

**Drainage Reports**

**Abbreviated Water & Sewer Need Reports**

**Water Study**

**Wastewater Study**

**Stormwater Waiver Application**

***PRELIMINARY DRAINAGE REPORT***

**Reserve at Black Mountain  
Scottsdale, Arizona**

**Case No. 536-PA-2016**

**Prepared For:**

*Pinnacle Land Development, LLC*

Stormwater Review By:  
Nerijus Baronas, P.E., CFM  
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Review Cycle 1 Date 2-3-17



291015001  
December 2016  
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**Kimley»Horn**



City of Scottsdale  
Stormwater Management Division

Memorandum

To: KimleyHorn  
Attn: Kevin W. Payne, PE

From Nerijus Baronas, P.E., CFM  
City of Scottsdale Sr. Stormwater Engineer  
480-312-7072, nbaronas@scottsdaleaz.gov

Re: Drainage review comments for Reserve at Black Mountain.  
Case number: 26-ZN-2016  
Review date: 11-30-2016

**RESUBMITTAL INFORMATION:** Please address the following review comments:

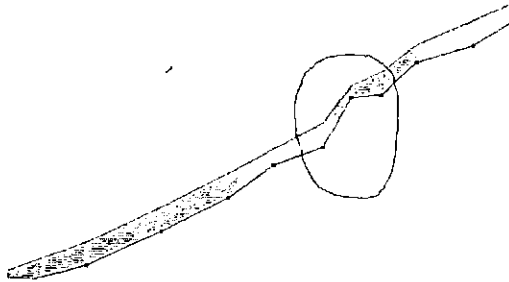
**Policy and Design Related Issues:**

1. The content and analysis requirements for case drainage reports in support of general plan amendments and zoning applications are not the same as those for case drainage reports in support of development review or preliminary plat applications. The City requires significantly less information and analysis for the former applications due to the preliminary nature of these applications. In general, case drainage reports submitted in support of zoning applications should include a 50% level of design and analysis.
2. Missing off-site watershed delineation exhibits
3. Provide HEC-1 schematic depicting all basins, storage, routing and concentration points consistent with the submitted model. Schematic shall be provided for existing and proposed conditions.
4. HEC-1 model LG Record – Green and Ampt Loss Rate, Field 5 RTIMP appears to be low for proposed condition when compared to existing condition. Provide Exhibit with analysis do show Percent of subbasin which is impervious for all proposed condition basins.
5. Provide rating tables for storage basin volume and outflow/overflow analysis.
6. Land use map is missing
7. Soils Map is missing
8. Proposed Condition HEC-RAS model is missing
9. Erosion setback limits analysis and discussion need to be expanded.
10. Identify proposed condition stormwater infrastructure sizes (catch basins, storm drains, culverts and erosion mitigation measures)
11. Revise bank station locations in HEC-RAS model



- 12 Submit DDMS and HEC-1 digital input / output files
- 13 Proposed condition drainage map add flow direction arrows which will conform to each lot grading upon development
- 14 Show and callout retaining walls if any
- 15 Discuss how each individual lot will be developed Do you plan to provide custom G&D for each lot?
- 16 Review / revise wash flow line of Ex HEC-RAS model

Attachment 1 Plan Existing Conditions\_B11 11.03.2016



### **Resubmittal Checklist**

- **Please briefly respond to the above comments (or check it with marker) and include the response in the re-submittal Please also see comments in preliminary drainage report**
- 1 Copies of Drainage Report
- 1 CD's with pdf files of drainage report and all supporting hydrologic and hydraulic digital files

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*- ADD LATERAL EROSION SETBACK ANALYSIS / DISCUSSION.*

List of Appendices

- A Site Location Map
- B FEMA Federal Insurance Rate Map (FIRM)
- C Hydrologic/Hydraulic Calculations
- D Exhibits
- E Stormwater Storage Waiver

*MISSING HEC-RAS:  
- DIGITAL FILES FOR  
EX. AND PROP. CONDITIONS  
- HEC-RAS SECTION LOCATIONS.*

List of Figures in Appendix D (Exhibits)

- Figure 1: Context Aerial Map
- Figure 2: Offsite Watershed Exhibit – Andaluza Proposed Conditions
- Figure 3: Offsite Watershed Exhibit – Sierra Highlands Proposed Conditions
- Figure 4: Soils Map
- Figure 5: Existing Conditions Drainage Map
- Figure 6: Existing Conditions HEC-1 Map
- Figure 7: Proposed Conditions Land Use Map
- Figure 8: Proposed Conditions Drainage Map
- Figure 9: Proposed Conditions HEC-1 Map
- Figure 10: Preliminary Grading and Drainage Plan

*UPDATE FIGURE #'S*

*MISSING*

## 1.0 Introduction

### 1.1 Project Description

Pinnacle Land Development, LLC is proposing to construct a single-family housing development consisting of 30 lots on the northwest corner of Black Mountain Road and 84th Street. The project is anticipated to consist of a single-family housing development and associated site infrastructure.

### 1.2 Site Location

The proposed development encompasses approximately 35.6± net acres in a portion of the Southwest Quarter of Section 1, Township 5 North, Range 4 East of the Gila and Salt River Meridian in Maricopa County, Arizona. The parcel is bounded by Black Mountain Road to the south, 84th Street to the east, Vista Viento Estates to the north, and the Sand Flower subdivision to the west. A site location map is included in Appendix A and a Context Aerial Map is provided as Figure 1 in Appendix D.

The site is currently undeveloped natural desert landscape that falls within the Environmentally Sensitive Lands Overlay (ESLO).

### 1.3 Purpose

This Preliminary Drainage Report is intended to satisfy City of Scottsdale requirements and demonstrate conformance to the overall drainage characteristics of the area. This report provides a description of the current storm water drainage patterns and systems and a description of the required and proposed drainage improvements.

### 1.4 Objectives

This report provides a drainage plan for the subject site that is intended to meet the drainage standards and guidelines of the City of Scottsdale and the Flood Control District of Maricopa County (FCDMC). In particular, this report will demonstrate the following:

1. Buildings and site amenities will be elevated such that regional storm water flows from un-named regulatory washes do not adversely impact the development.
2. Permanent drainage facilities will have a positive outfall, and any detained storm water will be disposed of within 36 hours.
3. Drainage facilities will be designed such that the 100-year post-development flows are collected and conveyed in such a manner so as to not cause damage to buildings and property.
4. Storm water detention and attenuation is provided with the intention of discharging at the same rate of pre-development at the property boundaries.

5. Building finished floor elevations are in compliance with City of Scottsdale requirements.

**2.0 Description of Existing Drainage Conditions and Characteristics**

**2.1 Existing Off-Site Drainage Calculations**

Offsite contributing drainage areas have been developed as part of the Andaluza and Sierra Highlands developments (Figures 2 and 3), currently under construction. The Andaluza and Sierra Highland HEC-1 Models were re-created within this study using updated NOAA-14 rainfall information. The offsite flow was quantified with three (3) concentration points at the upstream boundary of the site using the same nomenclature as the Andaluza and Sierra Highlands HEC-1 models. Table 1 summarizes the contributing flow from the upstream developments.

**Table 1 Existing Offsite Flows**

Concentration Point	2-Yr (cfs)	10-Yr (cfs)	100-Yr (cfs)
ARET20	3	7	18
SCP030	7	19	42
SCP025	42	94	184

**2.2 Existing Site Drainage Conditions**

The site currently consists of vacant land. The general topography of the site slopes from the northeast to the southwest at approximately 1-2% and could be described as hilly terrain with incised watercourses. One significant wash (> 50 cfs) transects the site and another wash exceeds the 50 cfs threshold onsite, downstream of CP060. Natural desert vegetation exists throughout the site. A soils map of the project area is provided as Figure 4 in Appendix D.

Site watersheds were delineated using topography flown for the project, supplemented with 2-foot contours provided by the FCDMC. The site is mostly comprised of seventeen (17) on-site sub-basins which drain to the southwest and exit the site at fifteen (15) locations along the western and southern property lines. Watershed, soil, land use, and time of concentration information was input into DDMSW in the form of GIS shapefiles. DDMSW was utilized to develop a HEC-1 model using the Green and Ampt loss-rate method.

Sub-basins and corresponding 100-year discharges are shown on the Existing Conditions Drainage Map, Figure 5 in Appendix D. A schematic of the Existing Conditions HEC-1 model is included as Figure 6 in Appendix D.

**2.3 Context Relative to Adjacent Projects and Improvements**

The improvements to 84<sup>th</sup> Street have been completed within the last year. See Figure 1 in Appendix D for the Context Aerial Map.

## 2.4 FEMA Flood Hazard Areas

The site is located in an unshaded Zone X according to the Flood Insurance Rate Map (FIRM) 04013C0895L, dated October 16, 2013. Unshaded Zone X areas are defined by FEMA as “areas determined to be outside the 0.2% annual chance floodplain.” Refer to Appendix B for the FEMA FIRMette map for the site.

## 3.0 Proposed Drainage Plan

### 3.1 General Description

The following items are considered in the proposed drainage conditions analysis

- Area Types (pavement, building, and desert landscaping)
- Magnitude of Areas
- Slopes
- Cross Drainage
- Detention Basins/Attenuation from Culverts

### 3.2 Proposed Off-Site Drainage Conditions

Black Mountain Road, to the south of the site, will be improved to an urban roadway section, without adding additional lanes. 84<sup>th</sup> Street, east of the site, is in its built-out condition, therefore no future improvements are anticipated. The areas to the north and west are developed.

### 3.3 Proposed Site Drainage Conditions

Site-generated storm water will be collected in natural channels and proposed residential streets and attenuated by three on-site detention basins. The thirty (30) lots are graded to either drain into the street or to the back into natural channels. Future land use is shown on Figure 7 in Appendix D. Refer to Figure 8 for proposed sub-basins and attenuation locations and Figure 9 for a schematic of the Proposed Conditions HEC-1 model.

The proposed site was modeled hydrologically using developed conditions loss-rate parameters generated using DDMSW. A comparison of pre versus post discharges is provided in Table 2.

Table 2: Peak Discharge Reduction from Proposed Improvements

UPDATE PER COMMENTS ON FIGURE 8.

Concentration Point	Pre			Post		
	2-Yr (cfs)	10-Yr (cfs)	100-Yr (cfs)	2-Yr (cfs)	10-Yr (cfs)	100-Yr (cfs)
OF-10	1	2	5	0	1	1
ON-10	1	2	3	1	1	3
ON-20	2	5	11	0	1	2
ON-30	0	1	2	0	1	1
ON-40	8	18	43	3	13	41
ON-50	1	1	3	0	0	1
ON-70	9	23	57	9	23	56
ON-80	1	3	7	1	3	6
ON-90	0	1	1	0	0	0
ON-100	0	0	1	0	0	1
ON-110	0	1	1	0	1	1
ON-120	2	4	9	1	2	5
ON-130	43	95	187	43	95	187
ON-140	0	0	1	0	0	1
ON-150	1	1	3	1	1	3

ADD RTMP VALUES FOR EX. & PROP. COND.

**3.4 Storm Water Storage Requirements**

Due to the location of the project in the ESLO overlay zone, the site is only required to ensure pre versus post runoff conditions are met. A stormwater storage waiver has been submitted to formalize the storage requirements for this project, see Appendix E.

**3.5 Pre- and Post-Development Runoff Characteristics at Concentration Points**

The existing site consists of approximately 35.6± acres of vacant land that drains from the northeast to the southwest. The existing drainage patterns create fifteen (15) concentration points along the downstream perimeter of the site, as shown on Figure 5. These concentration points are maintained in proposed conditions, as shown on Figure 8.

**3.6 Proposed Drainage Structures or Special Drainage Facilities**

Storm water quality will be maintained by elevating the outfall headwall, or orifice plate, 6 to 9 inches above the basin bottom. This will allow the basin to capture and dispose of the first flush of storm water via natural percolation. Orifice plates or pipe sizing will be used to meter the storm water outflow. Sizing recommendations will be included with the Final Drainage Report.

Project roadways will have four drainage crossings, two of which originate in detention basins and will be used to meter outflow. The crossing west of Lot 4 will consist of a single barrel 24-inch RCP and the crossing east of Lot 1 will consist of a double barrel 24-inch RCP.

Normal depth calculations used to size roadside ditches and determine roadway drainage capacities will be included in the Final Drainage Report.

Building finished floor elevations need to be at least one foot above the highest adjacent water surface elevation.

### **3.7 ADEQ AZPDES requirements**

An executed Notice of Intent (NOI) will be submitted to the Arizona Department of Environmental Quality (ADEQ) in conformance with the Arizona Pollution Discharge Elimination System Permit (AZPDES) permit. The NOI and associated storm water management best management practices will remain active on the site until construction is complete and a Notice of Termination is filed with ADEQ in conformance with the AZPDES permit.

### **3.8 Project Phasing**

This project will be constructed in a single phase. The lots will be graded individually (Figure 10) but will maintain the patterns set forth in this report and the preliminary plat.

## 4.0 Special Conditions

### 4.1 404 Discussion

A Preliminary Jurisdictional Delineation is being prepared and will be submitted to the U S Army Corps of Engineers (Corps) for concurrence. There are approximately 0.45 acres of potentially jurisdictional Waters of the U S (WOUS) onsite. Based on preliminary impact calculations, it appears the the project will qualify for a Nationwide Permit (NWP) No. 20-Residential Developments that requires Pre-Construction Notification (PCN) to the Corps.

## 5.0 Data Analysis Methods

### 5.1 Hydrologic Procedures, Parameter Selection, and Assumptions

Hydrologic calculations for the site were performed using the Green & Ampt loss-rate method in HEC-1 maintaining the outfall locations developed within the existing conditions HEC-1 model. The DDMSW program was used to generate HEC-1 input files based on land-use, soils, and impervious cover.

For analysis of the proposed site, the site was sub-divided into 27 sub-basins consisting of paved areas, building areas, or landscaped areas. For each sub-basin, DDMSW generated loss-rate and unit hydrograph parameters for HEC-1. Future imperviousness was derived within DDMSW based on land use codes assigned according to lot density. Individual lot envelopes and associated right-of-way indicate a lot density of 1-2 homes/acre which corresponds to the large lot residential designation within DDMSW. HEC-1 output is located in Appendix C. Figure 8, which identifies the drainage sub-basin and concentration points, is located in Appendix D.

### 5.2 Hydraulic Procedures, Methods, Parameter Selection, and Assumptions

The site is divided into 27 sub-basins that drain into several natural and man-made channels. See Figure 8 in Appendix D for proposed drainage structures and concentration points associated with each drainage basin.

The hydraulic capacity of the proposed streets will be determined using normal depth calculations during final design.

Cross-drainage pipes will be modeled during final design. Roadway elevations should be designed to account for headwater generated by these culverts.

HEC-RAS was utilized to develop water surface profiles for washes >50 cfs. A steep drop in the channel bed elevation of Wash 70 occurs between XS 1122 and 1160 on Wash 70. This is due to an outcropping of bedrock that prevents the channel upstream from reaching its equilibrium slope. Floodplains were delineated in the natural channels using the 100-year discharges for existing conditions. In proposed conditions the flows are slightly lower as demonstrated in Table 2, so the existing conditions discharges are more conservative. Drainage Easements for the two washes > 50 cfs will be dedicated to the City. The easements will encompass the limits of the 100-year floodplain.

Erosion hazard setbacks (EHS) were developed using Arizona Department of Water Resources (ADWR) State Standards. EHS were delineated by setting back from the channel banks and modified by setting back from the floodplain limit when the floodplain limits were closer to the stream centerline.

Storm water quality will be maintained by elevating the surface basin outfall above the bottom of the basin, so that the first flush of storm water runoff will infiltrate within the basin.

## 6.0 Conclusion

Based on the results of this preliminary drainage report, the following can be concluded

- Off-site storm water flows from upstream development will be accommodated and passed through the site safely with adjacent residences elevated at least 1-ft above the 100-year water surface elevations
- This project is compatible with the overall natural drainage patterns and impacts to hydrology from development can be more than adequately attenuated and mitigated
- Flows leaving the developed site on the west and south will be less than or equal to existing conditions thus meeting ESLO pre versus post requirements

This drainage report is intended to provide a level of assurance that the proposed improvements will adhere to all appropriate reviewing agency guidelines with respect to drainage and flood protection

## 7.0 References

- 1 City of Scottsdale, *Design Standards and Policies Manual, Chapter 4 Grading and Drainage*, January 2010
- 2 Federal Emergency Management Agency (FEMA), *Flood Insurance Rate Map (FIRM) of Maricopa County, Arizona and Incorporated Areas, Panel 895 of 4425, Map Number 04013C0895L*, October 16, 2013
- 3 Flood Control District of Maricopa County (FCDMC), *Drainage Design Manual for Maricopa County, Hydrology Volume, February, 2008*
- 4 Flood Control District of Maricopa County (FCDMC), *Drainage Design Manual for Maricopa County, Hydraulics Volume, January, 1996*
- 5 Kimley-Horn, *Final Drainage Report for Andaluza*, August, 2014
- 6 Kimley-Horn, *Final Drainage Report for Sierra Highlands*, November, 2014

*Appendix A*

Site Location Map

# Site Location Map

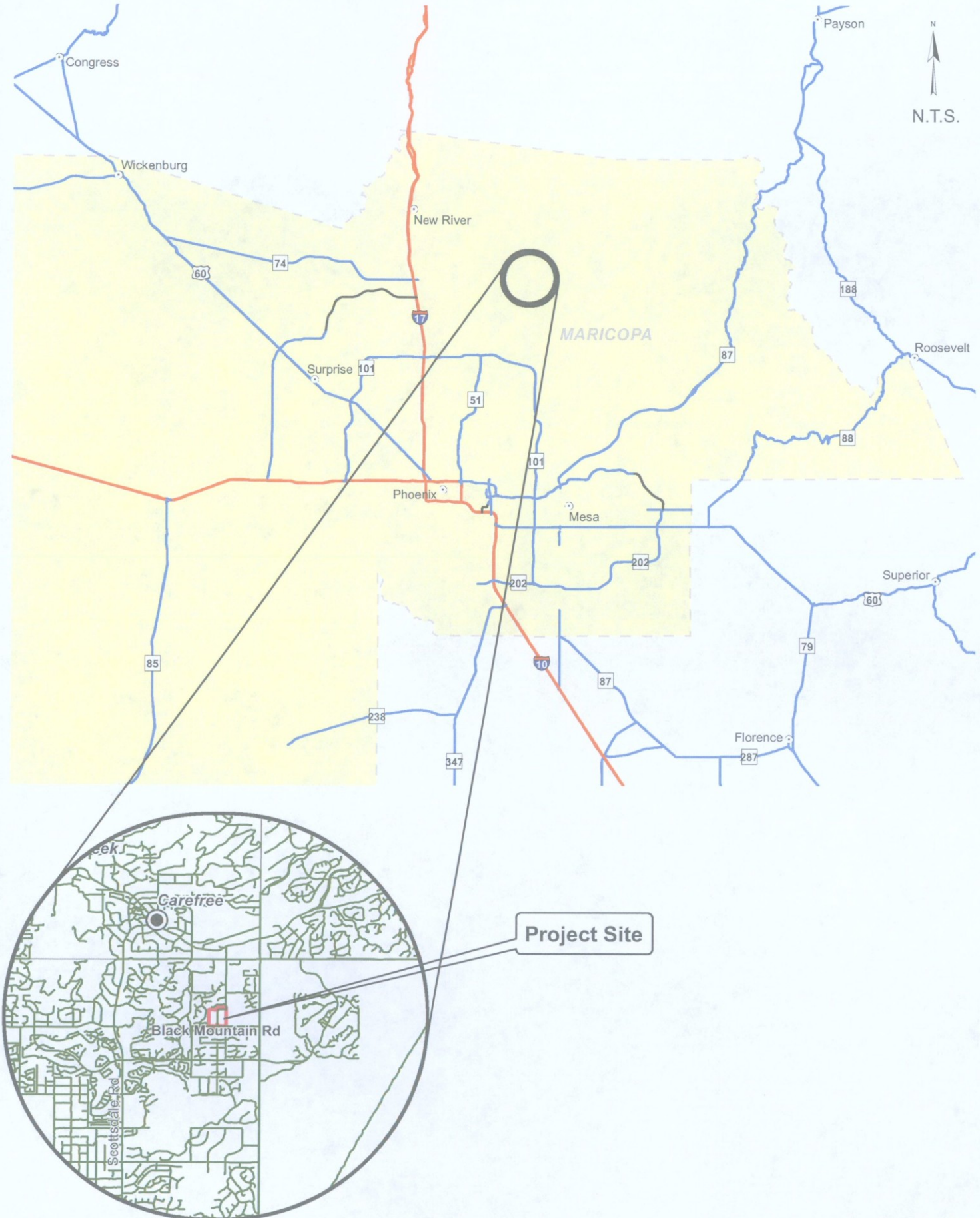
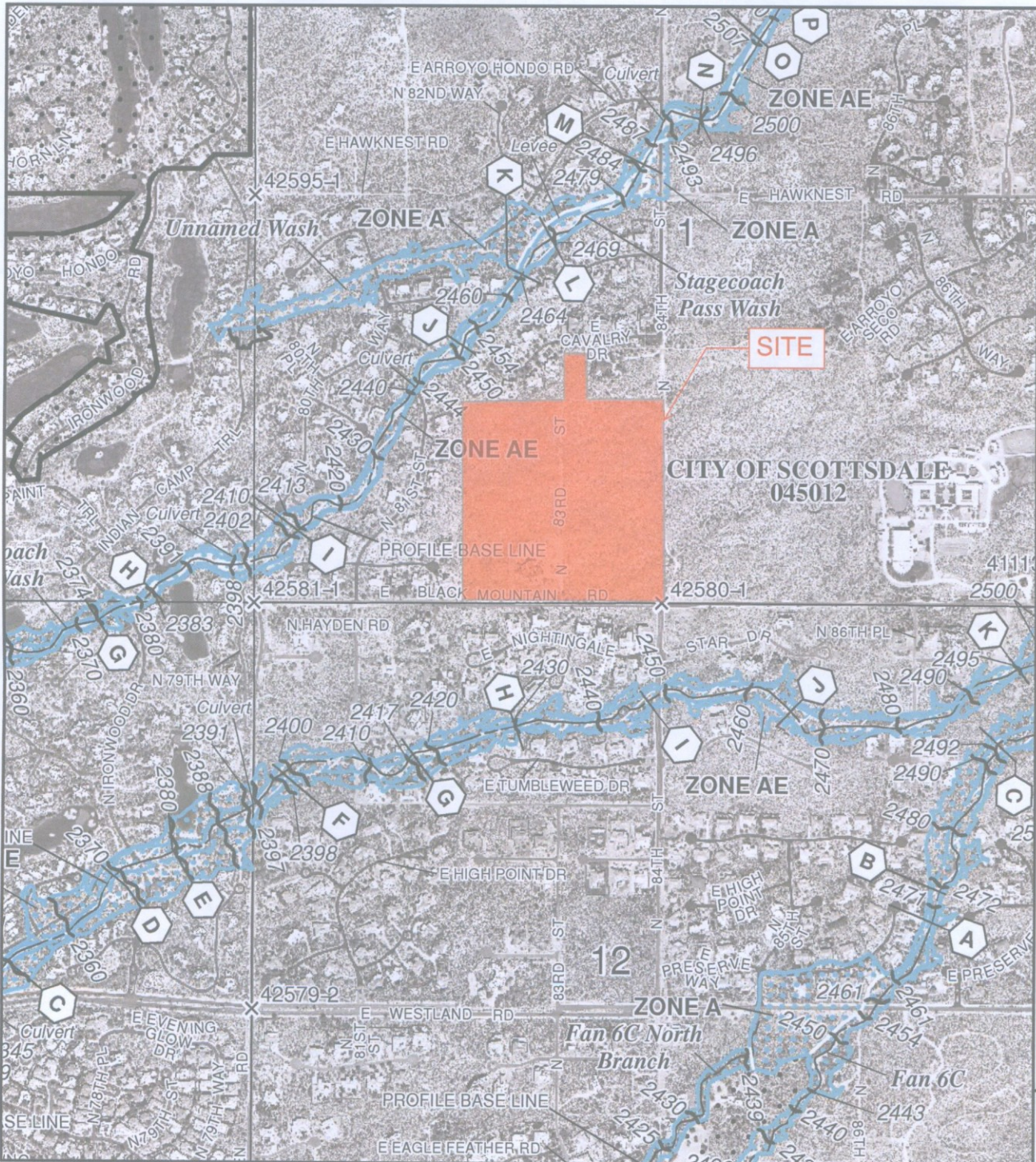


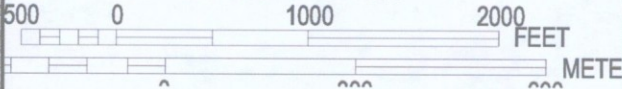
FIGURE 1

*Appendix B*

FEMA Flood Insurance Rate Map (FIRM)



MAP SCALE 1" = 1000'



NFIP

PANEL U895L

NATIONAL FLOOD INSURANCE PROGRAM

**FIRM**  
**FLOOD INSURANCE RATE MAP**  
**MARICOPA COUNTY,**  
**ARIZONA**  
**AND INCORPORATED AREAS**

**PANEL 895 OF 4425**  
 (SEE MAP INDEX FOR FIRM PANEL LAYOUT)

**CONTAINS:**

COMMUNITY	NUMBER	PANEL	SUFFIX
MARICOPA COUNTY	040037	0895	L
CAREFREE, TOWN OF	040126	0895	L
SCOTTSDALE, CITY OF	045012	0895	L

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.



**MAP NUMBER**  
**04013C0895L**  
**MAP REVISED**  
**OCTOBER 16, 2013**

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at [www.msc.fema.gov](http://www.msc.fema.gov)

*Appendix C*

Hydrologic/Hydraulic Calculations

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1*****
*****
*
* FLOOD HYDROGRAPH PACKAGE (HEC-1) *
*
* JUN 1998 *
*
* VERSION 4.1 *
*
* RUN DATE 19DEC16 TIME 15:01:37 *
*
*****
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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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X X X X X XX
X X X X X
XXXXXXX XXXX X XXXXX X
X X X X X
X X X X X
X X XXXXXXX XXXXX XXX

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THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE. THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION  
 NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,  
 DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION  
 KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

LINE	ID	1	2	3	4	5	6	7	8	9	10
1	ID	Flood Control District of Maricopa County									
2	ID	BLACK MOUNTAIN - BLACK MOUNTAIN EXISTING CONDITIONS									
3	ID	2 YEAR									
4	ID	6 Hour Storm									
5	ID	Unit Hydrograph: Clark									
6	ID	Storm: Multiple									
7	ID	08/23/2016									
	*DIAGRAM										
8	IT	5	1JAN99	0	2000						
9	IO	5									
10	IN	15									
	*										
11	KK	OF-10	BASIN								
12	BA	0.0018									
13	PB	1.394									
14	PC	0.000	0.008	0.016	0.025	0.033	0.041	0.050	0.058	0.066	0.074
15	PC	0.087	0.099	0.118	0.138	0.216	0.377	0.834	0.911	0.931	0.950
16	PC	0.962	0.972	0.983	0.991	1.000					
17	LG	0.12	0.25	5.05	0.42	6					
18	UC	0.165	0.182								
19	UA	0	3.0	5.0	8.0	12.0	20.0	43.0	75.0	90.0	96.0
20	UA	100									
	*										
21	KK	ON-10	BASIN								
22	BA	0.0016									
23	LG	0.10	0.25	5.05	0.44	5					
24	UC	0.198	0.282								
25	UA	0	3.0	5.0	8.0	12.0	20.0	43.0	75.0	90.0	96.0
26	UA	100									
	*										
27	KK	ON-20	BASIN								
28	BA	0.0058									
29	LG	0.10	0.25	5.05	0.44	5					
30	UC	0.281	0.386								
31	UA	0	3.0	5.0	8.0	12.0	20.0	43.0	75.0	90.0	96.0
32	UA	100									
	*										
33	KK	ON-30	BASIN								
34	BA	0.0009									



\*  
 95 KK SOF-30 BASIN  
 96 BA 0.007  
 97 LG 0.35 0.36 5.05 0.27 0  
 98 UC 0.166 0.146  
 99 UA 0 3.0 5.0 8.0 12.0 20.0 43.0 75.0 90.0 96.0  
 100 UA 100  
 \*

101 KK SROF30 ROUTE  
 102 RS 1 FLOW  
 103 RC 0.035 0.035 0.035 386 0.0214 2484.00  
 104 RX 0.00 37.00 45.00 52.00 66.00 81.00 96.00 153.00  
 105 RY 2484.0 2480.00 2478.00 2476.00 2476.00 2478.00 2480.00 2484.00  
 \*

106 KK SON-26 BASIN  
 107 BA 0.001  
 108 LG 0.35 0.36 5.05 0.27 0  
 109 UC 0.138 0.279  
 110 UA 0 3.0 5.0 8.0 12.0 20.0 43.0 75.0 90.0 96.0  
 111 UA 100  
 \*

112 KK SCP026 COMBINE  
 113 HC 2  
 \*

114 KK SR2628 ROUTE  
 115 RS 1 FLOW  
 116 RC 0.035 0.035 0.035 740 0.0214 2484.00  
 117 RX 0.00 37.00 45.00 52.00 66.00 81.00 96.00 153.00  
 118 RY 2484.0 2480.00 2478.00 2476.00 2476.00 2478.00 2480.00 2484.00  
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HEC-1 INPUT

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

119 KK SON-28 BASIN  
 120 BA 0.010  
 121 LG 0.31 0.26 5.05 0.26 15  
 122 UC 0.133 0.106  
 123 UA 0 5.0 16.0 30.0 65.0 77.0 84.0 90.0 94.0 97.0  
 124 UA 100  
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125 KK SCP028 COMBINE  
 126 HC 2  
 \*

127 KK SRET28 STORAGE  
 128 RS 1 STOR  
 129 SV 0.11 0.26 0.30 0.35 0.40 0.46  
 130 SQ 3.94 6.13 11.27 20.23 31.64 45.04  
 131 SE 2475.0 2476.00 2477.00 2477.30 2477.50 2477.80 2478.00  
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132 KK SON-27 BASIN  
 133 BA 0.009  
 134 LG 0.30 0.25 5.58 0.20 17  
 135 UC 0.139 0.168  
 136 UA 0 5.0 16.0 30.0 65.0 77.0 84.0 90.0 94.0 97.0  
 137 UA 100  
 \*

138 KK SRET27 STORAGE  
 139 RS 1 STOR  
 140 SV 0.18 0.39 0.64 0.78  
 141 SQ 2.00 3.30 4.22 4.61  
 142 SE 2472.0 2473.00 2474.00 2475.00 2475.50  
 \*

143 KK SON-30 BASIN  
 144 BA 0.001  
 145 LG 0.35 0.36 5.05 0.27 0  
 146 UC 0.112 0.177  
 147 UA 0 3.0 5.0 8.0 12.0 20.0 43.0 75.0 90.0 96.0  
 148 UA 100  
 \*

149 KK SCP030 COMBINE  
 150 HC 3  
 \*

151 KK RSON30 ROUTE  
 152 RS 1 FLOW  
 153 RC 0.035 0.035 0.035 530 0.0226 2464.00  
 154 RX 0.00 4.00 6.00 8.00 10.00 13.00 33.00 43.00

155 RY 2464.0 2463.00 2462.00 2461.00 2461.00 2462.00 2463.00 2464.00

\*

HEC-1 INPUT

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

156 KK ON-60 BASIN  
157 BA 0.005  
158 LG 0.10 0.25 5.05 0.44 5  
159 UC 0.292 0.425  
160 UA 0 3.0 5.0 8.0 12.0 20.0 43.0 75.0 90.0 96.0  
161 UA 100  
\*

162 KK CP060 COMBINE  
163 HC 2  
\*

164 KK RON60 ROUTE  
165 RS 1 FLOW  
166 RC 0.035 0.035 0.035 2435 0.0111 2454.00  
167 RX 0.00 3.00 5.00 8.00 13.00 17.00 21.00 27.00  
168 RY 2454.0 2453.00 2452.00 2451.00 2451.00 2452.00 2453.00 2454.00  
\*

169 KK ON-70 BASIN  
170 BA 0.0123  
171 LG 0.12 0.25 4.96 0.44 6  
172 UC 0.374 0.494  
173 UA 0 3.0 5.0 8.0 12.0 20.0 43.0 75.0 90.0 96.0  
174 UA 100  
\*

175 KK CP070 COMBINE  
176 HC 2  
\*

177 KK ON-80 BASIN  
178 BA 0.0043  
179 LG 0.11 0.25 5.05 0.43 6  
180 UC 0.308 0.564  
181 UA 0 3.0 5.0 8.0 12.0 20.0 43.0 75.0 90.0 96.0  
182 UA 100  
\*

183 KK ON-90 BASIN  
184 BA 0.0005  
185 LG 0.10 0.25 4.33 0.62 5  
186 UC 0.147 0.171  
187 UA 0 3.0 5.0 8.0 12.0 20.0 43.0 75.0 90.0 96.0  
188 UA 100  
\*

189 KK ON-100 BASIN  
190 BA 0.0003  
191 LG 0.10 0.25 4.33 0.62 5  
192 UC 0.146 0.171  
193 UA 0 3.0 5.0 8.0 12.0 20.0 43.0 75.0 90.0 96.0  
194 UA 100  
\*

HEC-1 INPUT

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

195 KK CPBND2 COMBINE  
196 HC 3  
\*

197 KK SOF-25 BASIN  
198 BA 0.112  
199 LG 0.32 0.33 5.71 0.22 12  
200 UC 0.376 0.375  
201 UA 0 3.0 5.0 8.0 12.0 20.0 43.0 75.0 90.0 96.0  
202 UA 100  
\*

203 KK SROF25 ROUTE  
204 RS 1 FLOW  
205 RC 0.035 0.035 0.035 1880 0.0164 2486.00  
206 RX 0.00 29.00 41.00 47.00 50.00 64.00 95.00 128.00  
207 RY 2486.0 2480.00 2478.00 2476.00 2476.00 2478.00 2480.00 2486.00  
\*

208 KK SON-22 BASIN  
209 BA 0.015  
210 LG 0.34 0.36 6.00 0.17 5  
211 UC 0.288 0.479  
212 UA 0 3.0 5.0 8.0 12.0 20.0 43.0 75.0 90.0 96.0



57	.	.	.	.	.	.	.	ON-150
63	CPBNDY	.	.	.	.	.	.	.
65	.	AON-20	.	.	.	.	.	.
	.	V	.	.	.	.	.	.
	.	V	.	.	.	.	.	.
71	.	ARET20	.	.	.	.	.	.
	.	V	.	.	.	.	.	.
	.	V	.	.	.	.	.	.
76	.	RAON20	.	.	.	.	.	.
81	.	.	ON-40	.	.	.	.	.
87	.	CP040	.	.	.	.	.	.
89	.	.	ON-50	.	.	.	.	.
95	.	.	.	SOF-30	.	.	.	.
	.	.	.	V	.	.	.	.
	.	.	.	V	.	.	.	.
101	.	.	.	SROF30	.	.	.	.
106	.	.	.	.	SON-26	.	.	.
112	.	.	.	SCP026	.	.	.	.
	.	.	.	V	.	.	.	.
	.	.	.	V	.	.	.	.
114	.	.	.	SR2628	.	.	.	.
119	.	.	.	.	SON-28	.	.	.
125	.	.	.	SCP028	.	.	.	.
	.	.	.	V	.	.	.	.
	.	.	.	V	.	.	.	.
127	.	.	.	SRET28	.	.	.	.
132	.	.	.	.	SON-27	.	.	.
	.	.	.	.	V	.	.	.
	.	.	.	.	V	.	.	.
138	.	.	.	SRET27	.	.	.	.
143	.	.	.	.	SON-30	.	.	.
149	.	.	.	SCP030	.	.	.	.
	.	.	.	V	.	.	.	.
	.	.	.	V	.	.	.	.
151	.	.	.	RSON30	.	.	.	.
156	.	.	.	.	ON-60	.	.	.
162	.	.	.	CP060	.	.	.	.
	.	.	.	V	.	.	.	.
	.	.	.	V	.	.	.	.
164	.	.	.	RON60	.	.	.	.
169	.	.	.	.	ON-70	.	.	.
175	.	.	.	CP070	.	.	.	.
177	.	.	.	.	ON-80	.	.	.
183	.	.	.	.	ON-90	.	.	.
189	.	.	.	.	ON-100	.	.	.
195	.	.	.	CPBND2	.	.	.	.

```

197 . . . . . SOF-25
. . . . . V
. . . . . V
203 . . . . . SROF25
. . . . .
. . . . .
208 . . . . . SON-22
. . . . .
. . . . .
214 . . . . . SCP022
. . . . . V
. . . . . V
216 . . . . . SR2225
. . . . .
. . . . .
221 . . . . . SON-25
. . . . .
. . . . .
227 . . . . . SON-24
. . . . . V
. . . . . V
233 . . . . . SRET24
. . . . .
. . . . .
238 . . . . . SCP025
. . . . . V
. . . . . V
240 . . . . . RSON25
. . . . .
. . . . .
245 . . . . . ON-130
. . . . .
. . . . .
251 . . . . . CP130

```

(\*\*\*) RUNOFF ALSO COMPUTED AT THIS LOCATION

```

1*****
*****
*
*
* FLOOD HYDROGRAPH PACKAGE (HEC-1) *
*
* JUN 1998 *
*
* VERSION 4.1 *
*
*
* RUN DATE 19DEC16 TIME 15:01:37 *
*
*
*****
*****

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```

*
* U.S. ARMY CORPS OF ENGINEERS
*
* HYDROLOGIC ENGINEERING CENTER
*
* 609 SECOND STREET
*
* DAVIS, CALIFORNIA 95616
*
* (916) 756-1104
*

```

Flood Control District of Maricopa County  
BLACK MOUNTAIN - BLACK MOUNTAIN EXISTING CONDITIONS  
2 YEAR  
6 Hour Storm  
Unit Hydrograph: Clark  
Storm: Multiple  
08/23/2016

```

9 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 1JAN99 STARTING DATE
ITIME 0000 STARTING TIME
NQ 2000 NUMBER OF HYDROGRAPH ORDINATES
NDDATE 7JAN99 ENDING DATE
NDTIME 2235 ENDING TIME
ICENT 19 CENTURY MARK

```

COMPUTATION INTERVAL .08 HOURS  
TOTAL TIME BASE 166.58 HOURS

ENGLISH UNITS  
DRAINAGE AREA SQUARE MILES  
PRECIPITATION DEPTH INCHES  
LENGTH, ELEVATION FEET

FLOW  
STORAGE VOLUME  
SURFACE AREA  
TEMPERATURE

CUBIC FEET PER SECOND  
ACRE-FEET  
ACRES  
DEGREES FAHRENHEIT

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			BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
				6-HOUR	24-HOUR	72-HOUR			
HYDROGRAPH AT	OF-10	1.	4.08	0.	0.	0.	.00		
HYDROGRAPH AT	ON-10	1.	4.17	0.	0.	0.	.00		
HYDROGRAPH AT	ON-20	2.	4.17	0.	0.	0.	.01		
HYDROGRAPH AT	ON-30	0.	4.08	0.	0.	0.	.00		
HYDROGRAPH AT	ON-110	0.	4.00	0.	0.	0.	.00		
HYDROGRAPH AT	ON-120	2.	4.25	0.	0.	0.	.01		
HYDROGRAPH AT	ON-140	0.	4.00	0.	0.	0.	.00		
HYDROGRAPH AT	ON-150	1.	4.08	0.	0.	0.	.00		
8 COMBINED AT	CPBNDY	6.	4.17	1.	0.	0.	.02		
HYDROGRAPH AT	AON-20	11.	4.08	1.	0.	0.	.02		
ROUTED TO	ARET20	3.	4.42	1.	0.	0.	.02	2482.86	4.42
ROUTED TO	RAON20	3.	4.75	1.	0.	0.	.02	2450.24	4.75
HYDROGRAPH AT	ON-40	6.	4.33	1.	0.	0.	.02		
2 COMBINED AT	CP040	8.	4.33	2.	0.	0.	.04		
HYDROGRAPH AT	ON-50	1.	4.08	0.	0.	0.	.00		
HYDROGRAPH AT	SOF-30	3.	4.08	0.	0.	0.	.01		
ROUTED TO	SROF30	3.	4.17	0.	0.	0.	.01	2476.06	4.17
HYDROGRAPH AT	SON-26	0.	4.08	0.	0.	0.	.00		
2 COMBINED AT	SCP026	4.	4.17	0.	0.	0.	.01		
ROUTED TO	SR2628	3.	4.17	0.	0.	0.	.01	2476.06	4.17
HYDROGRAPH AT	SON-28	8.	4.00	1.	0.	0.	.01		
2 COMBINED AT	SCP028	9.	4.08	1.	0.	0.	.02		
ROUTED TO	SRET28	5.	4.25	1.	0.	0.	.02	2476.32	4.25
HYDROGRAPH AT	SON-27	7.	4.00	1.	0.	0.	.01		

+	ROUTED TO	SRET27	2.	4.33	1.	0.	0.	.01		
+									2472.93	4.33
+	HYDROGRAPH AT	SON-30	0.	4.08	0.	0.	0.	.00		
+	3 COMBINED AT	SCP030	7.	4.25	1.	0.	0.	.03		
+	ROUTED TO	RSON30	7.	4.33	1.	0.	0.	.03		
+									2461.56	4.33
+	HYDROGRAPH AT	ON-60	2.	4.25	0.	0.	0.	.00		
+	2 COMBINED AT	CP060	8.	4.25	1.	0.	0.	.03		
+	ROUTED TO	RON60	7.	4.58	1.	0.	0.	.03		
+									2451.44	4.58
+	HYDROGRAPH AT	ON-70	4.	4.25	0.	0.	0.	.01		
+	2 COMBINED AT	CP070	9.	4.42	2.	0.	0.	.05		
+	HYDROGRAPH AT	ON-80	1.	4.25	0.	0.	0.	.00		
+	HYDROGRAPH AT	ON-90	0.	4.08	0.	0.	0.	.00		
+	HYDROGRAPH AT	ON-100	0.	4.08	0.	0.	0.	.00		
+	3 COMBINED AT	CPBND2	1.	4.17	0.	0.	0.	.01		
+	HYDROGRAPH AT	SOF-25	44.	4.25	5.	1.	0.	.11		
+	ROUTED TO	SROF25	38.	4.33	5.	1.	0.	.11		
+									2477.08	4.33
+	HYDROGRAPH AT	SON-22	5.	4.25	1.	0.	0.	.01		
+	2 COMBINED AT	SCP022	42.	4.33	6.	1.	0.	.13		
+	ROUTED TO	SR2225	42.	4.33	6.	1.	0.	.13		
+									2477.12	4.33
+	HYDROGRAPH AT	SON-25	1.	4.08	0.	0.	0.	.00		
+	HYDROGRAPH AT	SON-24	2.	4.08	0.	0.	0.	.00		
+	ROUTED TO	SRET24	0.	4.42	0.	0.	0.	.00		
+									2467.47	4.42
+	3 COMBINED AT	SCP025	42.	4.33	6.	2.	1.	.13		
+	ROUTED TO	RSON25	43.	4.42	6.	2.	1.	.13		
+									2453.66	4.42
+	HYDROGRAPH AT	ON-130	1.	4.25	0.	0.	0.	.00		
+	2 COMBINED AT	CP130	43.	4.42	6.	2.	1.	.14		

\*\*\* NORMAL END OF HEC-1 \*\*\*





\*  
 95 KK SOF-30 BASIN  
 96 BA 0.007  
 97 LG 0.35 0.36 5.05 0.27 0  
 98 UC 0.166 0.146  
 99 UA 0 3.0 5.0 8.0 12.0 20.0 43.0 75.0 90.0 96.0  
 100 UA 100  
 \*

101 KK SROF30 ROUTE  
 102 RS 1 FLOW  
 103 RC 0.035 0.035 0.035 386 0.0214 2484.00  
 104 RX 0.00 37.00 45.00 52.00 66.00 81.00 96.00 153.00  
 105 RY 2484.0 2480.00 2478.00 2476.00 2476.00 2478.00 2480.00 2484.00  
 \*

106 KK SON-26 BASIN  
 107 BA 0.001  
 108 LG 0.35 0.36 5.05 0.27 0  
 109 UC 0.138 0.279  
 110 UA 0 3.0 5.0 8.0 12.0 20.0 43.0 75.0 90.0 96.0  
 111 UA 100  
 \*

112 KK SCP026 COMBINE  
 113 HC 2  
 \*

114 KK SR2628 ROUTE  
 115 RS 1 FLOW  
 116 RC 0.035 0.035 0.035 740 0.0214 2484.00  
 117 RX 0.00 37.00 45.00 52.00 66.00 81.00 96.00 153.00  
 118 RY 2484.0 2480.00 2478.00 2476.00 2476.00 2478.00 2480.00 2484.00  
 \*

1

HEC-1 INPUT

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

119 KK SON-28 BASIN  
 120 BA 0.010  
 121 LG 0.31 0.26 5.05 0.26 15  
 122 UC 0.133 0.106  
 123 UA 0 5.0 16.0 30.0 65.0 77.0 84.0 90.0 94.0 97.0  
 124 UA 100  
 \*

125 KK SCP028 COMBINE  
 126 HC 2  
 \*

127 KK SRET28 STORAGE  
 128 RS 1 STOR  
 129 SV 0.11 0.26 0.30 0.35 0.40 0.46  
 130 SQ 3.94 6.13 11.27 20.23 31.64 45.04  
 131 SE 2475.0 2476.00 2477.00 2477.30 2477.50 2477.80 2478.00  
 \*

132 KK SON-27 BASIN  
 133 BA 0.009  
 134 LG 0.30 0.25 5.58 0.20 17  
 135 UC 0.139 0.168  
 136 UA 0 5.0 16.0 30.0 65.0 77.0 84.0 90.0 94.0 97.0  
 137 UA 100  
 \*

138 KK SRET27 STORAGE  
 139 RS 1 STOR  
 140 SV 0.18 0.39 0.64 0.78  
 141 SQ 2.00 3.30 4.22 4.61  
 142 SE 2472.0 2473.00 2474.00 2475.00 2475.50  
 \*

143 KK SON-30 BASIN  
 144 BA 0.001  
 145 LG 0.35 0.36 5.05 0.27 0  
 146 UC 0.112 0.177  
 147 UA 0 3.0 5.0 8.0 12.0 20.0 43.0 75.0 90.0 96.0  
 148 UA 100  
 \*

149 KK SCP030 COMBINE  
 150 HC 3  
 \*

151 KK RSON30 ROUTE  
 152 RS 1 FLOW  
 153 RC 0.035 0.035 0.035 530 0.0226 2464.00  
 154 RX 0.00 4.00 6.00 8.00 10.00 13.00 33.00 43.00

155 RY 2464.0 2463.00 2462.00 2461.00 2461.00 2462.00 2463.00 2464.00

\*

HEC-1 INPUT

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

156 KK ON-60 BASIN  
 157 BA 0.005  
 158 LG 0.10 0.25 5.05 0.44 5  
 159 UC 0.250 0.357  
 160 UA 0 3.0 5.0 8.0 12.0 20.0 43.0 75.0 90.0 96.0  
 161 UA 100  
 \*

162 KK CP060 COMBINE  
 163 HC 2  
 \*

164 KK RON60 ROUTE  
 165 RS 1 FLOW  
 166 RC 0.035 0.035 0.035 2435 0.0111 2454.00  
 167 RX 0.00 3.00 5.00 8.00 13.00 17.00 21.00 27.00  
 168 RY 2454.0 2453.00 2452.00 2451.00 2451.00 2452.00 2453.00 2454.00  
 \*

169 KK ON-70 BASIN  
 170 BA 0.0123  
 171 LG 0.12 0.25 4.96 0.44 6  
 172 UC 0.321 0.416  
 173 UA 0 3.0 5.0 8.0 12.0 20.0 43.0 75.0 90.0 96.0  
 174 UA 100  
 \*

175 KK CP070 COMBINE  
 176 HC 2  
 \*

177 KK ON-80 BASIN  
 178 BA 0.0043  
 179 LG 0.11 0.25 5.05 0.43 6  
 180 UC 0.264 0.475  
 181 UA 0 3.0 5.0 8.0 12.0 20.0 43.0 75.0 90.0 96.0  
 182 UA 100  
 \*

183 KK ON-90 BASIN  
 184 BA 0.0005  
 185 LG 0.10 0.25 4.33 0.62 5  
 186 UC 0.123 0.141  
 187 UA 0 3.0 5.0 8.0 12.0 20.0 43.0 75.0 90.0 96.0  
 188 UA 100  
 \*

189 KK ON-100 BASIN  
 190 BA 0.0003  
 191 LG 0.10 0.25 4.33 0.62 5  
 192 UC 0.123 0.141  
 193 UA 0 3.0 5.0 8.0 12.0 20.0 43.0 75.0 90.0 96.0  
 194 UA 100  
 \*

HEC-1 INPUT

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

195 KK CPBND2 COMBINE  
 196 HC 3  
 \*

197 KK SOF-25 BASIN  
 198 BA 0.112  
 199 LG 0.32 0.33 5.71 0.22 12  
 200 UC 0.376 0.375  
 201 UA 0 3.0 5.0 8.0 12.0 20.0 43.0 75.0 90.0 96.0  
 202 UA 100  
 \*

203 KK SROF25 ROUTE  
 204 RS 1 FLOW  
 205 RC 0.035 0.035 0.035 1880 0.0164 2486.00  
 206 RX 0.00 29.00 41.00 47.00 50.00 64.00 95.00 128.00  
 207 RY 2486.0 2480.00 2478.00 2476.00 2476.00 2478.00 2480.00 2486.00  
 \*

208 KK SON-22 BASIN  
 209 BA 0.015  
 210 LG 0.34 0.36 6.00 0.17 5  
 211 UC 0.288 0.479  
 212 UA 0 3.0 5.0 8.0 12.0 20.0 43.0 75.0 90.0 96.0

213	UA	100																		
	*																			
214	KK	SCP022	COMBINE																	
215	HC	2																		
	*																			
216	KK	SR2225	ROUTE																	
217	RS	1	FLOW																	
218	RC	0.035	0.035	0.035	398	0.0164	2486.00													
219	RX	0.00	29.00	41.00	47.00	50.00	64.00	95.00	128.00											
220	RY	2486.0	2480.00	2478.00	2476.00	2476.00	2478.00	2480.00	2486.00											
	*																			
221	KK	SON-25	BASIN																	
222	BA	0.002																		
223	LG	0.34	0.37	6.00	0.17	4														
224	UC	0.130	0.210																	
225	UA	0	3.0	5.0	8.0	12.0	20.0	43.0	75.0	90.0	96.0									
226	UA	100																		
	*																			
227	KK	SON-24	BASIN																	
228	BA	0.003																		
229	LG	0.32	0.31	6.00	0.17	11														
230	UC	0.154	0.144																	
231	UA	0	3.0	5.0	8.0	12.0	20.0	43.0	75.0	90.0	96.0									
232	UA	100																		
	*																			

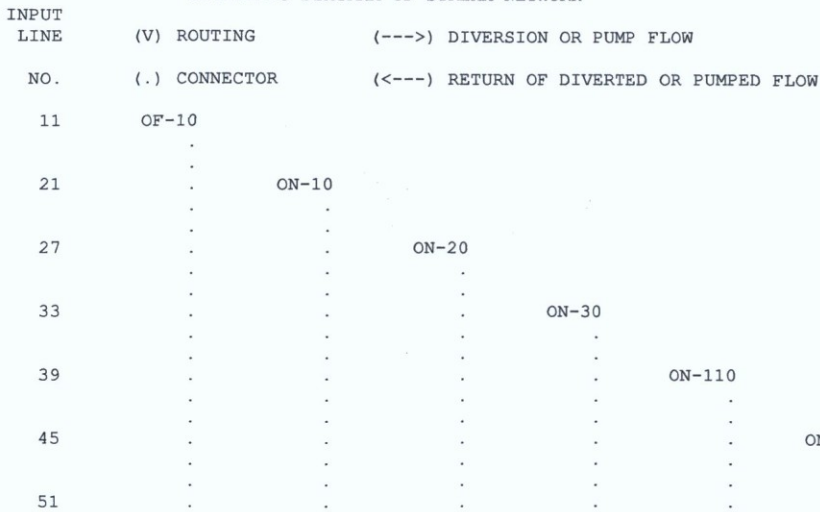
HEC-1 INPUT

PAGE 7

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

233	KK	SRET24	STORAGE																	
234	RS	1	STOR																	
235	SV		0.12	0.26	0.44															
236	SQ		0.82	1.25	1.57															
237	SE	2467.0	2468.00	2469.00	2470.00															
	*																			
238	KK	SCP025	COMBINE																	
239	HC	3																		
	*																			
240	KK	RSON25	ROUTE																	
241	RS	1	FLOW																	
242	RC	0.035	0.035	0.035	643	0.0249	2456.00													
243	RX	0.00	13.00	16.00	19.00	31.00	33.00	36.00	39.00											
244	RY	2456.0	2455.00	2454.00	2453.00	2453.00	2454.00	2455.00	2456.00											
	*																			
245	KK	ON-130	BASIN																	
246	BA	0.0037																		
247	LG	0.10	0.25	5.24	0.40	5														
248	UC	0.289	0.575																	
249	UA	0	3.0	5.0	8.0	12.0	20.0	43.0	75.0	90.0	96.0									
250	UA	100																		
	*																			
251	KK	CP130	COMBINE																	
252	HC	2																		
	*																			
253	ZZ																			

SCHEMATIC DIAGRAM OF STREAM NETWORK



57	.	.	.	.	.	.	.	ON-150
63	CPBNDY	.	.	.	.	.	.	.
65	.	AON-20	.	.	.	.	.	.
	.	V	.	.	.	.	.	.
	.	V	.	.	.	.	.	.
71	.	ARET20	.	.	.	.	.	.
	.	V	.	.	.	.	.	.
	.	V	.	.	.	.	.	.
76	.	RAON20	.	.	.	.	.	.
81	.	.	ON-40	.	.	.	.	.
87	.	CP040	.	.	.	.	.	.
89	.	.	ON-50	.	.	.	.	.
95	.	.	.	SOF-30	.	.	.	.
	.	.	.	V	.	.	.	.
	.	.	.	V	.	.	.	.
101	.	.	.	SROF30	.	.	.	.
106	.	.	.	.	SON-26	.	.	.
112	.	.	.	SCP026	.	.	.	.
	.	.	.	V	.	.	.	.
	.	.	.	V	.	.	.	.
114	.	.	.	SR2628	.	.	.	.
119	.	.	.	.	SON-28	.	.	.
125	.	.	.	SCP028	.	.	.	.
	.	.	.	V	.	.	.	.
	.	.	.	V	.	.	.	.
127	.	.	.	SRET28	.	.	.	.
132	.	.	.	.	SON-27	.	.	.
	.	.	.	.	V	.	.	.
	.	.	.	.	V	.	.	.
138	.	.	.	SRET27	.	.	.	.
143	.	.	.	.	SON-30	.	.	.
149	.	.	.	SCP030	.	.	.	.
	.	.	.	V	.	.	.	.
	.	.	.	V	.	.	.	.
151	.	.	.	RSON30	.	.	.	.
156	.	.	.	.	ON-60	.	.	.
162	.	.	.	CP060	.	.	.	.
	.	.	.	V	.	.	.	.
	.	.	.	V	.	.	.	.
164	.	.	.	RON60	.	.	.	.
169	.	.	.	.	ON-70	.	.	.
175	.	.	.	CP070	.	.	.	.
177	.	.	.	.	ON-80	.	.	.
183	.	.	.	.	ON-90	.	.	.
189	.	.	.	.	.	ON-100	.	.
195	.	.	.	CPBND2	.	.	.	.

