	2671.36	234.82	1.75	5.00	2670.65	235.00	1.75

CONTINUITY SUMMARY (AC-FT) - INFLOW- .0000E+00 EXCESS- .3452E+03 OUTFLOW- .3423E+03 BASIN STORAGE- .1573E+01 PERCENT ERROR- .4

SUB22	MANE	3.81	2039.98	194.51	2.01	5.00	2022.26	195.00	2.02

CONTINUITY SUMMARY (AC-FT) - INFLOW- .0000E+00 EXCESS- .1498E+03 OUTFLOW- .1489E+03 BASIN STORAGE- .2071E+00 PERCENT ERROR- .5

SUB23	MANE	3.04	751.66	196.97	2.03	5.00	728.65	195.00	2.04

CONTINUITY SUMMARY (AC-FT) - INFLOW- .0000E+00 EXCESS- .4305E+02 OUTFLOW- .4281E+02 BASIN STORAGE- .5365E-01 PERCENT ERROR- .4

SUB24	MANE	2.66	678.90	196.00	1.57	5.00	647.26	195.00	1.57

CONTINUITY SUMMARY (AC-FT) - INFLOW- .0000E+00 EXCESS- .4137E+02 OUTFLOW- .4107E+02 BASIN STORAGE- .8519E-01 PERCENT ERROR- .5

SUB25N	MANE	4.37	1200.73	204.17	2.07	5.00	1176.79	205.00	2.07

CONTINUITY SUMMARY (AC-FT) - INFLOW- .0000E+00 EXCESS- .8725E+02 OUTFLOW- .8642E+02 BASIN STORAGE- .2553E+00 PERCENT ERROR- .7

SUB25S	MANE	3.06	1329.98	195.13	2.22	5.00	1325.86	195.00	2.22

CONTINUITY SUMMARY (AC-FT) - INFLOW- .0000E+00 EXCESS- .7460E+02 OUTFLOW- .7409E+02 BASIN STORAGE- .1172E+00 PERCENT ERROR- .5

SUB26	MANE	1.12	384.74	191.51	1.64	5.00	370.17	190.00	1.64

CONTINUITY SUMMARY (AC-FT) - INFLOW- .0000E+00 EXCESS- .1958E+02 OUTFLOW- .1950E+02 BASIN STORAGE- .2792E-01 PERCENT ERROR- .2

SUB26A MANE 3.74 569.56 205.77 1.57 5.00 562.86 205.00 1.57

CONTINUITY SUMMARY (AC-FT) - INFLOW- .0000E+00 EXCESS- .4416E+02 OUTFLOW- .4385E+02 BASIN STORAGE- .1038E+00 PERCENT ERROR- .5

SUB27B MANE 5.00 1265.44 195.19 2.00 5.00 1259.11 195.00 2.01

CONTINUITY SUMMARY (AC-FT) - INFLOW- .0000E+00 EXCESS- .8178E+02 OUTFLOW- .8168E+02 BASIN STORAGE- .2212E-01 PERCENT ERROR- .1

SUB28A MANE 4.88 75.16 221.45 2.06 5.00 74.56 220.00 2.06

CONTINUITY SUMMARY (AC-FT) - INFLOW- .0000E+00 EXCESS- .9673E+01 OUTFLOW- .9457E+01 BASIN STORAGE- .1448E+00 PERCENT ERROR- .7

SUB27A MANE 1.24 241.82 186.36 2.11 5.00 213.26 185.00 2.11

CONTINUITY SUMMARY (AC-FT) - INFLOW- .0000E+00 EXCESS- .9561E+01 OUTFLOW- .9563E+01 BASIN STORAGE- .1672E-02 PERCENT ERROR- .0

SUB13D MANE 3.45 155.50 189.71 2.11 5.00 155.15 190.00 2.11

CONTINUITY SUMMARY (AC-FT) - INFLOW- .0000E+00 EXCESS- .8211E+01 OUTFLOW- .8196E+01 BASIN STORAGE- .1444E-02 PERCENT ERROR- .2

SUB16Z MANE .63 304.00 186.73 3.29 5.00 268.83 185.00 3.28

CONTINUITY SUMMARY (AC-FT) - INFLOW- .0000E+00 EXCESS- .1227E+02 OUTFLOW- .1227E+02 BASIN STORAGE- .1174E-02 PERCENT ERROR- -.1

SUB16D MANE .94 124.72 185.71 3.29 5.00 120.27 185.00 3.29

CONTINUITY SUMMARY (AC-FT) - INFLOW- .0000E+00 EXCESS- .4557E+01 OUTFLOW- .4556E+01 BASIN STORAGE- .9210E-04 PERCENT ERROR- .0

