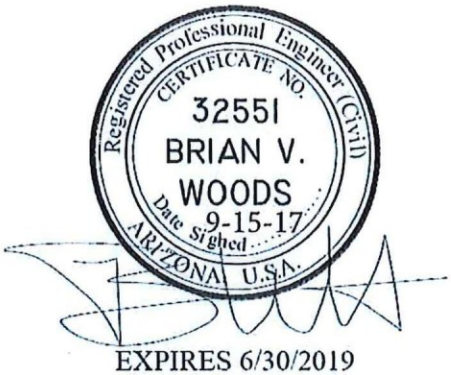
GRADING & DRAINAGE ENGINEERS, INC
PROFESSIONAL CIVIL ENGINEERING SERVICES

DRAINAGE REPORT

For Pinnacle Vista Apartments
APN: 212-11-005L
6301 E. Pinnacle Vista Drive, Scottsdale
CASE #: 14-DR-2017

TABLE OF CONTENTS

Plan #
Case # 14-DR-2017
Q-S #
☑ Accepted
☐ Corrections
DG 10/24/17
Reviewed By Date



EXPIRES 6/30/2019

4803 West Creedance Blvd • Glendale AZ 85310
Tel: (623) 581-3371 • Email: designs@gdengineers.com

1.0 Introduction / Location / Purpose

This Drainage Report serves to analyze the hydrology and hydraulics associated with stormwater runoff affecting the proposed Pinnacle Vista Apartments site. The project has an Assessor's Parcel Number 212-11-005L and is located at 6249 E. Pinnacle Vista Drive in Scottsdale. This location is within the Southeast Quarter of Section 33, Township 5 North, Range 4 East of the Gila and Salt River Base and Meridian, Maricopa County Arizona. The Scottsdale Quarter Section maps is 49-42. The subject parcel is zoned R-3, is approximately 1.6 acres, and is currently undeveloped (see Figure 1).

The main objective of this drainage report is to analyze the stormwater run-off crossing the subject parcel in accordance with the City of Scottsdale Design Standards and Policies Manual (DSPM).

Figure 1: Aerial View of Parcel 212-11-005L

2.0 Description of Existing Drainage Conditions

The overall area to include the subject parcel is currently located in a shaded Flood Zone AO per the Flood Insurance Rate Map recorded by FEMA in their catalog (ID number 04013C1305L) and dated October 16, 2013. Stormwater generally flows in a southwesterly direction. See Figure 2 below for a snapshot of the FEMA floodplain map.

Based on the site survey, the northern portion of the site has six elliptical (54" by 36") pipe culverts with headwalls crossing Pinnacle Vista Drive. The culverts drain into an existing wash that is very defined (see Reference 2).