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197 . . . . . SOF-25
. . . . . V
. . . . . V
203 . . . . . SROF25
. . . . .
. . . . .
208 . . . . . SON-22
. . . . .
. . . . .
214 . . . . . SCP022.....
. . . . . V
. . . . . V
216 . . . . . SR2225
. . . . .
. . . . .
221 . . . . . SON-25
. . . . .
. . . . .
227 . . . . . SON-24
. . . . . V
. . . . . V
233 . . . . . SRET24
. . . . .
. . . . .
238 . . . . . SCP025.....
. . . . . V
. . . . . V
240 . . . . . RSON25
. . . . .
. . . . .
245 . . . . . ON-130
. . . . .
. . . . .
251 . . . . . CP130.....

```

(\*\*\*) RUNOFF ALSO COMPUTED AT THIS LOCATION

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1*****
*****
*
* FLOOD HYDROGRAPH PACKAGE (HEC-1) *
*
* JUN 1998 *
*
* VERSION 4.1 *
*
* RUN DATE 19DEC16 TIME 14:59:32 *
*
*****
*****

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```

*
* U.S. ARMY CORPS OF ENGINEERS
*
* HYDROLOGIC ENGINEERING CENTER
*
* 609 SECOND STREET
*
* DAVIS, CALIFORNIA 95616
*
* (916) 756-1104
*

```

Flood Control District of Maricopa County  
BLACK MOUNTAIN - BLACK MOUNTAIN EXISTING CONDITIONS  
10 YEAR  
6 Hour Storm  
Unit Hydrograph: Clark  
Storm: Multiple  
08/23/2016

```

9 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 1JAN99 STARTING DATE
ITIME 0000 STARTING TIME
NQ 2000 NUMBER OF HYDROGRAPH ORDINATES
NDDATE 7JAN99 ENDING DATE
NDTIME 2235 ENDING TIME
ICENT 19 CENTURY MARK

```

COMPUTATION INTERVAL .08 HOURS  
TOTAL TIME BASE 166.58 HOURS

ENGLISH UNITS  
DRAINAGE AREA SQUARE MILES  
PRECIPITATION DEPTH INCHES  
LENGTH, ELEVATION FEET

FLOW  
STORAGE VOLUME  
SURFACE AREA  
TEMPERATURE

CUBIC FEET PER SECOND  
ACRE-FEET  
ACRES  
DEGREES FAHRENHEIT

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			BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
				6-HOUR	24-HOUR	72-HOUR			
HYDROGRAPH AT	OF-10	2.	4.08	0.	0.	0.	.00		
HYDROGRAPH AT	ON-10	2.	4.08	0.	0.	0.	.00		
HYDROGRAPH AT	ON-20	5.	4.17	0.	0.	0.	.01		
HYDROGRAPH AT	ON-30	1.	4.08	0.	0.	0.	.00		
HYDROGRAPH AT	ON-110	1.	4.00	0.	0.	0.	.00		
HYDROGRAPH AT	ON-120	4.	4.17	0.	0.	0.	.01		
HYDROGRAPH AT	ON-140	0.	4.00	0.	0.	0.	.00		
HYDROGRAPH AT	ON-150	1.	4.00	0.	0.	0.	.00		
8 COMBINED AT	CPBNDY	15.	4.08	1.	0.	0.	.02		
HYDROGRAPH AT	AON-20	22.	4.08	2.	0.	0.	.02		
ROUTED TO	ARET20	7.	4.33	2.	0.	0.	.02	2483.66	4.33
ROUTED TO	RAON20	6.	4.58	2.	0.	0.	.02	2450.37	4.58
HYDROGRAPH AT	ON-40	15.	4.25	2.	0.	0.	.02		
2 COMBINED AT	CP040	18.	4.25	3.	1.	0.	.04		
HYDROGRAPH AT	ON-50	1.	4.08	0.	0.	0.	.00		
HYDROGRAPH AT	SOF-30	9.	4.08	0.	0.	0.	.01		
ROUTED TO	SROF30	8.	4.08	0.	0.	0.	.01	2476.16	4.08
HYDROGRAPH AT	SON-26	1.	4.08	0.	0.	0.	.00		
2 COMBINED AT	SCP026	9.	4.08	1.	0.	0.	.01		
ROUTED TO	SR2628	8.	4.17	1.	0.	0.	.01	2476.16	4.17
HYDROGRAPH AT	SON-28	17.	4.00	1.	0.	0.	.01		
2 COMBINED AT	SCP028	21.	4.08	2.	0.	0.	.02		
ROUTED TO	SRET28	15.	4.17	2.	0.	0.	.02	2477.39	4.17
HYDROGRAPH AT	SON-27	13.	4.00	1.	0.	0.	.01		

+	ROUTED TO	SRET27	3.	4.33	1.	0.	0.	.01		
+									2473.70	4.33
+	HYDROGRAPH AT	SON-30	1.	4.00	0.	0.	0.	.00		
+	3 COMBINED AT	SCP030	19.	4.17	3.	1.	0.	.03		
+	ROUTED TO	RSON30	18.	4.25	3.	1.	0.	.03		
+									2461.94	4.25
+	HYDROGRAPH AT	ON-60	4.	4.17	0.	0.	0.	.00		
+	2 COMBINED AT	CP060	22.	4.25	3.	1.	0.	.03		
+	ROUTED TO	RON60	16.	4.33	3.	1.	0.	.03		
+									2451.72	4.33
+	HYDROGRAPH AT	ON-70	9.	4.25	1.	0.	0.	.01		
+	2 COMBINED AT	CP070	23.	4.33	4.	1.	0.	.05		
+	HYDROGRAPH AT	ON-80	3.	4.17	0.	0.	0.	.00		
+	HYDROGRAPH AT	ON-90	1.	4.00	0.	0.	0.	.00		
+	HYDROGRAPH AT	ON-100	0.	4.00	0.	0.	0.	.00		
+	3 COMBINED AT	CPBND2	3.	4.17	0.	0.	0.	.01		
+	HYDROGRAPH AT	SOF-25	92.	4.25	10.	3.	1.	.11		
+	ROUTED TO	SROF25	83.	4.33	10.	3.	1.	.11		
+									2477.54	4.33
+	HYDROGRAPH AT	SON-22	10.	4.17	1.	0.	0.	.01		
+	2 COMBINED AT	SCP022	92.	4.33	12.	3.	1.	.13		
+	ROUTED TO	SR2225	92.	4.33	12.	3.	1.	.13		
+									2477.61	4.33
+	HYDROGRAPH AT	SON-25	2.	4.08	0.	0.	0.	.00		
+	HYDROGRAPH AT	SON-24	4.	4.08	0.	0.	0.	.00		
+	ROUTED TO	SRET24	1.	4.42	0.	0.	0.	.00		
+									2467.93	4.42
+	3 COMBINED AT	SCP025	94.	4.33	12.	3.	1.	.13		
+	ROUTED TO	RSON25	93.	4.33	12.	3.	1.	.13		
+									2454.03	4.33
+	HYDROGRAPH AT	ON-130	2.	4.25	0.	0.	0.	.00		
+	2 COMBINED AT	CP130	95.	4.33	12.	3.	1.	.14		

\*\*\* NORMAL END OF HEC-1 \*\*\*





\*  
 95 KK SOF-30 BASIN  
 96 BA 0.007  
 97 LG 0.35 0.36 5.05 0.27 0  
 98 UC 0.166 0.146  
 99 UA 0 3.0 5.0 8.0 12.0 20.0 43.0 75.0 90.0 96.0  
 100 UA 100  
 \*

101 KK SROF30 ROUTE  
 102 RS 1 FLOW  
 103 RC 0.035 0.035 0.035 386 0.0214 2484.00  
 104 RX 0.00 37.00 45.00 52.00 66.00 81.00 96.00 153.00  
 105 RY 2484.0 2480.00 2478.00 2476.00 2476.00 2478.00 2480.00 2484.00  
 \*

106 KK SON-26 BASIN  
 107 BA 0.001  
 108 LG 0.35 0.36 5.05 0.27 0  
 109 UC 0.138 0.279  
 110 UA 0 3.0 5.0 8.0 12.0 20.0 43.0 75.0 90.0 96.0  
 111 UA 100  
 \*

112 KK SCP026 COMBINE  
 113 HC 2  
 \*

114 KK SR2628 ROUTE  
 115 RS 1 FLOW  
 116 RC 0.035 0.035 0.035 740 0.0214 2484.00  
 117 RX 0.00 37.00 45.00 52.00 66.00 81.00 96.00 153.00  
 118 RY 2484.0 2480.00 2478.00 2476.00 2476.00 2478.00 2480.00 2484.00  
 \*

HEC-1 INPUT

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

119 KK SON-28 BASIN  
 120 BA 0.010  
 121 LG 0.31 0.26 5.05 0.26 15  
 122 UC 0.133 0.106  
 123 UA 0 5.0 16.0 30.0 65.0 77.0 84.0 90.0 94.0 97.0  
 124 UA 100  
 \*

125 KK SCP028 COMBINE  
 126 HC 2  
 \*

127 KK SRET28 STORAGE  
 128 RS 1 STOR  
 129 SV 0.11 0.26 0.30 0.35 0.40 0.46  
 130 SQ 3.94 6.13 11.27 20.23 31.64 45.04  
 131 SE 2475.0 2476.00 2477.00 2477.30 2477.50 2477.80 2478.00  
 \*

132 KK SON-27 BASIN  
 133 BA 0.009  
 134 LG 0.30 0.25 5.58 0.20 17  
 135 UC 0.139 0.168  
 136 UA 0 5.0 16.0 30.0 65.0 77.0 84.0 90.0 94.0 97.0  
 137 UA 100  
 \*

138 KK SRET27 STORAGE  
 139 RS 1 STOR  
 140 SV 0.18 0.39 0.64 0.78  
 141 SQ 2.00 3.30 4.22 4.61  
 142 SE 2472.0 2473.00 2474.00 2475.00 2475.50  
 \*

143 KK SON-30 BASIN  
 144 BA 0.001  
 145 LG 0.35 0.36 5.05 0.27 0  
 146 UC 0.112 0.177  
 147 UA 0 3.0 5.0 8.0 12.0 20.0 43.0 75.0 90.0 96.0  
 148 UA 100  
 \*

149 KK SCP030 COMBINE  
 150 HC 3  
 \*

151 KK RSON30 ROUTE  
 152 RS 1 FLOW  
 153 RC 0.035 0.035 0.035 530 0.0226 2464.00  
 154 RX 0.00 4.00 6.00 8.00 10.00 13.00 33.00 43.00

155 RY 2464.0 2463.00 2462.00 2461.00 2461.00 2462.00 2463.00 2464.00

\*

HEC-1 INPUT

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

156 KK ON-60 BASIN  
 157 BA 0.005  
 158 LG 0.10 0.25 5.05 0.44 5  
 159 UC 0.191 0.265  
 160 UA 0 3.0 5.0 8.0 12.0 20.0 43.0 75.0 90.0 96.0  
 161 UA 100  
 \*

162 KK CP060 COMBINE  
 163 HC 2  
 \*

164 KK RON60 ROUTE  
 165 RS 1 FLOW  
 166 RC 0.035 0.035 0.035 2435 0.0111 2454.00  
 167 RX 0.00 3.00 5.00 8.00 13.00 17.00 21.00 27.00  
 168 RY 2454.0 2453.00 2452.00 2451.00 2451.00 2452.00 2453.00 2454.00  
 \*

169 KK ON-70 BASIN  
 170 BA 0.0123  
 171 LG 0.12 0.25 4.96 0.44 6  
 172 UC 0.246 0.309  
 173 UA 0 3.0 5.0 8.0 12.0 20.0 43.0 75.0 90.0 96.0  
 174 UA 100  
 \*

175 KK CP070 COMBINE  
 176 HC 2  
 \*

177 KK ON-80 BASIN  
 178 BA 0.0043  
 179 LG 0.11 0.25 5.05 0.43 6  
 180 UC 0.202 0.354  
 181 UA 0 3.0 5.0 8.0 12.0 20.0 43.0 75.0 90.0 96.0  
 182 UA 100  
 \*

183 KK ON-90 BASIN  
 184 BA 0.0005  
 185 LG 0.10 0.25 4.33 0.62 5  
 186 UC 0.094 0.104  
 187 UA 0 3.0 5.0 8.0 12.0 20.0 43.0 75.0 90.0 96.0  
 188 UA 100  
 \*

189 KK ON-100 BASIN  
 190 BA 0.0003  
 191 LG 0.10 0.25 4.33 0.62 5  
 192 UC 0.093 0.104  
 193 UA 0 3.0 5.0 8.0 12.0 20.0 43.0 75.0 90.0 96.0  
 194 UA 100  
 \*

HEC-1 INPUT

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

195 KK CPBND2 COMBINE  
 196 HC 3  
 \*

197 KK SOF-25 BASIN  
 198 BA 0.112  
 199 LG 0.32 0.33 5.71 0.22 12  
 200 UC 0.376 0.375  
 201 UA 0 3.0 5.0 8.0 12.0 20.0 43.0 75.0 90.0 96.0  
 202 UA 100  
 \*

203 KK SROF25 ROUTE  
 204 RS 1 FLOW  
 205 RC 0.035 0.035 0.035 1880 0.0164 2486.00  
 206 RX 0.00 29.00 41.00 47.00 50.00 64.00 95.00 128.00  
 207 RY 2486.0 2480.00 2478.00 2476.00 2476.00 2478.00 2480.00 2486.00  
 \*

208 KK SON-22 BASIN  
 209 BA 0.015  
 210 LG 0.34 0.36 6.00 0.17 5  
 211 UC 0.288 0.479  
 212 UA 0 3.0 5.0 8.0 12.0 20.0 43.0 75.0 90.0 96.0



57	.	.	.	.	.	.	.	ON-150
63	CPBNDY	.	.	.	.	.	.	.
65	.	AON-20	.	.	.	.	.	.
	.	V	.	.	.	.	.	.
	.	V	.	.	.	.	.	.
71	.	ARET20	.	.	.	.	.	.
	.	V	.	.	.	.	.	.
	.	V	.	.	.	.	.	.
76	.	RAON20	.	.	.	.	.	.
81	.	.	ON-40	.	.	.	.	.
87	.	CP040	.	.	.	.	.	.
89	.	.	ON-50	.	.	.	.	.
95	.	.	.	SOF-30	.	.	.	.
	.	.	.	V	.	.	.	.
	.	.	.	V	.	.	.	.
101	.	.	.	SROP30	.	.	.	.
106	.	.	.	.	SON-26	.	.	.
112	.	.	.	SCP026	.	.	.	.
	.	.	.	V	.	.	.	.
	.	.	.	V	.	.	.	.
114	.	.	.	SR2628	.	.	.	.
119	.	.	.	.	SON-28	.	.	.
125	.	.	.	SCP028	.	.	.	.
	.	.	.	V	.	.	.	.
	.	.	.	V	.	.	.	.
127	.	.	.	SRET28	.	.	.	.
132	.	.	.	.	SON-27	.	.	.
	.	.	.	.	V	.	.	.
	.	.	.	.	V	.	.	.
138	.	.	.	SRET27	.	.	.	.
143	.	.	.	.	SON-30	.	.	.
149	.	.	.	SCP030	.	.	.	.
	.	.	.	V	.	.	.	.
	.	.	.	V	.	.	.	.
151	.	.	.	RSON30	.	.	.	.
156	.	.	.	.	ON-60	.	.	.
162	.	.	.	CP060	.	.	.	.
	.	.	.	V	.	.	.	.
	.	.	.	V	.	.	.	.
164	.	.	.	RON60	.	.	.	.
169	.	.	.	.	ON-70	.	.	.
175	.	.	.	CP070	.	.	.	.
177	.	.	.	.	ON-80	.	.	.
183	.	.	.	.	ON-90	.	.	.
189	.	.	.	.	.	ON-100	.	.
195	.	.	.	CPBND2	.	.	.	.

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197 . . . . . SOF-25
    . . . . . V
203 . . . . . SROF25
    . . . . .
208 . . . . . SON-22
    . . . . .
214 . . . . . SCP022.....
    . . . . . V
216 . . . . . SR2225
    . . . . .
221 . . . . . SON-25
    . . . . .
227 . . . . . SON-24
    . . . . . V
233 . . . . . SRET24
    . . . . . V
    . . . . .
238 . . . . . SCP025.....
    . . . . . V
240 . . . . . RSON25
    . . . . . V
245 . . . . . ON-130
    . . . . .
251 . . . . . CP130.....

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(\*\*\*) RUNOFF ALSO COMPUTED AT THIS LOCATION

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1*****
*****
*
* FLOOD HYDROGRAPH PACKAGE (HEC-1) *
* JUN 1998 *
* VERSION 4.1 *
* RUN DATE 19DEC16 TIME 14:54:43 *
*
*****
*****

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\*  
\* U.S. ARMY CORPS OF ENGINEERS  
\* HYDROLOGIC ENGINEERING CENTER  
\* 609 SECOND STREET  
\* DAVIS, CALIFORNIA 95616  
\* (916) 756-1104  
\*

Flood Control District of Maricopa County  
BLACK MOUNTAIN - BLACK MOUNTAIN EXISTING CONDITIONS  
100 YEAR  
6 Hour Storm  
Unit Hydrograph: Clark  
Storm: Multiple  
08/23/2016

```

9 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      1JAN99  STARTING DATE
          ITIME      0000  STARTING TIME
          NQ         2000  NUMBER OF HYDROGRAPH ORDINATES
          NDDATE     7JAN99  ENDING DATE
          NDTIME     2235  ENDING TIME
          ICENT      19  CENTURY MARK

```

COMPUTATION INTERVAL .08 HOURS  
TOTAL TIME BASE 166.58 HOURS

```

ENGLISH UNITS
DRAINAGE AREA      SQUARE MILES
PRECIPITATION DEPTH  INCHES
LENGTH, ELEVATION  FEET

```

FLOW  
STORAGE VOLUME  
SURFACE AREA  
TEMPERATURE

CUBIC FEET PER SECOND  
ACRE-FEET  
ACRES  
DEGREES FAHRENHEIT

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			BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
				6-HOUR	24-HOUR	72-HOUR			
HYDROGRAPH AT	OF-10	5.	4.00	0.	0.	0.	.00		
HYDROGRAPH AT	ON-10	3.	4.08	0.	0.	0.	.00		
HYDROGRAPH AT	ON-20	11.	4.08	1.	0.	0.	.01		
HYDROGRAPH AT	ON-30	2.	4.00	0.	0.	0.	.00		
HYDROGRAPH AT	ON-110	1.	4.00	0.	0.	0.	.00		
HYDROGRAPH AT	ON-120	9.	4.08	1.	0.	0.	.01		
HYDROGRAPH AT	ON-140	1.	4.00	0.	0.	0.	.00		
HYDROGRAPH AT	ON-150	3.	4.00	0.	0.	0.	.00		
8 COMBINED AT	CPBNDY	33.	4.08	3.	1.	0.	.02		
HYDROGRAPH AT	AON-20	39.	4.08	3.	1.	0.	.02		
ROUTED TO	ARET20	18.	4.33	3.	1.	0.	.02	2484.65	4.33
ROUTED TO	RAON20	16.	4.50	3.	1.	0.	.02	2450.63	4.50
HYDROGRAPH AT	ON-40	35.	4.17	4.	1.	0.	.02		
2 COMBINED AT	CP040	43.	4.25	7.	2.	1.	.04		
HYDROGRAPH AT	ON-50	3.	4.00	0.	0.	0.	.00		
HYDROGRAPH AT	SOF-30	17.	4.08	1.	0.	0.	.01		
ROUTED TO	SROF30	16.	4.08	1.	0.	0.	.01	2476.31	4.08
HYDROGRAPH AT	SON-26	2.	4.08	0.	0.	0.	.00		
2 COMBINED AT	SCP026	18.	4.08	1.	0.	0.	.01		
ROUTED TO	SR2628	17.	4.17	1.	0.	0.	.01	2476.32	4.17
HYDROGRAPH AT	SON-28	29.	4.00	2.	0.	0.	.01		
2 COMBINED AT	SCP028	38.	4.08	3.	1.	0.	.02		
ROUTED TO	SRET28	36.	4.08	3.	1.	0.	.02	2477.87	4.08
HYDROGRAPH AT	SON-27	23.	4.00	2.	0.	0.	.01		

+	ROUTED TO	SRET27	4.	4.42	2.	0.	0.	.01	2475.04	4.42
+										
+	HYDROGRAPH AT	SON-30	2.	4.00	0.	0.	0.	.00		
+	3 COMBINED AT	SCP030	42.	4.08	5.	1.	0.	.03		
+	ROUTED TO	RSON30	41.	4.17	5.	1.	0.	.03	2462.30	4.17
+										
+	HYDROGRAPH AT	ON-60	9.	4.08	1.	0.	0.	.00		
+	2 COMBINED AT	CP060	50.	4.17	6.	2.	1.	.03		
+	ROUTED TO	RON60	40.	4.25	6.	2.	1.	.03	2452.14	4.25
+										
+	HYDROGRAPH AT	ON-70	20.	4.17	2.	0.	0.	.01		
+	2 COMBINED AT	CP070	57.	4.25	8.	2.	1.	.05		
+	HYDROGRAPH AT	ON-80	7.	4.17	1.	0.	0.	.00		
+	HYDROGRAPH AT	ON-90	1.	4.00	0.	0.	0.	.00		
+	HYDROGRAPH AT	ON-100	1.	4.00	0.	0.	0.	.00		
+	3 COMBINED AT	CPBND2	8.	4.08	1.	0.	0.	.01		
+	HYDROGRAPH AT	SOF-25	172.	4.25	21.	5.	2.	.11		
+	ROUTED TO	SROF25	162.	4.33	21.	5.	2.	.11	2478.02	4.33
+										
+	HYDROGRAPH AT	SON-22	20.	4.17	3.	1.	0.	.01		
+	2 COMBINED AT	SCP022	180.	4.33	24.	6.	2.	.13		
+	ROUTED TO	SR2225	181.	4.33	24.	6.	2.	.13	2478.12	4.33
+										
+	HYDROGRAPH AT	SON-25	4.	4.08	0.	0.	0.	.00		
+	HYDROGRAPH AT	SON-24	8.	4.08	1.	0.	0.	.00		
+	ROUTED TO	SRET24	1.	4.42	1.	0.	0.	.00	2468.75	4.50
+										
+	3 COMBINED AT	SCP025	184.	4.33	24.	6.	2.	.13		
+	ROUTED TO	RSON25	184.	4.33	24.	6.	2.	.13	2454.48	4.33
+										
+	HYDROGRAPH AT	ON-130	5.	4.17	1.	0.	0.	.00		
+	2 COMBINED AT	CP130	187.	4.33	25.	6.	2.	.14		

\*\*\* NORMAL END OF HEC-1 \*\*\*









137	CPP40	.....		
	V			
	V			
139	DETA			
	V			
	V			
146	RDETA			
151		PON30		
		V		
		V		
157		RPON30		
162			PON50	
168				PON60
174	CP060	.....		
	V			
	V			
176	DETB			
	V			
	V			
183	RDETB			
188		ON-40		
194	CP040	.....		
196		SOF-30		
		V		
		V		
202		SROF30		
207			SON-26	
213		SCP026	.....	
		V		
		V		
215		SR2628		
220			SON-28	
226		SCP028	.....	
		V		
		V		
228		SRET28		
233			SON-27	
			V	
			V	
239			SRET27	
244				SON-30
250		SCP030	.....	
		V		
		V		
252		RSON30		
257			PON70	
263		CPP70	.....	
		V		
		V		
265		RCPP70		
270			PON80	
			V	
			V	
276			RPON80	

```

281 . . . . . PON100
. . . . . V
. . . . . V
287 . . . . . DETC
. . . . . V
. . . . . V
294 . . . . . RDETC
. . . . .
. . . . .
299 . . . . . ON-75
. . . . .
. . . . .
305 . . . . . CP075
. . . . . V
. . . . . V
307 . . . . . RCP075
. . . . .
. . . . .
312 . . . . . ON-70
. . . . .
. . . . .
318 . . . . . PON110
. . . . . V
. . . . . V
324 . . . . . DETD
. . . . .
. . . . .
331 . . . . . CP070
. . . . .
. . . . .
333 . . . . . SOF-25
. . . . . V
. . . . . V
339 . . . . . SROF25
. . . . .
. . . . .
344 . . . . . SON-22
. . . . .
. . . . .
350 . . . . . SCP022
. . . . . V
. . . . . V
352 . . . . . SR2225
. . . . .
. . . . .
357 . . . . . SON-25
. . . . .
. . . . .
363 . . . . . SON-24
. . . . . V
. . . . . V
369 . . . . . SRET24
. . . . .
. . . . .
374 . . . . . SCP025
. . . . . V
. . . . . V
376 . . . . . RSON25
. . . . .
. . . . .
381 . . . . . PON90
. . . . . V
. . . . . V
387 . . . . . RPON90
. . . . .
. . . . .
392 . . . . . ON-130
. . . . .
. . . . .
398 . . . . . CP130
. . . . .

```

(\*\*\*) RUNOFF ALSO COMPUTED AT THIS LOCATION

```

1*****
*****
*
*
* FLOOD HYDROGRAPH PACKAGE (HEC-1) *
*
* JUN 1998 *
*
* VERSION 4.1 *
*
* RUN DATE 22DEC16 TIME 15:45:15 *
*
*
*****
*****

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*
*
* U.S. ARMY CORPS OF ENGINEERS
*
* HYDROLOGIC ENGINEERING CENTER
*
* 609 SECOND STREET
*
* DAVIS, CALIFORNIA 95616
*
* (916) 756-1104
*

```

\*  
 215 KK SR2628 ROUTE  
 216 RS 1 FLOW  
 217 RC 0.035 0.035 0.035 740 0.0214 2484.00  
 218 RX 0.00 37.00 45.00 52.00 66.00 81.00 96.00 153.00  
 219 RY 2484.0 2480.00 2478.00 2476.00 2476.00 2478.00 2480.00 2484.00  
 \*

220 KK SON-28 BASIN  
 221 BA 0.010  
 222 LG 0.31 0.26 5.05 0.26 15  
 223 UC 0.133 0.106  
 224 UA 0 5.0 16.0 30.0 65.0 77.0 84.0 90.0 94.0 97.0  
 225 UA 100  
 \*

226 KK SCP028 COMBINE  
 227 HC 2  
 \*

HEC-1 INPUT

PAGE 7

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

228 KK SRET28 STORAGE  
 229 RS 1 STOR  
 230 SV 0.11 0.26 0.30 0.35 0.40 0.46  
 231 SQ 3.94 6.13 11.27 20.23 31.64 45.04  
 232 SE 2475.0 2476.00 2477.00 2477.30 2477.50 2477.80 2478.00  
 \*

233 KK SON-27 BASIN  
 234 BA 0.009  
 235 LG 0.30 0.25 5.58 0.20 17  
 236 UC 0.139 0.168  
 237 UA 0 5.0 16.0 30.0 65.0 77.0 84.0 90.0 94.0 97.0  
 238 UA 100  
 \*

239 KK SRET27 STORAGE  
 240 RS 1 STOR  
 241 SV 0.18 0.39 0.64 0.78  
 242 SQ 2.00 3.30 4.22 4.61  
 243 SE 2472.0 2473.00 2474.00 2475.00 2475.50  
 \*

244 KK SON-30 BASIN  
 245 BA 0.001  
 246 LG 0.35 0.36 5.05 0.27 0  
 247 UC 0.112 0.177  
 248 UA 0 3.0 5.0 8.0 12.0 20.0 43.0 75.0 90.0 96.0  
 249 UA 100  
 \*

250 KK SCP030 COMBINE  
 251 HC 3  
 \*

252 KK RSON30 ROUTE  
 253 RS 1 FLOW  
 254 RC 0.035 0.035 0.035 320 0.0188 2471.00  
 255 RX 0.00 17.00 25.00 30.00 34.00 37.00 40.00 45.00  
 256 RY 2471.0 2470.00 2469.00 2468.00 2468.00 2469.00 2470.00 2471.00  
 \*

257 KK PON70 BASIN  
 258 BA 0.0026  
 259 LG 0.10 0.25 5.05 0.44 5  
 260 UC 0.267 0.430  
 261 UA 0 3.0 5.0 8.0 12.0 20.0 43.0 75.0 90.0 96.0  
 262 UA 100  
 \*

HEC-1 INPUT

PAGE 8

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

263 KK CPP70 COMBINE  
 264 HC 2  
 \*

265 KK RCPP70 ROUTE  
 266 RS 1 FLOW  
 267 RC 0.035 0.035 0.035 1046 0.0239 2458.00  
 268 RX 0.00 4.00 12.00 23.00 32.00 41.00 44.00 47.00  
 269 RY 2458.0 2457.00 2456.00 2455.00 2455.00 2456.00 2457.00 2458.00  
 \*

270 KK PON80 BASIN

271 BA 0.0004  
 272 LG 0.10 0.25 5.05 0.37 5  
 273 UC 0.282 0.354  
 274 UA 0 3.0 5.0 8.0 12.0 20.0 43.0 75.0 90.0 96.0  
 275 UA 100  
 \*

276 KK RPON80 ROUTE  
 277 RS 1 FLOW  
 278 RC 0.035 0.035 0.035 1104 0.0281 2458.00  
 279 RX 0.00 4.00 12.00 23.00 32.00 41.00 44.00 47.00  
 280 RY 2458.0 2457.00 2456.00 2455.00 2455.00 2456.00 2457.00 2458.00  
 \*

281 KK PON100 BASIN  
 282 BA 0.0057  
 283 LG 0.28 0.25 5.05 0.34 14  
 284 UC 0.191 0.199  
 285 UA 0 5.0 16.0 30.0 65.0 77.0 84.0 90.0 94.0 97.0  
 286 UA 100  
 \*

287 KK DETC  
 288 KM DETENTION BASIN C  
 289 RS 1 STOR 0  
 290 SA .164 0.202 0.243 0.288  
 291 SE 0 1.0 2.0 3.0  
 292 SS 2.6 12 2.3 1.5  
 293 SL 1.0 0.1963 0.6 0.5  
 \*

294 KK RDETC ROUTE  
 295 RS 1 FLOW  
 296 RC 0.035 0.035 0.035 575 0.0296 2458.00  
 297 RX 0.00 4.00 12.00 23.00 32.00 41.00 44.00 47.00  
 298 RY 2458.0 2457.00 2456.00 2455.00 2455.00 2456.00 2457.00 2458.00  
 \*

1

HEC-1 INPUT

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

299 KK ON-75 BASIN  
 300 BA 0.0061  
 301 LG 0.16 0.25 5.05 0.40 8  
 302 UC 0.322 0.536  
 303 UA 0 3.0 5.0 8.0 12.0 20.0 43.0 75.0 90.0 96.0  
 304 UA 100  
 \*

305 KK CP075 COMBINE  
 306 HC 4  
 \*

307 KK RCP075 ROUTE  
 308 RS 1 FLOW  
 309 RC 0.035 0.035 0.035 250 0.032 2449.00  
 310 RX 0.00 2.00 9.00 16.00 19.00 24.00 34.00 47.00  
 311 RY 2449.0 2448.00 2447.00 2446.00 2446.00 2447.00 2448.00 2449.00  
 \*

312 KK ON-70 BASIN  
 313 BA 0.0004  
 314 LG 0.10 0.25 4.33 0.62 5  
 315 UC 0.136 0.125  
 316 UA 0 3.0 5.0 8.0 12.0 20.0 43.0 75.0 90.0 96.0  
 317 UA 100  
 \*

318 KK PON110 BASIN  
 319 BA 0.0101  
 320 LG 0.26 0.25 4.96 0.36 13  
 321 UC 0.250 0.314  
 322 UA 0 5.0 16.0 30.0 65.0 77.0 84.0 90.0 94.0 97.0  
 323 UA 100  
 \*

324 KK DETD  
 325 KM DETENTION BASIN D  
 326 RS 1 STOR 0  
 327 SA 0.174 0.211 0.250 0.294  
 328 SE 0 1.0 2.0 3.0  
 329 SS 2.6 12 2.3 1.5  
 330 SL 0.75 0.1963 0.6 0.5  
 \*

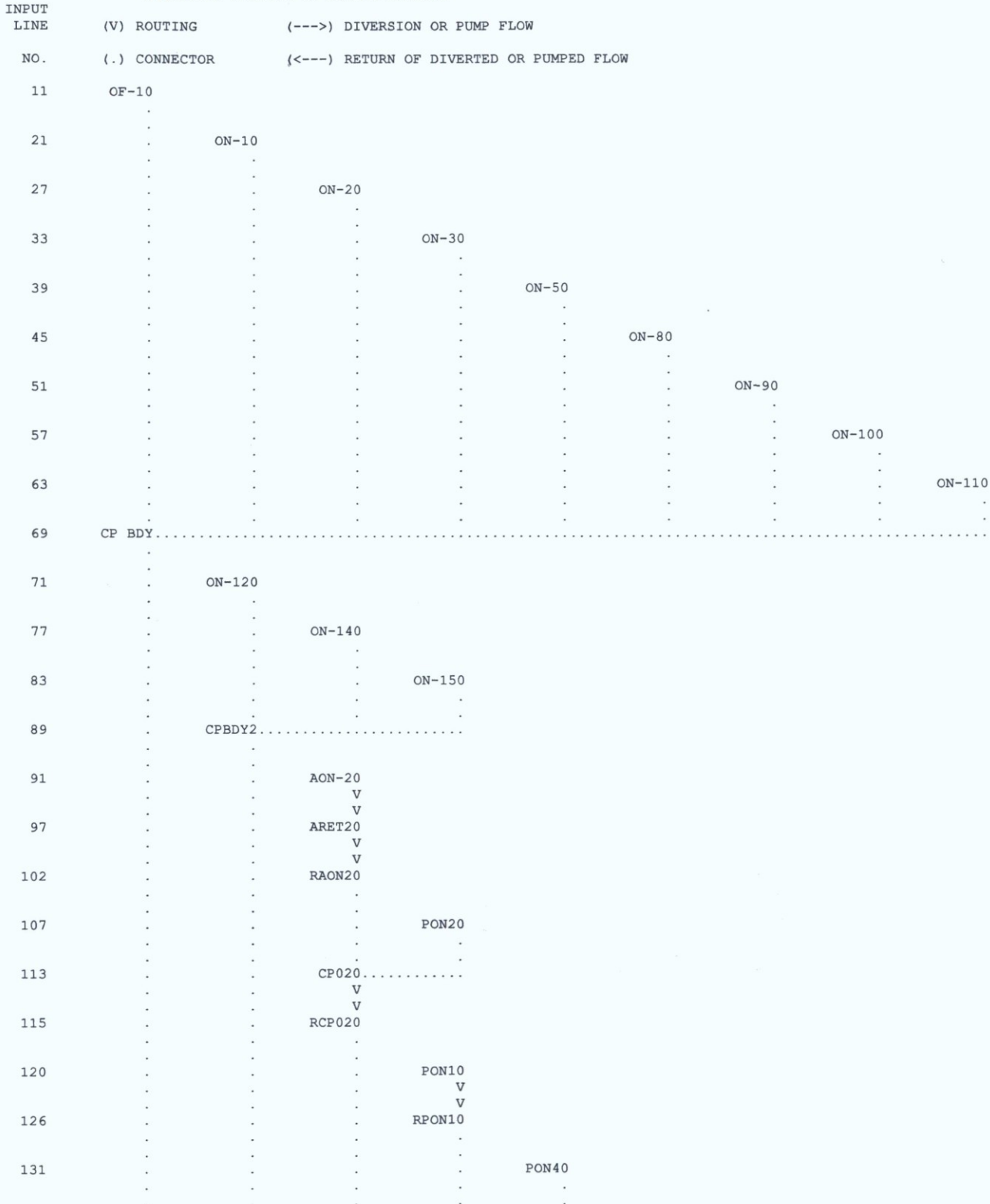
331 KK CP070 COMBINE  
 332 HC 3  
 \*



	*											
392	KK	ON-130	BASIN									
393	BA	0.0035										
394	LG	0.10	0.25	5.24	0.40	5						
395	UC	0.337	0.681									
396	UA	0	3.0	5.0	8.0	12.0	20.0	43.0	75.0	90.0	96.0	
397	UA	100										
	*											
398	KK	CP130	COMBINE									
399	HC	3										
	*											
400	ZZ											

1

SCHEMATIC DIAGRAM OF STREAM NETWORK





+		AON-20	11.	4.08	1.	0.	0.	.02		
		ROUTED TO								
+		ARET20	3.	4.42	1.	0.	0.	.02	2482.86	4.42
+		ROUTED TO								
+		RAON20	3.	4.42	1.	0.	0.	.02	2475.18	4.42
+		HYDROGRAPH AT								
		PON20	1.	4.08	0.	0.	0.	.00		
+		2 COMBINED AT								
		CP020	3.	4.33	1.	0.	0.	.02		
+		ROUTED TO								
+		RCP020	3.	4.33	1.	0.	0.	.02	2468.49	4.33
+		HYDROGRAPH AT								
		PON10	1.	4.08	0.	0.	0.	.00		
+		ROUTED TO								
+		RPON10	1.	4.08	0.	0.	0.	.00	2468.31	4.08
+		HYDROGRAPH AT								
		PON40	0.	4.17	0.	0.	0.	.00		
+		3 COMBINED AT								
+		CPP40	4.	4.25	1.	0.	0.	.02		
+		ROUTED TO								
+		DETA	3.	4.67	1.	0.	0.	.02	1.52	4.67
+		ROUTED TO								
+		RDETA	3.	4.67	1.	0.	0.	.02	2454.53	4.67
+		HYDROGRAPH AT								
		PON30	0.	4.17	0.	0.	0.	.00		
+		ROUTED TO								
+		RPON30	0.	4.25	0.	0.	0.	.00	2457.17	4.25
+		HYDROGRAPH AT								
		PON50	1.	4.17	0.	0.	0.	.00		
+		HYDROGRAPH AT								
		PON60	8.	4.08	1.	0.	0.	.02		
+		4 COMBINED AT								
+		CP060	9.	4.08	2.	0.	0.	.04		
+		ROUTED TO								
+		DETB	5.	4.75	2.	0.	0.	.04	2.14	4.75
+		ROUTED TO								
+		RDETB	3.	5.08	2.	0.	0.	.04	2445.07	5.08
+		HYDROGRAPH AT								
		ON-40	1.	4.08	0.	0.	0.	.00		
+		2 COMBINED AT								
+		CP040	3.	5.08	2.	0.	0.	.05		
+		HYDROGRAPH AT								
		SOF-30	3.	4.08	0.	0.	0.	.01		
+		ROUTED TO								
+		SROF30	3.	4.17	0.	0.	0.	.01	2476.06	4.17
+		HYDROGRAPH AT								
		SON-26	0.	4.08	0.	0.	0.	.00		
+		2 COMBINED AT								
+		SCP026	4.	4.17	0.	0.	0.	.01		
+		ROUTED TO								
+		SR2628	3.	4.17	0.	0.	0.	.01	2476.06	4.17
+		HYDROGRAPH AT								
		SON-28	8.	4.00	1.	0.	0.	.01		



+		SR2225	42.	4.33	6.	1.	0.	.13		
+									2477.12	4.33
	HYDROGRAPH AT									
+		SON-25	1.	4.08	0.	0.	0.	.00		
	HYDROGRAPH AT									
+		SON-24	2.	4.08	0.	0.	0.	.00		
	ROUTED TO									
+		SRET24	0.	4.42	0.	0.	0.	.00		
+									2467.47	4.42
	3 COMBINED AT									
+		SCP025	42.	4.33	6.	2.	1.	.13		
	ROUTED TO									
+		RSN25	43.	4.42	6.	2.	1.	.13		
+									2453.66	4.42
	HYDROGRAPH AT									
+		PON90	0.	4.08	0.	0.	0.	.00		
	ROUTED TO									
+		RPON90	0.	4.17	0.	0.	0.	.00		
+									2453.01	4.17
	HYDROGRAPH AT									
+		ON-130	1.	4.25	0.	0.	0.	.00		
	3 COMBINED AT									
+		CP130	43.	4.42	6.	2.	1.	.14		

\*\*\* NORMAL END OF HEC-1 \*\*\*



35	LG	0.10	0.25	5.05	0.44	5					
36	UC	0.082	0.052								
37	UA	0	3.0	5.0	8.0	12.0	20.0	43.0	75.0	90.0	96.0
38	UA	100									
	*										
39	KK	ON-50	BASIN								
40	BA	0.0002									
41	LG	0.10	0.25	5.05	0.44	5					
42	UC	0.056	0.019								
43	UA	0	3.0	5.0	8.0	12.0	20.0	43.0	75.0	90.0	96.0
44	UA	100									
	*										

HEC-1 INPUT

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

45	KK	ON-80	BASIN								
46	BA	0.0031									
47	LG	0.12	0.25	5.05	0.43	6					
48	UC	0.207	0.302								
49	UA	0	3.0	5.0	8.0	12.0	20.0	43.0	75.0	90.0	96.0
50	UA	100									
	*										
51	KK	ON-90	BASIN								
52	BA	0.0001									
53	LG	0.10	0.25	4.33	0.62	5					
54	UC	0.078	0.028								
55	UA	0	3.0	5.0	8.0	12.0	20.0	43.0	75.0	90.0	96.0
56	UA	100									
	*										

57	KK	ON-100	BASIN								
58	BA	0.0003									
59	LG	0.10	0.25	4.33	0.62	5					
60	UC	0.106	0.095								
61	UA	0	3.0	5.0	8.0	12.0	20.0	43.0	75.0	90.0	96.0
62	UA	100									
	*										
63	KK	ON-110	BASIN								
64	BA	0.0004									
65	LG	0.10	0.25	4.58	0.55	5					
66	UC	0.085	0.054								
67	UA	0	3.0	5.0	8.0	12.0	20.0	43.0	75.0	90.0	96.0
68	UA	100									
	*										

69	KK	CP BDY	COMBINE								
70	HC	9									
	*										
71	KK	ON-120	BASIN								
72	BA	0.0019									
73	LG	0.19	0.25	5.05	0.39	10					
74	UC	0.152	0.189								
75	UA	0	3.0	5.0	8.0	12.0	20.0	43.0	75.0	90.0	96.0
76	UA	100									
	*										

77	KK	ON-140	BASIN								
78	BA	0.0002									
79	LG	0.10	0.25	5.46	0.35	5					
80	UC	0.092	0.059								
81	UA	0	3.0	5.0	8.0	12.0	20.0	43.0	75.0	90.0	96.0
82	UA	100									
	*										

HEC-1 INPUT

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

83	KK	ON-150	BASIN								
84	BA	0.001									
85	LG	0.10	0.25	6.00	0.28	5					
86	UC	0.122	0.140								
87	UA	0	3.0	5.0	8.0	12.0	20.0	43.0	75.0	90.0	96.0
88	UA	100									
	*										

89	KK	CPBDY2	COMBINE								
90	HC	3									
	*										
91	KK	AON-20	BASIN								
92	BA	0.018									
93	LG	0.31	0.28	5.05	0.27	13					
94	UC	0.191	0.198								





\*  
 215 KK SR2628 ROUTE  
 216 RS 1 FLOW  
 217 RC 0.035 0.035 0.035 740 0.0214 2484.00  
 218 RX 0.00 37.00 45.00 52.00 66.00 81.00 96.00 153.00  
 219 RY 2484.0 2480.00 2478.00 2476.00 2476.00 2478.00 2480.00 2484.00  
 \*

220 KK SON-28 BASIN  
 221 BA 0.010  
 222 LG 0.31 0.26 5.05 0.26 15  
 223 UC 0.133 0.106  
 224 UA 0 5.0 16.0 30.0 65.0 77.0 84.0 90.0 94.0 97.0  
 225 UA 100  
 \*

226 KK SCP028 COMBINE  
 227 HC 2  
 \*

HEC-1 INPUT

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

228 KK SRET28 STORAGE  
 229 RS 1 STOR  
 230 SV 0.11 0.26 0.30 0.35 0.40 0.46  
 231 SQ 3.94 6.13 11.27 20.23 31.64 45.04  
 232 SE 2475.0 2476.00 2477.00 2477.30 2477.50 2477.80 2478.00  
 \*

233 KK SON-27 BASIN  
 234 BA 0.009  
 235 LG 0.30 0.25 5.58 0.20 17  
 236 UC 0.139 0.168  
 237 UA 0 5.0 16.0 30.0 65.0 77.0 84.0 90.0 94.0 97.0  
 238 UA 100  
 \*

239 KK SRET27 STORAGE  
 240 RS 1 STOR  
 241 SV 0.18 0.39 0.64 0.78  
 242 SQ 2.00 3.30 4.22 4.61  
 243 SE 2472.0 2473.00 2474.00 2475.00 2475.50  
 \*

244 KK SON-30 BASIN  
 245 BA 0.001  
 246 LG 0.35 0.36 5.05 0.27 0  
 247 UC 0.112 0.177  
 248 UA 0 3.0 5.0 8.0 12.0 20.0 43.0 75.0 90.0 96.0  
 249 UA 100  
 \*

250 KK SCP030 COMBINE  
 251 HC 3  
 \*

252 KK RSON30 ROUTE  
 253 RS 1 FLOW  
 254 RC 0.035 0.035 0.035 320 0.0188 2471.00  
 255 RX 0.00 17.00 25.00 30.00 34.00 37.00 40.00 45.00  
 256 RY 2471.0 2470.00 2469.00 2468.00 2468.00 2469.00 2470.00 2471.00  
 \*

257 KK PON70 BASIN  
 258 BA 0.0026  
 259 LG 0.10 0.25 5.05 0.44 5  
 260 UC 0.229 0.362  
 261 UA 0 3.0 5.0 8.0 12.0 20.0 43.0 75.0 90.0 96.0  
 262 UA 100  
 \*

HEC-1 INPUT

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

263 KK CPP70 COMBINE  
 264 HC 2  
 \*

265 KK RCPP70 ROUTE  
 266 RS 1 FLOW  
 267 RC 0.035 0.035 0.035 1046 0.0239 2458.00  
 268 RX 0.00 4.00 12.00 23.00 32.00 41.00 44.00 47.00  
 269 RY 2458.0 2457.00 2456.00 2455.00 2455.00 2456.00 2457.00 2458.00  
 \*

270 KK PON80 BASIN



333	KK	SOF-25	BASIN											
334	BA	0.112												
335	LG	0.32	0.33	5.71	0.22	12								
336	UC	0.376	0.375											
337	UA	0	3.0	5.0	8.0	12.0	20.0	43.0	75.0	90.0	96.0			
338	UA	100												

\*

HEC-1 INPUT

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

339	KK	SROF25	ROUTE											
340	RS	1	FLOW											
341	RC	0.035	0.035	0.035	1880	0.0164	2486.00							
342	RX	0.00	29.00	41.00	47.00	50.00	64.00	95.00	128.00					
343	RY	2486.0	2480.00	2478.00	2476.00	2476.00	2478.00	2480.00	2486.00					

\*

344	KK	SON-22	BASIN											
345	BA	0.015												
346	LG	0.34	0.36	6.00	0.17	5								
347	UC	0.288	0.479											
348	UA	0	3.0	5.0	8.0	12.0	20.0	43.0	75.0	90.0	96.0			
349	UA	100												

\*

350	KK	SCP022	COMBINE											
351	HC	2												

\*

352	KK	SR2225	ROUTE											
353	RS	1	FLOW											
354	RC	0.035	0.035	0.035	398	0.0164	2486.00							
355	RX	0.00	29.00	41.00	47.00	50.00	64.00	95.00	128.00					
356	RY	2486.0	2480.00	2478.00	2476.00	2476.00	2478.00	2480.00	2486.00					

\*

357	KK	SON-25	BASIN											
358	BA	0.002												
359	LG	0.34	0.37	6.00	0.17	4								
360	UC	0.130	0.210											
361	UA	0	3.0	5.0	8.0	12.0	20.0	43.0	75.0	90.0	96.0			
362	UA	100												

\*

363	KK	SON-24	BASIN											
364	BA	0.003												
365	LG	0.32	0.31	6.00	0.17	11								
366	UC	0.154	0.144											
367	UA	0	3.0	5.0	8.0	12.0	20.0	43.0	75.0	90.0	96.0			
368	UA	100												

\*

369	KK	SRET24	STORAGE											
370	RS	1	STOR											
371	SV		0.12	0.26	0.44									
372	SQ		0.82	1.25	1.57									
373	SE	2467.0	2468.00	2469.00	2470.00									

\*

HEC-1 INPUT

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

374	KK	SCP025	COMBINE											
375	HC	3												
376	KK	RSON25	ROUTE											
377	RS	1	FLOW											
378	RC	0.035	0.035	0.035	643	0.0249	2456.00							
379	RX	0.00	13.00	16.00	19.00	31.00	33.00	36.00	39.00					
380	RY	2456.0	2455.00	2454.00	2453.00	2453.00	2454.00	2455.00	2456.00					

\*

381	KK	PON90	BASIN											
382	BA	0.0004												
383	LG	0.10	0.25	5.05	0.44	5								
384	UC	0.130	0.150											
385	UA	0	3.0	5.0	8.0	12.0	20.0	43.0	75.0	90.0	96.0			
386	UA	100												

\*

387	KK	RPON90	ROUTE											
388	RS	1	FLOW											
389	RC	0.035	0.035	0.035	666	0.0330	2456.00							
390	RX	0.00	13.00	16.00	19.00	31.00	33.00	36.00	39.00					
391	RY	2456.0	2455.00	2454.00	2453.00	2453.00	2454.00	2455.00	2456.00					

1

1

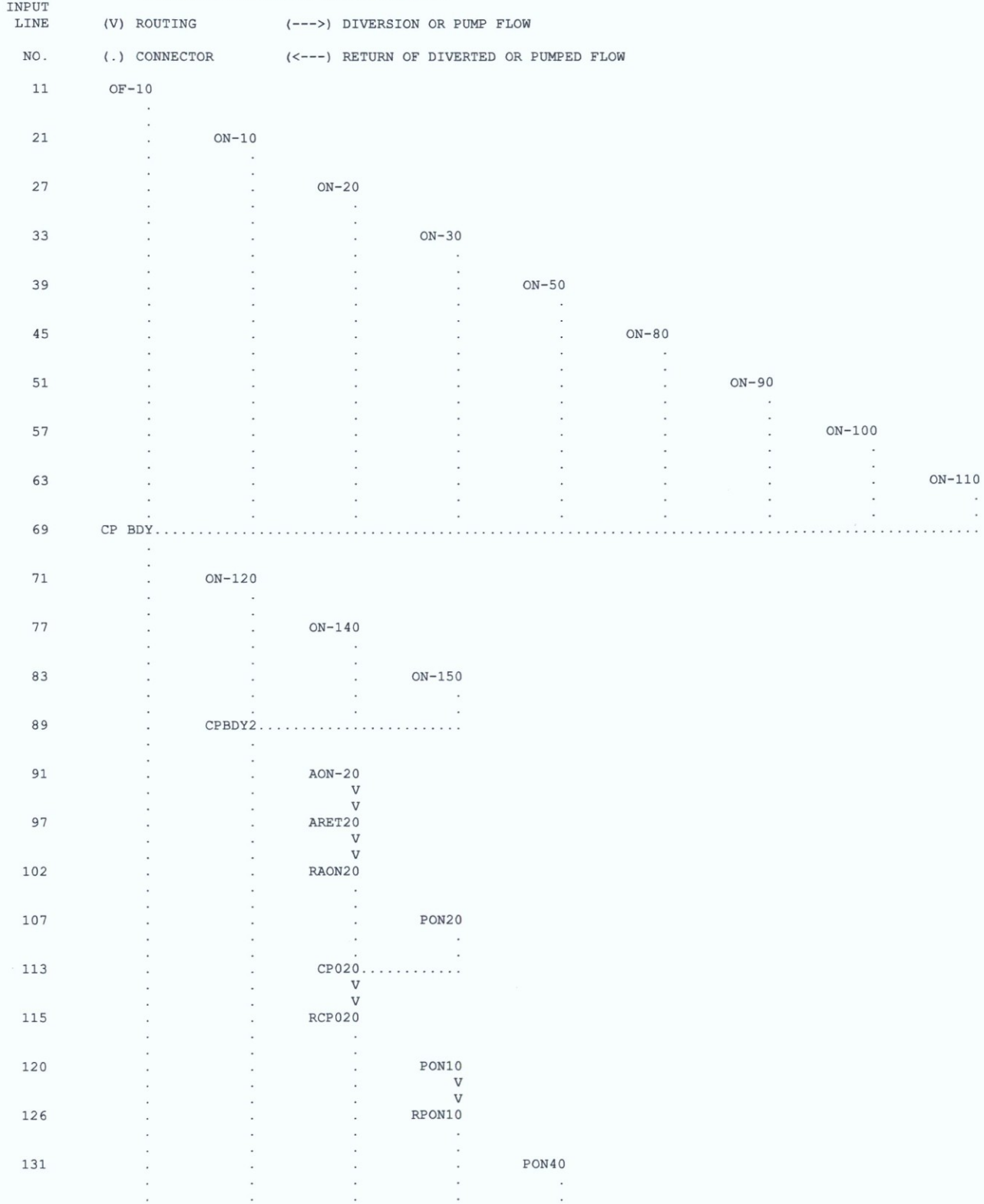
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*
392      KK  ON-130  BASIN
393      BA  0.0035
394      LG  0.10   0.25   5.24   0.40   5
395      UC  0.289  0.575
396      UA  0     3.0    5.0    8.0    12.0   20.0   43.0   75.0   90.0   96.0
397      UA  100
*
398      KK  CP130  COMBINE
399      HC  3
*
400      ZZ

```

1

SCHEMATIC DIAGRAM OF STREAM NETWORK



137	CPP40.....		
	V		
	V		
139	DETA		
	V		
	V		
146	RDETA		
151		PON30	
		V	
		V	
157		RPON30	
162			PON50
168			PON60
174	CP060.....		
	V		
	V		
176	DetB		
	V		
	V		
183	RDETB		
188		ON-40	
194	CP040.....		
196		SOF-30	
		V	
		V	
202		SROF30	
207			SON-26
213	SCP026.....		
	V		
	V		
215	SR2628		
220			SON-28
226	SCP028.....		
	V		
	V		
228	SRET28		
233		SON-27	
		V	
		V	
239		SRET27	
244			SON-30
250	SCP030.....		
	V		
	V		
252	RSON30		
257			PON70
263	CPP70.....		
	V		
	V		
265	RCP70		
270		PON80	
		V	
		V	
276		RPON80	

```

281 . . . . . PON100
      . . . . . V
      . . . . . V
287 . . . . . DETC
      . . . . . V
      . . . . . V
294 . . . . . RDETC
      . . . . .
      . . . . .
299 . . . . . ON-75
      . . . . .
      . . . . .
305 . . . . . CP075
      . . . . . V
      . . . . . V
307 . . . . . RCP075
      . . . . .
      . . . . .
312 . . . . . ON-70
      . . . . .
      . . . . .
318 . . . . . PON110
      . . . . . V
      . . . . . V
324 . . . . . DETD
      . . . . .
      . . . . .
331 . . . . . CP070
      . . . . .
      . . . . .
333 . . . . . SOF-25
      . . . . . V
      . . . . . V
339 . . . . . SROF25
      . . . . .
      . . . . .
344 . . . . . SON-22
      . . . . .
      . . . . .
350 . . . . . SCP022
      . . . . . V
      . . . . . V
352 . . . . . SR2225
      . . . . .
      . . . . .
357 . . . . . SON-25
      . . . . .
      . . . . .
363 . . . . . SON-24
      . . . . . V
      . . . . . V
369 . . . . . SRET24
      . . . . .
      . . . . .
374 . . . . . SCP025
      . . . . . V
      . . . . . V
376 . . . . . RSON25
      . . . . .
      . . . . .
381 . . . . . PON90
      . . . . . V
      . . . . . V
387 . . . . . RPON90
      . . . . .
      . . . . .
392 . . . . . ON-130
      . . . . .
      . . . . .
398 . . . . . CP130
      . . . . .

```

(\*\*\*) RUNOFF ALSO COMPUTED AT THIS LOCATION

```

1*****
*****
*
*
* FLOOD HYDROGRAPH PACKAGE (HEC-1) *
*
* JUN 1998 *
*
* VERSION 4.1 *
*
* RUN DATE 22DEC16 TIME 15:43:52 *
*
*
*****
*****

```

```

*
*
* U.S. ARMY CORPS OF ENGINEERS
*
* HYDROLOGIC ENGINEERING CENTER
*
* 609 SECOND STREET
*
* DAVIS, CALIFORNIA 95616
*
* (916) 756-1104
*
*

```



+		AON-20	22.	4.08	2.	0.	0.	.02		
		ROUTED TO								
+		ARET20	7.	4.33	2.	0.	0.	.02	2483.66	4.33
+		ROUTED TO								
+		RAON20	7.	4.42	2.	0.	0.	.02	2475.29	4.42
+		HYDROGRAPH AT								
		PON20	1.	4.08	0.	0.	0.	.00		
		2 COMBINED AT								
+		CP020	7.	4.33	2.	0.	0.	.02		
		ROUTED TO								
+		RCP020	7.	4.42	2.	0.	0.	.02	2468.66	4.42
+		HYDROGRAPH AT								
		PON10	2.	4.08	0.	0.	0.	.00		
		ROUTED TO								
+		RPON10	2.	4.08	0.	0.	0.	.00	2468.42	4.08
+		HYDROGRAPH AT								
		PON40	1.	4.08	0.	0.	0.	.00		
		3 COMBINED AT								
+		CPP40	9.	4.17	2.	1.	0.	.02		
		ROUTED TO								
+		DETA	9.	4.33	2.	0.	0.	.02	1.67	4.33
+		ROUTED TO								
+		RDETA	9.	4.33	2.	0.	0.	.02	2454.76	4.33
+		HYDROGRAPH AT								
		PON30	0.	4.08	0.	0.	0.	.00		
		ROUTED TO								
+		RPON30	0.	4.17	0.	0.	0.	.00	2457.24	4.17
+		HYDROGRAPH AT								
		PON50	2.	4.08	0.	0.	0.	.00		
		HYDROGRAPH AT								
+		PON60	20.	4.08	2.	0.	0.	.02		
		4 COMBINED AT								
+		CP060	22.	4.08	4.	1.	0.	.04		
		ROUTED TO								
+		DetB	20.	4.25	4.	1.	0.	.04	2.46	4.25
+		ROUTED TO								
+		RDETB	13.	4.58	4.	1.	0.	.04	2445.24	4.58
+		HYDROGRAPH AT								
		ON-40	2.	4.08	0.	0.	0.	.00		
		2 COMBINED AT								
+		CP040	13.	4.58	4.	1.	0.	.05		
		HYDROGRAPH AT								
+		SOF-30	9.	4.08	0.	0.	0.	.01		
		ROUTED TO								
+		SROF30	8.	4.08	0.	0.	0.	.01	2476.16	4.08
+		HYDROGRAPH AT								
		SON-26	1.	4.08	0.	0.	0.	.00		
		2 COMBINED AT								
+		SCP026	9.	4.08	1.	0.	0.	.01		
		ROUTED TO								
+		SR2628	8.	4.17	1.	0.	0.	.01	2476.16	4.17
+		HYDROGRAPH AT								
		SON-28	17.	4.00	1.	0.	0.	.01		



+		SR2225	92.	4.33	12.	3.	1.	.13		
+									2477.61	4.33
	HYDROGRAPH AT									
+		SON-25	2.	4.08	0.	0.	0.	.00		
	HYDROGRAPH AT									
+		SON-24	4.	4.08	0.	0.	0.	.00		
	ROUTED TO									
+		SRET24	1.	4.42	0.	0.	0.	.00		
+									2467.93	4.42
	3 COMBINED AT									
+		SCP025	94.	4.33	12.	3.	1.	.13		
	ROUTED TO									
+		RSON25	93.	4.33	12.	3.	1.	.13		
+									2454.03	4.33
	HYDROGRAPH AT									
+		PON90	0.	4.08	0.	0.	0.	.00		
	ROUTED TO									
+		RPON90	0.	4.08	0.	0.	0.	.00		
+									2453.02	4.08
	HYDROGRAPH AT									
+		ON-130	2.	4.25	0.	0.	0.	.00		
	3 COMBINED AT									
+		CP130	95.	4.33	12.	3.	1.	.14		

\*\*\* NORMAL END OF HEC-1 \*\*\*