SUB16A MANE 4.08 34.91 210.49 1.23 5.00 34.63 210.00 1.23

CONTINUITY SUMMARY (AC-FT) - INFLOW- .0000E+00 EXCESS- .2930E+01 OUTFLOW- .2880E+01 BASIN STORAGE- .1675E-01 PERCENT ERROR- 1.1

SUB28B MANE 5.71 992.66 194.26 2.46 5.00 982.83 195.00 2.46

CONTINUITY SUMMARY (AC-FT) - INFLOW- .0000E+00 EXCESS- .6671E+02 OUTFLOW- .6654E+02 BASIN STORAGE- .1914E-01 PERCENT ERROR- .2

SUB31B MANE 4.14 979.46 210.86 1.56 5.00 976.08 210.00 1.56

CONTINUITY SUMMARY (AC-FT) - INFLOW- .0000E+00 EXCESS- .8241E+02 OUTFLOW- .8217E+02 BASIN STORAGE- .5421E-01 PERCENT ERROR- .2

SUBGL2 MANE 4.16 274.52 195.45 1.66 5.00 273.00 195.00 1.66

CONTINUITY SUMMARY (AC-FT) - INFLOW- .0000E+00 EXCESS- .1542E+02 OUTFLOW- .1537E+02 BASIN STORAGE- .5246E-02 PERCENT ERROR- .3

SUB32A MANE 4.44 969.92 203.27 1.70 5.00 969.51 205.00 1.70

CONTINUITY SUMMARY (AC-FT) - INFLOW- .0000E+00 EXCESS- .7936E+02 OUTFLOW- .7914E+02 BASIN STORAGE- .2952E-01 PERCENT ERROR- .2

SUB12D MANE 2.17 265.11 195.26 1.09 5.00 260.29 195.00 1.09

CONTINUITY SUMMARY (AC-FT) - INFLOW- .0000E+00 EXCESS- .1141E+02 OUTFLOW- .1138E+02 BASIN STORAGE- .1316E-01 PERCENT ERROR- .1

SUB14D MANE 3.07 101.22 197.51 1.56 5.00 99.04 195.00 1.57

CONTINUITY SUMMARY (A-FT) - INFLOW- .0000E+00 EXCESS- .5119E+01 OUTFLOW- .5082E+01 BASIN STORAGE- .7323E-02 PERCENT ERROR- .6

SUB12Z MANE 2.33 108.59 197.08 1.40 5.00 100.48 195.00 1.40

CONTINUITY SUMMARY (AC-FT) - INFLOW- .0000E+00 EXCESS- .5342E+01 OUTFLOW- .5305E+01 BASIN STORAGE- .8406E-02 PERCENT ERROR- .5

SUB124	MANE	2.25	248.09	191.08	3.07	5.00	234.76	190.00	3.07

CONTINUITY SUMMARY (AC-FT) - INFLOW- .0000E+00 EXCESS- .1051E+02 OUTFLOW- .1049E+02 BASIN STORAGE- .6554E-02 PERCENT ERROR- .1

SUB144	MANE	1.00	379.33	194.56	1.48	5.00	374.55	195.00	1.48

CONTINUITY SUMMARY (AC-FT) - INFLOW- .0000E+00 EXCESS- .1620E+02 OUTFLOW- .1612E+02 BASIN STORAGE- .8091E-02 PERCENT ERROR- .4

SUB130	MANE	2.77	614.99	194.71	2.10	5.00	614.90	195.00	2.10

CONTINUITY SUMMARY (AC-FT) - INFLOW- .0000E+00 EXCESS- .3098E+02 OUTFLOW- .3081E+02 BASIN STORAGE- .4101E-01 PERCENT ERROR- .4

SUB134	MANE	2.84	240.02	209.16	2.26	5.00	238.35	210.00	2.26

CONTINUITY SUMMARY (AC-FT) - INFLOW- .0000E+00 EXCESS- .2207E+02 OUTFLOW- .2170E+02 BASIN STORAGE- .5486E-01 PERCENT ERROR- 1.4

SUB136	MANE	3.46	224.46	203.13	1.91	5.00	220.19	205.00	1.91

CONTINUITY SUMMARY (AC-FT) - INFLOW- .0000E+00 EXCESS- .1601E+02 OUTFLOW- .1581E+02 BASIN STORAGE- .5577E-01 PERCENT ERROR- .9

SUB158	MANE	1.61	387.04	191.97	1.61	5.00	358.63	195.00	1.61

CONTINUITY SUMMARY (AC-FT) - INFLOW- .0000E+00 EXCESS- .1571E+02 OUTFLOW- .1566E+02 BASIN STORAGE- .6540E-02 PERCENT ERROR- .3

SUB168	MANE	1.38	382.51	191.23	1.93	5.00	376.51	190.00	1.94

CONTINUITY SUMMARY (AC-FT) - INFLOW- .0000E+00 EXCESS- .1467E+02 OUTFLOW- .1465E+02 BASIN STORAGE- .5623E-02 PERCENT ERROR- .1