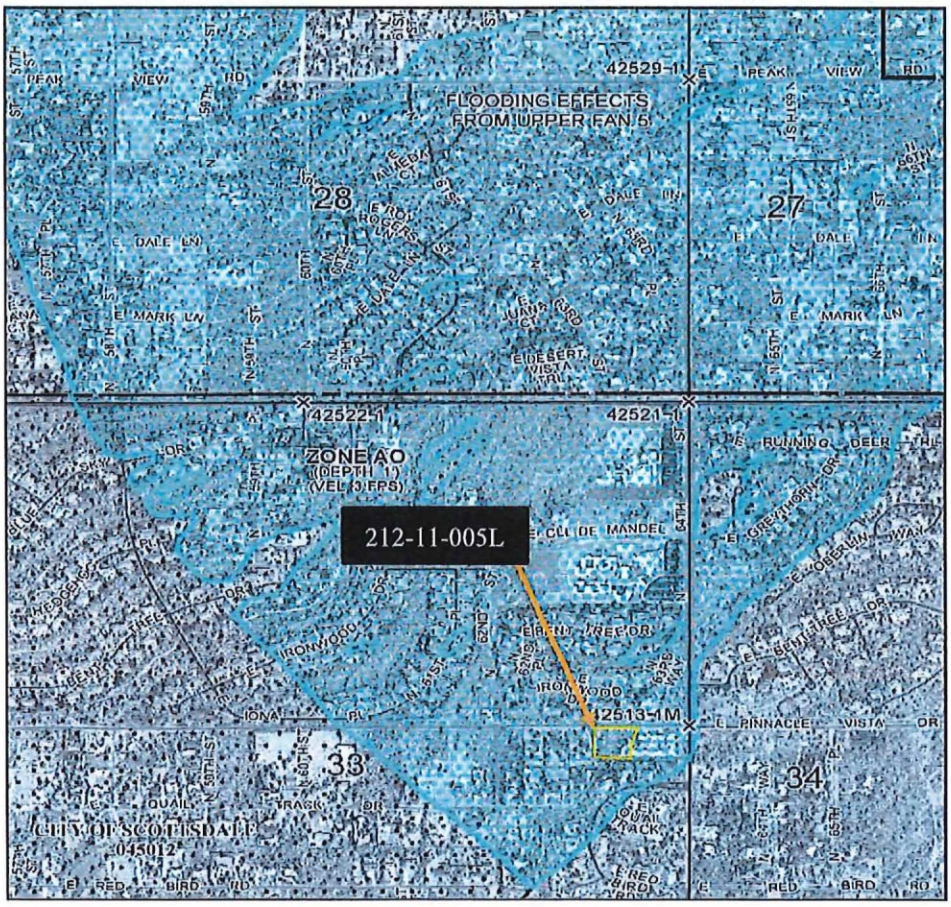


Figure 2: FEMA Floodplain Map

3.0 Proposed Drainage Plan

The proposed improvements are designed to have minimal effect to the existing upstream and downstream conditions. The proposed construction is also designed to maintain the historic locations of flow entrance and exit points. The existing wash will remain in an undisturbed state. On-site retention will be provided for the pre-vs-post new hardscape runoff. Since the lot is within an AO Zone (1' depth), proposed finished floor elevations will be established two feet above the highest adjacent grade.

Retention will be stored in two separate, on-site basins where the requirements are calculated using a pre-vs-post analysis for the proposed hardscape (under roof, pavement, etc).

Volume Required = C(P/12)(Area)
Where C = 0.95 - 0.45 = 0.5
(0.95 for new hardscape and 0.45 for existing desert)
P, is from NOAA Atlas 14, = 2.5"
A is the area of hardscape

For the northeastern area of the site (pool + northern parking area),
Volume required = (0.95 - 0.45)(2.5/12)(5,686 sf) = 592 cubic feet
Volume provided (Basin B1 with 1975 high water elevation):
V = (1/2)(1,025 sf + 1,701 sf)(0.5') = 681 cubic feet
Since this basin has less than 6" of ponding depth, it is assumed that dry-up is through percolation and evaporation. If volume is exceeded, it would spill into the wash.

The remaining hardscape area (buildings + parking) volume required:
Volume required = (0.95 - 0.45)(2.5/12)(20,068 sf) = 2,090 cubic feet
Volume provided (Basin B2 (@1,972.5 high water elevation):
V = (1/2)(396 sf + 3,001 sf)(1.5') = 2,547 cubic feet
Bleed-off of Basin B2 is to the existing wash with a proposed 6" diameter pipe to be located on the southeast corner of the retention basin. For sediment reasons the invert of the pipe will be 6 inches above the bottom elevation of the basin. Calculating a minimum slope of one percent and assuming the pipe is only flowing half full, provides a 0.243 cfs drain rate (see Hydraulic Toolbox program results shown below). Therefore, 2,547 / 0.243 / 3600 yields about a three hour drain time for the basin, which is much less than the 36 hour requirement.

Type:	Circular	Define...
Side Slope 1 (Z1):	0.0	H : 1V
Side Slope 2 (Z2):	0.0	H : 1V
Channel Width (B):	0.0	(ft)
Pipe Diameter (D):	0.5	(ft)
Longitudinal Slope:	0.01	(ft/ft)
Override Default		
Manning's Roughness:	0.0150	

Parameter	Value	Unit
Flow	0.243	cfs
Depth	0.250	ft
Area of Flow	0.098	sq ft
Wetted Perimeter	0.785	ft
Hydraulic Radius	0.125	ft
Average Velocity	2.477	fps
Top Width (T)	0.500	ft
Froude Number	0.985	
Critical Depth	0.248	ft

Furthermore, the pool backwash system shall not drain into the wash. Proposed is to have the backwash line drain into the proposed sewer manhole that will be located on the northwest portion of the proposed site parking. See Reference 2 showing the proposed grading and drainage plan incorporating the above items.

4.0 Data Evaluation and Methods

A FLO 2D analysis developed by the Flood Control District of Maricopa County was used to determine the flow within the wash (Reference 1). The maximum 100-year event yields a flow of 175 cubic feet per second.

Based on city comments, the FLO-2D flowrate shown is not for design but for planning purposes only (city reference Sec. 4-1.800 of the DSPM). Furthermore, a 30 percent factor of safety for the wash flowrate is requested. Therefore, 228 cfs (175 x 1.3) will be used for the wash evaluation. The 30 percent safety factor is used due to the potential for upstream split flows and since the existing upstream culvert was designed with a 558 cfs flowrate. However, all proposed improvements are at least two feet higher than any adjacent water surface. If the wash were to flow two feet higher, which equates to about 570 cfs, it still wouldn't flood any of the hardscape. Additionally, the proposed building floor elevations are at least four feet higher than the water surface of a 228 cfs flow. Therefore, from a planning standpoint the proposed design is sufficient to prevent flooding from any flow within the wash.