```

1*****
*****
*
*
* FLOOD HYDROGRAPH PACKAGE (HEC-1) *
*
* JUN 1998 *
*
* VERSION 4.1 *
*
* RUN DATE 22DEC16 TIME 15:37:12 *
*
*
*****
*****

```

```

*
*
* U.S. ARMY CORPS OF ENGINEERS
*
* HYDROLOGIC ENGINEERING CENTER
*
* 609 SECOND STREET
*
* DAVIS, CALIFORNIA 95616
*
* (916) 756-1104
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X X XXXXXXX XXXXX X
X X X X X XX
X X X X X X
XXXXXXX XXXX X XXXXX X
X X X X X X
X X X X X X
X X XXXXXXX XXXXX XXX

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THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE. THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION

NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY, DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

LINE	ID	1	2	3	4	5	6	7	8	9	10
1	ID	Flood Control District of Maricopa County									
2	ID	BLACK MOUNTAIN_PROP - BLACK MOUNTAIN PROPOSED CONDITIONS									
3	ID	100 YEAR									
4	ID	6 Hour Storm									
5	ID	Unit Hydrograph: Clark									
6	ID	Storm: Single									
7	ID	12/22/2016									
	*DIAGRAM										
8	IT	5	1JAN99	0	2000						
9	IO	5									
10	IN	15									
	*										
11	KK	OF-10	BASIN								
12	BA	0.0005									
13	PB	3.143									
14	PC	0.000	0.008	0.016	0.025	0.033	0.041	0.050	0.058	0.066	0.074
15	PC	0.087	0.099	0.118	0.138	0.216	0.377	0.834	0.911	0.931	0.950
16	PC	0.962	0.972	0.983	0.991	1.000					
17	LG	0.10	0.25	5.05	0.44	5					
18	UC	0.098	0.109								
19	UA	0	3.0	5.0	8.0	12.0	20.0	43.0	75.0	90.0	96.0
20	UA	100									
	*										
21	KK	ON-10	BASIN								
22	BA	0.0018									
23	LG	0.10	0.25	5.05	0.44	5					
24	UC	0.147	0.240								
25	UA	0	3.0	5.0	8.0	12.0	20.0	43.0	75.0	90.0	96.0
26	UA	100									
	*										
27	KK	ON-20	BASIN								
28	BA	0.0009									
29	LG	0.12	0.25	5.05	0.42	6					
30	UC	0.122	0.219								
31	UA	0	3.0	5.0	8.0	12.0	20.0	43.0	75.0	90.0	96.0
32	UA	100									
	*										
33	KK	ON-30	BASIN								
34	BA	0.0004									

35	LG	0.10	0.25	5.05	0.44	5					
36	UC	0.063	0.039								
37	UA	0	3.0	5.0	8.0	12.0	20.0	43.0	75.0	90.0	96.0
38	UA	100									
	*										
39	KK	ON-50	BASIN								
40	BA	0.0002									
41	LG	0.10	0.25	5.05	0.44	5					
42	UC	0.043	0.014								
43	UA	0	3.0	5.0	8.0	12.0	20.0	43.0	75.0	90.0	96.0
44	UA	100									
	*										

1

HEC-1 INPUT

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

45	KK	ON-80	BASIN								
46	BA	0.0031									
47	LG	0.12	0.25	5.05	0.43	6					
48	UC	0.158	0.225								
49	UA	0	3.0	5.0	8.0	12.0	20.0	43.0	75.0	90.0	96.0
50	UA	100									
	*										
51	KK	ON-90	BASIN								
52	BA	0.0001									
53	LG	0.10	0.25	4.33	0.62	5					
54	UC	0.059	0.021								
55	UA	0	3.0	5.0	8.0	12.0	20.0	43.0	75.0	90.0	96.0
56	UA	100									
	*										

57	KK	ON-100	BASIN								
58	BA	0.0003									
59	LG	0.10	0.25	4.33	0.62	5					
60	UC	0.081	0.070								
61	UA	0	3.0	5.0	8.0	12.0	20.0	43.0	75.0	90.0	96.0
62	UA	100									
	*										
63	KK	ON-110	BASIN								
64	BA	0.0004									
65	LG	0.10	0.25	4.58	0.55	5					
66	UC	0.065	0.040								
67	UA	0	3.0	5.0	8.0	12.0	20.0	43.0	75.0	90.0	96.0
68	UA	100									
	*										

69	KK	CP BDY	COMBINE								
70	HC	9									
	*										

71	KK	ON-120	BASIN								
72	BA	0.0019									
73	LG	0.19	0.25	5.05	0.39	10					
74	UC	0.117	0.141								
75	UA	0	3.0	5.0	8.0	12.0	20.0	43.0	75.0	90.0	96.0
76	UA	100									
	*										
77	KK	ON-140	BASIN								
78	BA	0.0002									
79	LG	0.10	0.25	5.46	0.35	5					
80	UC	0.070	0.044								
81	UA	0	3.0	5.0	8.0	12.0	20.0	43.0	75.0	90.0	96.0
82	UA	100									
	*										

1

HEC-1 INPUT

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

83	KK	ON-150	BASIN								
84	BA	0.001									
85	LG	0.10	0.25	6.00	0.28	5					
86	UC	0.094	0.104								
87	UA	0	3.0	5.0	8.0	12.0	20.0	43.0	75.0	90.0	96.0
88	UA	100									
	*										
89	KK	CPBDY2	COMBINE								
90	HC	3									
	*										
91	KK	ACN-20	BASIN								
92	BA	0.018									
93	LG	0.31	0.28	5.05	0.27	13					
94	UC	0.191	0.198								





\*  
 215 KK SR2628 ROUTE  
 216 RS 1 FLOW  
 217 RC 0.035 0.035 0.035 740 0.0214 2484.00  
 218 RX 0.00 37.00 45.00 52.00 66.00 81.00 96.00 153.00  
 219 RY 2484.0 2480.00 2478.00 2476.00 2476.00 2478.00 2480.00 2484.00  
 \*

220 KK SON-28 BASIN  
 221 BA 0.010  
 222 LG 0.31 0.26 5.05 0.26 15  
 223 UC 0.133 0.106  
 224 UA 0 5.0 16.0 30.0 65.0 77.0 84.0 90.0 94.0 97.0  
 225 UA 100  
 \*

226 KK SCP028 COMBINE  
 227 HC 2  
 \*

HEC-1 INPUT

PAGE 7

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

228 KK SRET28 STORAGE  
 229 RS 1 STOR  
 230 SV 0.11 0.26 0.30 0.35 0.40 0.46  
 231 SQ 3.94 6.13 11.27 20.23 31.64 45.04  
 232 SE 2475.0 2476.00 2477.00 2477.30 2477.50 2477.80 2478.00  
 \*

233 KK SON-27 BASIN  
 234 BA 0.009  
 235 LG 0.30 0.25 5.58 0.20 17  
 236 UC 0.139 0.168  
 237 UA 0 5.0 16.0 30.0 65.0 77.0 84.0 90.0 94.0 97.0  
 238 UA 100  
 \*

239 KK SRET27 STORAGE  
 240 RS 1 STOR  
 241 SV 0.18 0.39 0.64 0.78  
 242 SQ 2.00 3.30 4.22 4.61  
 243 SE 2472.0 2473.00 2474.00 2475.00 2475.50  
 \*

244 KK SON-30 BASIN  
 245 BA 0.001  
 246 LG 0.35 0.36 5.05 0.27 0  
 247 UC 0.112 0.177  
 248 UA 0 3.0 5.0 8.0 12.0 20.0 43.0 75.0 90.0 96.0  
 249 UA 100  
 \*

250 KK SCP030 COMBINE  
 251 HC 3  
 \*

252 KK RSON30 ROUTE  
 253 RS 1 FLOW  
 254 RC 0.035 0.035 0.035 320 0.0188 2471.00  
 255 RX 0.00 17.00 25.00 30.00 34.00 37.00 40.00 45.00  
 256 RY 2471.0 2470.00 2469.00 2468.00 2468.00 2469.00 2470.00 2471.00  
 \*

257 KK PON70 BASIN  
 258 BA 0.0026  
 259 LG 0.10 0.25 5.05 0.44 5  
 260 UC 0.175 0.269  
 261 UA 0 3.0 5.0 8.0 12.0 20.0 43.0 75.0 90.0 96.0  
 262 UA 100  
 \*

HEC-1 INPUT

PAGE 8

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

263 KK CPP70 COMBINE  
 264 HC 2  
 \*

265 KK RCP070 ROUTE  
 266 RS 1 FLOW  
 267 RC 0.035 0.035 0.035 1046 0.0239 2458.00  
 268 RX 0.00 4.00 12.00 23.00 32.00 41.00 44.00 47.00  
 269 RY 2458.0 2457.00 2456.00 2455.00 2455.00 2456.00 2457.00 2458.00  
 \*

270 KK PON80 BASIN





```

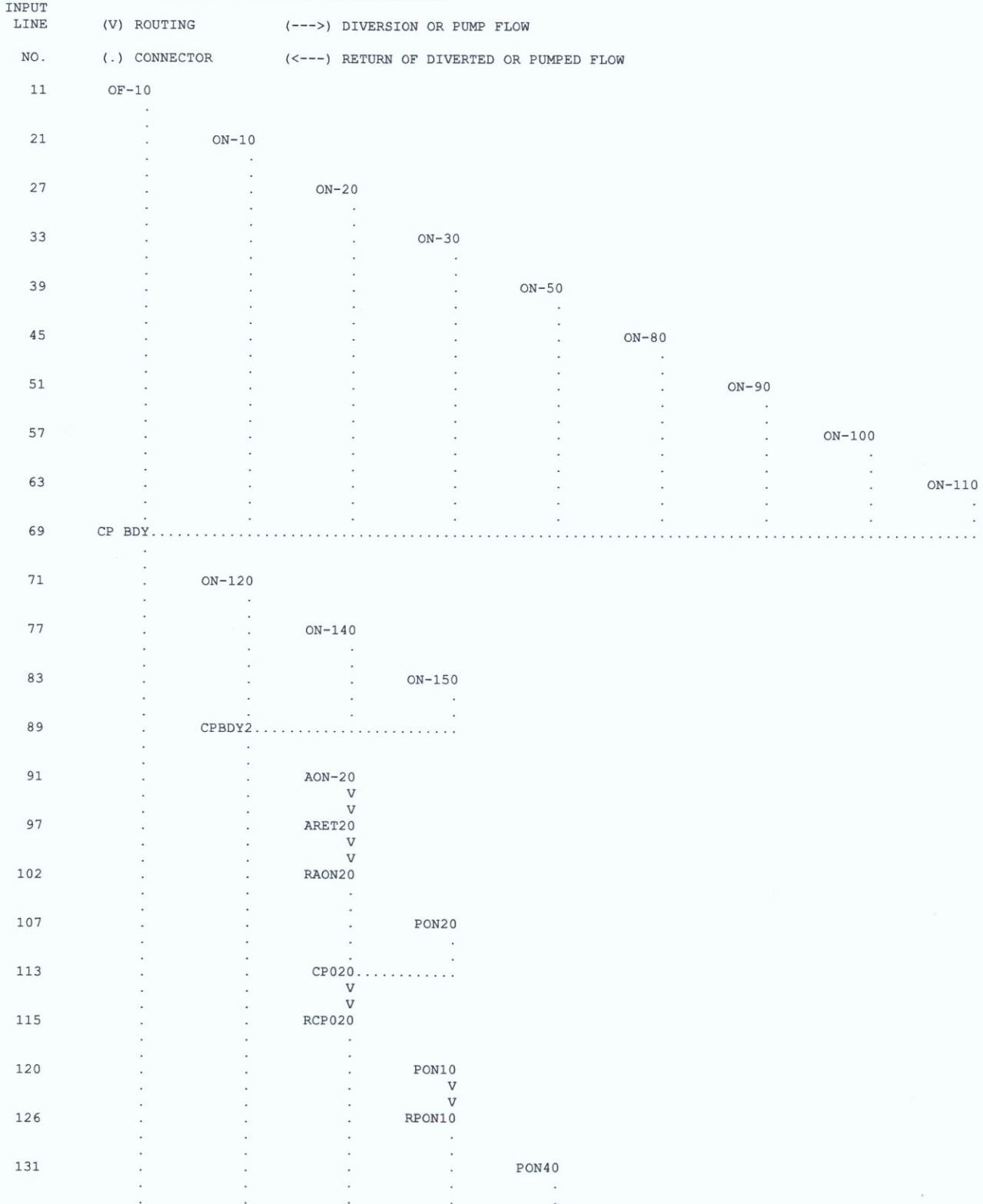
*
392      KK  ON-130  BASIN
393      BA  0.0035
394      LG  0.10   0.25   5.24   0.40   5
395      UC  0.221  0.427
396      UA  0     3.0    5.0    8.0    12.0   20.0   43.0   75.0   90.0   96.0
397      UA  100
*

398      KK  CP130  COMBINE
399      HC  3
*
400      ZZ

```

1

SCHMATIC DIAGRAM OF STREAM NETWORK



137	CPP40	.....		
	V			
	V			
139	DETA			
	V			
	V			
146	RDETA			
151		PON30		
		V		
		V		
157		RPON30		
162			PON50	
168				PON60
174	CP060	.....		
	V			
	V			
176	DETB			
	V			
	V			
183	RDETB			
188		ON-40		
194	CP040	.....		
196		SOF-30		
		V		
		V		
202		SROF30		
207			SON-26	
213	SCP026	.....		
	V			
	V			
215	SR2628			
220			SON-28	
226	SCP028	.....		
	V			
	V			
228	SRET28			
233			SON-27	
			V	
			V	
239			SRET27	
244				SON-30
250	SCP030	.....		
	V			
	V			
252	RSON30			
257			PON70	
263	CPP70	.....		
	V			
	V			
265	RCP070			
270			PON80	
			V	
			V	
276			RPON80	

```

281 . . . . . PON100
      . . . . . V
      . . . . . V
287 . . . . . DETC
      . . . . . V
      . . . . . V
294 . . . . . RDETC
      . . . . .
      . . . . .
299 . . . . . ON-75
      . . . . .
      . . . . .
305 . . . . . CP075
      . . . . . V
      . . . . . V
307 . . . . . RCP075
      . . . . .
      . . . . .
312 . . . . . ON-70
      . . . . .
      . . . . .
318 . . . . . PON110
      . . . . . V
      . . . . . V
324 . . . . . DETD
      . . . . .
      . . . . .
331 . . . . . CP070
      . . . . .
      . . . . .
333 . . . . . SOF-25
      . . . . . V
      . . . . . V
339 . . . . . SROF25
      . . . . .
      . . . . .
344 . . . . . SON-22
      . . . . .
      . . . . .
350 . . . . . SCP022
      . . . . . V
      . . . . . V
352 . . . . . SR2225
      . . . . .
      . . . . .
357 . . . . . SON-25
      . . . . .
      . . . . .
363 . . . . . SON-24
      . . . . . V
      . . . . . V
369 . . . . . SRET24
      . . . . .
      . . . . .
374 . . . . . SCP025
      . . . . . V
      . . . . . V
376 . . . . . RSON25
      . . . . .
      . . . . .
381 . . . . . PON90
      . . . . . V
      . . . . . V
387 . . . . . RPON90
      . . . . .
      . . . . .
392 . . . . . ON-130
      . . . . .
      . . . . .
398 . . . . . CP130
      . . . . .

```

(\*\*\*) RUNOFF ALSO COMPUTED AT THIS LOCATION

```

1*****
*****
*
* FLOOD HYDROGRAPH PACKAGE (HEC-1) *
*
* JUN 1998 *
*
* VERSION 4.1 *
*
* RUN DATE 22DEC16 TIME 15:37:12 *
*
*
*****
*****

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```

*
* U.S. ARMY CORPS OF ENGINEERS
* HYDROLOGIC ENGINEERING CENTER
* 609 SECOND STREET
* DAVIS, CALIFORNIA 95616
* (916) 756-1104
*

```



+		AON-20	39.	4.08	3.	1.	0.	.02		
	ROUTED TO									
+		ARET20	18.	4.33	3.	1.	0.	.02	2484.65	4.33
+	ROUTED TO									
+		RAON20	18.	4.33	3.	1.	0.	.02	2475.51	4.33
+	HYDROGRAPH AT									
		PON20	3.	4.00	0.	0.	0.	.00		
	2 COMBINED AT									
+		CP020	19.	4.33	4.	1.	0.	.02		
	ROUTED TO									
+		RCP020	19.	4.33	4.	1.	0.	.02	2468.96	4.33
+	HYDROGRAPH AT									
		PON10	5.	4.00	0.	0.	0.	.00		
	ROUTED TO									
+		RPON10	5.	4.00	0.	0.	0.	.00	2468.55	4.00
+	HYDROGRAPH AT									
		PON40	2.	4.08	0.	0.	0.	.00		
	3 COMBINED AT									
+		CPP40	21.	4.25	4.	1.	0.	.02		
	ROUTED TO									
+		DETA	21.	4.25	4.	1.	0.	.02	1.91	4.25
+	ROUTED TO									
+		RDETA	21.	4.33	4.	1.	0.	.02	2455.04	4.33
+	HYDROGRAPH AT									
		PON30	1.	4.08	0.	0.	0.	.00		
	ROUTED TO									
+		RPON30	1.	4.08	0.	0.	0.	.00	2457.32	4.08
+	HYDROGRAPH AT									
		PON50	4.	4.08	0.	0.	0.	.00		
	HYDROGRAPH AT									
+		PON60	41.	4.00	3.	1.	0.	.02		
	4 COMBINED AT									
+		CP060	58.	4.08	8.	2.	1.	.04		
	ROUTED TO									
+		DETB	56.	4.17	7.	2.	1.	.04	2.98	4.17
+	ROUTED TO									
+		RDETB	40.	4.33	7.	2.	1.	.04	2445.48	4.33
+	HYDROGRAPH AT									
		ON-40	4.	4.00	0.	0.	0.	.00		
	2 COMBINED AT									
+		CP040	41.	4.33	8.	2.	1.	.05		
	HYDROGRAPH AT									
+		SOF-30	17.	4.08	1.	0.	0.	.01		
	ROUTED TO									
+		SROF30	16.	4.08	1.	0.	0.	.01	2476.31	4.08
+	HYDROGRAPH AT									
		SON-26	2.	4.08	0.	0.	0.	.00		
	2 COMBINED AT									
+		SCP026	18.	4.08	1.	0.	0.	.01		
	ROUTED TO									
+		SR2628	17.	4.17	1.	0.	0.	.01	2476.32	4.17
+	HYDROGRAPH AT									
		SON-28	29.	4.00	2.	0.	0.	.01		



### HEC-1 Detention Basins

Detention Basin A			Detention Basin B			Detention Basin C			Detention Basin D		
Depth (ft)	Surface Area (ac)	$\Delta V$ (af)	Depth (ft)	Surface Area (ac)	$\Delta V$ (af)	Depth (ft)	Surface Area (ac)	$\Delta V$ (af)	Depth (ft)	Surface Area (ac)	$\Delta V$ (af)
0	0.098	--	0	0.135	--	0	0.164	--	0	0.174	--
1	0.126	0.11	1	0.166	0.15	1	0.202	0.18	1	0.211	0.19
2	0.161	0.14	2	0.200	0.18	2	0.243	0.22	2	0.250	0.23
--	--	--	3	0.235	0.22	3	0.288	0.27	3	0.294	0.27
<b><math>V_{total} =</math></b>		<b>0.25</b>	<b><math>V_{total} =</math></b>		<b>0.55</b>	<b><math>V_{total} =</math></b>		<b>0.67</b>	<b><math>V_{total} =</math></b>		<b>0.69</b>