SUB170	MANE	1.54	282.06	193.68	1.54	5.00	264.89	195.00	1.54

CONTINUITY SUMMARY (AC-FT) - INFLOW- .0000E+00 EXCESS- .1140E+02 OUTFLOW- .1135E+02 BASIN STORAGE- .5280E-02 PERCENT ERROR- .4

SUB172	MANE	1.58	192.66	192.26	1.53	5.00	182.90	195.00	1.53

CONTINUITY SUMMARY (AC-FT) - INFLOW- .0000E+00 EXCESS- .7966E+01 OUTFLOW- .7930E+01 BASIN STORAGE- .5634E-02 PERCENT ERROR- .4

SUB178	MANE	1.38	304.43	192.87	1.93	5.00	275.63	195.00	1.93

CONTINUITY SUMMARY (AC-FT) - INFLOW- .0000E+00 EXCESS- .1250E+02 OUTFLOW- .1247E+02 BASIN STORAGE- .6415E-02 PERCENT ERROR- .2

SUB174	MANE	3.14	232.62	205.08	1.56	5.00	232.61	205.00	1.56

CONTINUITY SUMMARY (AC-FT) - INFLOW- .0000E+00 EXCESS- .1495E+02 OUTFLOW- .1481E+02 BASIN STORAGE- .4164E-01 PERCENT ERROR- .7

SUB176	MANE	2.00	205.29	193.89	1.93	5.00	199.00	195.00	1.92

CONTINUITY SUMMARY (AC-FT) - INFLOW- .0000E+00 EXCESS- .9301E+01 OUTFLOW- .9261E+01 BASIN STORAGE- .7520E-02 PERCENT ERROR- .3

SUB146	MANE	1.26	125.20	199.82	1.92	5.00	124.48	200.00	1.94

CONTINUITY SUMMARY (AC-FT) - INFLOW- .0000E+00 EXCESS- .7235E+01 OUTFLOW- .7176E+01 BASIN STORAGE- .6936E-02 PERCENT ERROR- .7

SUB148	MANE	1.82	306.51	195.98	1.73	5.00	301.57	195.00	1.73

CONTINUITY SUMMARY (AC-FT) - INFLOW- .0000E+00 EXCESS- .1440E+02 OUTFLOW- .1433E+02 BASIN STORAGE- .7736E-02 PERCENT ERROR- .4

SUB147	MANE	1.98	212.86	195.50	1.73	5.00	209.26	195.00	1.73

CONTINUITY SUMMARY (AC-FT) - INFLOW- .0000E+00 EXCESS- .1022E+02 OUTFLOW- .1017E+02 BASIN STORAGE- .5849E-02 PERCENT ERROR- .5

SUB150	MANE	4.08	160.28	211.05	1.90	5.00	159.86	210.00	1.90

CONTINUITY SUMMARY (AC-FT) - INFLOW- .0000E+00 EXCESS- .1416E+02 OUTFLOW- .1389E+02 BASIN STORAGE- .6510E-01 PERCENT ERROR- 1.4

SUB152	MANE	2.75	119.67	203.42	1.92	5.00	116.40	200.00	1.92

CONTINUITY SUMMARY (AC-FT) - INFLOW- .0000E+00 EXCESS- .8165E+01 OUTFLOW- .8088E+01 BASIN STORAGE- .1462E-01 PERCENT ERROR- .6

SUB156	MANE	4.24	177.11	206.40	1.91	5.00	174.04	210.00	1.91

CONTINUITY SUMMARY (AC-FT) - INFLOW- .0000E+00 EXCESS- .1457E+02 OUTFLOW- .1434E+02 BASIN STORAGE- .5964E-01 PERCENT ERROR- 1.2

SUB190	MANE	5.00	80.67	200.51	1.92	5.00	79.20	200.00	1.92

CONTINUITY SUMMARY (AC-FT) - INFLOW- .0000E+00 EXCESS- .5478E+01 OUTFLOW- .5415E+01 BASIN STORAGE- .2313E-01 PERCENT ERROR- .7

SUB180	MANE	1.30	233.89	190.65	1.76	5.00	225.62	190.00	1.75

CONTINUITY SUMMARY (AC-FT) - INFLOW- .0000E+00 EXCESS- .9022E+01 OUTFLOW- .9004E+01 BASIN STORAGE- .4263E-02 PERCENT ERROR- .2

SUB182	MANE	1.23	224.85	191.31	1.67	5.00	209.68	190.00	1.67

CONTINUITY SUMMARY (AC-FT) - INFLOW- .0000E+00 EXCESS- .8906E+01 OUTFLOW- .8884E+01 BASIN STORAGE- .4656E-02 PERCENT ERROR- .2