The Erosion Setback (Es) and Scour Depth (Ds) were calculated using State Standard 5-96 (SS5-96). The equations for a straight channel reach were used.

Erosion Setback = $1.0(Q_{100})^{0.5}$

Es = 1.0(228 cfs)^0.5 = 15.1'

15.1' < 20' minimum; therefore, erosion setback = 20 feet
(as a note, a 20' erosion setback is good for up to 400 cfs)

The erosion setback line is shown on the Grading & Drainage plan 20 feet from the high water elevation of the wash.

Scour Depth is calculated as: Ds = Dgs + Dlts
Dgs = General Scour = 0.157*(Q100)^0.4
Dlts = Long Term Scour = 0.02*(Q100)^0.6
Ds = 0.157(228)^0.4 + 0.02(228)^0.6 = 1.9'
Ds = 3' minimum
Since there are no habitable structures proposed within the 20' erosion setback, no footings / scour walls are proposed for the permit.

Additionally, the Hydraulic Toolbox program was used to evaluate the approximate flow depth within the wash. Using both an average defined channel section as well as an average for the overall channel, the maximum flow depth was calculated to be between 3.2 and 3.4 feet. The 3.4 feet depth of water is shown on the Grading & Drainage plan.

Average Defined Channel

Type: Cross Section | Define...

Side Slope 1 (Z1):	0.0	H : 1V
Side Slope 2 (Z2):	0.0	H : 1V
Channel Width (B):	0.0	(ft)
Pipe Diameter (D):	0.0	(ft)
Longitudinal Slope:	0.0071	(ft/ft)

☐ Override Default
Manning's Roughness: 0.0450
☐ Use Lining

Parameter	Value	Unit
Flow	228.000	cfs
Depth	3.402	ft
Area of Flow	48.182	sq ft
Wetted Perimeter	21.725	ft
Hydraulic Radius	2.218	ft
Average Velocity	4.732	fps
Top Width (T)	19.774	ft
Froude Number	0.534	
Critical Depth	2.407	ft
Critical Velocity	7.597	fps

Hydraulic Toolbox - Channel Analysis

Average Channel

Type: Trapezoidal — Define...

Side Slope 1 (Z1):	1.75	H : 1V
Side Slope 2 (Z2):	2.25	H : 1V
Channel Width (B):	8.0	(ft)
Pipe Diameter (D):	0.0	(ft)
Longitudinal Slope:	0.009	(ft/ft)

☐ Override Default

Manning's Roughness: 0.0450

☐ Use Lining

Parameter	Value	Unit
Flow	228.000	cfs
Depth	3.159	ft
Area of Flow	45.221	sq ft
Wetted Perimeter	22.143	ft
Hydraulic Radius	2.042	ft
Average Velocity	5.042	fps
Top Width (T)	20.634	ft
Froude Number	0.600	
Critical Depth	2.387	ft
Critical Velocity	7.479	fps

Hydraulic Toolbox - Channel Analysis

Furthermore, a drainage easement line will be established based on the water surface of the wash. The proposed easement line conservatively covers the inundation of flow and is shown on the Grading & Drainage plan.

5.0 Conclusions

The flow shown in Reference 1 (based on FLO-2D) and the AO Zone shall govern the design of the proposed lot. The historic location of flow entrance and exit points shall remain. The proposed finished floor elevation is set at least two feet above any adjacent natural grade. The proposed site development is designed to have very little to no impact on existing downstream flowrates. This report has been developed in accordance with Maricopa County and Scottsdale regulations, standards, and policies.

6.0 Warning and Disclaimer of Liability

WARNING AND DISCLAIMER OF LIABILITY PURSUANT TO S.R.C §37-22
"The degree of flood protection provided by the requirements in this article is considered reasonable for regulatory purposes and is based on scientific and engineering considerations. Floods larger than the base flood can and will occur on rare occasions. Floodwater heights may be increased by manmade or natural causes. This article (Chapter 37, Article II) shall not create liability on the part of the city, any officer or employee thereof, or the federal government for any

flood damages that result from reliance on this article or any administrative decision lawfully made thereunder."
Compliance with Drainage and Floodplain Regulations and Ordinances does not insure complete protection from flooding. The Floodplain Regulations and Ordinances meet established local and federal standards for floodplain management, but neither this review nor the Regulations and Ordinances take into account such flood related problems as natural erosion, streambed meander or man-made obstructions and diversions, all of which may have an adverse effect in the event of a flood. You are advised to consult your own engineer or other expert regarding these considerations.
I have read and understand the above. If I am an agent for an owner I have made the owner aware of and explained this disclaimer.