HEC-RAS Version 4.1.0 Jan 2010  
 U.S. Army Corps of Engineers  
 Hydrologic Engineering Center  
 609 Second Street  
 Davis, California

```

X      X  XXXXXX   XXXX      XXXX      XX      XXXX
X      X  X       X  X      X  X      X  X      X
X      X  X       X       X  X      X  X      X
XXXXXXXX XXXX   X       XXX  XXXX   XXXXXXX  XXXX
X      X  X       X       X  X      X  X      X
X      X  X       X  X      X  X      X  X      X
X      X  XXXXXX   XXXX      X  X      X  X      XXXXX
  
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PROJECT DATA

Project Title: BlackMountain  
 Project File : BlackMountain.prj  
 Run Date and Time: 11/2/2016 11:10:03 AM

Project in English units

PLAN DATA

Plan Title: ExistingConditions\_BM  
 Plan File :  
 k:\TUC\_WaterResources\Shift\PHX\291015001\_BlackMountain\Design\Drainage\HECRAS\BlackMountain.p01

Geometry Title: ExistingConditions\_BM  
 Geometry File :  
 k:\TUC\_WaterResources\Shift\PHX\291015001\_BlackMountain\Design\Drainage\HECRAS\BlackMountain.g01

Flow Title : ExistingConditions\_100yr  
 Flow File :  
 k:\TUC\_WaterResources\Shift\PHX\291015001\_BlackMountain\Design\Drainage\HECRAS\BlackMountain.f01

Plan Summary Information:

Number of:	Cross Sections =	29	Multiple Openings =	0
	Culverts =	0	Inline Structures =	0
	Bridges =	0	Lateral Structures =	0

Computational Information

Water surface calculation tolerance	=	0.01
Critical depth calculation tolerance	=	0.01
Maximum number of iterations	=	20
Maximum difference tolerance	=	0.3
Flow tolerance factor	=	0.001

Computation Options

Critical depth computed at all cross sections	
Conveyance Calculation Method:	At breaks in n values only
Friction Slope Method:	Average Conveyance
Computational Flow Regime:	Subcritical Flow

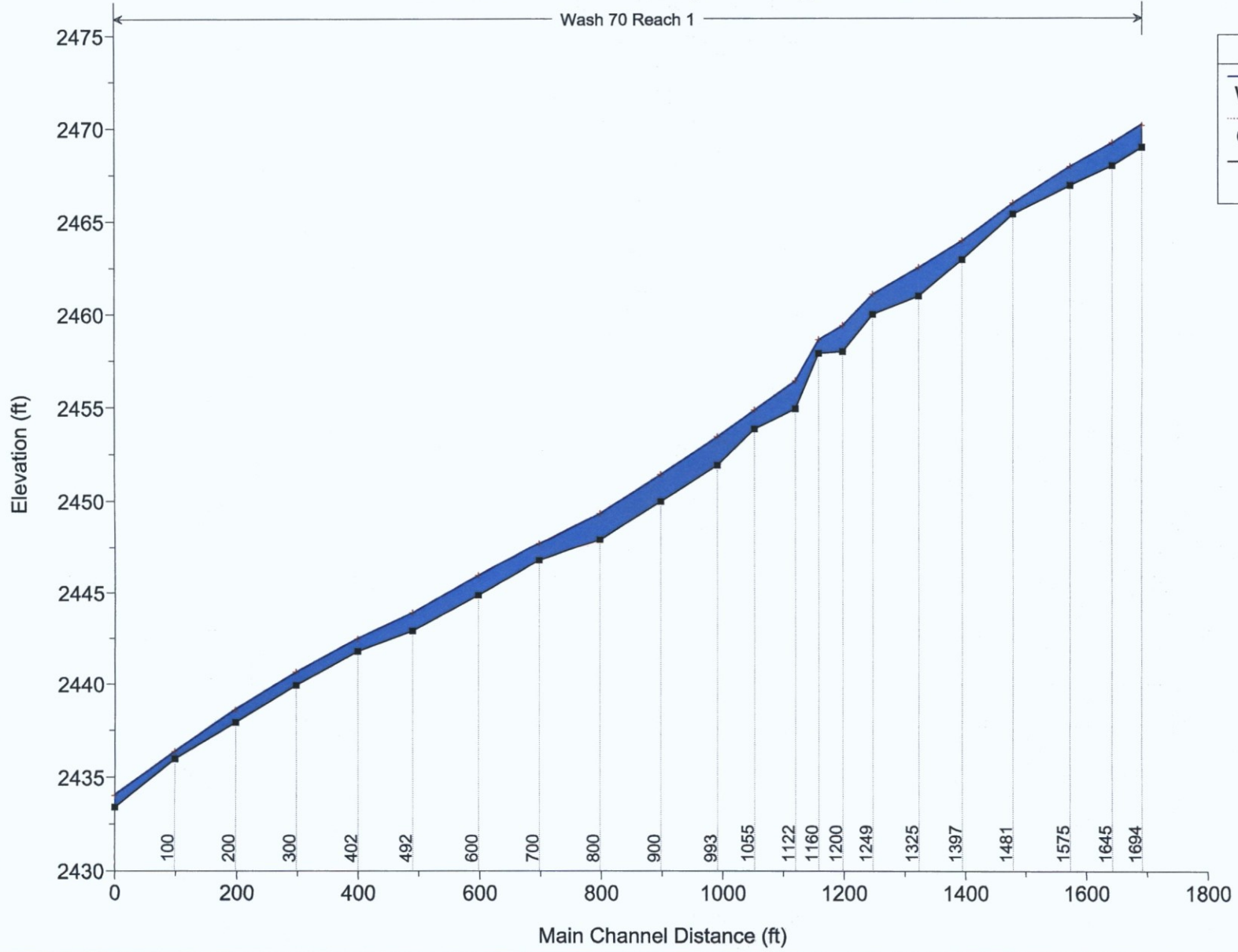
HEC-RAS Plan: ExistingCond River: Wash 70 Reach: Reach 1 Profile: 100yr

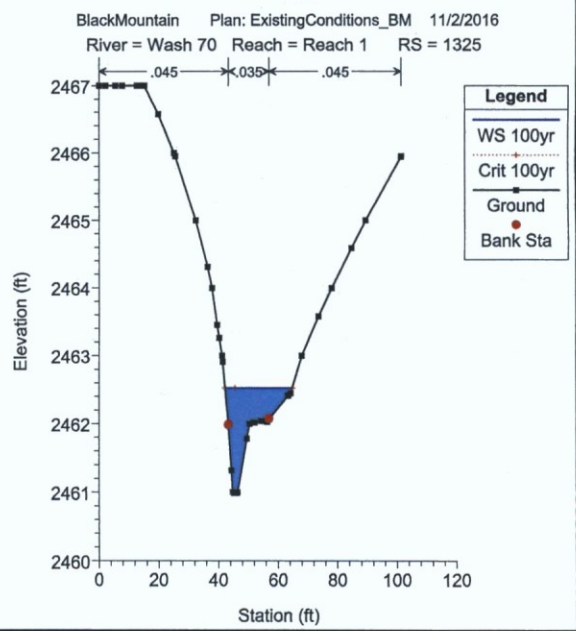
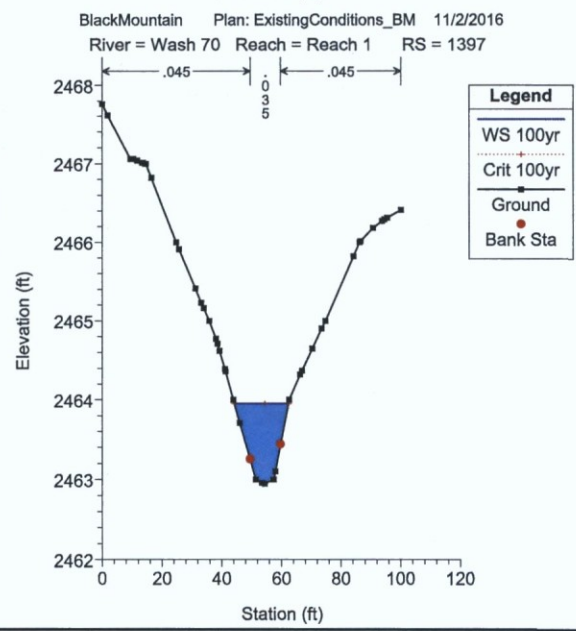
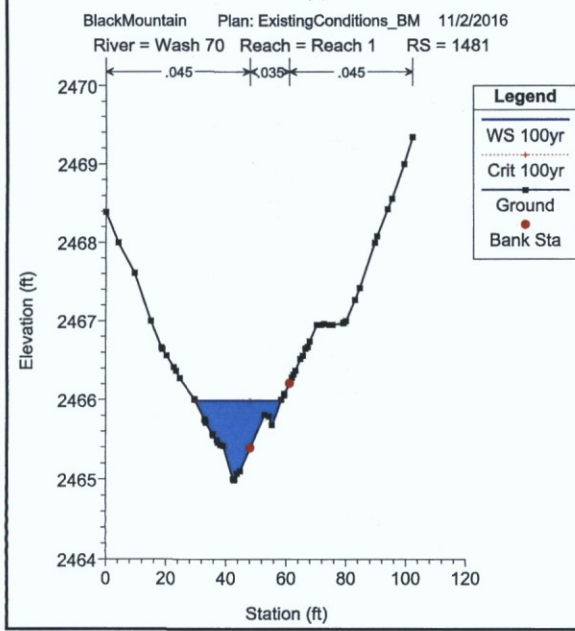
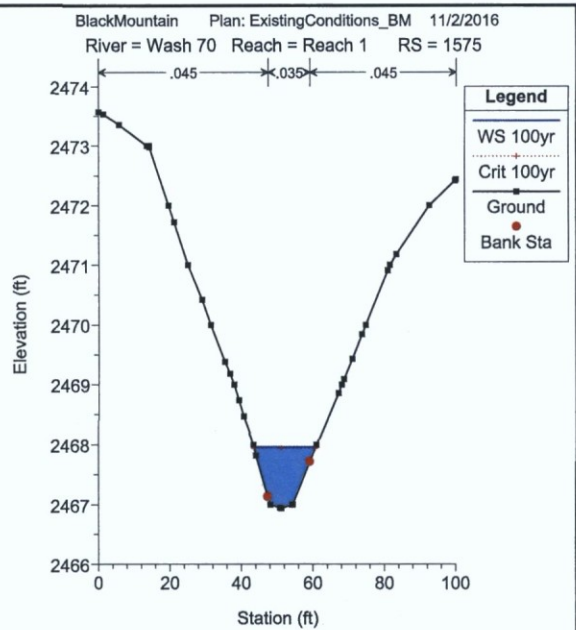
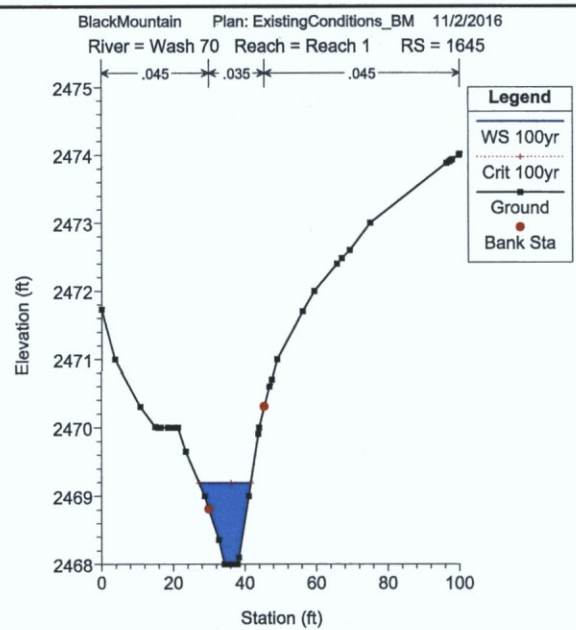
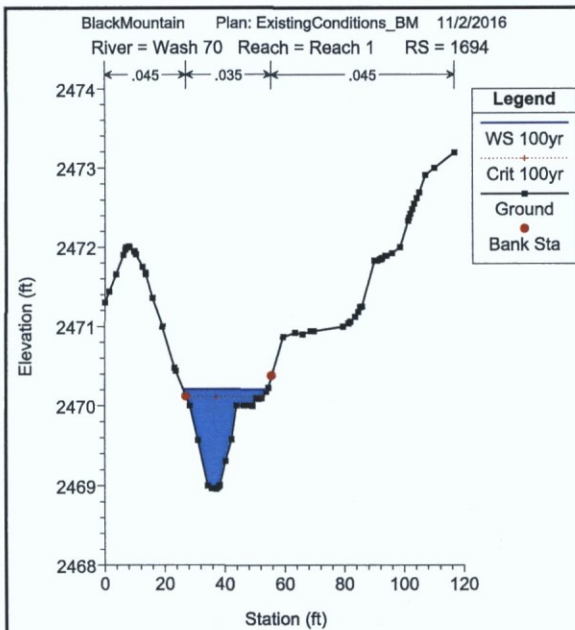
Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
Reach 1	1694	100yr	50	2468.96	2470.20	2470.11	2470.38	0.013984	3.36	14.932860	27.96	0.80
Reach 1	1645	100yr	50	2468.00	2469.19	2469.19	2469.58	0.018425	5.05	10.235050	14.31	0.97
Reach 1	1575	100yr	50	2466.94	2467.95	2467.94	2468.29	0.016748	4.80	11.395480	17.13	0.93
Reach 1	1481	100yr	50	2465.39	2465.98	2465.98	2466.22	0.031957	3.19	13.060340	28.54	1.07
Reach 1	1397	100yr	50	2462.95	2463.95	2463.95	2464.30	0.016035	4.96	11.616950	18.14	0.93
Reach 1	1325	100yr	57	2460.99	2462.52	2462.52	2462.85	0.016931	4.74	13.408380	22.56	0.92
Reach 1	1249	100yr	57	2459.99	2461.08	2461.08	2461.41	0.015797	4.95	13.894860	22.49	0.92
Reach 1	1200	100yr	57	2458.00	2459.39	2459.39	2459.86	0.017204	5.71	10.951490	13.00	0.98
Reach 1	1160	100yr	57	2457.90	2458.62	2458.62	2458.88	0.022072	4.90	15.651680	30.38	1.04
Reach 1	1122	100yr	57	2454.94	2456.41	2456.41	2456.83	0.016949	5.34	11.967420	16.20	0.95
Reach 1	1055	100yr	57	2453.86	2454.85	2454.85	2455.23	0.018127	5.41	12.955130	19.04	0.99
Reach 1	993	100yr	57	2451.93	2453.43	2453.43	2453.88	0.018664	5.68	11.116230	12.12	1.00
Reach 1	900	100yr	57	2449.98	2451.41	2451.41	2451.86	0.017366	5.52	11.047640	12.74	0.97
Reach 1	800	100yr	57	2447.94	2449.32	2449.32	2449.71	0.015901	5.18	12.488610	19.13	0.93
Reach 1	700	100yr	57	2446.79	2447.71	2447.71	2447.97	0.019996	4.77	15.879550	32.49	1.00
Reach 1	600	100yr	57	2444.87	2445.94	2445.94	2446.21	0.016122	4.91	16.967150	34.83	0.93
Reach 1	492	100yr	57	2442.91	2443.89	2443.89	2444.11	0.014190	4.42	18.519180	41.06	0.86
Reach 1	402	100yr	57	2441.80	2442.49	2442.45	2442.69	0.018068	4.29	17.527020	34.17	0.94
Reach 1	300	100yr	57	2439.95	2440.65	2440.65	2440.90	0.021629	4.87	16.182060	33.70	1.03
Reach 1	200	100yr	57	2437.93	2438.64	2438.59	2438.82	0.018331	4.41	18.377780	38.88	0.95
Reach 1	100	100yr	57	2435.99	2436.37	2436.36	2436.51	0.031105	3.90	20.435900	68.52	1.12
Reach 1	2	100yr	57	2433.42	2434.08	2434.03	2434.26	0.018734	3.52	18.099390	48.66	0.90

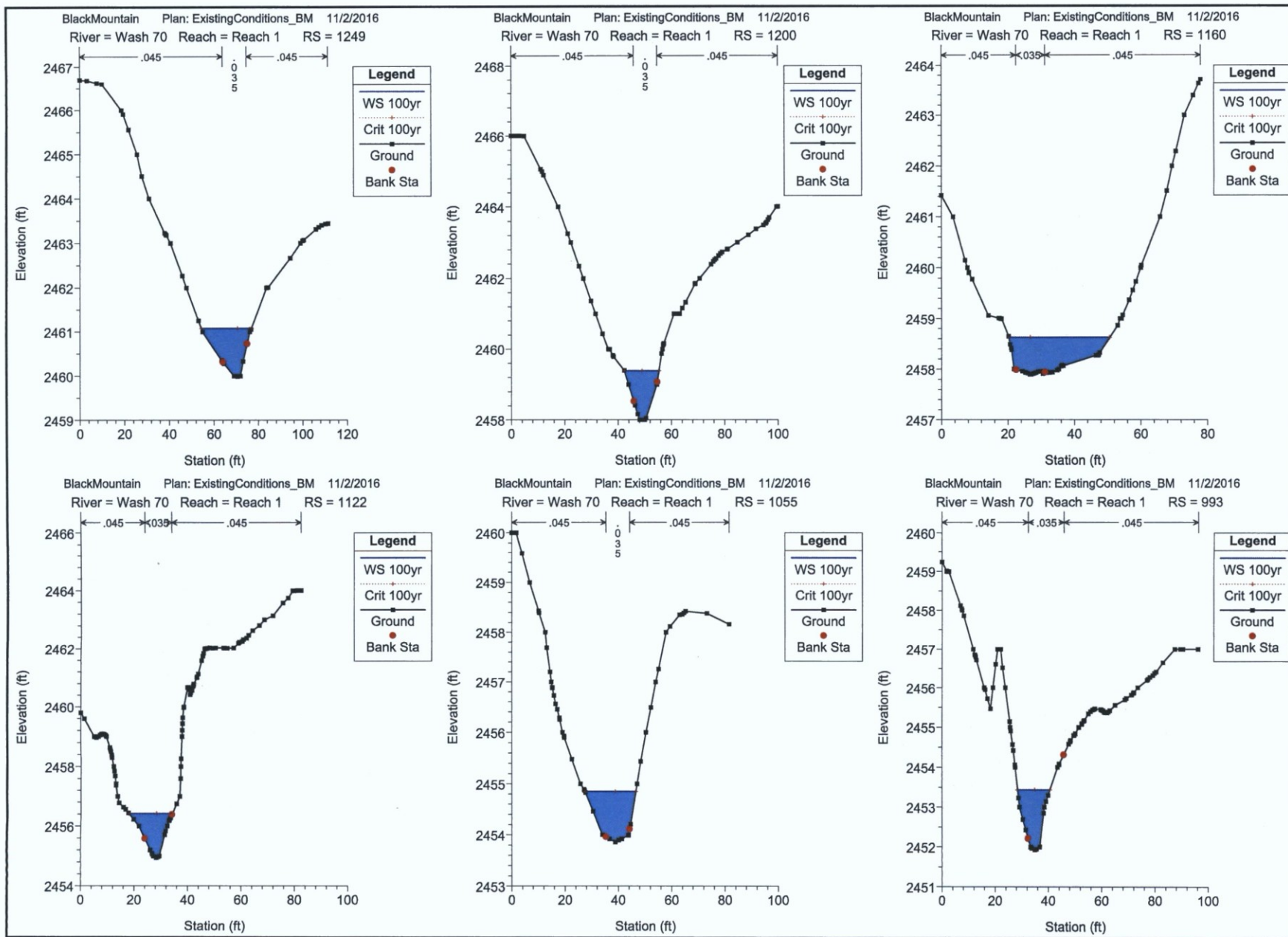
Wash 70 Reach 1

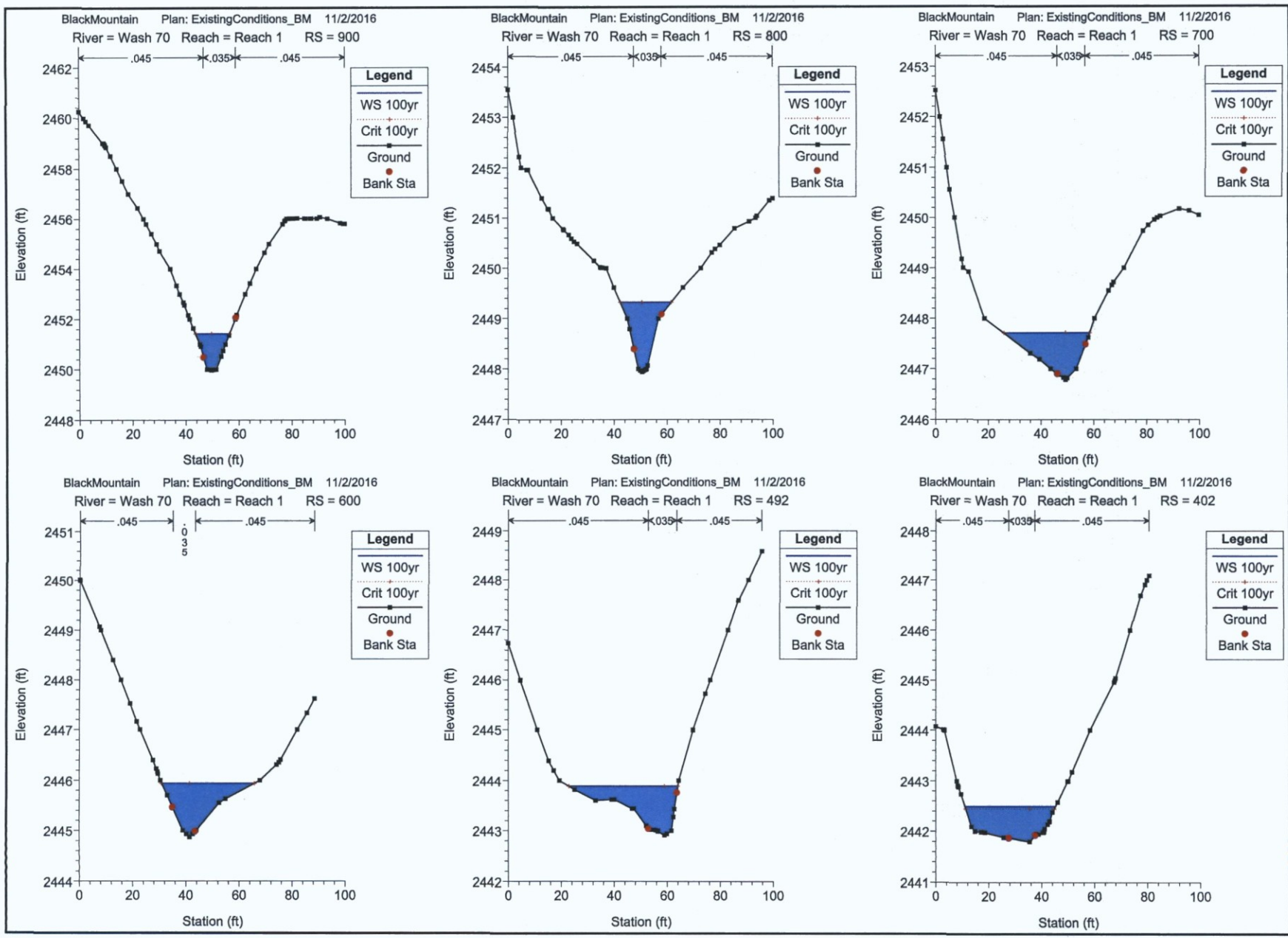
**Legend**

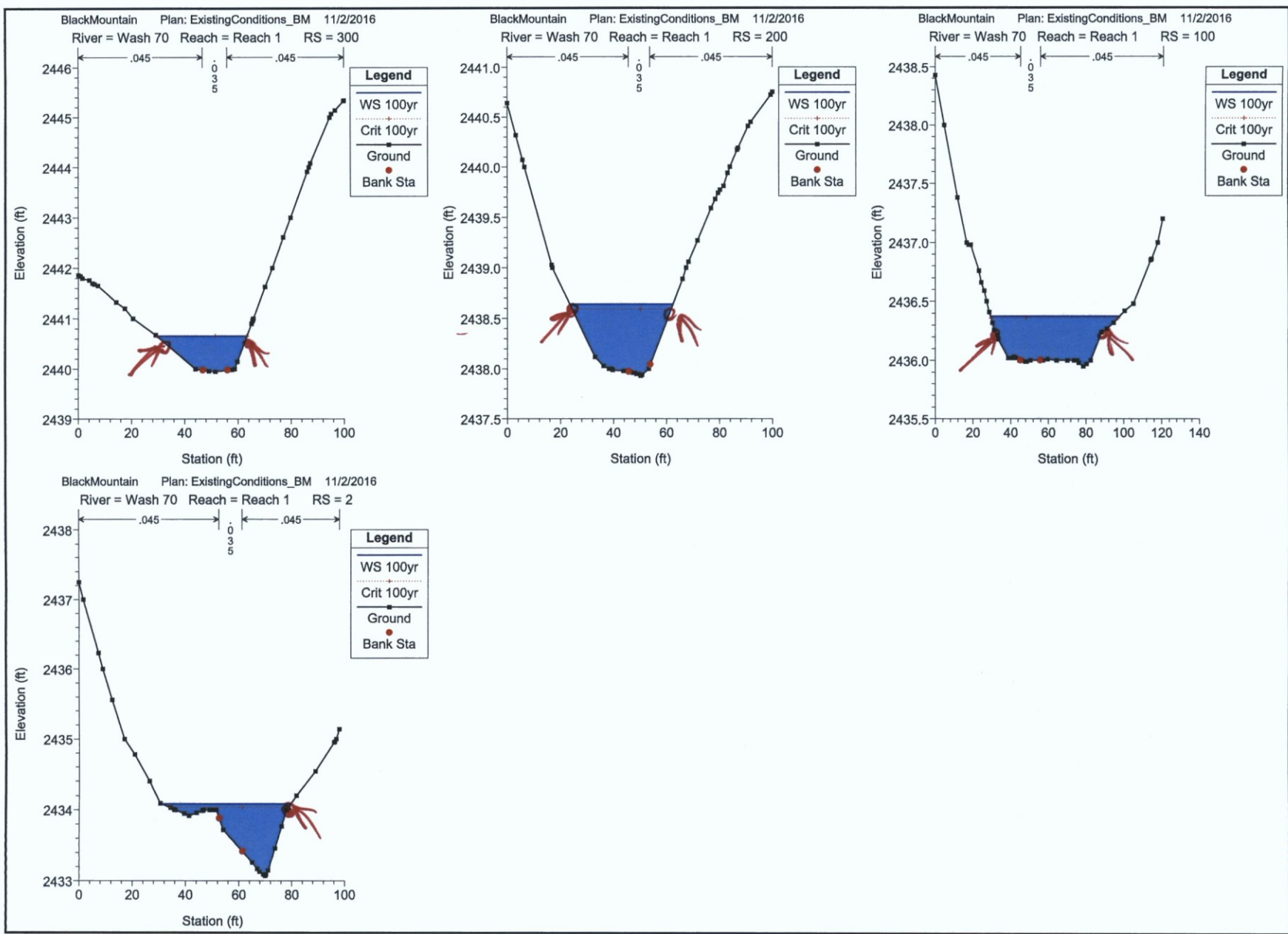
- WS 100yr
- Crit 100yr
- Ground











HEC-RAS Plan: ExistingCond River: Wash 140 Reach: Reach 1 Profile: 100yr

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
Reach 1	623	100yr	187	2457.98	2460.29	2460.04	2460.94	0.014948	7.13	33.054720	30.27	0.98
Reach 1	567	100yr	187	2457.89	2459.70	2459.70	2460.13	0.014955	6.80	42.690110	48.43	0.96
Reach 1	442	100yr	187	2455.33	2456.79	2456.57	2457.02	0.008659	3.89	49.129730	51.88	0.69
Reach 1	332	100yr	187	2453.12	2455.17	2455.17	2455.79	0.014612	7.02	33.144140	28.11	0.96
Reach 1	232	100yr	187	2451.98	2453.60	2453.59	2454.22	0.017044	6.75	31.402220	27.38	1.02
Reach 1	132	100yr	187	2450.78	2452.21	2452.21	2452.58	0.014323	5.87	44.602770	58.77	0.93
Reach 1	33	100yr	187	2449.00	2450.62	2450.19	2450.81	0.005001	3.59	57.450110	60.98	0.55

BlackMountain Plan: ExistingConditions\_BM 11/2/2016

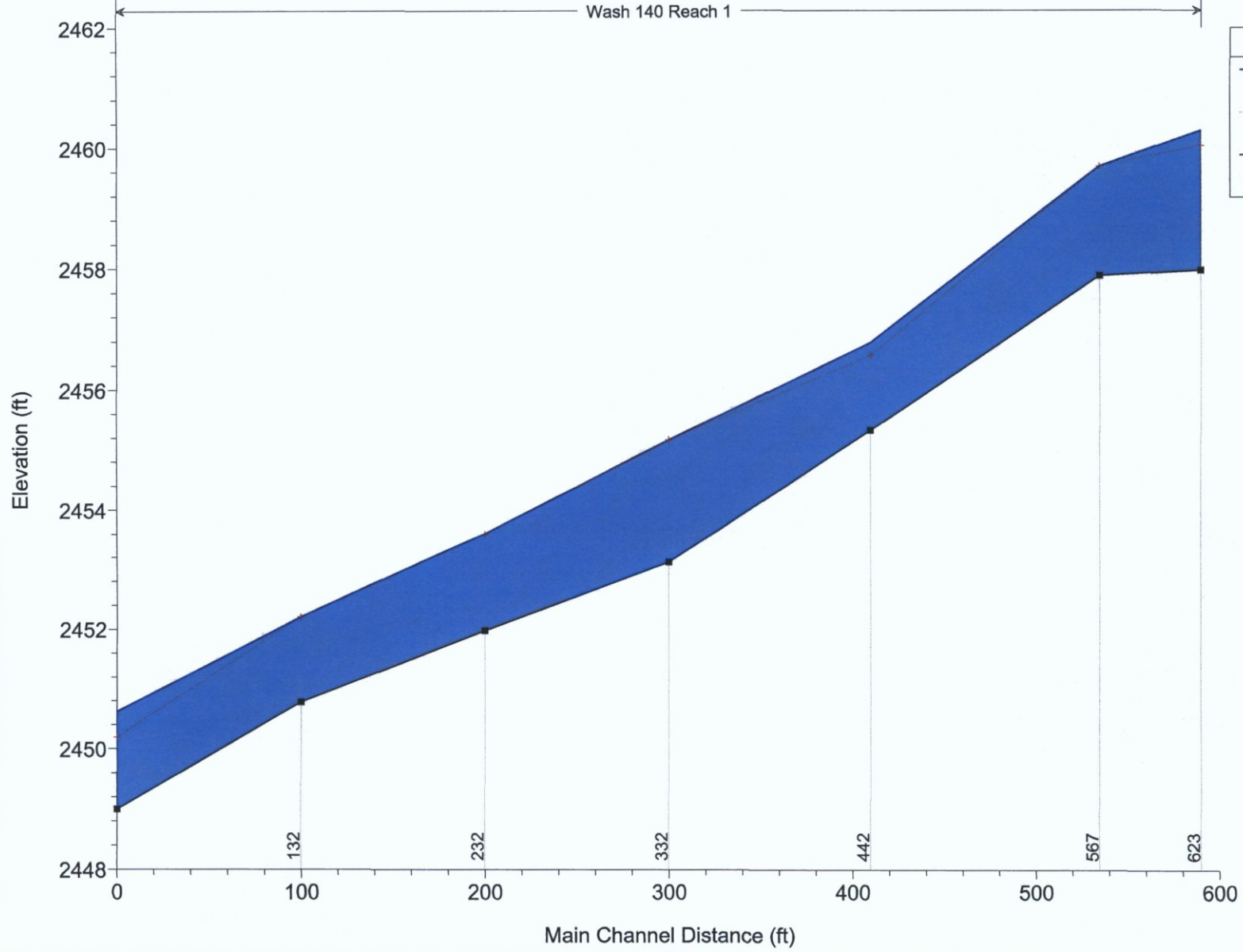
Wash 140 Reach 1

**Legend**

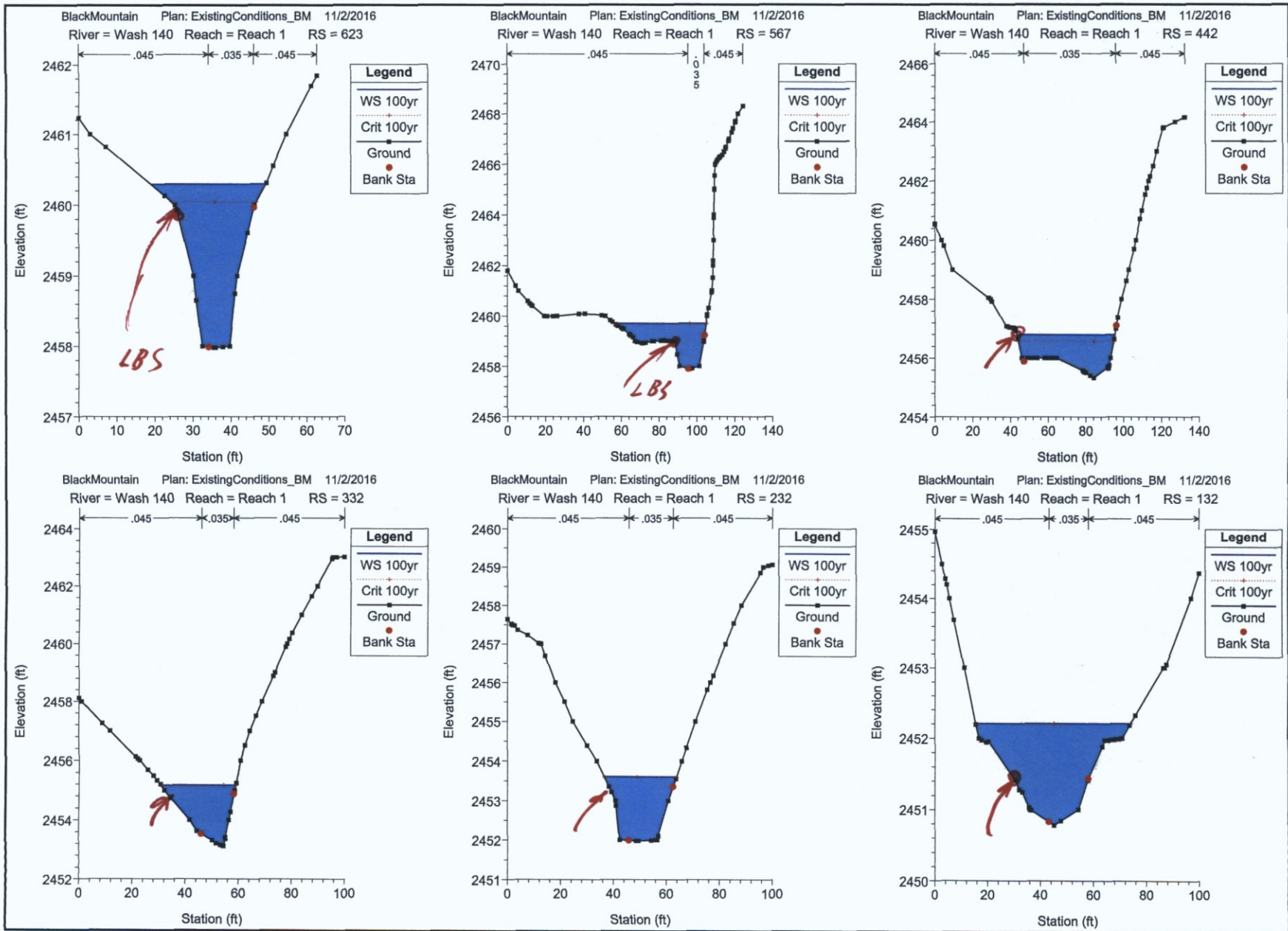
WS 100yr

Crit 100yr

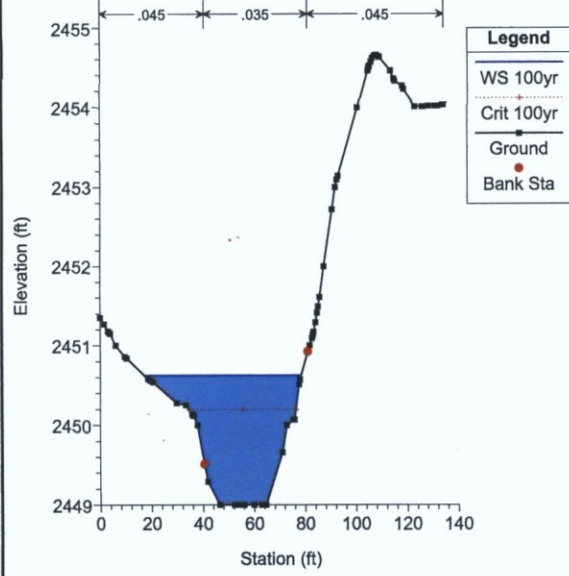
Ground



SUBMIT DIGITAL HEC-RAS  
MODEL. REVISE BANK STATIONS. (TYP)



BlackMountain Plan: ExistingConditions\_BM 11/2/2016  
River = Wash 140 Reach = Reach 1 RS = 33



## Culvert Designer/Analyzer Report Entrance

---

Analysis Component

---

Storm Event	Design	Discharge	46.00 cfs
-------------	--------	-----------	-----------

---



---

Peak Discharge Method: User-Specified

---

Design Discharge	46.00 cfs	Check Discharge	0.00 cfs
------------------	-----------	-----------------	----------

---



---

Tailwater properties: Trapezoidal Channel

---



---

Tailwater conditions for Design Storm.

---

Discharge	46.00 cfs	Bottom Elevation	63.00 ft
Depth	0.83 ft	Velocity	4.15 ft/s

---

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	2-24 inch Circular	46.00 cfs	68.44 ft	12.32 ft/s
Weir	Not Considered	N/A	N/A	N/A

# Culvert Designer/Analyzer Report

## Entrance

Component: Culvert-1

---

### Culvert Summary

Computed Headwater Elev.	68.44 ft	Discharge	46.00 cfs
Inlet Control HW Elev.	68.44 ft	Tailwater Elevation	63.83 ft
Outlet Control HW Elev.	68.22 ft	Control Type	Inlet Control
Headwater Depth/Height	1.72		

---

### Grades

Upstream Invert	65.00 ft	Downstream Invert	63.00 ft
Length	60.00 ft	Constructed Slope	0.033333 ft/ft

---

### Hydraulic Profile

Profile	S2	Depth, Downstream	1.15 ft
Slope Type	Steep	Normal Depth	1.07 ft
Flow Regime	Supercritical	Critical Depth	1.71 ft
Velocity Downstream	12.32 ft/s	Critical Slope	0.009682 ft/ft

---

### Section

Section Shape	Circular	Mannings Coefficient	0.013
Section Material	Concrete	Span	2.00 ft
Section Size	24 inch	Rise	2.00 ft
Number Sections	2		

---

### Outlet Control Properties

Outlet Control HW Elev.	68.22 ft	Upstream Velocity Head	1.01 ft
Ke	0.50	Entrance Loss	0.50 ft

---

### Inlet Control Properties

Inlet Control HW Elev.	68.44 ft	Flow Control	N/A
Inlet Type	Square edge w/headwall	Area Full	6.3 ft <sup>2</sup>
K	0.00980	HDS 5 Chart	1
M	2.00000	HDS 5 Scale	1
C	0.03980	Equation Form	1
Y	0.67000		

---

# Culvert Designer/Analyzer Report

## Lot 4

---

Analysis Component

---

Storm Event	Design	Discharge	19.00 cfs
-------------	--------	-----------	-----------

---

Peak Discharge Method: User-Specified

---

Design Discharge	19.00 cfs	Check Discharge	0.00 cfs
------------------	-----------	-----------------	----------

---

Tailwater properties: Trapezoidal Channel

---

Tailwater conditions for Design Storm.

---

Discharge	19.00 cfs	Bottom Elevation	67.00 ft
Depth	0.62 ft	Velocity	2.44 ft/s

---

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	1-24 inch Circular	19.00 cfs	70.29 ft	7.46 ft/s
Weir	Not Considered	N/A	N/A	N/A

---

# Culvert Designer/Analyzer Report

## Lot 4

Component: Culvert-1

### Culvert Summary

Computed Headwater Elev.	70.29 ft	Discharge	19.00 cfs
Inlet Control HW Elev.	70.29 ft	Tailwater Elevation	67.62 ft
Outlet Control HW Elev.	70.27 ft	Control Type	Inlet Control
Headwater Depth/Height	1.39		

### Grades

Upstream Invert	67.50 ft	Downstream Invert	67.00 ft
Length	60.00 ft	Constructed Slope	0.008333 ft/ft

### Hydraulic Profile

Profile	S2	Depth, Downstream	1.51 ft
Slope Type	Steep	Normal Depth	1.51 ft
Flow Regime	Supercritical	Critical Depth	1.57 ft
Velocity Downstream	7.46 ft/s	Critical Slope	0.007688 ft/ft

### Section

Section Shape	Circular	Mannings Coefficient	0.013
Section Material	Concrete	Span	2.00 ft
Section Size	24 inch	Rise	2.00 ft
Number Sections	1		

### Outlet Control Properties

Outlet Control HW Elev.	70.27 ft	Upstream Velocity Head	0.80 ft
Ke	0.50	Entrance Loss	0.40 ft

### Inlet Control Properties

Inlet Control HW Elev.	70.29 ft	Flow Control	N/A
Inlet Type	Square edge w/headwall	Area Full	3.1 ft <sup>2</sup>
K	0.00980	HDS 5 Chart	1
M	2.00000	HDS 5 Scale	1
C	0.03980	Equation Form	1
Y	0.67000		

*Appendix D*

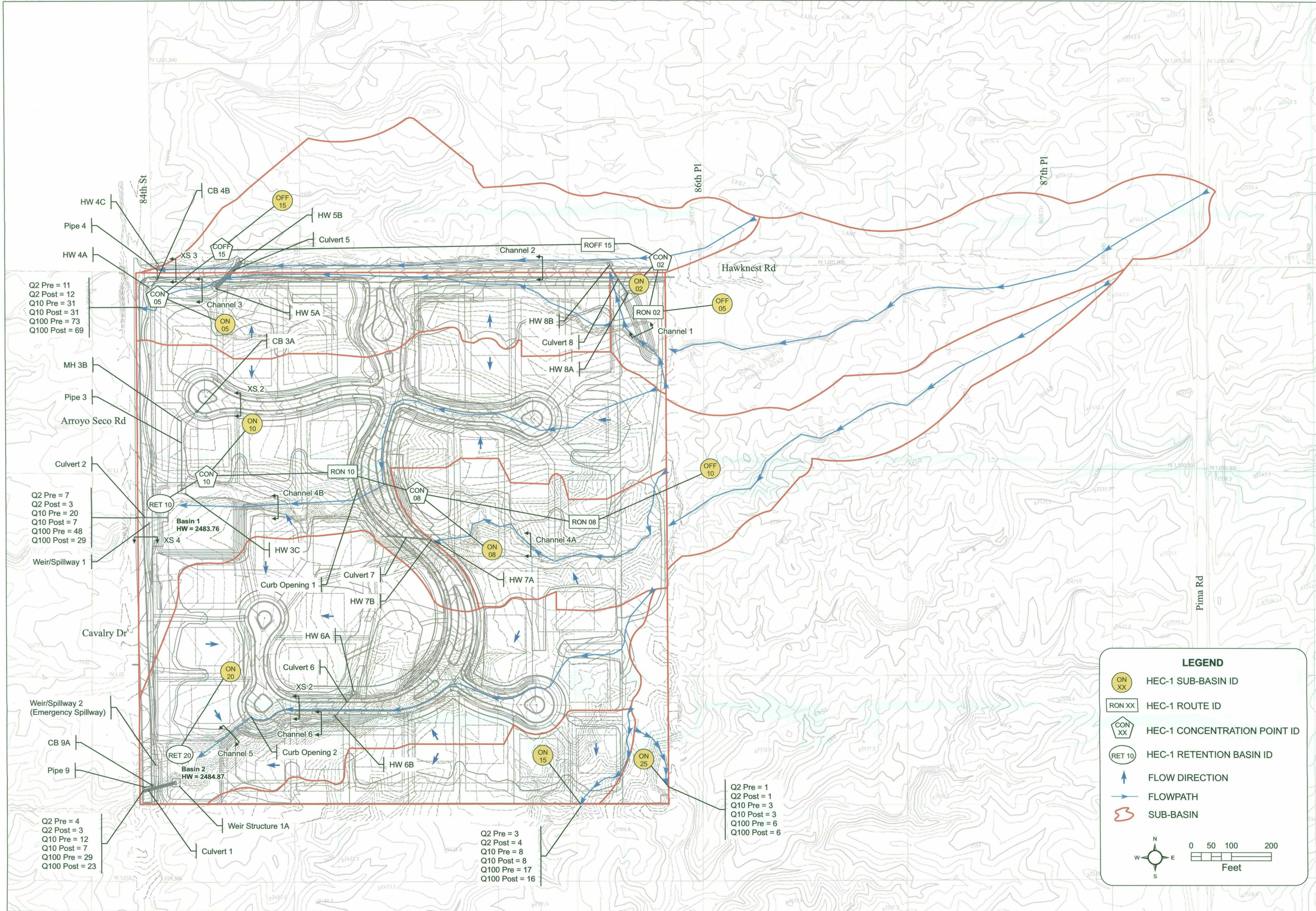
Exhibits

K:\PHX\_Civil\2010\15001 - Black Mountain\CADD\Exhibits\Drainage Fig 1 Context Aerial.dwg Nov 01, 2016 kyle.campbell



RESERVE AT BLACK MOUNTAIN  
 FIGURE 1  
 CONTEXT AERIAL  
 MAP  
 DATE: 11/1/2016  
 SCOTTSDALE, ARIZONA





Q2 Pre = 11  
Q2 Post = 12  
Q10 Pre = 31  
Q10 Post = 31  
Q100 Pre = 73  
Q100 Post = 69

Q2 Pre = 7  
Q2 Post = 3  
Q10 Pre = 20  
Q10 Post = 7  
Q100 Pre = 48  
Q100 Post = 29

Q2 Pre = 4  
Q2 Post = 3  
Q10 Pre = 12  
Q10 Post = 7  
Q100 Pre = 29  
Q100 Post = 23

Q2 Pre = 3  
Q2 Post = 4  
Q10 Pre = 8  
Q10 Post = 8  
Q100 Pre = 17  
Q100 Post = 16

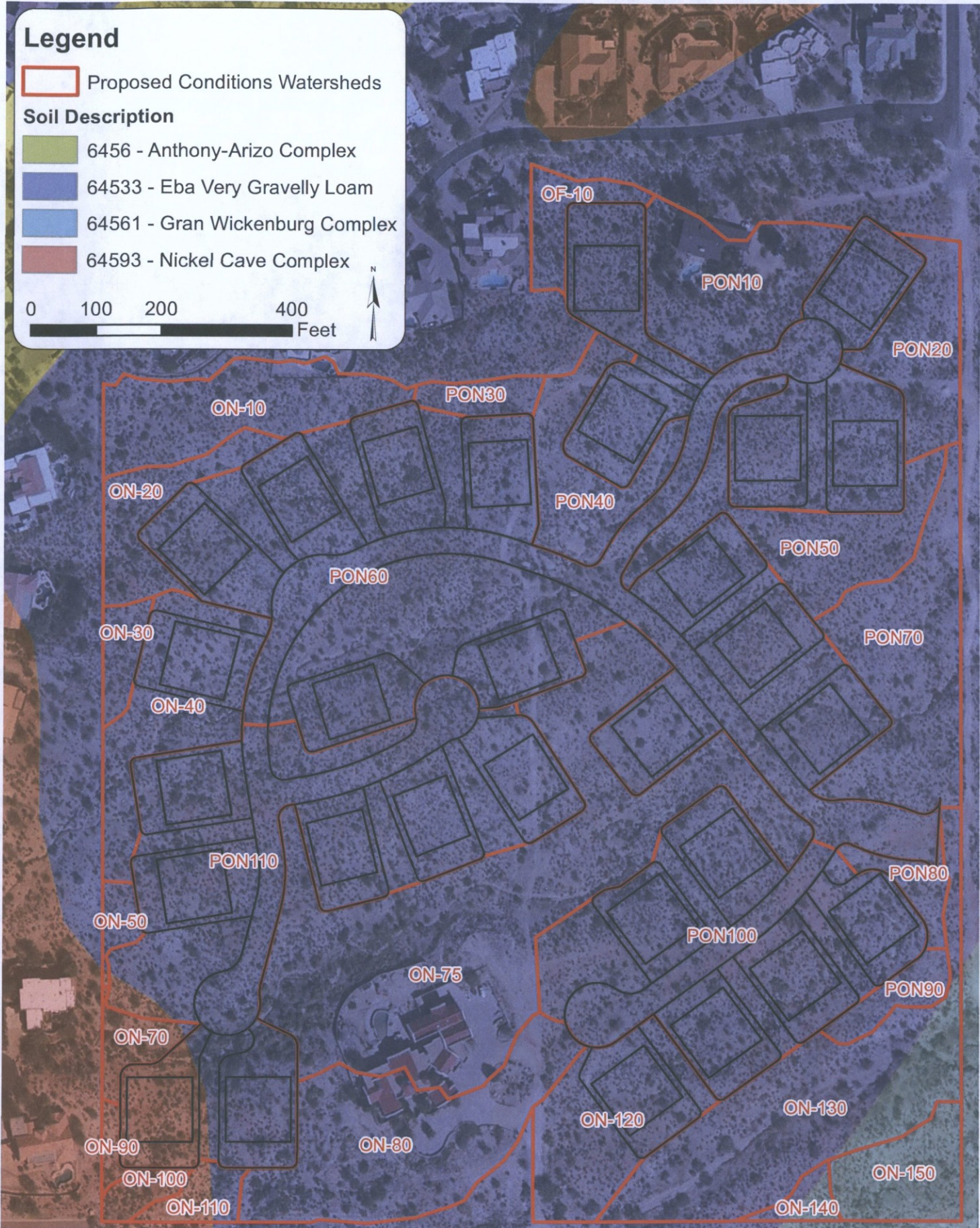
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Q2 Post = 1  
Q10 Pre = 3  
Q10 Post = 3  
Q100 Pre = 6  
Q100 Post = 6

**LEGEND**

- ON XX HEC-1 SUB-BASIN ID
- RON XX HEC-1 ROUTE ID
- CON XX HEC-1 CONCENTRATION POINT ID
- RET 10 HEC-1 RETENTION BASIN ID
- FLOW DIRECTION
- FLOWPATH
- SUB-BASIN

0 50 100 200  
Feet

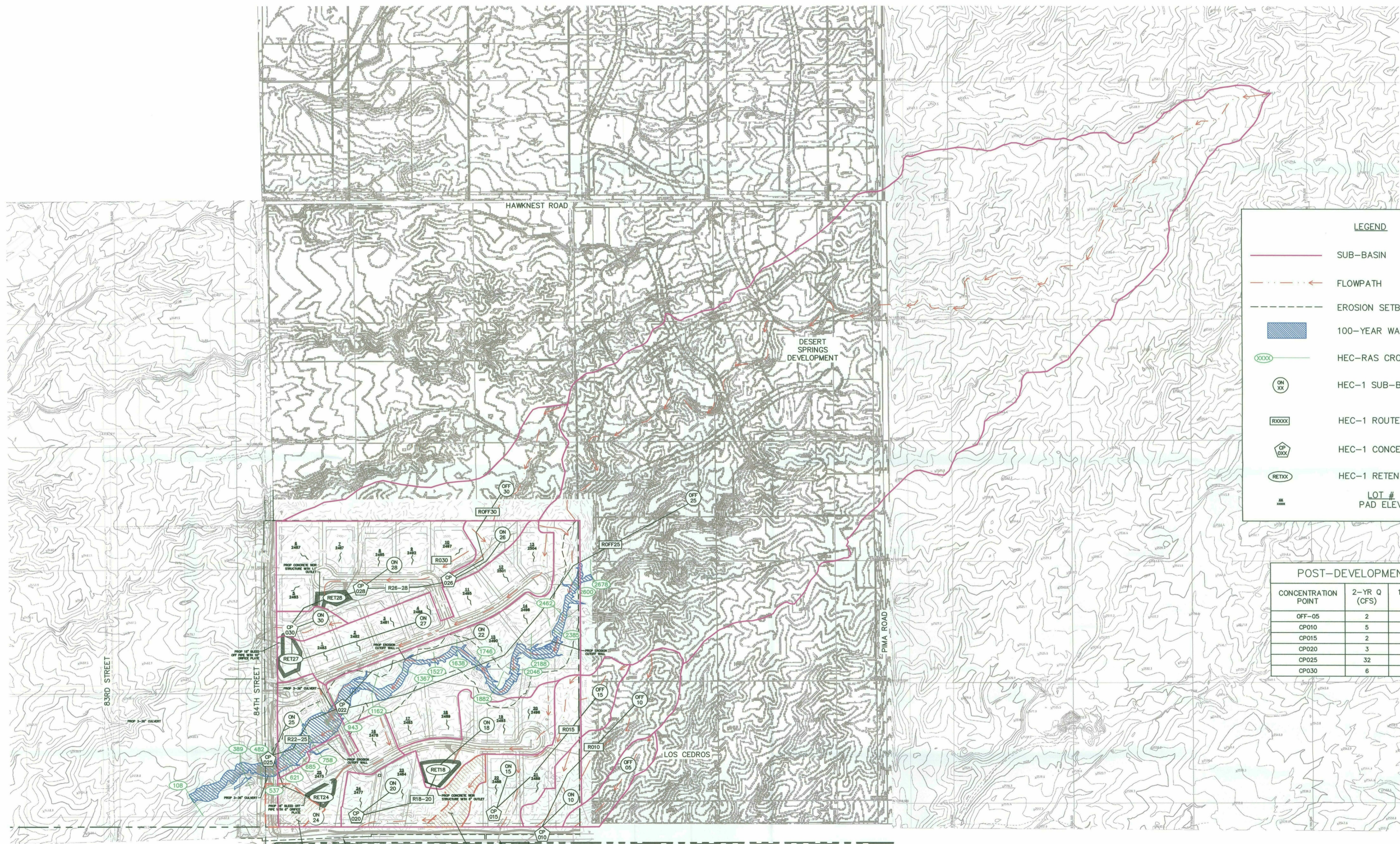
# Soils Map



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FIGURE 4

K:\PHX\_Civil\191822000-Sierra Highlands\CADD\Exhibits\Water\Proposed\_Drainage\_Map.dwg Nov 21, 2014 derrick.turner  
 XREFS: x2200000.dwg x2200001.dwg x2200002.dwg x2200003.dwg x2200004.dwg x2200005.dwg x2200006.dwg x2200007.dwg x2200008.dwg x2200009.dwg x2200010.dwg  
 OF AND WARRIOR RELIANCE ON THIS DOCUMENT WITHOUT WRITTEN AUTHORIZATION AND ADAPTATION BY KIMLEY-HORN AND ASSOCIATES, INC. SHALL BE WITHOUT LIABILITY TO KIMLEY-HORN AND ASSOCIATES, INC.



**LEGEND**

- SUB-BASIN
- - - FLOWPATH
- - - - EROSION SETBACK
- 100-YEAR WATER SURFACE LIMITS
- XXXX HEC-RAS CROSS SECTION
- ON XX HEC-1 SUB-BASIN ID
- ROFFXX HEC-1 ROUTE ID
- CP XXX HEC-1 CONCENTRATION POINT ID
- RETXX HEC-1 RETENTION BASIN ID
- XX LOT #  
PAD ELEV

**POST-DEVELOPMENT RUNOFF**

CONCENTRATION POINT	2-YR Q (CFS)	10-YR Q (CFS)	100-YR Q (CFS)
OFF-05	2	3	6
CP010	5	9	17
CP015	2	5	11
CP020	3	7	15
CP025	32	78	186
CP030	6	17	43

EXIST 24" CULVERT

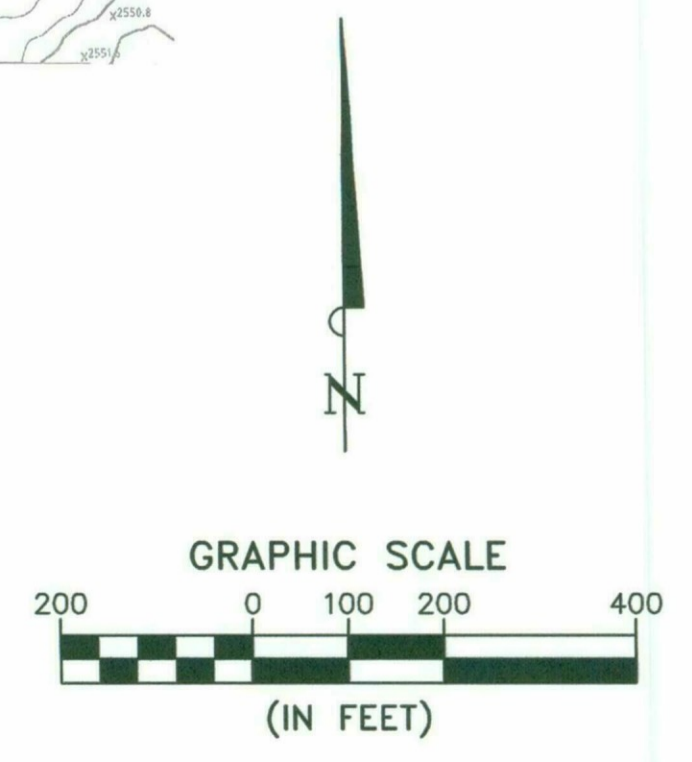
EXIST 24" CULVERT

EXIST 24" CULVERT

Q<sub>100</sub> is approximately 4.2 CFS, PRORATED BY AREA FROM APPROXIMATELY 30% OF THE Q<sub>100</sub> FROM SUB-BASIN ON20

AREA TRIBUTARY TO BLACK MOUNTAIN BOULEVARD AND 84TH STREET = 33,077 SF (REDUCED BY 19,302 SF FROM EXISTING CONDITIONS)

SIERRA BOULDERS DEVELOPMENT



SCALE (H): 1"=200'  
SCALE (V): NONE

DESIGNED BY: ZRS  
DRAWN BY: ZRS  
CHECKED BY: ZRS

DATE: MAY 2014

NO. \_\_\_\_\_

REVISION \_\_\_\_\_

BY DATE APPR. \_\_\_\_\_

**Kimley Horn**

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7740 North 16th Street, Suite 300  
Phoenix, Arizona 85020 (602) 944-5500

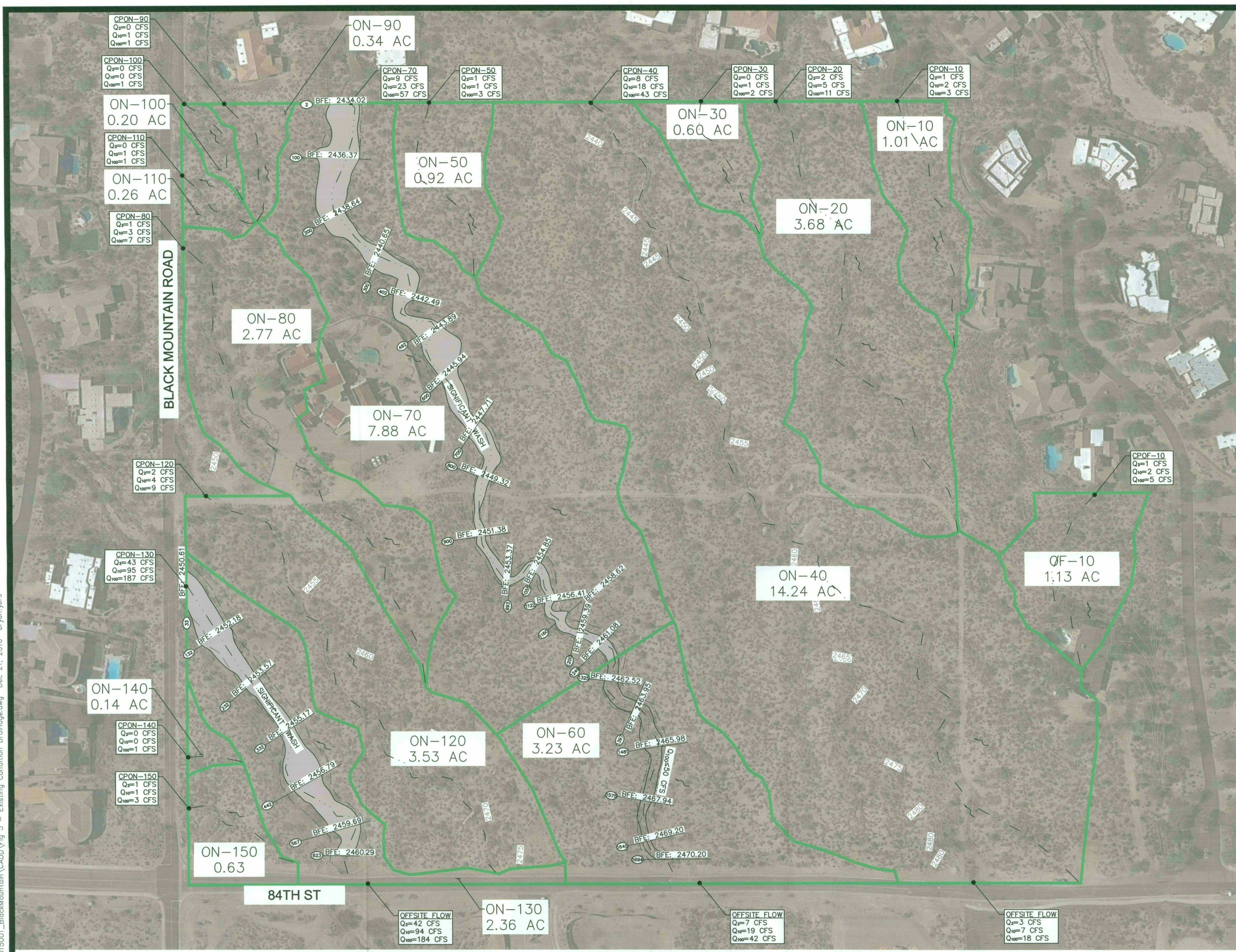
CITY OF SCOTTSDALE  
SIERRA HIGHLANDS  
PROPOSED CONDITIONS  
FIGURE 4

PROJECT NO.  
191822000

DRAWING NAME  
FIGURE 4

1 OF 1

K:\TUC\_WaterResources\Shift\PHX\291015001\_BlackMountain\CADD\Fig 5 - Existing Condition Drainage.dwg Dec 21, 2016 bryan.yurs



EXISTING RUNOFF (CFS)			
CP	2 YEAR	10 YEAR	100 YEAR
OF-10	1	2	5
ON-10	1	2	3
ON-20	2	5	11
ON-30	0	1	2
ON-40	8	18	43
ON-50	1	1	3
ON-70	9	23	57
ON-80	1	3	7
ON-90	0	1	1
ON-100	0	0	1
ON-110	0	1	1
ON-120	2	4	9
ON-130	43	95	187
ON-140	0	0	1
ON-150	1	1	3

**LEGEND**

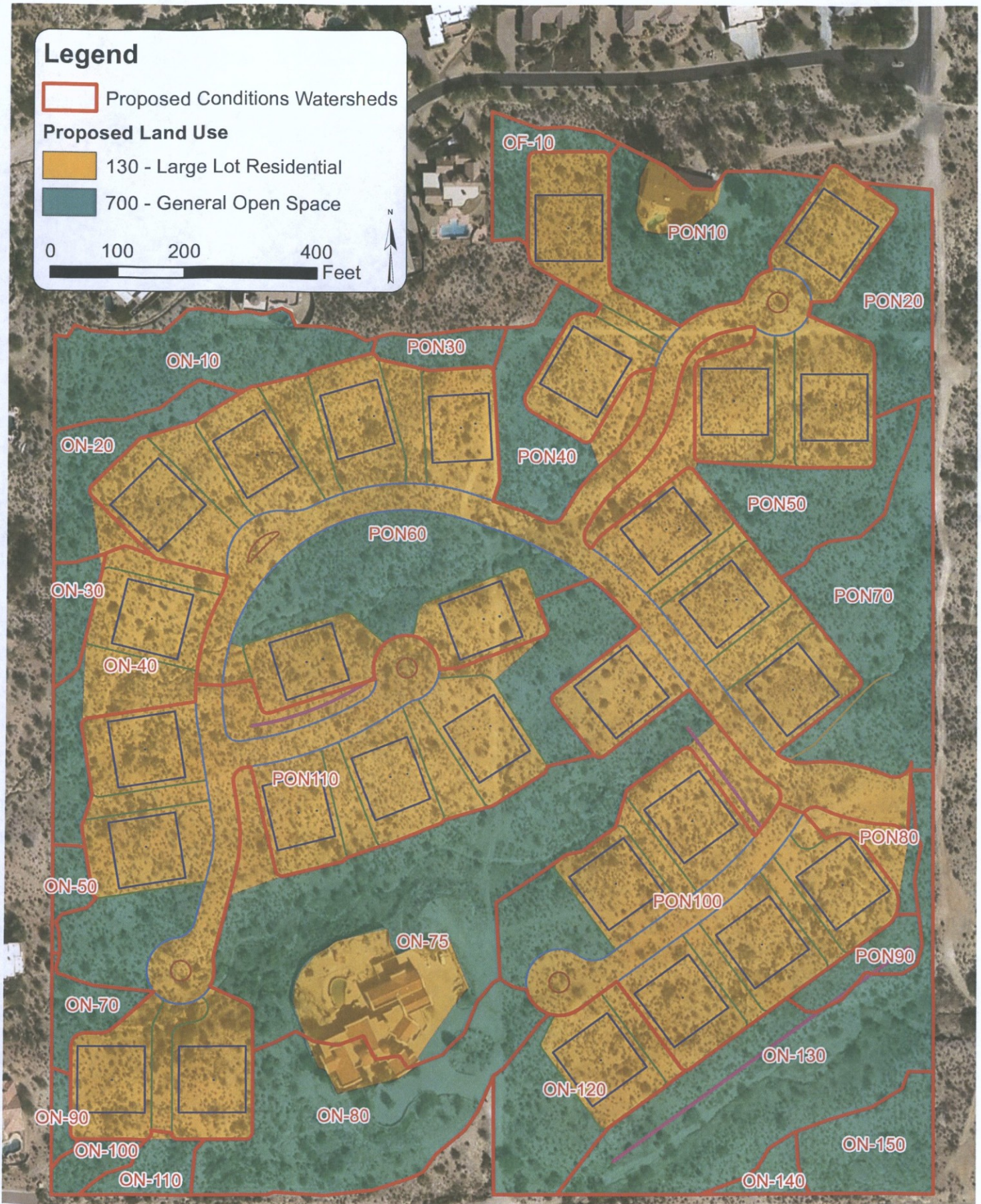
- SUB-BASIN LIMIT
- STREAM CENTERLINE
- EROSION HAZARD SETBACK
- FLOW ARROW
- SIGNIFICANT WASH LIMITS
- HEC-RAS RIVER STATION

GRAPHIC SCALE IN FEET

NORTH

RESERVE AT BLACK MOUNTAIN  
 FIGURE 5  
 EXISTING CONDITIONS  
 DRAINAGE MAP  
 DATE: 12/21/2016  
 SCOTTSDALE, ARIZONA

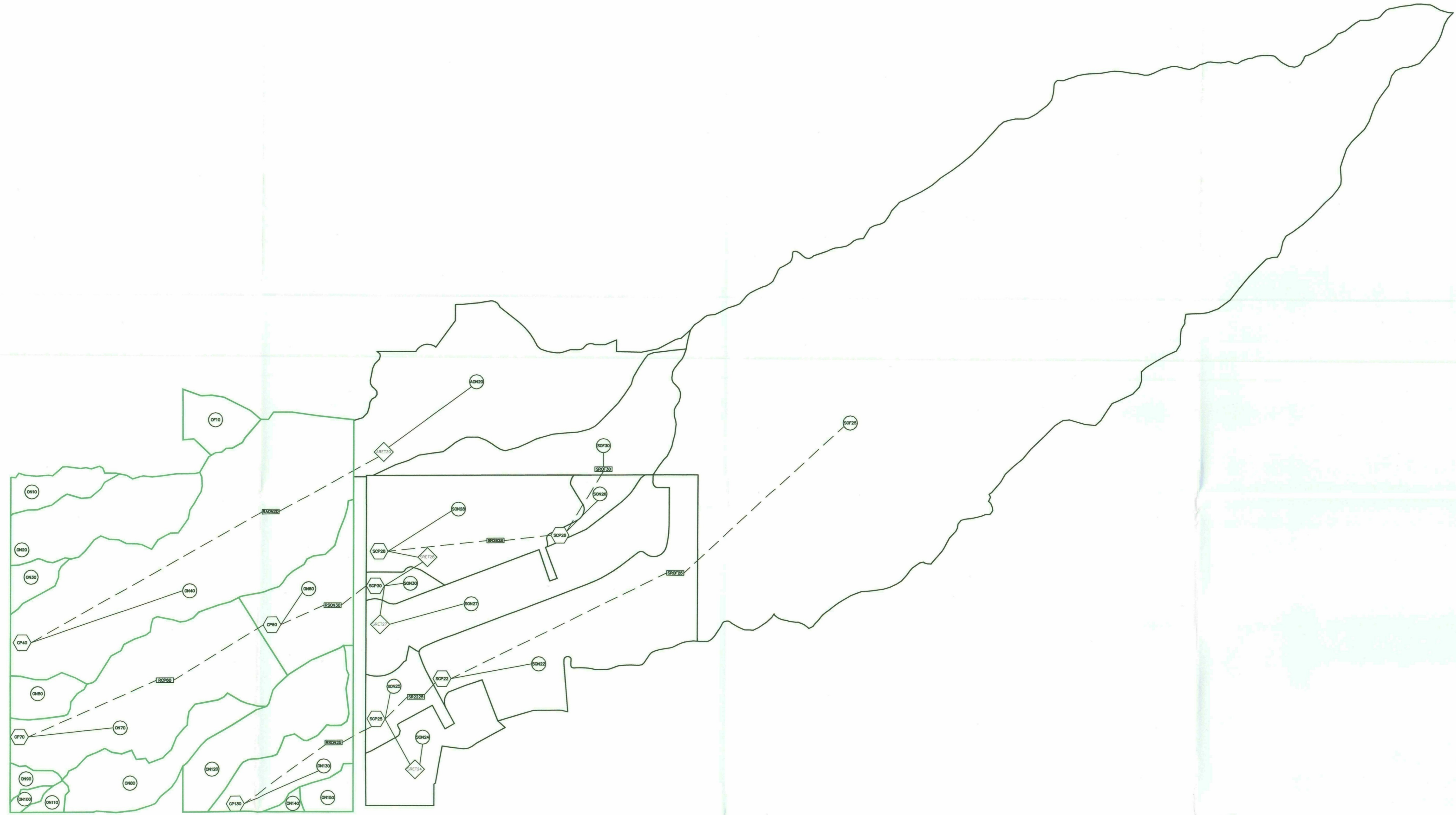
# Proposed Conditions Land Use Map



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FIGURE 7

K:\TUC\_WaterResources\Shift\PHX\291015001\_BlackMountain\CADD\Fig 6 - HEC1 Existing.dwg Dec 21, 2016 bryan.yurs



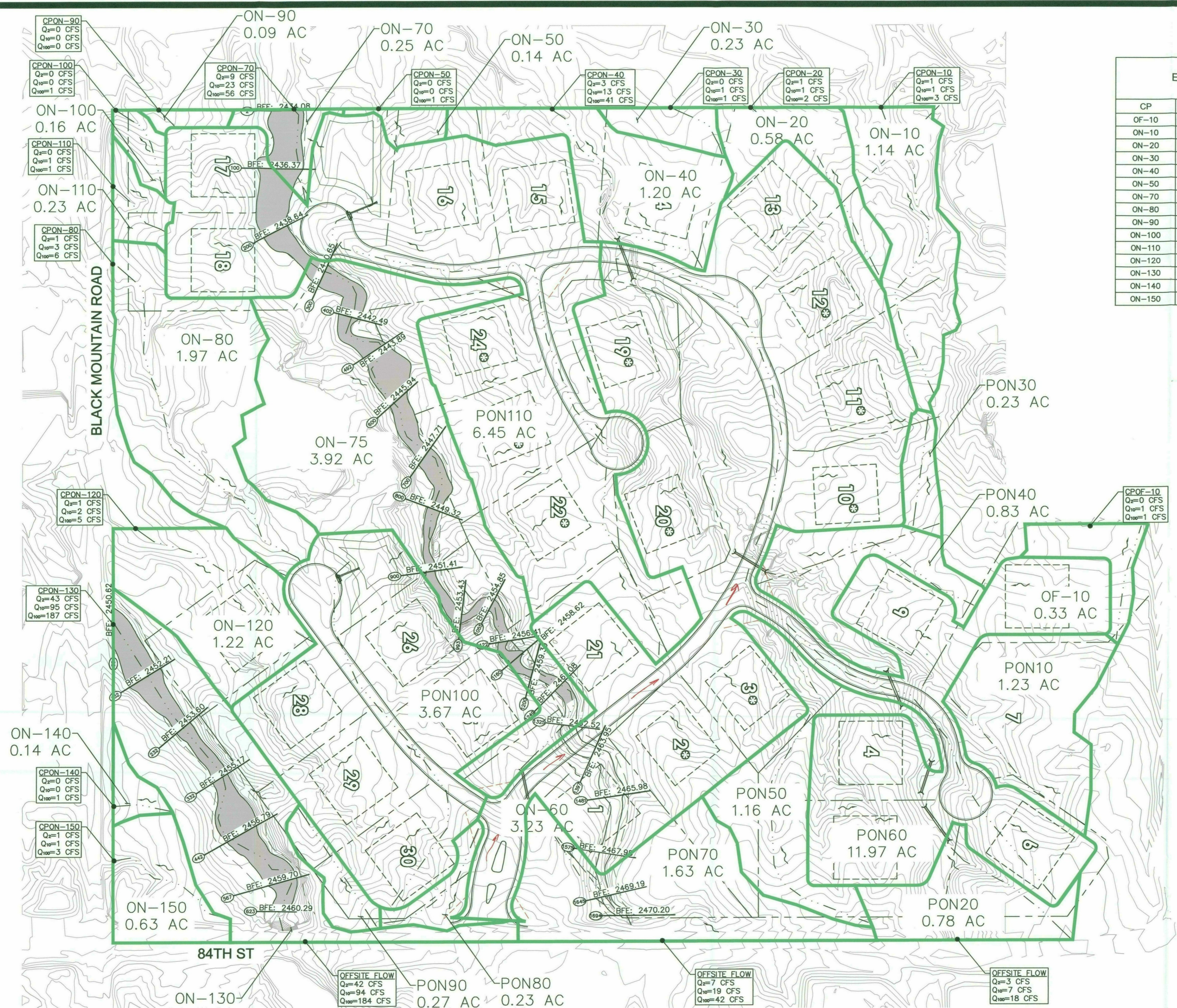
**LEGEND**

- ONSITE SUB-BASIN LIMIT
- OFFSITE SUBBASIN LIMIT
- HEC-1 SUBBASIN ID
- HEC-1 ROUTE ID
- HEC-1 DETENTION BASIN
- HEC-1 CONCENTRATION POINT

RESERVE AT BLACK MOUNTAIN  
FIGURE 6  
EXISTING CONDITIONS  
HEC-1 SCHEMATIC  
DATE: 12/21/2016  
SCOTTSDALE, ARIZONA



K:\TUC\_WaterResources\Shift\PHX\291015001\_BlackMountain\CADD\Fig 8 - Proposed Conditions Drainage.dwg Dec 21, 2016 bryan.years



CP	EXISTING RUNOFF (CFS)			PROPOSED RUNOFF (CFS)		
	2 YEAR	10 YEAR	100 YEAR	2 YEAR	10 YEAR	100 YEAR
OF-10	1	2	5	0	1	1
ON-10	1	2	3	1	1	3
ON-20	2	5	11	0	1	2
ON-30	0	1	2	0	1	1
ON-40	8	18	43	3	13	41
ON-50	1	1	3	0	0	1
ON-70	9	23	57	9	23	58
ON-80	1	3	7	1	3	6
ON-90	0	1	1	0	0	0
ON-100	0	0	1	0	0	1
ON-110	0	1	1	0	1	1
ON-120	2	4	9	1	2	5
ON-130	43	95	187	43	95	187
ON-140	0	0	1	0	0	1
ON-150	1	1	3	1	1	3

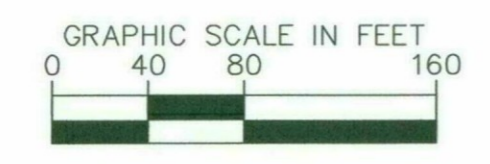
ADD COLUMN FOR PROPOSED CONDITION NODE NAME WHEN DIFFERENT THAN EX CONDITION.

Note 50P022?

ADD PROPOSED CONTOUR LAYER.

**LEGEND**

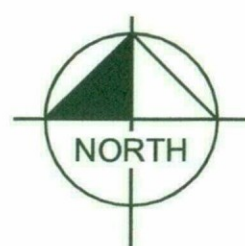
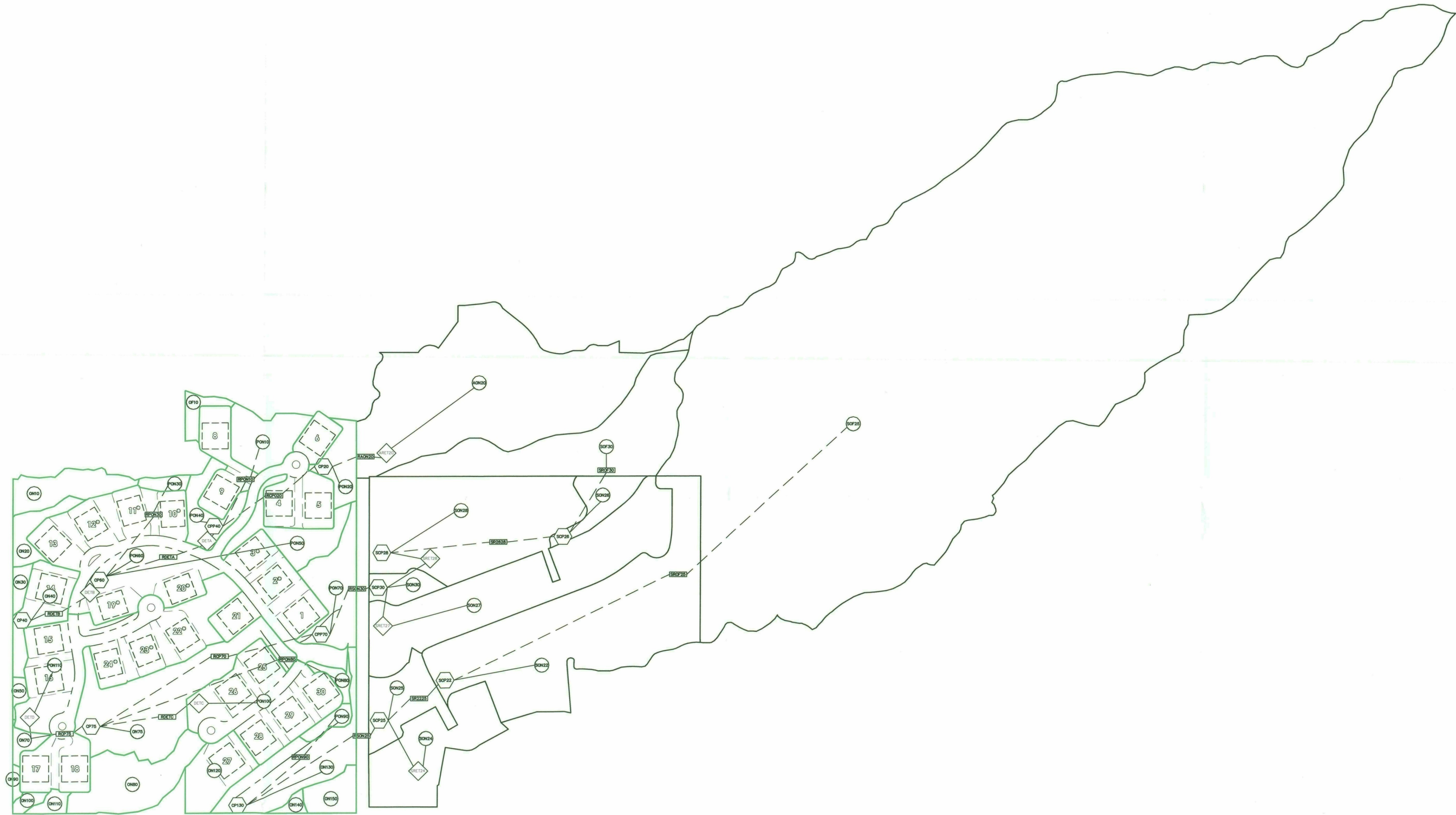
- SUB-BASIN LIMIT
- STREAM CENTERLINE
- EROSION HAZARD SETBACK
- FLOW ARROW
- BUILDING ENVELOPE
- SIGNIFICANT WASH LIMITS
- HEC-RAS RIVER STATION



RESERVE AT BLACK MOUNTAIN  
 FIGURE 8  
 PROPOSED CONDITIONS  
 DRAINAGE MAP  
 DATE: 12/21/2016  
 SCOTTSDALE, ARIZONA



K:\TUC\_WaterResources\Shitt\PHX\291015001\_BlockMountain\CADD\Fig 9 - HEC1 Proposed.dwg Dec 22, 2016 bryan.yurs



**LEGEND**

-  ONSITE SUB-BASIN LIMIT
-  OFFSITE SUBBASIN LIMIT
-  HEC-1 SUBBASIN ID
-  HEC-1 ROUTE ID
-  HEC-1 DETENTION BASIN
-  HEC-1 CONCENTRATION POINT

RESERVE AT BLACK MOUNTAIN  
 FIGURE 9  
 PROPOSED CONDITIONS  
 HEC-1 SCHEMATIC  
 DATE: 12/22/2016  
 SCOTTSDALE, ARIZONA



*Appendix E*

Stormwater Storage Waiver



# Request for Stormwater Storage Waiver

City of Scottsdale Case Numbers:

\_\_\_ - PA - \_\_\_ - ZN - \_\_\_ - UP - \_\_\_ - DR - \_\_\_ - PP - \_\_\_ PC# \_\_\_\_\_

The applicant/developer must complete and submit this form to the city for processing and obtain approval of waiver request **before submitting improvement plans**. Denial of the waiver may require the developer to submit a revised site plan to the Development Review Board.

Date 01/04/2016 Project Name Reserve at Black Mountain  
 Project Location Northwest corner of Black Mountain Road and 84th Street  
 Applicant Contact Andrew Jupp Company Name Kimley-Horn and Associates  
 Phone 602-994-7423 Fax 602-944-7423 E-mail andrew.jupp@kimley-horn.com  
 Address 7740 N. 16th Street, Suite 300, Phoenix, AZ 85020

### Waiver Criteria

A project must meet at least one of three criteria listed below for the city to consider waiving some or all required stormwater storage. **However, regardless of the criteria, a waiver will only be granted if the applicant can demonstrate that the effect of a waiver will not increase the potential for flooding on any property.** Check the applicable box and provide a signed engineering report and supporting engineering analysis that demonstrate the project meets the criteria and that the effect of a waiver will not increase the potential for flooding on any property.

If the runoff for the project has been included in a storage facility at another location, the applicant must demonstrate that the stormwater storage facility was specifically designed to accommodate runoff from the subject property and that the runoff will be conveyed to this location through an adequately designed conveyance facility.

- 1. The development is adjacent to a conveyance facility that an engineering analysis shows is designed and constructed to handle the additional runoff from the site as a result of development.
- 2. The development is on a parcel less than one-half acre in size.
- 3. Stormwater storage requirements conflict with requirements of the Environmentally Sensitive Lands Ordinance (ESLO).

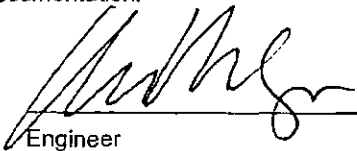
For a full storage waiver, a conflict with ESLO is limited to:

- Property located in the hillside landform as defined in the city Zoning Ordinance
- Property in the upper desert landform that has a land slope steeper than 5% as defined in the city Zoning Ordinance
- Property within the ESL zoning overlay district where the only viable location for a stormwater storage basin requires blasting

This full waiver only applies to those portions of property meeting one of these three requirements.

Partial waivers are available for projects or portions of properties within the Environmentally Sensitive Lands Zoning Overlay District, not meeting any of the three full waiver criteria above, if post-development peak discharge rates do not exceed pre-development conditions, based on the 10- and 100-year storm events.

By signing below, I certify that the stated project meets the waiver criteria selected above as demonstrated by the attached documentation.

  
 \_\_\_\_\_  
 Engineer

1/3/17  
 \_\_\_\_\_  
 Date

## Planning, Neighborhood & Transportation Division

7447 E Indian School Road, Suite 105, Scottsdale, AZ 85251 • Phone: 480-312-2500 • Fax: 480-312-7781



# Request for Stormwater Storage Waiver

City of Scottsdale Case Numbers:

- PA -

- ZN -

- UP -

- DR -

- PP -

PC#

## CITY STAFF TO COMPLETE THIS PAGE

Project Name \_\_\_\_\_

### Check Appropriate Boxes:

Meets waiver criteria (specify):  1  2  3

Recommend approve waiver.

Recommend deny waiver:

None of waiver criteria met.

Downstream conditions prohibit waiver of any storage.

Other:

Explain: \_\_\_\_\_  
\_\_\_\_\_

Return waiver request:

Insufficient data provided.

Other: \_\_\_\_\_

Explain: \_\_\_\_\_  
\_\_\_\_\_

### Recommended Conditions of Waiver:

All storage requirements waived.

Post-development peak discharge rates do not exceed pre-development conditions.

Other:

Explain: \_\_\_\_\_  
\_\_\_\_\_

Waiver approved per above conditions.

Waiver denied.

\_\_\_\_\_  
Floodplain Administrator or Designee

\_\_\_\_\_  
Date

## **Planning, Neighborhood & Transportation Division**

7447 E Indian School Road, Suite 105, Scottsdale, AZ 85251 • Phone: 480-312-2500 • Fax: 480-312-7781



# Request for Stormwater Storage Waiver

City of Scottsdale Case Numbers:

- PA -      - ZN -      - UP -      - DR -      - PP -      PC#

## In-Lieu Fee and In-Kind Contributions

In-lieu fees are only applicable to projects where post-development peak discharge rates exceed pre-development levels, based on the 10- and 100-year storm events. If the city grants a waiver, the developer is required to calculate and contribute an in-lieu fee based on what it would cost the city to provide a storage basin, sized as described below, including costs such as land acquisition, construction, landscaping, design, construction management, and maintenance over a 75-year design life. The fee for this cost is \$1.87 per cubic foot of stormwater storage for a virtual storage basin designed to mitigate the increase in runoff associated with the 100-year/2-hour storm event. The applicant may submit site-specific in-lieu fee calculations subject to the Floodplain Administrator's approval.

The Floodplain Administrator considers in-kind contributions on a case-by-case basis. An in-kind contribution can serve as part of or instead of the calculated in-lieu fee. In-kind contributions must be stormwater related and must constitute a public benefit. In-lieu fees and in-kind contributions are subject to the approval of the Floodplain Administrator or designee.

Project Name \_\_\_\_\_

The waived stormwater storage volume is calculated using a simplified approach as follows:

**V = ΔCRA; where**

V = stormwater storage volume required, in cubic feet,

ΔC = increase in weighted average runoff coefficient over disturbed area ( $C_{post} - C_{pre}$ ),

R = 100-year/2-hour precipitation depth, in feet (DSPM, Appendix 4-1D, page 11), and

A = area of disturbed ground, in square feet

Furthermore,

R = \_\_\_\_\_

ΔC = \_\_\_\_\_

$V_w = V - V_p$ ; where

A = \_\_\_\_\_

$V_w$  = volume waived,

V = \_\_\_\_\_

V = volume required, and

$V_p$  = \_\_\_\_\_

$V_p$  = volume provided

$V_w$  = \_\_\_\_\_

An in-lieu fee will be paid, based on the following calculations and supporting documentation:  
In-lieu fee (\$) =  $V_w$  (cu. ft.) x \$1.87 per cubic foot = \_\_\_\_\_

An in-kind contribution will be made, as follows:  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

No in-lieu fee is required. Reason:

Stormwater storage requirements conflict with requirements of the Environmentally Sensitive Land Ordinance (ESLO).  
\_\_\_\_\_  
\_\_\_\_\_

Approved by:

\_\_\_\_\_  
Floodplain Administrator or Designee

\_\_\_\_\_  
Date

## Planning, Neighborhood & Transportation Division

7447 E Indian School Road, Suite 105, Scottsdale, AZ 85251 • Phone: 480-312-2500 • Fax: 480-312-7781



WATER BASIS OF DESIGN

## RESERVE AT Black Mountain

Prepared for:

Pinnacle Land Development, LLC  
7440 E. Pinnacle Peak Road  
Scottsdale, AZ 85255

Prepared by:

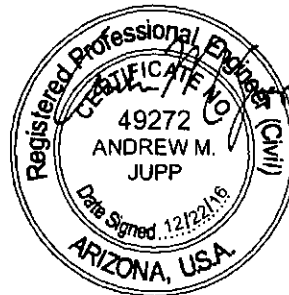
Kimley-Horn and Associates, Inc.  
7740 N. 16<sup>th</sup> Street, Suite 300  
Phoenix, Arizona 85020

**Kimley»»Horn**

29101500  
December 2016  
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# Preliminary Water Basis of Design

## RESERVE AT BLACK MOUNTAIN



Exp. Date 03/31/18

DECEMBER 19, 2016

Prepared By:

**Kimley»»Horn**

## Contents

Introduction .....	1
Intent .....	1
Project Description .....	1
Distribution System Description .....	1
Existing Distribution System.....	1
Proposed Distribution System.....	1
Basis of Design .....	2
Design Methodology .....	2
Water System Analysis .....	2
Results .....	2

## Tables

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-------------------------------	---

## Appendices

- Appendix A – Site Location Map
- Appendix B – Proposed Water System Layout
- Appendix C – WaterCAD Analysis Results
- Appendix D – Fire Flow Test Results

## INTRODUCTION

### INTENT

The purpose of this water report is to support the water system for the proposed Reserve at Black Mountain single-family residential development located at the northwest corner of Black Mountain Road and 84<sup>th</sup> Street in Scottsdale, Arizona. This report presents the basis of design criteria that will be used for the engineering design of the proposed development utilizing current water design standards and guidelines set forth by the City of Scottsdale, Arizona.

### PROJECT DESCRIPTION

Black Mountain is located within Section 1 of Township 5 North, Range 4 East of the Gila and Salt River Base and Meridian, Maricopa County, Arizona. The site is bound to the South by Black Mountain Road and 84<sup>th</sup> Street to the east. The site is surrounded by existing single family residential developments. See **Appendix A: Site Location Map.**

Black Mountain is a proposed 36-acre single-family residential subdivision, consisting of 30 new single-family residential units. The proposed zoning for the project is R1-43 ESL with amended standards with existing zoning of R-190 ESL.

## DISTRIBUTION SYSTEM DESCRIPTION

### EXISTING DISTRIBUTION SYSTEM

The site is surrounded by existing single-family residential development. Per the City of Scottsdale Quarter Section Map 59-47 there is an existing 12-inch DIP waterline in Black Mountain Road directly to the South of the site. An 12 -inch DIP waterline exists in 84<sup>th</sup> Street for the northern 620 feet of the adjacent frontage. This main then enters the subdivision to the East of 84<sup>th</sup> Street and loops down to the main in Black Mountain Road. The remainder of 84<sup>th</sup> Street does not contain existing waterline adjacent to the site

According to Figure 6.1-3 of the City of Scottsdale Design Standards and Policies Manual (DS&PM), the site is located in Pressure Zone 11 with existing ground elevation ranging from 2440 feet in the south to 2480 feet in the north. A Pressure Reducing Valve is located adjacent to the site in Black Mountain Road approximately 300 feet from the western boundary of the site forming the boundary the pressure zone.

The existing house located in the northeastern portion of site will continue to be serviced from the infrastructure in 84<sup>th</sup> Street. The house in the middle of the site will continue to be serviced from the infrastructure in Black Mountain Road.

### PROPOSED DISTRIBUTION SYSTEM

The proposed Black Mountain site is in pressure zone 11. All lots on site will be serviced from a water main that connects to the existing 12" line east of the PRV in Black Mountain Road and the existing 8" line in 84<sup>th</sup> Street at Cassandra Way. The proposed on-site distribution system will consist of an 8" Class 350 DIP



water line that will provide potable water and fire protection. Refer to **Appendix B** for the Proposed Water System Layout Exhibit.

## BASIS OF DESIGN

### DESIGN METHODOLOGY

The WaterCAD v8i water system modeling software distributed by Haestad Methods, Inc. was used to model the proposed water network. A fire flow test was performed to determine the residual and static pressures of the existing system. The fire flow test was performed on existing hydrants at 84<sup>th</sup> Street just south of Black Mountain Road. See **Appendix D** for complete fire flow test results.

According to Section 6-1.407 of the DSPM, distribution systems shall be designed with a minimum residual pressure of 50 psi and a maximum static pressure of 120 psi. For fire flow scenarios, a minimum design pressure of 30 psi is required.

### WATER SYSTEM ANALYSIS

The proposed water distribution system was modeled under 4 design scenarios: Average Day, Max Day, Peak Hour and Max Day plus Fire Flow. Average Day Demands are based on Figure 6.1-2 in the DS&PM, with peaking factors per section 6-1.404. A fire flow of 1,000 gpm per section 6-1.501 of the DS&PM was used. See **Table 1** below for a summary of water demands.

**Table 1 Water Demands**

Land Use	Dwelling units (du)	Average Daily Demand (gpd/du)	Average Daily Flow (gpd)	ADF (gpm)	Max Day Flow (gpd)	MDF (gpm)	Peak Hour Flow (gpd)	PHF (gpm)
<2 du/ac	31	537.64	15,053	10.4	30,107	21.0	52,686	36.6

Average Day, Max Day, and Peak Hour Demands are applied at hydraulic model nodes based on number of adjacent proposed units. Fire flow demands are applied to all junctions within the project boundary.

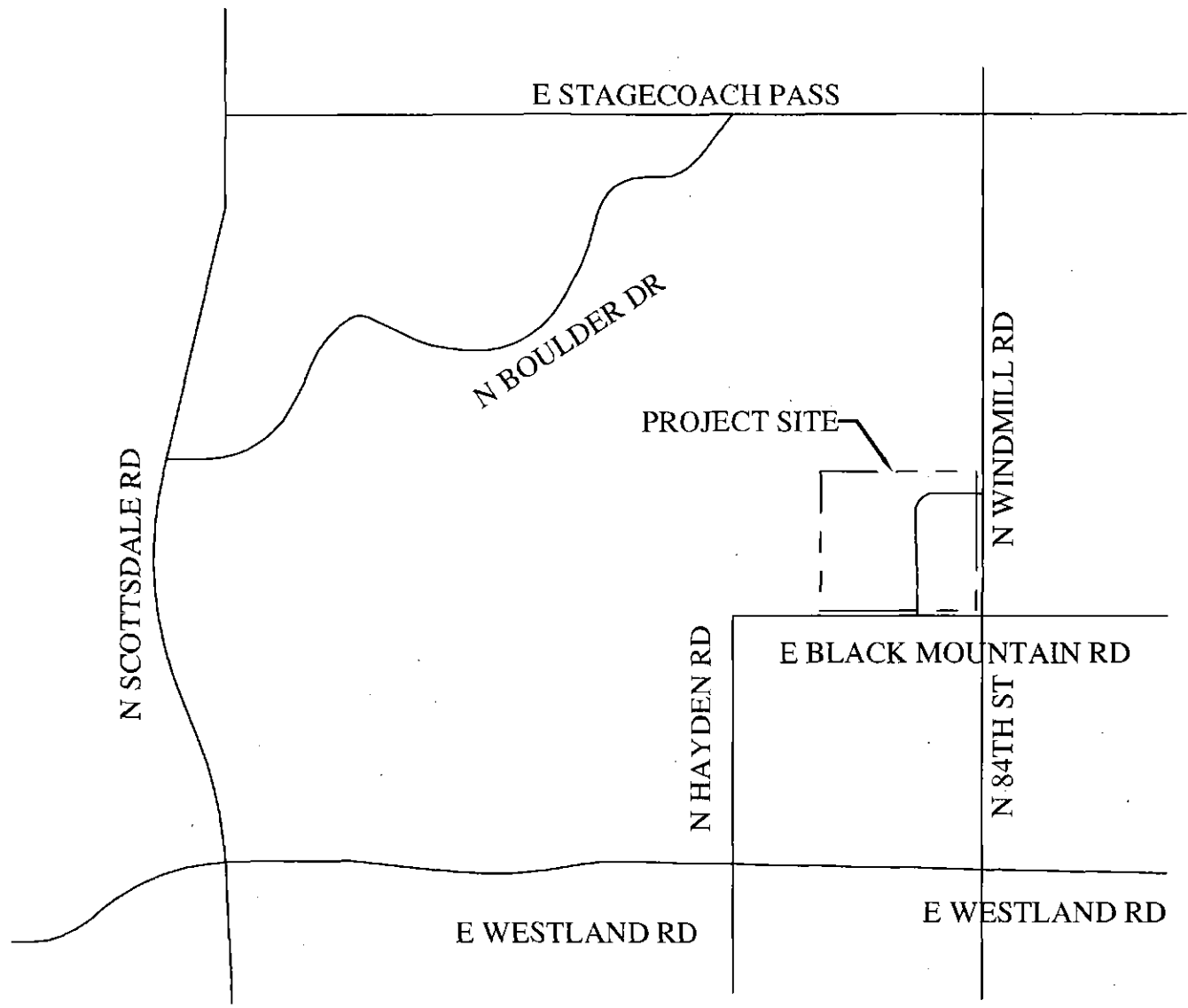
### RESULTS

Based on the fire flow tests performed and the results of the WaterCAD analysis, the proposed water system is capable of providing the required domestic flows at pressures ranging from 80 psi to 60 psi in the average day, max day, and peak hour scenarios. The fire flow pressures meet the minimum requirement of 30 psi, ranging from 30 psi to 45 psi.

Refer to **Appendix C** for the WaterCAD results.

Appendix A – Site Location Map

N:\P\1\_CAD\2010\10001 - Black Mountain\Reports\Water 100\Zonable\Vicinity Map.dwg Aug 19, 2016 11:46:00 AM

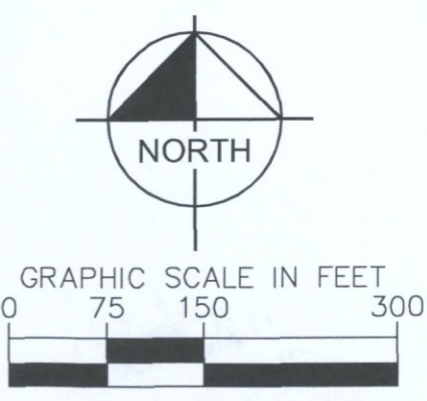
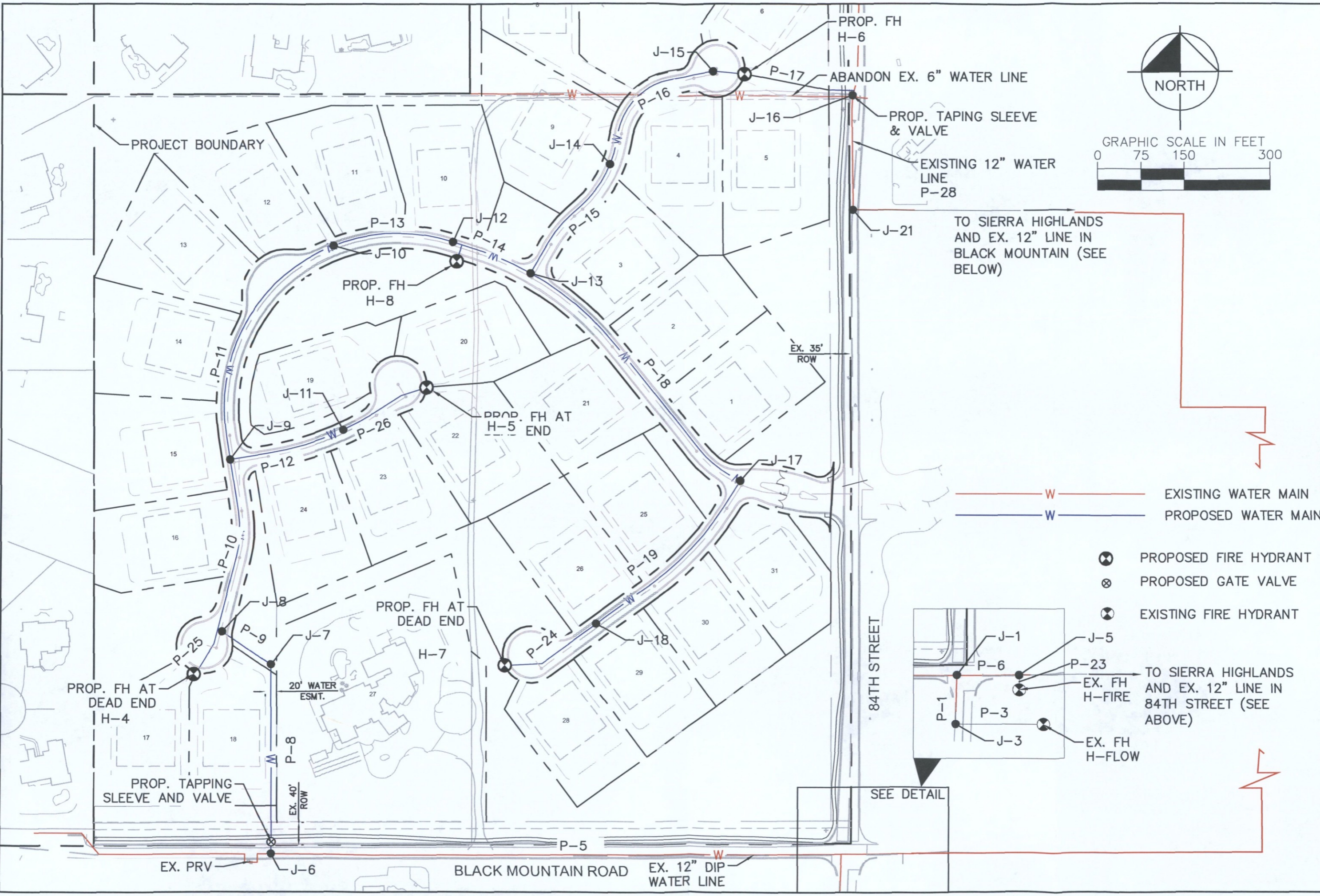


BLACK MOUNTAIN  
VICINITY MAP  
NTS



Appendix B – Proposed Water System  
Layout

Black Mountain Water System Layout Drawing Dec 15, 2016 kyle.compass  
 THE DOCUMENT, TOGETHER WITH THE CONCEPTS AND DESIGNS PRESENTED HEREIN, IS INTENDED ONLY FOR THE SPECIFIC PURPOSE AND CLIENT FOR WHICH IT WAS PREPARED. NO USE OF AND IMPROPER RELIANCE ON THIS DOCUMENT WITHOUT WRITTEN AUTHORIZATION AND ADAPTATION BY KIMLEY-HORN AND ASSOCIATES, INC. SHALL BE WITHOUT LIABILITY TO KIMLEY-HORN AND ASSOCIATES, INC.



<h2 style="margin: 0;">Kimley»Horn</h2> <p style="font-size: small; margin: 0;">             © 2016 KIMLEY-HORN AND ASSOCIATES, INC.              7740 North 16th Street, Suite 300              Phoenix, Arizona 85020 (602) 944-5500           </p>	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%; font-size: x-small;">SCALE (H): 1"=40'</td> <td style="width: 50%; font-size: x-small;">DATE: DEC 2016</td> </tr> <tr> <td style="font-size: x-small;">SCALE (V): NONE</td> <td style="font-size: x-small;">DESIGNED BY:</td> </tr> <tr> <td style="font-size: x-small;">DRAWN BY:</td> <td style="font-size: x-small;">CHECKED BY:</td> </tr> <tr> <td style="font-size: x-small;">NO.</td> <td style="font-size: x-small;">REVISION</td> </tr> <tr> <td style="font-size: x-small;">DATE</td> <td style="font-size: x-small;">DATE</td> </tr> </table>	SCALE (H): 1"=40'	DATE: DEC 2016	SCALE (V): NONE	DESIGNED BY:	DRAWN BY:	CHECKED BY:	NO.	REVISION	DATE	DATE
SCALE (H): 1"=40'	DATE: DEC 2016										
SCALE (V): NONE	DESIGNED BY:										
DRAWN BY:	CHECKED BY:										
NO.	REVISION										
DATE	DATE										
BLACK MOUNTAIN WATER BODY WATER SYSTEM LAYOUT SCOTTSDALE ARIZONA											
PROJECT NO. 291015001 DRAWING NAME 1 of 1											

# Appendix C – WaterCAD Analysis Results

Average Day

Max Day

Peak Hour

Max Day Plus Fire Flow

**Active Scenario: Average Day**  
**FlexTable: Junction Table**

ID	Label	Elevation (ft)	Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)
32	J-1	2,465.00	0.0000	2,631.59	72
35	J-3	2,460.00	0.0000	2,631.59	74
41	J-5	2,466.00	0.0000	2,631.59	72
42	J-6	2,442.00	0.0000	2,631.59	82
46	J-7	2,442.00	0.0000	2,631.59	82
47	J-8	2,442.00	0.6714	2,631.59	82
48	J-9	2,446.00	1.0071	2,631.59	80
49	J-10	2,451.00	1.3428	2,631.59	78
50	J-11	2,453.00	1.3428	2,631.59	77
51	J-12	2,460.00	0.3357	2,631.59	74
52	J-13	2,465.00	1.0071	2,631.59	72
53	J-14	2,471.00	1.0071	2,631.59	69
54	J-15	2,468.00	1.3428	2,631.59	71
55	J-16	2,482.00	0.0000	2,631.59	65
56	J-17	2,470.00	1.0071	2,631.59	70
57	J-18	2,458.00	1.3428	2,631.59	75
97	J-19	2,446.00	0.0000	2,631.59	80
98	J-20	2,456.00	0.0000	2,631.59	76
99	J-21	2,470.00	0.0000	2,631.59	70

**Active Scenario: Average Day**  
**FlexTable: Pipe Table**

Label	Length (Scaled) (ft)	Start Node	Stop Node	Diameter (in)	Hazen- Williams C	Flow (gpm)	Velocity (ft/s)	Headloss Gradient (ft/ft)	Headloss (ft)
P-1	199	J-1	J-3	12.0	130.0	0.0000	0.00	0.000	0.00
P-3	231	H- FLOW	J-3	8.0	130.0	0.0000	0.00	0.000	0.00
P-5	1,004	J-6	J-1	12.0	130.0	-5.3268	0.02	0.000	0.00
P-6	48	J-1	J-5	12.0	130.0	-5.3268	0.02	0.000	0.00
P-7	21	J-5	H-FIRE	6.0	130.0	-10.4068	0.12	0.000	0.00
P-8	335	J-6	J-7	8.0	130.0	5.3268	0.03	0.000	0.00
P-9	105	J-7	J-8	8.0	130.0	5.3268	0.03	0.000	0.00
P-10	309	J-8	J-9	8.0	130.0	4.6555	0.03	0.000	0.00
P-11	437	J-9	J-10	8.0	130.0	2.3055	0.01	0.000	0.00
P-13	197	J-10	J-12	8.0	130.0	0.9627	0.01	0.000	0.00
P-14	173	J-12	J-13	8.0	130.0	0.6270	0.00	0.000	0.00
P-15	226	J-13	J-14	8.0	130.0	-2.7301	0.02	0.000	0.00
P-16	308	J-14	J-15	8.0	130.0	-3.7372	0.02	0.000	0.00
P-17	219	J-15	J-16	8.0	130.0	-5.0800	0.03	0.000	0.00
P-18	517	J-13	J-17	8.0	130.0	2.3500	0.01	0.000	0.00
P-19	403	J-17	J-18	8.0	130.0	1.3429	0.01	0.000	0.00
P-22	9	R-1	PMP-1	100.0	130.0	10.4045	0.00	0.000	0.00
P-23	10	PMP-1	H-FIRE	100.0	130.0	10.4040	0.00	0.000	0.00
P-24	122	J-18	H-7	12.0	130.0	0.0001	0.00	0.000	0.00
P-25	94	J-8	H-4	12.0	130.0	-0.0001	0.00	0.000	0.00
P-26	92	J-11	H-5	12.0	130.0	0.0001	0.00	0.000	0.00
P-28	206	J-16	J-21	12.0	130.0	-5.0800	0.01	0.000	0.00
P-29	1,526	J-21	J-20	12.0	130.0	-5.0800	0.01	0.000	0.00
P-30	1,353	J-20	J-19	12.0	130.0	-5.0800	0.01	0.000	0.00
P-31	880	J-19	J-5	12.0	130.0	-5.0800	0.01	0.000	0.00
P-32	25	H-6	J-15	6.0	130.0	0.0000	0.00	0.000	0.00
P-12	276	J-9	J-11	8.0	130.0	1.3429	0.01	0.000	0.00
P-34	23	J-12	H-8	6.0	130.0	0.0000	0.00	0.000	0.00

**Active Scenario: Average Day**

**FlexTable: Pump Table**

ID	Label	Elevation (ft)	Pump Definition	Status (Initial)	Hydraulic Grade (Suction) (ft)	Hydraulic Grade (Discharge) (ft)
78	PMP-1	2,466.00	Fire Flow Test	On	2,466.00	2,631.59
Flow (Total) (gpm)		Pump Head (ft)				
10.4045		165.59				

**Active Scenario: Average Day**

**FlexTable: Reservoir Table**

ID	Label	Elevation (ft)	Zone	Flow (Out net) (gpm)	Hydraulic Grade (ft)
74	R-1	2,466.00	<None>	10.4045	2,466.00

**Active Scenario: Max Day + FF**  
**Fire Flow Node FlexTable: Fire Flow Report**

Label	Fire Flow Iterations	Satisfies Fire Flow Constraints ?	Fire Flow (Needed) (gpm)	Fire Flow (Available) (gpm)	Flow (Total Needed) (gpm)	Flow (Total Available) (gpm)	Pressure (Residual Lower Limit) (psi)	Pressure (Calculated Residual) (psi)	Pressure (Calculated Zone Lower Limit) (psi)	Junction w/ Minimum Pressure (Zone)
H-FIRE	5	True	1,000.0000	1,287.4022	999.9999	1,287.4022	30	37	30	J-16
H-FLOW	5	True	1,000.0000	1,264.7939	999.9999	1,264.7939	30	36	30	J-16
H-4	5	True	1,000.0000	1,248.5557	999.9999	1,248.5557	30	44	30	J-16
H-5	5	True	1,000.0000	1,241.6906	999.9999	1,241.6906	30	35	30	J-16
H-6	5	True	1,000.0000	1,208.8417	999.9999	1,208.8417	30	32	30	J-16
H-7	20	True	1,000.0000	1,167.1859	999.9999	1,167.1859	30	31	30	J-17
H-8	5	True	1,000.0000	1,227.7716	999.9999	1,227.7716	30	35	30	J-16
J-1	5	True	1,000.0000	1,264.7928	999.9999	1,264.7928	30	37	30	J-16
J-3	5	True	1,000.0000	1,264.7924	999.9999	1,264.7924	30	39	30	J-16
J-5	5	True	1,000.0000	1,265.1691	999.9999	1,265.1691	30	37	30	J-16