SUB186	MANE	1.82	165.94	192.23	1.93	5.00	154.44	190.00	1.93

CONTINUITY SUMMARY (AC-FT) - INFLOW- .0000E+00 EXCESS- .6718E+01 OUTFLOW- .6695E+01 BASIN STORAGE- .3467E-02 PERCENT ERROR- .3

SUB191	MANE	1.72	210.06	197.20	1.92	5.00	204.61	200.00	1.92

CONTINUITY SUMMARY (AC-FT) - INFLOW- .0000E+00 EXCESS- .1364E+02 OUTFLOW- .1353E+02 BASIN STORAGE- .5439E-01 PERCENT ERROR- .4

SUB192	MANE	1.98	99.50	198.50	1.92	5.00	97.86	200.00	1.92

CONTINUITY SUMMARY (AC-FT) - INFLOW- .0000E+00 EXCESS- .6511E+01 OUTFLOW- .6453E+01 BASIN STORAGE- .2690E-01 PERCENT ERROR- .5

SUB12d	MANE	4.75	667.04	200.15	1.76	5.00	662.11	205.00	1.76

CONTINUITY SUMMARY (AC-FT) - INFLOW- .0000E+00 EXCESS- .5185E+02 OUTFLOW- .5171E+02 BASIN STORAGE- .2559E-01 PERCENT ERROR- .2

SUB12C	MANE	4.70	391.60	209.95	1.76	5.00	391.49	210.00	1.76

CONTINUITY SUMMARY (AC-FT) - INFLOW- .0000E+00 EXCESS- .3326E+02 OUTFLOW- .3317E+02 BASIN STORAGE- .2214E-01 PERCENT ERROR- .3

SUB13C	MANE	4.82	204.31	197.30	1.93	5.00	197.73	200.00	1.93

CONTINUITY SUMMARY (AC-FT) - INFLOW- .0000E+00 EXCESS- .1240E+02 OUTFLOW- .1233E+02 BASIN STORAGE- .3605E-02 PERCENT ERROR- .5

SUB12B	MANE	4.81	634.78	216.59	1.76	5.00	630.37	215.00	1.75

CONTINUITY SUMMARY (AC-FT) - INFLOW- .0000E+00 EXCESS- .8574E+02 OUTFLOW- .8555E+02 BASIN STORAGE- .8077E-01 PERCENT ERROR- .1

SUB13B	MANE	5.27	538.31	204.95	1.93	5.00	537.76	205.00	1.94

CONTINUITY SUMMARY (AC-FT) - INFLOW- .0000E+00 EXCESS- .3954E+02 OUTFLOW- .3943E+02 BASIN STORAGE- .1770E-01 PERCENT ERROR- .2

SUB12A	MANE	4.98	456.05	214.74	1.76	5.00	455.64	215.00	1.76

CONTINUITY SUMMARY (AC-FT) - INFLOW- .0000E+00 EXCESS- .4426E+02 OUTFLOW- .4414E+02 BASIN STORAGE- .3340E-01 PERCENT ERROR- .2

SUB13A	MANE	5.08	379.83	213.24	1.93	5.00	378.61	215.00	1.93

CONTINUITY SUMMARY (AC-FT) - INFLOW- .0000E+00 EXCESS- .3748E+02 OUTFLOW- .3739E+02 BASIN STORAGE- .3251E-01 PERCENT ERROR- .2

SUB184	MANE	.99	462.32	190.09	1.94	5.00	461.31	190.00	1.93

CONTINUITY SUMMARY (AC-FT) - INFLOW- .0000E+00 EXCESS- .1715E+02 OUTFLOW- .1713E+02 BASIN STORAGE- .5574E-02 PERCENT ERROR- .1

APPENDIX B
(ASLD Planning Permit No. 47-97397)
Soils, Sediment Basin Sizing Equilibrium Slope and
Allowable Velocity Analysis
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1.0 SOILS DESCRIPTION

The soils impacting the study area involve 3 soil classifications based on the Soil Conservation Services (SCS) soil survey for the Agila - Carefree Area (Issued April 1, 1986) as shown on Plate B-1.

Soil Survey Unit No. 6 - Anthony - Arizo Complex.
This soil classification occurs outside the study area boundary but in the Rawhide Wash channel bottom and thus, it represents the type of soil being conveyed downstream in the wash and into the proposed project drainage channel system. The arizo soil is the primary soil occurring in the Rawhide Wash Channel bottom. The top 1 to 8-inches of this soil unit is a gravelly sandy loam to, very gravelly sandy loam. The next soil strata unit from 8 to 60-inches deep is a very gravelly loamy sand. Plate B-2 shows a gradation plot of the various soil types in this unit.