	Brian Woods, P.E.	15 Sept 2017
Plan Check No.	Owner or Agent	Date

7.0 Attachments

Reference 1	**FLO-2D Map**
Reference 2	**Grading and Drainage Plan**

FLO-2D Model Results

Maximum Discharge (cfs)

- 0 - 10
- 11 - 25
- 26 - 50
- 51 - 100
- 101 - 200
- 201 - 250
- 251 - 500
- 501 - 700
- 701 - 1,000
- > 1,000

Flood Control District of Maricopa County
2801 W Durango St
Phoenix, AZ 85009
(602) 506-2419
http://www.fcd.maricopa.gov

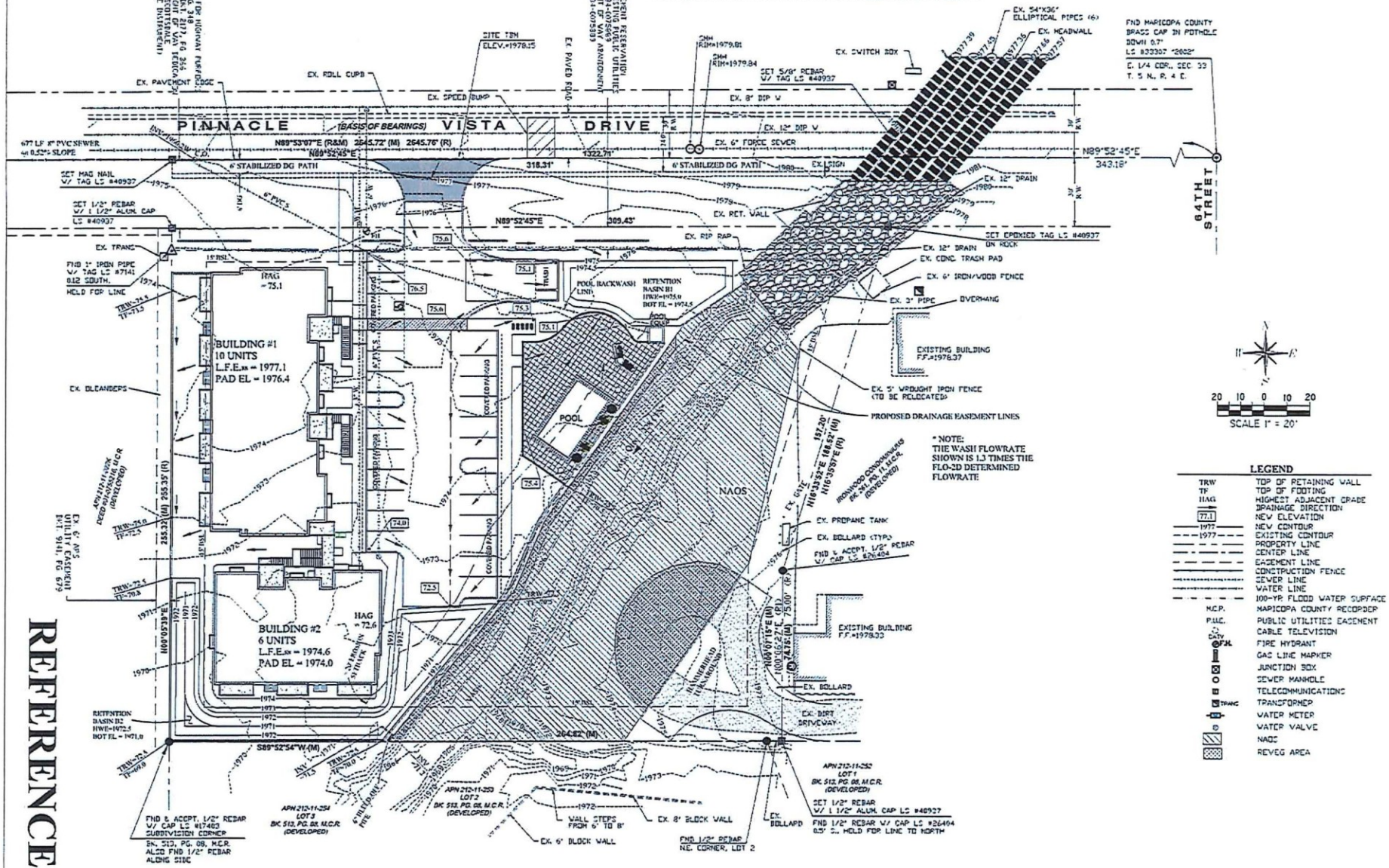
1:732 — 1 inch = 61 feet

0 30 60 120 ft

PINNACLE VISTA

6301 E PINNACLE VISTA DR, SCOTTSDALE

PRELIM. GRADING & DRAINAGE PLAN



REFERENCE 2

PROJECT NO: 650-PA-2016
CASE # 14-DR-2017