J-6	5	True	1,000.0000	1,259.8054	999.9999	1,259.8054	30	46	30	J-16
J-7	5	True	1,000.0000	1,250.9987	999.9999	1,250.9987	30	45	30	J-16
J-8	5	True	1,000.0000	1,248.5549	1,001.3427	1,249.8977	30	45	30	J-16
J-9	5	True	1,000.0000	1,241.6871	1,002.0142	1,243.7013	30	42	30	J-16
J-10	5	True	1,000.0000	1,232.1951	1,002.6855	1,234.8807	30	40	30	J-16
J-11	5	True	1,000.0000	1,241.6920	1,002.6855	1,244.3777	30	36	30	J-16
J-12	5	True	1,000.0000	1,227.7725	1,000.6713	1,228.4437	30	36	30	J-16
J-13	5	True	1,000.0000	1,223.6821	1,002.0142	1,225.6964	30	35	30	J-16
J-14	5	True	1,000.0000	1,217.9137	1,002.0142	1,219.9280	30	33	30	J-16
J-15	5	True	1,000.0000	1,208.8385	1,002.6855	1,211.5242	30	35	30	J-16
J-16	3	True	1,000.0000	1,200.9063	999.9999	1,200.9063	30	30	34	H-6
J-17	3	True	1,000.0000	1,167.5867	1,002.0142	1,169.6010	30	30	33	J-16
J-18	20	True	1,000.0000	1,167.1926	1,002.6855	1,169.8783	30	31	30	J-17
J-19	5	True	1,000.0000	1,246.2762	999.9999	1,246.2762	30	45	30	J-16
J-20	5	True	1,000.0000	1,224.3459	999.9999	1,224.3459	30	41	30	J-16
J-21	5	True	1,000.0000	1,203.5238	999.9999	1,203.5238	30	35	30	J-16

**Active Scenario: Max Day**  
**FlexTable: Junction Table**

ID	Label	Elevation (ft)	Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)
32	J-1	2,465.00	0.0000	2,631.56	72
35	J-3	2,460.00	0.0000	2,631.56	74
41	J-5	2,466.00	0.0000	2,631.56	72
42	J-6	2,442.00	0.0000	2,631.56	82
46	J-7	2,442.00	0.0000	2,631.56	82
47	J-8	2,442.00	1.3430	2,631.56	82
48	J-9	2,446.00	2.0145	2,631.56	80
49	J-10	2,451.00	2.6860	2,631.56	78
50	J-11	2,453.00	2.6860	2,631.56	77
51	J-12	2,460.00	0.6715	2,631.56	74
52	J-13	2,465.00	2.0145	2,631.56	72
53	J-14	2,471.00	2.0145	2,631.56	69
54	J-15	2,468.00	2.6860	2,631.56	71
55	J-16	2,482.00	0.0000	2,631.56	65
56	J-17	2,470.00	2.0145	2,631.56	70
57	J-18	2,458.00	2.6860	2,631.56	75
97	J-19	2,446.00	0.0000	2,631.56	80
98	J-20	2,456.00	0.0000	2,631.56	76
99	J-21	2,470.00	0.0000	2,631.56	70

**Active Scenario: Max Day**  
**FlexTable: Pipe Table**

Label	Length (Scaled) (ft)	Start Node	Stop Node	Diameter (in)	Hazen- Williams C	Flow (gpm)	Velocity (ft/s)	Headloss Gradient (ft/ft)	Headloss (ft)
P-1	199	J-1	J-3	12.0	130.0	0.0000	0.00	0.000	0.00
P-3	231	H- FLOW	J-3	8.0	130.0	0.0000	0.00	0.000	0.00
P-5	1,004	J-6	J-1	12.0	130.0	-10.6550	0.03	0.000	0.00
P-6	48	J-1	J-5	12.0	130.0	-10.6550	0.03	0.000	0.00
P-7	21	J-5	H-FIRE	6.0	130.0	-20.8165	0.24	0.000	0.00
P-8	335	J-6	J-7	8.0	130.0	10.6550	0.07	0.000	0.00
P-9	105	J-7	J-8	8.0	130.0	10.6550	0.07	0.000	0.00
P-10	309	J-8	J-9	8.0	130.0	9.3120	0.06	0.000	0.00
P-11	437	J-9	J-10	8.0	130.0	4.6115	0.03	0.000	0.00
P-13	197	J-10	J-12	8.0	130.0	1.9255	0.01	0.000	0.00
P-14	173	J-12	J-13	8.0	130.0	1.2540	0.01	0.000	0.00
P-15	226	J-13	J-14	8.0	130.0	-5.4610	0.03	0.000	0.00
P-16	308	J-14	J-15	8.0	130.0	-7.4755	0.05	0.000	0.00
P-17	219	J-15	J-16	8.0	130.0	-10.1616	0.06	0.000	0.00
P-18	517	J-13	J-17	8.0	130.0	4.7006	0.03	0.000	0.00
P-19	403	J-17	J-18	8.0	130.0	2.6861	0.02	0.000	0.00
P-22	9	R-1	PMP-1	100.0	130.0	20.8134	0.00	0.000	0.00
P-23	10	PMP-1	H-FIRE	100.0	130.0	20.8139	0.00	0.000	0.00
P-24	122	J-18	H-7	12.0	130.0	0.0001	0.00	0.000	0.00
P-25	94	J-8	H-4	12.0	130.0	0.0000	0.00	0.000	0.00
P-26	92	J-11	H-5	12.0	130.0	0.0000	0.00	0.000	0.00
P-28	206	J-16	J-21	12.0	130.0	-10.1616	0.03	0.000	0.00
P-29	1,526	J-21	J-20	12.0	130.0	-10.1616	0.03	0.000	0.00
P-30	1,353	J-20	J-19	12.0	130.0	-10.1616	0.03	0.000	0.00
P-31	880	J-19	J-5	12.0	130.0	-10.1616	0.03	0.000	0.00
P-32	25	H-6	J-15	6.0	130.0	0.0000	0.00	0.000	0.00
P-12	276	J-9	J-11	8.0	130.0	2.6860	0.02	0.000	0.00
P-34	23	J-12	H-8	6.0	130.0	0.0000	0.00	0.000	0.00

**Active Scenario: Max Day**  
**FlexTable: Pump Table**

ID	Label	Elevation (ft)	Pump Definition	Status (Initial)	Hydraulic Grade (Suction) (ft)	Hydraulic Grade (Discharge) (ft)
78	PMP-1	2,466.00	Fire Flow Test	On	2,466.00	2,631.56
Flow (Total) (gpm)		Pump Head (ft)				
20.8143		165.56				

**Active Scenario: Max Day**  
**FlexTable: Reservoir Table**

ID	Label	Elevation (ft)	Zone	Flow (Out net) (gpm)	Hydraulic Grade (ft)
74	R-1	2,466.00	<None>	20.8134	2,466.00

**Active Scenario: Peak Hour**  
**FlexTable: Junction Table**

ID	Label	Elevation (ft)	Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)
32	J-1	2,465.00	0.0000	2,631.49	72
35	J-3	2,460.00	0.0000	2,631.49	74
41	J-5	2,466.00	0.0000	2,631.49	72
42	J-6	2,442.00	0.0000	2,631.49	82
46	J-7	2,442.00	0.0000	2,631.48	82
47	J-8	2,442.00	2.3600	2,631.48	82
48	J-9	2,446.00	3.5400	2,631.48	80
49	J-10	2,451.00	4.7200	2,631.48	78
50	J-11	2,453.00	4.7200	2,631.48	77
51	J-12	2,460.00	1.1800	2,631.48	74
52	J-13	2,465.00	3.5400	2,631.48	72
53	J-14	2,471.00	3.5400	2,631.48	69
54	J-15	2,468.00	4.7200	2,631.48	71
55	J-16	2,482.00	0.0000	2,631.48	65
56	J-17	2,470.00	3.5400	2,631.48	70
57	J-18	2,458.00	4.7200	2,631.48	75
97	J-19	2,446.00	0.0000	2,631.49	80
98	J-20	2,456.00	0.0000	2,631.49	76
99	J-21	2,470.00	0.0000	2,631.48	70

**Active Scenario: Peak Hour**  
**FlexTable: Pipe Table**

Label	Length (Scaled) (ft)	Start Node	Stop Node	Diameter (in)	Hazen- Williams C	Flow (gpm)	Velocity (ft/s)	Headloss Gradient (ft/ft)	Headloss (ft)
P-1	199	J-1	J-3	12.0	130.0	0.0020	0.00	0.000	0.00
P-3	231	H- FLOW	J-3	8.0	130.0	-0.0020	0.00	0.000	0.00
P-5	1,004	J-6	J-1	12.0	130.0	-18.7294	0.05	0.000	0.00
P-6	48	J-1	J-5	12.0	130.0	-18.7316	0.05	0.000	0.00
P-7	21	J-5	H-FIRE	6.0	130.0	-36.5939	0.42	0.000	0.00
P-8	335	J-6	J-7	8.0	130.0	18.7294	0.12	0.000	0.00
P-9	105	J-7	J-8	8.0	130.0	18.7294	0.12	0.000	0.00
P-10	309	J-8	J-9	8.0	130.0	16.3682	0.10	0.000	0.00
P-11	437	J-9	J-10	8.0	130.0	8.1060	0.05	0.000	0.00
P-13	197	J-10	J-12	8.0	130.0	3.3860	0.02	0.000	0.00
P-14	173	J-12	J-13	8.0	130.0	2.2028	0.01	0.000	0.00
P-15	226	J-13	J-14	8.0	130.0	-9.5994	0.06	0.000	0.00
P-16	308	J-14	J-15	8.0	130.0	-13.1394	0.08	0.000	0.00
P-17	219	J-15	J-16	8.0	130.0	-17.8623	0.11	0.000	0.00
P-18	517	J-13	J-17	8.0	130.0	8.2622	0.05	0.000	0.00
P-19	403	J-17	J-18	8.0	130.0	4.7222	0.03	0.000	0.00
P-22	9	R-1	PMP-1	100.0	130.0	36.5908	0.00	0.000	0.00
P-23	10	PMP-1	H-FIRE	100.0	130.0	36.5923	0.00	0.000	0.00
P-24	122	J-18	H-7	12.0	130.0	0.0020	0.00	0.000	0.00
P-25	94	J-8	H-4	12.0	130.0	0.0020	0.00	0.000	0.00
P-26	92	J-11	H-5	12.0	130.0	0.0020	0.00	0.000	0.00
P-28	206	J-16	J-21	12.0	130.0	-17.8623	0.05	0.000	0.00
P-29	1,526	J-21	J-20	12.0	130.0	-17.8623	0.05	0.000	0.00
P-30	1,353	J-20	J-19	12.0	130.0	-17.8623	0.05	0.000	0.00
P-31	880	J-19	J-5	12.0	130.0	-17.8623	0.05	0.000	0.00
P-32	25	H-6	J-15	6.0	130.0	-0.0020	0.00	0.000	0.00
P-12	276	J-9	J-11	8.0	130.0	4.7222	0.03	0.000	0.00
P-34	23	J-12	H-8	6.0	130.0	0.0020	0.00	0.000	0.00

**Active Scenario: Peak Hour**  
**FlexTable: Pump Table**

ID	Label	Elevation (ft)	Pump Definition	Status (Initial)	Hydraulic Grade (Suction) (ft)	Hydraulic Grade (Discharge) (ft)
78	PMP-1	2,466.00	Fire Flow Test	On	2,466.00	2,631.49
Flow (Total) (gpm)		Pump Head (ft)				
36.5910		165.49				

**Active Scenario: Peak Hour**  
**FlexTable: Reservoir Table**

ID	Label	Elevation (ft)	Zone	Flow (Out net) (gpm)	Hydraulic Grade (ft)
74	R-1	2,466.00	<None>	36.5908	2,466.00

# Appendix D – Fire Flow Test Results



Flow Tests

FLOW TESTING SERVICES

# Flow Test 1 Summary

EJ Flow Tests Project Name:	Sierra Highlands	City of Scottsdale requires a Maximum Static Pressure of 72 PSI for use as Safety Factor.
EJ Flow Tests Project No.:	14101	
Project Address:	East Black Mountain Road & North 84th Street, Scottsdale, Arizona 85266	
Date of Flow Test:	September 3, 2014	
Time of Flow Test:	7:15AM	
Data is Current and Reliable Until:	March 3, 2015	

### Raw Test Data:

Static Pressure: (measured in pounds per square inch)	85.0 psi
Residual Pressure: (measured in pounds per square inch)	40.0 psi
Pitot Pressure: (measured in pounds per square inch)	20.0 psi
Number of Outlets Flowed:	2
Fire Hydrant Orifice Diameter: (measured in inches)	2.5 inches
Coefficient of Discharge: (0.9 smooth/round outlet, 0.8 square/sharp outlet, 0.7 square/raised outlet)	0.9
Flowing GPM: (measured in gallons per minute)	1,501
GPM at 20 PSI:	1,831

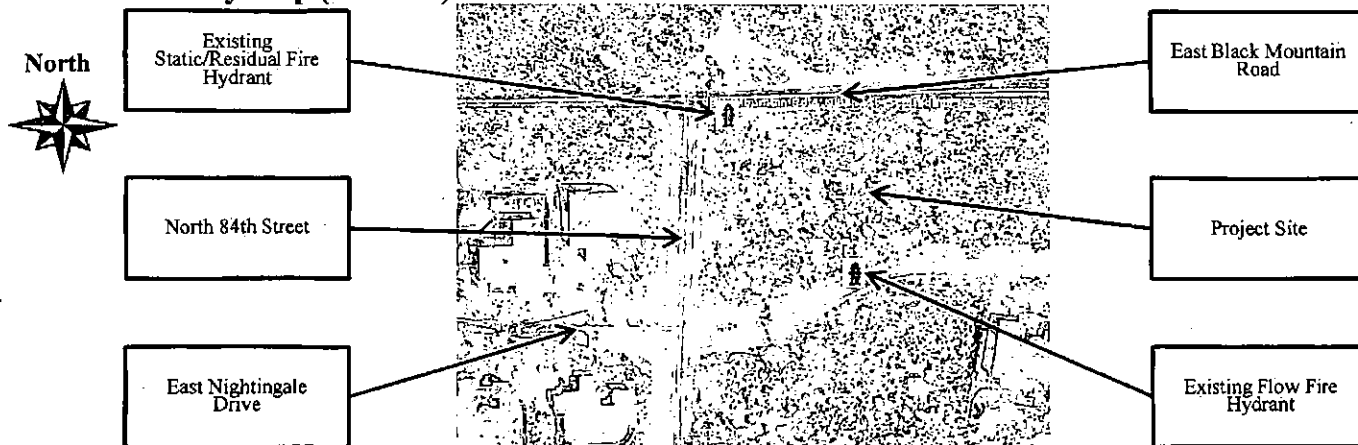
### Data with minimum safety factor of: 13 PSI

Static Pressure: (measured in pounds per square inch)	72.0 psi
Residual Pressure: (measured in pounds per square inch)	27.0 psi
Main Size: (measured in inches)	12 & 8
Approximate Distance Between Hydrants: (measured in feet)	500 ft
Approx. Static/Residual Hydrant Elevation: (measured above sea level)	2,466 ft
Approx. Flow Hydrant Elevation: (measured above sea level)	2,461 ft
Flowing GPM: (measured in gallons per minute)	1,501
GPM at 20 PSI:	1,623

### Conducted by/Witnessed by/City Forces Contacted:

Conducted by: John Echeverri & Cesar Reyna (EJ Flow Tests) 602.999.7637  
 Witnessed by: Jim Tunnell (City of Scottsdale) 602.819.7718  
 City Forces Contacted: City of Scottsdale (Permit Number: C45828)

### Flow Test Vicinity Map (No Scale)



EJ Flow Tests, LLC

21505 North 78th Ave. • Suite 125 • Peoria, Arizona 85382 • 602.999.7637 • [www.ejflowtests.com](http://www.ejflowtests.com)



## SEWER BASIS OF DESIGN

# Reserve at Black Mountain

Prepared for:

Pinnacle Land Development, LLC  
7440 E. Pinnacle Peak Road  
Scottsdale, AZ 85255

Prepared by:

Kimley-Horn and Associates, Inc.  
7740 N. 16<sup>th</sup> Street, Suite 300  
Phoenix, Arizona 85020

29101500  
December 16  
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**Kimley»Horn**

SEWER BASIS OF DESIGN

Reserve at Black Mountain

Prepared for:

Pinnacle Land Development, LLC  
7440 E. Pinnacle Peak Road  
Scottsdale, AZ 85255

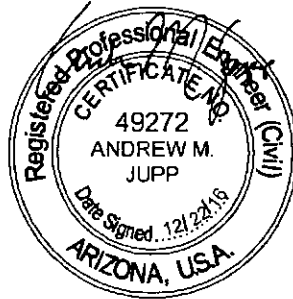
Prepared by:

Kimley-Horn and Associates, Inc.  
7740 N. 16<sup>th</sup> Street, Suite 300  
Phoenix, Arizona 85020

---

# Sewer Basis of Design

## RESERVE AT BLACK MOUNTAIN



Exp. Date 03/31/18

DECEMBER 19, 2016

Prepared By:

**Kimley»»Horn**

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## Appendices

- Appendix A – Site Location Map
- Appendix B – Proposed Sewer System Layout
- Appendix C – Flowmaster Calculations



## INTRODUCTION

### INTENT

The purpose of this sewer report is to support the sanitary sewer system for the proposed Reserve at Black Mountain residential development located at the northwest corner of Black Mountain and 84<sup>th</sup> Street in Scottsdale, Arizona. This report presents the basis of design criteria that will be used for the engineering design of the proposed development utilizing current sewer design standards and guidelines set forth by the City of Scottsdale, Arizona.

### PROJECT DESCRIPTION

Reserve at Black Mountain is located within Section 1 of Township 5 North, Range 4 East of the Gila and Salt River Base and Meridian, Maricopa County, Arizona. The site is bound to the South by Black Mountain Road, to the east by 84<sup>th</sup> Street, to the north by Vista Viento Estates, and to the west by Sandflower subdivision. See **Appendix A: Site Location Map**

Black Mountain is a proposed 32-acre single family residential subdivision, consisting of 24 single family residential units. According to the Maricopa County Assessor's website existing zoning is R-190, with proposed zoning of the project to be R1-43 ESL.

## DISTRIBUTION SYSTEM DESCRIPTION

### EXISTING COLLECTION SYSTEM

The site is surrounded by existing single family residential development. Per the City of Scottsdale Quarter Section Map 59-47 there is an existing 8-inch PVC sewer stub located at the southeast corner of the site in 84<sup>th</sup> Street at Black Mountain Road. This sewer main is too high to service this site. The existing house on Lot 27 (APN 216-34-268) currently utilizes a septic system, which is to be abandoned and serviced with the proposed gravity system with this project

### PROPOSED COLLECTION SYSTEM

The proposed Reserve at Black Mountain gravity sewer system will connect to the City of Scottsdale sewer at the cul-de-sac in Sandflower Drive. Multiple sewer outfall locations have been analyzed in order to avoid extensive hard dig that the geotechnical investigation has discovered along the Black Mountain Road alignment. Please see Appendix D: Geotechnical Investigation for more information regarding these subsurface results. This section of Black Mountain Road sewer extension was once stipulated with the development of Sandflower subdivision. However, upon construction, the stipulation was deleted due to very difficult hard dig that was encountered. The final sewer outfall alignment was chosen from several different alternatives and is based on the cooperation of the lot owner and the securement of a 20' wide public sewer easement over the lot. The proposed system will connect through lot 8 in Sandflower to the easternmost manhole located in Sandflower Drive.

The proposed on-site collection system will consist of an 8" PVC gravity sewer line that will collect and convey wastewater flows generated by the site. Lots 26,28, and 29 will be serviced using private on-lot



pumps and private individual ejector lines to a private manhole. This will then flow into the proposed gravity system utilizing a public gravity service for side of the street. Refer to **Appendix B** for the Proposed Sewer System Layout Exhibit.

## BASIS OF DESIGN

### DESIGN METHODOLOGY

Average Day Demand design flows are calculated based on design criteria detailed within the City of Scottsdale Design Standards and Polices Manual (DS&PM). Per DS&PM Chapter 7, a design flow of 100 gallons per capita per day (gpcpd) and a residential density of 2.5 persons per dwelling unit shall be used. Per conversations with Doug Mann, City of Scottsdale Water Services, this development shall be allowed to utilize a peaking factor based on Harmon's Formula per Arizona Administrative Code Title 18 chapter 19 for the purposes of determining downstream capacity within the Sandflower Subdivision that we are tying into. See **Table 1** below for a summary of sewer demands.

**Table 1 Onsite Sewer Demands**

Land Use	Dwelling units (du)	Density (persons/du)	Population (persons)	Average Day Demand (gpd)	Peaking Factor	Peak Flow (gpd)	Peak Flow (gpm)
<2 du/ac	31	2.5	78	7,800	4	31,200	21.7

Per the DS&PM, proposed sewer lines within the development were designed to achieve a full flow velocity of between 2.5 and 10 feet per second and maintain a maximum d/D ratio 0.65 when calculated with a Manning's "n" value of 0.013. To satisfy these requirements the proposed public 8-inch sewer will meet the design with a minimum slope of 0.0052 ft/ft (0.52%) and a maximum slope of 0.0833 ft/ft (8.33%). See **Appendix C** for pipe slope calculations.

### WASTEWATER SYSTEM ANALYSIS AND RESULTS

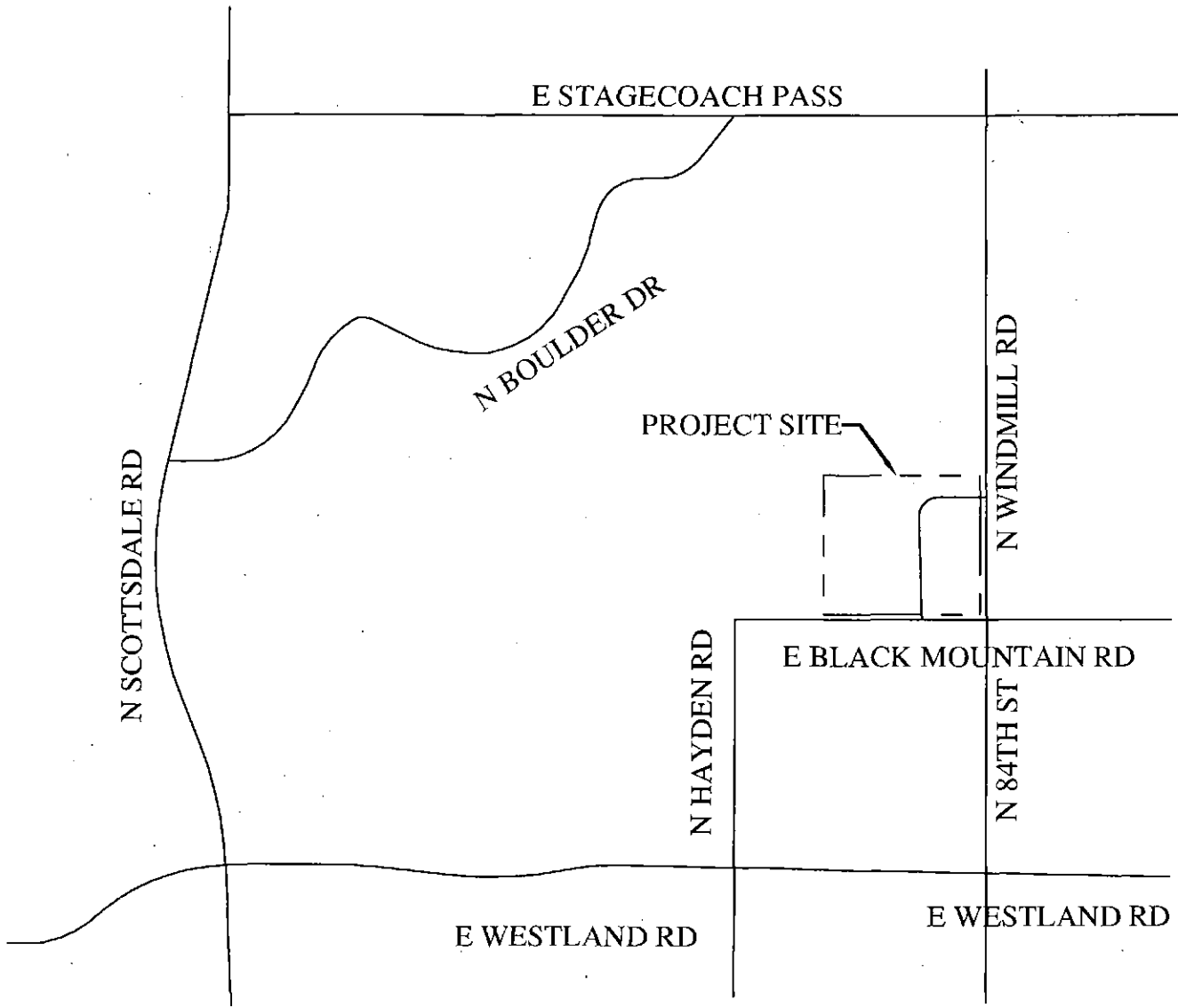
To determine the capacity of the proposed onsite wastewater collection system, the peak design flow was analyzed within the minimum design pipe slope. At the minimum design slope of 0.0052 ft/ft an 8-inch line has the capacity to convey approximately 563,000 gallons per day. An 8-inch line at the minimum design slope can convey the proposed peak design flow of 31,200 gallons per day at a normal depth of 0.84" or a d/D ratio of 0.10, at a velocity of 1.08 ft/s. See **Appendix C – Flowmaster Calculations** for pipe capacity calculations.

Sewer capacities were calculated for the downstream sewer mains located within the Sandflower subdivision. See **Appendix E Sandflower Alternatives Capacity Calculations**. These calculations utilize base sewer flows from the Sandflower report and proposed based sewer flows from Reserve at Black Mountain subdivision. Harmon's Formula per Arizona Administrative Code Title 18 chapter 19 was utilized to determine an appropriate peaking factor for each of the downstream sewer mains within 81<sup>st</sup> Street, E. Sandflower Drive and Hayden Road. See **Appendix F for excerpts from the Sandflower Sewer Master Plan**. The Sandflower Sewer Master Plan report does not utilize the current City of Scottsdale peaking

factor of 4 or d/D requirement of 0.65, however all pipes have excess actual capacity ( $d/D < 1.0$ ). Flowmaster software was utilized to re-calculate the d/D of the existing 8" and 10" lines downstream of the Reserves at Black Mountain tie-in points and results indicate that new d/D values range from 0.38 to 0.83. Based on this analysis, the existing sewer system has capacity to utilize the tie-in point shown in this report.

Appendix A – Site Location Map

K:\VRS\_Civil\2016\15001 - Black Mountain\Reports\Water BOD\Public\Vicinity Map.dwg Aug 15, 2016 14:44:34



BLACK MOUNTAIN  
VICINITY MAP  
NTS



Appendix B – Proposed Sewer System  
Layout



# Appendix C – Flowmaster Calculations

## Worksheet for 8-Inch Capacity

### Project Description

Friction Method                      Manning Formula  
Solve For                                Normal Depth

### Input Data

Roughness Coefficient                      0.013  
Channel Slope                                0.00520    ft/ft  
Diameter                                        0.67    ft  
Discharge                                      29000.00    gal/day

### Results

Normal Depth                                0.10    ft  
Flow Area                                      0.03    ft<sup>2</sup>  
Wetted Perimeter                            0.54    ft  
Hydraulic Radius                            0.06    ft  
Top Width                                      0.48    ft  
Critical Depth                                0.10    ft  
Percent Full                                  15.4    %  
Critical Slope                                0.00706    ft/ft  
Velocity                                        1.31    ft/s  
Velocity Head                                0.03    ft  
Specific Energy                              0.13    ft  
Froude Number                                0.87  
Maximum Discharge                         0.94    ft<sup>3</sup>/s  
Discharge Full                                0.87    ft<sup>3</sup>/s  
Slope Full                                      0.00001    ft/ft  
Flow Type                                      SubCritical

### GVF Input Data

Downstream Depth                         0.00    ft  
Length                                        0.00    ft  
Number Of Steps                             0

### GVF Output Data

Upstream Depth                             0.00    ft  
Profile Description  
Profile Headloss                            0.00    ft  
Average End Depth Over Rise             0.00    %  
Normal Depth Over Rise                   15.43    %  
Downstream Velocity                        Infinity    ft/s

---

## Worksheet for 8-Inch Capacity

---

GVF Output Data		
-----------------	--	--

Upstream Velocity	Infinity	ft/s
Normal Depth	0.10	ft
Critical Depth	0.10	ft
Channel Slope	0.00520	ft/ft
Critical Slope	0.00706	ft/ft

## 8" - Harmon's PF

### Project Description

Friction Method                      Manning Formula  
Solve For                                Normal Depth

### Input Data

Roughness Coefficient                      0.013  
Channel Slope                                0.52000 %  
Diameter                                        8.00 in  
Discharge                                      10.40 gpm

### Results

Normal Depth                                0.07 ft  
Flow Area                                      0.02 ft<sup>2</sup>  
Wetted Perimeter                            0.46 ft  
Hydraulic Radius                            0.05 ft  
Top Width                                      0.42 ft  
Critical Depth                                0.07 ft  
Percent Full                                  11.2 %  
Critical Slope                                0.00745 ft/ft  
Velocity                                        1.08 ft/s  
Velocity Head                                0.02 ft  
Specific Energy                              0.09 ft  
Froude Number                                0.84  
Maximum Discharge                        0.94 ft<sup>3</sup>/s  
Discharge Full                                0.87 ft<sup>3</sup>/s  
Slope Full                                      0.00000 ft/ft  
Flow Type                                      SubCritical

### GVF Input Data

Downstream Depth                        0.00 ft  
Length                                        0.00 ft  
Number Of Steps                            0

### GVF Output Data

Upstream Depth                            0.00 ft  
Profile Description  
Profile Headloss                            0.00 ft  
Average End Depth Over Rise            0.00 %  
Normal Depth Over Rise                   11.23 %  
Downstream Velocity                        Infinity ft/s

---

## 8" - Harmon's PF

---

### GVF Output Data

---

Upstream Velocity	Infinity	ft/s
Normal Depth	0.07	ft
Critical Depth	0.07	ft
Channel Slope	0.52000	%
Critical Slope	0.00745	ft/ft

## Worksheet for 8-Inch Full -Max

### Project Description

Friction Method                      Manning Formula  
Solve For                                Full Flow Capacity

### Input Data:

Roughness Coefficient	0.013	
Channel Slope	0.08330	ft/ft
Normal Depth	0.67	ft
Diameter	0.67	ft
Discharge	2254023.72	gal/day

### Results

Discharge	2254023.72	gal/day
Normal Depth	0.67	ft
Flow Area	0.35	ft <sup>2</sup>
Wetted Perimeter	2.09	ft
Hydraulic Radius	0.17	ft
Top Width	0.00	ft
Critical Depth	0.66	ft
Percent Full	100.0	%
Critical Slope	0.07763	ft/ft
Velocity	9.99	ft/s
Velocity Head	1.55	ft
Specific Energy	2.22	ft
Froude Number	0.00	
Maximum Discharge	3.75	ft <sup>3</sup> /s
Discharge Full	3.49	ft <sup>3</sup> /s
Slope Full	0.08330	ft/ft
Flow Type	SubCritical	

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%

---

## Worksheet for 8-Inch Full -Max

---

GVF Output Data
-----------------

Normal Depth Over Rise	100.00	%
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.67	ft
Critical Depth	0.66	ft
Channel Slope	0.08330	ft/ft
Critical Slope	0.07763	ft/ft

## Worksheet for 8-Inch Full - Min

### Project Description

Friction Method                      Manning Formula  
Solve For                                Full Flow Capacity

### Input Data

Roughness Coefficient                      0.013  
Channel Slope                                0.00520    ft/ft  
Normal Depth                                0.67    ft  
Diameter                                      0.67    ft  
Discharge                                    563167.59    gal/day

### Results

Discharge                                    563167.59    gal/day  
Normal Depth                                0.67    ft  
Flow Area                                    0.35    ft<sup>2</sup>  
Wetted Perimeter                            2.09    ft  
Hydraulic Radius                            0.17    ft  
Top Width                                    0.00    ft  
Critical Depth                               0.44    ft  
Percent Full                                100.0    %  
Critical Slope                                0.00857    ft/ft  
Velocity                                      2.50    ft/s  
Velocity Head                                0.10    ft  
Specific Energy                              0.76    ft  
Froude Number                               0.00  
Maximum Discharge                        0.94    ft<sup>3</sup>/s  
Discharge Full                               0.87    ft<sup>3</sup>/s  
Slope Full                                    0.00520    ft/ft  
Flow Type                                    SubCritical

### GVF Input Data

Downstream Depth                        0.00    ft  
Length                                      0.00    ft  
Number Of Steps                            0

### GVF Output Data

Upstream Depth                            0.00    ft  
Profile Description  
Profile Headloss                            0.00    ft  
Average End Depth Over Rise            0.00    %

---

## Worksheet for 8-Inch Full - Min

---

### GVF Output Data

Normal Depth Over Rise	100.00	%
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.67	ft
Critical Depth	0.44	ft
Channel Slope	0.00520	ft/ft
Critical Slope	0.00857	ft/ft

## Downstream Tie-In

### Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

### Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00700	ft/ft
Diameter	10.00	in
Discharge	0.99	mgd

### Results

Normal Depth	6.99	in
Flow Area	0.41	ft <sup>2</sup>
Wetted Perimeter	1.65	ft
Hydraulic Radius	2.96	in
Top Width	0.76	ft
Critical Depth	0.55	ft
Percent Full	69.9	%
Critical Slope	0.00799	ft/ft
Velocity	3.76	ft/s
Velocity Head	0.22	ft
Specific Energy	0.80	ft
Froude Number	0.91	
Maximum Discharge	1.97	ft <sup>3</sup> /s
Discharge Full	1.83	ft <sup>3</sup> /s
Slope Full	0.00489	ft/ft
Flow Type	SubCritical	

### GVF Input Data

Downstream Depth	0.00	in
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	in
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	69.91	%
Downstream Velocity	Infinity	ft/s

# Appendix D – Geotechnical Investigation

**REPORT ON GEOTECHNICAL  
INVESTIGATION**

---

**DESIGNATION:** 84th Street Residential

**LOCATION:** NWC 84<sup>th</sup> Street & Black Mountain Road  
Scottsdale, Arizona

**CLIENT:** Pinnacle Land Development, LLC

**PROJECT NO:** 161008SA

**DATE:** July 21, 2016

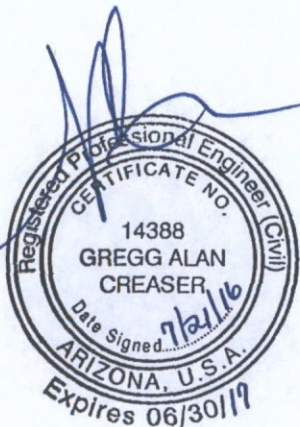


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APPENDIX – Field and Laboratory Data



## 1.0 INTRODUCTION

This report presents the results of a subsoil investigation carried out at the site of the proposed residential development to be constructed at the northwest corner of 84<sup>th</sup> Street and Black Mountain Road, in Scottsdale, Arizona.

We understand that the development will consist of 23 custom home lots on approximately 34.7 acres. The homes will be one or two stories with slab on grade (no basements) and masonry or wood frame walls. Due to the terrain, retaining walls and culverts may be required. Structural loads are expected to be light to moderate and no special considerations regarding settlement tolerances are known at this time. The lot will be paved to support light to moderate passenger vehicle traffic. Adjacent areas will be landscaped and utilized for storm water retention and disposal. Half street improvements to Black Mountain Road may also be required.

Due to the conceptual nature of the project at this time, this report is limited to providing geotechnical **recommendations for the infrastructure improvements only** and presents only preliminary recommendations for any of the proposed building lots or structures. Final recommendations will depend on the grading plans for each residential lot and inclusion of any basement levels, retaining walls, pools etc. It is **highly recommended that supplementary individual site investigations be conducted at each lot as the development plans become available.**

## 2.0 GENERAL SITE AND SOIL CONDITIONS

### 2.1 Site Conditions

The site is bounded on the north and west by single family residential, on the east by 84<sup>th</sup> Street and on the south by Black Mountain Road. There is an existing residential lot on the south central portion that the property to be developed wraps around. The site is currently native desert land with rolling terrain with high ridge lines and rock outcropping throughout the site. There are a few significant natural drainage washes that traverse the site in a general northeast to southwest direction. Remnants of an old dirt road (83<sup>rd</sup> street) through the center of the site are still present. Please refer to the attached seismic refraction survey and the following figures for additional site features:

**Figure 2.1.1 Dated 1996**



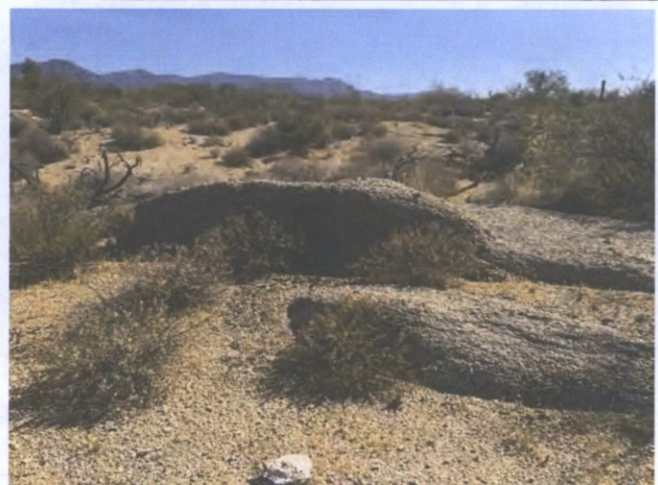
**Figure 2.1.2 Dated 2016**



**Figure 2.1.3 Photo 83<sup>rd</sup> Street Looking South**



**Figure 2.1.3 Typical Rock Out Cropping**



## 2.1 Geologic Conditions

The site is located outside any area that has undergone considerable subsidence due to groundwater removal. Areas of subsidence are known to produce earth fissuring, which has affected areas within several miles of the site. No evidence of earth fissures was observed on the site. Although it is unlikely, it is possible that earth fissures exist at depth and are not visible due to surface disruption on the site. Fissure gullies form over subsurface irregularities such as bedrock highs, which cause tensional stresses and differential subsidence. Where such anomalies are not present, subsidence tends to be uniform over a wide area, this having minimal effect on surficial structures. The closest known earth fissures are located about 15 miles south from this site. Based on local experience, subsidence and earth fissures historically have **not** been a problem in this immediate area.

## 2.2 Seismic Design Parameters

The project area is located in a seismic zone that is considered to have low historical seismicity. The seismicity of the Phoenix area has had only three magnitude 3.0 events in over 100 years. Liquefaction is not considered a concern as groundwater exceeds 15 meters below ground surface.

Although test pits were not advanced to 100 feet, based on the nature of the subsoils encountered in the test pits and geology in the area, Site Class Definition, Class C (Table 1613.5.2, 2006 IBC), or Residential Seismic Design Category B (Table R301.2.2.1.1, 2006 IRC) may be used for design of the structure.

## 2.3 General Subsurface Conditions

A total of 8 test pits were excavated across the site to determine the soil properties. Subsurface conditions at the site are typical for the area and consist generally of a 2-5 feet thick or less surface layer of clayey sand and silty sand underlain by well-graded sand and gravel with varying amounts of silt and clay, locally referred to as decomposed granite (DG). The DG transitions into weathered to competent granitic bedrock at the termination depths of the test pits. Very hard dense caliche layers along with rock out cropping's and core stones were noted throughout the site. The soil density generally increases with depth as evidenced by resistance to excavation. Accordingly competent granitic bedrock will likely be encountered by excavations for the proposed sewer & water line, and/or if deeper excavations are needed to grade the street to finished elevations. No groundwater was encountered during this investigation. Based on visual and tactile observation, the soils were in a 'dry' state at the time of investigation.

In addition to the test pits, nine seismic refraction survey lines were conducted, 6 along Black Mountain Road for the proposed sewer line, and 3 along the proposed access road alignment that will likely include utilities. Based on the survey the decomposed granite and caliche will be marginally rippable and excavations will likely encounter granite bedrock requiring specialized rock breaking equipment or blasting. Please refer to the Seismic Refraction report in the Appendix for more detail.

Laboratory testing indicates liquid limits are on the order of 31 to 41 with plasticity indices on the order of 6 to 19. The upper clayey soils exhibit volume increase (swell) due to wetting ranging from zero to 1.9 percent when re-compacted to moisture and density levels normally expected during construction. This is considered to be low. Due to the dry, granular nature of the native soils, undisturbed samples suitable for testing could not be obtained to evaluate the soil's in-place dry density or consolidation potential. The

material generated from the test pit excavations was typically well-graded angular sand with gravel-sized and occasional cobble-sized rock fragments, and containing a low amount of fines.

### 3.0 ANALYSIS AND RECOMMENDATIONS

#### 3.1 Analysis

Analysis of the field and laboratory data indicates that subsoils at the site are generally favorable for the support of the proposed access drive, infrastructure, and future homes on shallow foundations and slab-on-grade subject to remedial earthworks.

It appears that major grading will be required. Cuts and/or fills on the order of 5 feet ± are anticipated. Depending on grading scheme, it is possible that the structure may be partially supported on the residual soil (native soil or bedrock, and/or fill). Structural damage could occur due to differential movement along interfaces with the different bearing media. **In order to avoid this, a structure should be supported entirely on one bearing medium**, especially in the area of interfaces with fill material and bedrock. Depending on the grading plans, it is highly recommended to place all foundation elements entirely on weathered to competent bedrock or a minimum of 2 feet of engineered fill. Depending on the grading plan this may require slightly deeper than normal footings along portions of the buildings. This could be accomplished by over-excavating the planned footing width to expose the bedrock and backfilling with a lean (500 psi) grout to the proposed bottom of footing elevation. This potential for differential settlement is even greater for footings bearing on rock versus fill. **That combination should be avoided if at all possible** or differential settlement should be taken into account in the design.

Groundwater is not expected to be a factor in the design or construction of shallow foundations and underground utilities. **However it is possible to encounter perched water flows in the unconsolidated soils overlying the weathered bedrock surfaces. There also appears to be a drainage easement along the east side of the property which may receive significant flows. Strong consideration should be given to installing “french drain” interceptors on the uphill side of the lots to collect perched water flows at the bedrock interface to be discharged downhill or into the drainage easements.**