Soil Survey Unit No. 90 - Momoli Gravelly Sandy Loam.
This soil classification unit occurs in the northern and eastern portions of the study area. This soil involves a gravelly sandy loam (Unified Class: SM) for the 0-3-inch depth strata with a very gravelly sandy loam (Unified Class: GM, GM-GC) from 3 to 60-inches deep. The soil is classified a hydrologic soil Group B. Plate B-3 shows a gradation plot of this soil unit.

Soil Survey Unit No. 55 - Gilman Loams.
This soil unit occurs in the western and southern portions of the study area. This soil unit involves a loam, silt loam and fine sandy loam (Unified Class: CL, CL-ML and SM). The soil is classified a hydrologic soil Group B. Plate B-4 shows a gradation plot of this soil unit.

2.0 SEDIMENT BASIN SIZING

2.1 OVERVIEW OF CHANNEL DESIGN AND NEED FOR SEDIMENT BASIN

The existing Rawhide Wash Channel upstream of the study area is a steep sloped (2 to 3 percent plus) channel with high velocities (13 FPS ± 100-Year Storm) that is capable of conveying appreciable sediment.

The proposed Scottsdale Road Channel within the study area from the overhead electric easement to the Deer Valley Road Alignment (Section line of Sections 15 and 22) was designed to continue with a high velocity channel section capable of conveying sediment. A sediment basin was proposed on the west

side of Scottsdale Road and the Deer Valley Road intersection. The proposed channels downstream of the sediment basin are designed to be low velocity (less than 7.5 fps, 100-year storm) that will not convey heavy sediments (median sands to gravels).

The sediment basin is proposed to remove heavy sediments (median sands to gravels) thereby minimizing downstream maintenance problems and reduction of channel freeboard associated with sediment deposition.

2.2 SEDIMENT INFLOW VOLUME ESTIMATION FOR 100-YEAR 6-HOUR STORM

In order to size the sediment basin an estimate was made of potential sediment inflow for the design 100-year 6-hour storm from Rawhide Wash upstream of Pinnacle Peak Road. It was assumed that there was sufficient sediment supply in the Rawhide Wash Channel and contributing watershed such that the channel could convey as much sediment as hydraulically possible. The following sediment transport equation was used as obtained from Reference 4:

$$q_s = 0.0064 \frac{(n)^{1.77}(V)^{4.32}(G)^{0.45}}{(Y_h)^{0.30}\ (D_{50})^{0.61}} \quad \text{(Zeller-Fullerton, 1983)}$$

Where q_s = Unit width sediment transport rate (CFS/Foot width of channel at mid flow depth)

n = Manning's roughness factor

V = Mean Flow Velocity, fps

G = Gradation Coefficient of bed material

Y_h = Hydraulic depth (ft.) = Area/Topwidth

D_{50} = Diameter of bed material particle for which 50 percent is greater by weight (mm)

This equation is based on a regression analysis of hydraulic and sediment transport data for sand bed channels in arid regions. The listed regression limit for D_{50} are 0.5 to 10.0 mm. A D_{50} of 2.0 mm and gradation coefficient of 4.0 were used for this equation in the Final Report for Upper Indian Bend Wash Regional Drainage and Flood Control Plan for the City of Scottsdale (July 6, 1992). As shown on Plate B-2, the D_{50} of 2mm appears reasonable for the soils in the Rawhide Wash Channel.

The gradation coefficient of 4.0 was also used based on the U.I.B.W Report.

A representative channel section with the following parameters was chosen to compute the hydraulic parameters to utilize in this sediment transport equation. This representative channel section was chosen from review of drainage reports and topography mapping for the Rawhide Wash Channel through the Los Portonnes development which extends from Pinnacle Peak Road upstream 1/2 mile. Representative Channel Section Hydraulic Parameters:

Manning's 'n'	= 0.035
Slope	= 0.023 feet/feet
Bottom Width	= 200 feet
Average Side Slope	= 10(H):1(V)

For the average discharge for each 1/2 hour time interval shown on Plate B-5, the hydraulic parameters were computed and sediment discharge computed. Table B-1 summarizes this analysis. As shown on Table B-1 approximately 26.1 Acre - Feet of Sediment were estimated to be conveyed south across Pinnacle Peak road in Rawhide Wash. Referring to Plate B-2, the soil gradation curve for Rawhide Wash, it is noted that approximately 25 to 30 percent of these soils by weight are fine sand (0.5 mm) or smaller. This material is not expected to settle out in an in the sediment basin, where velocities are reduced to 3 to 4 fps for several hundred feet. As such only 75 percent of the 26.1 acre-feet or 19.6 acre-feet can potentially be trapped by the sediment basin.

A sediment basin outside and upstream of the study area on Rawhide Wash has been requested of the City of Scottsdale by the State Land Department to intercept a portion of this sediment volume. To date a final decision on this request has not been resolved.

For purposes of preliminary sizing of the sediment basin, 50 percent of the 19.6 acre-feet or 9.8 acre-feet was used. This volume was assumed to occur as a level infill of the sediment basin below the invert of the outlet structure, for a depth of 2 feet. Should no further sediment basin storage be provided upstream, the proposed sediment basin may need to be deepened to accommodate more sediment. As discussed in Sections 3.2 and 3.3, the sediment transport analysis for the proposed Scottsdale Road channel indicates that no upstream sediment storage should be implemented.

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Channel Hydraulic Parameters
B = 200 feet
Z = 20(H):1(V)
S = 0.023 ft./ft.
n = 0.035

TABLE B-1
RAWHIDE WASH AT PINNACLE PEAK ROAD
SEDIMENT INFLOW VOLUME ESTIMATION FOR 100-YEAR 6-HOUR STORM

(1) Time Interval No.	(2) Average Discharge (cfs)	(3) Duration (hours)	(4) Mean Velocity (fps)	(5) Flow Depth (ft)	(6) Topwidth (ft)	(7) Hydraulic Depth (Area/Topwidth) (ft)	(8) qs (cfs/ft)	(9) Width at Mid-Depth (ft)	(10) Vs Sediment Volume (ft^3)
1	2210	0.5	7.59	1.36	227.3	1.28	0.122	213.6	46,970
2	7110	0.5	11.58	2.70	254.1	2.42	0.626	227.0	255,770
3	9184	0.5	12.67	3.14	262.7	2.76	0.888	231.4	369,690
4	6854	0.5	11.44	2.65	252.9	2.37	0.598	226.5	243,670
5	4048	0.5	9.48	1.95	238.9	1.79	0.289	219.5	114,060
6	2346	0.5	7.76	1.41	228.2	1.32	0.133	214.1	51,330
7	1463	0.5	6.51	1.07	221.4	1.02	0.067	210.7	25,560
8	1156	0.5	5.95	0.93	218.6	1.89	0.048	209.3	17,980
9	884	0.5	5.37	0.79	215.8	1.76	0.032	207.9	11,990
								Total Sediment Inflow Volume	1,137,020 $ft.^3$
									26.1 Acre ft.

Notes: Vs = qs (cfs/feet width) x duration (hours) x 3600 sec./hr. x width at mid-depth (feet)

3.0 EQUILIBRIUM SLOPE ANALYSIS - SCOTTSDALE ROAD CHANNEL

3.1 GENERAL DISCUSSION (FROM UPPER INDIAN BEND WASH REPORT

Sediment transport analyses need to distinguish between short-term and long-term changes. Short-term changes are event specific and occur to some extent during each flood hydrograph. Examples of short-term changes would be local scour, general scour, bend scour, bedform troughs, and to some extent, low-flow incisement. With the exception of low-flow incisement, any visible signs of these processes may be difficult to detect after the flow has subsided.

Short-term scour processes can usually be quantified with empirical and/or theoretical relationships. With the aid of the computer, general scour is frequently evaluated with mobile boundary, sediment routing models.

Precise prediction of long-term channel impacts can be much more elusive than their short-term counterparts because of the time-span involved and the numerous variables that impact long-term changes. Since lateral erosion of the channel banks is proposed to be controlled by a combination of vegetative cover, bank protection at curves and grade controls and a passive concrete bank scour cutoff wall, this analysis will employ the concept of equilibrium slope to determine the long-term trend for aggradation or degradation of the channel bed.

Equilibrium slope is defined as the slope at which the sediment transport capacity of the channel bed will neither aggrade nor degrade. However, if the incoming sediment supply is greater than the transport capacity of the channel, aggradation will occur, as the channel attempts to steepen its slope, to generate a higher flow velocity (and resulting sediment transport rate). Conversely, if the sediment supply is less than the channel transport rate, the channel bed will degrade in order to flatten its slope, resulting in lower flow velocity and sediment transport rate. Ideally, flood control channels should be designed on the basis of this equilibrium slope.

An equilibrium slope analysis was utilized to provide some confidence that the selected channel geometries, roughness values, and available ground slopes could combine to move the dominant sediment loads through the system,

without causing any major long-term deposition. Should such deposition occur, the channel capacity might be jeopardized.

The first step in an equilibrium slope analysis is to determine the sediment supply to the channel. For ephemeral channels, the 5- to 10-year event is considered the dominant discharge most responsible for affecting long-term changes to the channel. The 10-year event was selected for use in this study. Accordingly, the sediment inflows quantified in this analysis are based on the 10-year discharge.

The sediment inflows computed for this analysis are based on a key assumption that the upstream washes are in a state of equilibrium. This is considered a reasonable assumption since the majority of the watershed is not presently developed to the extent that the natural supply of sediment is significantly disrupted.