Attention must be paid to provide proper drainage to limit the potential for water infiltration under the homes. Poor drainage will increase the potential for creating perched water on the soil-rock interface causing moisture problems inside the house. A minimum slope of at least 5 percent for a distance of 10 feet away from the structure is recommended in accordance with the Residential Code requirements for unpaved landscaped areas. If this slope cannot be provided, other conveyances are recommended such as roof drains and gutter systems and/or yard drains to direct water away from the structure. Roof drains should

not be allowed to discharge into planters adjacent to the structure and allowed to pond. Irrigated planters adjacent to the structures should be kept at a minimum and/or the use of low water use plants (xeriscape).

The presence of shallow bedrock, cobbles, and boulders may make site preparation, foundation excavation, and utility installations difficult. Weathered rock material may interfere with 'neat' foundation excavations and result in soil disturbance. This may result in concrete overages for foundation pours and/or the need to re-compact soils in the areas disturbed. **Excavation difficulties may be encountered in areas where bedrock is highly competent, and possible within any swimming pool excavation depending on depth.** Rock removal techniques may be required. This may include blasting and/or pneumatic rock hammering.

For exterior slabs-on-grade, frequent jointing is recommended to control cracking and reduce tripping hazards should differential movement occur. It is also recommended to pin the landing slab to the building floor/stem wall. This will reduce the potential for the exterior slab lifting and blocking the operation of out-swinging doors. Pinning typically consists of 24-inch long No. 4 reinforcing steel dowels placed at 12-inch centers.

### 3.2 Site Preparation

The entire area to be occupied by the proposed construction should be stripped of all vegetation, debris, rubble, and obviously loose surface soils. Special attention must be paid to areas where depressions from natural stream channels (washes), or drainage courses are evident. In areas where loose channel deposits occur, the loose material should be removed, generally to a depth of 1 to 2 feet, be re-placed and compacted.

If the engineered fill option is selected, subsoils should be further over-excavated **at least 2 feet** below proposed footing bottom elevation, or existing grade, **whichever is deeper**, extending at least 5 feet beyond the footing edges within all footing areas. The entire building pad does not require over-excavation provided footing lines can be accurately located during grading operations. It may be more feasible to over-excavate the entire building pad since the building footprint is relatively small.

A representative of the Geotechnical Engineer should examine the subgrade once sub-excavation is complete and prior to backfilling to ensure removal of deleterious materials. Fill placement and quality should be as defined in the "Fill and Backfill" section of this report.

All excavations must comply with current governmental regulations including the current OSHA Excavation and Trench Safety Standards. Side slopes for open-cut excavation should be cut back at

1:1 (horizontal:vertical). Steeper slopes may be possible when examined by a responsible party that is capable of evaluating soil classifications for slope stability and the effects of traffic vibration. The slopes should be protected from erosion due to run-off or long-term surcharge at the slope crest. Construction equipment, building materials, excavated soil and vehicular traffic should not be allowed within 10 feet or one-third the slope height, whichever is greater, from the top of slope. The Geotechnical Engineer and/or the contractor's responsible party should observe all cut slopes during excavation. Adjustments to the recommended slopes may be necessary due to wet zones, loose strata and other conditions not observed in the test pits. Localized shoring may also be required. Shotcrete or soil stabilizer on the slope face may be useful in preventing erosion due to run-off and/or drying of the slope. Depending on proximity, existing elements may require shoring, bracing or underpinning to provide structural stability and protect personnel working in the excavation.

Prior to placing engineered fill below footing bottom elevation, the exposed grade should be scarified to a depth of 8 inches, moisture-conditioned to optimum ( $\pm 2$  percent) and compacted to at least 95 percent of maximum dry density as determined by ASTM D-698. Pavement areas should be scarified, moisture-conditioned and compacted in a similar manner.

All cut areas and areas above footing bottom elevation that are to receive floor slab only fill should be scarified 8 inches, moisture conditioned to at least optimum to 3 percent above optimum and lightly but uniformly compacted to 90 but not more than 95 percent of maximum dry density as determined by ASTM D-698.

### **3.3 Foundation Design**

The following bearing capacities can be utilized for design of site walls and preliminary design only for houses:

**Table 3.3.1 Foundation Bearing Capacities**

Structure	Foundation Type	Foundation Depth	Bearing Medium	Bearing Capacity	Comments
Minor Structures	Spread	1.5 ft.	Native Soils	1,500 psf	1,3
Main Structure & Retaining Walls	Spread/Strip	2.0 ft.	Dense Native to Weathered Bedrock	4,000 psf	2,3
	Spread/Strip	1.5 ft.	Engineered Fill	2,500 psf	4,3

Comments:

1. For minor structures such as screen walls, planter walls, box culverts, etc. not connected to any main structure.
2. Shallow spread footings bearing on dense native or weathered bedrock at a minimum depth of 2 feet below existing grade or lowest adjacent finished grade within 5 feet, whichever is greater. If conditions dictate (such as deeper fill zones), the footings may be over-excavated the planned footing width, through any engineered fill, to contact dense native/weathered bedrock, and backfilled with a lean (500 psi) concrete grout back up to the proposed bottom of footing elevation.
3. A scour analysis should be performed to determine the scour depth. Foundation placed adjacent to washes should be deepened at least 2 feet below scour depth unless competent bedrock is encountered. In cases where competent bedrock is encountered foundation depths can be reduced to a nominal 12 inches provided they are doweled into the rock.
4. For building pads that will require mostly fill it is recommended to provide at a minimum of 2 feet of engineered fill below the bottom of foundation throughout the entire structure. This will require some over-excavation on the cut side of the lot.

These bearing capacities refer to the total of all loads, dead and live, and are net pressures. They may be increased one-third for wind, seismic or other loads of short duration. All footing excavations should be level and cleaned of all loose or disturbed materials. Positive drainage away from the proposed buildings **must** be maintained at all times.

Continuous masonry wall footings and isolated rectangular footings should be designed with minimum widths of 16 and 24 inches respectively, regardless of the resultant bearing pressure. Lightly loaded interior partitions (less than 800 plf) may be supported on reinforced thickened slab sections (minimum 12 inches of bearing width and 12 inches deep).

Estimated settlements under design loads are on the order of ½ to ¾ inch, (nil on bedrock) virtually all of which will occur during construction. Post-construction differential settlements will be on the order of one-half the total, under existing and compacted moisture contents. Additional localized settlements

of the same magnitude could occur if native supporting soils were to experience a significant increase in moisture content. **Positive drainage away from structures and controlled routing of roof runoff must be provided and maintained to prevent ponding adjacent to perimeter walls.** Planters requiring heavy watering should **not** be placed adjacent to or within 5 feet of the building. Care should be taken in design and construction to insure that domestic and interior storm drain water is contained to prevent seepage. Roof drainage should be directed to paved areas or storm drains. They should not discharge into planters adjacent to the structures.

Continuous footings and stem walls should be reinforced to distribute stresses arising from small differential movements, and long walls should be provided with control joints to accommodate these movements. **Slab reinforcement and frequent control joints are suggested to allow slight movement and prevent minor floor slab cracking especially in floor areas to be covered with hard tile.**

### 3.4 Lateral Pressures

The following lateral pressure values may be utilized for the proposed construction:

#### Active Pressures

Unrestrained Walls	35 pcf
Restrained Walls	60 pcf

#### Passive Pressures

Continuous Footings	350 pcf
Spread Footings or Drilled Piers	400 pcf
Coefficient of Friction (w/ passive pressure)	0.35
Coefficient of Friction (w/out passive pressure)	0.45
Coefficient of Friction (on Bedrock)	0.70

All backfill must be compacted to not less than 95 percent (ASTM D-698) to mobilize these passive values at low strain. Expansive soils should not be used as retaining wall backfill, except as a surface seal to limit infiltration of storm/irrigation water. The expansive pressures could greatly increase active pressures.

### 3.5 Fill and Backfill

Native soils, after removal of rock larger than 6 inches (3 inches preferred) are considered suitable for use in general grading fills and pad fills. The sandy silty soils may be sensitive to excessive moisture content and will become unstable at elevated moisture content. Accordingly, it may be necessary to compact soils on the dry side of optimum. The reduced moisture content under slabs-on-grade should only be used upon approval of the engineer in the field.

Successful backfill of below-grade walls (such as the anticipated retaining walls) can be difficult to achieve given the sometimes tight access. A well-graded granular import should be specified for backfill of below grade walls. Placement and compaction must be carefully controlled in order to minimize the potential for post construction settlement should the backfill zone be subjected to water infiltration. Even the most well controlled fills could experience additional settlement on the order of 1 inch if subjected to significant moisture increases. Accordingly, consideration should be given to constructing a structural slab over the backfill zone in the most critical areas such as interior slabs or reinforce and pin the landing/entry slabs to the building stem wall to span over the backfill zone. This will reduce the potential for the exterior slab dropping and creating a tripping hazard. Critical areas can be considered to include not only concrete walkways and slabs, but also concrete and asphaltic concrete paving. Paving over wall backfill zones should be detailed to minimize the effects of backfill settlement. Utility lines (especially gravity sewer lines), except for building service connections, should be avoided in this zone.

If imported common fill for use in site grading is required, it should be examined by a Soils Engineer to ensure that it is of low swell potential and free of organic or otherwise deleterious material. In general, the fill should have 100 percent passing the 3-inch sieve and no more than 60 percent passing the 200 sieve. For the fine fraction (passing the 40 sieve), the liquid limit and plasticity index should not exceed 30 percent and 10 percent, respectively. It should exhibit less than 1.5 percent swell potential when compacted to 95 percent of maximum dry density (ASTM D-698) at a moisture content of 2 percent below optimum, confined under a 100 psf surcharge, and inundated.

Fill should be placed on subgrade, which has been properly prepared and approved by a Soils Engineer. Fill must be wetted and thoroughly mixed to achieve optimum moisture content,  $\pm 2$  percent (optimum to +3 percent for under-slab fill). Fill should be placed in horizontal lifts of 8-inch thickness (or as dictated by compaction equipment) and compacted to the percent of maximum dry density per ASTM D-698 set forth as follows:

A.	Building Areas	
1.	Below footing level Fill less than 4 feet thick	95 or 500 psi slurry
2.	Below footing level Fill greater than 4 feet thick	98
3.	Below slabs-on-grade (non-expansive soils)	95
B.	Roadway Pavement Subgrade or Fill	
1.	Fill less than 4 feet thick	95
2.	Fill greater than 4 feet thick	98
C.	Utility Trench Backfill	95
D.	Aggregate Base Course	
1.	Below floor slabs	95
2.	Below asphalt paving	100
E.	Landscape Areas	90

### 3.6 Utilities Installation

Shallow trench excavations can be accomplished by conventional trenching equipment. Deeper excavations encountering weathered granite will be more difficult and may require rock removal techniques. The fact that a test pit was excavated to a certain depth does not mean that the soils may be excavated by normal means. The excavating contractor must make his/her own assessment as to excavatability. Trench walls should stand near-vertical for the short periods of time required to install shallow utilities **although some sloughing may occur in looser and/or sandier soils** requiring laying back of side slopes and/or temporary shoring. Adequate precautions must be taken to protect workmen in accordance with all current governmental regulations.

Backfill of trenches above bedding zones may be carried out with native excavated material provided over-sized material (>3 inches) is first removed. This material should be moisture-conditioned, placed in 8-inch lifts and mechanically compacted. Water settling is **not** recommended. Compaction requirements are summarized in the "Fill and Backfill" section of this report.

### 3.7 Conventional Slabs-on-Grade

To facilitate fine grading operations and aid in concrete curing, a 4-inch thick layer of granular material conforming to the gradation for aggregate base (A.B.) as per M.A.G. Specification Section 702 should be utilized beneath the slab. Dried subgrade soils **must** be re-moistened prior to placing the aggregate base if allowed to dry out, especially if fine-grained soils are used in the top 12-inches of the pad.

The native soils are capable of storing a significant amount of moisture and there is a potential for perched groundwater, which could greatly increase the natural vapor drive through the slab. Accordingly, if moisture sensitive flooring and/or adhesive are planned, the use of a vapor barrier or low permeability concrete should be considered. Vapor barriers should be a minimum 15-mil thick polyolefin (or equivalent), which meets ASTM E 1745 Class A specifications. Vapor barriers do increase the potential for slab curling and water entrapment under the slab. Accordingly, if a vapor barrier is used, additional precautions such as low slump concrete, frequent jointing and proper curing will be required to reduce curling potential and detailed to prevent the entrapment of outside water sources.

### 3.8 Corrosion

Laboratory testing for sulfate contents indicates 3 to 6 ppm. This value represents a negligible potential for sulfate attack on concrete. Subsurface concrete should use Type I or II cement, which is readily available and used in the area with cement content meeting or exceeding residential code requirements. There have been some issues with alkali silica reaction (ASR) in local supplier aggregate sources. Flyash should be allowed/required in the mix to help mitigate ASR.

Chloride concentrations were on the order of 24 to 32 ppm. These results indicate a low to moderate degree of corrosivity to direct buried metal. Chloride concentrations of 500 ppm or greater are considered severely corrosive. Soil pH of 7.6 to 7.7 was measured along with resistivities of 1350 to 2490 Ohm-cm. Accordingly, suitable pipe wall thickness and corrosion protection should be selected per the lifetime requirements of the project.

### 3.9 Asphalt/Concrete Pavement

If earthwork in paved areas is carried out to finish subgrade elevation as set forth herein, the subgrade will provide adequate support for pavements. The following table presents some options for various section and capacities for private residential roadways. The location designation is for reference only. The designer/owner should choose the appropriate sections to meet the anticipated traffic volume and life expectancy. The section capacity is reported as daily ESALs, Equivalent 18 kip Single Axle Loads. Typical heavy trucks impart 1.0 to 2.5 ESALs per truck depending on load. It takes approximately 1,200 passenger cars to impart 1 ESAL.

**Table 3.9.1 Pavement Sections**

Area of Placement	Flexible (AC Pavement)			Rigid (PCC Pavement)	
	Thickness		Daily 18-kip ESALs	Thickness PCCP	Daily 18-kip ESALs
	AC (0.39)	ABC (0.12)			
Driveways and Parking	2.0"	4.0"	4	5.0"	9
Roadways <sup>(3)</sup>	3.0"	4.0"	17	6.0"	23
	3.0"	7.0" <sup>(4)</sup>	55	7.0"	50

**Notes:**

1. Designs are based on AASHTO design equations and ADOT correlated R-Values.
2. The PCCP thickness is increased to provide better load transfer, and reduce potential for joint & edge failures. Design PCCP per ACI 330R-87.
3. Full depth asphalt or increased asphalt thickness can be increased by adding 1.0-inch asphalt for each 3 inches of base course replaced.
4. A pavement section of 3 inches of asphalt on 7 inches of aggregate base course is required to meet the City of Scottsdale minimum guidelines for local public streets.

**Pavement Design Parameters:**

Assume: One 18 kip Equivalent Single Axle Load(ESAL)/Truck  
 Life: 20 years  
 Subgrade Soil Profile:  
     % Passing #200 sieve: 20%  
     Plasticity Index: 19  
     k: 150 pci (assumed)  
     R value: 36 (per ADOT tables)  
     M<sub>R</sub>: 21,700 (per AASHTO design)

These designs assume that all subgrades are prepared in accordance with the recommendations contained in the "Site Preparation" and "Fill and Backfill" sections of this report, and paving operations carried out in a proper manner. If pavement subgrade preparation is not carried out immediately prior to paving, the entire area should be proof-rolled at that time with a heavy pneumatic-tired roller to identify locally unstable areas for repair.

Pavement base course material should be aggregate base per M.A.G. Section 702 Specifications. Asphalt concrete materials and mix design should conform to M.A.G. 710 and meet the City of Scottsdale requirements for public streets. It is recommended that a ½ inch or ¾ inch mix designation be used for the pavements. While a ¾ inch mix may have a somewhat rougher texture, it offers more stability and resistance to scuffing, particularly in truck turning areas. Pavement installation should be carried out under applicable portions of M.A.G. Section 321 and municipality standards. The asphalt supplier should be informed of the pavement use and required to provide a mix that will provide stability and be aesthetically acceptable. Some of the newer M.A.G. mixes are very coarse and could cause placing and finish problems. A mix design should be submitted for review to determine if it will be acceptable for the intended use.

For sidewalks and other areas not subjective to vehicular traffic a 4-inch section of concrete will be sufficient. For trash and dumpster enclosures a thicker section of 6 inches of concrete is recommended.

Portland Cement Concrete Pavement must have a minimum 28-day flexural strength 550 psi (compressive strength of approximately 3,700 psi). It may be cast directly on the prepared subgrade with proper compaction (reduced) and the elevated moisture content as recommended in the report. Lacking an aggregate base course, attention must be paid to using low slump concrete and proper curing, especially on the thinner sections. No reinforcing is necessary. Joint design and spacing should be in accordance with ACI recommendations. Construction joints should contain dowels or be tongue and grooved to provide load transfer. Tie bars are recommended on the joints adjacent to unsupported edges. Maximum joint spacing in feet should not exceed 2 to 3 times the thickness in inches. Joint sealing with a quality silicone sealer is recommended to prevent water from entering the subgrade allowing pumping and loss of support.

Proper subgrade preparation and joint sealing will reduce (but not eliminate) the potential for slab movements (thus cracking) on the expansive native soils. Frequent jointing will reduce uncontrolled cracking and increase the efficiency of aggregate interlock joint transfer.

#### 4.0 GENERAL

The scope of this investigation and report does not include regional considerations such as seismic activity and ground fissures resulting from subsidence due to groundwater withdrawal, or any considerations of hazardous releases or toxic contamination of any type.

Our analysis of data and the recommendations presented herein are based on the assumption that soil conditions do not vary significantly from those found at specific sample locations. Our work has been performed in accordance with generally accepted engineering principles and practice; this warranty is in lieu of all other warranties expressed or implied.

We recommend that a representative of the Geotechnical Engineer observe and test the earthwork and foundation portions of this project to ensure compliance to project specifications and the field applicability of subsurface conditions which are the basis of the recommendations presented in this report. If any significant changes are made in the scope of work or type of construction that was assumed in this report, we must review such revised conditions to confirm our findings if the conclusions and recommendations presented herein are to apply.

Respectfully submitted,  
SPEEDIE & ASSOCIATES, INC.



Keith R. Gravel, P.E.



Gregg A. Creaser, P.E.



**APPENDIX**

**FIELD AND LABORATORY INVESTIGATION**

**SOIL TEST PIT LOCATION PLAN**

**SOIL LEGEND**

**LOG OF TEST PITS**

**TABULATION OF TEST DATA**

**MOISTURE-DENSITY RELATIONS**

**SWELL TEST DATA**

**CORROSIVE TEST DATA**



**SEISMIC REFRACTION REPORT**

## FIELD AND LABORATORY INVESTIGATION

On June 2, 2016, test pits were excavated at the approximate location shown on the attached Soil Test Pit Location Plan. All exploration work was carried out under the full-time supervision of our staff engineer, who recorded subsurface conditions and obtained samples for laboratory testing. The soil test pits were advanced with a standard backhoe with an 18 inch bucket. Detailed information regarding the test pits and samples obtained can be found on an individual Log of Test Pit prepared for each location.

Laboratory testing consisted of grain-size distribution and plasticity (Atterberg Limits) tests for classification. Remolded swell tests were performed on samples compacted to densities and moisture contents expected during construction. All field and laboratory data is presented in this appendix.



-  - APPROXIMATE TEST PIT LOCATIONS
-  - APPROXIMATE SEISMIC LINE LOCATIONS



<b>TEST PIT / SEISMIC LINE LOCATION PLAN</b>				
DR: TSW	REV:	CHK:	DATE: 07/20/16	PROJECT NO. 16100BSA

**B4TH STREET RESIDENTIAL**  
 NWC 84TH STREET & BLACK MOUNTAIN ROAD  
 SCOTTSDALE, ARIZONA
















**SPEEDIE AND ASSOCIATES**  

 GEOTECHNICAL/ENVIRONMENTAL/MATERIALS ENGINEERS  
 3331 E. WOOD ST. PHOENIX, ARIZONA 85040 (602) 997-6391

# SOIL LEGEND

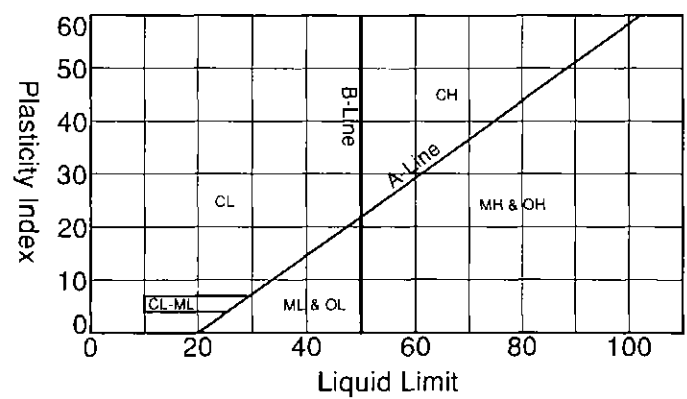
SAMPLE DESIGNATION	DESCRIPTION	
AS	<b>Auger Sample</b>	A grab sample taken directly from auger flights.
BS	<b>Large Bulk Sample</b>	A grab sample taken from auger spoils or from bucket of backhoe.
S	<b>Spoon Sample</b>	Standard Penetration Test (ASTM D-1586) Driving a 2.0 inch outside diameter split spoon sampler into undisturbed soil for three successive 6-inch increments by means of a 140 lb. weight free falling through a distance of 30 inches. The cumulative number of blows for the final 12 inches of penetration is the Standard Penetration Resistance.
RS	<b>Ring Sample</b>	Driving a 3.0 inch outside diameter spoon equipped with a series of 2.42-inch inside diameter, 1-inch long brass rings, into undisturbed soil for one 12-inch increment by the same means of the Spoon Sample. The blows required for the 12 inches of penetration are recorded.
LS	<b>Liner Sample</b>	Standard Penetration Test driving a 2.0-inch outside diameter split spoon equipped with two 3-inch long, 3/8-inch inside diameter brass liners, separated by a 1-inch long spacer, into undisturbed soil by the same means of the Spoon Sample.
ST	<b>Shelby Tube</b>	A 3.0-inch outside diameter thin-walled tube continuously pushed into the undisturbed soil by a rapid motion, without impact or twisting (ASTM D-1587).
--	<b>Continuous Penetration Resistance</b>	Driving a 2.0-inch outside diameter "Bullnose Penetrometer" continuously into undisturbed soil by the same means of the spoon sample. The blows for each successive 12-inch increment are recorded.

CONSISTENCY			RELATIVE DENSITY	
Clays & Silts	Blows/Foot	Strength (tons/sq ft)	Sands & Gravels	Blows/Foot
Very Soft	0 - 2	0 - 0.25	Very Loose	0 - 4
Soft	2 - 4	0.25 - 0.5	Loose	5 - 10
Firm	5 - 8	0.5 - 1.0	Medium Dense	11 - 30
Stiff	9 - 15	1 - 2	Dense	31 - 50
Very Stiff	16 - 30	2 - 4	Very Dense	> 50
Hard	> 30	> 4		

MAJOR DIVISIONS		SYMBOLS		TYPICAL DESCRIPTIONS
		GRAPH	LETTER	
COARSE GRAINED SOILS  MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS  (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
			GP	POORLY-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
	GRAVELS WITH FINES  (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES
			GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
	SAND AND SANDY SOILS  (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
			SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
SANDS WITH FINES  (APPRECIABLE AMOUNT OF FINES)	SANDS AND SANDY SOILS  (LITTLE OR NO FINES)		SM	SILTY SANDS, SAND-SILT MIXTURES
			SC	CLAYEY SANDS, SAND-CLAY MIXTURES
	SANDS AND SANDY SOILS  (LITTLE OR NO FINES)		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
FINE GRAINED SOILS  MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS  LIQUID LIMIT LESS THAN 50		OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
			MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
	SILTS AND CLAYS  LIQUID LIMIT GREATER THAN 50		CH	INORGANIC CLAYS OF HIGH PLASTICITY
		OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS	
HIGHLY ORGANIC SOILS			PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

MATERIAL SIZE	PARTICLE SIZE				
	Lower Limit		Upper Limit		
	mm	Sieve Size ♦	mm	Sieve Size ♦	
SANDS	Fine	0.075	#200	0.42	#40
	Medium	0.420	#40	2.00	#10
	Coarse	2.000	#10	4.75	#4
GRAVELS	Fine	4.75	#4	19	0.75" ✕
	Coarse	19	0.75" ✕	75	3" ✕
COBBLES	75	3" ✕	300	12" ✕	
BOULDERS	300	12" ✕	900	36" ✕	

♦U.S. Standard      ✕Clear Square Openings



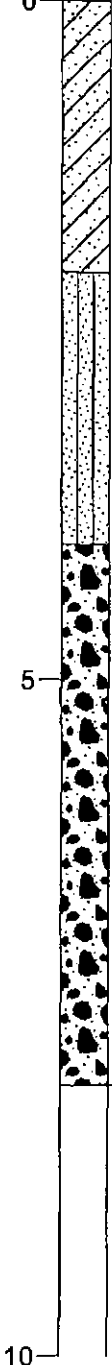
NOTE: DUAL OR MODIFIED SYMBOLS MAY BE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS OR TO PROVIDE A BETTER GRAPHICAL PRESENTATION OF THE SOIL

Depth (feet)

Graphic Log

Equipment Type: **Cat-416B**  
**Backhoe**  
 Surface Elevation: **N/A**  
 Visual Classification

Sample Number	Depth of Sample	Natural Water Content (%)	In-place Dry Density (P.C.F.)	Penetration Resistance Blows per Foot
---------------	-----------------	---------------------------	-------------------------------	---------------------------------------



Reddish Brown CLAYEY SAND (SC-Dry) with Little Gravel

2.0

BS-1

2.0

NT

NT

Light Brown SILTY SAND (SM-Dry) with Some Gravel, Weak to Moderate Calcareous Cementation

4.0

Light Brown WELL GRADED GRAVEL with SILT and SAND (GW/GM-Dry)

8.0

Test Pit Refusal on Bedrock

Excavation Date: **6-2-16**  
 Field Engineer/Technician: **K. Gravel**  
 Excavator: **E. Crain**  
 Contractor: **Geomechanics SW**

**Water Level**

Depth	Hour	Date
<i>Free Water was Not Encountered</i>		

NT = Not Tested

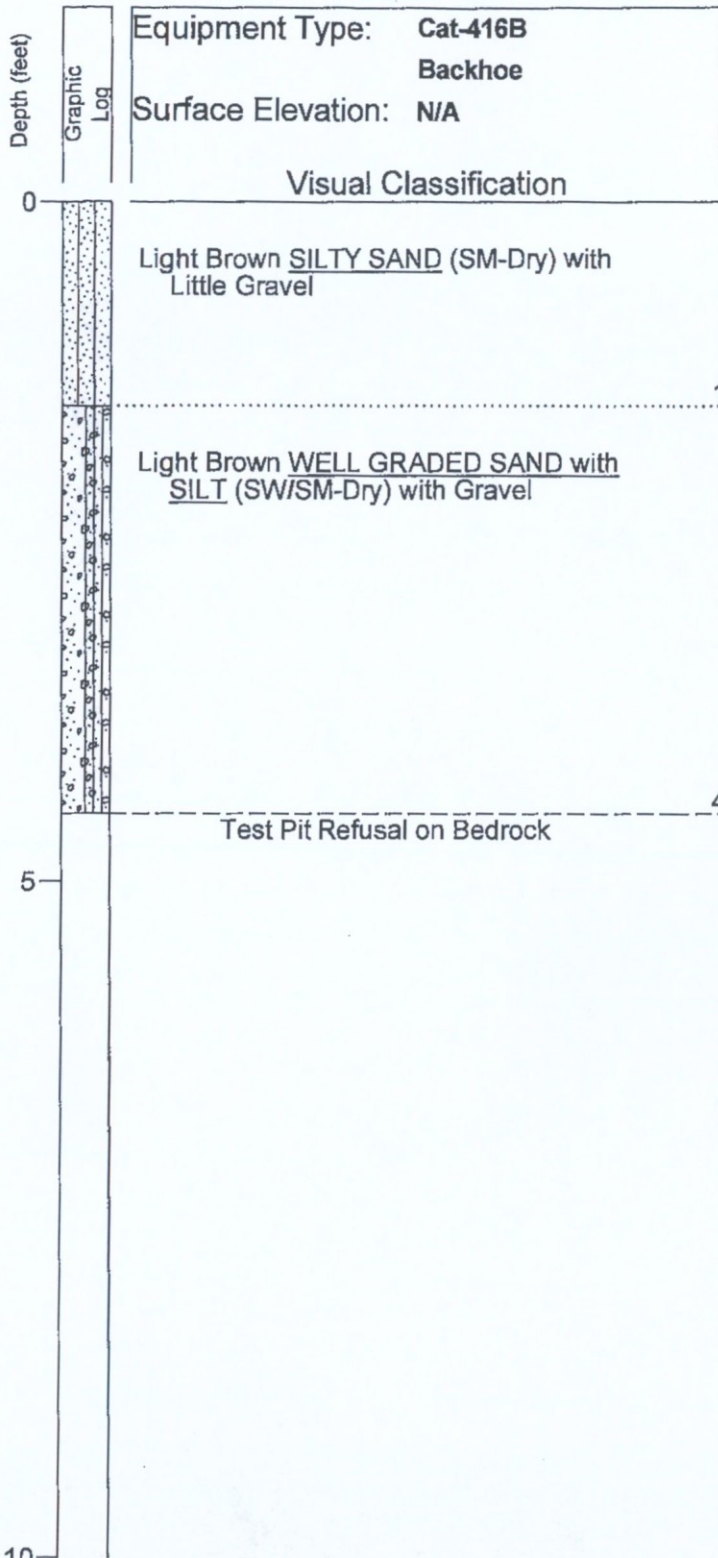
**SPEEDIE AND ASSOCIATES**

Log of Test Pit Number: **TP-1**

**84th Street Residential**  
**NWC 84th Street & Black Mountain Road**  
**Scottsdale, Arizona**

Project No.: **161008SA**

TEST PIT 161008SA.GPJ GENGEO.GDT 6/27/16



Sample Number	Depth of Sample	Natural Water Content (%)	In-place Dry Density (P.C.F.)	Penetration Resistance Blows per Foot
AS-1	3.0	NT	NT	

Excavation Date: **6-2-16**  
 Field Engineer/Technician: **K. Gravel**  
 Excavator: **E. Crain**  
 Contractor: **Geomechanics SW**

Water Level		
Depth	Hour	Date
<i>Free Water was Not Encountered</i>		

NT = Not Tested

**SPEEDIE AND ASSOCIATES**

Log of Test Pit Number: **TP-2**

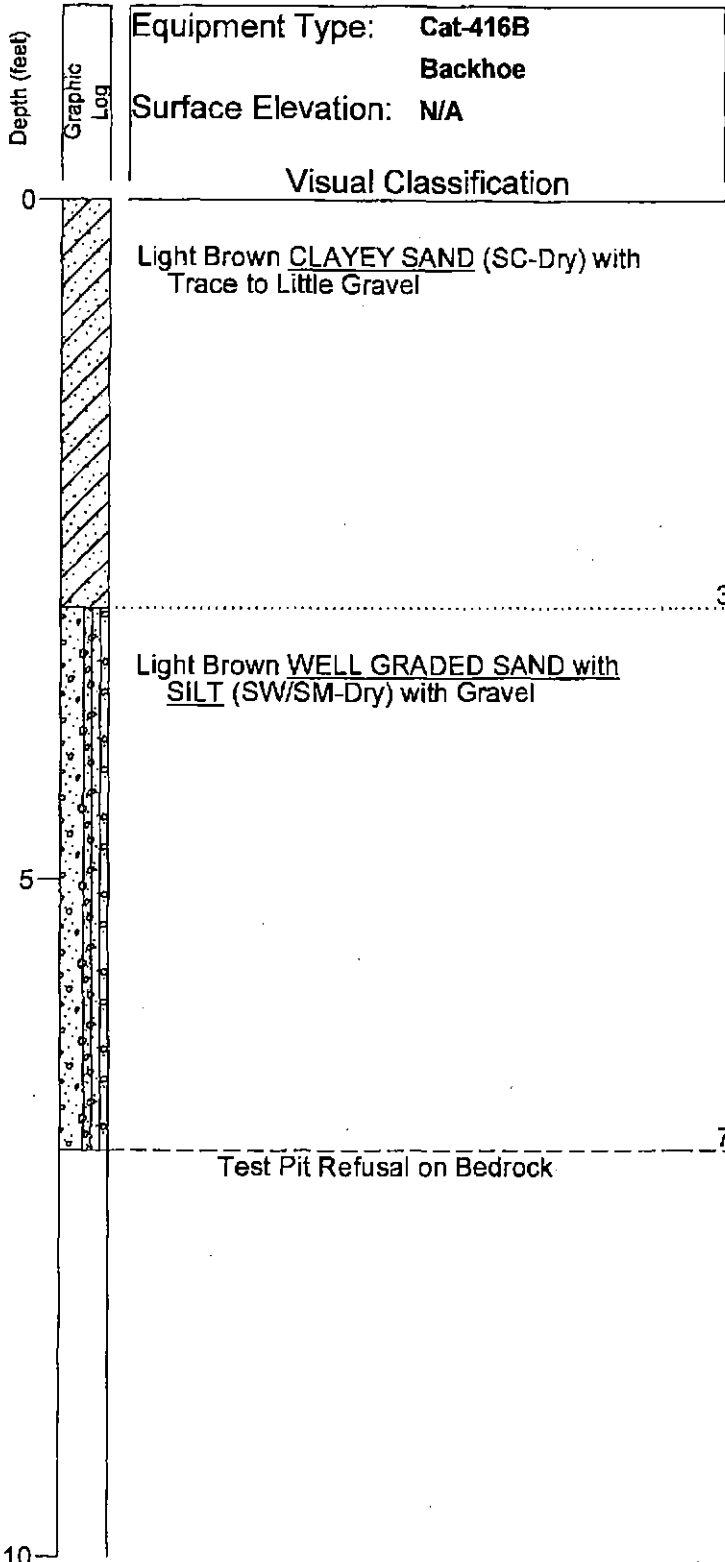
**84th Street Residential**

**NWC 84th Street & Black Mountain Road**

**Scottsdale, Arizona**

Project No.: **161008SA**

TEST PIT 161008SA.GPJ GENGEO.GDT 8/27/16



Sample Number	Depth of Sample	Natural Water Content (%)	In-place Dry Density (P.C.F.)	Penetration Resistance Blows per Foot
				0 28 60

Excavation Date: **6-2-16**  
 Field Engineer/Technician: **K. Gravel**  
 Excavator: **E. Crain**  
 Contractor: **Geomechanics SW**

Water Level		
Depth	Hour	Date
<i>Free Water was Not Encountered</i>		

NT = Not Tested

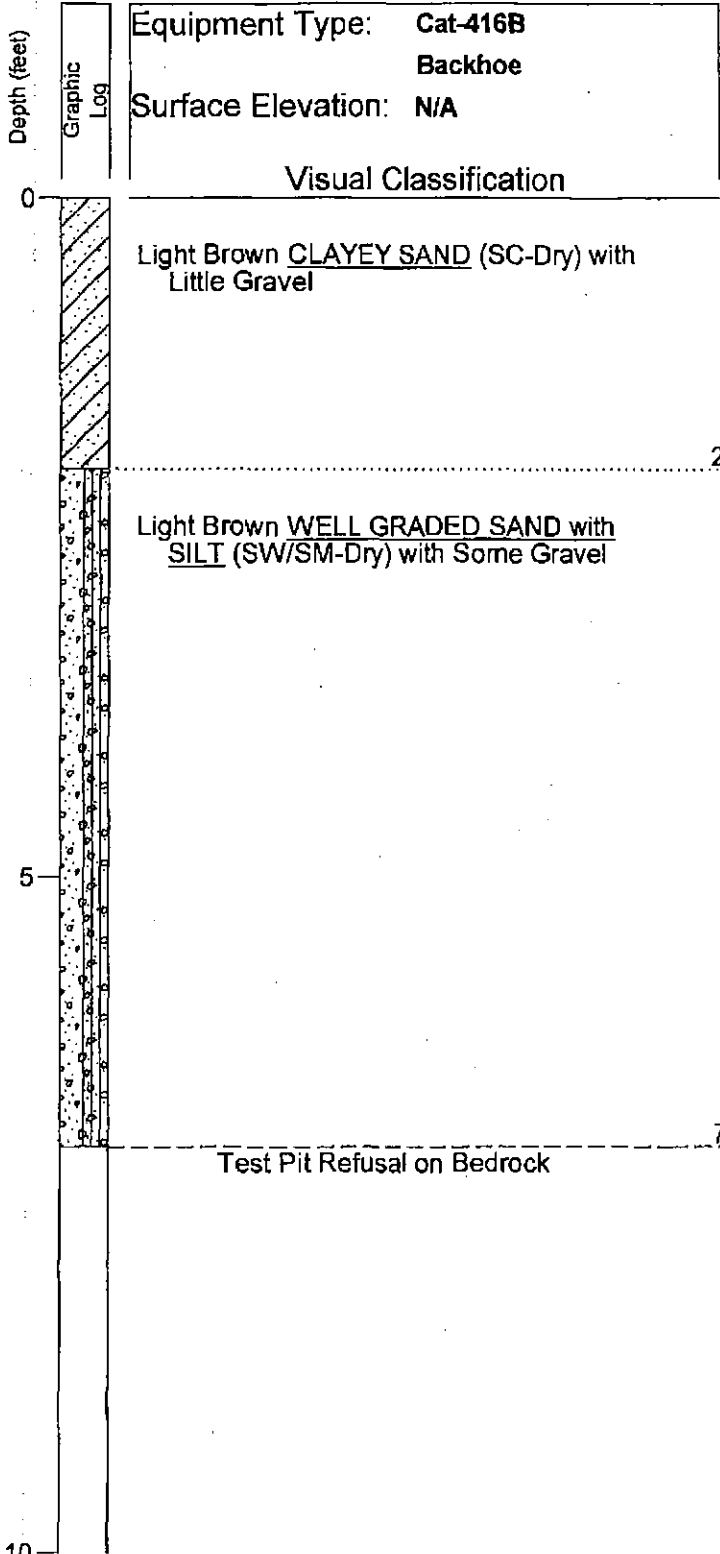
**SPEEDIE AND ASSOCIATES**

Log of Test Pit Number: **TP-3**

**84th Street Residential**  
**NWC 84th Street & Black Mountain Road**  
**Scottsdale, Arizona**

Project No.: **161008SA**

TEST PIT 161008SA.GPJ GENGEO.GDT 6/27/16



Sample Number	Depth of Sample	Natural Water Content (%)	In-place Dry Density (P.C.F.)	Penetration Resistance Blows per Foot
BS-1	6.0	NT	NT	

Excavation Date: 6-2-16  
 Field Engineer/Technician: K. Gravel  
 Excavator: E. Crain  
 Contractor: Geomechanics SW

Water Level

Depth	Hour	Date
Free Water was Not Encountered		

NT = Not Tested

**SPEEDIE AND ASSOCIATES**

Log of Test Pit Number: TP-4

84th Street Residential

NWC 84th Street & Black Mountain Road

Scottsdale, Arizona

Project No.: 161008SA

TEST PIT 161008SA.GPJ GEN GEO.GDT 6/27/16

Equipment Type: **Cat-416B Backhoe**  
 Surface Elevation: **N/A**

Visual Classification  
 Light Brown CLAYEY SAND (SC-Dry) with Strong Calcareous Cementation

Test Pit Refusal on Bedrock 2.3

Sample Number	Depth of Sample	Natural Water Content (%)	In-place Dry Density (P.C.F.)	Penetration Resistance Blows per Foot
				0 25 50

Excavation Date: **6-2-16**  
 Field Engineer/Technician: **K. Gravel**  
 Excavator: **E. Crain**  
 Contractor: **Geomechanics SW**



Water Level

Depth	Hour	Date
<i>Free Water was Not Encountered</i>		

NT = Not Tested

**SPEEDIE AND ASSOCIATES**  
 Log of Test Pit Number: **TP-5**  
**84th Street Residential**  
**NWC 84th Street & Black Mountain Road**  
**Scottsdale, Arizona**  
 Project No.: **161008SA**

TEST PIT 161008SA.GPJ GEN GEO. GDT 6/27/16

Depth (feet)	Graphic Log	Equipment Type: <b>Cat-416B</b> <b>Backhoe</b>	Sample Number	Depth of Sample	Natural Water Content (%)	In-place Dry Density (P.C.F.)	Penetration Resistance Blows per Foot
		Surface Elevation: <b>N/A</b>					
0		Visual Classification					0 26 50
		Light Brown <u>CLAYEY SAND</u> (SC-Dry) with Weak to Moderate Calcareous Cementation					
		2.0	AS-1	2.0	NT	NT	
		Light Brown <u>SILTY SAND</u> (SM-Dry) with Little Gravel					
5		6.0					
		Test Pit Refusal on Bedrock					
10							

Excavation Date: 6-2-16  
 Field Engineer/Technician: K. Gravel  
 Excavator: E. Crain  
 Contractor: Geomechanics SW

Water Level		
Depth	Hour	Date
Free Water was Not Encountered		

NT = Not Tested

**SPEEDIE AND ASSOCIATES**

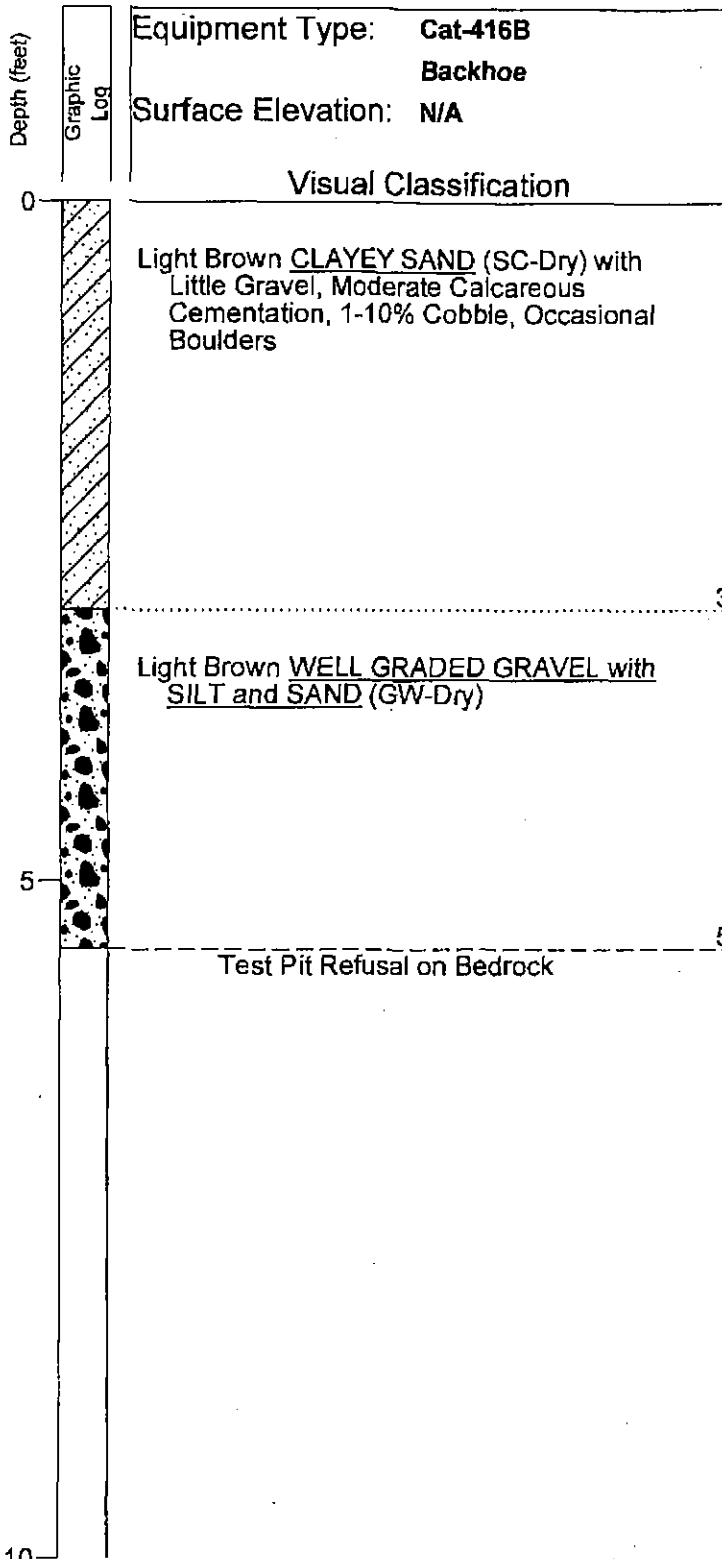
Log of Test Pit Number: TP-6

84th Street Residential  
 NWC 84th Street & Black Mountain Road  
 Scottsdale, Arizona

Project No.: 161008SA

TEST PIT 161008SA.GPJ GENGEO.GDT 6/27/16





Sample Number	Depth of Sample	Natural Water Content (%)	In-place Dry Density (P.C.F.)	Penetration Resistance Blows per Foot
				0 25 50

Excavation Date: **6-2-16**  
 Field Engineer/Technician: **K. Gravel**  
 Excavator: **E. Crain**  
 Contractor: **Geomechanics SW**

Water Level

Depth	Hour	Date
<i>Free Water was Not Encountered</i>		

NT = Not Tested

**SPEEDIE AND ASSOCIATES**

Log of Test Pit Number: **TP-8**

**84th Street Residential**

**NWC 84th Street & Black Mountain Road**

**Scottsdale, Arizona**

Project No.: **161008SA**

TEST PIT 161008SA.GPJ GENGEO.GDT 6/2/16

# TABULATION OF TEST DATA

SOIL BORING or TEST PIT NUMBER	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE INTERVAL (ft)	NATURAL WATER CONTENT (Percent of Dry Weight)	IN-PLACE DRY DENSITY (Pounds Per Cubic Foot)	PARTICLE SIZE DISTRIBUTION (Percent Finer)					ATTERBERG LIMITS			UNIFIED SOIL CLASSIFICATION	SPECIMEN DESCRIPTION
						#200 SIEVE	#40 SIEVE	#10 SIEVE	#4 SIEVE	3" SIEVE	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX		
TP-1	BS-1	BULK	0.0 - 2.0	NT	NT	19.2	31	50	78	NT	41	22	19	SC	CLAYEY SAND with GRAVEL
TP-4	BS-1	BULK	2.0 - 6.0	NT	NT	5.9	19	53	76	100	34	27	7	SW-SM	WELL-GRADED SAND with SILT and GRAVEL
TP-7	BS-1	BULK	0.0 - 3.0	NT	NT	20.5	36	62	83	100	31	25	6	SM	SILTY SAND with GRAVEL

Sieve analysis results do not include material greater than 3". Refer to the actual boring logs for the possibility of cobble and boulder sized materials.

NT=Not Tested  
Sheet 1 of 1

84th Street Residential  
NWC 84th Street & Black Mountain Road  
Scottsdale, Arizona  
Project No. 161008SA

**SPEEDIE  
AND ASSOCIATES**

# MOISTURE-DENSITY RELATIONS

PROJECT: 84th Street Residential

PROJECT NO.: 161008SA

LOCATION: NWC 84th Street & Black Mountain Road

DATE: 6/2/16

BORING NO.: TP-1

SAMPLE NO.: BS-1

SAMPLE DEPTH: 0 to 2

LABORATORY NO.:

METHOD OF COMPACTION: D698A

LIQUID LIMIT: 41

PLASTIC LIMIT: 22

PLASTICITY INDEX:

19

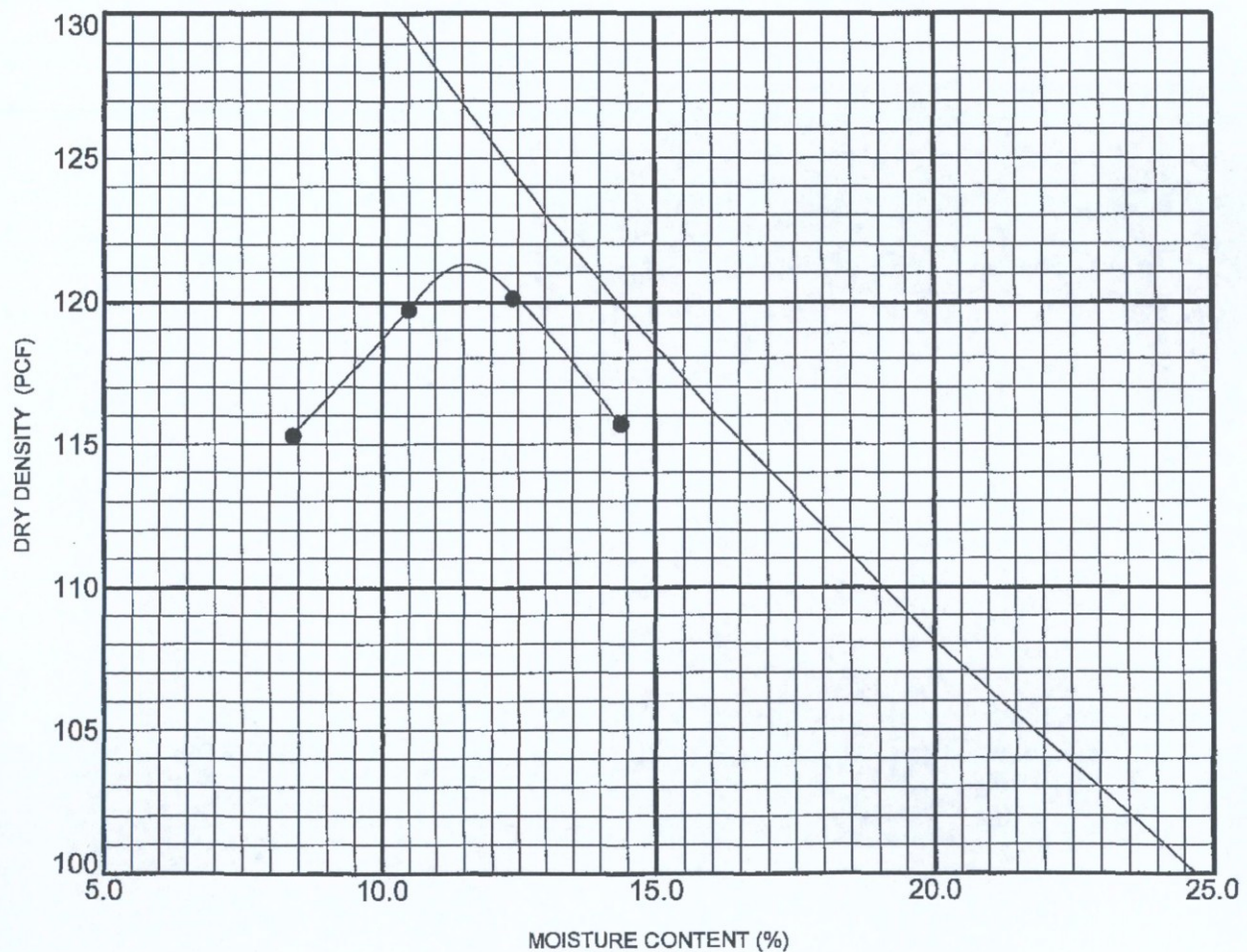
CLASSIFICATION: SC