A second basic assumption of equilibrium slope analysis is that the sediment supply used to determine equilibrium conditions for a specific channel reach be equal to the total supply of all sediment being delivered to that reach. This assumes that all sources of sediment inflow to a reach are at an equilibrium condition. This assumption simplifies the calculation of sediment inflows because it allows the use of the existing watercourse slopes to compute the hydraulic parameters and sediment transport rates of all incoming washes.

The equilibrium slope analysis utilized the following equation to compute both the sediment inflows (that is, sediment supply) and the sediment transport rate of the proposed channels.

$$qs = 0.0064 \frac{(n)^{1.77}(V)^{4.32}(G)^{0.45}}{(Yh)^{0.30}\ (D50)^{0.61}} \quad \text{(Zeller-Fullerton, 1983)}$$

Where
- qs = Unit width sediment transport rate (CFS/Ft)
- n = Manning's roughness factor
- V = Mean Flow Velocity, fps
- G = Gradation Coefficient of bed material
- Yh = Hydraulic depth (ft.) = Area/Topwidth
- D50 = Diameter of bed material particle for which 50 percent is greater by weight (mm)

This equation is based on a regression analysis of hydraulic and sediment transport data for sand bed channels in arid regions. The listed regression limits for D_{50} are 0.5 to 10.0 mm.

Bed-material data used for this study was taken from three sample locations upstream of the Outer Loop Highway alignment, north of the CAP. These samples were previously published in the report: Concept Drainage Design, Outer Loop Highway North of CAP Aqueduct, Simons, Li & Associates, Inc., March, 1989. Based on a review of the gradation curves for these three samples, a D_{50} of 2.0 mm, and gradation coefficient of 4.0, were selected for use in the equilibrium slope analysis. These values, which are typical of sand bed channels, were used for both the sediment supply calculations and the sediment transport rates through the proposed flood control channels. Plate B-2, Soil Gradation for Rawhide Wash upstream of Pinnacle Peak Road, also supports a D_{50} = 2mm for sediment inflow to the system.

3.2 EQUILIBRIUM CHANNEL SLOPE DESIGN FOR SCOTTSDALE ROAD CHANNEL

The calculation procedure to determine equilibrium slope is an interative procedure.

Step 1. The representative channel section described in Section 2.2 was used to estimate the 10-year sediment inflow to the proposed Scottsdale Road channel.

Manning's 'n'	= 0.035
Slope	= 0.023 feet/feet
Bottom Width	= 200 feet
Average Side Slope	= 10(H):1(V)
Q_{10}	= 3516 cfs
Mean Velocity	= 9.01 fps
Flow Depth	= 1.79 feet
Hydraulic Depth	= 1.66 feet
Width at Mid-depth	= 216.7 feet
q_s	= 0.237 cfs/feet
Q_s	= 51.6 cfs

Step 2. The following proposed Scottsdale Road channel hydraulic parameters were assumed;

Bottom Width	= 110 feet
Sideslope	= 3(H):1(V)
Manning's 'n'	= 0.035

A slope was initially estimated as 0.015 ft/ft. By trial the slope was varied until the proposed channel hydraulically could convey the 10-year sediment flow.

For S=0.015 ft/ft in proposed Scottsdale Road Channel

Mean Velocity	= 10.10 fps
Hydraulic Depth	= 2.73 feet
Flow Depth	= 2.93 feet
Width at Mid-depth	= 118.8 feet
qs	= 0.334 cfs/feet
Qs	= 0.334 x 118.8 feet
	= 39.7 cfs < 51.6 cfs (supply)

Therefore, Channel Aggrades, Try Steeper Slope

Try Slope	= 0.018 ft/ft
Mean Velocity	= 10.70 fps
Hydraulic Depth	= 2.59 feet
Flow Depth	= 2.78 feet
Width at Mid-Depth	= 118.3 feet
qs	= 0.436 cfs/ft
Qs	= 51.6 cfs = Supply of 51.6 cfs

If an upstream sediment basin or other channel development were constructed that reduced the sediment supply, the channel would tend to degrade to a more mild slope. Determine equilibrium channel slope for proposed Scottsdale channel if sediment supply (Q_{10}) were reduced by 25 percent to a supply of 38.7 cfs.

It is noted that the Rawhide Wash bed material has a D_{50} = 2 mm by Plate B-2, while the proposed Scottsdale channel bed material has a D_{50} = 4.5 mm by

Plate B-3. Use a weighted average D_{50} = 2.6 mm assuming the transport rate will involve 75% sediment supply and 25% scoured material from Scottsdale Road channel.

Try Slope	= 0.0165 ft/ft
Mean Velocity	= 10.4 fps
Hydraulic Depth	= 2.65 feet
Flow Depth	= 2.85 feet
Width at Mid-Depth	= 118.5 feet
q_s	= 0.326 cfs/ft width at mid-depth
Transport Rate, Q_s	= 38.6 $\simeq$ Supply Rate Target of 38.7 cfs

Therefore the equilibrium slope $\simeq$ 0.0165 ft/ft, if the sediment supply is reduced to 38.7 cfs.

3.3 CONCLUSIONS

The existing ground slope along the proposed Scottsdale Road channel from the electric line easement to the proposed sediment basin is approximately 0.019 feet/feet over the 2560 foot distance. The estimated equilibrium slope is 0.018 feet/feet for the proposed channel with no upstream sediment basin. With an assumed upstream sediment basin reducing sediment inflow by 25 percent, the equilibrium slope is estimated at 0.0165 feet/feet.

It is recommended that two grade control structures be installed over this reach designed for approximately 3 feet grade difference each. One structure is recommended at the channel entrance to the sediment basin and one midway between the sediment basin and Scottsdale Road. Based on this sediment transport analysis, it is recommended that additional sediment basins upstream are not desirable and should not be pursued. A reduction in upstream sediment supply is estimated to result in a milder equilibrium channel slope and a possible need for more or higher grade control structures.

4.0 ALLOWABLE VELOCITY ANALYSIS

4.1 GENERAL DISCUSSION

The proposed channels downstream of the sediment basin were evaluated by the allowable velocity approach as discussed in the Soil Conservation Service (SCS) Design of Open Channels Manual (Technical Release No. 25, TR-25, October, 1977).

This allowable velocity analysis was made for the 10-year storm discharges which were considered to represent the long term or dominant storm event that would dictate long-term sediment transport and erosional trends in the channels.

For this analysis it was necessary to estimate the concentration of fine sediment (less than 0.074 mm). From Step 1 of the earlier equilibrium slope analysis Q sediment for the 10-year discharge was 51.6 cfs. Referring to Plate B-2, there is approximately 25 percent finer by weight of silt or clay size soil. This fine-sediment will pass through the sediment basin and continue downstream in the proposed channels. Thus, for the 10-year storm there are 12.9 cubic feet/second fine sediment in suspension with 3516 cfs of water.

Assume sediment weight = 120 lb/ft^3 12.9
Cubic feet fine sediment x 120 lb/ft^3 = 1548 lb
Therefore, 1548 lb of fine sediment is conveyed in 3516 cubic feet of water per second at the 10-year discharge.
converting to mg/liter or ppm.
Soil = 1548 lb x 453.69 gram/lb x 1000 miligrams/gram = 7.02 x 10^8mg (milligrams)
Water = 3516 ft^3 x 28.32 $liters/ft^3$ = 99573 liters (1)

The estimated 10-year storm sediment concentration is

$$\frac{7.02 \times 10^8 \text{ mg}}{99573 \text{ liters}} = 7052 \text{ mg/l or ppm (parts per million)}$$

4.2 NORTHERN AND EASTERN STUDY AREA SOILS

Referring to Plate B-1, the northern and eastern portions of the study area are of a Momoli gravelly, sand loam. Referring to Plate B-3 and the major soil stratra from 3"-60" depth, the D_{75} (percent finer by weight) is approximately 18 mmvin size.

Referring to Plate B-6 (Figure 6-2 of SCS-TR-55);

There will be excess gravelly, sandy material excavated from the northern and eastern portions of the study area, during channel construction, which has a higher permissible velocity than the existing soils have in the southern and western areas.

It is proposed that the channel construction in these Gilman, sandy loam soils involve overexcavation and placement of a 6-inch layer of processed gravel (5mm or 1/4-inch) plus material obtained from the north or imported. This should produce similar permissible velocities in the south and west study area as are currently available in the north and east study area.

4.4 CONCLUSIONS

Referring to the 10-year storm channel velocities in Table 6, velocities are generally of 4.6 to 5.0 fps with small reaches up to 5.7 fps. Desert vegetation will be transplanted to channel inverts (bottom) and particularly sideslopes, where grass turf is not utilized. The southern and western study area channels are proposed to have additional gravelly soil placed to improve the bare earth permissible velocities to those discussed above. The proposed channels are expected to be generally stable for the long term or dominant 10-year storm discharges.

The duration of the 100-year storm discharges above the 5 fps velocity are approximately 2 hours. The duration of the peak 100-year storm velocities shown on Table 5 will be approximately 1/2 hour. Thus, for the infrequent 100-year storms some channel degradation and lateral erosion may occur. However, the regular interval spacings of road crossings and grade control structures are expected to limit channel degradation to acceptable levels. Likewise, the lateral erosion will be controlled at regular intervals by grade control structures, road crossings and vegetation and is expected to easily remain within the channel topwidth.