ASTM SOIL DESCRIPTION:

CLAYEY SAND with GRAVEL

MAXIMUM DRY DENSITY: 121.1 PCF

OPTIMUM MOISTURE CONTENT: 11.6%



**SPEEDIE  
AND ASSOCIATES**

# MOISTURE-DENSITY RELATIONS

PROJECT: 84th Street Residential

PROJECT NO.: 161008SA

LOCATION: NWC 84th Street & Black Mountain Road

DATE: 6/2/16

BORING NO.: TP-4

SAMPLE NO.: BS-1

SAMPLE DEPTH: 2 to 6

LABORATORY NO.:

METHOD OF COMPACTION:

D698A

LIQUID LIMIT: 34

PLASTIC LIMIT: 27

PLASTICITY INDEX: 7

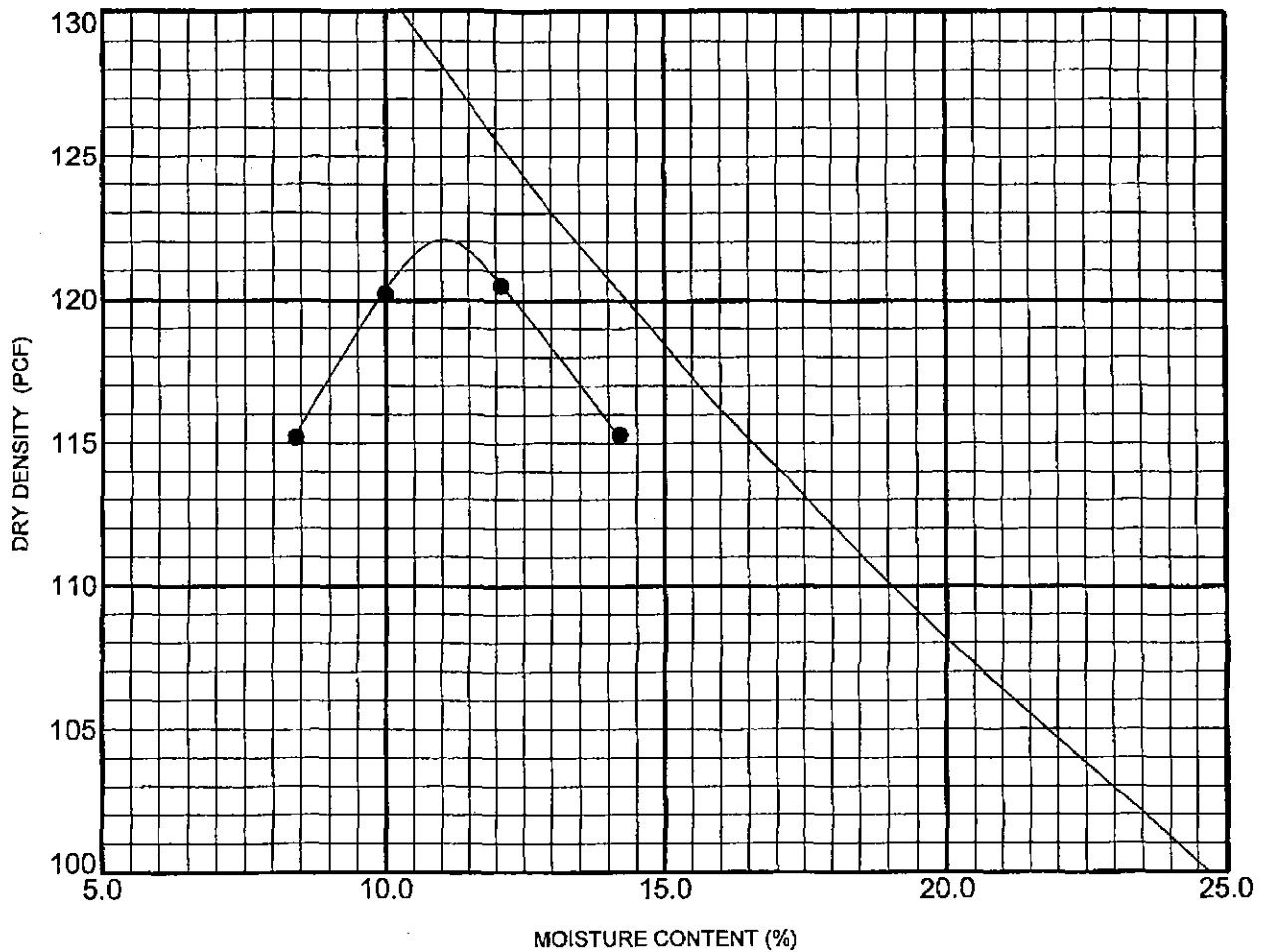
CLASSIFICATION: SW-SM

ASTM SOIL DESCRIPTION:

WELL-GRADED SAND with SILT and GRAVEL

MAXIMUM DRY DENSITY: 122.0 PCF

OPTIMUM MOISTURE CONTENT: 11.0%



**SPEEDIE  
AND ASSOCIATES**

# SWELL TEST DATA

BORING or TEST PIT No.	SAMPLE DEPTH, ft	MAXIMUM DRY DENSITY (pcf)	OPTIMUM MOISTURE CONTENT (%)	REMOLDED DRY DENSITY (pcf)	INITIAL MOISTURE CONTENT (%)	PERCENT COMPACTION	FINAL MOISTURE CONTENT (%)	CONFINING LOAD (psf)	TOTAL SWELL (%)
TP-1, BS-1	2.0	121.1	11.6	115.0	9.9	94.9	14.5	100	1.9
TP-4, BS-1	6.0	122.0	11.0	116.0	9.1	95.1	14.2	100	0.1

# CORROSIVE TEST DATA

SOIL BORING or TEST PIT NUMBER	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE INTERVAL (ft)	PERCENT FINER #200 SIEVE	pH	RESISTIVITY (Ohm-Centimeters)	SULFATE (SO4) (ppm)	CHLORIDE (CL) (ppm)	SULFIDE (+ or -)	REDOX (millivolts)	UNIFIED SOIL CLASSIFICATION	SPECIMEN DESCRIPTION
TP-1	BS-1	BULK	0.0 - 2.0	19.2	7.6	1350	6	32	NT	NT	SC	CLAYEY SAND with GRAVEL
TP-4	BS-1	BULK	2.0 - 6.0	5.9	7.7	2490	3	24	NT	NT	SW-SM	WELL-GRADED SAND with SILT and GRAVEL

84th Street Residential  
 NWC 84th Street & Black Mountain Road  
 Scottsdale, Arizona  
 Project No. 161008SA

SPEEDIE  
AND ASSOCIATES

*Report Prepared for:*

Speedie & Associates  
3331 East Wood Drive  
Phoenix, AZ 85040

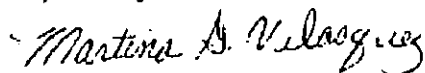
Prepared for: Mr. Kenny Euge  
Project Coordinator

Speedie Project No. 161008SA

*Report Prepared by:*

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Phoenix, Arizona 85021

Prepared by:



Ms. Martina G. Velasquez  
Geologist

Reviewed by:



Mr. Kenneth M. Euge, R.G.  
Principal Geologist

**SEISMIC REFRACTION SURVEY  
84<sup>TH</sup> STREET RESIDENTIAL  
NWC 84<sup>TH</sup> STREET & BLACK MOUNTAIN ROAD  
SCOTTSDALE, ARIZONA**

GCI Project No. 2016-120

July 13, 2016

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- Table B-2 Typical Excavatability Performance in Cemented Soils
- Table B-3 Excavateability of Materials
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**SEISMIC REFRACTION SURVEY  
84<sup>TH</sup> STREET RESIDENTIAL  
NWC 84<sup>TH</sup> STREET & BLACK MOUNTAIN ROAD  
SCOTTSDALE, ARIZONA**

**1.0 INTRODUCTION**

This report presents results of a seismic refraction geophysical field investigation and analysis to assess general subsurface conditions at the 84th Street Residential Project, located on the northwest corner of 84th Street and Black Mountain Road, in Scottsdale, Arizona (Figure 1). Nine seismic refraction survey lines were to be laid out along a proposed roadway to assess the subsurface condition within the alignment (Figures 2a and 2b). The seismic refraction survey lines BM-S1, BM-S2, BM-S3, BM-S4, BM-S5, and BM-S6 were directed toward the east, along Black Mountain Road. Seismic surveys BM-S7, BM-S8, and BM-S9 were approximately located along a proposed roadway alignment within the proposed development area. GM-S7 is located along the north-south roadway alignment in the east portion of the parcel. BM-S8 is located along an east-west segment of the proposed alignment in the north portion of the parcel. BM-S9 is located along a north-south roadway alignment that bisects the west portion of the parcel. The specific seismic survey line locations were selected following a joint reconnaissance of the lot area and discussion between Mr. Kenny Euge, II, Project Coordinator of Speedie & Associates and Mr. Kenneth M. Euge, Sr., R.G. of Geological Consultants Inc. This report is provided to supplement the geotechnical investigation being conducted by Speedie & Associates.

The seismic refraction survey line is underlain by a relatively thin veneer of naturally deposited and reworked alluvial soils derived from a decomposed granite bedrock (Pinnacle Peak Granite) which underlies the project area (Skotnicki, Steven J., et al, 1997). The alluvial soils are loose to dense and unconsolidated to poorly consolidated alluvium that consists of medium to dark reddish orange brown, angular to subangular silty sand with gravel, cemented with caliche at depth. Sheet flow-deposited, angular to subrounded, coarse gravel, pebbles, and cobble-size rock fragments and caliche fragments are locally scattered on top of the alluvial soil surface. The porphyritic granite bedrock pediment is locally exposed and capped with caliche. Based on our interpretation of the seismic survey results, weakly to moderately cemented alluvium and/or moderately to slightly decomposed granite bedrock could be encountered approximately four to thirty-five feet below the existing ground surface, where seismic surveys were conducted. Underlying, slightly weathered to unweathered granite bedrock, may be as little as five feet below the ground surface.

Seismic survey line data are used to develop reasonable interpretations of subsurface conditions within specified areas of the project site. The objectives of the seismic refraction geophysical surveys are to provide for, by indirect means, a higher level of confidence to:

- Indirectly characterize earth fill, natural soil, bedrock, or bedrock-like materials that may be present within and adjacent to the proposed roadway alignment.
- Evaluate the thicknesses of existing soil overburden alluvium and depth to underlying cemented or very dense alluvium, and moderately to slightly weathered and decomposed granitic bedrock.

The general requirements for this project were defined by Mr. Kenny Euge, II, Project Coordinator, of Speedie & Associates. Seismic survey field work for the seismic refraction survey lines was completed on June 14, 2016 (BM-S1, BM-S2, and BM-S3) and June 21, 2016 (BM-S4 through BM-S9).

The Scope of Work performed to accomplish the objectives of this study included:

- Mobilizing and demobilizing personnel and equipment to and from the job site.
- Completion of nine shallow seismic refraction surveys and preliminary field analysis of survey results. Figure 2 depicts the locations of the seismic refraction survey lines.
- A rough position survey using a hand-held GPS receiver to locate the seismic line relative to the site topography and cultural features observed at the site.
- A cursory examination of the residual soil and alluvial deposits exposed within and adjacent to the proposed roadway alignment.
- Computer analysis of field data and interpretation of results was performed to complete the assessment of the materials present, their relative quality and their excavateability.
- Preparation of this report to document the seismic refraction survey, its findings, interpretations, conclusions, and recommendations.

The seismic survey was designed to investigate representative areas along the proposed roadway alignment to address concerns relative to the site soil conditions and to determine the depth of bedrock (if present) that may be encountered at and in the vicinity of excavations proposed at this site, and qualitatively assess the relative ease of excavation of the soils, and bedrock that may be encountered. The effective penetration depth for the seismic refraction survey is estimated to be at least 30 feet below the ground surface. Velocity, thickness, and depth computations of different horizons, or zones, are provided to generally characterize site materials within the depth of interest expected at the project site. No direct subsurface explorations, such as test pits, were made by Geological Consultants Inc. as part of this seismic refraction survey. However, test pit explorations were conducted by Speedie & Associates as part of their geotechnical investigation.

## 2.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the results of the cursory site reconnaissance, seismic surveys, and the data interpretations, the following conclusions and recommendations are provided:

- 2.1 Site Geology:** The 84th Street Residential project area is underlain by soil and bedrock. The naturally deposited and reworked alluvial sediments are medium to dark reddish orange brown, loose to dense, and unconsolidated to poorly consolidated alluvium consisting of silty sand with gravel that is locally overlain with scattered accumulations of coarse gravel, pebbles, and cobble-size, angular to subrounded rock fragments and scattered caliche fragments.

Based on our interpretation of the seismic survey results, the subsurface material can be subdivided into three velocity layers. The top, low velocity layer consists of loose to slightly dense, uncemented to weakly cemented alluvium. The thickness of this layer ranges from zero to approximately 3.8'. The thickness of the middle layer ranges from approximately 4.1' to 35.2', and likely consists of moderately to slightly decomposed granite which may contain very hard granite core stones of variable diameter. The alluvial sediments are underlain by a relatively high velocity layer consisting of hard to very hard porphyritic granite bedrock. This bedrock, an exhumed pediment, is exposed in several areas across the project site where it appears to be caliche capped (Figures 21, 22, and 23).

Excavation of the alluvial soils and moderately to slightly decomposed granite bedrock, if encountered, is expected to be relatively easy to slightly difficult depending on the density and degree of cementation or decomposition of these underlying geologic units. Excavation of the high velocity, slightly weathered to unweathered granite bedrock will be very difficult and may necessitate use of specialized rock breaking equipment or blasting.

- 2.2 Seismic Survey Results:** Interpreted stratigraphy derived from the seismic survey data are depicted in Figures 3, 5, 7, 9, 11, 13, 15, 17, and 19. These figures include the average seismic velocities of the materials encountered along the seismic line, a thickness profile of the different velocity zones, and the calculated velocity zone boundaries. Our interpretations of the geologic materials represented by the measured seismic velocities are summarized in Table 1.

Based on our interpretations of the seismic data, the conclusions presented regarding the depth to various velocity zones are believed to be reasonable at the location of the seismic survey line. The conditions characterized by indirect seismic methods along the seismic survey line probably represent subsurface conditions that could be found within the project site. The calculated depth/velocity ranges are summarized in Table 1.

**Table 1**  
**Seismic Survey Line Calculated Depth/Velocity Ranges**  
**84th Street Residential Project**  
**NEC Lone Mountain Road & Via Cortana Road**  
**Scottsdale Arizona**

Survey Line No.	Depth Range at Shot Point (ft)			Average Seismic Velocity (ft/sec)	Interpreted Geologic Description	Qualitative Rippability
	A	B	C			
BM-S1	0 - 2.9	0 - 2.4	0 - 1.1	1,619	Loose to Slightly Dense, Non-Cemented to Weakly Caliche Cemented Alluvium	Slight
	2.9 - 21.0	2.4 - 17.0	1.1 - 5.2	5,347	Moderately to Strongly Caliche Cemented Alluvium and/or Moderately to Slightly Decomposed Granite Bedrock	Moderate
	21.0±	17.0±	5.2±	9,782	Slightly Weathered to Unweathered Granite Bedrock	Severe
BM-S2	0 - 1.3	0 - 0.9	0 - 0.9	1,000	Loose to Slightly Dense, Non-Cemented to Weakly Caliche Cemented Alluvium	Slight
	1.3 - 10.5	0.9 - 12.0	0.9 - 13.7	3,793	Moderately to Strongly Caliche Cemented Alluvium and/or Moderately to Slightly Decomposed Granite Bedrock	Moderate
	10.5±	12.0±	13.7±	13,064	Slightly Weathered to Unweathered Granite Bedrock	Severe
BM-S3	0 - 1.4	0 - 3.0	0 - 1.9	1,043	Loose to Slightly Dense, Non-Cemented to Weakly Caliche Cemented Alluvium	Slight
	1.4 - 14.7	3.0 - 16.2	1.9 - 11.2	2,897	Moderately to Strongly Caliche Cemented Alluvium and/or Moderately to Slightly Decomposed Granite Bedrock	Slight to Moderate
	14.7±	16.2±	11.2±	7,618	Slightly Weathered to Unweathered Granite Bedrock	Severe
BM-S4	0 - 3.1	0 - 4.0	0 - 2.6	1,452	Loose to Slightly Dense, Non-Cemented to Weakly Caliche Cemented Alluvium	Slight
	3.1 - 26.6	4.0 - 30.7	2.6 - 26.9	3,289	Moderately to Strongly Caliche Cemented Alluvium and/or Moderately to Slightly Decomposed Granite Bedrock	Moderate
	26.6±	30.7±	26.9±	6,006	Slightly Weathered to Unweathered Granite Bedrock	Severe

Survey Line No.	Depth Range at Shot Point (ft)			Average Seismic Velocity (ft/sec)	Interpreted Geologic Description	Qualitative Rippability
	A	B	C			
BM-S5	0 - 0.9	0 - 3.8	Nil	1,481	Loose to Slightly Dense, Non-Cemented to Weakly Caliche Cemented Alluvium	Slight
	0.9 - 11.3	3.8 - 13.3	0 - 10.5	2,056	Loose to Slightly Dense, Non-Cemented to Weakly Caliche Cemented Alluvium	Slight
	11.3±	13.3±	10.5±	10,806	Slightly Weathered to Unweathered Granite Bedrock	Severe
BM-S6	0 - 2.8	0 - 2.5	0 - 2.0	1,133	Loose to Slightly Dense, Non-Cemented to Weakly Caliche Cemented Alluvium	Slight
	2.8 - 16.9	2.5 - 23.6	2.0 - 25.7	4,699	Moderately to Strongly Caliche Cemented Alluvium and/or Moderately to Slightly Decomposed Granite Bedrock	Moderate
	16.9±	23.6±	25.7±	13,063	Slightly Weathered to Unweathered Granite Bedrock	Severe
BM-S7	Nil	0 - 3.0	0 - 2.7	1,757	Loose to Slightly Dense, Non-Cemented to Weakly Caliche Cemented Alluvium	Slight
	0 - 35.2	3.0 - 29.0	2.7 - 24.5	3,576	Moderately to Strongly Caliche Cemented Alluvium and/or Moderately to Slightly Decomposed Granite Bedrock	Moderate
	35.2±	29.0±	24.5±	8,698	Slightly Weathered to Unweathered Granite Bedrock	Severe
BM-S8	0 - 1.8	0 - 1.1	0 - 1.0	1,000	Loose to Slightly Dense, Non-Cemented to Weakly Caliche Cemented Alluvium	Slight
	1.8 - 16.0	1.1 - 9.0	1.0 - 13.4	3,981	Moderately to Strongly Caliche Cemented Alluvium and/or Moderately to Slightly Decomposed Granite Bedrock	Moderate
	16.0±	9.0±	13.4±	7,353	Slightly Weathered to Unweathered Granite Bedrock	Severe
BM-S9	0 - 1.0	0 - 1.5	0 - 1.3	1,000	Loose to Slightly Dense, Non-Cemented to Weakly Caliche Cemented Alluvium	Slight
	1.0 - 8.3	1.5 - 12.7	1.3 - 18.8	3,727	Moderately to Strongly Caliche Cemented Alluvium and/or Moderately to Slightly Decomposed Granite Bedrock	Moderate
	8.3±	12.7±	18.81±	5,886	Moderately to Strongly Caliche Cemented Alluvium and/or Moderately to Slightly Decomposed Granite Bedrock	Moderate to Severe

**2.3 Estimated Rock Strength:** If decomposed bedrock is encountered, this decomposed to moderately weathered granite could be described as "Very Soft Rock" with an estimated unconfined compressive strength between 246 and 435 pounds per square inch (psi) in the low velocity zone (Table B-1). According to the Unified Rock Classification System, the estimated unconfined compressive strength for the decomposed granite that retains the fabric of intact rock is probably less than 1,000 psi. Slightly weathered and decomposed granite bedrock with velocities ranging between 3,935 to 4,920 feet per second could have an unconfined compressive strength ranging from 435 to 1,450 psi. Where encountered, moderately to slightly weathered granite core stones, and the slightly weathered to unweathered granite bedrock could be considered hard to extremely hard rock with high compressive strengths ranging from 1,450 psi at the lower velocities to greater than 10,150 psi at the higher velocities (see Table B-1)

**2.4 Qualitative Rippability / Excavateability:** The estimated qualitative rippability/excavateability summarized in Table 2 is based on the interpretations of the seismic survey data, understanding of the site geological conditions, and professional experience. There is no guarantee that the seismic refraction survey results or the qualitative rippability/excavateability can be duplicated by others. We recommend this information be used with caution and only as guidelines.

Because the seismic velocities used to determine qualitative rippability/excavateability may vary from 10 to 20 percent, and due to the variability of the subsurface material, qualitative rippability/excavateability constraint categories listed in Table 2 may overlap at the transition from one constraint category to the next.

**2.5 Excavation Constraints:** The excavation constraints described in this report (Tables 1 and 2) are, in our opinion, reasonable for the locations where the seismic refraction surveys were conducted. The ultimate excavateability is dependent on many factors (variably cemented soils, cemented gravel to boulder soil zones, presence of large boulder and core stones, bedrock and soil physical properties, excavation methods, size and age of excavation equipment, level of effort applied by the contractor, etc.) and it may not be possible to correlate these factors with the results of the seismic refraction survey conducted for this investigation. The excavation contractor must exercise caution, and assume associated risks, when attempting to extrapolate these data to other areas where seismic surveys have not been conducted. There is no guarantee that the seismic refraction survey results (Table 1) or the qualitative rippability/excavateability (Table 2) can be duplicated by others. We recommend this information be used with caution and only as guidelines.

Prospective contractors or others involved with excavation at this site should review this report along with the excavateability performance charts and tables provided by manufacturers of rock and soil excavating equipment. This information can be used as part of their evaluation criteria for selecting equipment that may be used to excavate or fragment moderately to slightly weathered and unweathered bedrock expected to be

encountered at this site. However, the contractors using these data or making interpretation of this information, for any reason, do so at their sole risk.

The qualitative excavateability summarized in Table 2, along with our interpretation of the subsurface materials (Table 1) are provided so that a prospective contractor can relate seismic velocities to the subsurface materials they can expect to encounter where excavations may be proposed. Although a backhoe may be able to excavate low velocity material and a heavy, hydraulic impact rock breaker attached to a large track-mounted excavator might be able to fragment moderate to high velocity bedrock, strongly cemented zones, or fractured and jointed bedrock material, there are no guarantees due to the wide range of variables summarized herein that effect equipment suitability and material excavateability. Also, the progress of excavation in soils, cemented with caliche to a rock-like consistency and/or bedrock, where encountered, should be expected to be slow. Appendix B contains tables and charts, from various sources, on the rippability/excavateability of various materials.

**Table 2**  
Qualitative Excavateability Relative to Soil/Bedrock Type & P-Wave Velocity  
84th Street Residential Project, Scottsdale, Arizona

Unit	Average Velocity (feet per second)	Excavateability Constraints
Fill/Medium to Coarse Grained, Uncemented to Weakly Cemented Residual and Alluvial Soil & Strongly Decomposed Granite Bedrock	< 3,000	<b>Slight-</b> Should be excavateable using conventional earthmoving equipment. Gravel- to large cobble-size rock fragments could be encountered where the residual soil and alluvium is excavated. If large core stones or boulders are encountered, secondary fragmentation could be necessary. Marginal excavation conditions could be experienced where caliche-cemented alluvium is encountered.
Moderately to Strongly Caliche Cemented Alluvium or Moderately to Slightly Decomposed Granite Bedrock	3,000 to 6,000	<b>Marginal-</b> Potentially difficult to excavate with low horsepower-low torque conventional equipment where moderately to strongly caliche cemented soils and variably weathered granitic bedrock is encountered. Large, blocky, cobble to boulder-size corestones could be generated and could be difficult to excavate. Large rock fragments (boulders, etc.) could require special fragmentation methods such as heavy, high impact energy hydraulic hammers mounted on large track-hoes. Fragmentation could be difficult. Moderate to high horsepower excavation equipment and rippers could improve production where the bedrock is strongly broken; however, production could be slow.

Slightly Weathered to Unweathered Bedrock	> 6,000	<b>Severe-</b> Conventional, low horsepower/torque excavation equipment will likely experience refusal. Where allowed, blasting could be used for effective fragmentation. Very hard, massive or granite bedrock will be very difficult to excavate. Bedrock may be locally rippable using a large tractor such as a D-9, D10, or equivalent, with a single-shank ripper or heavy backhoe/trackhoe with heavy hydraulic impact hammers used along joint and fracture planes. Large boulder-size rock fragments could be generated that could require secondary fragmentation. Production expected to be very slow.
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No site-specific testing has been conducted at this site by Geological Consultants Inc. to verify the qualitative rippability/excavateability categories (Table 2) nor has any equipment performance evaluations been conducted relative to ripping or excavating site materials or to determine equipment suitability for this site. Therefore, the contractor must exercise caution and assume associated risks if the information provided herein is used by the contractor to assist with the determination of equipment suitability for fragmentation or excavation. For an indicator of the rippability and excavateability of the near surface soils and decomposed granite, refer to test pit logs provided in the Speedie & Associates geotechnical report.

- 2.6 Construction Vibration Considerations:** Blasting is not expected to be required at this site to assist with excavation except where high velocity (6,000 feet per second±) slightly weathered to unweathered granite bedrock is encountered. However, if heavy, vibration-producing equipment or blasting is used to assist with the excavations made at this site, the contractor should be required to keep ground vibrations from any construction source within applicable safe limits for surrounding structures including residential buildings and utilities.

We suggest that preconstruction surveys should be considered for all existing structures located within 300 to 500 feet of the proposed excavation areas where heavy construction equipment, such as vibratory compactors, high-energy impact hammers, or blasting, may be used. Likewise, we suggest construction equipment operations be monitored periodically during construction to assure the ground vibrations are within safe limits for the existing structures and utilities. However, we recommend the construction vibration intensities be limited to less than one inch per second for residential areas and for sensitive structures or components such as buried gas and water lines unless more restrictive allowable vibration limits are specified by other regulatory authorities. The purpose of the preconstruction surveys and construction vibration monitoring is to limit liability for property owners, the contractor, and other involved parties. If blasting is used, we recommend the blasting be conducted by a firm with personnel experienced with blasting in similar geological material and site conditions in close proximity to structures.

- 2.7 **Safety**: We recommend adequate "safety zones" be established and maintained around the proposed excavations during construction.
- 2.8 **Slope Stability Considerations**: If the vertical height of any permanent or temporary slopes excavated in close proximity or adjacent to existing structures exceed 5 feet and where the finish slope gradients are steeper than 2:1 (horizontal to vertical) or are steeper than current building and grading code requirements, the contractor must be required to provide shoring or a slope reinforcement/stabilization system, design by registered civil engineer or engineering geologist according to the local or County building code standards and according to the design recommendations provided by a registered civil (geotechnical) engineer or geologist. The purpose of the shoring / stabilization system is to provide permanent and temporary cut slopes or trench slopes will have an adequate factor of safety against failure and to mitigate potential damage to nearby structures.

### 3.0 GEOPHYSICAL SITE INVESTIGATION

The seismic refraction survey was conducted to indirectly investigate subsurface conditions and to develop reasonable interpretations of subsurface conditions.

#### 3.1 Site Specific Seismic Survey

Following the completion of a site reconnaissance to identify the seismic survey locations, seismic refraction surveys (BM-S1, BM-S2, BM-S3, BM-S4, BM-S5, BM-S6, BM-S7, BM-S8, and BM-S9) were made at the locations depicted in Figures 2. The seismic surveys were conducted to evaluate the soil overburden thickness and where possible, identify and characterize fill soil and decomposed granitic bedrock that may be present below existing grades along a proposed roadway alignment, and to characterize the qualitative excavateability of the soil and bedrock, if encountered.

Three shot points were used along the seismic survey line to evaluate possible non-horizontal subsurface boundary conditions (buried sloping surfaces, cementation zones, soil-change boundaries, etc.) that could be expected in this type of geological terrain (Figures 4, 6, 8, 10, 12, 14, 16, 18, and 20), and to improve the accuracy of the seismic wave velocity determinations. The seismic refraction surveys BM-S1 through BM-S9 were run over a total length (120-feet, including shot point offsets) sufficient to achieve adequate depth penetration (of at least 30 feet). The geometry of the seismic survey lines was set up to identify the subsurface layers or zones that could influence excavation proposed at the site.

As with any type of geophysical investigation method, there are limitations to its usefulness and application. Refer to Appendix A for additional information regarding seismic refraction surveys and their limitations.

#### 3.2 Equipment

Travel-time data for the seismic survey was obtained using Geometrics Inc. Model S12 SmartSeis™ 12-Channel Exploration Seismograph. Seismic wave arrivals are detected with digital grade vertical geophones with a dual hum-bucking coil and a frequency response above 14 Hz natural frequency. Geophones were placed beginning at Station 0 and at 10-foot intervals thereafter to the end of the seismic survey line. The seismic shock waves are produced by repeated impacts of a 16-pound sledge hammer onto a soft steel striking plate. Hammer impacts (shots) were made at five-foot offsets from each end of the seismic line traverse and at a shot point located at the center of the survey line spread. The distance from the impact locations (shot points) to the geophones and the travel time recorded for each station is stored in the seismographs onboard computer. If the field seismic data plots indicated the possible presence of anomalous subsurface conditions or spurious noise coincident with the hammer impacts, repeated impacts are used to verify the initial data reading or to correct the data. Topographic features,

outcrops, and other natural features found along the seismic survey lines that might influence the data interpretations are annotated with the field data plots.

### 3.3 Results

Interpretations of the seismic survey data obtained at the project site suggest the presence of a distinctive subsurface stratigraphic profile along the seismic survey line. Seismic velocities, calculated zone thicknesses, and depth to velocity zone boundaries for each interpreted bedrock, rock-like soil, or soil types are summarized in Table 1. The qualitative rippability/excavateability of the rock-like and soil units encountered along the seismic survey lines is summarized in Table 2. The seismic velocity profiles and distance-travel time data plots are depicted in Figures 3, 5, 7, 9, 11, 13, 15, 17, and 19. The depth scale depicted on the Y-axis of the velocity layer cross-sections assumes an arbitrary datum elevation of 100.0 feet. The cross-sections may be used to measure the depths to different velocity layer boundaries below the ground surface at any point along the seismic survey lines. The estimated accuracy of the velocity layer boundaries is approximately 20 percent. Figure 4, 6, 8, 10, 12, 14, 16, 18, and 20 includes photographs taken at the end shot points (A and C) of the seismic survey lines.

#### 4.0 GENERAL LIMITATIONS

The geologic observations, findings, conclusions, and recommendations presented in this report are based on (1) cursory observations of surface conditions and geologic materials where exposed and (2) analysis of the seismic refraction data gathered at the site. The services provided by Geological Consultants Inc. were performed in accordance with generally accepted geological principals and standard practices used by members of the geological profession in this locale at the time of this study.

It must be recognized that subsurface geologic conditions may vary from place to place and from those found at locations where measurements or surveys are made by the investigator. Generalized geological and rippability/excavateability recommendations presented in this report are based on the interpretations of the results of this investigation and it may not be possible for others to accurately correlate the geology and excavateability results to test explorations or investigations conducted by others. No warranty or representation, either expressed or implied, is or should be construed regarding geological conditions at locations other than those evaluated as part of this study.

The professional opinions, conclusions and recommendations presented in this report relate only to the project and locations specified in this report. If any changes are made in the project, the conclusions and/or recommendations in this report shall not be considered valid unless the changes are reviewed and the conclusions and recommendations of this study are modified and approved in writing by Geological Consultants Inc.

## 5.0 BIBLIOGRAPHY

AMEC; 2005; consultants report prepared for City of Phoenix entitled "Refraction Seismic Evaluation, Deer Valley Road-7th Street to Cave Creek Road"; COP Project No. ST85100044, AMEC Job No. 5-119-000199, Report No. 2; 2 September 2005.

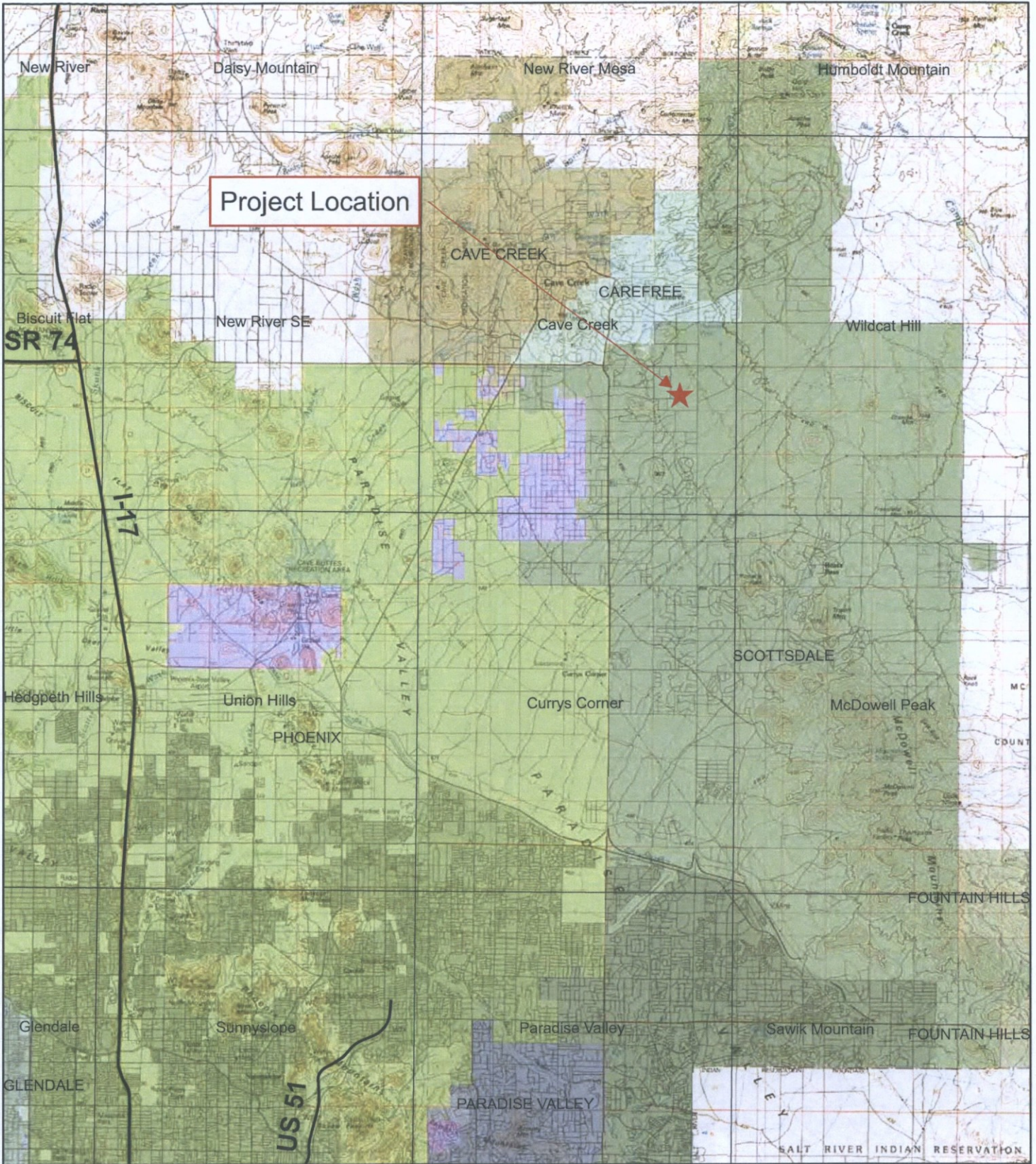
Caterpillar, Inc.; 2013; Caterpillar Performance Handbook, Edition 43; Section 18, Rippers, Seismic Wave Velocity Charts; pp. 18-75 to 18-80.

Weaver, J.M.; 1975; Geological Factors Significant in the Assessment of Rippability; The Civil Engineer in South Africa (Die siviele ingenieur in Suid-Afrika); Volume 17, Issue 12, December 1975; pp. 313-316.

Williamson, D.A.; 1984; Unified Rock Classification System; Bulletin of the Association of Engineering Geologists, Vol. XXI, No. 3, 1984; pp. 345-354.

**FIGURES**

**FIGURES**



**Project Location**

Seismic Refraction Survey  
 84th Street Residential  
 NWC 84th Street & Black Mountain Road  
 Scottsdale, Arizona  
 General Project Location Map  
 Figure 1

2333 West Northern Ave, Suite 1A  
 Phoenix, AZ 85021  
 phone 602-864-1888  
 fax 602-864-1899



Basemap from USGS 30'x60'  
 Phoenix North and Theodore  
 Roosevelt Lake Quadrangle Maps.



**Explanation:**



**BP-S1** Seismic Survey Line Location (approximate)

N



NOT TO SCALE

84th Street Residential  
 NWC 84th Street & Black Mountain Road  
 Seismic Refraction Survey Line  
 Location Map - West  
 Figure 2a



2333 West Northern Ave. Ste 1A  
 Phoenix, Arizona 85021  
 Phone 602-864-1888  
 Fax 602-864-1899



**Explanation:**



**BP-S1**

Seismic Survey Line Location  
(approximate)

N



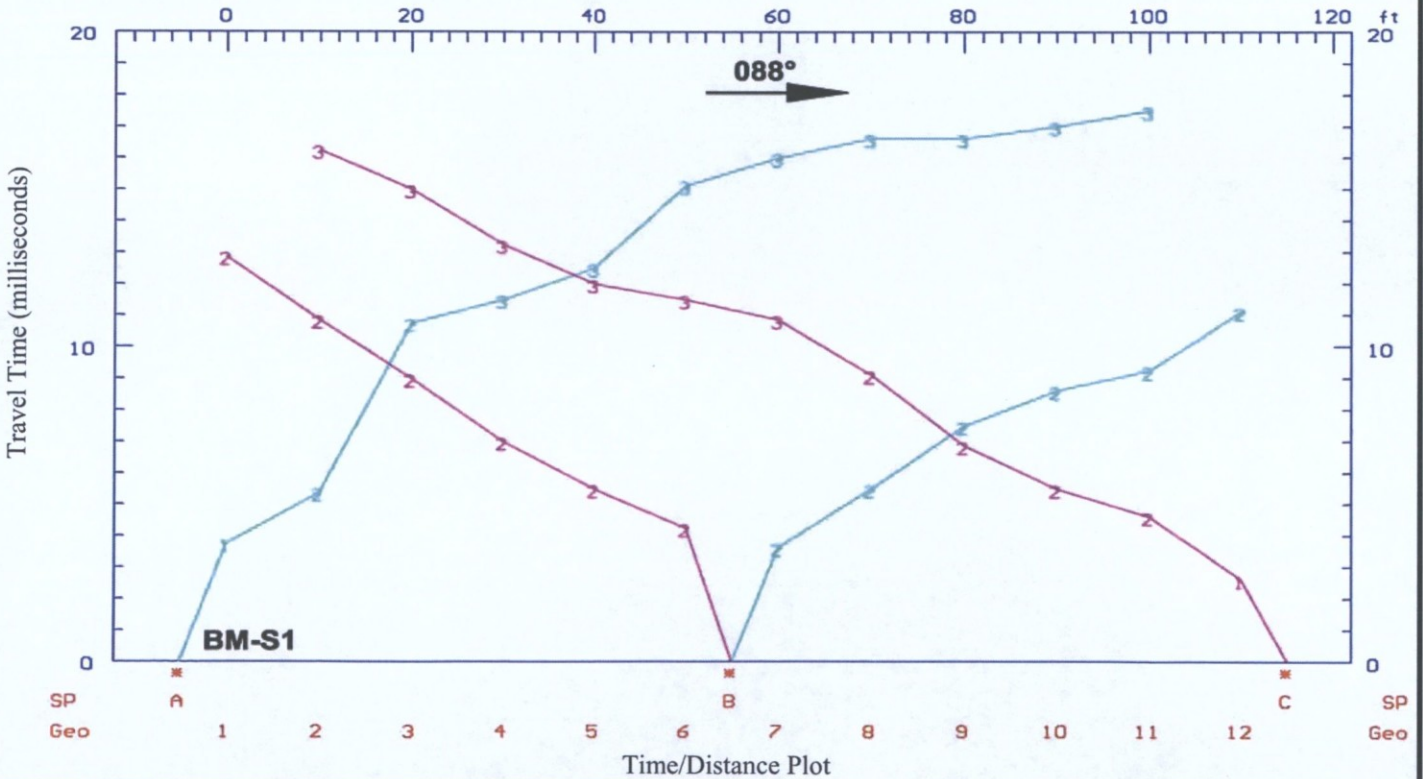
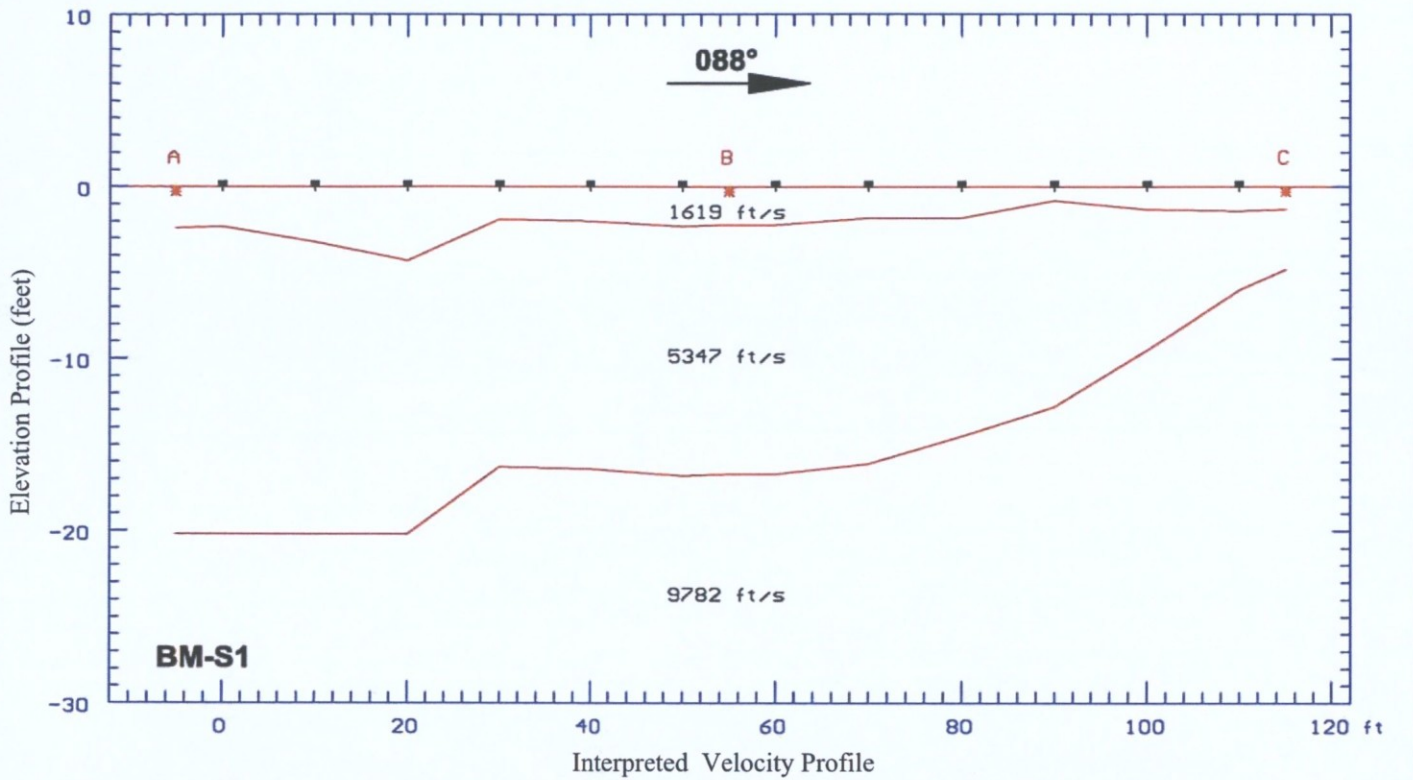
NOT TO SCALE

84th Street Residential  
NWC 84th Street & Black Mountain Road  
Seismic Refraction Survey Line  
Location Map - East  
Figure 2b



Geo-

2333 West Northern Ave. Ste 1A  
Phoenix, Arizona 85021  
Phone 602-864-1888



84th Street Residential  
 NWC 84th Street & Black Mountain Road  
 Seismic Survey BM-S2  
 Velocity Profile & Time-Distance Plot  
 Figure 3

Refer to Figure 2 for seismic survey line location and Figure 4 for photographs of the seismic survey line layout.



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 Ste 1A  
 Phoenix, Arizona 85021  
 Phone 602-864-1888



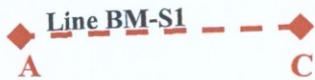
Figure 4; Photo 1: Seismic Survey Line BM-S1 view looking toward the east from Shot Point A toward Shot Point C.



Figure 4; Photo 2: Seismic Survey Line BM-S1 view looking toward the west from Shot Point C toward Shot Point A.

Photographs of seismic survey line CS-S1 taken June 14, 2016 by K. Euge, R.G.; Geological Consultants Inc. Project No. 2016-120.

**Explanation:**

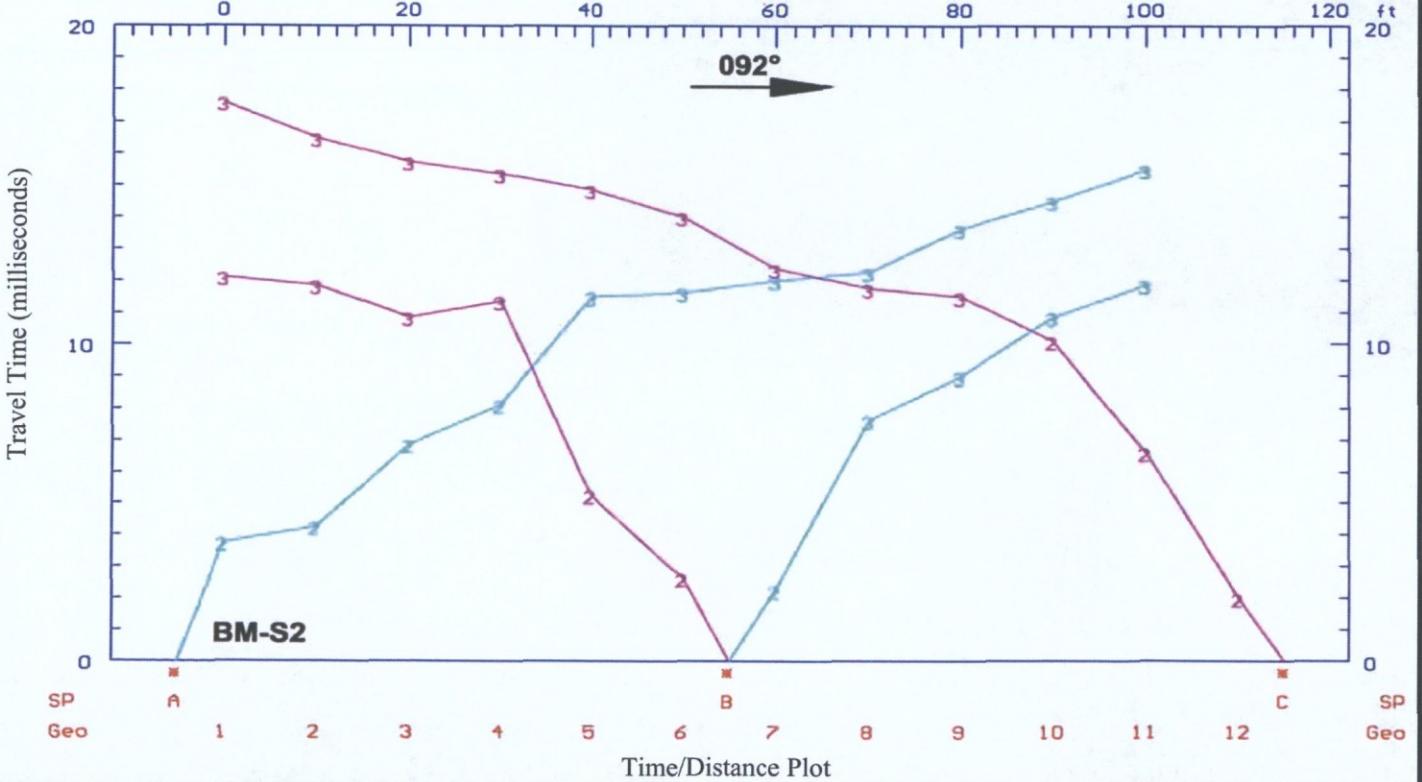
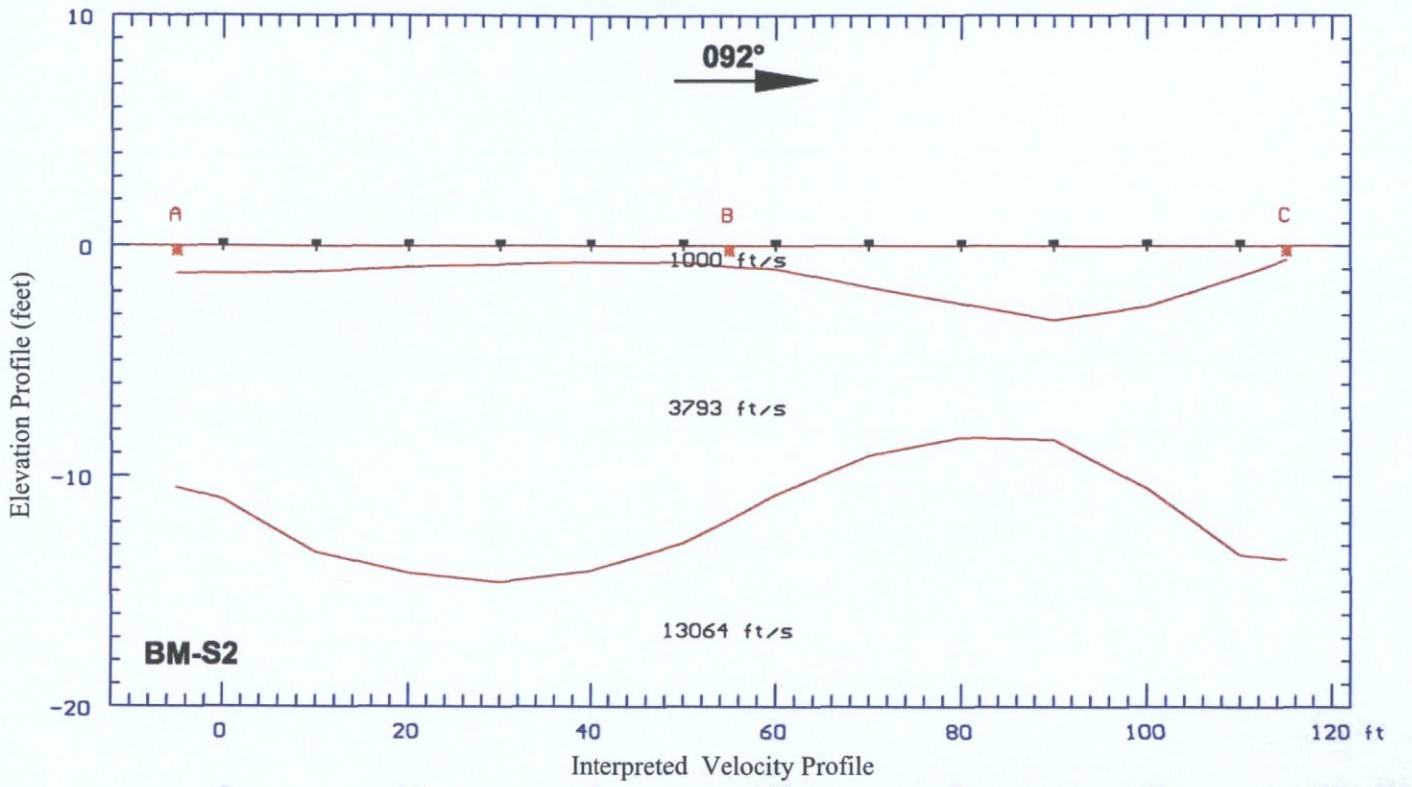


Seismic survey line location: A-shot point start; C-shot point end. Refer to Figure 3 for interpreted seismic line profiles and travel time-distance plot.

84th Street Residential  
NWC 84th Street & Black Mountain Road  
Seismic Survey BM-S1 Photographs  
Figure 4



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Phoenix, Arizona 85021  
Phone 602-864-1888



Refer to Figure 2 for seismic survey line location and Figure 6 for photographs of the seismic survey line layout.

84th Street Residential  
 NWC 84th Street & Black Mountain Road  
 Seismic Survey BM-S2  
 Velocity Profile & Time-Distance Plot  
 Figure 5



2333 West Northern Ave.  
 Ste 1A  
 Phoenix, Arizona 85021  
 Phone 602-864-1888



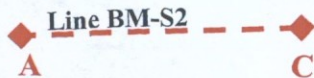
Figure 6; Photo 1: Seismic Survey Line BM-S2 view looking toward the east from Shot Point A toward Shot Point C.



Figure 6; Photo 2: Seismic Survey Line BM-S2 view looking toward the west from Shot Point C toward Shot Point A.

Photographs of seismic survey line BM-S2 taken June 14, 2016 by K. Euge, R.G.; Geological Consultants Inc. Project No. 2016-120.

**Explanation:**



Seismic survey line location: A-shot point start; C-shot point end. Refer to Figure 5 for interpreted seismic line profiles and travel time-distance plot.

84th Street Residential  
 NWC 84th Street & Black Mountain Road  
 Seismic Survey BM-S2 Photographs  
 Figure 6



2333 West Northern Ave. Ste 1A  
 Phoenix, Arizona 85021  
 Phone 602-864-1888

## APPENDIX A SEISMIC REFRACTION SURVEY

### A.1 GENERAL

In general, seismic wave velocities are related to the hardness, consolidation, and density of the materials through which seismic (shock) waves travel. Seismic velocities of subsurface soils and bedrock can be correlated to some of the physical properties of the material with reasonable levels of confidence. As with rock rippability (ease of excavation) for example, the Caterpillar tractor Company has correlated ranges of seismic velocities in different rock and soil materials to qualitative estimates of rippability for their D-9 tractor with a mounted hydraulic No.9 ripper.

The use of seismic velocities measured in various soils and rock types are considered reasonably conservative for evaluating soil and rock characteristics by "indirect" shallow geophysical seismic methods. Some general correlations are as follows:

- Soil, loose surface material, alluvium and strongly weathered and broken bedrock has velocities ranging from 500 feet per second (fps) to 1,200 fps;
- Moderately hard, slightly to moderately cemented, dense alluvial and colluvial sediments and moderately weathered and broken bedrock range from 1,200 fps to 3,000 fps;
- Very dense, hard, well-cemented soils and moderately competent bedrock range from 3,000 fps to 6,000 fps;
- Sound, relatively homogeneous or tightly jointed bedrock and uniformly, strongly cemented soils (silica hardpan, caliche, calcrete, etc.) have seismic velocities greater than 6,000 fps.

Soils and rock with velocities of less than 3,000 fps can usually be excavated with conventional earth moving equipment. Where materials with velocities in excess of 6,000 fps are found, blasting would normally be required for efficient fragmentation. However, if the rock is thinly bedded, jointed, or fractured, it may be possible to break the rock with heavy ripping using a single shank ripper or large ram-hoe. The resulting fragments will be of a size consistent with the fracture spacing and the progress of the excavation would be very slow. The intermediate material (velocities between 3,000 fps and 6,000 fps) would likely require heavy equipment and possibly the localized use of jack- hammers, ram-hoes, or selective blasting to provide cost-effective excavation.

### A.2 DATA COLLECTION

Refraction data were collected along seismic survey lines consisting of 12 geophones spaced 10 feet apart. This geometry provided coverage of about 110 feet along each survey line. Refer to Figure 2 for the seismic survey line locations. Seismic waves were generated at shot points located at line ends and the center to measure shallow materials (near-surface) seismic velocities. Data were recorded from both line ends so the effect of layer inclination, or dip on velocity boundaries, could be calculated. This geometry provided at least 40 feet, or more, of penetration at most line locations.

### **A.3 REFRACTION SEISMIC SURVEY LIMITATIONS**

The seismic survey data presented in this report are derived from and interpreted from an indirect geophysical investigative technique (seismic refraction surveys) employed at the specific locations indicated and from observations made of the surface geologic conditions exposed at the site. The interpretations made at the specific seismic survey sites are believed to be reasonable based on the information available at the time of this study. The interpretations may not represent, nor are they intended to represent, the subsurface condition at other locations.

Geologic contacts between rock and soil units are approximate, may be either gradual or abrupt, and the calculated depths could vary from 10 to 20 percent or more. Geological and geotechnical information provided others and our experience on similar projects in similar geological terrain were considered in the interpretations of subsurface conditions.

### **A.4 REFRACTION DATA PROCESSING**

Seismic Refraction Interpretation Programs (SIP) computer programs by RIMROCK GEOPHYSICS, were used to analyze seismic data obtained in the field. The programs calculate average velocities of any number of layers assuming the multilayered intervals do not include velocity inversions or "hidden" zones (i.e., high velocity zone over a low velocity zone). Thicknesses of each layer, except for the lowermost layer, are calculated along with the dip (inclination) angle of the layer boundary. The depth below the ground surface to each layer boundary is also provided.

Input data, velocity of each layer and seismic wave arrival times, obtained during the field work are checked by the computer program to assure that they satisfy reciprocity at least within 20 percent. These data are used to develop a meaningful geological model used to interpret subsurface stratigraphic conditions.

**APPENDIX B**

**ROCK HARDNESS & EXCAVATION CHARACTERISTICS**

**Tables B-1, B-2, and B-3**

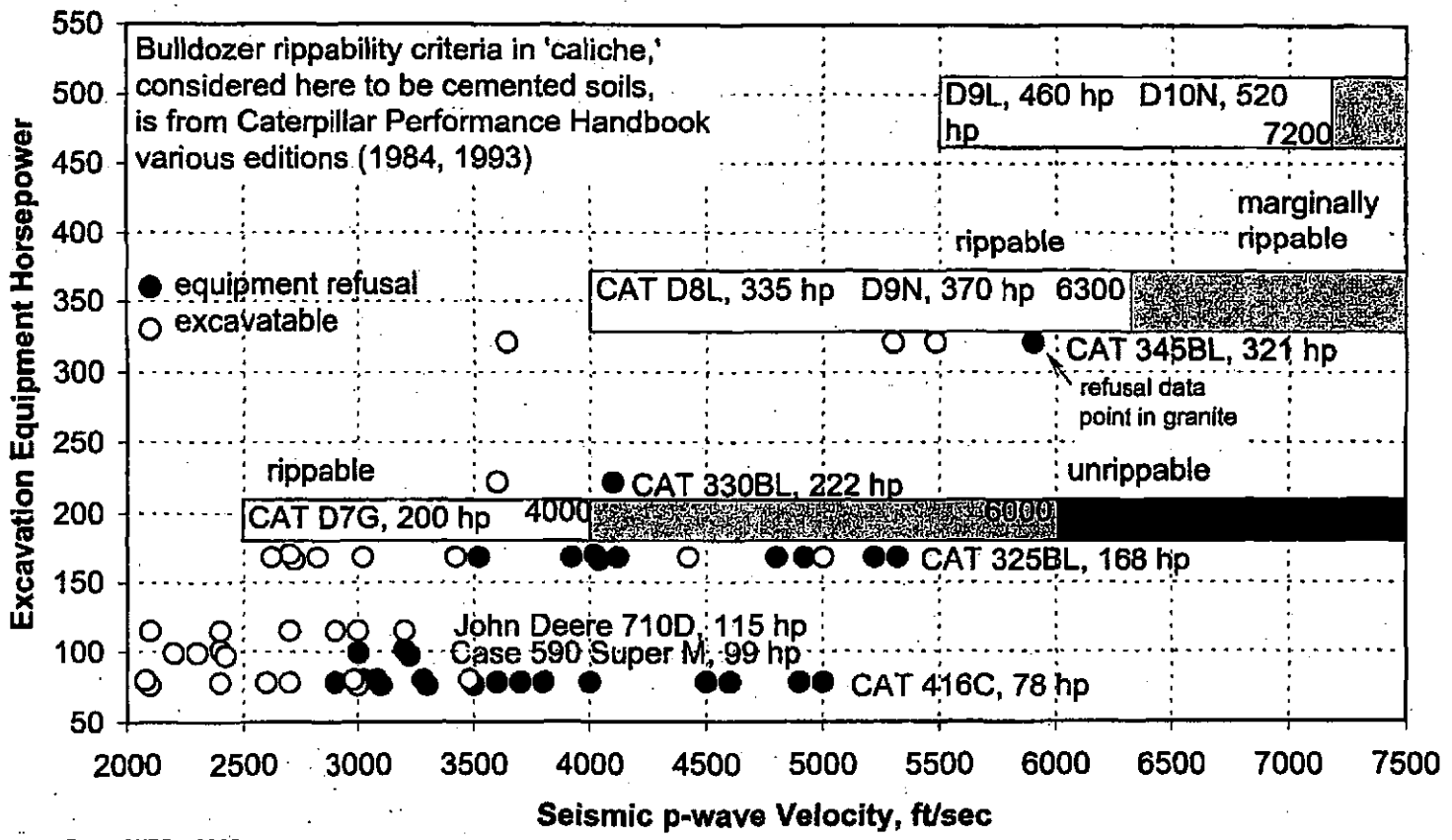
**Table B-1**  
**Rock Hardness & Excavation Characteristics<sup>(1)</sup>**

Rock Hardness Description	Identification Criteria	Unconfined Compressive Strength		Seismic Compression (P-Wave) Velocity		Excavation Characteristics
		MPa	psi	m/s	f/s	
Very Soft Rock	Material crumbles under firm blows with sharp end of geological pick; can be peeled with a knife; too hard to cut a triaxial sample by hand. SPT will refuse. Pieces up to 3-cm thick can be broken by finger pressure.	1.7 - 3.0	246 - 435	450 - 1,200	1,475 - 3,935	Easy Ripping
Soft Rock	Can just be scraped with a knife; indentations 1-mm to 3-mm show in specimen with firm blows of the pick point; has dull sound under hammer.	3.0 - 10.0	435 - 1,450	1,200 - 1,500	3,935 - 4,920	Hard Ripping
Hard Rock	Cannot be scraped with a knife; hand specimen can be broken with a pick with a single firm blow; rock rings under hammer.	10.0 - 20.0	1,450 - 2,900	1,500 - 1,850	4,920 - 6,070	Very Hard Ripping
Very Hard Rock	Hand specimen breaks with a pick after more than one blow; rock rings under hammer	20.0 - 70.0	2,900 - 10,150	1,850 - 2,150	6,070 - 7,050	Extremely Hard Ripping or Blasting
Extremely Hard Rock	Specimen requires many blows with geological pick to break through intact material; rock rings under hammer.	> 70.0	> 10,150	> 2,150	> 7,080	Blasting

Note: (1) Table from Weaver, J.M.; 1975; Geological Factors Significant in the Assessment of Rippability; The Civil Engineer in South Africa (*Die siviele iningenieur in Suid-Afrika*); Volume 17, Issue 12, December 1975; pp. 313-316.

Table B-2  
Typical Excavability Performance in Cemented Soils<sup>(2)</sup>

Figure 1 - Typical Excavability Performance in Cemented Soils for Various Equipment Completing Test Pits in Salt River Valley Area



Note: (2) From Caterpillar, Inc.; 2013; Caterpillar Performance Handbook, Edition 43; Section 18, Rippers, Seismic Wave Velocity Charts; pp. 18-75 to 18-80.

**Table B-3**  
**Excavatability of Materials<sup>(3)</sup>**

**TABLE 1**  
**Approximate Excavatability of Materials**  
**Using Various Ripping & Trenching Equipment**

Material & Range of Marginal Rippability by Seismic Velocity (Cat, 1984; 1993)	Typical Bulldozer Used as Ripper (Cat, 1984; 1993)	Equivalent Backhoe (Kirsten, 1982; 1988)
<b>"Caliche"</b>		
4,000 – 6,000 fps	D7G, 200 HP	235
6,300 – 8,600 fps	D8L, 335 HP	245
6,300 – 8,700 fps	D9N, 370 HP	-
7,200 – 10,300 fps	D9L, 460 HP	RH 40
7,200 – 10,300 fps	D10N, 520 HP	-
7,400 – 10,600 fps	D10, 700 HP	-
7,600 – 11,000 fps	D11N, 770 HP	-
<b>Conglomerate</b>		
4,600 – 5,700 fps	D7G, 200 HP	235
7,600 – 9,300 fps	D8L, 335 HP	245
7,600 – 9,300 fps	D9N, 370 HP	-
8,400 – 10,600 fps	D9L, 460 HP	RH 40
8,400 – 10,600 fps	D10N, 520 HP	-
9,000 – 11,000 fps	D10, 700 HP	-
9,300 – 11,500 fps	D11N, 770 HP	-
<b>Granite</b>		
4,300 – 4,800 fps	D7G, 200 HP	235
6,800 – 8,000 fps	D8L, 335 HP	245
6,800 – 8,000 fps	D9N, 370 HP	-
7,300 – 8,400 fps	D9L, 460 HP	RH 40
7,300 – 8,400 fps	D10N, 520 HP	-
7,800 – 9,000 fps	D10, 700 HP	-
8,100 – 9,500 fps	D11N, 770 HP	-
<b>Schist</b>		
4,300 – 5,300 fps	D7G, 200 HP	235
7,200 – 9,000 fps	D8L, 335 HP	245
7,200 – 9,000 fps	D9N, 370 HP	-
7,700 – 9,500 fps	D9L, 460 HP	RH 40
7,700 – 9,500 fps	D10N, 520 HP	-
8,000 – 10,000 fps	D10, 700 HP	-
8,300 – 10,500 fps	D11N, 770 HP	-

**Note:** Bulldozer and backhoe power are presented by Kirsten (1982, 1988) as a measure of equivalent performance for excavation. The Caterpillar D6D bulldozer and 225 backhoe and D4E/D5B bulldozer and 215 backhoe are considered equivalent. Seismic velocities below marginal indicate that the material is rippable. Seismic velocities above marginal indicate that the material is non-rippable. All velocities are approximate and represent a typical range. See the Caterpillar Performance Handbook (Caterpillar, 1984, 1993 or current edition) for details on use of this information. Different model configurations include variations in weight and horsepower.

From AMEC, 2005

Note: (3) From AMEC; 2005; consultants report prepared for City of Phoenix entitled "Refraction Seismic Evaluation, Deer Valley Road-7th Street to Cave Creek Road"; COP Project No. ST85100044, AMEC Job No. 5-119-000199, Report No. 2; 2 September 2005.

*Solution:*

1. Total Cycle Time =  $3.41 + 0.25 = 3.66$  min  

$$\text{Cycles/hour} = \frac{60 \text{ min/hr}}{3.66 \text{ min/cycle}} = 16.4$$
2. Production per cycle =  $\frac{300 \times 3 \times 2}{27} = 66.7$  BCY/cycle
3. Production =  $66.7 \text{ BCY/cycle} \times 16.4 \text{ cycles/hr} = 1094 \text{ BCY/hour}$
4. Remember results of this method are usually 10 to 20% high.  

$$\begin{aligned} \text{Actual Production} &= 80\% \times 1094 \\ &= 875 \text{ BCY/hr} \\ \text{or } 90\% \times 1094 &= 984 \text{ BCY/hr} \end{aligned}$$
5. Owning and Operating Costs  
 A D10T (ripping only) could have a \$115.00/hr O & O costs including \$30/hr operator
6. Loosening Costs  

$$\begin{aligned} \$115.00/\text{hr} \div 875 \text{ BCY/hr} &= \$0.131/\text{BCY} \\ \$115.00/\text{hr} \div 984 \text{ BCY/hr} &= \$0.117/\text{BCY} \end{aligned}$$
 The loosening cost should range from 11.7¢ to 13.1¢/BCY

• • •

**USE OF SEISMIC VELOCITY CHARTS**

The charts of ripper performance estimated by seismic wave velocities have been developed from field tests conducted in a variety of materials. Considering the extreme variations among materials and even among rocks of a specific classification, the charts must be recognized as being at best only one indicator of rippability.

Accordingly, consider the following precautions when evaluating the feasibility of ripping a given formation:

- Tooth penetration is often the key to ripping success, regardless of seismic velocity. This is particularly true in homogeneous materials such as mudstones and claystones and the fine-grained caliches. It is also true in tightly cemented formations such as conglomerates, some glacial tills and caliches containing rock fragments.

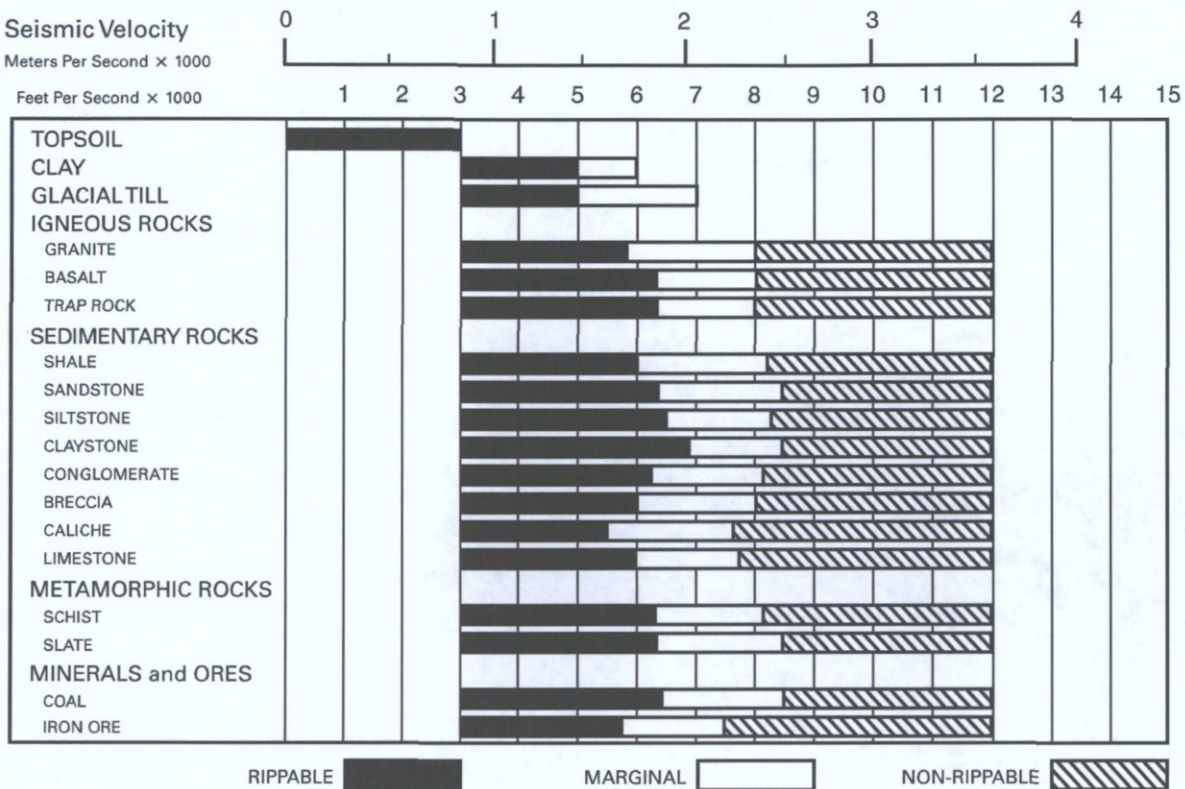
- Low seismic velocities of sedimentaries can indicate probable rippability. However, if the fractures and bedding joints do not allow tooth penetration, the material may not be ripped effectively.
- Pre-blasting or "popping" may induce sufficient fracturing to permit tooth entry, particularly in the caliches, conglomerates and some other rocks; but the economics should be checked carefully when considering popping in the higher grades of sandstones, limestones and granites.

Ripping is still more art than science, and much will depend on operator skill and experience. Ripping for scraper loading may call for different techniques than if the same material is to be dozed away. Cross-ripping requires a change in approach. The number of shanks used, length and depth of shank, tooth angle, direction, throttle position — all must be adjusted according to field conditions. Ripping success may well depend on the operator finding the proper combination for those conditions.

**D8R/D8T**

- Multi- or Single Shank No. 8 Ripper
- Estimated by Seismic Wave Velocities

Seismic Velocity  
 Meters Per Second × 1000  
 Feet Per Second × 1000



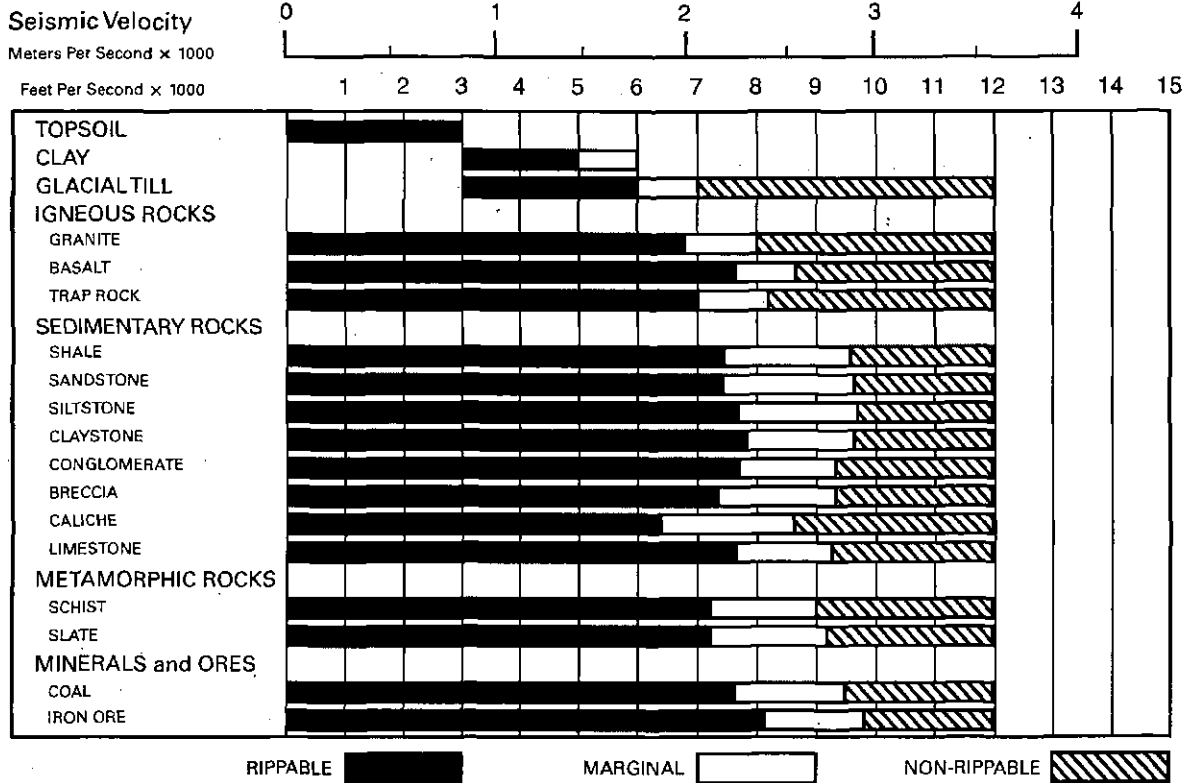
# Rippers

## Ripper Performance

- D9R/D9T

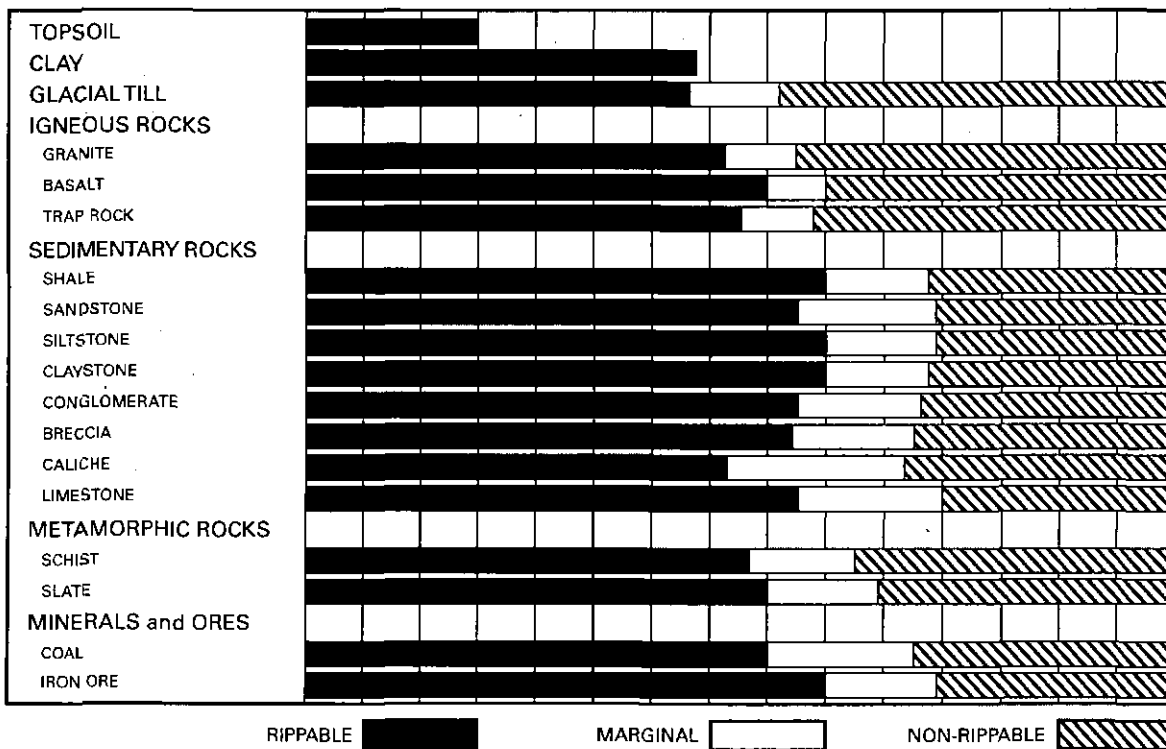
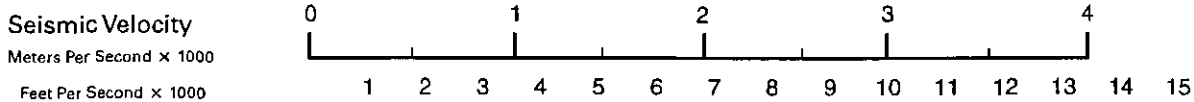
### D9R/D9T

- Multi- or Single Shank No. 9 Ripper
- Estimated by Seismic Wave Velocities



**D10T**

- Multi- or Single Shank No. 10 Ripper
- Estimated by Seismic Wave Velocities



# Rippers

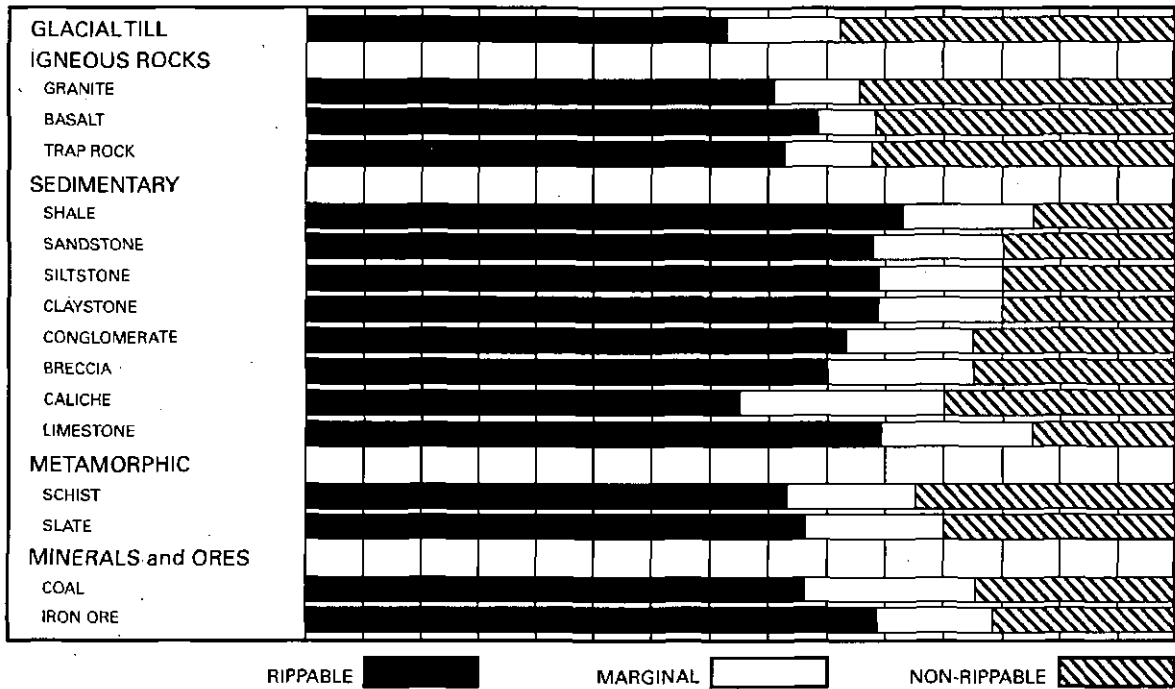
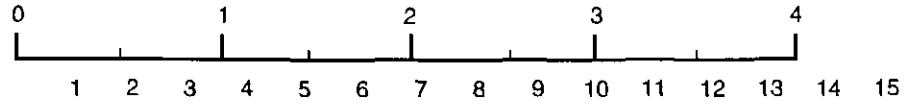
## Ripper Performance

### • D11T

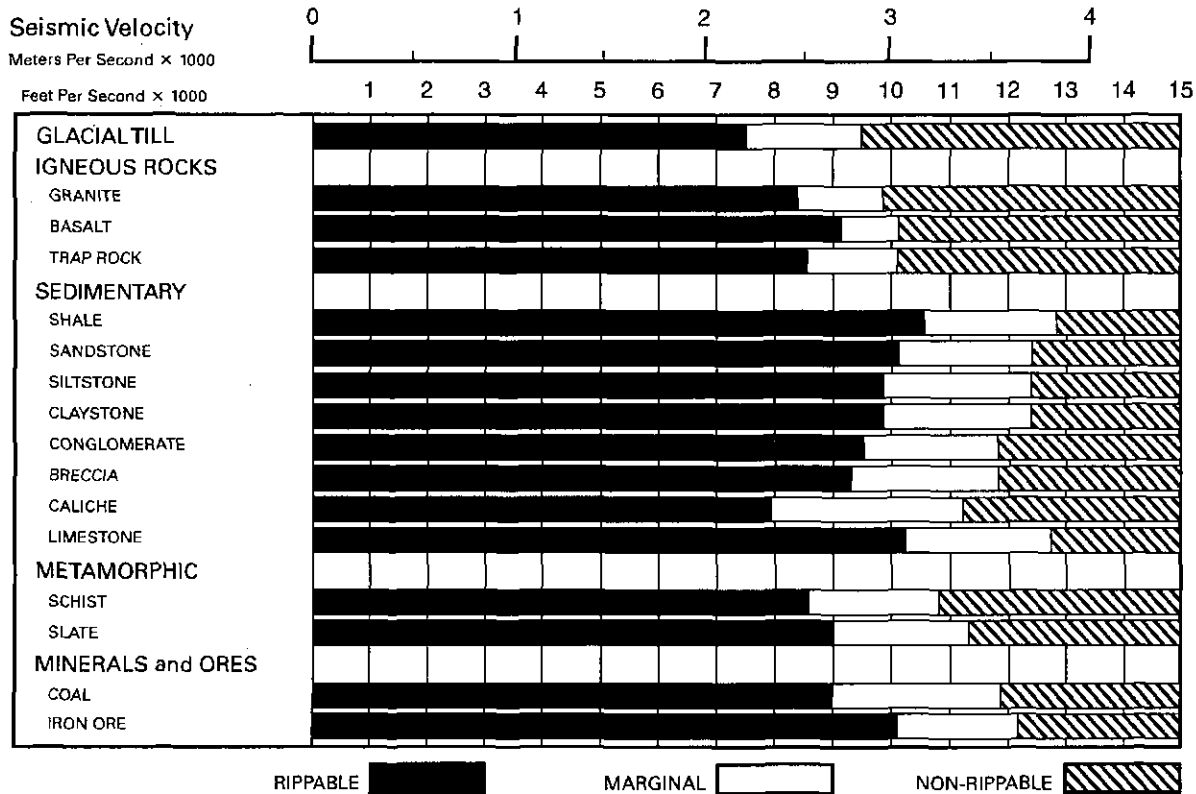
#### D11T

- Multi- or Single Shank No. 11 Ripper
- Estimated by Seismic Wave Velocities

Seismic Velocity  
Meters Per Second × 1000  
Feet Per Second × 1000



**D11T CD**  
 • Single Shank No. 11 Ripper  
 • Estimated by Seismic Wave Velocities



Appendix E – Sandflower Sewer Capacity  
Calculations

Reserve at Black Mountain- Sand Flower Downstream Capacity

Prepared By: Kimley Horn

October 28, 2016

			Existing Sandflower Master Plan				Adding Reserve at Black Mountain			
			Sandflower Calculations			Using Peaking Factor Per AAC Title 18 Ch 9				
Upstream Manhole	Diameter	Slope	DU	Population	d/D	Base Flow (MGD)	Peaking Factor	Peak Flow (MGD)	new d (ft)	new d/D
1	10									
2	10	2.50%	993	2483	0.58	0.558	2.13	1.19	0.43	0.516
3	10	0.70%	993	2483	0.72	0.558	2.13	1.19	0.69	0.828
4	10	0.70%	993	2483	0.72	0.558	2.13	1.19	0.69	0.828
5	10	0.70%	993	2483	0.72	0.558	2.13	1.19	0.69	0.828
6	10	0.70%	993	2483	0.72	0.558	2.13	1.19	0.69	0.828
7	10	0.70%	993	2483	0.72	0.558	2.13	1.19	0.69	0.828
8	10	0.70%	993	2483	0.72	0.558	2.13	1.19	0.69	0.828
9	10	0.70%	861	2153	0.65	0.525	2.17	1.14	0.69	0.828
10	10	0.70%	861	2153	0.65	0.525	2.17	1.14	0.69	0.828
13	10	1.50%	861	2153	0.7	0.525	2.17	1.14	0.49	0.588
14	8	4.87%	20	50	0.08	0.315	3.62	1.14	0.39	0.585
15	8	2.41%	16	40	0.09	0.314	3.62	1.14	0.25	0.375
16	8	1.58%	4	10	0.08	0.311	3.62	1.13	0.25	0.375
17	8	3.20%	3	8	0.06	0.311	3.62	1.12	0.46	0.69
18	8	1.60%	11	28	0.08	0.313	3.62	1.13	0.49	0.735
19	8	1.60%	7	18	0.08	0.312	3.62	1.13	0.49	0.735

Appendix F – Sandflower Sewer Master  
Plan Report

60-48

# WATER AND SEWER MASTER PLAN FOR SANDFLOWER SUBDIVISION

*Prepared For:*

*City of Scottsdale  
7447 East Indian School Road  
Scottsdale, Arizona 85251*

*Prepared by:*

*EVANS, KUHN & ASSOCIATES, INC.  
727 East Bethany Home Road  
Suite D-225  
Phoenix, Arizona 85014*



**EVANS, KUHN & ASSOCIATES, INC.**

*EKA# 3548  
November 17, 1993  
Revised June 24, 1994*

#### IV. SEWER SYSTEM

##### A. Existing Sewer System

The nearest existing City of Scottsdale sewer is the 8" line located at the intersection of Westland Drive and Hayden Road. It is proposed that this development will obtain sewer service by connecting to the system at the 8" line at the intersection of Hayden Road and Westland Drive. This connection would be made by running an 8" line south in the Hayden Road alignment to Westland Drive and connecting to the existing 8" line at that point.

##### B. Sandflower Sewer System

The proposed Sandflower sewer system is shown on Sewer Master Plan. The Sandflower Subdivision sewer system will outfall to the existing system at the intersection of Hayden Road and Westland Drive. Operation and maintenance of the sewer system will be by the City of Scottsdale.

The Sewer System Master Plan shows line sizes, slopes, and inverts at the manhole and cleanout locations. The following table shows the anticipated flows from the development and four off-site areas.

Area of Service	Dwelling Units	Flow Rate, MGD
Sandflower On-site	100	0.1
Off-site Area 1	288	0.3
Off-site Area 2	271	0.3
Off-site Area 3	202	0.2
Off-site Area 4	132	0.1

As the table indicates, the proposed sewer line in Hayden Road has capacity for the above described areas (also shown on MAP I-A). The flows calculated in the table are based on the City of Scottsdale's peak design requirement of 400 gpcd for sewers 12" and less in diameter and that the population density would be 2.5 persons per dwelling unit.

Map I-A, located in Appendix B; indicates the area included in the Sandflower sewer capacity analysis. The areas indicated by triangles and numbered 1, 2, 3 and 4 (also shaded) are the areas included in the Sandflower system analysis. The Sandflower system will be able to accept flows from these areas in the ultimate build-out condition. The Sandflower sewer system was also evaluated for the possibility of only the Sandflower subdivision being developed. Both of these design conditions are contained in Appendix B and show velocities in the Hayden Road line greater than 2 fps. The 10" pipe which is proposed has a slightly lower velocity under the 0.1 MGD flow condition, but allows for the 1.1 MGD ultimate capacity. The construction of a 8" line was also evaluated, but would limit the ultimate capacity of the Hayden Road line to approximately 0.6 MGD or 600 dwelling units. Therefore, the slight increase in velocity does not justify the construction of the 8" line over the proposed 10" line.

# SANDFLOWER SUBDIVISION - SEWER MASTER PLAN

Manhole Number	Invert Elev. ft.	Pipe Slope %	Pipe Length ft.	Pipe Diameter inches	Pipe Capacity MGD	Full Velocity fps	Dwelling Units	People per Dwelling	Required Capacity MGD	Partial Flow Depth inches	Ratio of Depth to Diameter	Partial Flow Area sq. ft.	Partial Perimeter ft.	Partial Velocity fps	Partial Capacity MGD
MH-53	2,483.7	2.10	250	8	1.13	5.02	271	2.5	0.27	2.8	0.35	0.10	0.84	4.12	0.28
MH-52	2,478.3														
CO-1	2,463.5	2.00	135	8	1.10	4.90	3	2.5	0.00	0.6	0.08	0.01	0.37	1.74	0.01
MH-68	2,480.7	1.98	122	8	1.10	4.87	5	2.5	0.01	0.6	0.08	0.01	0.37	1.73	0.01
MH-52	2,478.3														
MH-52	2,478.3	2.10	240	8	1.13	5.02	277	2.5	0.28	2.8	0.35	0.10	0.84	4.12	0.28
MH-51	2,473.2	1.80	225	8	1.05	4.65	278	2.5	0.28	3.0	0.38	0.12	0.88	4.01	0.30
MH-50	2,469.0	1.96	185	8	1.09	4.84	4	2.5	0.00	0.6	0.08	0.01	0.37	1.72	0.01
MH-67	2,472.7														
MH-50	2,469.0														
MH-50	2,469.0	2.30	350	8	1.18	5.25	284	2.5	0.28	2.7	0.34	0.10	0.83	4.25	0.28
MH-49	2,460.9	2.00	130	8	1.10	4.90	2	2.5	0.00	0.3	0.04	0.00	0.26	1.11	0.00
MH-66	2,472.3														
MH-65	2,469.6														
MH-64	2,466.9														
MH-63	2,464.2														
MH-49	2,460.9														
MH-49	2,460.9														
MH-48	2,456.1	2.10	215	8	1.13	5.02	292	2.5	0.29	2.9	0.36	0.11	0.86	4.17	0.29
MH-47	2,451.5	2.10	212	8	1.13	5.02	293	2.5	0.29	2.9	0.36	0.11	0.86	4.17	0.29
MH-46	2,446.9	2.10	285	8	1.13	5.02	294	2.5	0.29	2.9	0.36	0.11	0.86	4.17	0.29
MH-45	2,440.8	2.03	364	8	1.11	4.94	288	2.5	0.29	2.9	0.36	0.11	0.86	4.10	0.29
MH-69	2,448.2														
MH-45	2,440.8														
MH-45	2,440.8	1.00	302	8	0.78	3.46	584	2.5	0.58	5.3	0.66	0.24	1.27	3.77	0.58
MH-44	2,437.7	0.90	291	8	0.74	3.29	586	2.5	0.59	5.5	0.69	0.25	1.30	3.63	0.59
MH-54	2,435.0														
CO-2	2,442.8	2.00	150	8	1.10	4.90	0	2.5	0.00	0.6	0.08	0.01	0.37	1.74	0.01
MH-55	2,439.7	2.00	235	8	1.10	4.90	202	2.5	0.20	2.5	0.31	0.09	0.79	3.74	0.21
MH-62	2,473.3														
MH-61	2,468.5														
MH-60	2,463.9														
MH-61	2,468.5	2.00	225	8	1.10	4.90	204	2.5	0.20	2.5	0.31	0.09	0.79	3.74	0.21
MH-60	2,463.9	2.00	199	8	1.10	4.90	207	2.5	0.21	2.5	0.31	0.09	0.79	3.74	0.21

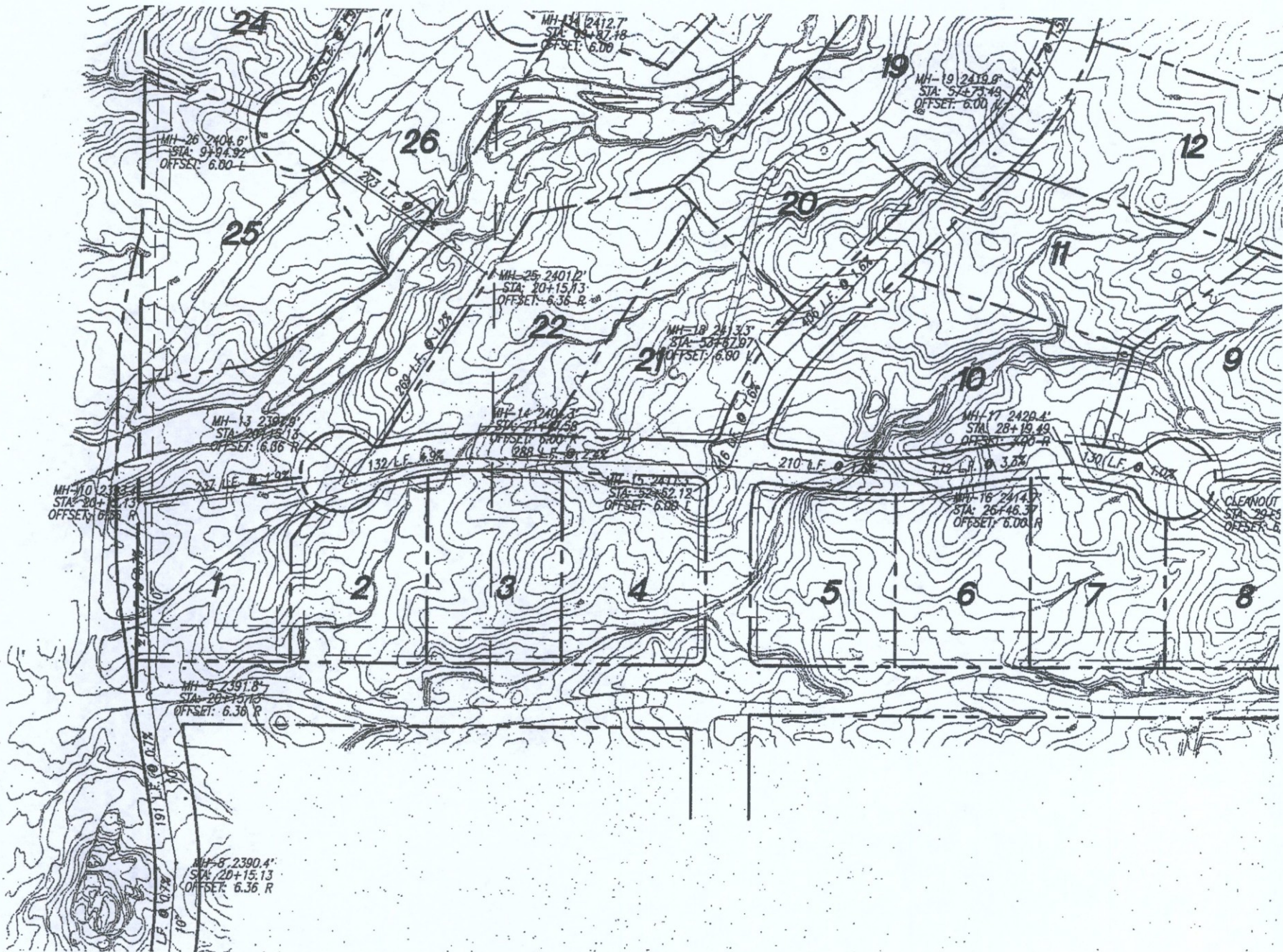
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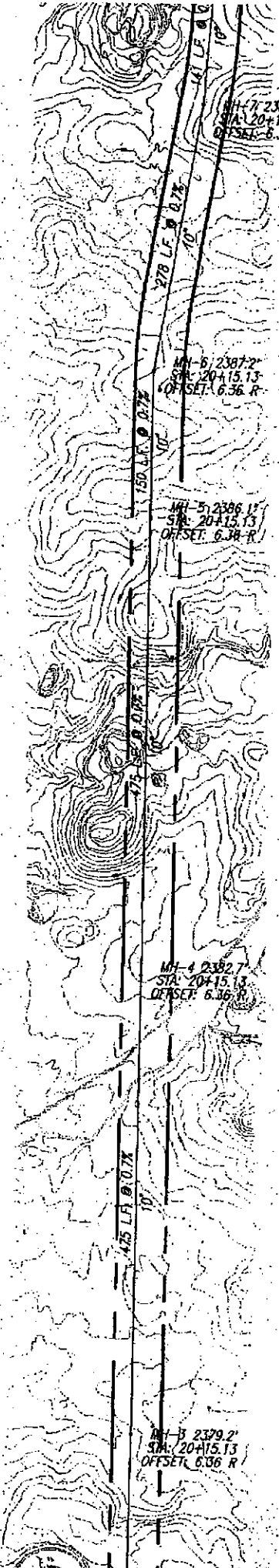
# SANDFLOWER SUBDIVISION - SEWER MASTER PLAN

Manhole Number	Invert Elev. ft.	Pipe Slope %	Pipe Length ft.	Pipe Diameter inches	Pipe Capacity MGD	Full Velocity fps	Dwelling Units	People per Dwelling	Required Capacity MGD	Partial Flow Depth inches	Ratio of Depth to Diameter	Partial Flow Area sq.ft.	Partial Perimeter ft.	Partial Velocity fps	Partial Capacity MGD
MH-59	2,459.9	2.00	105	8	1.10	4.90	210	2.5	0.21	2.5	0.31	0.09	0.79	3.74	0.21
MH-58	2,457.7	2.00	467	8	1.10	4.90	211	2.5	0.21	2.5	0.31	0.09	0.79	3.74	0.21
MH-57	2,448.2	2.00	40	8	1.10	4.90	212	2.5	0.21	2.5	0.31	0.09	0.79	3.74	0.21
MH-56	2,447.3	1.88	406	8	1.07	4.74	212	2.5	0.21	2.5	0.31	0.09	0.79	3.63	0.21
MH-55	2,439.7														
MH-55	2,439.7	2.01	234	8	1.11	4.91	218	2.5	0.22	2.6	0.33	0.10	0.81	3.92	0.24
MH-54	2,435.0														
MH-54	2,435.0	1.00	151	8	0.78	3.46	804	2.5	0.80	6.9	0.86	0.32	1.59	3.90	0.80
MH-33	2,433.4	1.00	150	8	0.78	3.46	804	2.5	0.80	6.9	0.86	0.32	1.59	3.90	0.80
MH-24	2,431.8														
MH-23	2,435.6	1.42	271	8	0.93	4.13	2	2.5	0.00	0.6	0.08	0.01	0.37	1.47	0.01
MH-24	2,431.8														
MH-24	2,431.8	4.30	102	8	1.62	7.18	809	2.5	0.81	4.2	0.53	0.18	1.08	7.27	0.86
MH-32	2,427.3	2.30	261	8	1.18	5.25	810	2.5	0.81	5.0	0.63	0.23	1.22	5.67	0.83
MH-31	2,421.2														
MH-43	2,432.8	1.00	206	8	0.78	3.46	3	2.5	0.00	0.7	0.09	0.02	0.40	1.31	0.01
MH-42	2,430.6	1.00	173	8	0.78	3.46	3	2.5	0.00	0.7	0.09	0.02	0.40	1.31	0.01
MH-41	2,428.8	1.00	175	8	0.78	3.46	6	2.5	0.01	0.7	0.09	0.02	0.40	1.31	0.01
MH-40	2,426.9	0.70	181	8	0.65	2.90	8	2.5	0.01	0.7	0.09	0.02	0.40	1.10	0.01
MH-39	2,425.5	0.70	133	8	0.65	2.90	10	2.5	0.01	0.7	0.09	0.02	0.40	1.10	0.01
MH-38	2,424.5	0.70	167	8	0.65	2.90	10	2.5	0.01	0.7	0.09	0.02	0.40	1.10	0.01
MH-37	2,423.2	0.70	97	8	0.65	2.90	12	2.5	0.01	0.7	0.09	0.02	0.40	1.10	0.01
MH-36	2,422.5	0.67	190	8	0.64	2.84	13	2.5	0.01	0.7	0.09	0.02	0.40	1.08	0.01
MH-31	2,421.2														
MH-31	2,421.2	1.15	152	8	0.84	3.71	825	2.5	0.83	8.0	1.00	0.35	2.09	3.71	0.84
MH-30	2,419.3														
CO-3	2,428.7	2.00	115	8	1.10	4.90	0	2.5	0.00	0.5	0.06	0.01	0.34	1.17	0.00
MH-35	2,426.3	2.30	302	8	1.18	5.25	2	2.5	0.00	0.3	0.04	0.00	0.26	1.19	0.00
MH-30	2,419.3														
MH-30	2,419.3	1.90	117	8	1.08	4.77	831	2.5	0.83	5.4	0.68	0.25	1.29	5.27	0.85
MH-29	2,417.1	2.00	262	8	1.10	4.90	831	2.5	0.83	5.3	0.66	0.24	1.27	5.33	0.83
MH-28	2,411.9	2.00	106	8	1.10	4.90	831	2.5	0.83	5.3	0.66	0.24	1.27	5.33	0.83
MH-27	2,409.8														

# SANDFLOWER SUBDIVISION - SEWER MASTER PLAN

Manhole Number	Invert Elev. ft.	Pipe Slope %	Pipe Length ft.	Pipe Diameter inches	Pipe Capacity MGD	Full Velocity fps	Dwelling Units	People per Dwelling	Required Capacity MGD	Partial Flow Depth inches	Ratio of Depth to Diameter	Partial Flow Area sq.ft.	Partial Perimeter ft.	Partial Velocity fps	Partial Capacity MGD
MH-34	2,412.7	1.76	170	8	1.03	4.59	3	2.5	0.00	0.4	0.05	0.01	0.30	1.18	0.00
MH-27	2,409.8														
MH-27	2,409.8	1.90	267	8	1.08	4.77	836	2.5	0.84	5.4	0.68	0.25	1.29	5.27	0.85
MH-26	2,404.6	1.20	273	8	0.86	3.79	837	2.5	0.84	8.0	1.00	0.35	2.09	3.79	0.85
MH-25	2,401.2	1.20	269	8	0.86	3.79	839	2.5	0.84	8.0	1.00	0.35	2.09	3.79	0.85
MH-13	2,397.9														
MH-22	2,432.0	2.30	133	8	1.18	5.25	0	2.5	0.00	0.4	0.05	0.01	0.30	1.35	0.01
MH-21	2,428.9	1.50	412	8	0.96	4.24	2	2.5	0.00	0.6	0.08	0.01	0.37	1.51	0.01
MH-20	2,422.6	1.50	173	8	0.96	4.24	6	2.5	0.01	0.6	0.08	0.01	0.37	1.51	0.01
MH-19	2,419.9	1.60	406	8	0.99	4.38	7	2.5	0.01	0.6	0.08	0.01	0.37	1.56	0.01
MH-18	2,413.3	1.60	116	8	0.99	4.38	11	2.5	0.01	0.6	0.08	0.01	0.37	1.56	0.01
MH-15	2,411.3														
CO-4	2,421.7	0.96	130	8	0.76	3.39	0	2.5	0.00	0.6	0.08	0.01	0.37	1.21	0.01
MH-17	2,420.4	3.27	172	8	1.41	6.26	3	2.5	0.00	0.5	0.06	0.01	0.34	1.49	0.01
MH-16	2,414.7	1.58	210	8	0.98	4.36	4	2.5	0.00	0.6	0.08	0.01	0.37	1.55	0.01
MH-15	2,411.3														
MH-15	2,411.3	2.41	288	8	1.21	5.38	18	2.5	0.02	0.7	0.09	0.02	0.40	2.04	0.02
MH-14	2,404.3	4.87	132	8	1.72	7.64	20	2.5	0.02	0.6	0.08	0.01	0.37	2.72	0.02
MH-13	2,397.9														
MH-13	2,397.9	1.85	237	8	1.06	4.71	860	2.5	0.86	5.6	0.70	0.26	1.32	5.22	0.87
MH-10	2,393.4	0.70	211	10	1.18	3.36	861	2.5	0.86	6.5	0.65	0.37	1.56	3.65	0.87
MH-9	2,391.8	0.70	191	10	1.18	3.36	861	2.5	0.86	6.5	0.65	0.37	1.56	3.65	0.87
MH-8	2,390.4	0.70	141	10	1.18	3.36	993	2.5	0.99	7.2	0.72	0.41	1.69	3.75	1.00
MH-7	2,389.3	0.70	278	10	1.18	3.36	993	2.5	0.99	7.2	0.72	0.41	1.69	3.75	1.00
MH-6	2,387.2	0.70	150	10	1.18	3.36	993	2.5	0.99	7.2	0.72	0.41	1.69	3.75	1.00
MH-5	2,386.1	0.70	475	10	1.18	3.36	993	2.5	0.99	7.2	0.72	0.41	1.69	3.75	1.00
MH-4	2,382.7	0.70	475	10	1.18	3.36	993	2.5	0.99	7.2	0.72	0.41	1.69	3.75	1.00
MH-3	2,379.2	0.70	475	10	1.18	3.36	993	2.5	0.99	7.2	0.72	0.41	1.69	3.75	1.00
MH-2	2,375.8	2.50	475	10	2.24	6.36	993	2.5	0.99	5.8	0.58	0.32	1.44	6.64	1.38
MH-1	2,363.9														





MI-7 2389.3'  
STA: 20+15.13  
OFFSET: 6.36 R

MI-6 2387.2'  
STA: 20+15.13  
OFFSET: 6.36 R

MI-5 2386.1'  
STA: 20+15.13  
OFFSET: 6.36 R

MI-4 2382.7'  
STA: 20+15.13  
OFFSET: 6.36 R

MI-3 2379.2'  
STA: 20+15.13  
OFFSET: 6.36 R

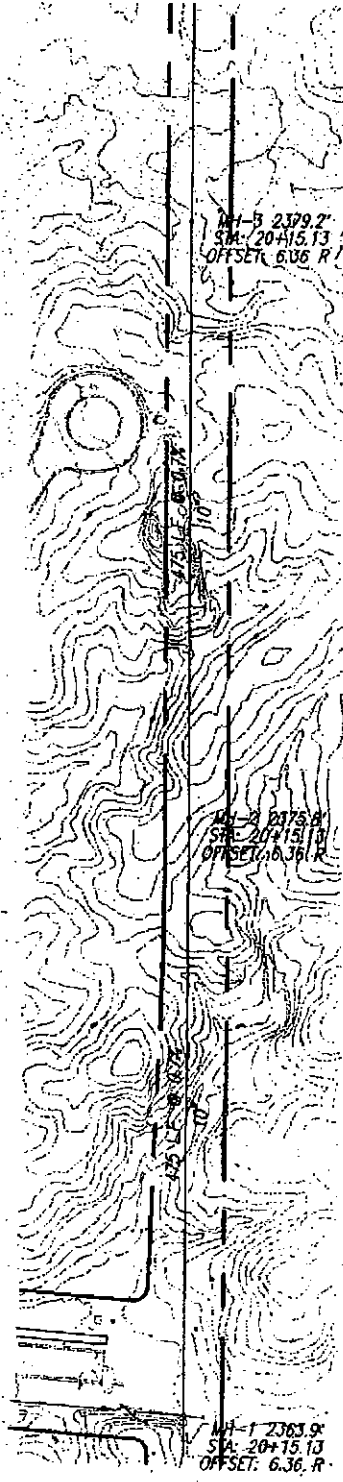
150 FT

10'

MI-B 2379.2'  
STA: 20+15.13  
OFFSET: 6.06 R

MI-A 2375.8'  
STA: 20+15.13  
OFFSET: 0.36 R

MI-1 2363.9'  
STA: 20+15.13  
OFFSET: 6.36 R



A CLASS III CULTURAL RESOURCE SURVEY OF 45 ACRES  
AT 35026 NORTH 84<sup>TH</sup> STREET, AT THE SOUTHWEST CORNER OF 84<sup>TH</sup> STREET  
AND CAVALRY DRIVE IN SCOTTSDALE, MARICOPA COUNTY, ARIZONA



ARCHAEOLOGICAL CONSULTING SERVICES, LTD.  
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TEMPE, ARIZONA 85282  
(480) 894-5477  
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*CULTURAL RESOURCE, ENVIRONMENTAL MANAGEMENT AND GIS SERVICES*

26-ZN-2016  
01/10/2017

**A CLASS III CULTURAL RESOURCE SURVEY OF 45 ACRES  
AT 35026 NORTH 84<sup>TH</sup> STREET, AT THE SOUTHWEST CORNER OF 84<sup>TH</sup>  
STREET AND CAVALRY DRIVE IN SCOTTSDALE, MARICOPA COUNTY,  
ARIZONA**

**Prepared for**  
Criterion Land Management LLC  
7440 E Pinnacle Peak Rd.  
Scottsdale, Arizona 85255

**Prepared by**  
Walter Punzmann, M.A.  
Peg Davis, M.A., RPA  
Douglas R. Mitchell, M.A., RPA

**Submitted by**  
Douglas R. Mitchell, M.A., RPA

Archaeological Consulting Services, Ltd.  
Project No. 16-137 CSUR3  
November 14, 2016  
December 21, 2016 (Submittal 2)

## SHPO SURVEY REPORT ABSTRACT

**Report Title:** A Class III Cultural Resource Survey of 45 Acres at 35026 North 84<sup>th</sup> Street, at the Southwest Corner of 84<sup>th</sup> Street and Cavalry Drive in Scottsdale, Maricopa County, Arizona

**Report Date:** November 14, 2016; December 21, 2016 (Submittal 2)

**Project Name:** 84<sup>th</sup> Street and Cavalry Drive

**Project Location:** The project area is located at 35026 North 84<sup>th</sup> Street, on the southwest corner of 84<sup>th</sup> Street and Cavalry Drive in Scottsdale, Arizona.

**Project Locator UTM:** N3740719 E416608      **Zone:** 12 NAD 83

**Project Sponsor:** Criterion Land Management LLC

**Sponsor Project Number(s):** n/a

**Lead Agency:** City of Scottsdale (COS)

**Other Involved Agencies:** n/a

**Applicable Regulations:** Under City of Scottsdale (COS) Ordinance 3242, adopted July 13, 1999, the Historic Property (HP) zoning overlay district is intended to protect and enhance the cultural, historical, social or archaeological heritage of the COS. The HP District encourages the retention of historic resources by keeping them in active use in their original appearance, setting, and placement. Under COS Ordinance 3243, adopted July 13, 1999, effective date August 12, 1999, amended April 16, 2002 by Ordinance 3432, before the construction can begin, a cultural resource assessment needs to take place to identify and evaluate any cultural resources that might be present within the project area. Arizona Revised Statute (A.R.S.) §41-865 refers to the state burial law as it applies to private land.

**Funding Source:** Private

**ASLD ROW Application Number:** n/a

**Description of the Project/Undertaking:** Criterion Land Management LLC, contracted with Archaeological Consulting Services Ltd. (ACS) to conduct a cultural resources survey of 45 acres of privately owned land for a proposed residential development.

**Project Area/Area of Potential Effects (APE):** The project area is located at 35026 North 84<sup>th</sup> Street, on the southwest corner of 84<sup>th</sup> Street and Cavalry Drive in Scottsdale, Arizona.

**Legal Description:** The project is located in Section 1, Township 5 North, Range 4 East, Gila and Salt Baseline Meridian as depicted on the Cave Creek 7.5 USGS topographic quadrangle.

**Land Jurisdiction:** Private

**Total Acres:** 45

**Acres Surveyed:** 45

**Acres Not Surveyed:** 0

## SHPO SURVEY REPORT ABSTRACT

**Consultant Firm/Organization:** ACS

**Project Number:** 16-137:CSUR3

**Permit Number(s):** n/a

**Date(s) of Fieldwork:** July 7, September 2, November 10, 2016

**Number of IOs Recorded:** 5

**Number of Sites Recorded:** 0

**Eligible Sites:** 0

**Ineligible Sites:** 0

**Unevaluated Sites:** 0

**Sites Not Relocated:** 0

### Site Summary Table

Land Jurisdiction	Identification Status	Site Number/ Property Address	Eligibility Status/ Criterion/Criteria	Recommended Treatment
N/A	N/A	N/A	N/A	N/A

**Comments:** ACS' intensive cultural resources survey of 45 acres at 35026 North 84<sup>th</sup> Street, located on the southwest corner of 84<sup>th</sup> Street and Cavalry Drive, identified five isolated occurrences and no archaeological sites. The isolated occurrences do not meet COS site criteria and are not considered significant. Mapping and field recording have exhausted their information potential. Based on the results of this survey and background research, no historic properties would be affected by this proposed project. Therefore, it is recommended that the proposed project be granted a Certificate of No Effect and be allowed to proceed without further cultural resource work.

Should a previously unidentified archaeological site be discovered in the course of construction, the property owner shall immediately notify the City Archaeologist and/or Historic Preservation Officer. The property owner shall have a preliminary study made by a qualified archaeologist to determine the effect that the proposed development project may have on the site. The City Archaeologist and/or Historic Preservation Officer, with concurrence from the qualified archaeologist hired by the property owner, shall evaluate on-site the significance of the archaeological finding as soon as possible. When the Historic Preservation Officer, the qualified archaeologist hired by the property owner, and the City Archaeologist concur that no adverse effect on the archaeological site will take place, the project may proceed immediately. Where an adverse effect on a significant archaeological site will take place, the project shall be referred to the Historic Preservation Commission at the commission's next regular meeting or a called meeting for review following the same procedure set forth for identified significant archaeological sites.

If human remains or funerary objects are identified during construction, work must stop in the vicinity of the find and the Arizona State Museum (Dr. Todd Pitezal, 520-621-4795) shall be notified, pursuant to

## SHPO SURVEY REPORT ABSTRACT

A.R.S. §41-865. Work in that area shall not resume until authorization is received from the Arizona State Museum

2 Project Area

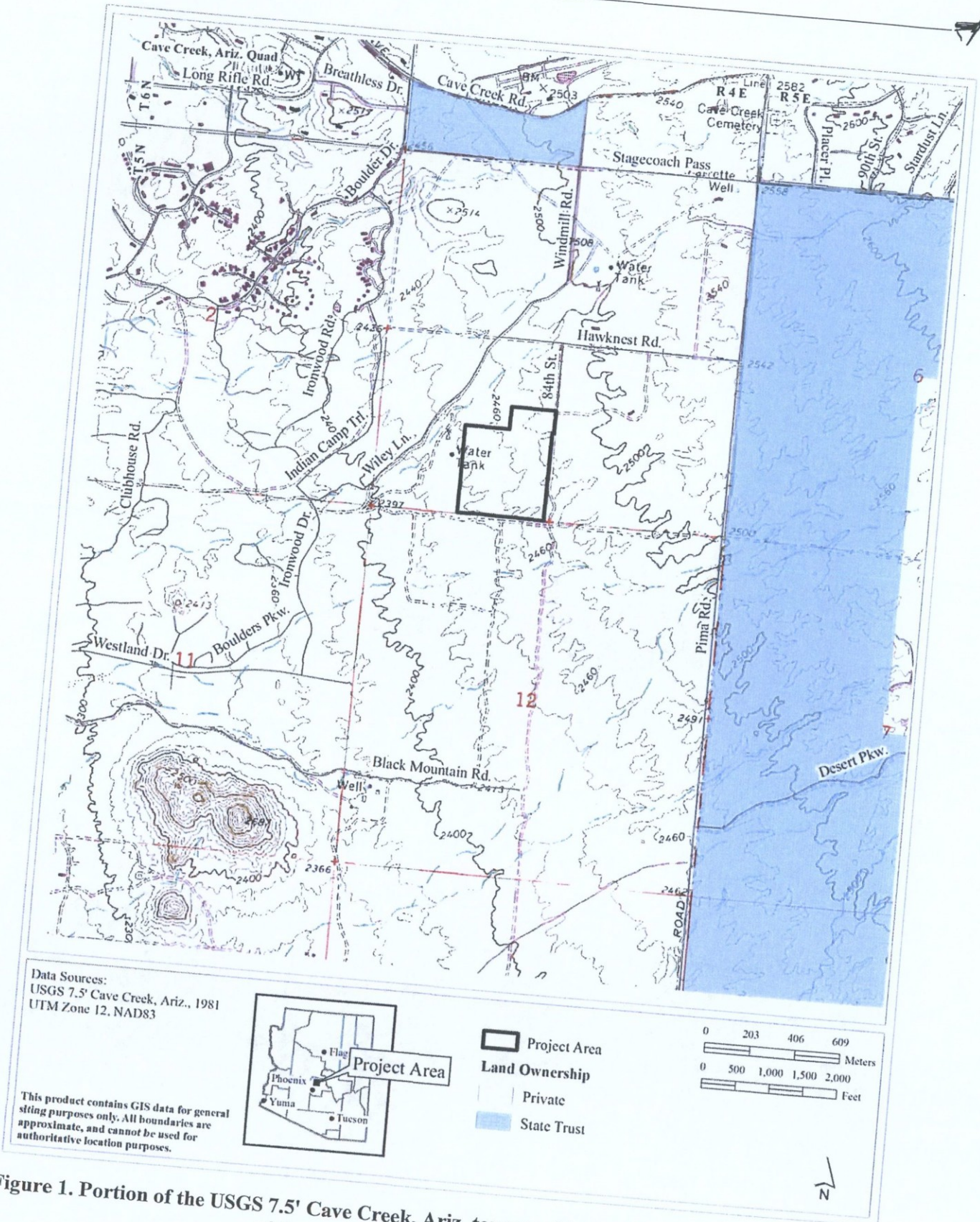
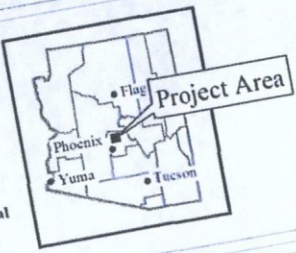


Figure 1. Portion of the USGS 7.5' Cave Creek, Ariz. topographic quadrangle, showing the location of the project area and land jurisdiction.



Data Sources:  
ESRI ArcGIS Online Imagery, 2015  
UTM Zone 12, NAD83

This product contains GIS data for general siting purposes only. All boundaries are approximate, and cannot be used for authoritative location purposes.



Project Area

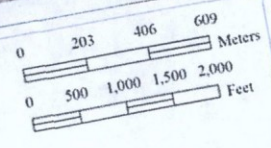


Figure 2. Contemporary aerial of North Scottsdale, showing the location of the project area at 84<sup>th</sup> Street and Cavalry Drive.



**CERTIFICATE OF NO EFFECT  
ARCHAEOLOGICAL RESOURCES**

26-ZN-2016

84th & Black Mountain

**APPLICATION INFORMATION**

LOCATION: 34834 N 83rd St

PARCEL: 216-34-267

Q.S.: 59-47

APPLICANT: Alex Stedman

COMPANY: Alex Stedman

ADDRESS: 120 S. Ash Ave. Tempe, AZ 85281

PHONE: 480-994-0994

Request by owner for a Zoning District Map Amendment from the Single-family Residential, Environmentally Sensitive Lands (R1-190/ESL) zoning district, to the Single-family Residential, Environmentally Sensitive Lands (R1-43 ESL) zoning district, on a +/- 45-acre site, generally located at the northwest corner of N. 84th Street and E. Black Mountain Road.

**Certificate of No Effect Criteria:**

In accordance with Chapter 46, Article VI, of the Scottsdale Revised City Code, the Historic Preservation Officer finds that:

- No archaeological resources are located on the property according to the archaeological survey and report and based upon the city's review of the report.

**STIPULATIONS**

1. Any development on the property is subject to the requirements of Scottsdale Revised Code, Chapter 46, Article VI, Protection of Archaeological Resources, Section 46-134 - Discoveries of archaeological resources during construction.

SIGNATURE:

*Steve Venker*

DATE:

1/11/17

Steve Venker, City Archaeologist 480-312-2831

**Planning and Development Services**

7447 E Indian School Road Suite 105, Scottsdale, AZ 85251. Phone: 480-312-7000 Fax: 480-312-7088

City of Scottsdale's Website: [www.scottsdaleaz.gov](http://www.scottsdaleaz.gov)